

IERS TECHNICAL NOTE 23

Definition and Realization of the International Celestial Reference System by VLBI Astrometry of Extragalactic Objects

C. Ma and M. Feissel (eds.)

June 1997

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V L B I

is a collaborative and cooperative activity. Without the continuing efforts of many individuals and institutions over the entire globe and an extended period of time, the new celestial reference frame would not have been possible. We wish to recognize and thank: the designers and fabricators of VLBI instrumentation from masers to receivers to data acquisition terminals to correlators; the operating personnel at observatories and correlator facilities; the schedule makers and coordinators; the generations of model builders, software developers, and analysts; and the far-sighted visionaries and funding agencies who thought the job could be done.

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Source position tables

World Wide Web: http://hpiers.obspm.fr/webiers/results/icrf/readme.html

Anonymous ftp: 145.238.100.28 (hpiers.obspm.fr)
cd iers/icrf/iau/icrf_src

Physical characteristics

World Wide Web: http://maia.usno.navy.mil/icrf
http://hpiers.obspm.fr/webiers/results/icrf/readme.html

Anonymous ftp: 145.238.100.28 (hpiers.obspm.fr)
cd iers/icrf/iau

S/X maps

Contents of TN23
Anonymous ftp: rorf.usno.navy.mil
cd TN23/SXImages

Future updates
World Wide Web: http://maia.usno.navy.mil/rorf/rrfid.html

Correction maps

World Wide Web: http://hpiers.obspm.fr/webiers/results/icrf/readme.html

Anonymous ftp: 145.238.100.28 (hpiers.obspm.fr)
cd iers/icrf/iau/source_maps

Position time series plots and values

Anonymous ftp: casa.usno.navy.mil
cd navnet/icrf

Dictionary of aliases

World Wide Web: http://maia.usno.navy.mil/icrf
http://hpiers.obspm.fr/webiers/results/icrf/readme.html

Anonymous ftp: 145.238.100.28 (hpiers.obspm.fr)
cd iers/icrf/iau

IERS Technical Notes

This series of publications gives technical information related to the IERS activities, e.g., reference frames, excitation of the Earth rotation, computational or analysis aspects, models, etc. It also contains the description and results of the analyses performed by the IERS Analysis Centres for the Annual Report global analysis.

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No 18: C. Boucher, Z. Altamimi, L. Duhem. Results and Analysis of the ITRF93

No 19: P. Charlot (ed.). Earth orientation, reference frames and atmospheric excitation functions submitted for the 1994 IERS Annual Report

No 20: C. Boucher, Z. Altamimi, M. Feissel, P. Sillard. Results and Analysis of the ITRF94

No 21: D.D. McCarthy (ed.). IERS Conventions (1996)

No 22: C. Reigber and M. Feissel (eds.). IERS missions, present and future. Report on the 1996 IERS Workshop

No 23: C. Ma and M. Feissel (eds.). Definition and Realization of the International Celestial Reference System by VLBI Astrometry of Extragalactic Objects

In preparation

C. Boucher, P. Sillard. Evolution of realization of global reference systems from space techniques and their links with ITRF

PART I

VLBI GLOBAL ASTROMETRY

THE CONTRIBUTION OF VLBI TO THE REALIZATION OF A CELESTIAL REFERENCE SYSTEM

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INTRODUCTION

Observations of celestial bodies, whether natural or artificial and including the Earth itself, can be used to describe motions only if they can be referred to a system of coordinate axes that are assumed to be fixed in space, or that have well known time variations with respect to something else that is fixed. These fixed axes are referred to as a celestial reference system. To make possible the comparison of results obtained in various fields, it is advantageous to adopt conventionally one definition of the celestial reference system. These coordinate axes can only be accessed indirectly through coordinates of a set of fiducial objects. Such a set of coordinates is referred to as a celestial reference frame.

The fixed directions underlying the FK5 (Fricke *et al.*, 1988) and the preceding fundamental star catalogues of positions and proper motions were defined from the dynamical modeling of the Earth's orbital motion (ecliptic, equinox). In the past, these fundamental directions were considered conventional for some decades; they were changed from time to time, in particular to take advantage of advances in modeling of the motion of solar system objects. In its 1991 Recommendations on Reference Systems (Bergeron, 1992; see also Guinot, 1979; Kovalevsky and Feissel, 1996), the International Astronomical Union (IAU) decided to select distant extragalactic objects as the basis of its new celestial reference system and to adopt directions that would be fixed with respect to a selected set of these objects. These directions would be consistent with their previous realizations, *i.e.*, the FK5 right ascension origin and pole, within the uncertainties of the FK5. A fundamental advantage of selecting extragalactic objects is that they are so distant that their proper motions are undetectable, even by the most precise present techniques.

In order that the use of this new reference system not be detrimental to the analysis of the highly accurate astrometric techniques, the IAU explicitely introduced the Theory of General Relativity as the background for all theoretical and data analysis problems related to time and space.

According to the adopted new rules, the fundamental directions of the celestial reference system will remain fixed in space; they will no longer be dependent on modeling the motion of solar system objects. The fiducial objects will be monitored. The adopted positions may be re-estimated when improved information is available, but the direction of the coordinate axes will be maintained by implementing the statistical condition that the coordinates of selected defining sources show no global rotation from the old set of coordinates to the new one.

The choice of extragalactic objects to realize the fiducial directions was made possible by the availability of a mature and highly precise observing technique, Very Long Baseline radio Interferometry (VLBI). The purpose of this IERS Technical Note is to describe how VLBI is used to define and maintain a celestial reference system that follows the 1991 IAU Resolutions on Reference Systems.

THE INTERNATIONAL CELESTIAL REFERENCE SYSTEM (ICRS)

The ICRS (Arias *et al.*, 1995, see also Part IV, this volume) was defined by the International Earth Rotation Service (IERS). It is expected to be adopted in 1997 by the IAU as the primary celestial reference system, replacing the FK5. It complies with the conditions specified by the 1991 IAU Recommendations. The Hipparcos star positions and proper motions and the JPL solar system ephemerides (starting with DE403) are already expressed in the ICRS. The origin of the ICRS axes is located at the barycentre of the solar system. For the sake of continuity with the FK5 system, the ICRS pole is in the J2000.0 direction defined by the conventional IAU models for precession (Lieske *et al.*, 1977) and nutation (Seidelmann, 1982). The origin of right ascensions is also defined consistently with that of the FK5 by fixing the right ascension of 3C 273B to the Hazard *et al.* (1971) FK4 value transformed to J2000.0.

Adopting extragalactic directions as primary celestial references has been considered for over a decade by the IAU. A series of Working Groups was organized jointly by several IAU astrometry commissions mainly to establish lists of appropriate objects. A decisive breakthrough was the codification by the Working Group on Reference Systems (1988-1991) of a comprehensive group of Recommendations (see section IV, this volume) that dealt with both the fundamental concepts of space-time references and their actual realizations. During the 1991-1994 term, the IAU Working Group on Reference Frames (WGRF) established a list of about 600 radio sources that would be used to realize an extragalactic celestial reference system. Meanwhile, the IERS had initiated and developed an operational process to maintain the celestial reference system. During the 1994-1997 term, the WGRF will conclude this long preparation by presenting for adoption by the 1997 IAU General Assembly a recommendation for the adoption of the ICRS and the future maintenance of the ICRF (International Celestial Reference Frame) by the IERS, assisted by an IAU advisory group.

VERY LONG BASELINE RADIO INTERFEROMETRY

History

VLBI is the only technique that provides simultaneous estimations of directions of extragalactic radio sources (quasars, galactic nuclei, ...), of terrestrial coordinates of observing sites and of the Earth's orientation.

The first development of VLBI, however, was motivated by its potential for radio astronomy. The history of radio astronomy dates from 1929 when Karl Jansky, a radio engineer, began looking at radio signals with decametric wavelengths which he found were associated with the centre of the Galaxy (Jansky, 1933, 1935). A few years later, Grote Reber further studied these emissions and published the first radio map of the sky (Reber, 1944). Research projects were started in radio astronomy in Australia and in Great Britain after World War II. Larger antennas were built and the first attempts were made to get finer resolution on the sky by using interferometry. These experiments were used to derive radio source catalogues, *e. g.*, the 3rd Cambridge Catalogue (Edge *et al.*, 1959), and to identify optical counterparts (Bolton *et al.*, 1949; Baade and Minkowsky, 1954). Bright compact sources were discovered in the course of these studies.

By the early 1960's, the development of connected-element interferometry, where the signals received by the two antennas are transmitted by cable to be referred to a single clock, had brought the interferometric resolution of observations to a few arcseconds. However, at that time, several independent investigators had concluded that sources with much finer structure were likely to exist that could not be resolved by the longest connected baseline, Jodrell Bank-Malvern (127 km, connected via a radio link). It became clear that understanding the physics of galactic nuclei and quasars made it necessary to reach an angular resolution of 0.001" (one milliarcsecond, mas), *i.e.*, the length of baselines had to be extended to thousands of kilometres. The signals at the two antennas could no longer be referred to the same clock, which put tight constraints on the stability of the station clocks. At about the same time, new commercial atomic time clocks with a stability of 10^{-12} became available. Two groups, in Canada and in the USA, developed an unconnected interferometric technique: the signals are recorded and dated separately on magnetic tapes at the two stations, the tapes being

shipped to a specialized computing centre where the signals are correlated. The first successful VLBI measurements, with a few hundredths of an arcsecond resolution, were obtained in 1967 (Broten *et al.*, 1967; Bare *et al.*, 1967).

The use of VLBI has proceeded in two general directions divided by the type of VLBI observable used. On one hand, VLBI continues to provide maps of the detailed structure of celestial objects using interferometric amplitude and phase information. This is the most common astrophysical application. The 10-antenna VLBA (Very Long Baseline Array) is the premier instrument designed specifically for such work, while international consortia such as the EVN (European VLBI Network) organize VLBI observations using arrays of existing observatories. The other face of VLBI is the precise measurement of celestial and terrestrial positions using the delay and delay rate observables, described below. The first VLBI astrometry reported in 1971 (Cohen and Shaffer, 1971) was no better than a few arcseconds. Global VLBI astrometric and geodetic programs were begun in the 1970's for the study of the Earth's rotation, for referencing solar system probe trajectories to inertial space and for monitoring tectonic plate motions and regional deformation. By the mid 1980's astrometric precision had improved to a few milliarcseconds (Fanselow *et al.*, 1984; Ma *et al.*, 1986). VLBI was a major participant in the IAU/IUGG MERIT Program (1978-1987), then in the IERS since its creation in 1988.

Applications to global astrometry and geodesy

VLBI (Fig. 1) is a geometric technique that measures accurately directions in space. Using a pair of distant antennas, the difference in the time of arrival at the two stations of signals emitted by the same radio source is measured with a precision of a few picoseconds. (Light travels one mm in three picoseconds). This time difference (delay) and its first time derivative (delay rate) are reconstructed by offline correlation of the signals recorded at the two ends of the baseline.

A key piece of equipment at the stations is the clock against which the events are dated. As the received signal is typically broadband noise, the reference time scale delivered by the clock must be extremely stable in the short term. VLBI makes use of the most stable frequency standards in the short term, *i.e.*, hydrogen masers that have a stability of 10^{-14} over 1000 seconds.

The frequency bands used in astrometric and geodetic applications are the S and X bands, with respective frequencies 2.3 and 8.4 GHz and wavelengths 13 and 3.6 cm. The signals are recorded under the Mark III protocol (Rogers *et al.*, 1983), but VLBA format has also been used.

The observing strategy aims at obtaining estimates of the desired global parameters that are not contaminated by poor determination of the ancillary local parameters that are necessary to consider in the data analysis. A typical observing session involves 6 to 21 terrestrial baselines observing a few tens of extragalactic radio sources over a 24-hour time span, producing several hundred to several thousand observations (delay and delay rate). The analysis consists of a least squares estimation of global parameters that describe the direction of radio sources and the position and motion of the observing stations, the Earth's orientation, and local parameters used to model the station behaviour and environment. Whereas the local and Earth orientation parameters are determined for each session, getting the radio source and station parameters requires the stacking of a number of observing sessions. An important aspect of the analysis is the use of state-of-the-art standards and models, such as the IERS Conventions (McCarthy, 1996).

The celestial reference frame results presented in this Technical Note are based on essentially all of the observations accumulated over about 15 years in several worldwide programs. Dual frequency Mark III data have both geodetic and astrometric applications. Most of the data (95% of nearly 2 million observations) were acquired primarily for geodetic purposes. The major geodetic programs include: NASA's Crustal Dynamics Project and Space Geodesy Program for plate tectonics, regional deformation and high resolution determination of the Earth Orientation Parameters (EOP); the International Radio Interferometry Surveying (IRIS-A), the program of the US Naval Observatory (USNO), NAVNET, and their successor NEOS for regular monitoring of EOP; the European and IRIS-S efforts organized by the Bonn Geodetic Institute; and USNO's NAVEX sessions for the terrestrial reference frame. The geodetic programs have used the brightest radio sources, gradually concentrating on the most compact as sensitivity improved. These geodetic sources are also the foundation of astrometric work because of the large number of observations for the ~150 most commonly used. The

astrometric programs which densify the sky include the Radio-Optical Reference Frame sessions done by US Naval Research Laboratory (NRL) and USNO and the space navigation efforts of Jet Propulsion Laboratory (JPL). More than 60 antennas distributed on all continents and several islands have participated including fixed stations ranging in size from 12 to 100 m in diameter as well as three small mobile VLBI systems. The numbers of observations per program used for the ICRF analysis are given in Table 1. The networks of baselines in the major programs are shown on Figure 2. The number of sources observed by various groups of observing programs is given in Table 2.

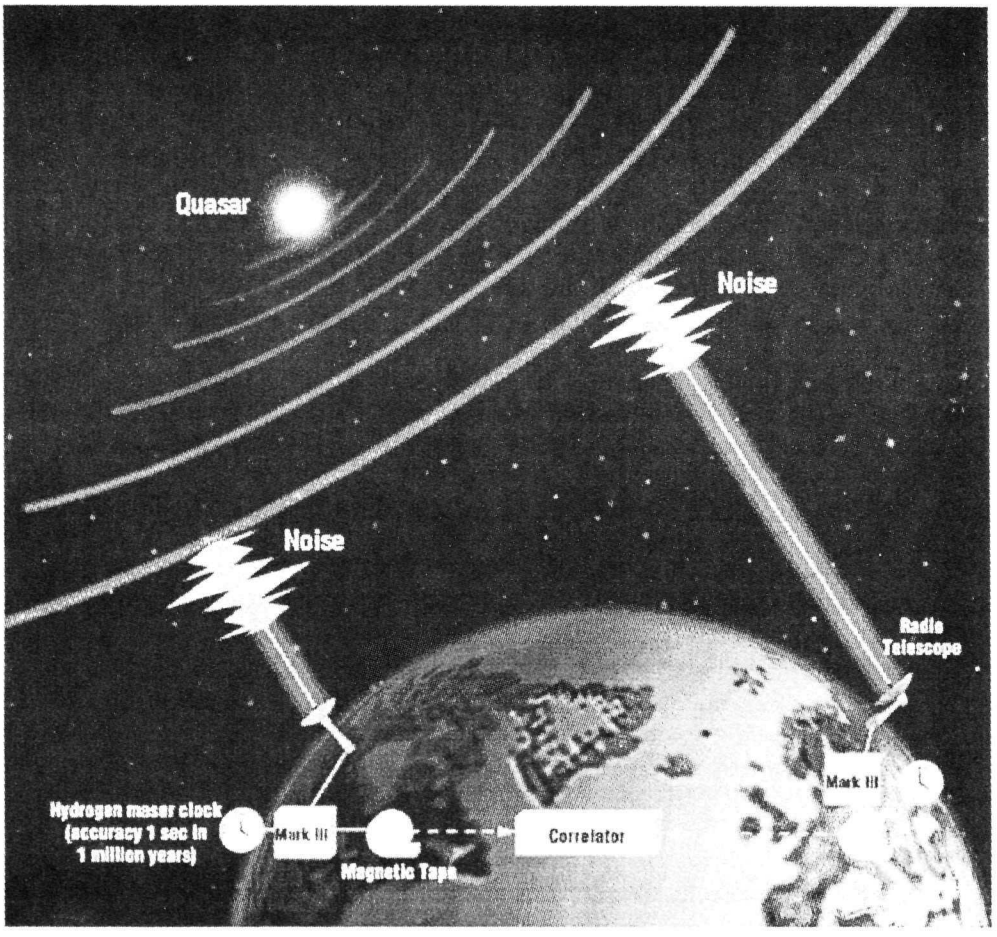


Figure 1. The principle of VLBI observations
(Drawing by John Hazen)

VLBI DATA ANALYSIS

A detailed description of astrometric and geodetic VLBI analysis is given by Sovers and Jacobs (1996). We summarize hereafter the most critical aspects that influence the construction of celestial reference frames.

Global modeling and parametrization

The astronomical modeling of observations entails expressing as a function of time the transformation between the celestial reference frame, materialized by the extragalactic radio source directions, and the terrestrial reference frame, materialized by the observing station coordinates. The terrestrial reference frame is rotating and orbiting around the Sun. The background theory is General Relativity, as recommended by the International Astronomical Union (see Section IV, this volume).

The global parameters are estimated as corrections to *a priori* parameters used to calculate approximate values of the observables, delays and delay rates. These parameters are as follows.

Celestial reference frame: equatorial coordinates (right ascension, declination) and in some cases their time derivatives, expressed in a reference system whose origin is at the barycentre of the solar system. A core of defining sources is assumed to have globally no rotation in inertial space.

Terrestrial reference frame: Cartesian station coordinates and their time derivatives, expressed in a reference system whose origin is at the Earth's centre of mass. The secular motion due to tectonic plate drifting (1 to 10 cm/year) is taken into account either by a model or, when observations are strong enough, as estimated parameters.

Earth orientation: Greenwich sidereal time, coordinates of the pole in the celestial and the terrestrial reference frames, and in some cases their time derivatives. The Earth orientation parameters are determined independently for each observing session. Omitting the direct estimation of the celestial pole coordinates (also called nutation offsets) in the analysis, *i.e.*, relying on standard precession and nutation models, would give rise to random and systematic errors at the level of several mas. In fact, VLBI is the most precise and accurate technique that can be used in the investigation of nutation and precession (see, *e.g.*, Souchay *et al.*, 1996).

The major sets of software in use for this modeling have been intensively tested and intercompared. They are considered to be consistently implemented within one picosecond for the delay and one femtosecond/second for the delay rate, one order of magnitude better than the observations. While the software implementation has been carefully checked, the model parameters required by the sotfware are not known well enough to produce a model that is accurate to better than a few tens of picoseconds.

However, as the space-time geometry of observations can never be fully uniform relative to the global parameters, errors in the estimations, both random and systematic, may be expected. These limitations have to be taken into account when estimating realistic uncertainties for the results.

Local modeling and parametrization

The local parametrization concerns the modeling of effects that are attached to the celestial objects or to the observing stations.

Local effects considered for the celestial objects are associated with asymmetric or time-evolving geometric structure of the radio sources that may produce apparent displacements when observed with baselines of different lengths (hence with different resolution of the source), or as the emission barycentre moves in the structure. If maps of a source are available, astrometric corrections can be made to always refer the source direction to the same conventional fiducial point in its structure (Charlot, 1990; Fey and Charlot, 1997). Other effects, such as transient gravitational lensing, may be present and would also give rise to spurious source motions. All these effects can amount to a few tenths of mas/year (Eubanks *et al.*, 1995).

Table 1. Observations used for ICRF: counts (in thousands) by time span and program

Program	1979-83	1984-86	1987-89	1990-92	1993-95	Total
CDP	23.7	67.4	110.6	75.6		277.4
POLA	24.8					24.8
MOBL	6.5	40.6	79.5	28.6		155.2
IRIS-A		77.5	91.2	144.8	18.2	331.7
GSI		.3	1.0	2.3	.2	3.8
IRIS-S		1.7	6.4	23.6	16.7	48.4
IRIS-P			9.8	14.3	6.1	30.2
USNO			1.7			1.7
NAVNET			14.0	75.8	5.9	95.7
EURMOB			3.7	11.9		15.6
CRL			.5	4.1	.6	5.3
NGS			.1	8.7	11.6	20.4
EUR				18.0	26.8	44.8
GERMAN				.9		.9
NAVEX				16.3	29.4	45.7
SGP				50.6	301.6	352.2
VLBA				3.2	4.9	8.0
NEOS-A					103.2	103.2
NEOS-B					19.9	19.9
NRL	.1		6.1	11.2	9.3	26.8
CRF					22.5	22.5
DSN			.5	10.0	3.1	13.6
Total	55.2	187.6	325.2	499.9	579.9	1647.8

The explanation of the acronyms is given in Appendix, p. I-14.

Table 2. Number of ICRF radio sources observed by various groups of VLBI programs

Program grouping	Purpose	Number of sources	Baselines
DSN	navigation, astrometry	281	2
CDP/SGP	survey, astrometry	368	77
NRL	astrometry	518	85
CDP/SGP	geodynamics	138	524
USNO/NAVNET/NAVEX	EOP, terrestrial reference frame	196	223
POLA/IRIS/NGS/NEOS	EOP	172	224
all others	geodesy	76	180

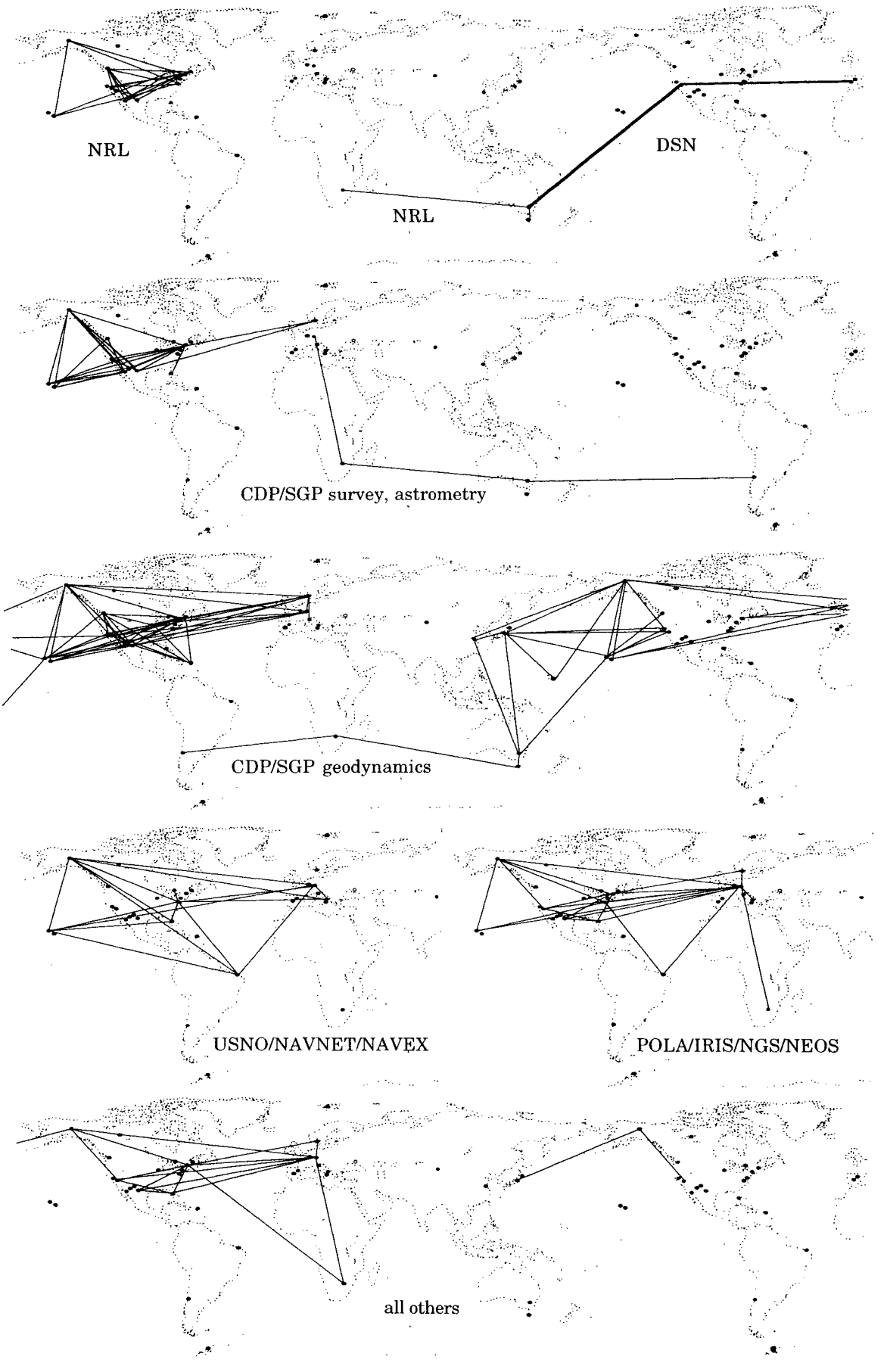


Figure 2. VLBI stations used for observing ICRF radio sources. The sets of baselines that collected 80% of observations in each of the groupings of programs in Table 2 are shown.

The terrestrial and environmental local effects are quite complex. They include tidal crustal motions, perturbation of the signal transmission through the ionosphere and the troposphere, and the station equipment.

Vertical and horizontal tidal motions (solid Earth tides with an amplitude of tens of cm, ocean tide loading effects with amplitudes of the order of one cm) are modeled with an accuracy of one mm by the IERS Conventions. Note that the VLBI analyses can also be exploited to test and improve these models.

The ionospheric delay to first order is inversely proportional to the squared frequency of the transmitted signal. This effect is eliminated by the use of two frequencies (S and X band), as done classically in radio-frequency work. The tropospheric delay is partially modeled by a conventional model that maps the delay as a function of the elevation of observations (*i.e.*, the length of the path of the signal in the troposphere). The zenith delay due to the dry component of the troposphere is around 7 nanoseconds and can be predicted to ~0.01 ns. That due to the wet component is smaller (<1 ns) but is poorly calibrated (~0.2 ns) from humidity. Calibrating it better would require knowledge of the water vapor content along the line of sight that may vary in time and azimuth during the session. The classical treatment of the effect is the estimation of the zenith delay using a conventional elevation-like mapping function for short time intervals (minutes to hours). An additional refinement is to parametrize and estimate the azimuthal dependence of the delay (gradient parameters). The correction of the tropospheric delay is currently the major modeling error in astrometric and geodetic VLBI.

Last but not least, the station clocks and electronic devices that are used from the receiver horn through the tape recorder introduce drifts and irregularities in the timing of the observations that are sent to the correlator. The clocks are generally synchronized within about one microsecond. The differential behavior of the timing devices is further modeled for each station, generally as piecewise time-linear segments, with sets of biases and drifts estimated from the observations. The numerous experiments performed on this part of the modeling have led to computational practices which seem to be harmless to global astronomical and geodetic parameters.

ERROR BUDGET OF VLBI-DERIVED CELESTIAL REFERENCE FRAMES

Global astrometric and geodetic VLBI as implemented since the early 1980's allows the construction of a global celestial reference frame that is accurate to better than 0.5 mas. The many improvements brought along the years to the observing programs and to the analyses (see the list of bibliographic references p. I-15) have continuously decreased the level of random and systematic errors. The level currently reached can be estimated by intercomparison of VLBI celestial reference frames obtained with various analysis strategies and modeling options. These experiments give a measure of the interaction of mismodeling with imperfect time-space geometry of observations. Their results are illustrated on Figure 3. The two identified main causes of remaining problems are as follows.

- Modeling the variations in the wet troposphere delay as a function of elevation, time and azimuth is the most deficient part of the analysis, with random and systematic effects of the order of 0.1-0.3 mas. Alternate approaches that have been studied consider additional *in situ* measurements, either with water vapor radiometers that measure directly the vapor content along the line of sight, or with results from analysis of collocated GPS stations. The work presented in this Technical Note used a recent improvement of the modeling that estimates an azimuthal dependence of the tropospheric delay (gradient correction, McMillan 1995). It is expected to remove systematic errors at the level of 0.3 mas and random ones at the level of 0.1 mas.

- The consideration of source structure, or source apparent motion, with random and systematic global effects at the level of 0.3 mas for the sources selected for astrometric work. In the implementation of the ICRF, all sources with detectable apparent motion were excluded from the set of defining sources.

The item labeled 'Baseline vector status' in Figure 3 may be taken as a rough estimate of remaining global analysis errors. It is at the level of 0.1 mas, clearly random. In principle, provided that coseismic and accidental station displacements are accounted for, a time-linear model for the

behaviour of the baselines is considered appropriate. When analyzing observations spanning many years and using more or less intensively observed baselines, the use of this model represents quite a strong constraint on the global solution. The unavoidable correlations between the estimated parameters may propagate into the coordinates of the extragalactic source errors coming from other parts of the modeling and analysis. Therefore, analysis strategies aiming primarily at astrometric results may consider the baseline vectors as local parameters, *i.e.*, parameters that are estimated for each session.

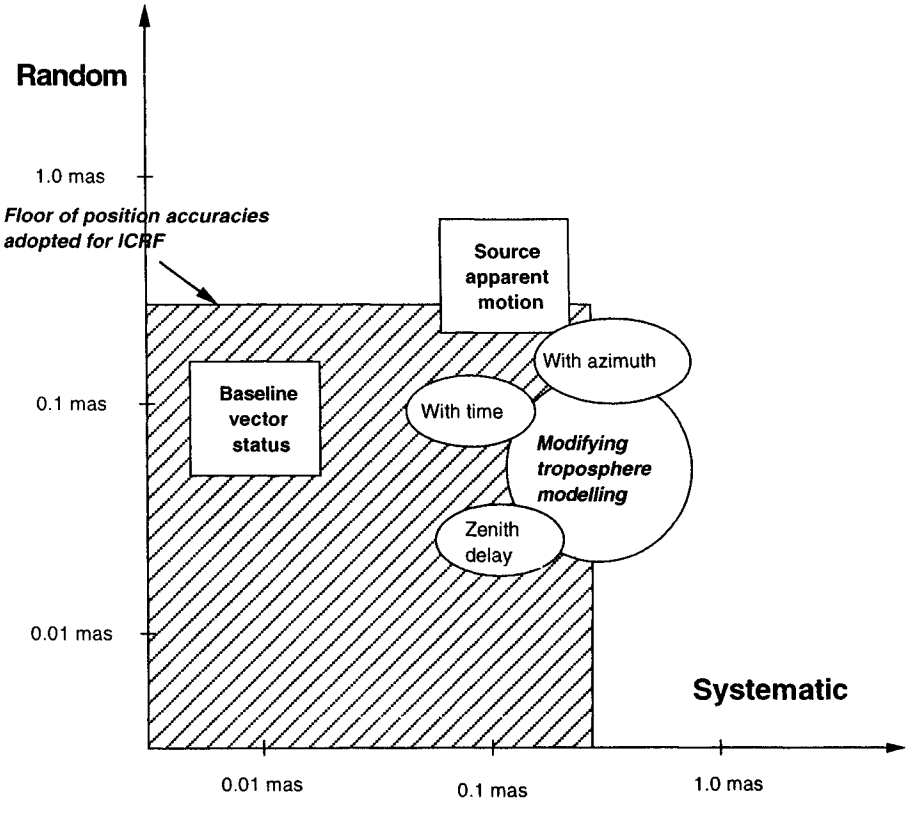


Figure 3. Random and systematic errors in VLBI celestial reference frames. Evaluations are based on the perturbation of analysis strategy with real data. The strategy retained in the implementation of the ICRF eliminated the sources with apparent motion from the list of defining sources and used an azimuth-dependent troposphere modeling that corrects most of the related systematic error.

GENERAL PROPERTIES OF VLBI EXTRAGALACTIC CELESTIAL REFERENCE FRAMES

The metrological characteristics of the VLBI-derived extragalactic reference frames result from the observing technique itself, from the objects that are selected for this application, and from its actual implementation and analysis.

Because VLBI observes in the microwave region of the electromagnetic spectrum, it is relatively insensitive to differences between day and night observing. This is in contract to ground based optical observations which have large changes in detection sensitivity from day to night. Furthermore, microwave observations are relatively insensitive to the weather (clouds, rain) compared to ground based optical observations. These advantages have allowed VLBI to observe the full 24 hour range of right ascensions within a single experiment. This avoids the need to patch together observations from various parts of the sky and thereby reducing the potential for zonal errors.

Although VLBI is an Earth-based technique, it shares more observational and analysis characteristics with a space astrometry program like Hipparcos than with classical transit circle work. In addition to the impressive improvement in precision, the whole approach itself is a large step forward. The so-called fundamental astrometry made use of observations of stars and planets by isolated instruments. In practice, each program would define its own celestial system. The fundamental catalogue (last issue: FK5) was reconstructed as homogenously as feasible from tens of these local catalogues. The computational means available to the astronomers made it impossible to analyze globally the complete data set, but this process was nevertheless a way to make available reference coordinates in a unique celestial reference system. The FK5 is a stellar realization of a dynamical reference system attached to the solar system. Its compilation was dependent on key models, such as those for precession, nutation and galactic rotation, and the tie of the star coordinates and proper motions to the fundamental directions in the solar system remained indirect.

From the Hipparcos continuous scanning of pairs of galactic directions, one constructs a rigid sphere of positions at some epoch as well as a system of highly homogeneous proper motions of galactic stars. Analyzing the entire data set provided by VLBI observations from a global Earth coverage of baselines that are operated in daily sessions over the years, one constructs directly a rigid sphere of extragalactic fixed directions. The analysis is completely redone as more data become available, physical models and estimation methods are improved, and new VLBI instrumentation is deployed.

With VLBI, each separate day of data gives the relative positions of the sources observed with some uncertainty. Adjusted nutation offsets for each day free the source coordinates from errors in precession/nutation. On different days different sets of sources are observed. It is the overlap of some common sources from one day to another that connects the positions together. From all the overlaps and directly measured relative positions comes the complete catalogue. Repeated measurements of relative positions, either directly in a day or indirectly from different days, improve the precision of the inferred positions. Varied combinations of baselines and of sets of observed sources improve the overall geometry and weaken the correlations of the source coordinates with the numerous phenomena modeled in the analysis.

Provided that observations are continued at a sufficient level, VLBI is fully capable of maintaining a set of highly stable directions referred to the most distant objects in the known universe to serve as a reference for all other sets of directions in the Galaxy, in the Solar System or on the Earth.

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Appendix: Explanation of acronyms in Table 1.

APT	Asia-Pacific Telescope
CDP	Crustal Dynamics Project - NASA
CRF	Celestial Reference Frame - NASA, USNO
CRL	Communications Research Laboratory, Japan - Pacific
DSN	Deep Space Network - astrometry
EUR	European geodesy - organized by Geodetic Institute, Bonn
EURMOB	European mobile
GERMAN	a few sessions between Germany and Asia
GSI	Geodetic Survey Institute, Japan - various places with transportable dish
IRIS-A	NOAA - EOP monitoring
IRIS-P	IRIS-Pacific - NAO Mizusawa (in beginning probably still IPMS)
IRIS-S	IRIS-South - Geodetic Institute, Bonn + IfAG + Wettzell
MOBL	mobile VLBI in N. America - NASA
NAVEX	USNO - extended networks
NAVNET	USNO - EOP monitoring
NEOS-A	National Earth Orientation Service (USNO, NOAA, NASA) - EOP monitoring
NEOS-B	EOP monitoring - different network than NEOS-A
NGS	NGS sessions in southern hemisphere and Canada
NRL	Naval Research Laboratory - astrometry
POLA	POLARIS - NOAA (in those days actually NGS, a small part of NOAA)
SGP	Space Geodesy Program - NASA (name created by Goddard)
USNO	early EOPs
VLBA	Very Long Baseline Array

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PART II

THE INTERNATIONAL CELESTIAL REFERENCE FRAME

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THE INTERNATIONAL CELESTIAL REFERENCE FRAME REALIZED BY VLBI

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Introduction

As described in Part I of this Technical Note, there exists a large resource of high accuracy, dual frequency VLBI data which were acquired from various networks for geodetic and astrometric purposes over a span of more than fifteen years and from which various radio source catalogues have been constructed. (See bibliography in Part I.). The goal of the work described below was to create the definitive catalogue for the ICRF (International Celestial Reference Frame) using the best data and methods available at the time the work was done. This work is the joint cooperative effort of a subgroup of the IAU Working Group on Reference Frames (WGRF) formed expressly for this purpose.

The subgroup has taken an empirical approach in the selection of data, analysis, estimation of errors, and categorization of the final results. Having gained experience from the past efforts listed in Part I., we let the data speak for themselves. The characterization of a radio source, *i.e.*, its position, how it was treated in the analysis, and whether it is suitable for use as a defining object, is derived entirely from the VLBI data and analysis and not from any other information. This approach leads to a rigorous selection of defining objects and a reliable realization of the ICRF as a set of relative positions oriented to the axes of the International Celestial Reference System, ICRS (Arias *et al.*, 1995).

Several points should be noted at the outset. The source positions and characteristics are derived from a particular, although comprehensive, set of data using specific frequencies and networks of stations and covering a certain interval of time. The underlying physics of the radio objects is not as well understood as that of stars, and we can only describe with certainty what the objects did during this particular time. It is clear that many quasars undergo changes in structure that can affect their realized positions at some level. From the data set we can see what has happened and surmise, but not predict theoretically, what can be expected. Unfortunately, while any given star is overwhelmingly likely to continue doing exactly what it has been doing, the same cannot be said of quasars. The brighter side of quasars and VLBI astrometry is that the level of astrometric uncertainty is at least one order of magnitude better than optical measurements of stars. The potential weakness is that the quality of the ICRF so derived cannot easily be given a purely theoretical underpinning.

Because the vast majority of observations were made for geodetic purposes and therefore used the brightest compact radio sources while the strictly astrometric observations constitute a small fraction of the total, the information available on the sources from the VLBI data varies enormously. The approach we have taken is to derive the measure of ideal behavior, *i.e.*, invariant position in the celestial frame, from the available data. In some cases thousands of observations lead to the discovery of statistically significant position variations. For other sources we might only be able to say that the variations in position are not inconsistent with their measurement uncertainties. Fortunately there is a sufficiently large class of radio sources with more than enough observations and minimal position variations to make the effort worthwhile.

Again proceeding in an empirical mode, this realization of the ICRF was considered only one of many, both actual and potential, better than preceding ones but by no means attaining perfection. Therefore, when discrepancies were discovered in comparisons with other realizations, the particular sources were considered less reliable for use in the ICRF. It was not possible, given the number of observations, to try to explain the small number of discrepant positions.

The geodetic/astrometric VLBI data set has a rich variety of stations and networks. Antennas range from 3 to 100 meters in diameter. Baselines range from a few tens of meters to nearly the diameter of the Earth. Although extreme baselines contributed very little to the number of observations and smaller mobile antennas lacked sensitivity to see any but the brightest sources, the entire data set was used (except for sessions entirely between antennas at a single observatory), pooled cooperatively from all the various observing programs. Besides providing the potential for extracting the maximum information, the use of the entire data set includes the widest variation that the network geometry and station size can impose upon the realized ICRF. The ICRF positions and stated uncertainties should then represent realistically how confidently the positions can be used in the future with arbitrary VLBI measurements. The VLBI data for this work were edited following the usual procedures of each contributing group.

It was considered essential that the realization of the ICRF be derived from a single analysis, even if imperfect, rather than from a combination catalogue made of several VLBI solutions. While the various recent catalogues are not inconsistent, except for a few discrepant sources, a combination loses certain information. The operational realization of the ICRF is a set of right ascensions and declinations, but the actual information is the much larger set of relative positions, whose quality is contained in the full covariance matrix. A typical combination catalogue does not give access to this information. In addition, there is extensive but not complete overlap of data used in some of the VLBI analyses. There are differences in modeling between groups. Consequently understanding the statistics and systematic errors of a combination solution is not straightforward.

Preparation for analysis

As suggested above, the sources can be characterized along several lines. The most important are variations in position seen in the data and number of observations. The underlying conceptual basis of this type of realization of the celestial reference frame is that positions are invariant with time. Therefore the first task was to ensure that this condition was not significantly violated. A series of solutions was made. In each solution the positions of all sources except for a small test set were estimated as time-invariant parameters. The position of each test source was re-estimated for each day the source was observed. Each source was treated as a test source in some solution. The complete set of source positions as functions of time was analysed to determine which sources had statistically significant variations in their positions. In addition, in another solution apparent linear motion was estimated simultaneously for all sources with sufficient data, generally two or more observing sessions. Two modes of variation were recognized. For sources with sufficient data to derive statistically significant apparent linear motions, a source was considered problematical if the apparent motion exceeded 50 microarcsecond/year and was larger than the formal error. Other sources were rejected if the weighted root-mean-square of the source position variations exceeded 0.5 milliarcsecond (mas) in arc length and were also more than 4 σ based on the formal position errors. Since these two classes of sources showed undesirably large position variation, they were treated differently from other sources in the final analysis. To accommodate their position variations without deforming the rigid geometry of the remaining sources, the positions of these sources were adjusted separately for each session in which they were observed.

The variations in position seen in the data set were not comprehensively analyzed to determine the causes. The position variations for some sources show clear correlations with changes in mapped structure and to some extent the position changes can be derived from the structure, but there is no strong evidence of any regularly repeated behavior. Figure 1 shows the smoothed time evolution of the astrometric positions in right ascension for three well observed sources of different quality. These images were derived from a 45-day moving average, with no overlap, of the arc source position data presented in Section III.4. The smoothed residuals in right ascension are multipled by the cosine of the declination to provide true arc residuals on the sky. A 45-day averaging period was chosen because a

spectral analysis of the position determinations for all sources provided no evidence of significant motions on periods shorter than this. The best-fit rate estimate for the smoothed data is shown for reference only.

More rigorous estimates for the apparent motion of these sources were obtained from proper motion solutions using the original VLBI data. The full solutions for apparent proper motions of all ICRF sources show that there is a net rotation rate of about 10 microarcseconds per year between the ICRF and a no-net rotation frame defined by averaging over all of the source proper motions. These small residual rotations were not removed from the data presented in Figure 1 or in Section III.4.

Figure 1(top) shows the time evolution of 0552+398, the most observed source in the ICRF, which shows a small, apparently linear motion. When the net ICRF rotation rate is removed using a full solution for proper motions, the observed angular rate for this source is only 8.1 ± 5.1 micro arc seconds per year, fully consistent with no motion. Figure 1(middle) shows the time evolution of 0923+392 (4C39.25) which, by contrast, is moving, in an approximately linear fashion at a much larger rate than can be explained by any residual rotation of the ICRF. This motion is not seen in other, angularly nearby, ICRF sources and clearly represents an intrinsic motion of the source. The observed angular rate of 57 ± 6 microarcseconds per year for this source in the full no-net-rotation proper motion solution translates to an apparent transverse velocity of 1.3 times the speed of light, strong evidence that this motion is not due to transverse velocity but instead to source structure changes.

Both 0552+398 and 0923+392 have weighted rms residual scatters of about 0.1 mas about the best fit line after the 45-day smoothing is applied, indicating that the short term stability of the ICRF is at approximately the 0.1 mas level, or better.

Figure 1(bottom) shows the time evolution of 2251+158 (3C454.3) (in the ICRF list of "Other" sources), which is not well represented by any linear trend over periods much longer than a few months. The scatter of the residuals of the smoothed right ascension data about the straight line fit is very much larger than can be explained from the formal errors. Clearly, the position of this source cannot be repeated to much better than 1 mas, which indicates the dangers involved in using such source positions as fiducial marks.

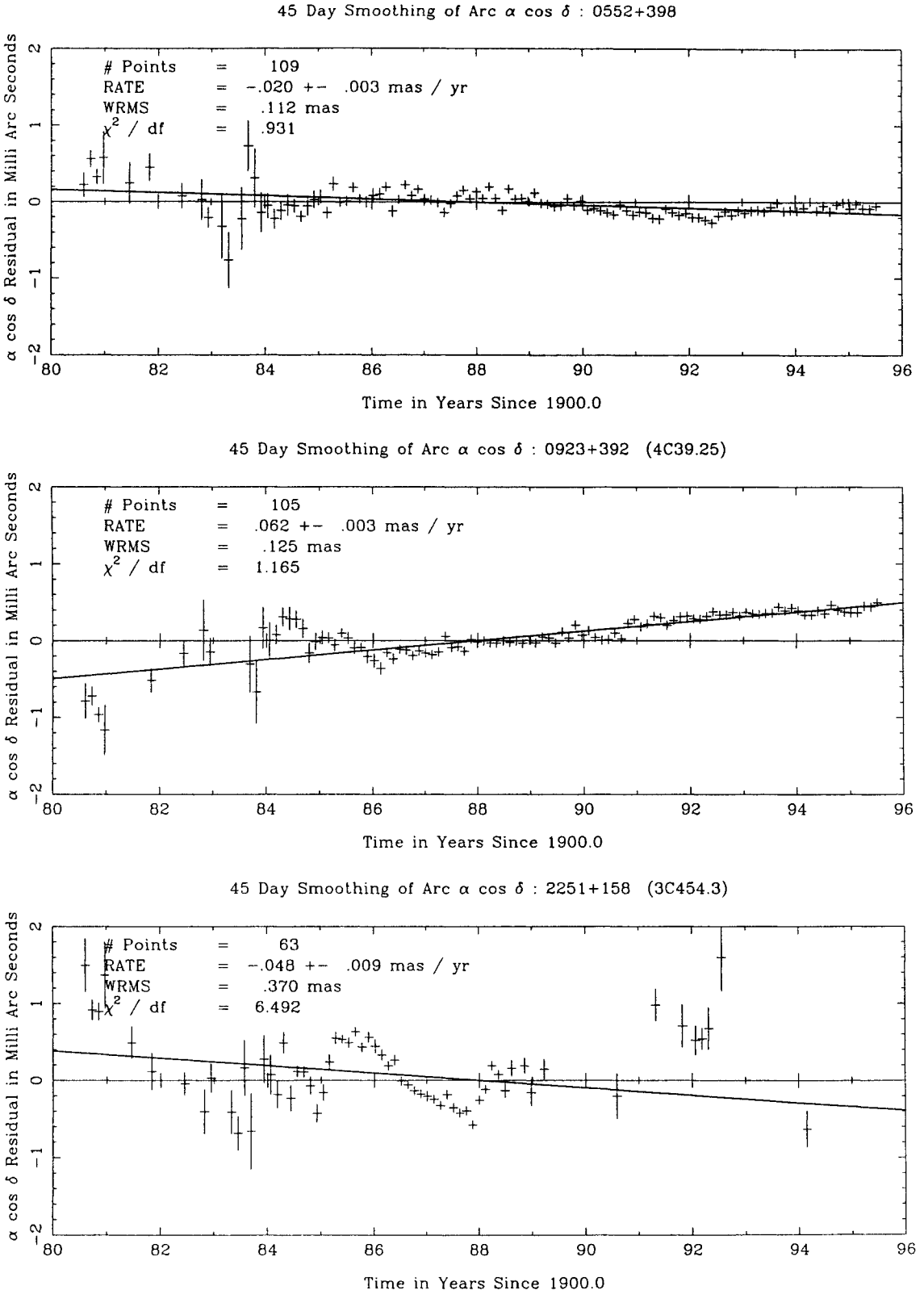


Figure 1. Smoothed time evolution of the astrometric position in right ascension for (top) 0552+398, (middle) 0923+392 (4C39.25) and (bottom) 2251+158 (3C454.3). In each case, the observed right ascension, after removal of the best fit mean, was multiplied by the cosine of the declination and subjected to a 45-day moving average, as discussed in the text.

Configuration of the ICRF Analysis

While the subgroup had access to several analysis systems and data sets, the solution for the ICRF was made at Goddard Space Flight Center (GSFC) largely for two reasons, one of convenience and one for better modeling. The Goddard system had access to more data and had already implemented an improved troposphere model. Similar results could have been obtained at the other analysis centers such as the Jet Propulsion Laboratory (JPL) but with greater effort.

The configuration of the ICRF analysis was developed as a balance between competing goals: the most data and the least systematic error, the best models and available options, the largest number of useful estimated parameters and computer speed, and the like. As improvements occur in the future, the balance will shift and the results will be better still.

The most important choices are related to data and modeling/estimation. To extract the most information from the data set both delay and delay rates were used, and only observations below 6 degrees were excluded. There may have been a slight increase in systematic error because of poorer modeling of low elevation and delay rate observations. The troposphere was modeled using the MTT mapping function (Herring, 1992) and estimates of the zenith troposphere effects in the form of 1-hr piecewise linear, continuous functions with constraints on the size of variations. While shorter time intervals have been shown to produce better geodetic results, they were not used in this analysis because of computer speed limitations. Time-variable troposphere gradients were estimated. The effect on the position results is described later. Because it was not available in the Goddard analysis system, no atmosphere structure information was used.

The primary geodetic parameters, the station positions, were estimated separately for each session. In this way any non-linear motion of the stations does not affect the integrity of the invariant source positions. There is no distortion of the relative source positions derived from a single day caused by forcing the station motions to follow a linear model. Station motions within a day from solid Earth tides and ocean loading were derived from unadjusted *a priori* models (McCarthy, 1992).

The weighting of the data followed the usual Goddard practice. For each session a pair of added noise values was computed for delays and delay rates which caused the reduced χ^2 to be close to unity when added to the variance of the observations derived from the correlation and fringe-finding process as well as the calibration of the ionosphere. Other modifications of the observation errors such as elevation-dependent and source-dependent noise were not used.

The unadjusted *a priori* models for geophysical effects and precession/nutation generally followed the IERS Standards (1992) (McCarthy, 1992). The VLBI theoretical model was the so-called consensus model given in the IERS Conventions (1996) (McCarthy, 1996).

The parameters were estimated using arc-parameter elimination (Ma *et al.*, 1990), which is an incremental least-squares method that can accommodate large numbers of parameters if they are associated only with particular data intervals. In the ICRF analysis several classes of parameters were adjusted. For each observing session, the adjusted arc parameters included:

1) positions of "arc" sources with identified excessive apparent motion or random variation,
2) two celestial pole offsets to account for errors in the standard precession/nutation models,
3) positions of the stations,
4) the rate of UT1 relative to a good *a priori* time series,
5) 1-hour troposphere parameters described above,
6) troposphere gradients in the E-W and N-S directions, linear in time,
7) quadratic clock polynomials for the gross clock behavior,
8) 1-hour clock parameters similar to the 1-hr troposphere parameters, and
9) necessary nuisance parameters such as clock jumps and baseline clock offsets.

Certain parameters were adjusted as invariant quantities from the entire data set. These global parameters included:

1) invariant source positions,
2) geometric axis offsets for all fixed antennas, and
3) 252 parameters for Earth rotation variations in the diurnal and semidiurnal bands caused by ocean tides.

The axis offset and ocean tide Earth rotationadjustments were all small but the estimates were included to eliminate any influence on the source positions.

After a series of test solutions to refine various aspects of the analysis, a final solution was run which included 1.6 million pairs of delays and rates from August 1979 through July 1995. The postfit weighted root-mean-square residuals were 32.6 ps for delay and 104.2 fs/s for rates with χ^2 per degree of freedom of 1.08. There were 1305 global parameters, ~650 000 arc parameters, and over 2.5 million degrees of freedom.

There are several results from the final solution, designated WGRF for the following discussions. Of primary importance is the set of invariant source positions and their formal errors, which are the basis for assigning realistic errors. The full covariance matrix of these source positions is another important result although rather massive for everyday use. The time series of source positions for arc sources from the individual session estimates show the level and character of their variations. For these sources an additional step was taken to calculate the weighted mean positions and weighted root-mean-square scatter as a measure of error. In addition, the observation and session counts for each source give some indication of the source's usefulness.

Determination of Realistic Error

Given the very large number of observations for some sources, the error contribution from their observation noise is very small and not a meaningful measure of uncertainty. It is necessary to consider several other effects to assign realistic errors. One is the statistical validity of the formal errors. Another is the cumulative influence of all modeling errors and editing decisions. Yet another is the magnitude of specific, identifiable systematic errors that could have distorted the results.

The VLBI data used here have also been analyzed for geodetic purposes. Extensive tests of the geodetic results (Ryan *et al.*, 1993) indicate that a multiplicative factor of 1.5 is appropriate to scale the formal errors of parameters such as station position to represent their actual variation over subsets of data. Because of the relative paucity of data for many sources and the computer time required, a similar analysis was not undertaken for the astrometric results. Nonetheless, it is probably necessary to apply a similar scaling factor to the formal errors of the source positions.

The cumulative effect of modeling errors and data editing can be examined by comparison of results from independent analyses. Intercomparison of different radio source catalogues addresses the problem of mismodeling and consequent systematic errors. Aspects that can be probed by catalogue comparisons include:

1) extension of the data set used in analysis;
2) analysis differences at different centers;
3) agreement between subsets of data;
4) intentional perturbations of modeling.

A number of such comparisons involved the current catalogue (WGRF), associated catalogues from the identical data base that were created for test purposes, and existing radio source catalogues. Existing catalogues include the 1994 and 1995 IERS realizations of the celestial reference frame (IERS94 and IERS95) and the radio-optical reference frame of Johnston *et al.* (1995) (RORF). Comparing WGRF with the latter indicates the magnitude of coordinate discrepancies to be expected among global catalogues that are intended to provide stable reference frames, and to some extent, points 1) and 2) as well. Points 2) and 3) were tested by comparisons with two catalogues based on independent data, analyzed with independent software. The two catalogues are denoted GSFC and JPL and are based, respectively, on CDP/SGP/IRIS/NAVNET/NEOS and JPL DSN data. They were analyzed, respectively at GSFC with CALC/SOLVE and at JPL with Modest. Finally, point 4) was tested with three additional catalogues: WGRFna, WGRFel, and WGRFng. In the solution giving

WGRFna, all source coordinates were treated as global parameters (*i.e.*, no sources were arc parameters). For WGRFel, the threshold for eliminating low-elevation observations was raised from 6 to 7 degrees. Finally, in the solution leading to WGRFng, no troposphere gradient parameters were estimated.

Assessment of the comparisons relies on several measures of the overall alignment and agreement of the coordinates. Table 1 shows such results for the nine pairs of catalogues in the comparisons. Rotational offsets (A_1, A_2, A_3) are the rotations about Cartesian axes to bring each pair into best coincidence; the χ^2 are calculated from differences after the rotation is applied to one catalogue of the pair. Off-diagonal covariances are neglected in all comparisons. Agreement between right ascensions and declinations is indicated by rms differences about the mean; another measure is a similar quantity for arc lengths between all pairs of sources. Potentially significant internal trends in variation of coordinate differences with α and δ are assessed by fitting linear models to all four combinations ($\Delta\alpha$ *vs.* α, δ; $\Delta\delta$ *vs.* α, δ). The largest variations of these fits over the celestial sphere, as well as their significance in units of the formal uncertainty of the slope, are reported in the last columns of the table. With three exceptions, they are all in $\Delta\,\delta$ *vs.* δ; the exceptions are $\Delta\alpha$ *vs.* α for IERS95-94, and $\Delta\delta$ *vs.* α for the WGRF no-arc-source and no-gradient variants.

Table 1. Summary of Catalogue Differences.

Catalogue pair	Rotation A_1	A_2	A_3	χ^2	rms residuals α	δ	Arc	Max. trend	trend signific.
	0.001"				0.001"			0.001" /100°	
WGRF - IERS95	0.1	-0.4	0.0	2.92	0.23	0.39	0.55	0.32	14
- RORF	-0.2	-0.5	0.0	2.77	0.10	0.38	0.42	0.32	15
IERS95 - IERS94	0.0	0.0	0.0	2.85	0.30	0.31	0.52	0.29	12
WGRF - GSFC	-0.1	-0.1	-0.0	1.68	0.09	0.29	0.39	0.15	7
- JPL	0.1	-0.3	-0.2	2.84	0.26	0.44	0.51	0.66	15
GSFC - JPL	0.2	-0.3	0.2	3.42	0.30	0.36	0.58	0.38	14
WGRF - WGRFna	0.2	-0.0	0.0	0.18	0.05	0.06	0.12	0.07	2
- WGRFel	0.0	0.0	0.0	0.04	0.01	0.02	0.04	0.02	2
- WGRFng	0.0	0.0	0.0	0.16	0.03	0.04	0.08	0.07	2

Table 1 shows that all the tested catalogues are rather well aligned: rotational offsets do not exceed 0.5 mas around any of the three axes. Systematic errors appear to be present, however, as indicated by the normalized χ^2 values of 2 to 3 for many comparisons after the removal of the rotational offsets. Note that the rotations and χ^2 values are considerably smaller for the last three pairs, which involve minor modeling variations on the same data set. This observation also holds true for the root-mean-square differences and their trends: these remain below 0.1 mas. In the "independent" and "subset" categories (lines 1-3 and 4-6, respectively), however, the picture is substantially different.

Differences are as large as 0.4 mas for coordinates and 0.6 mas for arc lengths, with trends reaching 0.7 mas and 15 σ apparent significance over the celestial sphere. These differences appear to be slightly larger when GSFC/JPL data differences are involved. The individual differences between the JPL and GSFC catalogues are shown on figure 2. They are present, however, with existing catalogues as well. Even the changes in the IERS celestial frame between successive years (line 3) can be as large as 0.3 mas in coordinates and their trends, and 0.5 mas in arc lengths. The significance of the systematic trends in coordinate differences is exaggerated in the results of Table 1, which were calculated with diagonal covariances. When correlations among all source coordinates are taken into account, the significance of such trends is known to decrease substantially. This is an indication that the quality of the source coordinates over some limited regions of the sky is considerably better than their coherence over the entire celestial sphere. The most likely source of such behavior is in the correlations among observations introduced by limitations of observing networks and schedules.

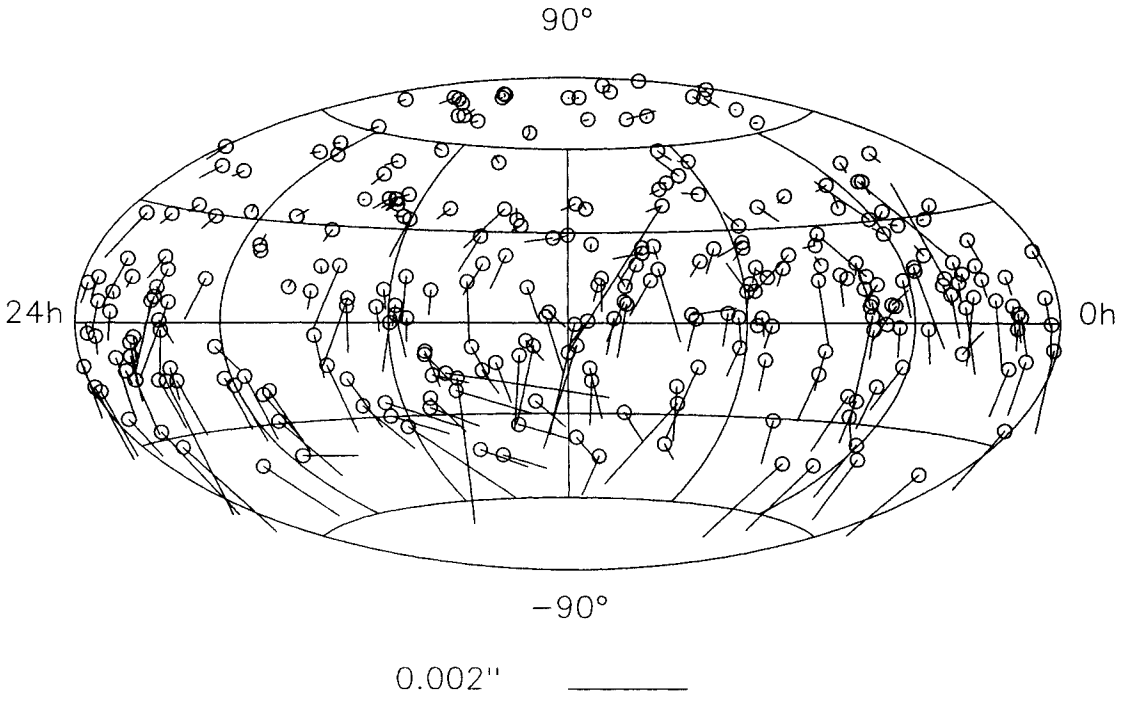


Figure 2. Vector position difference (αcosδ, δ) between JPL and GSFC catalogues. The data and analysis are completely disjoint. The scale is given at the bottom.

Another consideration of a comparison is whether one should expect such a level of agreement in light of the different models and different implementations. The influence of differences in software and analyst choices on VLBI analyses is a source of potential error. Comparisons of independent catalogues do not separate the software and analyst effects, however. In order to focus solely on the software component, a program of model comparison was undertaken. Three software packages (GSFC's CALC, used to generate the WGRF catalogue, JPL's Modest, and Paris Observatory's GLORIA) were compared in detail for all observables in one 24-hour VLBI observing session. After considerable effort to match modeling options, the delay and rate observables agreed to within ~1 ps and 1 fs/s wrms, respectively. Repercussions for source positions would thus be limited to the order of 1 ps = 0.3 mm, which on a 10000-km baseline is ~0.005 mas. This is approximately a factor of 60 lower than some of the systematic problems exposed in Table 1. Having isolated modeling differences, we next built catalogues using an identical subset of the data but different software (GSFC, JPL) and analyst choices. The resulting catalogues agreed as shown in Table 2.

Table 2. Differences between catalogues: same data, different software (unit: 0.001")

A_1	A_2	A_3		αcosδ	δ
0.14	-0.01	+0.00	bias:	0.007	0.020
±0.03	±0.02	±0.02	wrms:	0.154	0.207

Analyst choices may introduce scatter of a little less than one formal error (which are 0.178 and 0.290 mas in the median for α cosδ, δ, respectively) but do not significantly bias the coordinate means. The closeness of the model comparisons indicates that the level of agreement seen for the source positions is determined by other factors. The model comparisons indicate that one can place a very high confidence in the correctness of the model implementation.

The gradients in the troposphere, estimated from the data, illustrate how a systematic effect on the source positions can arise from a discrete change in the analysis. Figure 3 shows the differences between source declinations from analyses with and without gradient estimates. The effect is much larger than the formal errors and is caused by the greater troposphere thickness nearer the equator (MacMillan and Ma, 1997). While the effect is not large in absolute terms, it is systematic and would distort the celestial reference frame if ignored.

From a consideration of error sources such as described above, the subgroup concluded that a realistic error estimate for the invariant source positions could be made by inflating the formal errors by a factor of 1.5 followed by a root-sum-square increase of 0.25 mas. For the most frequently observed sources the 0.25 mas is the dominant error. The errors of the arc sources were also increased by 0.25 mas.

The method adopted at the IERS until 1995 for the realization of the extragalactic reference frame consisted of combining individual VLBI frames by applying an algorithm based on catalogue comparison. The position uncertainties derived from the combination reflected the disagreement between individual analyses.

To address the question of whether adopting a unique "error calibration law" for all sources eliminated or at least minimized systematic effects, a combined frame was made by adopting a 6-parameter comparison model (three angles, drifts in right ascension and declination as functions of declination, and a bias in declination). Individual VLBI frames submitted by GSFC, JPL, NOAA and USNO to the IERS in 1995 (Charlot, 1995) were then included in this combination.

The comparison of the "inflated" uncertainties with those obtained from catalogue combination showed that there were still a non-negligible number of sources whose inflated uncertainties were smaller than those resulting from the comparison of parallel analyses with a deformation correction model. For these sources the uncertainty for each coordinate was set to be the larger of the inflated or the comparison value.

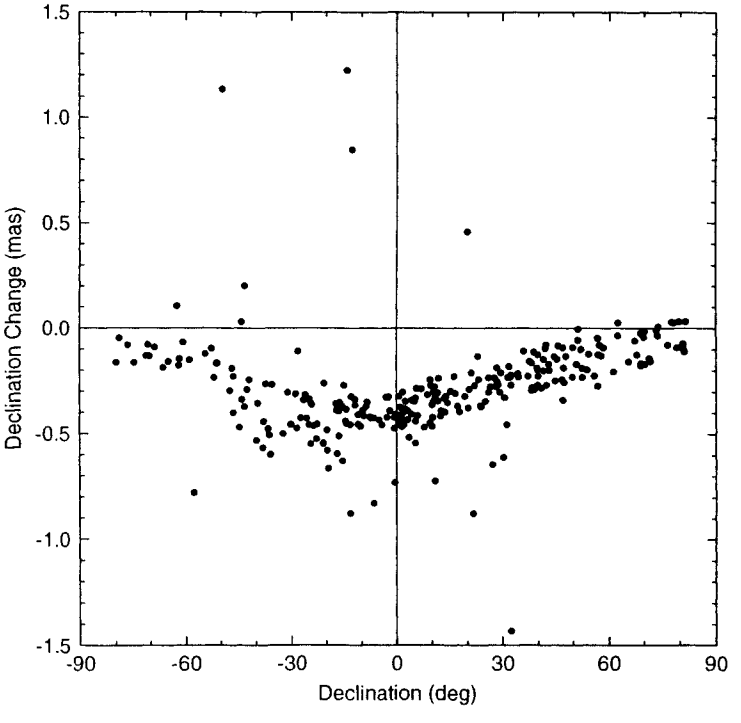


Figure 3. Effect of tropospheric gradients on declinations as a function of declination. The sense is (declinations with gradients estimated) - (declinations without gradients estimated).

Astrophysical Causes for Source Position Variations

Many extragalactic sources display structure on milliarcsecond scales for the strong radio emission associated with their compact cores. Temporal variations of the intrinsic structure of these objects may result in apparent motion when observations are made at several epochs. Until recently, the intrinsic structure of the majority of the sources has been mostly unknown. The surveys of Fey, Clegg, and Fomalont (1996) and Fey and Charlot (1997) show that most sources, when examined in detail, exhibit spatial structure on milliarcsecond scales. Their results show that the variation of intrinsic structure from source to source can be quite extreme, ranging from relatively compact naked-core objects, to compact double sources, to complex core-jet objects. The situation is exacerbated by the fact that compact extragalactic radio sources are known to have variable intensity and to have frequency and time-dependent intrinsic structure. Consequently, unknown and/or unmodeled source structure effects may be introduced into the astrometric solution.

Charlot (1990) has modeled the effects of radio source structure on measured VLBI group delays and delay rates. Results of this modeling suggest that these effects can be significant for extended sources (typically at a level of 100 picoseconds [~3 cm at the surface of the Earth or ~1 mas] in the group delay). Fey and Charlot (1997) calculated structure corrections based on the Charlot analysis using source models derived from Very Long Baseline Array (VLBA) observations of 169 extragalactic sources. Results of these calculations show that intrinsic structure contributions to the measured bandwidth synthesis delay are significant, ranging from maximum corrections of only a few picoseconds for the most compact sources to maximum corrections of several nanoseconds for the most extended sources. Fey and Charlot found a correlation between the compactness of the sources and their position uncertainties indicating that the more extended sources have larger position formal errors. They also define a source « structure index » based on the median of the calculated structure corrections. They suggest that this index can be used as an estimate of the astrometric quality of the sources as follows. Sources with an X band structure index of 1 may be considered very good astrometric sources. Sources with an X band index of 2 may be considered good sources while sources with an X band index of 3 should be considered marginal (and should only be used with caution). Finally, sources with an X band index of 4 should not be used at all for astrometric work. Additionally, sources should have an S band structure index of either 1 or 2, with a preferred value of 1, regardless of the value of their X band structure index.

Shown in Figure 4 are contour plots of the radio emission at 4 cm wavelength for four sources (0138-097, 0108+388, 0544+273, and 2201+315) observed by Fey and Charlot (1997). We have chosen these sources as representative of each structure index class. The X band structure index of these sources is indicated in each panel. The S band structure index of each source is 1 with the exception of 0108+388, which has an S band structure index of 2. Only the two sources 0544+273 (structure index 1) and 0138-097 (structure index 2) are ICRF defining sources (see next section). Figure 5 shows the corresponding structure effect maps. These indicate the corrections to the VLBI observables as a function of interferometer resolution. The mean, rms, median and maximum values of the structure corrections calculated by Fey and Charlot (1997) for these sources are also indicated in each panel.

Since even apparently stable sources can suddenly begin exhibiting rapid structure variations, the entire ICRF catalogue must be reobserved over time to ensure its continued precision on the submilliarcsecond level. Structure observations of the entire set of ICRF sources are either planned or in progress. This is being accomplished in the Northern Hemisphere with the VLBA. It will be more difficult to ascertain the structure of sources in the Southern Hemisphere due to the lack of observing facilities capable of adequate spatial imaging on the required scales. Almost all of the ICRF sources whose detailed structure is known are in the Northern Hemisphere. In addition, the ICRF can be improved in the future by enhancing the accuracy of the observations and the number of sources defining the frame can be expanded. New sources will continually be evaluated for addition to the ICRF catalogue and the radio positions of sources already in the catalogue will be revised through improved observational techniques. New data will be added to the existing database and reanalyzed, producing from first principles an improved and updated version of the catalogue whenever necessary.

Plans also exist for adding corrections of heretofore unmodeled source structure effects to the data. Charlot (1994) has demonstrated that the effect of intrinsic source structure on the bandwidth

synthesis delay observable can be successfully modeled. The author has shown that the variation in the astrometric position of the quasar 3C273 over an approximately 2-year period was due to variations of the intrinsic structure of the source. The work of Charlot also shows that global astrometry combined with imaging observations provides a method for measuring apparent motions of source components with respect to the global celestial reference frame and can thereby identify astrometrically stable components in extragalactic radio sources.

Categorization of sources

To be most useful in defining the ICRF a source should ideally show no variation in position in the data set, have sufficient data to support the absence of variation, and not have shown unexplained differences in position between realizations of equivalent validity. Several quality levels can be established for each of the 608 sources in the WGRF catalogue. These are based on one of three sets of criteria:

1) quality of data and observation history
2) consistency of coordinates derived from subsets of data
3) repercussions of source structure

To qualify for the list of sources that was used to orient the WGRF catalogue with respect to the IERS celestial reference system, a source must pass muster in all three categories. An attempt to quantify the criteria follows. In category 1) a source is disqualified if it is observed fewer than 20 times, or if the observations span less than 2 years. Each of the individual coordinate uncertainties and $\sigma_\alpha \cos\delta$ and σ_δ must also be smaller than 1 mas. In category 2) a source may be disqualified on the basis of the magnitudes and significance of its coordinate differences in several pairwise catalogue comparisons. After application of a global 3-dimensional rotation to place each pair of catalogues in best coincidence, if the coordinate differences exceed 0.5 mas or 3 σ in either coordinate, the source is disqualified. In category 3) three separate tests for structure effects must be satisfied. First, the source must have shown enough stability not to qualify for « arc position » estimation. Second, the average (absolute value) structure correction for VLBI delays, based on structure maps assumed to be valid for all observations, must not exceed 10 ps. Finally, in subsidiary fits that estimated time-rates-of-change of right ascension and declination, the time rate significance must not exceed two σ.

Some criteria that can be used to identify "problem sources" are related to their internal structure and their variation with time. If the structure varies with time, the effective centroid can move. Even with static structure, the baselines and their time-varying orientation can induce apparent shifts in position. A simple way to assess the time variability is to estimate rates of change of right ascension and declinations with time. An equivalent method, which also has the virtue of tracking nonlinear changes with time, is to estimate a new set of angular coordinates for each observing session or some other relatively short time period. The former method produces the list of sources with significant apparent « proper motion ». The latter method is used to select sources whose coordinates are not assumed to be constant in time but rather are estimated as arc parameters.

A more direct assessment of the effects of extended source structure is provided by using externally generated source maps to calculate structure corrections to VLBI observables. A number of such maps were available from the work of Fey with the VLBA. Only the source structure information for the 42 sources observed by Fey, Clegg, and Fomalont (1996) was explicitly used to classify sources for fitness in the ICRF. Out of these 42 sources, only two (1308+326 and 2145+067) are in the ICRF defining list (see next page) of 212 sources. While the fraction of sources with maps is rather small (42 of 608), the corresponding fraction of VLBI observations involving these sources is respectable (55%). Making the gross approximation that the structures do not vary with time, VLBI delay corrections could in principle be calculated for these observations. The average (absolute) correction exceeds 10 ps for 17 of the 42 mapped sources. After the WGRF analysis was completed, more sources were mapped and their structure indices computed. Four sources (0153+744, 0518+165, 0831+557, 1532+016) with stable positions and already included in the best category were found to have an X band structure index of 4. The structure of the first three sources, however, appears to be stable over time.

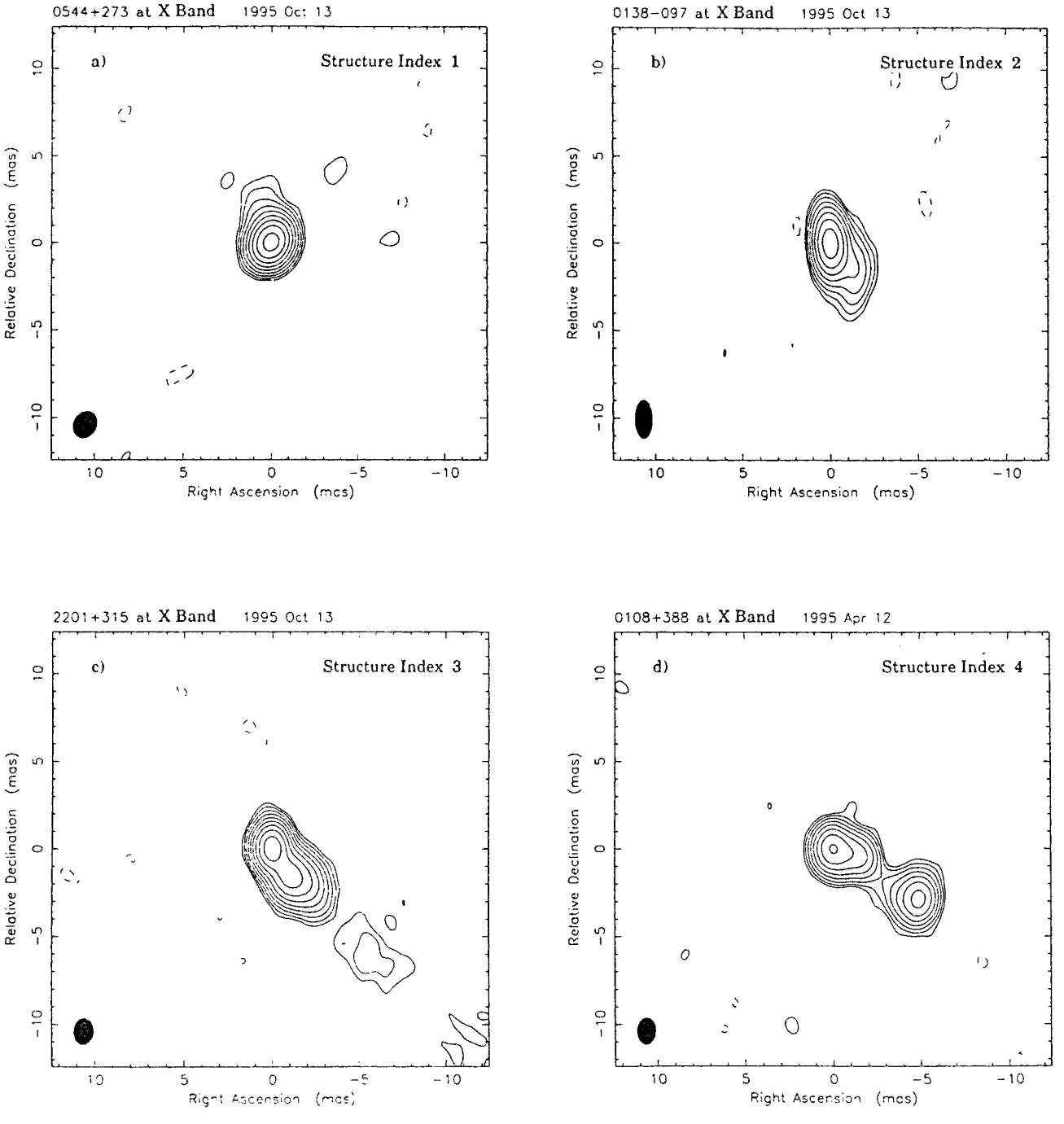


Figure 4. Contour plots of the radio emission at 4 cm wavelength for the four sources a) 0544+273, b) 0138-097, c) 2201+315, and d) 0108+388. These sources are representative of each structure index class. The X band structure index of these sources is indicated in each panel. The S band structure index of each source is 1 with the exception of 0108+388 which has an S band structure index of 2. Fey and Charlot (1997) suggest that sources with an X band structure index of 1 may be considered very good astrometric sources. Sources with an X band index of 2 may be considered good sources while sources with an X band index of 3 should be considered marginal (and should only be used with caution). Finally, these authors suggest that sources with an X band index of 4 should not be used at all for astrometric work.

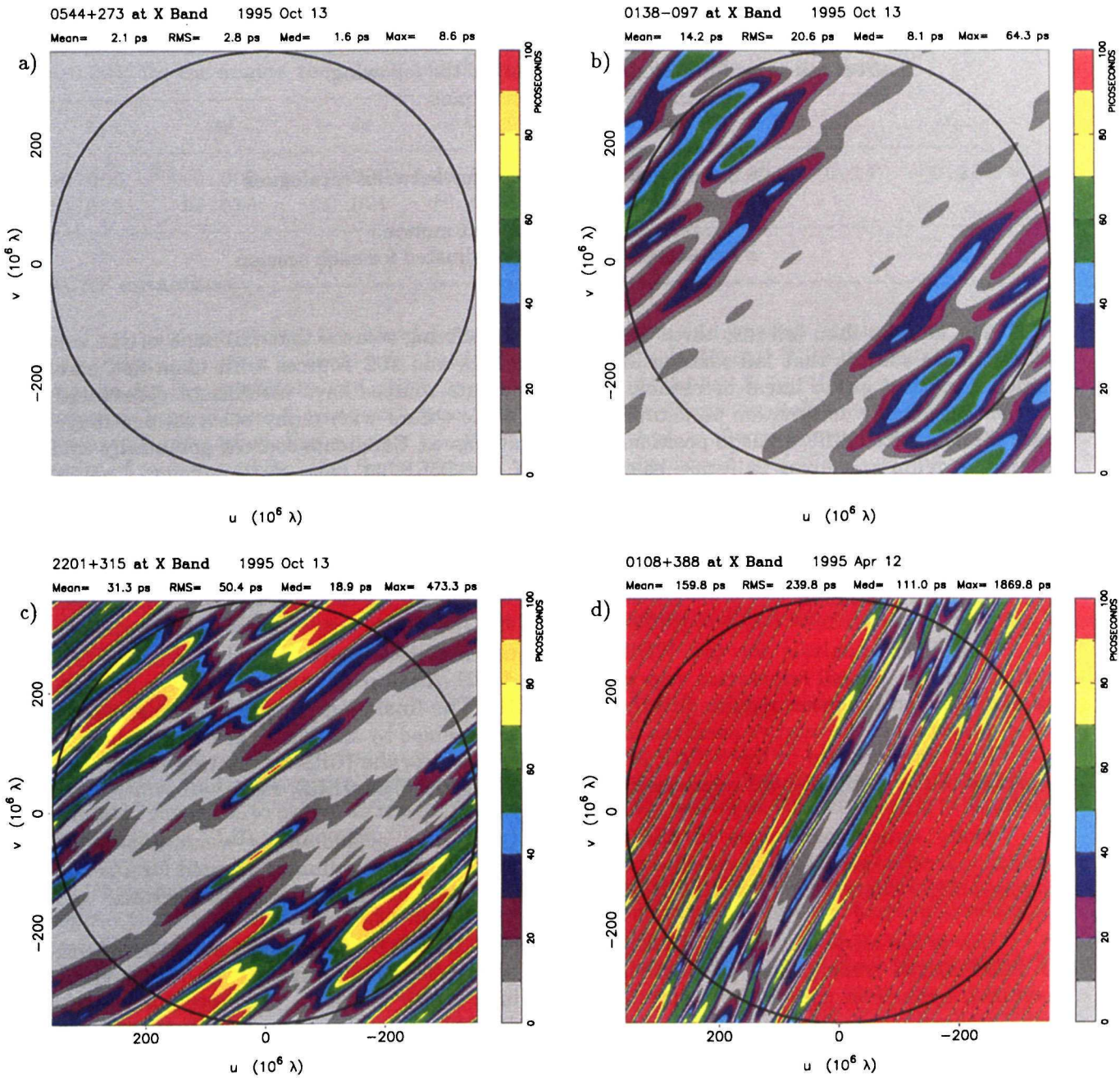


Figure 5: Color plots showing the magnitude of the structure correction (absolute value) induced in the bandwidth synthesis delay by the extended radio emission at X band of the four sources a) 0544+273, b) 0138−097, c) 2201+315 and d) 0108+388. The structure correction is plotted as a function of the length and orientation of the VLBI baseline projected onto the sky, expressed in millions of wavelengths (u, v coordinates). The color scale is identical in each panel and ranges from 0 to 100 picoseconds (ps). All structure corrections larger than 100 ps are plotted as red. The circle drawn in these plots has a radius equal to one Earth diameter, corresponding to the longest baselines that can be theoretically observed with Earth-based VLBI. The mean, rms, median, and maximum values of the structure corrections for all baselines contained within this circle are indicated in each panel. The structure index classes defined by Fey & Charlot (1997) are based on the median.

Table 3 summarizes the somewhat arbitrary criteria used to reject sources based on their data, behavior, and structure.

Table 3. Selection of Defining Sources

Sources fail to be defining sources for any of the following:

- Arclength formal error >1 mas
- <20 observations
- <2-year span of data
- 3 σ or >0.5 mas discrepancy between catalogues
- Excessive structure
- Large, significant apparent motions
- Arc source, *i.e.*, position adjusted for each session

The sources then fall into three categories: 212 defining sources that fail none of the criteria, 294 candidate sources that fail some or all of the criteria, and 102 sources with identified excessive position variation, either linear or random. Some candidate sources have insufficient observations or duration for reliable designation as defining sources while others with many observations may have larger than expected differences in position between catalogues. Candidate sources potentially could be designated defining sources in future realizations of the ICRF as more data become available or analysis improves. The third category of other sources does include sources that may be useful for purposes such as radio-optical frame ties. While only the defining sources have a formal role in the ICRF, the positions of all sources are consistent with the ICRF.

Orientation of the ICRF

The VLBI analysis for the WGRF catalogue described above provided accurate relative positions and an overall orientation very near to the ICRS (Arias *et al.*, 1995). However, the solution was not designed to obtain results directly on the ICRS. The final stage in the ICRF realization was the rigid rotation of the relative positions to the ICRS maintained by the IERS. The extragalactic radio source catalogue obtained in the WGRF solution was aligned to the ICRS by rotating it onto the last realization of the IERS celestial reference frame, RSC(IERS) 95 C 02 (IERS, 1996).

Radio source coordinates in RSC(IERS) 95 C 02 were evaluated by combining individual extragalactic reference frames submitted to the IERS in 1995. The coordinates adopted for a set of 236 defining sources aligned the axes of RSC(IERS) 95 C 02 to the IERS celestial reference system.

Due to the model adopted in the compilation of RSC(IERS) 95 C 02, the frame was affected by the deformations coming from the individual catalogues. The improvements in the models and procedures applied in the WGRF solution resulted in a frame free from deformations but slightly misoriented with respect to RSC(IERS) 95 C 02. In the procedure applied to rotate the WGRF solution to IERS frame, care was taken not to transfer to the former the deformations of the latter.

The algorithm used to put the WGRF coordinates in ICRS was based on catalogue comparison on the basis of common sources (Arias *et al.*, 1988). However, not all common sources contributed to the calculation of the rotation angles between frames. From the 212 highest quality sources selected by the WGRF, 117 were defining sources in RSC(IERS) 95 C 02. These sources are well distributed in the northern hemisphere but rather sparse in the south. To obtain a better sky distribution of sources, 16 IERS defining sources not in the WGRF list but with rather high quality were added, resulting in 133 common objects for comparison.

The extragalactic frame RSC(WGRF) 95 R 01 was obtained by putting the radio source coordinates from the WGRF solution in ICRS via comparison to RSC(IERS) 95 C 02. Table 4 shows that both frames are aligned to better than 0.010 mas. The deformation of RSC(IERS) 95 C 02 relative to RSC(WGRF) 95 R 01 is represented mainly by a bias of the principal plane. To test the stability of the axes of the system, we estimated the relative orientation between RSC(WGRF) 95 R 01 and RSC(IERS) 95 C 02 on the basis of different subsets of sources. The scattering of the rotation parameters obtained in the different comparisons indicate that the axes are stable within 0.020 mas.

Table 4. Alignment of the ICRF axes on ICRS. Relative orientation and deformation parameters to transform RSC(IERS) 95 C 02 to RSC(WGRF) 95 R 01. A_1, A_2, A_3 are the rotation angles between axes of the frames; D_α and D_δ are the drifts in right ascension and declination as functions of declination, respectively; B_δ is the bias in declination. All these parameters have been adjusted on the basis of the 133 common defining sources. r_α and r_δ are the weighted rms residuals in $\alpha \cos \delta$ and δ respectively. Units: 0.001" for the angles, the biases and the rms residuals; 0.001"/deg for the drifts.

A_1	A_2	A_3	D_α	D_δ	B_δ	r_α	r_δ
-0.006	+0.007	+0.005	+0.000	+0.002	-0.280	0.14	0.20
±0.018	±0.018	±0.021	±0.001	±0.000	±0.020		

The ICRF catalogue

The positions, errors, δ-α correlations, and observation and session statistics of the ICRF defining sources are given in Table 5 (p. II-22) identified by the ICRF and IERS designations. Similar information for the candidate and other sources is given in Tables 6 (p. II-29) and 7 (p. II-40), respectively. X band and S band structure indices are given where available, and Hipparcos link sources are also identified. Figures 6. a, b, c, d show the distribution of errors respectively for the three categories of sources and for all of them. Figure 7 shows the distributions of objects on the sky for the same four categories. It can be seen that there is moderately even distribution of all sources but the southern hemisphere is deficient in defining sources. This is caused by the small number of VLBI stations in the south and limited observing programs. While all sources are given ICRF designations, it should be emphasized that the quality and intended use of the three categories are quite different. The best astrometric quality resides in the defining sources and those candidate sources with the smallest errors. The positions of the "other" sources should be used carefully and only where less accuracy can be tolerated.

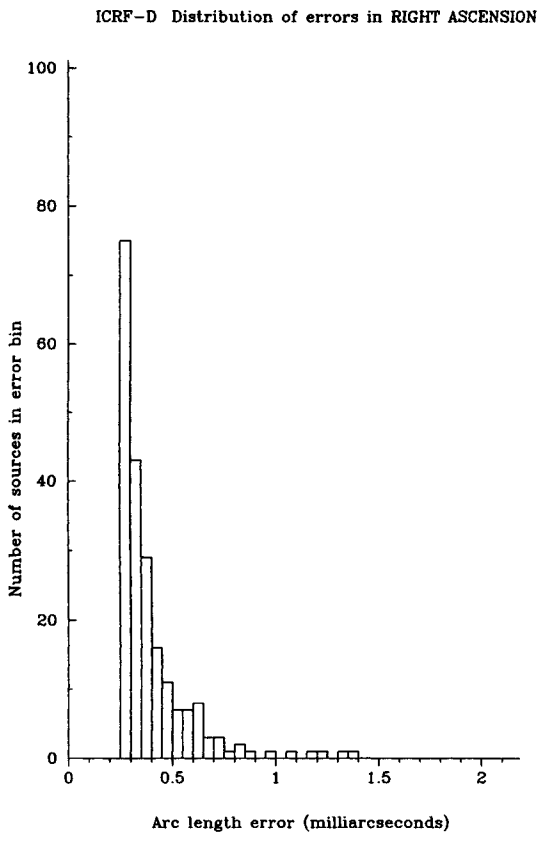
Evolution of the ICRF

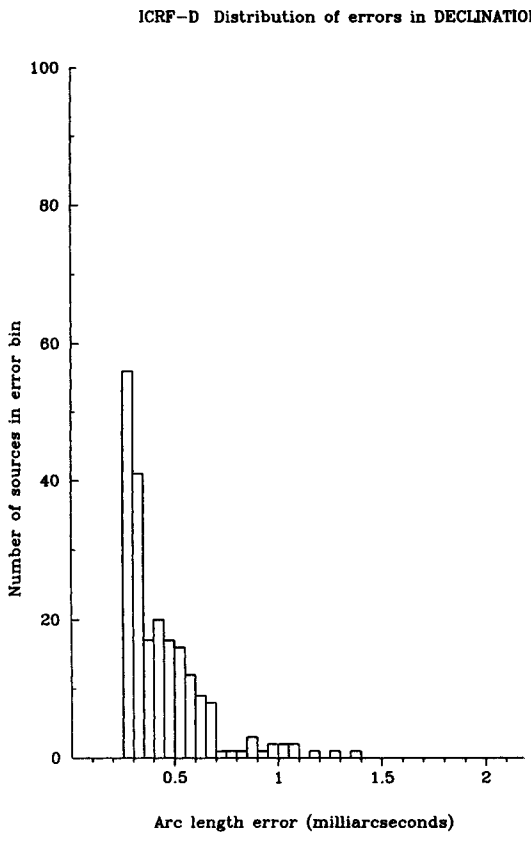
The current realization condenses the information from a particular VLBI data set spanning a defined interval and reflects a certain state of VLBI analysis. As time progresses we expect the realization of the ICRF to evolve although changes in the ICRF catalogue will be infrequent compared to past practice in VLBI astrometry.

There are several features that distinguish this type of realization from the conventional stellar catalogues that formerly defined the celestial reference frame. First, while we know the positional history of the sources, we cannot predict with absolute certainty what future observations will reveal. The current positions and velocities are a snapshot (or a movie), and continued observations are essential to maintain the viability and integrity of the ICRF. New sources must be observed to replenish and expand the list of candidates, and their positions in the ICRF must be determined. Current sources need to be observed periodically to track their behavior. Second, as observations accumulate, it should be possible to move candidate sources up or down the scale of usefulness. However, it is conceivable, perhaps even probable, that an identical categorization of sources from an analysis using twice as long an interval would show sources changing categories in unpredictable ways. For example, there is no physical reason to expect that linear position changes can continue indefinitely. Such motion would call into question the fundamental basis of the extragalactic frame, the great distances of the objects. Directed position changes should cease at some time. Conversely, a source now stationary could start apparent motion. Only the data analysis will show. The problem of position variation may be solved in the future if the application of source structure information permits the identification and use of truly kinematically stable points in the sky. This remains to be demonstrated. Unlike stellar catalogues, however, the original VLBI observations should always be accessible for improved analysis *de novo*.

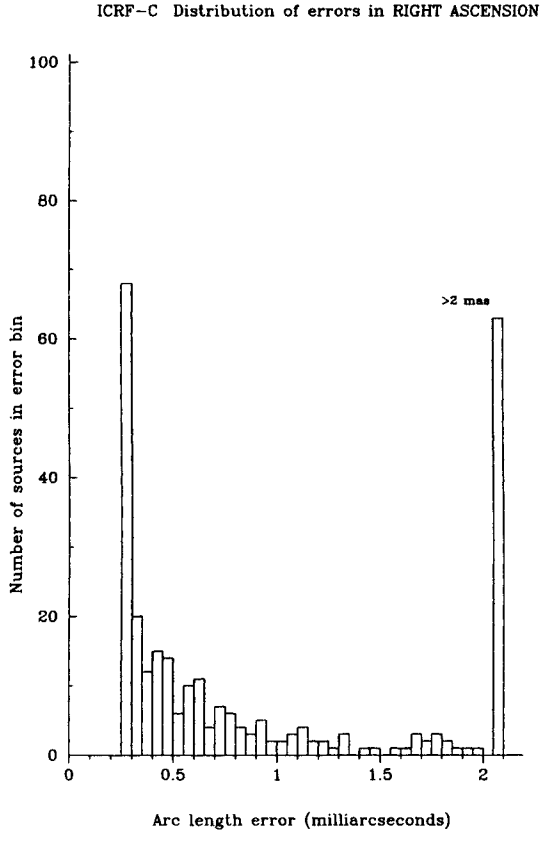
Despite the burden of maintenance, the ICRF realized by VLBI astrometry is a great step forward. Compared to stellar realizations it is intrinsically simpler, much more accurate, more stable, and less susceptible to systematic deformations. It will serve the purposes of astronomy well.

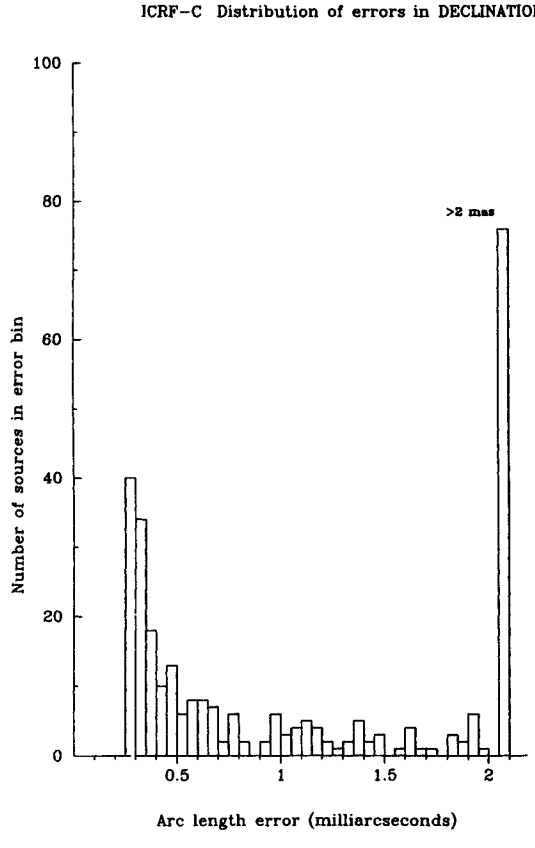
a)





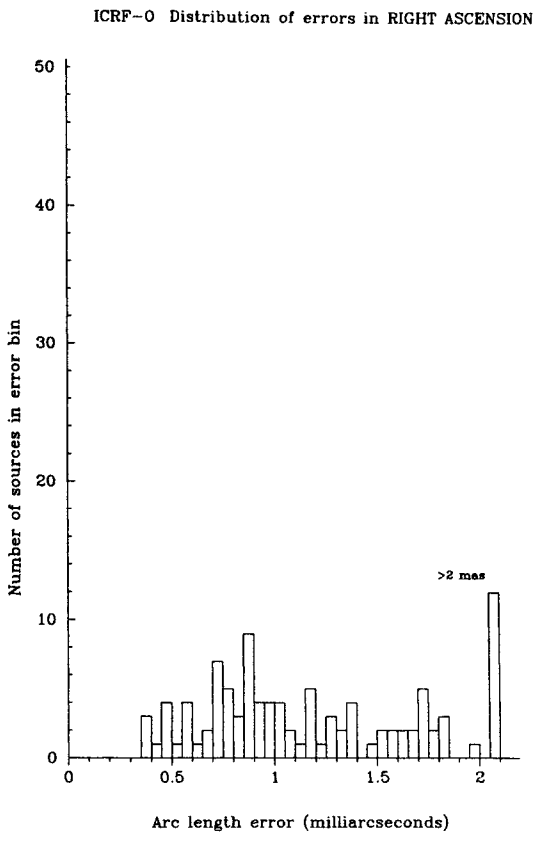
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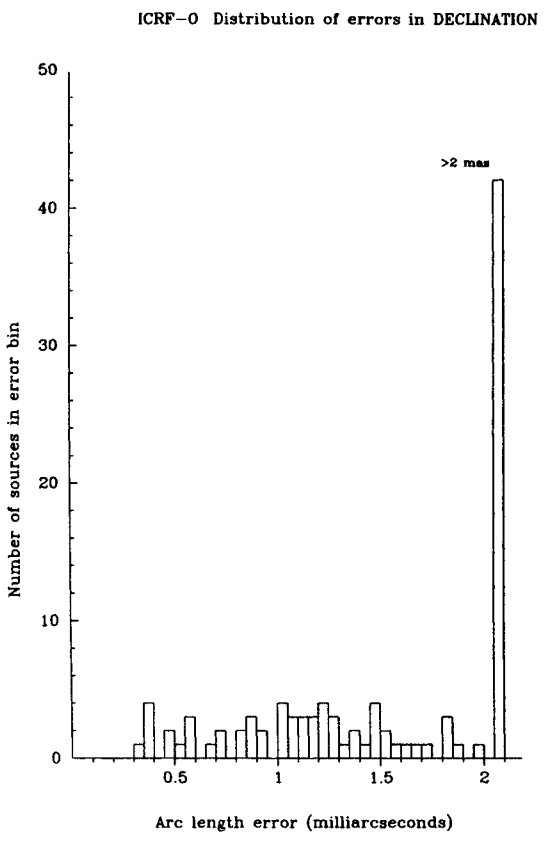




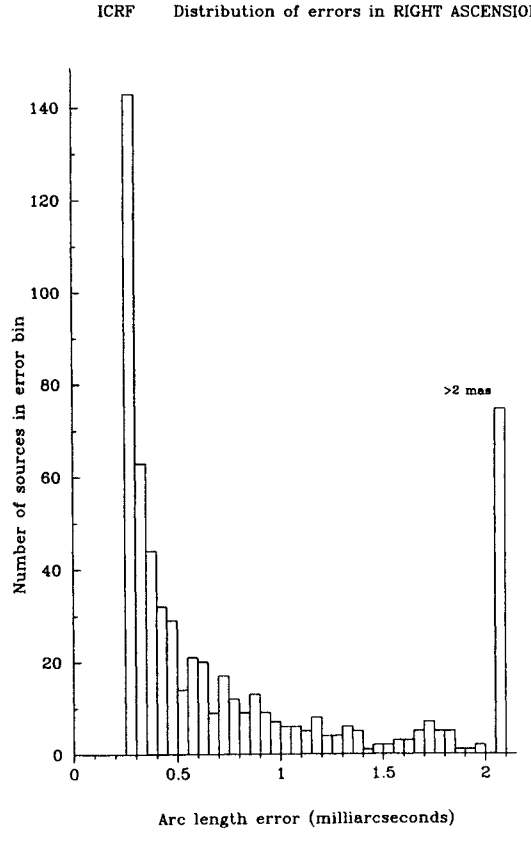
Figures 6. Histograms of source position errors for
a) defining sources; b) candidate sources.

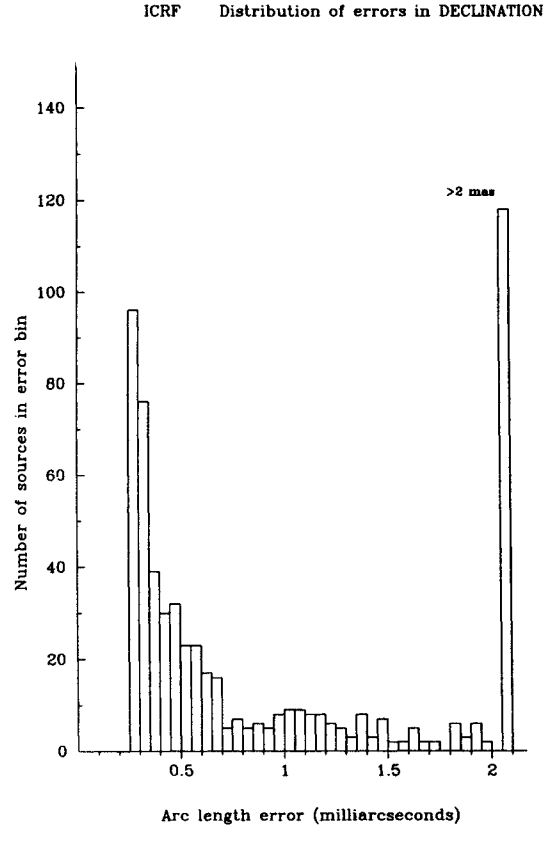
c)



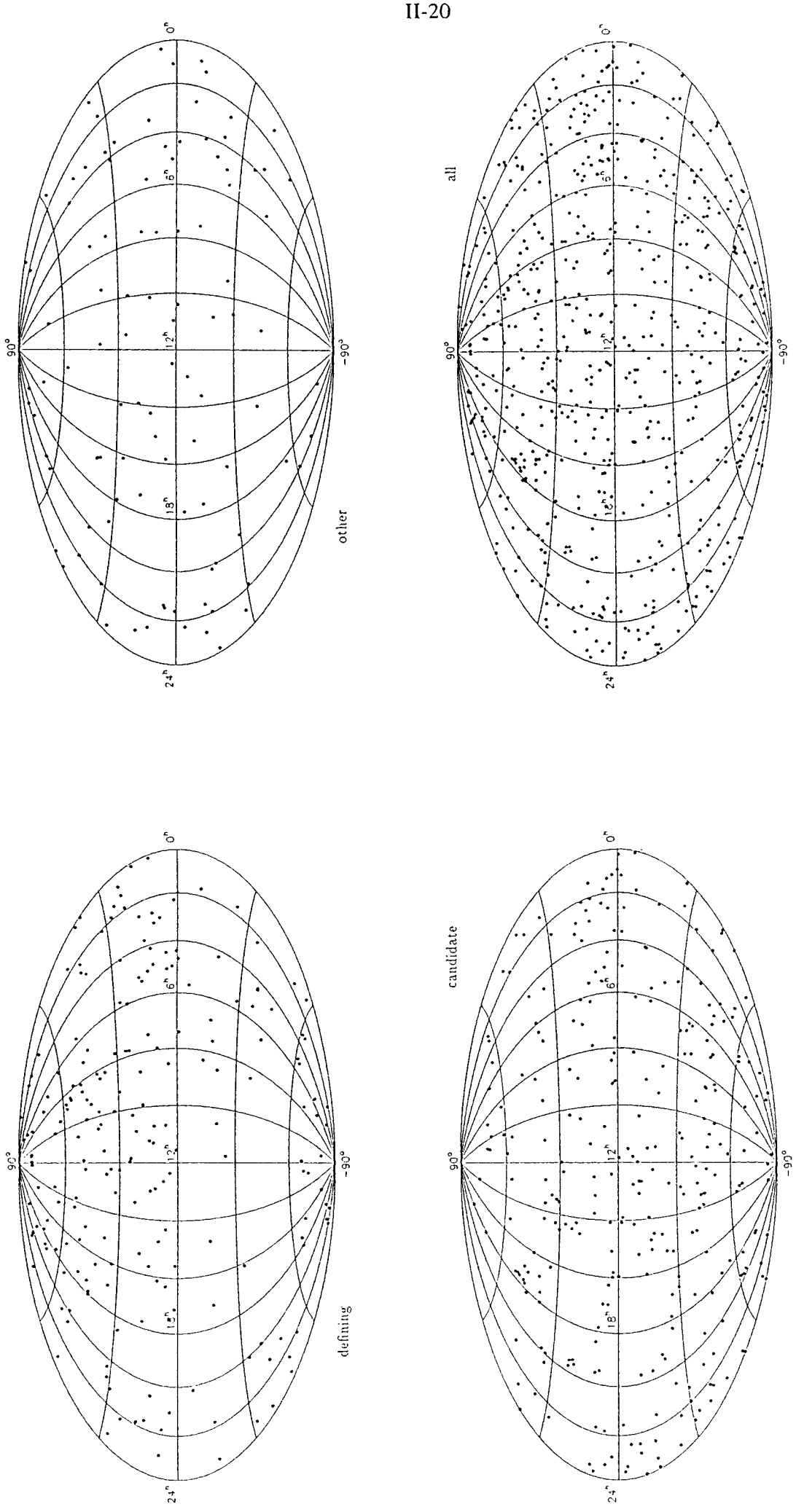


d)





Figures 6. (cont.) Histograms of source position errors for
c) other sources; d) all sources.



Figures 7. Distribution on the sky for defining sources; candidates sources; other sources; all sources.

Table 5. Coordinates of the 212 defining sources in ICRF (see notes p. II-28)

ICRF Designation (1)	IERS Des. (2)	Inf. (3) X S H	Right Ascension J2000.0 h m s	Declination J2000.0 o ' "	Uncertainty R.A. s	Uncertainty Dec. "	Corr. RA-Dc	Mean MJD of observation	First MJD of observation	Last MJD of observation	Nb sess.	Nb del. (4)
ICRF J000557.1+382015	0003+380		0 5 57.175409	38 20 15.14857	0.000041	0.00051	-.041	49087.0	48720.9	49554.8	2	41
ICRF J001031.0+105829	0007+106		0 10 31.005888	10 58 29.50412	0.000032	0.00068	.540	47938.9	47288.7	49690.0	10	74
ICRF J001033.9+172418	0007+171		0 10 33.990619	17 24 18.76135	0.000021	0.00035	-.402	48730.8	47931.6	49662.8	19	57
ICRF J001331.1+405137	0010+405	2 1	0 13 31.130213	40 51 37.14407	0.000026	0.00034	-.038	49549.6	48434.7	49820.5	7	219
ICRF J001708.4+813508	0014+813		0 17 8.474953	81 35 8.13633	0.000121	0.00026	.012	49505.2	47023.7	49924.8	78	1453
ICRF J004204.5+232001	0039+230		0 42 4.545183	23 20 1.06129	0.000036	0.00060	.090	48898.1	48328.5	49533.8	3	44
ICRF J004959.4-573827	0047-579		0 49 59.473091	-57 38 27.33992	0.000047	0.00053	.298	48697.0	47626.5	49407.6	13	46
ICRF J011205.8+224438	0109+224	*	1 12 5.824718	22 44 38.78619	0.000027	0.00049	.082	48733.1	48434.7	49736.9	7	97
ICRF J012642.7+255901	0123+257		1 26 42.792631	25 59 1.30079	0.000030	0.00054	.167	48856.4	48328.5	49659.8	4	71
ICRF J013305.7-520003	0131-522		1 33 5.762585	-52 0 3.94693	0.000049	0.00081	.399	49039.1	48162.4	49895.6	6	30
ICRF J013658.5+475129	0133+476	2 2	1 36 58.594810	47 51 29.10006	0.000026	0.00027	.021	48629.0	45138.8	49750.8	190	2196
ICRF J013738.3-243053	0135-247		1 37 38.346378	-24 30 53.88526	0.000055	0.00042	-.188	48321.8	47640.2	49790.7	3	29
ICRF J014125.8-092843	0138-097	2 1	1 41 25.832025	- 9 28 43.67381	0.000081	0.00088	.063	47138.1	46875.8	49498.8	2	20
ICRF J015127.1+274441	0148+274		1 51 27.146149	27 44 41.79365	0.000031	0.00043	-.064	48963.9	48328.5	49659.8	5	112
ICRF J015218.0+220707	0149+218		1 52 18.059047	22 7 7.70004	0.000020	0.00029	-.437	48294.0	46977.9	49848.8	50	243
ICRF J015734.9+744243	0153+744	4 3 *	1 57 34.964908	74 42 43.22998	0.000091	0.00031	.059	49495.7	47019.9	49820.5	11	400
ICRF J020333.3+723253	0159+723		2 3 33.385004	72 32 53.66741	0.000072	0.00031	.033	48800.7	47011.4	49667.9	17	108
ICRF J020504.9+321230	0202+319		2 5 4.925371	32 12 30.09560	0.000022	0.00030	-.441	48017.7	45466.3	49736.9	35	214
ICRF J021748.9+014449	0215+015	1 1	2 17 48.954740	1 44 49.69909	0.000022	0.00039	-.215	49302.1	48328.5	49547.8	5	133
ICRF J022239.6+430207	0219+428		2 22 39.611500	43 2 7.79884	0.000034	0.00043	-.098	49103.6	48650.8	49554.8	7	64
ICRF J022256.4-344128	0220-349		2 22 56.401625	-34 41 28.73011	0.000050	0.00044	-.209	48679.5	47640.2	49790.7	4	35
ICRF J022850.0+672103	0224+671		2 28 50.051459	67 21 3.02926	0.000052	0.00031	-.080	45097.6	44090.5	49600.3	42	801
ICRF J022934.9-784745	0230-790		2 29 34.946647	-78 47 45.60129	0.000149	0.00049	.028	48828.1	47626.5	49895.6	11	52
ICRF J023838.9+163659	0235+164	1 1	2 38 38.930108	16 36 59.27471	0.000018	0.00027	.090	47475.7	44447.0	49909.6	194	2595
ICRF J024229.1+110100	0239+108	2 2	2 42 29.170847	11 1 0.72823	0.000018	0.00030	-.483	48582.3	47511.1	49662.8	43	153
ICRF J025134.5+431515	0248+430		2 51 34.536779	43 15 15.82858	0.000027	0.00033	-.074	49109.4	47931.6	49690.0	10	169
ICRF J025927.0+074739	0256+075		2 59 27.076633	7 47 39.64323	0.000021	0.00035	-.607	48247.0	47011.4	49445.6	44	190
ICRF J030350.6-621125	0302-623		3 3 50.631333	-62 11 25.54983	0.000047	0.00033	.129	49059.2	48162.4	49650.8	15	97
ICRF J030903.6+102916	0306+102		3 9 3.623523	10 29 16.34082	0.000023	0.00042	-.804	48974.1	47394.1	49667.9	18	76
ICRF J030956.0-605839	0308-611		3 9 56.099167	-60 58 39.05628	0.000038	0.00029	.037	49029.5	47626.5	49895.6	79	738

Table 5. (cont.) Coordinates of the 212 defining sources in ICRF

ICRF Designation (1)	IERS Des. (2)	Inf. (3) X S H	Right Ascension J2000.0 h m s	Declination J2000.0 o ' "	Uncertainty R.A. s	Uncertainty Dec. "	Corr. RA-Dc	Mean MJD of observation	First MJD span	Last MJD	Nb sess.	Nb del. (4)
ICRF J031301.9+412001	0309+411	*	3 13 1.962129	41 20 1.18353	0.000026	0.00031	-.321	48371.0	47165.8	49848.8	29	127
ICRF J034506.4+145349	0342+147		3 45 6.416546	14 53 49.55818	0.000021	0.00032	-.622	48809.6	47394.1	49445.6	23	177
ICRF J040305.5+260001	0400+258	3 2 *	4 3 5.586048	26 0 1.50274	0.000020	0.00030	-.127	48990.5	47005.8	49820.5	37	397
ICRF J040922.0+121739	0406+121	2 1	4 9 22.008740	12 17 39.84750	0.000021	0.00033	-.704	48399.2	46977.9	49565.9	28	149
ICRF J041636.5-185108	0414-189		4 16 36.544466	-18 51 8.34012	0.000051	0.00048	-.078	47814.6	46840.8	49790.7	3	31
ICRF J042442.2-375620	0422-380		4 24 42.243727	-37 56 20.78423	0.000033	0.00119	.251	49081.7	48162.4	49750.8	11	60
ICRF J042446.8+003606	0422+004	2 1	4 24 46.842052	0 36 6.32983	0.000020	0.00063	.038	48938.2	45997.8	49820.5	11	245
ICRF J042636.6+051819	0423+051		4 26 36.604102	5 18 19.87204	0.000031	0.00087	.101	48977.3	48194.7	49667.9	9	64
ICRF J042840.4-375619	0426-380		4 28 40.424306	-37 56 19.58031	0.000036	0.00047	.011	48125.7	47640.2	49692.6	5	39
ICRF J043900.8-452222	0437-454		4 39 0.854714	-45 22 22.56260	0.000057	0.00078	-.123	49443.5	48766.9	49895.6	7	32
ICRF J044238.6-001743	0440-003	1 1	4 42 38.660762	- 0 17 43.41910	0.000025	0.00064	.262	47735.2	47011.4	49576.9	15	111
ICRF J044907.6+112128	0446+112		4 49 7.671119	11 21 28.59662	0.000024	0.00051	-.143	49312.0	47394.1	49854.8	5	32
ICRF J045005.4-810102	0454-810		4 50 5.440195	-81 1 2.23146	0.000137	0.00032	-.005	48784.2	47626.5	49895.6	18	148
ICRF J045952.0+022931	0457+024		4 59 52.050664	2 29 31.17631	0.000019	0.00032	.062	48993.4	47005.8	49750.8	36	394
ICRF J050145.2+135607	0458+138	2 2	5 1 45.270840	13 56 7.22063	0.000037	0.00064	-.770	48830.7	47394.1	49848.8	13	20
ICRF J050523.1+045942	0502+049		5 5 23.184723	4 59 42.72448	0.000037	0.00060	-.584	48897.7	47394.1	49667.9	6	28
ICRF J050643.9-610940	0506-612		5 6 43.988739	-61 9 40.99328	0.000047	0.00035	.145	48760.5	48110.9	49594.7	16	69
ICRF J050842.3+843204	0454+844		5 8 42.363503	84 32 4.54402	0.000194	0.00028	-.046	48674.7	46977.9	49611.9	42	250
ICRF J051002.3+180041	0507+179	2 2	5 10 2.369122	18 0 41.58171	0.000020	0.00030	-.396	49401.9	47605.1	49820.5	24	339
ICRF J051644.9-620705	0516-621		5 16 44.926178	-62 7 5.38930	0.000048	0.00042	.202	49455.4	48749.6	49895.6	9	56
ICRF J052109.8+163822	0518+165	4 4	5 21 9.886021	16 38 22.05122	0.000048	0.00101	.569	48535.4	47931.6	49659.8	9	77
ICRF J052257.9-362730	0521-365	*	5 22 57.984651	-36 27 30.85092	0.000036	0.00106	.404	49078.4	48110.9	49895.6	6	25
ICRF J052930.0-724528	0530-727		5 29 30.042235	-72 45 28.50731	0.000073	0.00035	-.149	48819.8	47626.5	49911.8	50	200
ICRF J053954.2-283955	0537-286		5 39 54.281429	-28 39 55.94745	0.000036	0.00046	.282	48980.5	48573.8	49629.6	18	58
ICRF J054138.0-054149	0539-057	2 1	5 41 38.083384	- 5 41 49.42839	0.000019	0.00046	-.188	49489.2	47176.5	49820.5	6	173
ICRF J054236.1+495107	0538+498		5 42 36.137916	49 51 7.23356	0.000053	0.00054	.185	49065.1	48538.8	49533.8	4	45
ICRF J054734.1+272156	0544+273	1 1	5 47 34.148941	27 21 56.84240	0.000032	0.00043	-.730	49054.4	47394.1	49659.8	14	34
ICRF J055932.0+235353	0556+238		5 59 32.033133	23 53 53.92690	0.000022	0.00032	-.591	48492.7	47394.1	49848.8	28	57
ICRF J061423.8+604621	0609+607	3 2	6 14 23.866195	60 46 21.75538	0.000044	0.00034	.058	48014.6	45466.3	49498.8	16	217
ICRF J062603.0+820225	0615+820		6 26 3.006188	82 2 25.56764	0.000142	0.00030	.009	48606.5	47019.9	49600.3	30	230

Table 5. (cont.) Coordinates of the 212 defining sources in ICRF

ICRF Designation (1)	IERS Des. (2)	Inf. (3) X S H	Right Ascension J2000.0 h m s	Declination J2000.0 o ' "	Uncertainty R.A. s	Uncertainty Dec. "	Corr. RA-Dc	Mean MJD of observation span	First MJD	Last MJD	Nb sess.	Nb del. (4)
ICRF J063111.9-415426	0629-418		6 31 11.998059	-41 54 26.94611	0.000086	0.00095	-.001	48257.9	47626.5	49790.7	6	24
ICRF J063546.5-751616	0637-752	*	6 35 46.507934	-75 16 16.81533	0.000071	0.00027	.005	49058.3	47626.5	49911.8	156	2417
ICRF J064204.2+675835	0636+680	1 1	6 42 4.257418	67 58 35.62085	0.000053	0.00030	-.086	49495.2	48357.8	49820.5	29	550
ICRF J064632.0+445116	0642+449	1 1	6 46 32.025985	44 51 16.59013	0.000024	0.00027	.070	49389.0	45466.3	49924.8	86	1250
ICRF J065024.5-163739	0648-165		6 50 24.581852	-16 37 39.72500	0.000042	0.00070	-.059	47534.9	46875.8	49594.7	2	33
ICRF J071046.1+473211	0707+476	2 1	7 10 46.104900	47 32 11.14267	0.000028	0.00029	.003	49334.4	46977.9	49820.5	9	326
ICRF J072153.4+712036	0716+714	*	7 21 53.448459	71 20 36.36339	0.000058	0.00028	.092	48388.0	47165.8	49750.8	115	688
ICRF J072516.8+142513	0722+145		7 25 16.807752	14 25 13.74684	0.000023	0.00046	.001	48703.8	47394.1	49694.8	10	62
ICRF J072550.6-005456	0723-008	3 2	7 25 50.639953	- 0 54 56.54438	0.000019	0.00034	-.190	48083.7	44773.8	49820.5	19	334
ICRF J072611.7+791131	0718+792	2 1	7 26 11.735177	79 11 31.01624	0.000097	0.00027	.060	49787.0	48223.7	49924.8	38	1457
ICRF J073545.8-173548	0733-174		7 35 45.812508	-17 35 48.50131	0.000061	0.00138	-.342	48915.0	45900.1	49272.7	7	48
ICRF J073856.4-673550	0738-674		7 38 56.496292	-67 35 50.82583	0.000090	0.00052	.054	49189.4	47626.5	49895.6	7	33
ICRF J074110.7+311200	0738+313		7 41 10.703308	31 12 0.22862	0.000022	0.00029	.031	48627.1	45466.3	49848.8	22	512
ICRF J074625.8+254902	0743+259		7 46 25.874166	25 49 2.13488	0.000033	0.00066	-.372	48511.9	47407.6	49498.8	6	21
ICRF J074836.1+240024	0745+241		7 48 36.109278	24 0 24.11018	0.000019	0.00028	-.022	48240.5	47517.4	49600.3	114	617
ICRF J075301.3+535259	0749+540	1 1	7 53 1.384573	53 52 59.63716	0.000030	0.00027	.060	49755.0	45775.8	49897.8	37	2087
ICRF J075706.6+095634	0754+100		7 57 6.642936	9 56 34.85210	0.000021	0.00034	-.086	47266.2	45997.8	49848.8	15	215
ICRF J080839.6+495036	0804+499	1 1	8 8 39.666274	49 50 36.53046	0.000027	0.00026	.081	49582.5	47165.8	49924.8	155	9947
ICRF J080856.6+405244	0805+410	2 1	8 8 56.652038	40 52 44.88889	0.000023	0.00027	.050	49673.4	48720.9	49897.8	36	1519
ICRF J081525.9+363515	0812+367		8 15 25.944824	36 35 15.14830	0.000031	0.00046	.189	47764.8	45775.8	49554.8	6	75
ICRF J082057.4-125859	0818-128	*	8 20 57.447616	-12 58 59.16949	0.000029	0.00046	-.480	48831.3	47512.0	49896.8	8	37
ICRF J082447.2+555242	0820+560	2 1	8 24 47.236351	55 52 42.66938	0.000031	0.00026	.054	49263.8	46977.9	49848.8	48	2072
ICRF J082455.4+391641	0821+394		8 24 55.483865	39 16 41.90430	0.000029	0.00037	.164	48624.1	48194.7	49576.9	9	102
ICRF J082804.7-373106	0826-373	*	8 28 4.780268	-37 31 6.28064	0.000051	0.00050	-.053	48454.6	47511.1	49629.6	9	48
ICRF J083148.8+042939	0829+046		8 31 48.876955	4 29 39.08534	0.000026	0.00053	-.018	49137.6	48649.8	49533.8	4	59
ICRF J083223.2+491321	0828+493		8 32 23.216688	49 13 21.03823	0.000031	0.00037	.078	48526.3	47023.7	49498.8	18	133
ICRF J083454.9+553421	0831+557	4 3	8 34 54.903997	55 34 21.07080	0.000097	0.00068	.096	48902.3	47931.6	49456.8	8	70
ICRF J083639.2-201659	0834-201		8 36 39.215215	-20 16 59.50350	0.000035	0.00071	-.113	47992.1	46840.8	49650.8	5	33
ICRF J083722.4+582501	0833+585	3 1	8 37 22.409733	58 25 1.84521	0.000043	0.00031	.060	49393.6	46977.9	49820.5	19	334
ICRF J084205.0+183540	0839+187		8 42 5.094180	18 35 40.99061	0.000026	0.00048	.243	48609.7	47875.8	49659.8	8	118

Table 5. (cont.) Coordinates of the 212 defining sources in ICRF

ICRF Designation (1)	IERS Des. (2)	Inf. (3) X	S	H	Right Ascension J2000.0 h m s	Declination J2000.0 o ' "	Uncertainty R.A. s	Dec. "	Corr. RA-Dc	Mean MJD of observation	First MJD	Last MJD span	Nb sess.	Nb del. (4)
ICRF J085441.9+575729	0850+581				8 54 41.996385	57 57 29.93928	0.000055	0.00044	-.252	49254.7	48720.9	49533.8	3	56
ICRF J090303.9+465104	0859+470	3	2		9 3 3.990103	46 51 4.13753	0.000026	0.00028	.029	48772.2	47005.8	49820.5	107	653
ICRF J091552.4+293324	0912+297	1	1	*	9 15 52.401620	29 33 24.04274	0.000032	0.00057	.223	49057.0	48194.7	49659.8	7	100
ICRF J092058.4+444153	0917+449				9 20 58.458480	44 41 53.98502	0.000026	0.00030	-.124	48755.5	46977.9	49600.3	28	141
ICRF J092136.2+621552	0917+624	2	1		9 21 36.231054	62 15 52.18035	0.000039	0.00027	.030	49215.0	45775.8	49820.5	11	477
ICRF J094855.3+403944	0945+408	2	2		9 48 55.338145	40 39 44.58719	0.000027	0.00033	.094	48666.4	47931.6	49659.8	9	123
ICRF J095456.8+174331	0952+179				9 54 56.823626	17 43 31.22242	0.000024	0.00053	-.040	48755.5	48158.8	49565.9	15	91
ICRF J095819.6+472507	0955+476	1	1		9 58 19.671648	47 25 7.84250	0.000026	0.00026	.039	49398.1	48720.9	49924.8	335	11583
ICRF J095820.9+322402	0955+326			*	9 58 20.949621	32 24 2.20929	0.000031	0.00047	.081	48569.4	47761.7	49554.8	6	101
ICRF J095847.2+653354	0954+658				9 58 47.245101	65 33 54.81806	0.000042	0.00026	.017	48614.9	46976.8	49883.8	236	7668
ICRF J101447.0+230116	1012+232				10 14 47.065445	23 1 16.57091	0.000024	0.00039	-.344	48580.3	47407.6	49576.9	11	83
ICRF J102311.5+394815	1020+400	3	1		10 23 11.565623	39 48 15.38539	0.000029	0.00036	.017	48469.6	46977.9	49694.8	9	116
ICRF J103303.7+411606	1030+415				10 33 3.707841	41 16 6.23297	0.000042	0.00044	.195	47892.4	47019.9	49498.8	12	82
ICRF J103502.1-201134	1032-199				10 35 2.155274	-20 11 34.35975	0.000050	0.00048	.050	48645.5	47176.5	49790.7	4	33
ICRF J104117.1+061016	1038+064	3	1		10 41 17.162504	6 10 16.92378	0.000020	0.00035	-.423	48204.3	47568.6	49736.9	16	114
ICRF J104146.7+523328	1038+528				10 41 46.781639	52 33 28.23127	0.000029	0.00028	.061	49331.0	48524.8	49883.8	43	525
ICRF J104148.8+523355	1038+529				10 41 48.897638	52 33 55.60790	0.000073	0.00056	-.323	49506.7	48650.8	49883.8	12	67
ICRF J104244.6+120331	1040+123				10 42 44.605212	12 3 31.26407	0.000024	0.00040	-.077	48805.3	47659.7	49790.7	9	89
ICRF J104423.0+805439	1039+811				10 44 23.062554	80 54 39.44303	0.000117	0.00027	.009	48930.0	47288.7	49694.8	34	266
ICRF J105148.7+211952	1049+215	2	1		10 51 48.789073	21 19 52.31411	0.000020	0.00030	.018	49497.7	47931.6	49820.5	6	218
ICRF J105811.5+811432	1053+815	1	1		10 58 11.535365	81 14 32.67521	0.000118	0.00027	.095	49403.8	47453.0	49909.6	92	1916
ICRF J105843.3-800354	1057-797				10 58 43.309786	-80 3 54.15949	0.000106	0.00027	.004	49023.8	47626.5	49911.8	148	2004
ICRF J111358.6+144226	1111+149				11 13 58.695097	14 42 26.95262	0.000023	0.00042	-.107	48224.7	47005.8	49456.8	16	149
ICRF J111857.3+123441	1116+128	3	2		11 18 57.301443	12 34 41.71806	0.000018	0.00031	-.156	49282.2	47274.8	49820.5	23	243
ICRF J113053.2+381518	1128+385	1	1		11 30 53.282612	38 15 18.54707	0.000022	0.00026	-.042	49534.8	45775.8	49924.8	175	7357
ICRF J113320.0+004052	1130+009	2	1		11 33 20.055797	0 40 52.83720	0.000022	0.00051	-.515	49111.9	47019.9	49820.5	23	211
ICRF J114608.1-244732	1143-245				11 46 8.103374	-24 47 32.89681	0.000080	0.00068	-.205	48071.1	47640.2	49895.6	3	33
ICRF J115019.2+241753	1147+245				11 50 19.212173	24 17 53.83503	0.000045	0.00063	-.108	49039.0	48720.9	49533.8	2	23
ICRF J115113.4-672811	1148-671				11 51 13.426591	-67 28 11.09423	0.000088	0.00059	.431	48705.2	48043.8	49407.6	5	33
ICRF J115312.4+805829	1150+812	2	2		11 53 12.499130	80 58 29.15451	0.000114	0.00027	.009	49157.4	46976.8	49820.5	41	1058

Table 5. (cont.) Coordinates of the 212 defining sources in ICRF

ICRF Designation (1)	IERS Des. (2)	Inf. (3) X	S	H	Right Ascension J2000.0 h m s	Declination J2000.0 o ' "	Uncertainty R.A. s	Dec. "	Corr. RA-Dc	Mean MJD of observation	First MJD span	Last MJD	Nb sess.	Nb del. (4)
ICRF J115324.4+493108	1150+497			*	11 53 24.466626	49 31 8.83014	0.000036	0.00037	.296	48715.7	47931.6	49694.8	6	80
ICRF J115825.7+245017	1155+251				11 58 25.787505	24 50 17.96369	0.000037	0.00060	.266	48860.8	48179.7	49659.8	7	78
ICRF J121555.6+344815	1213+350	3	1		12 15 55.601049	34 48 15.22053	0.000027	0.00035	.014	49425.3	48194.7	49820.5	11	298
ICRF J121752.0+300700	1215+303				12 17 52.081987	30 7 0.63625	0.000030	0.00054	.198	48795.4	48434.7	49667.9	5	77
ICRF J121906.4+482956	1216+487				12 19 6.414733	48 29 56.16497	0.000032	0.00032	.081	48755.8	46977.9	49736.9	12	204
ICRF J122222.5+041315	1219+044	2	1		12 22 22.549618	4 13 15.77630	0.000017	0.00026	-.238	49589.0	48378.8	49924.8	237	7633
ICRF J122340.4+804004	1221+809	2	1		12 23 40.493698	80 40 4.34031	0.000123	0.00030	-.088	49531.2	48022.7	49820.5	9	515
ICRF J122847.4+370612	1226+373	1	1		12 28 47.423662	37 6 12.09578	0.000027	0.00032	-.073	49313.1	48378.8	49750.8	6	167
ICRF J123924.5+073017	1236+077	2	1		12 39 24.588312	7 30 17.18909	0.000021	0.00042	-.068	49639.0	48378.8	49820.5	4	163
ICRF J123946.6-684530	1236-684				12 39 46.651396	-68 45 30.89260	0.000155	0.00100	-.358	49261.0	48043.8	49895.6	3	24
ICRF J125438.2+114105	1252+119				12 54 38.255601	11 41 5.89507	0.000019	0.00032	-.035	48651.0	46977.9	49848.8	36	241
ICRF J125459.9-713818	1251-713				12 54 59.921421	-71 38 18.43664	0.000066	0.00032	.067	48770.8	47626.5	49692.6	19	144
ICRF J130020.9+141718	1257+145				13 0 20.918799	14 17 18.53107	0.000038	0.00063	.297	49383.4	48804.9	49690.0	10	59
ICRF J131028.6+322043	1308+326	1	1		13 10 28.663845	32 20 43.78295	0.000020	0.00026	-.152	49096.1	44773.8	49924.8	869	40832
ICRF J132700.8+221050	1324+224			*	13 27 0.861311	22 10 50.16306	0.000020	0.00031	-.534	48961.9	48429.0	49736.9	37	116
ICRF J134345.9+660225	1342+662	2	1		13 43 45.959534	66 2 25.74503	0.000059	0.00035	-.014	49242.0	47783.2	49611.9	6	116
ICRF J134408.6+660611	1342+663				13 44 8.679674	66 6 11.64381	0.000047	0.00029	.144	48481.3	47453.0	49848.8	36	226
ICRF J134934.6+534117	1347+539	3	2		13 49 34.656623	53 41 17.04028	0.000034	0.00032	-.001	49519.9	47931.6	49820.5	10	358
ICRF J141908.1+062834	1416+067	2	1		14 19 8.180173	6 28 34.80349	0.000083	0.00129	.186	49420.1	48194.7	49820.5	8	118
ICRF J141946.5+542314	1418+546			*	14 19 46.597401	54 23 14.78721	0.000031	0.00027	-.048	47698.1	45138.8	49848.8	130	2179
ICRF J143645.8+633637	1435+638			*	14 36 45.802138	63 36 37.86658	0.000048	0.00033	.141	48265.6	47023.7	49611.9	12	192
ICRF J144516.4+095836	1442+101				14 45 16.465213	9 58 36.07244	0.000027	0.00040	.430	48733.3	47011.4	49883.8	33	200
ICRF J144815.0-162024	1445-161				14 48 15.054162	-16 20 24.54888	0.000030	0.00043	-.865	48520.9	47605.1	49565.9	18	39
ICRF J144828.7+760111	1448+762				14 48 28.778877	76 1 11.59717	0.000176	0.00045	.285	48457.2	47019.9	49554.8	8	67
ICRF J150048.6+475115	1459+480	2	1		15 0 48.654199	47 51 15.53826	0.000034	0.00038	.118	48587.3	47459.8	49554.8	9	98
ICRF J150609.5+373051	1504+377				15 6 9.529958	37 30 51.13241	0.000024	0.00029	-.091	49017.6	46977.9	49611.9	18	198
ICRF J151656.7+193212	1514+197				15 16 56.796194	19 32 12.99187	0.000026	0.00049	-.040	48620.5	48434.7	49533.8	5	91
ICRF J153452.4+013104	1532+016	4	2		15 34 52.453675	1 31 4.20657	0.000020	0.00049	-.539	48646.8	47407.6	49576.9	23	110
ICRF J154049.4+144745	1538+149				15 40 49.491511	14 47 45.88485	0.000019	0.00030	-.536	48426.7	45138.8	49790.7	39	201
ICRF J154917.4+503805	1547+507				15 49 17.468534	50 38 5.78820	0.000035	0.00036	.345	48164.7	47005.8	49498.8	11	106

Table 5. (cont.) Coordinates of the 212 defining sources in ICRF

ICRF Designation (1)	IERS Des. (2)	Inf. (3) X S H	Right Ascension J2000.0 h m s	Declination J2000.0 o ' "	Uncertainty R.A. s	Uncertainty Dec. "	Corr. RA-Dc	Mean MJD of observation span	First MJD of observation span	Last MJD of observation span	Nb sess.	Nb del. (4)
ICRF J155658.8-791404	1549-790		15 56 58.869899	-79 14 4.28134	0.000111	0.00032	.105	48792.8	47626.5	49895.6	15	156
ICRF J160207.2+332653	1600+335	3 1	16 2 7.263468	33 26 53.07267	0.000027	0.00053	-.159	49180.9	48103.5	49694.8	9	43
ICRF J160734.7-333108	1604-333		16 7 34.762344	-33 31 8.91313	0.000047	0.00048	-.881	49164.5	48393.7	49790.7	15	39
ICRF J160846.2+102907	1606+106	2 1	16 8 46.203179	10 29 7.77585	0.000017	0.00026	-.426	49344.4	45138.8	49924.8	533	18985
ICRF J161903.6+061302	1616+063		16 19 3.687684	6 13 2.24357	0.000028	0.00067	.049	49119.5	48194.7	49554.8	5	76
ICRF J162418.4-680912	1619-680		16 24 18.437150	-68 9 12.49811	0.000071	0.00057	-.053	48839.8	47626.5	49407.6	7	46
ICRF J162557.6+413440	1624+416	3 2	16 25 57.669700	41 34 40.62922	0.000026	0.00031	-.046	48372.9	46364.9	49883.8	31	247
ICRF J163813.4+572023	1637+574		16 38 13.456293	57 20 23.97918	0.000032	0.00027	-.085	47192.8	44857.8	49692.6	292	4339
ICRF J164207.8+685639	1642+690	3 2	16 42 7.848514	68 56 39.75640	0.000050	0.00027	.004	45979.8	44090.5	49848.8	150	1899
ICRF J165801.4+344328	1656+348		16 58 1.419204	34 43 28.40240	0.000048	0.00058	-.393	49385.0	48853.8	49883.8	5	56
ICRF J170734.4+014845	1705+018	2 1	17 7 34.415277	1 48 45.69923	0.000019	0.00031	-.103	49323.7	48194.7	49883.8	30	296
ICRF J170934.3-172853	1706-174		17 9 34.345380	-17 28 53.36480	0.000039	0.00056	-.924	48907.6	48093.0	49662.8	18	43
ICRF J172341.0-650036	1718-649		17 23 41.029765	-65 0 36.61518	0.000092	0.00106	.239	48651.6	48110.9	49407.6	5	21
ICRF J172727.6+453039	1726+455	2 1	17 27 27.650808	45 30 39.73139	0.000024	0.00026	-.127	49589.8	48720.9	49917.8	128	4185
ICRF J172818.6+501310	1727+502		17 28 18.623853	50 13 10.47001	0.000140	0.00098	-.188	48540.1	47459.8	49576.9	9	39
ICRF J172824.9+042704	1725+044	2 1	17 28 24.952716	4 27 4.91401	0.000020	0.00041	.000	49212.9	47931.6	49883.8	10	274
ICRF J174535.2+172001	1743+173	2 1	17 45 35.208181	17 20 1.42341	0.000018	0.00030	-.257	49272.9	46977.9	49848.8	31	296
ICRF J174614.0+622654	1745+624	1 2	17 46 14.034146	62 26 54.73842	0.000038	0.00027	-.043	49664.5	48916.8	49924.8	60	1609
ICRF J174832.8+700550	1749+701		17 48 32.840231	70 5 50.76882	0.000077	0.00037	-.025	47325.4	44203.7	49924.8	16	210
ICRF J175322.6+440945	1751+441		17 53 22.647901	44 9 45.68608	0.000032	0.00033	.169	49015.8	47931.6	49533.8	6	144
ICRF J180132.3+440421	1800+440		18 1 32.314854	44 4 21.90031	0.000036	0.00046	.115	48687.0	48194.7	49659.8	8	71
ICRF J180323.4-650736	1758-651	*	18 3 23.496605	-65 7 36.76177	0.000085	0.00054	.081	49241.4	48043.8	49895.6	4	29
ICRF J182407.0+565101	1823+568	1 1 *	18 24 7.068372	56 51 1.49088	0.000033	0.00028	-.047	48232.8	45138.8	49750.8	92	703
ICRF J183250.1+283335	1830+285		18 32 50.185631	28 33 35.95530	0.000035	0.00065	-.283	48734.8	48357.8	49659.8	7	50
ICRF J184208.9+794617	1845+797		18 42 8.989953	79 46 17.12801	0.000137	0.00036	-.399	48610.5	44203.7	49659.8	15	161
ICRF J184233.6+680925	1842+681	2 1	18 42 33.641636	68 9 25.22788	0.000061	0.00034	.056	48518.1	47165.8	49694.8	8	136
ICRF J184916.0+670541	1849+670	1 2	18 49 16.072300	67 5 41.67993	0.000048	0.00028	-.003	49709.0	48649.8	49820.5	4	412
ICRF J185457.2+735119	1856+737		18 54 57.299946	73 51 19.90747	0.000094	0.00043	.276	48602.2	47011.4	49667.9	8	101
ICRF J191240.0-801005	1903-802		19 12 40.019176	-80 10 5.94627	0.000169	0.00041	.004	48421.5	47626.5	48865.8	5	26
ICRF J195542.7+513148	1954+513	2 1	19 55 42.738273	51 31 48.54623	0.000028	0.00027	.001	48836.6	45775.8	49820.5	41	673

Table 5. (cont.) Coordinates of the 212 defining sources in ICRF

ICRF Designation (1)	IERS Des. (2)	Inf. (3) X S H	Right Ascension J2000.0 h m s	Declination J2000.0 o ' "	Uncertainty R.A. s	Uncertainty Dec. "	Corr. RA-Dc	Mean MJD of observation	First MJD span	Last MJD span	Nb sess.	Nb del. (4)
ICRF J195759.8-384506	1954-388		19 57 59.819271	-38 45 6.35626	0.000025	0.00039	.103	49775.4	48766.9	49917.8	13	257
ICRF J200324.1-325145	2000-330		20 3 24.116306	-32 51 45.13231	0.000040	0.00068	.175	48685.0	47512.0	49535.0	11	33
ICRF J201114.2-064403	2008-068		20 11 14.215847	- 6 44 3.55519	0.000050	0.00063	-.838	49068.6	48346.0	49662.8	13	29
ICRF J201713.0+744047	2017+745	2 1	20 17 13.079311	74 40 47.99991	0.000072	0.00028	.091	49459.5	47288.7	49820.5	23	465
ICRF J202319.0+315302	2021+317	3 1	20 23 19.017351	31 53 2.30595	0.000022	0.00031	.091	48563.6	45775.8	49611.9	22	215
ICRF J203147.9+545503	2030+547		20 31 47.958562	54 55 3.14060	0.000042	0.00051	.080	48616.4	47023.7	49659.8	7	86
ICRF J203154.9+121941	2029+121	3 1	20 31 54.994279	12 19 41.34043	0.000019	0.00034	.073	48966.6	47019.9	49848.8	14	230
ICRF J203837.0+511912	2037+511		20 38 37.034755	51 19 12.66269	0.000028	0.00027	.038	47284.6	45138.8	49736.9	190	3063
ICRF J205051.1+312727	2048+312		20 50 51.131502	31 27 27.37368	0.000108	0.00090	.151	49098.3	48194.7	49690.0	6	34
ICRF J205133.7+744140	2051+745		20 51 33.734576	74 41 40.49823	0.000110	0.00038	-.491	48765.0	47011.4	49554.8	20	73
ICRF J205616.3-471447	2052-474		20 56 16.359851	-47 14 47.62768	0.000033	0.00043	-.139	49285.7	48162.4	49911.8	15	104
ICRF J210138.8+034131	2059+034	2 1	21 1 38.834187	3 41 31.32159	0.000026	0.00058	-.033	48629.7	48434.7	49533.8	4	74
ICRF J210544.9-782534	2059-786		21 5 44.961453	-78 25 34.54664	0.000205	0.00058	.030	48784.8	47626.5	49895.6	7	24
ICRF J210933.1-411020	2106-413		21 9 33.188582	-41 10 20.60530	0.000032	0.00042	-.221	48703.7	47626.5	49662.8	17	72
ICRF J211529.4+293338	2113+293	1 1	21 15 29.413455	29 33 38.36694	0.000020	0.00028	-.027	48852.1	46977.9	49820.5	37	641
ICRF J211630.8-805355	2109-811		21 16 30.845958	-80 53 55.22339	0.000180	0.00039	-.020	49328.3	48043.8	49895.6	9	66
ICRF J213901.3+142335	2136+141	1 1	21 39 1.309267	14 23 35.99199	0.000018	0.00029	-.042	48861.8	45466.3	49848.8	22	351
ICRF J214622.9-152543	2143-156		21 46 22.979340	-15 25 43.88526	0.000028	0.00044	-.770	48854.6	48196.8	49565.9	14	24
ICRF J214805.4+065738	2145+067	2 2	21 48 5.458679	6 57 38.60422	0.000023	0.00026	.000	48939.7	44773.8	49924.8	1087	33641
ICRF J215203.1-780706	2146-783		21 52 3.154504	-78 7 6.63962	0.000221	0.00063	.316	48577.3	47626.5	49330.5	7	29
ICRF J215224.8+173437	2150+173	2 2	21 52 24.819405	17 34 37.79482	0.000020	0.00039	-.028	48516.6	47005.8	49456.8	23	150
ICRF J220743.7-534633	2204-540		22 7 43.733296	-53 46 33.82004	0.000045	0.00056	.016	48786.5	48110.9	49790.7	6	27
ICRF J221205.9+235540	2209+236		22 12 5.966318	23 55 40.54388	0.000023	0.00039	-.031	48674.5	48194.7	49848.8	9	141
ICRF J223036.4+694628	2229+695		22 30 36.469725	69 46 28.07698	0.000071	0.00034	.161	48418.0	47459.8	49600.3	16	95
ICRF J223513.2-483558	2232-488		22 35 13.236524	-48 35 58.79455	0.000049	0.00065	.394	49223.5	48162.4	49741.7	6	30
ICRF J225717.3+074312	2254+074		22 57 17.303120	7 43 12.30284	0.000023	0.00052	-.519	48052.0	47011.4	49736.9	26	139
ICRF J231448.5-313839	2312-319		23 14 48.500631	-31 38 39.52651	0.000050	0.00103	.340	48250.7	47511.1	49895.6	6	27
ICRF J232159.8+273246	2319+272	3 1	23 21 59.862235	27 32 46.44343	0.000021	0.00033	.020	49197.7	47023.7	49820.5	21	321
ICRF J232225.9+505751	2320+506	3 1	23 22 25.982159	50 57 51.96371	0.000041	0.00044	-.011	49021.5	48720.9	49498.8	2	44
ICRF J232917.7-473019	2326-477		23 29 17.704369	-47 30 19.11519	0.000039	0.00053	.264	48341.4	47305.8	49629.6	31	138

Table 5. (cont.) Coordinates of the 212 defining sources in ICRF

ICRF Designation (1)	IERS Des. (2)	Inf. (3) X S H	Right Ascension J2000.0 h m s	Declination J2000.0 o ' "	Uncertainty R.A. s	Uncertainty Dec. "	Corr. RA-Dc	Mean MJD of observation span	First MJD of observation span	Last MJD of observation span	Nb sess.	Nb del. (4)
ICRF J233138.6-155657	2329-162		23 31 38.652436	-15 56 57.00952	0.000039	0.00051	.012	48859.0	47176.5	49650.8	2	25
ICRF J233159.4-381147	2329-384		23 31 59.476115	-38 11 47.65053	0.000042	0.00066	.095	48273.4	47640.2	49895.6	5	22

Notes

(1) ICRF Designations, constructed from J2000.0 coordinates with the format
ICRF JHHMMSS.s+DDMMSS or ICRF JHHMMSS.s-DDMMSS.
They follow the recommendations of the IAU Task Group on Designations.

(2) IERS Designations, previously constructed from B1950 coordinates.
The complete format, including acronym and epoch in addition to the coordinates, is
IERS BHHMM+DDd or IERS BHHMM-DDd

(3) X: Structure index at X band
S: Structure index at S band
H: Asterisk indicates that the source serves to link the Hipparcos stellar reference frame to the ICRS.

(4) Number of pairs of delay and delay rate observations.

Table 6. Coordinates of the candidate sources in ICRF (see notes p. II-39)

ICRF Designation (1)	IERS Des. (2)	Inf. (3) X	S	H	Right Ascension J2000.0 h m s	Declination J2000.0 o ' "	Uncertainty R.A. s	Uncertainty Dec. "	Corr. RA-Dc	Mean MJD of observation	First MJD span	Last MJD	Nb sess.	Nb del. (4)
ICRF J000435.6-473619	0002-478				0 4 35.655596	-47 36 19.60356	0.000079	0.00097	.019	49435.5	49330.5	49524.7	3	7
ICRF J000613.8-062335	0003-066	3	1		0 6 13.892887	- 6 23 35.33485	0.000019	0.00034	-.575	48728.1	47176.5	49565.9	41	114
ICRF J001052.5-415310	0008-421				0 10 52.519641	-41 53 10.78780	0.000652	0.00728	-.548	48551.8	48162.4	49330.5	2	6
ICRF J001101.2-261233	0008-264				0 11 1.246752	-26 12 33.37686	0.000035	0.00040	-.427	48892.4	47686.1	49790.7	7	38
ICRF J001611.0-001512	0013-005				0 16 11.088555	- 0 15 12.44534	0.000020	0.00037	-.675	48920.3	47394.1	49611.9	27	116
ICRF J002442.9-420203	0022-423				0 24 42.989850	-42 2 3.94978	0.000250	0.00222	-.528	49003.5	48162.4	49895.6	3	10
ICRF J003824.8+413706	0035+413				0 38 24.843613	41 37 6.00069	0.000053	0.00066	-.266	49422.9	49422.9	49422.9	1	19
ICRF J005846.5-565911	0056-572				0 58 46.581252	-56 59 11.47054	0.000084	0.00113	.454	48583.5	47626.5	49330.5	4	12
ICRF J005905.5+000651	0056-001	4	3		0 59 5.514949	0 6 51.62203	0.000033	0.00093	.304	49186.6	47005.8	49659.8	11	173
ICRF J011137.3+390628	0108+388	4	2		1 11 37.316975	39 6 28.10422	0.000030	0.00035	.077	49711.2	49099.7	49820.5	3	203
ICRF J011327.0+494824	0110+495				1 13 27.006813	49 48 24.04351	0.000055	0.00060	-.525	49422.9	49422.9	49422.9	1	23
ICRF J011343.1+022217	0111+021			*	1 13 43.144954	2 22 17.31631	0.000023	0.00038	-.822	48461.2	47023.7	49667.9	28	160
ICRF J011517.0-012704	0112-017				1 15 17.099966	- 1 27 4.57725	0.000018	0.00031	-.497	48419.3	47278.8	49662.8	57	200
ICRF J011935.0+321050	0116+319	4	4		1 19 35.000523	32 10 50.05410	0.001257	0.00806	.231	49284.0	48787.9	49820.5	4	10
ICRF J012031.6-270124	0118-272				1 20 31.663311	-27 1 24.65133	0.000124	0.00112	-.587	48170.1	47512.0	49650.8	2	13
ICRF J012141.5+114950	0119+115	2	1		1 21 41.595041	11 49 50.41319	0.000018	0.00030	-.429	48683.5	47394.1	49848.8	50	150
ICRF J012156.8+042224	0119+041	2	1		1 21 56.861698	4 22 24.73438	0.000017	0.00026	.412	48822.9	46977.9	49911.8	1050	23707
ICRF J014922.3+055553	0146+056	3	1		1 49 22.370918	5 55 53.56852	0.000022	0.00035	-.691	48208.1	47288.7	49736.9	23	107
ICRF J015002.6-072548	0147-076				1 50 2.697551	- 7 25 48.49067	0.000628	0.00580	-.229	49687.7	49535.0	49895.6	3	7
ICRF J015310.1-331025	0150-334				1 53 10.121676	-33 10 25.86226	0.000063	0.00142	.164	47846.0	47511.1	48757.4	3	17
ICRF J015456.2+474326	0151+474				1 54 56.289917	47 43 26.53907	0.000049	0.00046	.002	49750.8	49750.8	49750.8	1	36
ICRF J015537.0-404842	0153-410				1 55 37.059396	-40 48 42.35592	0.000439	0.00283	-.052	49203.1	48766.9	49535.0	3	9
ICRF J020213.6-762003	0202-765				2 2 13.694218	-76 20 3.05655	0.002733	0.00592	.145	48780.2	48110.9	49895.6	2	8
ICRF J020346.6+113445	0201+113	2	1		2 3 46.657063	11 34 45.40956	0.000018	0.00027	-.163	49139.9	47237.4	49924.8	122	856
ICRF J020450.4+151411	0202+149	2	2		2 4 50.413908	15 14 11.04337	0.000018	0.00026	.194	49004.4	45997.8	49924.8	238	4191
ICRF J020457.6-170119	0202-172				2 4 57.674364	-17 1 19.84022	0.000031	0.00039	-.097	48904.2	47171.5	49790.7	6	72
ICRF J022428.4+065923	0221+067	2	2		2 24 28.428183	6 59 23.34182	0.000019	0.00031	-.653	48789.9	47394.1	49662.8	35	77
ICRF J023145.8+132254	0229+131	2	1		2 31 45.894055	13 22 54.71630	0.000017	0.00026	.341	48150.5	44773.8	49917.8	1314	35363
ICRF J023752.4+284808	0234+285	3	2		2 37 52.405677	28 48 8.99008	0.000019	0.00026	.160	47723.9	44447.0	49904.8	1021	31420
ICRF J023945.4-023440	0237-027				2 39 45.472273	- 2 34 40.91378	0.000029	0.00077	-.429	49376.1	49253.8	49554.8	2	32

Table 6. (cont.) Coordinates of the candidate sources in ICRF

ICRF Designation (1)	IERS Des. (2)	Inf. (3) X	S	H	Right Ascension J2000.0 h m s	Declination J2000.0 o ' "	Uncertainty R.A. s	Dec. "	Corr. RA-Dc	Mean MJD of observation	First MJD	Last MJD span	Nb sess.	Nb del. (4)
ICRF J023951.2+041621	0237+040	2	1		2 39 51.263052	4 16 21.41185	0.000020	0.00036	-.578	48874.7	47941.3	49662.8	20	103
ICRF J024457.6+622806	0241+622			*	2 44 57.696828	62 28 6.51494	0.000425	0.00185	.022	49045.4	48223.7	49690.0	3	16
ICRF J025246.1-710435	0252-712				2 52 46.156121	-71 4 35.27541	0.003779	0.02839	.328	48162.4	48162.4	48162.4	1	2
ICRF J025329.1-544151	0252-549				2 53 29.180453	-54 41 51.43623	0.000055	0.00079	.141	48887.3	47626.5	49895.6	6	18
ICRF J025334.8+180542	0250+178				2 53 34.882297	18 5 42.52378	0.002758	0.03513	-.999	48977.5	48977.5	48977.5	1	1
ICRF J030230.5+121856	0259+121	3	1		3 2 30.546782	12 18 56.75084	0.009783	0.12252	-.397	49643.1	47941.3	49820.5	12	130
ICRF J030642.6+624302	0302+625	2	1		3 6 42.659562	62 43 2.02420	0.000065	0.00058	-.169	49179.4	48614.0	49896.8	21	70
ICRF J031155.2-765150	0312-770			*	3 11 55.250335	-76 51 50.84843	0.000221	0.00067	.476	48768.1	48110.9	49895.6	3	17
ICRF J031951.2+190131	0317+188	2	1		3 19 51.256736	19 1 31.29032	0.000028	0.00048	-.737	49377.6	48942.5	49662.8	9	20
ICRF J033553.9-543025	0334-546				3 35 53.924919	-54 30 25.11446	0.000066	0.00137	.211	48994.3	47626.5	49650.8	5	13
ICRF J033717.1+013722	0334+014	2	2		3 37 17.108822	1 37 22.74287	0.003043	0.01491	.615	49396.1	49177.8	49694.8	3	4
ICRF J033930.9-014635	0336-019	2	1	*	3 39 30.937785	- 1 46 35.80391	0.000017	0.00026	.337	49437.7	44773.8	49924.8	303	7113
ICRF J034423.1+155943	0341+158	2	1		3 44 23.172178	15 59 43.36987	0.000039	0.00132	-.382	48969.0	47394.1	49659.8	11	34
ICRF J035721.9-481215	0355-483				3 57 21.917867	-48 12 15.16075	0.000092	0.00221	.698	48656.4	48162.4	49330.5	3	9
ICRF J040221.2-314725	0400-319				4 2 21.266012	-31 47 25.94544	0.000044	0.00052	-.361	49318.6	48766.9	49482.7	4	27
ICRF J040659.0-382628	0405-385				4 6 59.035298	-38 26 28.04070	0.000189	0.00122	-.367	48971.9	48162.4	49692.6	3	10
ICRF J040748.4-121136	0405-123			*	4 7 48.430971	-12 11 36.65948	0.000177	0.00123	-.152	49297.5	48766.9	49398.5	2	25
ICRF J040820.3-654509	0407-658				4 8 20.380244	-65 45 9.07841	0.001072	0.00630	-.236	48507.8	48162.4	48766.9	2	7
ICRF J040905.7-123848	0406-127				4 9 5.769741	-12 38 48.14414	0.000029	0.00044	-.816	48894.7	47941.3	49790.7	18	35
ICRF J042356.0+415002	0420+417				4 23 56.009804	41 50 2.71305	0.000029	0.00035	.233	48365.2	47568.6	49694.8	18	173
ICRF J042747.5+045708	0425+048	3	3		4 27 47.570443	4 57 8.32698	0.000111	0.01110	-.983	48867.5	47394.1	49662.8	12	25
ICRF J043221.1-510925	0431-512				4 32 21.178158	-51 9 25.18839	0.000237	0.00323	.864	48510.0	48043.8	49895.6	3	7
ICRF J044017.1-433308	0438-436				4 40 17.179991	-43 33 8.60397	0.000031	0.00038	-.187	49195.4	47941.3	49790.7	20	89
ICRF J044331.6+344106	0440+345	2	1		4 43 31.635194	34 41 6.66403	0.000037	0.00047	-.050	49754.1	48093.0	49868.8	13	290
ICRF J044923.3+633209	0444+634				4 49 23.310440	63 32 9.43451	0.000094	0.00066	-.115	49422.9	49422.9	49422.9	1	23
ICRF J045314.6-280737	0451-282				4 53 14.646803	-28 7 37.32750	0.000100	0.00188	-.694	48761.9	47176.5	49398.5	9	41
ICRF J045550.7-461558	0454-463				4 55 50.772475	-46 15 58.68148	0.000064	0.00271	-.122	49015.7	49015.7	49015.7	1	6
ICRF J050112.8-015914	0458-020	2	1		5 1 12.809889	- 1 59 14.25619	0.000017	0.00026	.398	49316.0	44773.8	49924.8	559	15943
ICRF J050215.4+060907	0459+060	3	1		5 2 15.445934	6 9 7.49448	0.000034	0.00106	-.339	49685.6	47394.1	49820.5	6	94
ICRF J050401.7-604952	0503-608				5 4 1.701356	-60 49 52.53773	0.000252	0.00138	.520	48563.7	48110.9	49330.5	3	12

Table 6. (cont.) Coordinates of the candidate sources in ICRF

ICRF Designation (1)	IERS Des. (2)	Inf. (3) X S H	Right Ascension J2000.0 h m s	Declination J2000.0 o ' "	Uncertainty R.A. s	Uncertainty Dec. "	Corr. RA-Dc	Mean MJD of observation span	First MJD of observation span	Last MJD of observation span	Nb sess.	Nb del. (4)
ICRF J050927.4+101144	0506+101		5 9 27.457073	10 11 44.60026	0.000065	0.00130	-.654	48909.0	47394.1	49736.9	28	63
ICRF J051349.1-215916	0511-220		5 13 49.114333	-21 59 16.09208	0.000052	0.00140	-.550	48768.7	47176.5	49790.7	13	43
ICRF J051637.7-723707	0517-726		5 16 37.719042	-72 37 7.46573	0.000622	0.00284	.426	49423.7	48757.4	49895.6	3	12
ICRF J052234.4-610757	0522-611		5 22 34.425537	-61 7 57.13318	0.000069	0.00060	.295	48382.0	47626.5	48757.4	3	15
ICRF J052531.4-455754	0524-460		5 25 31.400087	-45 57 54.68568	0.000125	0.00164	.521	49750.8	49750.8	49750.8	1	18
ICRF J053056.4+133155	0528+134	1 1	5 30 56.416744	13 31 55.14954	0.000017	0.00026	.277	48026.8	44773.8	49924.8	1884	51914
ICRF J053238.9+073243	0529+075		5 32 38.998447	7 32 43.34567	0.000105	0.00111	.252	48474.9	44773.8	49694.8	10	53
ICRF J053932.0-155030	0537-158		5 39 32.010168	-15 50 30.32097	0.000051	0.00104	-.716	48283.7	47941.3	49031.1	7	9
ICRF J055530.8+394849	0552+398	2 1	5 55 30.805608	39 48 49.16500	0.000022	0.00026	.108	48175.6	44090.5	49924.8	2343	118072
ICRF J060309.1+174216	0600+177	2 1	6 3 9.130274	17 42 16.81064	0.000038	0.00111	-.746	49534.7	47394.1	49820.5	23	191
ICRF J060752.6+672055	0602+673		6 7 52.671683	67 20 55.40986	0.000078	0.00043	-.096	49750.8	49750.8	49750.8	1	37
ICRF J060759.6-083449	0605-085		6 7 59.699234	- 8 34 49.97806	0.000019	0.00033	-.423	47995.7	44773.8	49750.8	31	149
ICRF J060940.9-154240	0607-157		6 9 40.949516	-15 42 40.67238	0.000049	0.00140	-.443	49047.1	45466.3	49790.7	19	89
ICRF J061357.6+130645	0611+131		6 13 57.692754	13 6 45.40144	0.000047	0.00117	-.529	48945.9	47394.1	49667.9	9	27
ICRF J061635.9-345616	0614-349		6 16 35.981345	-34 56 16.56410	0.005405	0.03903	-.947	48766.9	48766.9	48766.9	1	2
ICRF J061732.3-363414	0615-365		6 17 32.323936	-36 34 14.80314	0.004648	0.04163	-.969	48766.9	48766.9	48766.9	1	3
ICRF J062331.7-441302	0622-441		6 23 31.786306	-44 13 2.54171	0.000640	0.00450	-.068	48162.4	48162.4	48162.4	1	5
ICRF J062419.0+385648	0620+389		6 24 19.021315	38 56 48.73591	0.000025	0.00033	-.016	49631.0	49391.7	49690.0	6	112
ICRF J063920.9-334600	0637-337		6 39 20.904728	-33 46 0.11360	0.000095	0.00117	.168	47782.3	47511.1	48865.8	3	10
ICRF J064524.0+212151	0642+214		6 45 24.099488	21 21 51.20191	0.000034	0.00054	-.878	49125.6	48093.0	49662.8	15	43
ICRF J064814.0-304419	0646-306	2 2	6 48 14.096463	-30 44 19.65964	0.000035	0.00041	-.601	49131.7	47640.2	49662.8	8	145
ICRF J064848.4-473427	0647-475		6 48 48.452021	-47 34 27.18600	0.005321	0.02110	-.739	48766.9	48766.9	48766.9	1	2
ICRF J065358.2+370540	0650+371		6 53 58.282844	37 5 40.60649	0.000035	0.00052	-.227	49030.1	48348.6	49750.8	37	113
ICRF J070001.5+170921	0657+172	2 1	7 0 1.525540	17 9 21.70163	0.000018	0.00027	-.026	48854.1	47517.4	49692.6	113	849
ICRF J070134.5-463436	0700-465		7 1 34.547145	-46 34 36.62034	0.000469	0.00392	-.332	48162.4	48162.4	48162.4	1	3
ICRF J072905.4-363945	0727-365		7 29 5.425027	-36 39 45.29030	0.054838	0.28833	-.999	48766.9	48766.9	48766.9	1	1
ICRF J073816.9-332212	0736-332		7 38 16.949145	-33 22 12.77740	0.000305	0.00193	-.452	49082.7	48766.9	49398.5	2	8
ICRF J073918.0+013704	0736+017		7 39 18.033894	1 37 4.61797	0.000020	0.00035	-.560	47553.9	44773.8	49600.3	26	130
ICRF J074202.7+490015	0738+491		7 42 2.748951	49 0 15.60912	0.000042	0.00039	-.096	49750.8	49750.8	49750.8	1	34
ICRF J074331.6-672625	0743-673		7 43 31.611506	-67 26 25.54618	0.001087	0.06235	-.185	48600.5	48110.9	49535.0	4	17

Table 6. (cont.) Coordinates of the candidate sources in ICRF

ICRF Designation (1)	IERS Des. (2)	Inf. (3) X S H	Right Ascension J2000.0 h m s	Declination J2000.0 o ' "	Uncertainty R.A. s	Uncertainty Dec. "	Corr. RA-Dc	Mean MJD of observation span	First MJD of observation span	Last MJD of observation span	Nb sess.	Nb del. (4)
ICRF J075052.0+123104	0748+126		7 50 52.045731	12 31 4.82823	0.000019	0.00030	-.154	47761.5	44773.8	49662.8	19	239
ICRF J080815.5-075109	0805-077	3 1	8 8 15.536036	- 7 51 9.88642	0.000019	0.00032	-.459	48618.6	47176.5	49790.7	27	95
ICRF J081108.8-492943	0809-493		8 11 8.802530	-49 29 43.50928	0.000722	0.00539	-.152	48043.8	48043.8	48043.8	1	5
ICRF J081126.7+014652	0808+019	1 1	8 11 26.707322	1 46 52.21998	0.000018	0.00031	-.317	49268.6	46977.9	49820.5	29	279
ICRF J081815.9+422245	0814+425		8 18 15.999611	42 22 45.41498	0.000024	0.00027	.029	48208.8	45138.8	49690.0	137	1496
ICRF J082526.8-501038	0823-500		8 25 26.869117	-50 10 38.48735	0.000227	0.00148	-.399	48784.2	48162.4	49895.6	3	21
ICRF J082538.6+615728	0821+621		8 25 38.612165	61 57 28.57917	0.000111	0.00050	.293	49422.9	49422.9	49422.9	1	28
ICRF J082550.3+030924	0823+033	2 1	8 25 50.338356	3 9 24.52016	0.000017	0.00026	.123	49199.7	45466.3	49911.8	408	11767
ICRF J082601.5-223027	0823-223		8 26 1.572952	-22 30 27.20373	0.000123	0.00278	-.556	47023.6	46875.8	47171.5	2	12
ICRF J083052.0+241059	0827+243		8 30 52.086191	24 10 59.82068	0.000023	0.00037	.003	48238.8	47023.7	49611.9	11	123
ICRF J083322.3-444138	0831-445		8 33 22.315631	-44 41 38.71463	0.000603	0.00381	-.254	49027.6	48043.8	49895.6	6	15
ICRF J083520.6-451035	0833-450		8 35 20.655289	-45 10 35.15391	0.001715	0.01125	-.395	48132.8	48043.8	48162.4	2	4
ICRF J084124.3+705342	0836+710		8 41 24.365236	70 53 42.17328	0.000117	0.00064	.140	48387.6	46977.9	49694.8	7	105
ICRF J084127.0-754027	0842-754		8 41 27.034888	-75 40 27.87078	0.002953	0.00740	-.514	48205.3	48110.9	48865.8	2	8
ICRF J085448.8+200630	0851+202	2 1 *	8 54 48.874924	20 6 30.64088	0.000018	0.00026	.086	47708.7	44203.7	49924.8	2173	64014
ICRF J090216.8-141530	0859-140		9 2 16.830898	-14 15 30.87530	0.000042	0.00044	-.560	48495.2	46875.8	49600.3	20	70
ICRF J090910.0+012135	0906+015		9 9 10.091601	1 21 35.61770	0.000020	0.00035	-.422	48304.1	47005.8	49750.8	22	186
ICRF J091437.9+024559	0912+029		9 14 37.913439	2 45 59.24629	0.000072	0.00109	-.898	48863.7	47407.6	49554.8	4	13
ICRF J092246.4-395935	0920-397		9 22 46.418275	-39 59 35.06753	0.000035	0.00075	-.471	49064.5	47686.1	49911.8	20	90
ICRF J092314.4+384939	0920+390		9 23 14.452940	38 49 39.91017	0.000025	0.00032	-.134	49847.9	49736.9	49910.8	11	110
ICRF J092751.8-203451	0925-203		9 27 51.824304	-20 34 51.23227	0.000091	0.00626	-.526	48662.3	47941.3	49517.3	24	68
ICRF J093032.5-853359	0936-853		9 30 32.571196	-85 33 59.69200	0.004016	0.00396	.068	48887.3	48162.4	49650.8	4	15
ICRF J095524.7+690113	0951+692		9 55 24.774751	69 1 13.70255	0.000107	0.00065	.123	49238.5	49225.8	49267.8	3	97
ICRF J100159.9-443800	0959-443		10 1 59.907283	-44 38 0.60564	0.000549	0.00411	-.490	48506.8	48043.8	49895.6	2	8
ICRF J100614.0-501813	1004-500		10 6 14.009559	-50 18 13.47089	0.001635	0.01727	-.887	49535.0	49535.0	49535.0	1	2
ICRF J101353.4+244916	1011+250		10 13 53.428730	24 49 16.44127	0.000038	0.00069	-.276	49233.4	48353.6	49694.8	17	42
ICRF J101725.8+611627	1014+615		10 17 25.887530	61 16 27.49687	0.000085	0.00053	.199	49422.9	49422.9	49422.9	1	34
ICRF J102232.7-103744	1020-103	*	10 22 32.798030	-10 37 44.38842	0.007404	0.02425	.877	49650.8	49650.8	49650.8	1	2
ICRF J102444.8+191220	1022+194	2 2	10 24 44.809595	19 12 20.41526	0.000047	0.00099	-.218	49688.4	47783.2	49820.5	8	175
ICRF J103507.0+562846	1031+567	*	10 35 7.040181	56 28 46.79673	0.000209	0.00185	.562	48462.2	47023.7	49690.0	15	95

Table 6. (cont.) Coordinates of the candidate sources in ICRF

ICRF Designation (1)	IERS Des. (2)	Inf. (3) X S H	Right Ascension J2000.0 h m s	Declination J2000.0 o ' "	Uncertainty R.A. s	Uncertainty Dec. "	Corr. RA-Dc	Mean MJD of observation	First MJD of observation	Last MJD of observation span	Nb sess.	Nb del. (4)
ICRF J104142.9-474006	1039-474		10 41 42.939703	-47 40 6.52738	0.029517	0.28851	-1.000	49535.0	49535.0	49535.0	1	1
ICRF J104455.9+065538	1042+071		10 44 55.911265	6 55 38.26250	0.000035	0.00069	-.504	48909.9	47783.2	49498.8	5	19
ICRF J104827.6+714335	1044+719	1 1	10 48 27.619892	71 43 35.93846	0.000056	0.00026	.024	49651.6	47605.1	49909.6	108	4169
ICRF J105104.7-313814	1048-313		10 51 4.777555	-31 38 14.30773	0.000069	0.00058	-.228	47671.5	47640.2	47686.1	2	22
ICRF J105653.6+701145	1053+704		10 56 53.617499	70 11 45.91587	0.000057	0.00029	-.010	49462.0	49125.7	49883.8	17	246
ICRF J110331.5-325116	1101-325	*	11 3 31.526414	-32 51 16.69195	0.000064	0.00183	.297	48815.6	47511.1	49650.8	5	7
ICRF J110352.2-535700	1101-536		11 3 52.221670	-53 57 0.69643	0.000033	0.00033	.134	49235.8	47626.5	49895.6	25	181
ICRF J110427.3+381231	1101+384	1 1 *	11 4 27.313906	38 12 31.79908	0.000039	0.00052	.557	49668.7	49519.8	49690.0	2	32
ICRF J110712.6-682050	1105-680		11 7 12.694528	-68 20 50.72894	0.000304	0.00163	.640	48934.7	48388.4	49330.5	3	19
ICRF J111826.9-463415	1116-462		11 18 26.957601	-46 34 15.00140	0.000062	0.00082	.491	48556.1	48110.9	49330.5	6	16
ICRF J112027.8+142054	1117+146	3 4	11 20 27.807269	14 20 54.99422	0.000538	0.00710	-.454	49207.4	49098.6	49533.8	2	4
ICRF J112704.3-185717	1124-186		11 27 4.392428	-18 57 17.44154	0.000019	0.00030	-.208	49242.7	46875.8	49911.8	91	684
ICRF J112813.3+592514	1125+596		11 28 13.340725	59 25 14.80002	0.000118	0.00076	.263	49422.9	49422.9	49422.9	1	27
ICRF J113007.0-144927	1127-145	4 2	11 30 7.052573	-14 49 27.38793	0.000037	0.00114	-.351	49312.6	45259.2	49790.7	26	352
ICRF J113130.5-050019	1128-047		11 31 30.516713	- 5 0 19.65713	0.000031	0.00061	-.087	49408.6	49099.7	49547.8	4	48
ICRF J113143.2-581853	1129-580		11 31 43.287417	-58 18 53.44656	0.001192	0.01188	.805	49535.0	49535.0	49535.0	1	2
ICRF J114701.3-381211	1144-379		11 47 1.370687	-38 12 11.02348	0.000024	0.00030	-.328	49308.2	47654.0	49924.8	64	314
ICRF J114751.5-072441	1145-071	3 1	11 47 51.554038	- 7 24 41.14107	0.000018	0.00029	-.045	49194.8	47176.5	49819.8	56	464
ICRF J115043.8-002354	1148-001		11 50 43.870784	- 0 23 54.20485	0.000024	0.00056	.089	48127.8	47023.7	49848.8	17	128
ICRF J115912.7-094052	1156-094	3 3	11 59 12.711697	- 9 40 52.04888	0.000079	0.00322	-.773	49323.1	47941.3	49790.7	8	17
ICRF J115931.8+291443	1156+295	2 2	11 59 31.833914	29 14 43.82693	0.000020	0.00026	-.071	48185.2	46977.9	49848.8	285	7176
ICRF J120935.2-401613	1206-399		12 9 35.243318	-40 16 13.10027	0.018417	0.02742	.244	47807.2	47511.1	48043.8	3	9
ICRF J121546.7-173145	1213-172		12 15 46.751764	-17 31 45.40287	0.000043	0.00041	.004	48762.4	46840.8	49868.8	4	34
ICRF J121806.2-460029	1215-457		12 18 6.252147	-46 0 29.01041	0.001021	0.00776	-.811	48746.5	48162.4	49330.5	2	6
ICRF J122131.6+281358	1219+285		12 21 31.690512	28 13 58.50014	0.000023	0.00034	-.495	46621.3	44447.0	49848.8	27	203
ICRF J122452.4+033050	1222+037		12 24 52.421888	3 30 50.29322	0.000053	0.00195	-.032	48144.4	46502.8	49576.9	47	185
ICRF J122454.3-831310	1221-829		12 24 54.383445	-83 13 10.10523	0.003023	0.00611	-.493	48043.8	48043.8	48043.8	1	4
ICRF J123049.4+122328	1228+126	3 2	12 30 49.423381	12 23 28.04390	0.000034	0.00047	-.057	49380.5	46502.8	49924.8	40	457
ICRF J123715.2-504623	1234-504		12 37 15.238939	-50 46 23.17192	0.001450	0.00627	-.679	48766.9	48766.9	48766.9	1	6
ICRF J123943.0-102328	1237-101		12 39 43.061423	-10 23 28.69259	0.000043	0.00064	.221	49398.5	49398.5	49398.5	1	8

Table 6. (cont.) Coordinates of the candidate sources in ICRF

ICRF Designation (1)	IERS Des. (2)	Inf. (3) X	S	H	Right Ascension J2000.0 h m s	Declination J2000.0 o ' "	Uncertainty R.A. s	Dec. "	Corr. RA-Dc	Mean MJD of observation	First MJD	Last MJD span	Nb sess.	Nb del. (4)
ICRF J123959.4-113722	1237-113				12 39 59.430198	-11 37 22.98492	0.001402	0.01335	-.675	49889.7	49883.8	49895.6	2	4
ICRF J124251.3+375100	1240+381				12 42 51.369079	37 51 0.02510	0.000051	0.00042	-.316	49534.2	49429.9	49750.8	2	80
ICRF J124604.2-073046	1243-072				12 46 4.232116	- 7 30 46.57478	0.000027	0.00046	-.578	47836.0	47176.5	49498.8	11	40
ICRF J124646.8-254749	1244-255				12 46 46.802038	-25 47 49.28871	0.000020	0.00029	-.299	49085.4	46875.8	49895.6	87	557
ICRF J125359.5-405930	1251-407				12 53 59.533598	-40 59 30.68936	0.000171	0.00503	.543	49814.0	49650.8	49895.6	2	9
ICRF J125614.2+565225	1254+571			*	12 56 14.233964	56 52 25.23721	0.000105	0.00096	.656	49690.0	49690.0	49690.0	1	24
ICRF J125759.0-315516	1255-316				12 57 59.060767	-31 55 16.85182	0.000025	0.00041	.220	49500.7	47640.2	49911.8	13	208
ICRF J130533.0-103319	1302-102			*	13 5 33.015018	-10 33 19.42796	0.000020	0.00033	-.481	48565.2	47176.5	49600.3	25	78
ICRF J130933.9+115424	1307+121	3	2		13 9 33.932424	11 54 24.55204	0.000044	0.00076	.098	49705.3	49099.7	49820.5	3	137
ICRF J131607.9-333859	1313-333	1	1		13 16 7.985934	-33 38 59.17236	0.000024	0.00031	-.466	49069.2	47415.7	49692.6	67	322
ICRF J131736.4+342515	1315+346	2	1	*	13 17 36.494181	34 25 15.93257	0.000025	0.00049	-.464	49169.7	47946.4	49690.0	21	88
ICRF J132304.2-445233	1320-446				13 23 4.245804	-44 52 33.85272	0.000623	0.00321	.149	49065.5	48766.9	49895.6	3	17
ICRF J132527.6-430108	1322-427				13 25 27.615217	-43 1 8.80528	0.000198	0.00161	.732	49205.8	48110.9	49895.6	3	14
ICRF J132616.5+315409	1323+321	4	4		13 26 16.511396	31 54 9.51991	0.000188	0.00199	.028	49398.8	48223.7	49542.2	6	110
ICRF J133108.2+303032	1328+307				13 31 8.288145	30 30 32.95986	0.000094	0.00119	.442	49095.9	48787.9	49498.8	4	25
ICRF J133237.5-664650	1329-665				13 32 37.517448	-66 46 50.44682	0.092072	0.94670	.979	48766.9	48766.9	48766.9	1	1
ICRF J133752.4-650924	1334-649				13 37 52.444609	-65 9 24.89757	0.000798	0.00335	-.259	48969.7	48043.8	49895.6	2	10
ICRF J134022.9+375443	1338+381			*	13 40 22.951763	37 54 43.83468	0.000111	0.00120	-.483	49287.4	49031.1	49848.8	7	29
ICRF J134733.3+121724	1345+125	4	4		13 47 33.361635	12 17 24.24023	0.000028	0.00064	.032	49297.5	47659.7	49542.2	9	187
ICRF J135256.5-441240	1349-439				13 52 56.534909	-44 12 40.38741	0.000038	0.00066	-.548	48911.6	48110.9	49692.6	16	49
ICRF J135406.8-020603	1351-018				13 54 6.895314	- 2 6 3.19053	0.000018	0.00030	.023	49625.3	48573.8	49910.8	38	417
ICRF J135546.6-632642	1352-632				13 55 46.611660	-63 26 42.57485	0.000518	0.00349	.265	49573.6	49535.0	49650.8	2	6
ICRF J135711.2-152728	1354-152				13 57 11.244965	-15 27 28.78636	0.000020	0.00031	-.512	48251.4	46875.8	49662.8	91	309
ICRF J135755.3+764321	1357+769	1	1		13 57 55.371524	76 43 21.05116	0.000076	0.00026	-.068	49585.2	47011.4	49924.8	178	17427
ICRF J135900.1-415252	1355-416				13 59 0.183255	-41 52 52.63210	0.001757	0.01158	-.393	48110.9	48110.9	48110.9	1	4
ICRF J140445.8-013021	1402-012				14 4 45.895486	- 1 30 21.94945	0.000122	0.00160	.297	49287.6	48664.8	49690.0	6	34
ICRF J140501.1+041535	1402+044	2	1		14 5 1.119805	4 15 35.81906	0.000018	0.00031	-.212	49589.6	48888.7	49883.8	33	322
ICRF J140856.4-075226	1406-076				14 8 56.481199	- 7 52 26.66622	0.000041	0.00043	-.673	48701.5	47176.5	49790.7	22	58
ICRF J141154.8+213423	1409+218				14 11 54.862136	21 34 23.43722	0.000076	0.00209	-.406	49001.4	48863.2	49498.8	2	23
ICRF J141946.6+382148	1417+385				14 19 46.613740	38 21 48.47498	0.000050	0.00054	-.193	49750.8	49750.8	49750.8	1	30

Table 6. (cont.) Coordinates of the candidate sources in ICRF

ICRF Designation (1)	IERS Des. (2)	Inf. (3) X	S	H	Right Ascension J2000.0 h m s	Declination J2000.0 o ' "	Uncertainty R.A. s	Dec. "	Corr. RA-Dc	Mean MJD of observation	First MJD	Last MJD span	Nb sess.	Nb del. (4)
ICRF J141959.2+270625	1417+273				14 19 59.297083	27 6 25.55244	0.000070	0.00166	-.455	48930.3	48863.2	49533.8	2	30
ICRF J142230.3+322310	1420+326				14 22 30.379016	32 23 10.43924	0.000082	0.00579	-.568	49086.8	48863.2	49533.8	2	9
ICRF J142700.3+234800	1424+240			*	14 27 0.391837	23 48 0.03493	0.000073	0.00149	-.500	48914.2	48863.2	49554.8	3	40
ICRF J143257.6-180135	1430-178				14 32 57.690619	-18 1 35.24845	0.000059	0.00445	-.897	48767.6	48160.3	49565.9	13	23
ICRF J143439.7+195200	1432+200	2	1		14 34 39.793350	19 52 0.73552	0.000141	0.00099	.016	49740.0	48863.2	49820.5	3	169
ICRF J143535.4+301224	1433+304	2	1		14 35 35.402170	30 12 24.51975	0.000173	0.00211	.168	48926.8	48863.2	49498.8	2	10
ICRF J143809.4-220454	1435-218				14 38 9.469411	-22 4 54.74790	0.000081	0.00069	-.746	48901.4	47176.5	49445.6	23	60
ICRF J144553.3-162901	1443-162				14 45 53.376319	-16 29 1.61908	0.000032	0.00046	-.872	48583.9	47941.3	49565.9	13	29
ICRF J145427.4-374733	1451-375				14 54 27.409777	-37 47 33.14437	0.000029	0.00047	-.010	48839.4	47511.1	49650.8	12	60
ICRF J145432.9-401232	1451-400				14 54 32.912346	-40 12 32.51446	0.000029	0.00037	-.050	49399.3	47640.2	49895.6	14	108
ICRF J150506.4+032630	1502+036				15 5 6.477205	3 26 30.81298	0.000032	0.00075	-.180	49101.0	48853.8	49554.8	3	49
ICRF J150704.7-165230	1504-166				15 7 4.786942	-16 52 30.26722	0.000021	0.00032	-.659	48398.5	46840.8	49694.8	39	122
ICRF J151002.9+570243	1508+572				15 10 2.922371	57 2 43.37606	0.000035	0.00030	-.067	49715.9	49541.8	49917.8	8	213
ICRF J151344.8-101200	1511-100				15 13 44.893455	-10 12 0.26452	0.000024	0.00038	-.685	48337.8	46875.8	49611.9	23	68
ICRF J151741.8-242219	1514-241			*	15 17 41.813134	-24 22 19.47579	0.000026	0.00035	-.702	48400.4	46840.8	49565.9	20	59
ICRF J152237.6-273010	1519-273				15 22 37.675993	-27 30 10.78535	0.000020	0.00029	-.206	49033.8	46875.8	49895.6	119	531
ICRF J154929.4+023701	1546+027	2	1		15 49 29.436848	2 37 1.16336	0.000018	0.00032	-.362	49030.9	47005.8	49848.8	29	240
ICRF J155059.1-825806	1540-828				15 50 59.144724	-82 58 6.84194	0.004432	0.00508	.149	48779.1	48043.8	49330.5	2	7
ICRF J155751.4-000150	1555+001				15 57 51.433965	- 0 1 50.41366	0.000018	0.00030	-.570	48287.7	44773.8	49659.8	62	235
ICRF J155821.9-140959	1555-140				15 58 21.949635	-14 9 59.07210	0.001209	0.01638	-.999	48833.4	48704.1	48977.5	4	4
ICRF J155930.9+030448	1557+032				15 59 30.972613	3 4 48.25682	0.000029	0.00040	-.133	49678.0	49541.8	49883.8	7	91
ICRF J160140.4+431647	1600+432				16 1 40.443935	43 16 47.75702	0.000164	0.00210	-.012	49883.8	49883.8	49883.8	1	5
ICRF J160140.5+431646	1600+431				16 1 40.515432	43 16 46.47617	0.000161	0.00471	.292	49883.8	49883.8	49883.8	1	3
ICRF J160431.0-444131	1600-445				16 4 31.020029	-44 41 31.95353	0.042414	0.65519	.999	49535.0	49535.0	49535.0	1	1
ICRF J161341.0+341247	1611+343	3	1	*	16 13 41.064250	34 12 47.90905	0.000021	0.00026	-.216	48648.8	44773.8	49924.8	834	27514
ICRF J161637.5+045932	1614+051				16 16 37.556818	4 59 32.73653	0.000018	0.00030	-.154	49199.1	47605.1	49904.8	41	296
ICRF J162606.0-295126	1622-297				16 26 6.020829	-29 51 26.97074	0.000029	0.00038	-.613	48640.5	46840.8	49917.8	20	124
ICRF J165039.5-294346	1647-296				16 50 39.544133	-29 43 46.95469	0.000072	0.00082	-.958	48973.9	48346.0	49662.8	13	17
ICRF J165352.2+394536	1652+398	3	2	*	16 53 52.216693	39 45 36.60877	0.000023	0.00029	-.029	49018.2	45997.8	49910.8	25	420
ICRF J165802.7+473749	1656+477				16 58 2.779637	. 47 37 49.23143	0.000044	0.00045	.000	49234.0	49184.9	49498.8	2	32

Table 6. (cont.) Coordinates of the candidate sources in ICRF

ICRF Designation (1)	IERS Des. (2)	Inf. (3) X S H	Right Ascension J2000.0 h m s	Declination J2000.0 o ' "	Uncertainty R.A. s	Uncertainty Dec. "	Corr. RA-Dc	Mean MJD of observation span	First MJD of observation span	Last MJD of observation span	Nb sess.	Nb del. (4)
ICRF J165809.0+074127	1655+077		16 58 9.011473	7 41 27.54050	0.000021	0.00037	-.387	48578.9	47407.6	49659.8	15	96
ICRF J165833.4+051516	1656+053		16 58 33.447346	5 15 16.44429	0.000018	0.00031	-.089	48005.3	44773.8	49429.9	41	584
ICRF J170053.1-261051	1657-261		17 0 53.154046	-26 10 51.72492	0.000024	0.00033	-.620	48238.6	46875.8	49662.8	36	123
ICRF J170717.7+453610	1705+456	3 2	17 7 17.753406	45 36 10.55272	0.000069	0.00077	-.079	49682.5	48434.7	49820.5	6	183
ICRF J173315.1-372232	1729-373		17 33 15.192721	-37 22 32.39565	0.000550	0.00354	-.335	49650.8	49650.8	49650.8	1	2
ICRF J173420.5+385751	1732+389		17 34 20.578531	38 57 51.44298	0.000023	0.00029	-.174	48576.0	46977.9	49600.3	43	257
ICRF J173549.0+504911	1734+508		17 35 49.005166	50 49 11.56586	0.000037	0.00042	.219	49429.9	49429.9	49429.9	1	87
ICRF J173735.7-563403	1733-565		17 37 35.770462	-56 34 3.15477	0.000665	0.00430	.887	49173.5	48388.4	49330.5	2	6
ICRF J173927.3+495503	1738+499		17 39 27.390512	49 55 3.36831	0.000039	0.00037	-.118	49590.6	49422.9	49750.8	3	92
ICRF J173957.1+473758	1738+476	2 1	17 39 57.129064	47 37 58.36131	0.000031	0.00034	.176	48364.5	47288.7	49848.8	13	135
ICRF J174036.9+521143	1739+522	2 1	17 40 36.977847	52 11 43.40753	0.000028	0.00026	-.104	48846.4	47165.8	49909.6	1006	58894
ICRF J174425.4-514443	1740-517		17 44 25.450704	-51 44 43.79284	0.000633	0.00373	.627	48766.9	48766.9	48766.9	1	5
ICRF J174726.6+465850	1746+470		17 47 26.647300	46 58 50.92630	0.000036	0.00037	-.231	49596.3	49422.9	49750.8	3	89
ICRF J175132.8+093900	1749+096	1 1	17 51 32.818576	9 39 0.72846	0.000017	0.00026	-.436	48923.8	44447.0	49924.8	825	20158
ICRF J175151.2-252400	1748-253		17 51 51.263054	-25 24 0.06011	0.000470	0.00503	.230	48802.3	48110.9	49098.6	2	10
ICRF J180024.7+384830	1758+388		18 0 24.765360	38 48 30.69771	0.000024	0.00029	-.052	49570.0	49429.9	49826.8	4	157
ICRF J180045.6+782804	1803+784	2 1 *	18 0 45.683911	78 28 4.01854	0.000087	0.00026	-.027	47884.0	45138.8	49917.8	1620	68029
ICRF J180650.6+694928	1807+698		18 6 50.680653	69 49 28.10859	0.000052	0.00027	.032	48181.8	45997.8	49882.8	50	423
ICRF J180821.8+454220	1806+456		18 8 21.885910	45 42 20.86644	0.000034	0.00040	-.338	49495.4	49422.9	49547.8	2	50
ICRF J180957.8-455241	1806-458		18 9 57.871831	-45 52 41.01367	0.000485	0.00233	-.565	49629.6	49629.6	49629.6	1	2
ICRF J181935.0-634548	1814-637		18 19 35.002525	-63 45 48.19427	0.000794	0.00851	-.293	49277.1	48162.4	49895.6	3	12
ICRF J182057.8-252812	1817-254		18 20 57.848684	-25 28 12.58397	0.000119	0.00104	-.117	49362.8	48804.9	49833.8	4	24
ICRF J182402.8+104423	1821+107	3 1	18 24 2.855269	10 44 23.77392	0.000020	0.00036	-.156	48819.1	45466.3	49790.7	20	341
ICRF J183537.2-714958	1829-718		18 35 37.205091	-71 49 58.21900	0.001166	0.00475	.412	48766.9	48766.9	48766.9	1	7
ICRF J183728.7-710843	1831-711		18 37 28.714952	-71 8 43.55453	0.000064	0.00033	-.004	48850.0	47626.5	49692.6	17	189
ICRF J191109.6-200655	1908-201		19 11 9.652867	-20 6 55.10860	0.000030	0.00091	-.623	48874.2	46840.8	49790.7	41	153
ICRF J192332.1-210433	1920-211		19 23 32.189804	-21 4 33.33284	0.000024	0.00035	-.724	48637.7	47407.6	49662.8	40	92
ICRF J192559.6+210626	1923+210		19 25 59.605374	21 6 26.16209	0.000019	0.00028	-.197	48372.8	45138.8	49662.8	109	665
ICRF J192840.8+084848	1926+087		19 28 40.855498	8 48 48.41260	0.000075	0.00258	.041	49678.3	49541.8	49690.0	3	29
ICRF J193006.1-605609	1925-610		19 30 6.160015	-60 56 9.18402	0.000082	0.00098	-.157	48438.5	47626.5	49330.5	5	18

Table 6. (cont.) Coordinates of the candidate sources in ICRF

ICRF Designation (1)	IERS Des. (2)	Inf. (3) X S H	Right Ascension J2000.0 h m s	Declination J2000.0 o ' "	Uncertainty R.A. s	Uncertainty Dec. "	Corr. RA-Dc	Mean MJD of observation span	First MJD of observation span	Last MJD of observation span	Nb sess.	Nb del. (4)
ICRF J193124.9+224331	1929+226	1 1	19 31 24.916786	22 43 31.25884	0.000029	0.00050	-.149	49755.2	48614.0	49904.8	9	256
ICRF J193435.0+104340	1932+106		19 34 35.025577	10 43 40.36503	0.000050	0.00173	-.310	49690.0	49690.0	49690.0	1	22
ICRF J193510.4+203154	1932+204	1 1	19 35 10.472891	20 31 54.15344	0.000041	0.00137	.232	49168.1	48804.9	49554.8	5	22
ICRF J193716.2-395801	1933-400		19 37 16.217368	-39 58 1.55290	0.000034	0.00046	-.604	48596.7	47640.2	49662.8	23	85
ICRF J193925.0-634245	1934-638		19 39 25.026661	-63 42 45.62554	0.000430	0.00187	-.214	48963.3	48766.9	49650.8	2	9
ICRF J193926.6-152543	1936-155		19 39 26.657726	-15 25 43.05792	0.000029	0.00108	-.839	48722.5	47176.5	49662.8	22	62
ICRF J193957.2-100241	1937-101		19 39 57.256570	-10 2 41.52067	0.000027	0.00096	-.215	49357.5	48110.9	49650.8	5	77
ICRF J194121.7-621121	1936-623		19 41 21.768473	-62 11 21.05558	0.000753	0.00583	-.331	48162.4	48162.4	48162.4	1	5
ICRF J194606.2+230004	1943+228		19 46 6.251939	23 0 4.41107	0.000518	0.00620	-.408	48861.0	48797.8	48919.9	3	10
ICRF J195330.8+353759	1951+355	2 1	19 53 30.875733	35 37 59.36071	0.000073	0.00207	.554	49144.8	48919.9	49533.8	3	32
ICRF J195740.5+333827	1955+335	*	19 57 40.550036	33 38 27.94555	0.000099	0.00148	-.429	49163.8	49098.6	49554.8	2	21
ICRF J200925.3-484953	2005-489	*	20 9 25.390729	-48 49 53.72128	0.000643	0.00737	.369	48833.8	47626.5	49750.8	7	36
ICRF J202510.8+334300	2023+335	3 3	20 25 10.842102	33 43 0.21600	0.000142	0.00193	-.454	48976.5	48223.7	49667.9	4	27
ICRF J204008.7-250746	2037-253		20 40 8.772845	-25 7 46.66253	0.000060	0.00056	-.420	48666.1	47686.1	49650.8	3	18
ICRF J205741.6-373402	2054-377		20 57 41.603472	-37 34 2.98978	0.000258	0.00195	-.426	49089.5	48162.4	49398.5	2	12
ICRF J210159.1-421916	2058-425		21 1 59.114188	-42 19 16.16206	0.000936	0.00935	.669	49017.6	48162.4	49895.6	4	11
ICRF J210217.0+470216	2100+468	*	21 2 17.056050	47 2 16.25468	0.000181	0.00193	.186	49467.2	49177.8	49690.0	3	10
ICRF J211810.5-301911	2115-305		21 18 10.597647	-30 19 11.60596	0.000236	0.00247	-.741	48904.1	48162.4	49398.5	2	5
ICRF J212912.1-153841	2126-158		21 29 12.175895	-15 38 41.04054	0.000020	0.00033	-.242	49109.4	47176.5	49883.8	44	163
ICRF J213410.3-015317	2131-021	2 1	21 34 10.309614	- 1 53 17.23883	0.000018	0.00030	-.537	48519.0	47176.5	49736.9	56	195
ICRF J214710.1+092946	2144+092		21 47 10.162975	9 29 46.67236	0.000020	0.00032	-.284	47658.1	45997.8	49848.8	23	321
ICRF J214712.7-753613	2142-758		21 47 12.730293	-75 36 13.22513	0.000192	0.00060	.280	48289.6	47626.5	48749.6	4	14
ICRF J215137.8+055212	2149+056		21 51 37.875502	5 52 12.95459	0.000021	0.00034	-.662	48377.8	45466.3	49662.8	23	125
ICRF J215705.9-694123	2152-699		21 57 5.980566	-69 41 23.68553	0.000212	0.00132	.780	48509.0	48110.9	49330.5	3	11
ICRF J215852.0-301332	2155-304		21 58 52.065068	-30 13 32.11840	0.000354	0.00191	-.376	49253.6	48766.9	49895.6	3	14
ICRF J221302.4-252930	2210-257		22 13 2.498009	-25 29 30.08140	0.000084	0.00201	-.400	48701.6	46875.8	49694.8	3	13
ICRF J221438.5-383545	2211-388		22 14 38.569326	-38 35 45.01022	0.000564	0.00353	.160	49127.8	48766.9	49398.5	2	7
ICRF J221620.0+351814	2214+350		22 16 20.009936	35 18 14.18072	0.000051	0.00080	-.197	49750.8	49750.8	49750.8	1	28
ICRF J222547.2-045701	2223-052		22 25 47.259294	- 4 57 1.39048	0.000019	0.00061	-.646	48183.0	44773.8	49736.9	34	111
ICRF J222940.0-083254	2227-088	1 1	22 29 40.084339	- 8 32 54.43530	0.000018	0.00062	-.309	49215.2	45466.3	49820.5	37	208

Table 6. (cont.) Coordinates of the candidate sources in ICRF

ICRF Designation (1)	IERS Des. (2)	Inf. (3) X S H	Right Ascension J2000.0 h m s	Declination J2000.0 o ' "	Uncertainty R.A. s	Uncertainty Dec. "	Corr. RA-Dc	Mean MJD of observation span	First MJD of observation span	Last MJD of observation span	Nb sess.	Nb del. (4)
ICRF J223040.2-394252	2227-399		22 30 40.278611	-39 42 52.06692	0.000053	0.00106	.510	48896.9	48162.4	49895.6	4	16
ICRF J223622.4+282857	2234+282	2 1	22 36 22.470868	28 28 57.41338	0.000019	0.00026	.100	48611.2	45725.8	49924.8	1125	34156
ICRF J223634.0-143322	2233-148		22 36 34.087158	-14 33 22.18931	0.000055	0.00062	-.694	48636.1	47176.5	49662.8	16	32
ICRF J224838.6-323552	2245-328		22 48 38.685719	-32 35 52.18748	0.000073	0.00161	-.795	48728.9	47394.1	49662.8	26	85
ICRF J225504.2-084404	2252-090	3 3	22 55 4.239777	- 8 44 4.02151	0.000057	0.00234	-.619	49610.8	47394.1	49820.5	17	137
ICRF J225536.7+420252	2253+417		22 55 36.707842	42 2 52.53256	0.000027	0.00031	-.146	48127.3	47005.8	49662.8	46	266
ICRF J225717.5+024317	2254+024	1 1	22 57 17.563086	2 43 17.51193	0.000022	0.00050	-.679	48809.9	47394.1	49848.8	22	122
ICRF J230223.8-371806	2259-375		23 2 23.888469	-37 18 6.84027	0.008831	0.06321	-.434	48746.5	48162.4	49330.5	2	2
ICRF J230305.8-303011	2300-307		23 3 5.821287	-30 30 11.47289	0.021640	0.03255	.246	48368.5	48110.9	49398.5	2	5
ICRF J230343.5-680737	2300-683	*	23 3 43.565673	-68 7 37.45706	0.035391	0.45061	-.999	49650.8	49650.8	49650.8	1	1
ICRF J231409.3-445549	2311-452		23 14 9.382823	-44 55 49.23782	0.000320	0.00259	.111	48863.3	48162.4	49330.5	2	10
ICRF J232044.8+051349	2318+049		23 20 44.856618	5 13 49.95245	0.000019	0.00032	-.606	48446.7	47019.9	49667.9	35	166
ICRF J232331.9-031705	2320-035		23 23 31.953753	- 3 17 5.02363	0.000018	0.00040	-.552	48886.2	47394.1	49736.9	54	193
ICRF J232747.9-144755	2325-150		23 27 47.964255	-14 47 55.75021	0.000051	0.00102	.302	48034.2	47176.5	49535.0	2	11
ICRF J233040.8+110018	2328+107		23 30 40.852252	11 0 18.70971	0.000020	0.00032	-.498	48250.9	46977.9	49611.9	27	157
ICRF J233355.2-234340	2331-240		23 33 55.237802	-23 43 40.65782	0.000080	0.00233	-.773	48803.8	46875.8	49398.5	25	67
ICRF J233612.1-523621	2333-528		23 36 12.144624	-52 36 21.94997	0.000534	0.00372	.468	48579.6	48110.9	49573.6	3	9
ICRF J233757.3-023057	2335-027	3 1	23 37 57.339083	- 2 30 57.62923	0.000096	0.00784	-.716	48729.9	47941.3	49600.3	24	40
ICRF J234636.8+093045	2344+092		23 46 36.838560	9 30 45.51493	0.000020	0.00032	-.458	48573.6	47288.7	49667.9	25	122
ICRF J235430.1-151311	2351-154		23 54 30.195186	-15 13 11.21285	0.000103	0.00538	-.675	48664.2	47394.1	49694.8	31	62
ICRF J235600.6-682003	2353-686		23 56 0.681458	-68 20 3.47158	0.000103	0.00056	-.012	48560.7	48162.4	48757.4	3	17
ICRF J235753.2-531113	2355-534		23 57 53.266123	-53 11 13.68933	0.000040	0.00048	.180	48516.8	47626.5	49790.7	18	81
ICRF J235810.8-102008	2355-106		23 58 10.882414	-10 20 8.61132	0.000018	0.00028	-.261	48848.8	47394.1	49883.8	134	616
ICRF J235933.1+385042	2356+385		23 59 33.180777	38 50 42.31796	0.000085	0.00144	-.282	49519.8	49519.8	49519.8	1	4

Notes

(1) ICRF Designations, constructed from J2000.0 coordinates with the format
ICRF JHHMMSS.s+DDMMSS or ICRF JHHMMSS.s-DDMMSS.
They follow the recommendations of the IAU Task Group on Designations.

(2) IERS Designations, previously constructed from B1950 coordinates.
The complete format, including acronym and epoch in addition to the coordinates, is
IERS BHHMM+DDd or IERS BHHMM-DDd

(3) X: Structure index at X band
S: Structure index at S band
H: Asterisk indicates that the source serves to link the Hipparcos stellar reference frame to the ICRS.

(4) Number of pairs of delay and delay rate observations.

Table 7. Coordinates of the other sources in ICRF (see notes p. II-43)

ICRF Designation (1)	IERS Des. (2)	Inf. (3) X	S	H	Right Ascension J2000.0 h m s	Declination J2000.0 o ' "	Uncertainty R.A. s	Dec. "	Mean MJD of observation	First MJD	Last MJD span	Nb sess.	Nb del. (4)
ICRF J001945.7+732730	0016+731	2	1		0 19 45.786433	73 27 30.01751	0.000093	0.00039	48894.7	47165.8	49750.8	411	21652
ICRF J002232.4+060804	0019+058				0 22 32.441263	6 8 4.26943	0.000172	0.00351	49127.9	47394.1	49790.7	18	51
ICRF J002914.2+345632	0026+346	4	4		0 29 14.242502	34 56 32.24702	0.000312	0.00248	49382.7	47011.4	49820.5	12	201
ICRF J005041.3-092905	0048-097	1	1		0 50 41.317392	- 9 29 5.21022	0.000037	0.00090	49249.2	44773.8	49924.8	374	9641
ICRF J010245.7+582411	0059+581	2	1		1 2 45.762387	58 24 11.13669	0.000046	0.00038	49501.0	48720.9	49924.8	244	31138
ICRF J010645.1-403419	0104-408				1 6 45.107969	-40 34 19.96036	0.000150	0.00259	49399.7	47511.1	49917.8	116	719
ICRF J010838.7+013500	0106+013				1 8 38.771070	1 35 0.31714	0.000079	0.00214	46746.8	44447.0	49897.8	1204	24158
ICRF J011612.5-113615	0113-118				1 16 12.521959	-11 36 15.43371	0.000103	0.00293	48898.9	47176.5	49600.3	28	92
ICRF J013741.2+330935	0134+329			*	1 37 41.299454	33 9 35.13378	0.000194	0.00650	48597.5	48194.7	49667.9	10	64
ICRF J021046.2-510101	0208-512				2 10 46.200412	-51 1 1.89187	0.000105	0.00128	49152.9	47305.8	49911.8	166	1871
ICRF J021730.8+734932	0212+735	2	2		2 17 30.813365	73 49 32.62180	0.000118	0.00049	47445.3	44857.8	49600.3	1304	42970
ICRF J024008.1-230915	0237-233	4	3		2 40 8.174536	-23 9 15.73288	0.000407	0.00752	49347.5	48126.7	49662.8	19	244
ICRF J024104.7-081520	0238-084	4	2		2 41 4.798520	- 8 15 20.75174	0.000056	0.00290	49625.2	47176.5	49917.8	38	378
ICRF J030335.2+471616	0300+470	2	1		3 3 35.242225	47 16 16.27549	0.000047	0.00057	48144.6	45138.8	49736.9	736	23188
ICRF J031948.1+413042	0316+413			*	3 19 48.160106	41 30 42.10328	0.000182	0.00380	46427.5	44090.5	49751.9	195	5784
ICRF J032153.1+122113	0319+121				3 21 53.103501	12 21 13.95380	0.000068	0.00148	48586.6	47019.9	49790.7	12	144
ICRF J032957.6+275615	0326+277			*	3 29 57.669425	27 56 15.49901	0.000138	0.00210	48673.3	47165.8	49694.8	24	108
ICRF J033413.6-400825	0332-403				3 34 13.654484	-40 8 25.39779	0.000142	0.00163	48667.0	47640.2	49790.7	15	72
ICRF J033630.1+321829	0333+321				3 36 30.107611	32 18 29.34237	0.000068	0.00117	48549.1	44773.8	49576.9	73	424
ICRF J034035.6-211931	0338-214				3 40 35.607839	-21 19 31.17150	0.000097	0.00072	48292.6	46875.8	49629.6	4	34
ICRF J035929.7+505750	0355+508				3 59 29.747263	50 57 50.16149	0.000146	0.00142	46522.7	44090.5	49771.8	509	14647
ICRF J040353.7-360501	0402-362				4 3 53.749905	-36 5 1.91299	0.000142	0.00247	48953.0	47415.7	49924.8	104	445
ICRF J040534.0-130813	0403-132				4 5 34.003421	-13 8 13.69129	0.000052	0.00149	48959.3	47176.5	49650.8	3	43
ICRF J040820.3+303230	0405+304			*	4 8 20.377574	30 32 30.49043	0.000201	0.00512	49508.6	49177.8	49690.0	8	56
ICRF J042315.8-012033	0420-014	3	1	*	4 23 15.800726	- 1 20 33.06524	0.000051	0.00116	48071.3	44773.8	49895.6	1289	28507
ICRF J043311.0+052115	0430+052	4	3	*	4 33 11.095560	5 21 15.61961	0.000117	0.00261	46766.3	44090.5	49542.2	51	679
ICRF J043701.4-184448	0434-188				4 37 1.482726	-18 44 48.61337	0.000095	0.00212	48633.6	46875.8	49861.8	120	478
ICRF J045703.1-232452	0454-234	2	1		4 57 3.179223	-23 24 52.01989	0.000065	0.00158	48881.0	46440.9	49924.8	1090	15911
ICRF J050321.1+020304	0500+019				5 3 21.197194	2 3 4.67555	0.000097	0.00328	48702.4	47394.1	49848.8	13	92
ICRF J053007.9-250329	0528-250				5 30 7.962815	-25 3 29.89975	0.000113	0.00122	48755.0	47512.0	49650.8	12	72

Table 7. (cont.) Coordinates of the other sources in ICRF

ICRF Designation (1)	IERS Des. (2)	Inf. (3) X S H	Right Ascension J2000.0 h m s	Declination J2000.0 o ' "	Uncertainty R.A. s	Uncertainty Dec. "	Mean MJD of observation	First MJD span	Last MJD	Nb sess.	Nb del. (4)
ICRF J053850.3-440508	0537-441	3 1 *	5 38 50.361540	-44 5 8.93895	0.000126	0.00216	49238.2	47305.8	49911.8	266	2098
ICRF J053942.3+143345	0536+145	1 1	5 39 42.365997	14 33 45.56181	0.000061	0.00286	48975.3	47605.1	49667.9	32	78
ICRF J071338.1+434917	0710+439	4 3	7 13 38.164136	43 49 17.20702	0.000120	0.00272	49264.0	48179.7	49611.9	23	307
ICRF J071424.8+353439	0711+356		7 14 24.817575	35 34 39.79350	0.000131	0.00223	48238.8	45466.3	49667.9	13	131
ICRF J073019.1-114112	0727-115	2 1	7 30 19.112468	-11 41 12.60041	0.000043	0.00105	48776.5	45259.2	49924.8	1384	32167
ICRF J073807.3+174218	0735+178	*	7 38 7.393745	17 42 18.99829	0.000039	0.00056	49065.8	44773.8	49750.8	503	12686
ICRF J074533.0+101112	0742+103	4 1	7 45 33.059509	10 11 12.69254	0.000049	0.00108	48006.6	44773.8	49820.5	316	6712
ICRF J074554.0-004417	0743-006	2 1	7 45 54.082299	- 0 44 17.53921	0.000105	0.00284	47387.2	45997.8	49694.8	25	198
ICRF J092129.3-261843	0919-260	3 2	9 21 29.353871	-26 18 43.38615	0.000128	0.00339	49223.8	46840.8	49911.8	187	2389
ICRF J092703.0+390220	0923+392	2 1	9 27 3.013906	39 2 20.85196	0.000042	0.00047	48039.2	44090.5	49924.8	2185	96427
ICRF J095533.1+690355	0951+693		9 55 33.173011	69 3 55.06104	0.000215	0.00089	49464.9	49141.8	49917.8	10	397
ICRF J095649.8+251516	0953+254	2 1	9 56 49.875356	25 15 16.04963	0.000043	0.00060	49232.2	44447.0	49909.6	250	5878
ICRF J100741.4+135629	1004+141	3 2	10 7 41.498082	13 56 29.60073	0.000050	0.00104	49254.9	47011.4	49904.8	21	317
ICRF J102429.5-005255	1021-006		10 24 29.586611	- 0 52 55.49786	0.000119	0.00244	49253.9	48664.8	49690.0	9	97
ICRF J103716.0-293402	1034-293	1 1	10 37 16.079728	-29 34 2.81318	0.000107	0.00242	48768.6	46440.9	49911.8	620	5639
ICRF J104806.6-190935	1045-188		10 48 6.620574	-19 9 35.72656	0.000084	0.00173	48683.5	47176.5	49629.6	3	18
ICRF J105829.6+013358	1055+018		10 58 29.605209	1 33 58.82372	0.000052	0.00182	47703.2	44773.8	49662.8	266	4021
ICRF J110708.6-444907	1104-445		11 7 8.694143	-44 49 7.61841	0.000152	0.00247	49113.9	47626.5	49911.8	216	1478
ICRF J112553.7+261019	1123+264		11 25 53.711931	26 10 19.97862	0.000067	0.00112	48715.5	46977.9	49848.8	147	1120
ICRF J114658.2+395834	1144+402		11 46 58.297906	39 58 34.30461	0.000078	0.00116	47065.9	45138.8	49662.8	138	2084
ICRF J122906.6+020308	1226+023	*	12 29 6.699728	2 3 8.59824	0.000119	0.00284	46610.7	44090.5	49751.9	1120	27264
ICRF J125611.1-054721	1253-055		12 56 11.166507	- 5 47 21.52481	0.000111	0.00300	47337.9	44090.5	49882.8	242	4321
ICRF J130252.4+574837	1300+580	1 1	13 2 52.465276	57 48 37.60941	0.000069	0.00075	49830.6	49422.9	49897.8	14	874
ICRF J133739.7-125724	1334-127	2 1	13 37 39.782777	-12 57 24.69308	0.000054	0.00130	48947.4	46840.8	49924.8	1080	23245
ICRF J135704.4+191907	1354+195		13 57 4.436658	19 19 7.37228	0.000057	0.00131	47372.1	44447.0	49692.6	103	1482
ICRF J140700.3+282714	1404+286	3 1 *	14 7 0.394410	28 27 14.68993	0.000051	0.00111	47270.8	44342.2	49694.8	1180	33641
ICRF J141558.8+132023	1413+135	1 3	14 15 58.817491	13 20 23.71254	0.000088	0.00260	48463.5	45138.8	49848.8	29	107
ICRF J142756.2-420619	1424-418		14 27 56.297557	-42 6 19.43749	0.000165	0.00285	48891.8	47305.8	49909.6	182	934
ICRF J145907.5+714019	1458+718	3 3	14 59 7.583954	71 40 19.86799	0.000188	0.00092	49543.4	48194.7	49820.5	10	417
ICRF J150424.9+102939	1502+106	2 1	15 4 24.979782	10 29 39.19865	0.000050	0.00137	48080.2	44447.0	49662.8	603	12485

Table 7. (cont.) Coordinates of the other sources in ICRF

ICRF Designation (1)	IERS Des. (2)	Inf. (3) X S H	Right Ascension J2000.0 h m s	Declination J2000.0 o ' "	Uncertainty R.A. s	Uncertainty Dec. "	Mean MJD of observation	First MJD	Last MJD span	Nb sess.	Nb del. (4)
ICRF J151250.5-090559	1510-089	3 1	15 12 50.532937	- 9 5 59.82948	0.000064	0.00181	48546.6	44773.8	49895.6	312	3756
ICRF J155035.2+052710	1548+056		15 50 35.269244	5 27 10.44822	0.000046	0.00103	47546.1	44773.8	49692.6	258	5739
ICRF J160913.3+264129	1607+268	4 4	16 9 13.320772	26 41 29.03661	0.000091	0.00206	49315.3	44090.5	49820.5	10	247
ICRF J161749.2-771718	1610-771		16 17 49.276341	-77 17 18.46743	0.000239	0.00092	49185.0	47626.5	49911.8	144	1849
ICRF J162546.8-252738	1622-253	1 1	16 25 46.891640	-25 27 38.32671	0.000081	0.00205	48907.5	46840.8	49924.8	750	10193
ICRF J163515.4+380804	1633+382	3 1	16 35 15.492972	38 8 4.50061	0.000061	0.00069	47914.7	44447.0	49924.8	456	13175
ICRF J164029.6+394646	1638+398	1 1	16 40 29.632774	39 46 46.02854	0.000031	0.00039	49368.5	45322.5	49924.8	233	14985
ICRF J164258.8+394836	1641+399	*	16 42 58.809950	39 48 36.99399	0.000091	0.00104	46595.1	44090.5	49771.8	1145	42754
ICRF J171913.0+174506	1717+178		17 19 13.048474	17 45 6.43699	0.000065	0.00147	48244.5	47011.4	49667.9	12	133
ICRF J173302.7-130449	1730-130		17 33 2.705785	-13 4 49.54820	0.000089	0.00250	47500.6	45259.2	49924.8	624	14448
ICRF J174358.8-035004	1741-038	1 1	17 43 58.856142	- 3 50 4.61667	0.000037	0.00084	48671.3	44773.8	49924.8	1467	41345
ICRF J175342.4+284804	1751+288	2 1	17 53 42.473634	28 48 4.93913	0.000066	0.00147	49206.3	47005.8	49848.8	22	244
ICRF J181945.3-552120	1815-553		18 19 45.399520	-55 21 20.74557	0.000198	0.00196	48756.8	47626.5	49911.8	74	554
ICRF J182314.1+793849	1826+796	4 2	18 23 14.108739	79 38 49.00270	0.000383	0.00122	49348.0	47019.9	49542.2	20	403
ICRF J190255.9+315941	1901+319		19 2 55.938891	31 59 41.70211	0.000070	0.00114	49072.8	48103.5	49756.8	19	190
ICRF J192451.0-291430	1921-293	2 1	19 24 51.055959	-29 14 30.12084	0.000084	0.00217	48425.1	45259.2	49917.8	899	15705
ICRF J192748.4+735801	1928+738		19 27 48.495214	73 58 1.56997	0.000181	0.00081	48080.8	44772.8	49611.9	116	944
ICRF J194025.5-690756	1935-692		19 40 25.528136	-69 7 56.97209	0.000340	0.00189	48972.8	47626.5	49895.6	10	36
ICRF J195510.7-611519	1950-613		19 55 10.770607	-61 15 19.14003	0.000792	0.00365	49048.7	48766.9	49330.5	2	12
ICRF J200057.0-174857	1958-179	1 1	20 0 57.090449	-17 48 57.67236	0.000069	0.00185	49067.1	46875.8	49911.8	591	7567
ICRF J200530.9+775243	2007+777	3 1	20 5 30.998513	77 52 43.24766	0.000146	0.00039	49097.1	45997.8	49694.8	235	11430
ICRF J200617.6+642445	2005+642		20 6 17.694616	64 24 45.41805	0.000133	0.00035	49573.8	49422.9	49798.8	3	52
ICRF J200744.9+402948	2005+403		20 7 44.944909	40 29 48.60472	0.000355	0.00489	48064.0	44773.8	49667.9	8	46
ICRF J201115.7-154640	2008-159		20 11 15.710887	-15 46 40.25296	0.000144	0.00507	48225.6	46840.8	49662.8	35	83
ICRF J202206.6+613658	2021+614	4 3	20 22 6.681695	61 36 58.80479	0.000123	0.00124	49304.3	47165.8	49600.3	27	658
ICRF J212344.5+053522	2121+053	2 1	21 23 44.517381	5 35 22.09321	0.000063	0.00110	47948.5	44773.8	49909.6	657	18823
ICRF J213032.8+050217	2128+048		21 30 32.877495	5 2 17.47450	0.000268	0.00328	48208.4	47288.7	49554.8	22	79
ICRF J213135.2-120704	2128-123	3 2 *	21 31 35.261752	-12 7 4.79583	0.000068	0.00168	48886.9	45466.3	49924.8	462	4897
ICRF J213638.5+004154	2134+004	4 1	21 36 38.586304	0 41 54.21353	0.000115	0.00333	46731.8	44090.5	49897.8	884	18282
ICRF J215155.5-302753	2149-307		21 51 55.524002	-30 27 53.69786	0.000078	0.00154	48434.1	47640.2	49020.5	12	61

Table 7. (cont.) Coordinates of the other sources in ICRF

ICRF Designation (1)	IERS Des. (2)	Inf. (3) X S H	Right Ascension J2000.0 h m s	Declination J2000.0 o ' "	Uncertainty R.A. s	Uncertainty Dec. "	Mean MJD of observation	First MJD	Last MJD span	Nb sess.	Nb del. (4)
ICRF J215806.2-150109	2155-152		21 58 6.281926	-15 1 9.32725	0.000186	0.00303	47917.2	46835.8	49600.3	37	130
ICRF J220243.2+421639	2200+420	3 1 *	22 2 43.291381	42 16 39.97998	0.000066	0.00087	46736.2	44090.5	49883.8	839	21824
ICRF J220314.9+314538	2201+315	3 1 *	22 3 14.975796	31 45 38.27004	0.000034	0.00053	49110.2	45492.6	49883.8	188	7996
ICRF J221852.0-033536	2216-038	3 1 *	22 18 52.037725	- 3 35 36.87944	0.000056	0.00152	47624.5	44773.8	49848.8	449	9472
ICRF J223236.4+114350	2230+114	4 2	22 32 36.408913	11 43 50.90434	0.000079	0.00202	48000.6	45997.8	49662.8	165	1315
ICRF J224618.2-120651	2243-123		22 46 18.231969	-12 6 51.27684	0.000051	0.00124	49115.0	44773.8	49924.8	133	930
ICRF J225357.7+160853	2251+158	*	22 53 57.747938	16 8 53.56088	0.000079	0.00137	46700.1	44090.5	49848.8	1121	30988
ICRF J225805.9-275821	2255-282	1 2	22 58 5.962888	-27 58 21.25659	0.000088	0.00240	48869.9	46875.8	49911.8	662	7579
ICRF J234029.0+264156	2337+264	4 3 *	23 40 29.029471	26 41 56.80428	0.000095	0.00106	49388.4	48357.8	49848.8	10	363
ICRF J234802.6-163112	2345-167		23 48 2.608517	-16 31 12.02167	0.000139	0.00287	47712.9	46440.9	49662.8	153	849
ICRF J235421.6+455304	2351+456	*	23 54 21.680275	45 53 4.23669	0.000096	0.00127	48370.1	47011.4	49662.8	29	172
ICRF J235509.4+495008	2352+495		23 55 9.458164	49 50 8.34014	0.000208	0.00262	48116.3	47019.9	49659.8	14	140

Notes

(1) ICRF Designations, constructed from J2000.0 coordinates with the format
ICRF JHHMMSS.s+DDMMSS or ICRF JHHMMSS.s-DDMMSS.
They follow the recommendations of the IAU Task Group on Designations.

(2) IERS Designations, previously constructed from B1950 coordinates.
The complete format, including acronym and epoch in addition to the coordinates, is
IERS BHHMM+DDd or IERS BHHMM-DDd

(3) X: Structure index at X band
S: Structure index at S band
H: Asterisk indicates that the source serves to link the Hipparcos stellar reference frame to the ICRS.

(4) Number of pairs of delay and delay rate observations.

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PART III

TECHNICAL INFORMATION ON THE ICRF EXTRAGALACTIC RADIO SOURCES

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1.	Introduction	III- 3
2.	Physical characteristics of radio sources	III- 11
3.	Dual-frequency VLBA images and structure corrections for 193 sources	III- 25
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1. Introduction

This part gives various types of information about the physics, the astrometry and the nomenclature of the ICRF objects. Parts III-2 (Physical characteristics) and III-5 (Dictionary of aliases) include all of the 608 objects. Parts III-3 (Maps) and III-4 (Stability of source positions) include respectively 193 and 379 objects. Table III-1 hereafter indicates which objects are available in Parts III-3 and III-4, and gives in addition the status of each of them (Defining, Candidate, Other).

Table III-1. Availability of maps and position time series for the 608 ICRF objects (see notes p. III-9)

ICRF Designation (1)	IERS Des. (2)	Info (3)			ICRF Designation (1)	IERS Des. (2)	Info (3)		
J000435.6-473619	0002-478	C			J010245.7+582411	0059+581	O	M	S
J000557.1+382015	0003+380	D		S	J010645.1-403419	0104-408	O		S
J000613.8-062335	0003-066	C	M	S	J010838.7+013500	0106+013	O		S
J001031.0+105829	0007+106	D			J011137.3+390628	0108+388	C	M	S
J001033.9+172418	0007+171	D		S	J011205.8+224438	0109+224	D		S
J001052.5-415310	0008-421	C			J011327.0+494824	0110+495	C		
J001101.2-261233	0008-264	C		S	J011343.1+022217	0111+021	C		
J001331.1+405137	0010+405	D	M	S	J011517.0-012704	0112-017	C		S
J001611.0-001512	0013-005	C		S	J011612.5-113615	0113-118	O		
J001708.4+813508	0014+813	D		S	J011935.0+321050	0116+319	C	M	
J001945.7+732730	0016+731	O	M	S	J012031.6-270124	0118-272	C		
J002232.4+060804	0019+058	O			J012141.5+114950	0119+115	C	M	S
J002442.9-420203	0022-423	C			J012156.8+042224	0119+041	C	M	S
J002914.2+345632	0026+346	O	M		J012642.7+255901	0123+257	D		S
J003824.8+413706	0035+413	C			J013305.7-520003	0131-522	D		S
J004204.5+232001	0039+230	D		S	J013658.5+475129	0133+476	D	M	S
J004959.4-573827	0047-579	D		S	J013738.3-243053	0135-247	D		S
J005041.3-092905	0048-097	O	M	S	J013741.2+330935	0134+329	O		
J005846.5-565911	0056-572	C			J014125.8-092843	0138-097	D	M	
J005905.5+000651	0056-001	C	M		J014922.3+055553	0146+056	C	M	S

Table III-1. (cont.) Availability of maps and position time series for the 608 ICRF objects

ICRF Designation (1)	IERS Des. (2)	Info (3)			ICRF Designation (1)	IERS Des. (2)	Info (3)		
J015002.6-072548	0147-076	C			J033717.1+013722	0334+014	C	M	
J015127.1+274441	0148+274	D		S	J033930.9-014635	0336-019	C	M	S
J015218.0+220707	0149+218	D		S	J034035.6-211931	0338-214	O		S
J015310.1-331025	0150-334	C			J034423.1+155943	0341+158	C	M	
J015456.2+474326	0151+474	C			J034506.4+145349	0342+147	D		S
J015537.0-404842	0153-410	C			J035721.9-481215	0355-483	C		
J015734.9+744243	0153+744	D	M	S	J035929.7+505750	0355+508	O		S
J020213.6-762003	0202-765	C			J040221.2-314725	0400-319	C		S
J020333.3+723253	0159+723	D		S	J040305.5+260001	0400+258	D	M	S
J020346.6+113445	0201+113	C	M	S	J040353.7-360501	0402-362	O		S
J020450.4+151411	0202+149	C	M	S	J040534.0-130813	0403-132	O		S
J020457.6-170119	0202-172	C		S	J040659.0-382628	0405-385	C		
J020504.9+321230	0202+319	D		S	J040748.4-121136	0405-123	C		
J021046.2-510101	0208-512	O		S	J040820.3+303230	0405+304	O		
J021730.8+734932	0212+735	O	M	S	J040820.3-654509	0407-658	C		
J021748.9+014449	0215+015	D	M	S	J040905.7-123848	0406-127	C		
J022239.6+430207	0219+428	D		S	J040922.0+121739	0406+121	D	M	S
J022256.4-344128	0220-349	D		S	J041636.5-185108	0414-189	D		S
J022428.4+065923	0221+067	C	M		J042315.8-012033	0420-014	O	M	S
J022850.0+672103	0224+671	D		S	J042356.0+415002	0420+417	C		S
J022934.9-784745	0230-790	D		S	J042442.2-375620	0422-380	D		
J023145.8+132254	0229+131	C	M	S	J042446.8+003606	0422+004	D	M	
J023752.4+284808	0234+285	C	M	S	J042636.6+051819	0423+051	D		
J023838.9+163659	0235+164	D	M	S	J042747.5+045708	0425+048	C	M	
J023945.4-023440	0237-027	C			J042840.4-375619	0426-380	D		S
J023951.2+041621	0237+040	C	M	S	J043221.1-510925	0431-512	C		
J024008.1-230915	0237-233	O	M	S	J043311.0+052115	0430+052	O	M	S
J024104.7-081520	0238-084	O	M	S	J043701.4-184448	0434-188	O		S
J024229.1+110100	0239+108	D	M		J043900.8-452222	0437-454	D		S
J024457.6+622806	0241+622	C			J044017.1-433308	0438-436	C		S
J025134.5+431515	0248+430	D		S	J044238.6-001743	0440-003	D	M	
J025246.1-710435	0252-712	C			J044331.6+344106	0440+345	C	M	S
J025329.1-544151	0252-549	C		S	J044907.6+112128	0446+112	D		S
J025334.8+180542	0250+178	C			J044923.3+633209	0444+634	C		
J025927.0+074739	0256+075	D			J045005.4-810102	0454-810	D		S
J030230.5+121856	0259+121	C	M		J045314.6-280737	0451-282	C		
J030335.2+471616	0300+470	O	M	S	J045550.7-461558	0454-463	C		
J030350.6-621125	0302-623	D		S	J045703.1-232452	0454-234	O	M	S
J030642.6+624302	0302+625	C	M	S	J045952.0+022931	0457+024	D		S
J030903.6+102916	0306+102	D		S	J050112.8-015914	0458-020	C	M	S
J030956.0-605839	0308-611	D		S	J050145.2+135607	0458+138	D	M	
J031155.2-765150	0312-770	C			J050215.4+060907	0459+060	C	M	S
J031301.9+412001	0309+411	D		S	J050321.1+020304	0500+019	O		S
J031948.1+413042	0316+413	O		S	J050401.7-604952	0503-608	C		
J031951.2+190131	0317+188	C	M		J050523.1+045942	0502+049	D		S
J032153.1+122113	0319+121	O		S	J050643.9-610940	0506-612	D		S
J032957.6+275615	0326+277	O		S	J050842.3+843204	0454+844	D		S
J033413.6-400825	0332-403	O		S	J050927.4+101144	0506+101	C		
J033553.9-543025	0334-546	C			J051002.3+180041	0507+179	D	M	S
J033630.1+321829	0333+321	O		S	J051349.1-215916	0511-220	C		

Table III-1. (cont.) Availability of maps and position time series for the 608 ICRF objects

ICRF Designation (1)	IERS Des. (2)	Info (3)			ICRF Designation (1)	IERS Des. (2)	Info (3)		
J051637.7-723707	0517-726	C			J073019.1-114112	0727-115	O	M	S
J051644.9-620705	0516-621	D		S	J073545.8-173548	0733-174	D		
J052109.8+163822	0518+165	D	M		J073807.3+174218	0735+178	O		S
J052234.4-610757	0522-611	C			J073816.9-332212	0736-332	C		
J052257.9-362730	0521-365	D			J073856.4-673550	0738-674	D		S
J052531.4-455754	0524-460	C			J073918.0+013704	0736+017	C		
J052930.0-724528	0530-727	D		S	J074110.7+311200	0738+313	D		S
J053007.9-250329	0528-250	O		S	J074202.7+490015	0738+491	C		
J053056.4+133155	0528+134	C	M	S	J074331.6-672625	0743-673	C		
J053238.9+073243	0529+075	C			J074533.0+101112	0742+103	O	M	S
J053850.3-440508	0537-441	O	M	S	J074554.0-004417	0743-006	O	M	
J053932.0-155030	0537-158	C			J074625.8+254902	0743+259	D		
J053942.3+143345	0536+145	O	M		J074836.1+240024	0745+241	D		S
J053954.2-283955	0537-286	D		S	J075052.0+123104	0748+126	C		S
J054138.0-054149	0539-057	D	M	S	J075301.3+535259	0749+540	D	M	S
J054236.1+495107	0538+498	D		S	J075706.6+095634	0754+100	D		S
J054734.1+272156	0544+273	D	M		J080815.5-075109	0805-077	C	M	S
J055530.8+394849	0552+398	C	M	S	J080839.6+495036	0804+499	D	M	S
J055932.0+235353	0556+238	D			J080856.6+405244	0805+410	D	M	S
J060309.1+174216	0600+177	C	M		J081108.8-492943	0809-493	C		
J060752.6+672055	0602+673	C			J081126.7+014652	0808+019	C	M	S
J060759.6-083449	0605-085	C		S	J081525.9+363515	0812+367	D		S
J060940.9-154240	0607-157	C		S	J081815.9+422245	0814+425	C		S
J061357.6+130645	0611+131	C			J082057.4-125859	0818-128	D		S
J061423.8+604621	0609+607	D	M	S	J082447.2+555242	0820+560	D	M	S
J061635.9-345616	0614-349	C			J082455.4+391641	0821+394	D		S
J061732.3-363414	0615-365	C			J082526.8-501038	0823-500	C		
J062331.7-441302	0622-441	C			J082538.6+615728	0821+621	C		
J062419.0+385648	0620+389	C		S	J082550.3+030924	0823+033	C	M	S
J062603.0+820225	0615+820	D		S	J082601.5-223027	0823-223	C		
J063111.9-415426	0629-418	D			J082804.7-373106	0826-373	D		S
J063546.5-751616	0637-752	D		S	J083052.0+241059	0827+243	C		S
J063920.9-334600	0637-337	C			J083148.8+042939	0829+046	D		S
J064204.2+675835	0636+680	D	M	S	J083223.2+491321	0828+493	D		S
J064524.0+212151	0642+214	C			J083322.3-444138	0831-445	C		
J064632.0+445116	0642+449	D	M	S	J083454.9+553421	0831+557	D	M	
J064814.0-304419	0646-306	C	M	S	J083520.6-451035	0833-450	C		
J064848.4-473427	0647-475	C			J083639.2-201659	0834-201	D		S
J065024.5-163739	0648-165	D		S	J083722.4+582501	0833+585	D	M	S
J065358.2+370540	0650+371	C		S	J084124.3+705342	0836+710	C		S
J070001.5+170921	0657+172	C	M	S	J084127.0-754027	0842-754	C		
J070134.5-463436	0700-465	C			J084205.0+183540	0839+187	D		S
J071046.1+473211	0707+476	D	M	S	J085441.9+575729	0850+581	D		S
J071338.1+434917	0710+439	O	M	S	J085448.8+200630	0851+202	C	M	S
J071424.8+353439	0711+356	O		S	J090216.8-141530	0859-140	C		S
J072153.4+712036	0716+714	D		S	J090303.9+465104	0859+470	D	M	S
J072516.8+142513	0722+145	D		S	J090910.0+012135	0906+015	C		
J072550.6-005456	0723-008	D	M	S	J091437.9+024559	0912+029	C		
J072611.7+791131	0718+792	D	M	S	J091552.4+293324	0912+297	D	M	S
J072905.4-363945	0727-365	C			J092058.4+444153	0917+449	D		S

Table III-1. (cont.) Availability of maps and position time series for the 608 ICRF objects

ICRF Designation (1)	IERS Des. (2)	Info (3)			ICRF Designation (1)	IERS Des. (2)	Info (3)		
J092129.3-261843	0919-260	O	M	S	J111826.9-463415	1116-462	C		
J092136.2+621552	0917+624	D	M	S	J111857.3+123441	1116+128	D	M	S
J092246.4-395935	0920-397	C			J112027.8+142054	1117+146	C	M	
J092314.4+384939	0920+390	C		S	J112553.7+261019	1123+264	O		S
J092703.0+390220	0923+392	O	M	S	J112704.3-185717	1124-186	C		S
J092751.8-203451	0925-203	C			J112813.3+592514	1125+596	C		
J093032.5-853359	0936-853	C			J113007.0-144927	1127-145	C	M	S
J094855.3+403944	0945+408	D	M	S	J113053.2+381518	1128+385	D	M	S
J095456.8+174331	0952+179	D			J113130.5-050019	1128-047	C		
J095524.7+690113	0951+692	C			J113143.2-581853	1129-580	C		
J095533.1+690355	0951+693	O		S	J113320.0+004052	1130+009	D	M	
J095649.8+251516	0953+254	O	M	S	J114608.1-244732	1143-245	D		
J095819.6+472507	0955+476	D	M	S	J114658.2+395834	1144+402	O		S
J095820.9+322402	0955+326	D		S	J114701.3-381211	1144-379	C		S
J095847.2+653354	0954+658	D		S	J114751.5-072441	1145-071	C	M	S
J100159.9-443800	0959-443	C			J115019.2+241753	1147+245	D		S
J100614.0-501813	1004-500	C			J115043.8-002354	1148-001	C		
J100741.4+135629	1004+141	O	M	S	J115113.4-672811	1148-671	D		S
J101353.4+244916	1011+250	C			J115312.4+805829	1150+812	D	M	S
J101447.0+230116	1012+232	D		S	J115324.4+493108	1150+497	D		S
J101725.8+611627	1014+615	C			J115825.7+245017	1155+251	D		S
J102232.7-103744	1020-103	C			J115912.7-094052	1156-094	C	M	
J102311.5+394815	1020+400	D	M	S	J115931.8+291443	1156+295	C	M	S
J102429.5-005255	1021-006	O		S	J120935.2-401613	1206-399	C		
J102444.8+191220	1022+194	C	M	S	J121546.7-173145	1213-172	C		S
J103303.7+411606	1030+415	D		S	J121555.6+344815	1213+350	D	M	S
J103502.1-201134	1032-199	D		S	J121752.0+300700	1215+303	D		S
J103507.0+562846	1031+567	C			J121806.2-460029	1215-457	C		
J103716.0-293402	1034-293	O	M	S	J121906.4+482956	1216+487	D		S
J104117.1+061016	1038+064	D	M	S	J122131.6+281358	1219+285	C		S
J104142.9-474006	1039-474	C			J122222.5+041315	1219+044	D	M	S
J104146.7+523328	1038+528	D		S	J122340.4+804004	1221+809	D	M	S
J104148.8+523355	1038+529	D		S	J122452.4+033050	1222+037	C		
J104244.6+120331	1040+123	D		S	J122454.3-831310	1221-829	C		
J104423.0+805439	1039+811	D		S	J122847.4+370612	1226+373	D	M	S
J104455.9+065538	1042+071	C			J122906.6+020308	1226+023	O		S
J104806.6-190935	1045-188	O		S	J123049.4+122328	1228+126	C	M	S
J104827.6+714335	1044+719	C	M	S	J123715.2-504623	1234-504	C		
J105104.7-313814	1048-313	C			J123924.5+073017	1236+077	D	M	S
J105148.7+211952	1049+215	D	M	S	J123943.0-102328	1237-101	C		
J105653.6+701145	1053+704	C		S	J123946.6-684530	1236-684	D		
J105811.5+811432	1053+815	D	M	S	J123959.4-113722	1237-113	C		
J105829.6+013358	1055+018	O		S	J124251.3+375100	1240+381	C		S
J105843.3-800354	1057-797	D		S	J124604.2-073046	1243-072	C		
J110331.5-325116	1101-325	C			J124646.8-254749	1244-255	C		S
J110352.2-535700	1101-536	C		S	J125359.5-405930	1251-407	C		
J110427.3+381231	1101+384	C	M	S	J125438.2+114105	1252+119	D		S
J110708.6-444907	1104-445	O		S	J125459.9-713818	1251-713	D		S
J110712.6-682050	1105-680	C			J125611.1-054721	1253-055	O		S
J111358.6+144226	1111+149	D		S	J125614.2+565225	1254+571	C		

Table III-1. (cont.) Availability of maps and position time series for the 608 ICRF objects

ICRF Designation (1)	IERS Des. (2)	Info (3)			ICRF Designation (1)	IERS Des. (2)	Info (3)		
J125759.0-315516	1255-316	C		S	J145427.4-374733	1451-375	C		S
J130020.9+141718	1257+145	D			J145432.9-401232	1451-400	C		S
J130252.4+574837	1300+580	O	M	S	J145907.5+714019	1458+718	O	M	S
J130533.0-103319	1302-102	C		S	J150048.6+475115	1459+480	D	M	S
J130933.9+115424	1307+121	C	M	S	J150424.9+102939	1502+106	O	M	S
J131028.6+322043	1308+326	D	M	S	J150506.4+032630	1502+036	C		
J131607.9-333859	1313-333	C	M	S	J150609.5+373051	1504+377	D		S
J131736.4+342515	1315+346	C	M	S	J150704.7-165230	1504-166	C		S
J132304.2-445233	1320-446	C			J151002.9+570243	1508+572	C		S
J132527.6-430108	1322-427	C			J151250.5-090559	1510-089	O	M	S
J132616.5+315409	1323+321	C	M		J151344.8-101200	1511-100	C		S
J132700.8+221050	1324+224	D			J151656.7+193212	1514+197	D		S
J133108.2+303032	1328+307	C			J151741.8-242219	1514-241	C		S
J133237.5-664650	1329-665	C			J152237.6-273010	1519-273	C		S
J133739.7-125724	1334-127	O	M	S	J153452.4+013104	1532+016	D	M	
J133752.4-650924	1334-649	C			J154049.4+144745	1538+149	D		S
J134022.9+375443	1338+381	C			J154917.4+503805	1547+507	D		S
J134345.9+660225	1342+662	D	M	S	J154929.4+023701	1546+027	C	M	S
J134408.6+660611	1342+663	D		S	J155035.2+052710	1548+056	O		S
J134733.3+121724	1345+125	C	M		J155059.1-825806	1540-828	C		
J134934.6+534117	1347+539	D	M	S	J155658.8-791404	1549-790	D		S
J135256.5-441240	1349-439	C		S	J155751.4-000150	1555+001	C		
J135406.8-020603	1351-018	C		S	J155821.9-140959	1555-140	C		
J135546.6-632642	1352-632	C			J155930.9+030448	1557+032	C		S
J135704.4+191907	1354+195	O		S	J160140.4+431647	1600+432	C		
J135711.2-152728	1354-152	C		S	J160140.5+431646	1600+431	C		
J135755.3+764321	1357+769	C	M	S	J160207.2+332653	1600+335	D	M	
J135900.1-415252	1355-416	C			J160431.0-444131	1600-445	C		
J140445.8-013021	1402-012	C			J160734.7-333108	1604-333	D		
J140501.1+041535	1402+044	C	M	S	J160846.2+102907	1606+106	D	M	S
J140700.3+282714	1404+286	O	M	S	J160913.3+264129	1607+268	O	M	S
J140856.4-075226	1406-076	C		S	J161341.0+341247	1611+343	C	M	S
J141154.8+213423	1409+218	C			J161637.5+045932	1614+051	C		S
J141558.8+132023	1413+135	O	M		J161749.2-771718	1610-771	O		S
J141908.1+062834	1416+067	D	M		J161903.6+061302	1616+063	D		S
J141946.5+542314	1418+546	D		S	J162418.4-680912	1619-680	D		S
J141946.6+382148	1417+385	C			J162546.8-252738	1622-253	O	M	S
J141959.2+270625	1417+273	C			J162557.6+413440	1624+416	D	M	S
J142230.3+322310	1420+326	C			J162606.0-295126	1622-297	C		S
J142700.3+234800	1424+240	C			J163515.4+380804	1633+382	O	M	S
J142756.2-420619	1424-418	O		S	J163813.4+572023	1637+574	D		S
J143257.6-180135	1430-178	C			J164029.6+394646	1638+398	O	M	S
J143439.7+195200	1432+200	C	M		J164207.8+685639	1642+690	D	M	S
J143535.4+301224	1433+304	C	M		J164258.8+394836	1641+399	O		S
J143645.8+633637	1435+638	D		S	J165039.5-294346	1647-296	C		
J143809.4-220454	1435-218	C			J165352.2+394536	1652+398	C	M	S
J144516.4+095836	1442+101	D		S	J165801.4+344328	1656+348	D		S
J144553.3-162901	1443-162	C			J165802.7+473749	1656+477	C		S
J144815.0-162024	1445-161	D			J165809.0+074127	1655+077	C		S
J144828.7+760111	1448+762	D		S	J165833.4+051516	1656+053	C		S

Table III-1. (cont.) Availability of maps and position time series for the 608 ICRF objects

ICRF Designation (1)	IERS Des. (2)	Info (3)			ICRF Designation (1)	IERS Des. (2)	Info (3)		
J170053.1-261051	1657-261	C		S	J192332.1-210433	1920-211	C		
J170717.7+453610	1705+456	C	M		J192451.0-291430	1921-293	O	M	S
J170734.4+014845	1705+018	D	M	S	J192559.6+210626	1923+210	C		S
J170934.3-172853	1706-174	D			J192748.4+735801	1928+738	O		S
J171913.0+174506	1717+178	O		S	J192840.8+084848	1926+087	C		
J172341.0-650036	1718-649	D			J193006.1-605609	1925-610	C		
J172727.6+453039	1726+455	D	M	S	J193124.9+224331	1929+226	C	M	S
J172818.6+501310	1727+502	D			J193435.0+104340	1932+106	C		
J172824.9+042704	1725+044	D	M	S	J193510.4+203154	1932+204	C	M	
J173302.7-130449	1730-130	O		S	J193716.2-395801	1933-400	C		S
J173315.1-372232	1729-373	C			J193925.0-634245	1934-638	C		
J173420.5+385751	1732+389	C		S	J193926.6-152543	1936-155	C		
J173549.0+504911	1734+508	C			J193957.2-100241	1937-101	C		S
J173735.7-563403	1733-565	C			J194025.5-690756	1935-692	O		S
J173927.3+495503	1738+499	C		S	J194121.7-621121	1936-623	C		
J173957.1+473758	1738+476	C	M	S	J194606.2+230004	1943+228	C		
J174036.9+521143	1739+522	C	M	S	J195330.8+353759	1951+355	C	M	
J174358.8-035004	1741-038	O	M	S	J195510.7-611519	1950-613	O		
J174425.4-514443	1740-517	C			J195542.7+513148	1954+513	D	M	S
J174535.2+172001	1743+173	D	M	S	J195740.5+333827	1955+335	C		
J174614.0+622654	1745+624	D	M	S	J195759.8-384506	1954-388	D		S
J174726.6+465850	1746+470	C		S	J200057.0-174857	1958-179	O	M	S
J174832.8+700550	1749+701	D		S	J200324.1-325145	2000-330	D		
J175132.8+093900	1749+096	C	M	S	J200530.9+775243	2007+777	O	M	S
J175151.2-252400	1748-253	C			J200617.6+642445	2005+642	O		S
J175322.6+440945	1751+441	D		S	J200744.9+402948	2005+403	O		
J175342.4+284804	1751+288	O	M	S	J200925.3-484953	2005-489	C		
J180024.7+384830	1758+388	C		S	J201114.2-064403	2008-068	D		
J180045.6+782804	1803+784	C	M	S	J201115.7-154640	2008-159	O		
J180132.3+440421	1800+440	D		S	J201713.0+744047	2017+745	D	M	S
J180323.4-650736	1758-651	D		S	J202206.6+613658	2021+614	O	M	S
J180650.6+694928	1807+698	C		S	J202319.0+315302	2021+317	D	M	S
J180821.8+454220	1806+456	C		S	J202510.8+334300	2023+335	C	M	
J180957.8-455241	1806-458	C			J203147.9+545503	2030+547	D		S
J181935.0-634548	1814-637	C			J203154.9+121941	2029+121	D	M	S
J181945.3-552120	1815-553	O		S	J203837.0+511912	2037+511	D		S
J182057.8-252812	1817-254	C		S	J204008.7-250746	2037-253	C		S
J182314.1+793849	1826+796	O	M	S	J205051.1+312727	2048+312	D		
J182402.8+104423	1821+107	C	M	S	J205133.7+744140	2051+745	D		S
J182407.0+565101	1823+568	D	M	S	J205616.3-471447	2052-474	D		S
J183250.1+283335	1830+285	D		S	J205741.6-373402	2054-377	C		
J183537.2-714958	1829-718	C			J210138.8+034131	2059+034	D	M	S
J183728.7-710843	1831-711	C		S	J210159.1-421916	2058-425	C		
J184208.9+794617	1845+797	D		S	J210217.0+470216	2100+468	C		
J184233.6+680925	1842+681	D	M	S	J210544.9-782534	2059-786	D		S
J184916.0+670541	1849+670	D	M	S	J210933.1-411020	2106-413	D		S
J185457.2+735119	1856+737	D		S	J211529.4+293338	2113+293	D	M	S
J190255.9+315941	1901+319	O		S	J211630.8-805355	2109-811	D		S
J191109.6-200655	1908-201	C		S	J211810.5-301911	2115-305	C		
J191240.0-801005	1903-802	D			J212344.5+053522	2121+053	O	M	S

Table III-1. (cont.) Availability of maps and position time series for the 608 ICRF objects

ICRF Designation (1)	IERS Des. (2)	Info (3)			ICRF Designation (1)	IERS Des. (2)	Info (3)		
J212912.1-153841	2126-158	C		S	J224838.6-323552	2245-328	C		
J213032.8+050217	2128+048	O			J225357.7+160853	2251+158	O		S
J213135.2-120704	2128-123	O	M	S	J225504.2-084404	2252-090	C	M	
J213410.3-015317	2131-021	C	M	S	J225536.7+420252	2253+417	C		S
J213638.5+004154	2134+004	O	M	S	J225717.3+074312	2254+074	D		
J213901.3+142335	2136+141	D	M	S	J225717.5+024317	2254+024	C	M	S
J214622.9-152543	2143-156	D			J225805.9-275821	2255-282	O	M	S
J214710.1+092946	2144+092	C		S	J230223.8-371806	2259-375	C		
J214712.7-753613	2142-758	C			J230305.8-303011	2300-307	C		
J214805.4+065738	2145+067	D	M	S	J230343.5-680737	2300-683	C		
J215137.8+055212	2149+056	C		S	J231409.3-445549	2311-452	C		
J215155.5-302753	2149-307	O			J231448.5-313839	2312-319	D		
J215203.1-780706	2146-783	D		S	J232044.8+051349	2318+049	C		S
J215224.8+173437	2150+173	D	M	S	J232159.8+273246	2319+272	D	M	S
J215705.9-694123	2152-699	C			J232225.9+505751	2320+506	D	M	S
J215806.2-150109	2155-152	O		S	J232331.9-031705	2320-035	C		
J215852.0-301332	2155-304	C			J232747.9-144755	2325-150	C		
J220243.2+421639	2200+420	O	M	S	J232917.7-473019	2326-477	D		S
J220314.9+314538	2201+315	O	M	S	J233040.8+110018	2328+107	C		S
J220743.7-534633	2204-540	D		S	J233138.6-155657	2329-162	D		S
J221205.9+235540	2209+236	D		S	J233159.4-381147	2329-384	D		
J221302.4-252930	2210-257	C			J233355.2-234340	2331-240	C		S
J221438.5-383545	2211-388	C			J233612.1-523621	2333-528	C		
J221620.0+351814	2214+350	C			J233757.3-023057	2335-027	C	M	
J221852.0-033536	2216-038	O	M	S	J234029.0+264156	2337+264	O	M	S
J222547.2-045701	2223-052	C			J234636.8+093045	2344+092	C		S
J222940.0-083254	2227-088	C	M	S	J234802.6-163112	2345-167	O		S
J223036.4+694628	2229+695	D		S	J235421.6+455304	2351+456	O		S
J223040.2-394252	2227-399	C			J235430.1-151311	2351-154	C		
J223236.4+114350	2230+114	O	M	S	J235509.4+495008	2352+495	O		S
J223513.2-483558	2232-488	D		S	J235600.6-682003	2353-686	C		
J223622.4+282857	2234+282	C	M	S	J235753.2-531113	2355-534	C		S
J223634.0-143322	2233-148	C			J235810.8-102008	2355-106	C		S
J224618.2-120651	2243-123	O		S	J235933.1+385042	2356+385	C		

Notes

(1) ICRF Designations, constructed from J2000.0 coordinates with the format
ICRF JHHMMSS.s+DDMMSS or ICRF JHHMMSS.s-DDMMSS
They follow the recommendations of the IAU Task Group on Designations.

(2) IERS Designation, constructed from B1950 coordinates.
The complete format, including acronym and epoch, is
IERS BHHMM+DDd or IERS BHHMM-DDd

(3) 1st column. Status of the source: [D]efining, [C]andidate, [O]ther
2nd column. [M]aps are shown in part III.3
3rd column. [S]tability of source positions is analyzed in part III.4

2. Physical characteristics of radio sources

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So far this Technical Note has discussed issues primarily related to the creation of the ICRS, in particular the selection of radio sources and the positions of sources in the ICRF. In this section, information on the known physical characteristics of the radio sources is presented. This information includes, where known, the object type, redshift, 6 cm flux, 15 cm or 11 cm flux, spectral index, V magnitude and a classification of spectrum for each source.

As opposed to the positional information presented in this Technical Note, which has been generated from first principles, the material in this section is entirely compiled information, obtained from other sources.

The primary sources for the information included here are:

• The "VLBI survey", 1985, Preston R.A., Morabito D.D., Williams J.G., Faulkner J., Jauncey D.L., Nicolson G.D., *Astron. J.*, **90**, p. 1559 (hereafter PM85). The survey was conducted by performing 2.29 GHz VLBI observations over the full sky. The result is a catalogue of 1398 objects with the following information: redshift, total flux, spectral index, optical identification, visual magnitude and references.

• The "Quasars and Active Galactic Nuclei (7th edition, 1996)" list of M. P. Veron-Cetty and P. Veron (hereafter VCV96). This was published as an ESO Scientific Report in 1996. This list includes 8609 quasars (defined as brighter than absolute B magnitude -23), 2833 AGNs (defined as fainter than absolute B magnitude -23), 220 BL Lac objects from 1662 references, and a list of 52 objects which at one time were considered quasars but have since been rejected as such objects. This catalogue is available from either the NASA/GSFC Astronomical Data Center (ADC) (http://adc.gsfc.nasa.gov/) or the Centre de Données astronomiques de Strasbourg (CDS) (http://cdsweb.u-strasbg.fr/CDS.html), as catalogue 7188 (or VII-188).

• "A Revised and Updated Catalog of Quasi-stellar Objects.", 1993, Hewitt, A. and Burbridge, G., *Astrophys. J. Suppl. Ser.*, **87**, p. 451 (hereafter HB93). This list is a catalogue of all known quasi-stellar objects (QSO's) with measured emission redshifts and BL Lac objects, complete to 1992 December 31. The catalogue contains 7312 objects, nearly all QSOs including about 90 BL Lac objects. The catalogue and references contain extensive information on names, positions, magnitudes, color, emission-line redshifts, absorption, variability, polarization, and X-ray, radio, and infrared data. This catalogue is available from the ADC or the CDS, as catalogue 7158 or VII-158, respectively.

• A listing "Master Source List" by T. Marshall Eubanks (private communication, January 14, 1997), giving for 691 radio sources a positional style (B1950.0) name, the "blokq.dat" name (as used by NASA/GSFC and USNO for observing and data reduction), J2000.0 coordinates, object type, redshift, and V magnitude.

Essentially, the table of radio source physical characteristics, sorted by J2000.0 right ascension, given below has been derived by sequentially obtaining data using these four references.

In practice, the PM85 VLBI survey was used as initial information for the object type, redshift, spectral index, 15 cm flux and visual magnitude.

Secondly, a comparison was made with all of the files of the VCV96 catalogue. Matches were done here by name, as well as by coordinates. Objects within 5 arc minutes were considered to match, although all eventual matches found were at better than the 13 arc second level. Again, some special handling was done for the cases of very close sources. The V magnitude of M 81=NGC 3031 was corrected, using a value from the RC3 (Gérard de Vaucouleurs *et al.* (1991), "Third Reference Catalogue of Bright Galaxies", Springer-Verlag, New York, NY). In this comparison, a great deal of significant information was brought in, including the 6 cm flux, classification of spectrum and 11 cm flux when no 15 cm value was available from the PM85. In addition the VCV96 type of object, redshift and V magnitude data replaced the PM85 ones.

Thirdly, the HB93 data were merged in a similar fashion. Here again some special handling was done for cases of close sources. Also, at least 10 sources had J2000.0 positions that were off by from 10 to 147 arc seconds. These cases were carefully investigated to make sure a correct match was made. In addition, at least two sources had alias names that appear to be incorrect in the HB93 catalogue (0951+699 is not NGC 3034 = M 82, and 1602+178 is not CL 4), and special handling was done for matching involving these names.

As a fourth step, a comparison was made with the Eubanks data. This provided a check on the object type, redshift, and V magnitude data, and provided such data for a few objects that did not match with any in the previous catalogues.

At each of these steps, comparison printouts were generated to show the differences between the database as it existed so far and the new data being read. As just noted, this provided for checks that the right objects were being matched and that the data were reasonable.

A number of fairly minor discrepancies were found between the VCV96, HB93, and Eubanks listings, but most of these were on the ~0.1 V magnitude level or 0.1 redshift level and were ignored. Larger discrepancies of redshift and discrepancies in object type were investigated and resolved, sometimes via the use of the NED database (telnet to hepburn.ipac.caltech.edu, user "NED", or http://nedwww.ipac.caltech.edu). The single exception for which the VCV96 redshift value was found not to be correct was the value for ICRF J144815.0-162024 (1445-161). The VCV96 compilation gives a redshift of 1.776, while Eubanks cited a value of 2.41. Checking into this showed that the original reference (Chu Y., Zhu X., Butcher H. 1986, *Chin. Astron. Astrophys.* **10**, p. 196) did indeed list a redshift of 1.776, but also an alternate redshift of 2.42 since the spectral line identification was uncertain. Later compilations (PKSCAT90, NED, and M. Drinkwater, *et al.* (1997), "The Parkes Half-Jansky Flat-Spectrum Sample", *Monthly Notes Roy. Astron. Soc.*, **284**, p. 85) give the redshift as 2.417. That value has been entered in the table for this source.

It is planned to continue to improve this database file, with new information as it becomes available, and via searches through the NED, Simbad, and other databases. Future versions of this information will be posted to the web sites described in this Technical Note page v.

This research has made use of the NASA/IPAC Extragalactic Database (NED) which is operated by the Jet Propulsion Laboratory, Caltech, under contract with the National Aeronautics and Space Administration. This research has also made use of the Simbad database, operated at CDS, Strasbourg, France.

Table III-2. Physical characteristics of radio sources (See notes page III-24).

ICRF Designation	IERS Des.	Tp (1)	Redsh. (2)	Flux (Jy) 6cm	Flux (Jy) 15cm (3)	SP (4)	mv	cl. sp (5)
ICRF J000435.6-473619	0002-478	Q				-.2	19.0	
ICRF J000557.1+382015	0003+380	G	.229	.50	.60	-.3	19.4	
ICRF J000613.8-062335	0003-066	L	.347	1.58	1.69		18.5	
ICRF J001031.0+105829	0007+106	G	.090	.42	.23*		15.4	S1
ICRF J001033.9+172418	0007+171	Q	1.601	1.19	.91*	.4	18.0	
ICRF J001052.5-415310	0008-421	G			3.10	-1.3	22.0	
ICRF J001101.2-261233	0008-264	Q	1.093	.81	.58	.3	19.0	
ICRF J001331.1+405137	0010+405	G	.256	1.05	1.18*	-.3	17.9	S1
ICRF J001611.0-001512	0013-005	Q	1.574	.79	.82*	-.4	19.8	
ICRF J001708.4+813508	0014+813	Q	3.387	.55	1.00	-.2	16.5	
ICRF J001945.7+732730	0016+731	Q	1.781	1.65	1.50	.2	19.0	
ICRF J002232.4+060804	0019+058	L		.54	.48*	.2	19.5	
ICRF J002442.9-420203	0022-423	G	.937			-.8		
ICRF J002914.2+345632	0026+346	G	.517		1.80	-.3	20.2	
ICRF J003824.8+413706	0035+413	Q	1.353	.64	.40*		19.9	

Table III-2. (cont.) Physical characteristics of radio sources

ICRF Designation	IERS Des.	Tp (1)	Redsh. (2)	Flux (Jy) 6cm	Flux (Jy) 15cm (3)	SP (4)	mv	cl. sp (5)
ICRF J004204.5+232001	0039+230							
ICRF J004959.4-573827	0047-579	Q	1.797	2.19	1.96*	.4	18.5	
ICRF J005041.3-092905	0048-097	L		1.92	1.30	.5	17.4	HP
ICRF J005846.5-565911	0056-572	Q	.018			.5	18.0	
ICRF J005905.5+000651	0056-001	Q	.717	1.41	2.20	-.4	17.3	
ICRF J010245.7+582411	0059+581							
ICRF J010645.1-403419	0104-408	Q	.584	.85	.57*	.6	19.0	
ICRF J010838.7+013500	0106+013	Q	2.107	3.67	3.90	.5	18.4	HP
ICRF J011137.3+390628	0108+388	G	.669			.5		
ICRF J011205.8+224438	0109+224	L		.78	.38*		15.7	HP
ICRF J011327.0+494824	0110+495	Q	.395	.56	.53*		18.4	
ICRF J011343.1+022217	0111+021	A	.047			.2	16.3	
ICRF J011517.0-012704	0112-017	Q	1.365	1.16	1.38*	.2	17.7	
ICRF J011612.5-113615	0113-118	Q	.672	1.88	1.78*	.1	18.5	
ICRF J011935.0+321050	0116+319	G	.059		2.20	-.5	16.0	
ICRF J012031.6-270124	0118-272	L	> .557	.78	1.00	.3	15.6	HP
ICRF J012141.5+114950	0119+115	Q	.570	1.00	1.80	.3	19.0	HP
ICRF J012156.8+042224	0119+041	Q	.637	1.67	.90	.2	19.5	HP
ICRF J012642.7+255901	0123+257	Q	2.353	.97	.90	.9	17.5	
ICRF J013305.7-520003	0131-522	Q	.020			.1	20.0	
ICRF J013658.5+475129	0133+476	Q	.859	3.26	2.10	.5	19.0	HP
ICRF J013738.3-243053	0135-247	Q	.831	1.65	1.49	.3	17.3	
ICRF J013741.2+330935	0134+329	G	.367	5.37	8.97*	-.9	16.2	S1
ICRF J014125.8-092843	0138-097	L	> .501	1.19	.90	.9	16.6	HP
ICRF J014922.3+055553	0146+056	Q	2.345	1.17	.73*		20.0	
ICRF J015002.6-072548	0147-076	G	.017	.30			15.6	S2
ICRF J015127.1+274441	0148+274	G	1.260		.70		20.0	
ICRF J015218.0+220707	0149+218	Q	1.320	1.08	1.40	-.2	18.0	
ICRF J015310.1-331025	0150-334	Q	.610	.86	1.00	-.1	18.6	
ICRF J015456.2+474326	0151+474	Q	1.026	.51				
ICRF J015537.0-404842	0153-410	G	.226			-.4	18.5	
ICRF J015734.9+744243	0153+744	Q	2.338	1.51	2.10	-.3	16.0	
ICRF J020213.6-762003	0202-765	Q	.389	.81	1.40*	-.9	16.9	
ICRF J020333.3+723253	0159+723	L		.33	.32*	.2	19.2	
ICRF J020346.6+113445	0201+113	Q	3.560	1.20	1.30		19.5	
ICRF J020450.4+151411	0202+149	Q	.833		3.20	-.5	21.9	
ICRF J020457.6-170119	0202-172	Q	1.740	1.60	1.20		18.0	HP
ICRF J020504.9+321230	0202+319	Q	1.466	1.02	1.60	.6	18.0	
ICRF J021046.2-510101	0208-512	Q	1.003	3.21	3.56*	-.2	16.9	HP
ICRF J021730.8+734932	0212+735	Q	2.367	2.20	2.30	-.1	20.0	HP
ICRF J021748.9+014449	0215+015	Q	1.715	.36	.36*		18.8	HP
ICRF J022239.6+430207	0219+428	L	.444	1.04	1.14*		15.2	HP
ICRF J022256.4-344128	0220-349	Q	1.490				22.0	
ICRF J022428.4+065923	0221+067	Q	.511	.77	1.40		19.0	HP
ICRF J022850.0+672103	0224+671	Q			1.20	.3	19.5	
ICRF J022934.9-784745	0230-790	Q	1.070	.77	.57*	.5	18.9	
ICRF J023145.8+132254	0229+131	Q	2.065	1.01	2.00	-.5	17.7	
ICRF J023752.4+284808	0234+285	Q	1.207	1.45	1.24*		18.5	HP
ICRF J023838.9+163659	0235+164	L	.940	2.79	2.00	.6	15.5	HP
ICRF J023945.4-023440	0237-027	Q	1.116	.58	.43*	.5	21.0	

Table III-2. (cont.) Physical characteristics of radio sources

ICRF Designation	IERS Des.	Tp (1)	Redsh. (2)	Flux (Jy) 6cm	15cm (3)	SP (4)	mv	cl. sp (5)
ICRF J023951.2+041621	0237+040	Q	.978	.75	.80	.1	18.5	
ICRF J024008.1-230915	0237-233	Q	2.225	3.16	5.34*	-.7	16.6	
ICRF J024104.7-081520	0238-084	G	.005	.88	.58*	1.5	12.3	S3
ICRF J024229.1+110100	0239+108	Q			1.80	-.3	20.0	
ICRF J024457.6+622806	0241+622	G	.044	.20	.24*		12.2	S1
ICRF J025134.5+431515	0248+430	Q	1.310	1.21	.96*	.4	17.6	
ICRF J025246.1-710435	0252-712	G	.563					
ICRF J025329.1-544151	0252-549	Q	.537	.80	.76*	.1	18.0	
ICRF J025334.8+180542	0250+178	Q				-.5	18.5	
ICRF J025927.0+074739	0256+075	Q	.893	.98	.70	.6	18.0	HP
ICRF J030230.5+121856	0259+121							
ICRF J030335.2+471616	0300+470	L		2.22	1.81*		17.0	
ICRF J030350.6-621125	0302-623	Q				.5	18.0	
ICRF J030642.6+624302	0302+625							
ICRF J030903.6+102916	0306+102	Q	.863	.70	1.30	.4	18.4	
ICRF J030956.0-605839	0308-611	Q				.7	18.5	
ICRF J031155.2-765150	0312-770	G	.223	.56	.60*	.3	16.1	S1
ICRF J031301.9+412001	0309+411	G	.136	.46	.60	.1	18.0	S1
ICRF J031948.1+413042	0316+413	L	.017	18.72	24.80	1.0	12.5	
ICRF J031951.2+190131	0317+188	G				-.1	19.0	
ICRF J032153.1+122113	0319+121	Q	2.670	1.05	1.40	-.5	19.0	
ICRF J032957.6+275615	0326+277	Q	1.533	.64	.84*		17.5	
ICRF J033413.6-400825	0332-403	Q	1.445	2.60	1.93*	.5	18.5	HP
ICRF J033553.9-543025	0334-546	Q				.2	20.0	
ICRF J033630.1+321829	0333+321	Q	1.259	2.50	2.30		17.5	
ICRF J033717.1+013722	0334+014							
ICRF J033930.9-014635	0336-019	Q	.852	2.59	2.70	-.4	18.4	HP
ICRF J034035.6-211931	0338-214	L	.048	.93	.82*	.2	17.5	
ICRF J034423.1+155943	0341+158							
ICRF J034506.4+145349	0342+147							
ICRF J035721.9-481215	0355-483	Q	1.016	.57	.60*	-.1	16.4	
ICRF J035929.7+505750	0355+508				6.80			
ICRF J040221.2-314725	0400-319	Q	1.288		1.15	-.1		
ICRF J040305.5+260001	0400+258	Q	2.109	1.79	1.40		18.0	
ICRF J040353.7-360501	0402-362	Q	1.417	1.39	1.04*	.5	17.2	
ICRF J040534.0-130813	0403-132	Q	.571	2.93	4.00	.1	17.1	HP
ICRF J040659.0-382628	0405-385	Q	1.285	1.06	1.03	.1	18.0	
ICRF J040748.4-121136	0405-123	G	.574	1.99	2.70	-.4	14.9	S1
ICRF J040820.3+303230	0405+304							
ICRF J040820.3-654509	0407-658							
ICRF J040905.7-123848	0406-127	Q	1.563	.52	.59*	.1	19.0	
ICRF J040922.0+121739	0406+121	L	1.020	1.62	1.16*	.5	20.2	HP
ICRF J041636.5-185108	0414-189	Q	1.536	.77	1.00	.2	18.5	
ICRF J042315.8-012033	0420-014	Q	.915	1.58	1.00	.3	17.0	HP
ICRF J042356.0+415002	0420+417	Q			1.70			
ICRF J042442.2-375620	0422-380	Q	.782	.81	.49*		18.1	
ICRF J042446.8+003606	0422+004	L		1.60	.80	.4	17.0	HP
ICRF J042636.6+051819	0423+051	Q	1.333			.2	19.5	
ICRF J042747.5+045708	0425+048	A				-1.3	20.0	
ICRF J042840.4-375619	0426-380	L	>1.030	1.13	1.44	.2	19.0	

Table III-2. (cont.) Physical characteristics of radio sources

ICRF Designation	IERS Des.	Tp (1)	Redsh. (2)	Flux (Jy) 6cm	15cm (3)	SP (4)	mv	cl. sp (5)
ICRF J043221.1-510925	0431-512	Q	.557	.59	.68*	-.3	18.0	
ICRF J043311.0+052115	0430+052	G	.033	5.09	6.40	1.8	15.1	S1
ICRF J043701.4-184448	0434-188	Q	2.702	1.09	1.30	.3	19.0	
ICRF J043900.8-452222	0437-454	Q				.2	20.6	
ICRF J044017.1-433308	0438-436	Q	2.852	7.58	6.17*		19.5	HP
ICRF J044238.6-001743	0440-003	Q	.844	2.39	3.53*	-.2	19.2	HP
ICRF J044331.6+344106	0440+345							
ICRF J044907.6+112128	0446+112	G			1.80		20.0	
ICRF J044923.3+633209	0444+634	Q	.781	.51	.52*		19.7	
ICRF J045005.4-810102	0454-810	G	.444	1.36	1.17*	.2	19.2	S1
ICRF J045314.6-280737	0451-282	Q	2.560	2.17	2.30	.1	18.2	
ICRF J045550.7-461558	0454-463	Q	.858	2.88	2.36*	-.2	17.4	
ICRF J045703.1-232452	0454-234	Q	1.003	1.86	1.76*		18.5	HP
ICRF J045952.0+022931	0457+024	Q	2.384	1.21	1.30	-.2	18.5	
ICRF J050112.8-015914	0458-020	Q	2.286	1.65	2.00	-.2	19.5	HP
ICRF J050145.2+135607	0458+138					.5		
ICRF J050215.4+060907	0459+060	A				-.5	19.5	
ICRF J050321.1+020304	0500+019	G	.583		2.00	-.5		
ICRF J050401.7-604952	0503-608	Q				.4	19.5	
ICRF J050523.1+045942	0502+049	Q	.954		.60	.5	19.0	
ICRF J050643.9-610940	0506-612	Q	1.093	2.05	1.89*	-.4	16.9	
ICRF J050842.3+843204	0454+844	L	.112	1.40	1.30	.3	16.5	HP
ICRF J050927.4+101144	0506+101	A			4.10	.2	19.5	
ICRF J051002.3+180041	0507+179				.70			
ICRF J051349.1-215916	0511-220	Q	1.296	.87	1.30	.1	19.5	
ICRF J051637.7-723707	0517-726							
ICRF J051644.9-620705	0516-621							
ICRF J052109.8+163822	0518+165	Q	.759	4.16	5.99*	-.7	18.8	
ICRF J052234.4-610757	0522-611	Q	1.400	.67	.71*	-.1	18.1	
ICRF J052257.9-362730	0521-365	L	.055	8.89	11.50	-.5	14.6	
ICRF J052531.4-455754	0524-460	Q	1.479	.94	.91*	.1	17.3	
ICRF J052930.0-724528	0530-727							
ICRF J053007.9-250329	0528-250	Q	2.765	.85	1.32*	-.2	17.3	
ICRF J053056.4+133155	0528+134	Q	2.070	4.37	2.69*	.5	20.0	
ICRF J053238.9+073243	0529+075	A			1.10		19.0	
ICRF J053850.3-440508	0537-441	L	.896	3.96	3.84*	.1	16.5	HP
ICRF J053932.0-155030	0537-158	Q	.947	.44	.63*	-.1	18.0	
ICRF J053942.3+143345	0536+145							
ICRF J053954.2-283955	0537-286	Q	3.104	1.23	1.00	.5	20.0	
ICRF J054138.0-054149	0539-057	Q	.839	1.51	1.28*	1.4	20.4	
ICRF J054236.1+495107	0538+498	Q	.545	8.18	12.98*	-.8	17.8	
ICRF J054734.1+272156	0544+273							
ICRF J055530.8+394849	0552+398	Q	2.365	5.43	3.40		18.0	
ICRF J055932.0+235353	0556+238							
ICRF J060309.1+174216	0600+177							
ICRF J060752.6+672055	0602+673	Q				.4	20.6	
ICRF J060759.6-083449	0605-085	Q	.872	2.73	3.05*	.2	18.5	HP
ICRF J060940.9-154240	0607-157	Q	.324	3.13	1.00	-.4	18.0	
ICRF J061357.6+130645	0611+131							
ICRF J061423.8+604621	0609+607	Q	2.690	1.10			19.1	

Table III-2. (cont.) Physical characteristics of radio sources

ICRF Designation	IERS Des.	Tp (1)	Redsh. (2)	Flux (Jy) 6cm	15cm (3)	SP (4)	mv	cl. sp (5)
ICRF J061635.9-345616	0614-349	A				-.6	18.0	
ICRF J061732.3-363414	0615-365							
ICRF J062331.7-441302	0622-441	Q	.688	.89	.77*	.2	16.9	
ICRF J062419.0+385648	0620+389	Q	3.469	.87	1.80		20.0	
ICRF J062603.0+820225	0615+820	Q	.710	1.00	1.30		17.5	
ICRF J063111.9-415426	0629-418	Q	1.416	.74	.53*	.5	19.3	
ICRF J063546.5-751616	0637-752	G	.654	6.19	4.51*	-.1	15.8	S1
ICRF J063920.9-334600	0637-337					.4		
ICRF J064204.2+675835	0636+680	Q	3.177	.54	.32*	.8	16.6	
ICRF J064524.0+212151	0642+214	G	.245		1.80	-.7	19.5	
ICRF J064632.0+445116	0642+449	Q	3.408	.78	1.20	-.1	18.5	
ICRF J064814.0-304419	0646-306	Q	.455		.90	.2		
ICRF J064848.4-473427	0647-475							
ICRF J065024.5-163739	0648-165							
ICRF J065358.2+370540	0650+371	Q	1.982	.97	1.00	.4	18.0	
ICRF J070001.5+170921	0657+172							
ICRF J070134.5-463436	0700-465					.3		
ICRF J071046.1+473211	0707+476	Q	1.292	1.00	.80	-.3	18.2	
ICRF J071338.1+434917	0710+439	G	.518	1.66	2.00	-.2	19.7	
ICRF J071424.8+353439	0711+356	Q	1.626	1.51	1.90	-.3	19.0	
ICRF J072153.4+712036	0716+714	L		1.12	.70	.4	15.5	HP
ICRF J072516.8+142513	0722+145				5.30			
ICRF J072550.6-005456	0723-008	L	.127	2.25	2.10	-.4	18.0	
ICRF J072611.7+791131	0718+792				1.00			
ICRF J072905.4-363945	0727-365							
ICRF J073019.1-114112	0727-115	Q				.1		
ICRF J073545.8-173548	0733-174				3.10	-.5		
ICRF J073807.3+174218	0735+178	L	> .424	1.99	2.00	.1	16.2	HP
ICRF J073816.9-332212	0736-332							
ICRF J073856.4-673550	0738-674	Q	1.663	.56	.45*		19.8	
ICRF J073918.0+013704	0736+017	Q	.191	1.92	2.90	.1	16.5	HP
ICRF J074110.7+311200	0738+313	G	.630	2.48	1.90	.2	16.1	S1
ICRF J074202.7+490015	0738+491							
ICRF J074331.6-672625	0743-673	Q	1.510	1.96	2.74*	-1.0	16.4	
ICRF J074533.0+101112	0742+103				3.90	-.1		
ICRF J074554.0-004417	0743-006	Q	.996	1.31	1.01*	.4	17.1	
ICRF J074625.8+254902	0743+259				.60			
ICRF J074836.1+240024	0745+241	Q	.409	.84	.74*	.2	19.0	HP
ICRF J075052.0+123104	0748+126	Q	.889	2.22	2.00	.5	18.0	
ICRF J075301.3+535259	0749+540	L	.200	.56	.67*	-.3	18.5	
ICRF J075706.6+095634	0754+100	L	.660	1.48	1.04*	.2	15.0	HP
ICRF J080815.5-075109	0805-077	Q	1.837	1.01	1.10	-.1	18.4	
ICRF J080839.6+495036	0804+499	Q	1.433	2.07	1.30	.5	18.9	HP
ICRF J080856.6+405244	0805+410	Q	1.420	.77	.70	-.3	19.0	
ICRF J081108.8-492943	0809-493					-.3		
ICRF J081126.7+014652	0808+019	L		.67	.39	.4	17.2	
ICRF J081525.9+363515	0812+367	Q	1.025	1.01	1.20		20.0	
ICRF J081815.9+422245	0814+425	L	.258	1.68	1.60	.6	18.2	HP
ICRF J082057.4-125859	0818-128	L		.86	.90	-.1	15.0	
ICRF J082447.2+555242	0820+560	Q	1.417	.92	1.70	-.3	18.0	

Table III-2. (cont.) Physical characteristics of radio sources

ICRF Designation	IERS Des.	Tp (1)	Redsh. (2)	Flux (Jy) 6cm	15cm (3)	SP (4)	mv	cl. sp (5)
ICRF J082455.4+391641	0821+394	Q	1.216	.99	1.90	-.2	18.5	
ICRF J082526.8-501038	0823-500							
ICRF J082538.6+615728	0821+621	Q	.542	.62	.34*		17.6	
ICRF J082550.3+030924	0823+033	L	.506	1.43	1.42	.9	16.8	HP
ICRF J082601.5-223027	0823-223	L	> .910	.78	1.03*	.5	16.2	HP
ICRF J082804.7-373106	0826-373							
ICRF J083052.0+241059	0827+243	Q	.941	.94	1.30		17.3	
ICRF J083148.8+042939	0829+046	L	.180	.70	.70	.2	16.4	HP
ICRF J083223.2+491321	0828+493	L	.548	1.02	.50	-.3	18.8	HP
ICRF J083322.3-444138	0831-445							
ICRF J083454.9+553421	0831+557	G	.242			-.5	18.5	
ICRF J083520.6-451035	0833-450							
ICRF J083639.2-201659	0834-201	Q	2.752	3.42	3.30	-.3	19.4	
ICRF J083722.4+582501	0833+585	Q	2.101	1.11	.50*	1.3	18.0	
ICRF J084124.3+705342	0836+710	Q	2.172	2.57	4.40	-.3	16.5	
ICRF J084127.0-754027	0842-754	G	.524	1.38	2.15*	-.7	18.9	S1
ICRF J084205.0+183540	0839+187	Q	1.272	1.20	2.20	.2	16.4	
ICRF J085441.9+575729	0850+581	Q	1.322	1.41	1.60	.8	18.0	
ICRF J085448.8+200630	0851+202	L	.306	2.61	3.38*	-.4	15.4	HP
ICRF J090216.8-141530	0859-140	Q	1.339	2.25	2.90	-.4	16.6	
ICRF J090303.9+465104	0859+470	Q	1.462	1.78	2.20	-.1	18.7	
ICRF J090910.0+012135	0906+015	Q	1.018	1.01	.76	-.2	17.8	
ICRF J091437.9+024559	0912+029	Q	.427		.68	-.3	18.5	
ICRF J091552.4+293324	0912+297	L		.20	.24*		16.4	HP
ICRF J092058.4+444153	0917+449	Q	2.180	.80	.54*	.6	19.0	
ICRF J092129.3-261843	0919-260	Q	2.300	2.38	1.20	.2	18.4	
ICRF J092136.2+621552	0917+624	Q	1.446	1.24	1.60	.2	19.5	
ICRF J092246.4-395935	0920-397	Q	.591	1.51	2.10	-.2	18.8	
ICRF J092314.4+384939	0920+390							
ICRF J092703.0+390220	0923+392	Q	.698	7.57	4.20	1.0	17.9	
ICRF J092751.8-203451	0925-203	G	.348	.69	.81*	-.2	16.4	S1
ICRF J093032.5-853359	0936-853					.3		
ICRF J094855.3+403944	0945+408	Q	1.252	1.38	1.70		17.5	
ICRF J095456.8+174331	0952+179	Q	1.478	.74	1.00	-.3	17.2	
ICRF J095524.7+690113	0951+692	G						S
ICRF J095533.1+690355	0951+693	G	.000	.09	.50		6.9	S1
ICRF J095649.8+251516	0953+254	Q	.712	1.79	1.30	1.3	17.2	
ICRF J095819.6+472507	0955+476	Q	1.873	.74	1.10	.1	18.7	
ICRF J095820.9+322402	0955+326	Q	.530	.85	.70	-.3	15.8	
ICRF J095847.2+653354	0954+658	L	.367	1.46	.90	.4	16.7	HP
ICRF J100159.9-443800	0959-443	Q	.837	.83	.87*	-.1	17.0	
ICRF J100614.0-501813	1004-500							
ICRF J100741.4+135629	1004+141	Q	2.707	.74	.81	-.1	19.0	
ICRF J101353.4+244916	1011+250	Q	1.636	.61	.52*		16.6	
ICRF J101447.0+230116	1012+232	Q	.565	.81	.74*	-.3	17.5	
ICRF J101725.8+611627	1014+615		2.800				18.1	
ICRF J102232.7-103744	1020-103	Q	.197	.46	.57*	-.4	16.1	
ICRF J102311.5+394815	1020+400	Q	1.254	.87	1.20	-.3	17.5	
ICRF J102429.5-005255	1021-006	Q	2.552	.75	.92	-.4	18.5	
ICRF J102444.8+191220	1022+194	Q	.828	.60	1.04	.7	17.5	

Table III-2. (cont.) Physical characteristics of radio sources

ICRF Designation	IERS Des.	Tp (1)	Redsh. (2)	Flux (Jy) 6cm	15cm (3)	SP (4)	mv	cl. sp (5)
ICRF J103303.7+411606	1030+415	Q	1.120	1.13	.80	.3	18.2	HP
ICRF J103502.1-201134	1032-199	Q	2.198	1.02	1.10*	.1	19.0	
ICRF J103507.0+562846	1031+567	G	.459		1.80	-.3	20.3	
ICRF J103716.0-293402	1034-293	Q	.312	1.51	1.30	.2	16.5	HP
ICRF J104117.1+061016	1038+064	Q	1.265	1.32	1.64	-.4	16.7	
ICRF J104142.9-474006	1039-474							
ICRF J104146.7+523328	1038+528	Q	.677	.42	.43*	.2	17.6	
ICRF J104148.8+523355	1038+529	Q	2.296	.14	.15*		18.6	
ICRF J104244.6+120331	1040+123	Q	1.028	1.39	2.38	-.7	17.3	
ICRF J104423.0+805439	1039+811	Q	1.260	1.14	.90*	.4	16.5	
ICRF J104455.9+065538	1042+071	G	.698	.50	.50*		20.5	
ICRF J104806.6-190935	1045-188	Q	.595	1.11	.94*	.3	18.5	
ICRF J104827.6+714335	1044+719	Q	1.150	.71	1.00	.1	17.8	
ICRF J105104.7-313814	1048-313				.50	-.1		
ICRF J105148.7+211952	1049+215	Q	1.300	1.25	1.70	-.4	18.5	
ICRF J105653.6+701145	1053+704	Q	2.492	.71	.60	.3	18.5	
ICRF J105811.5+811432	1053+815	Q	.706	.77	.60	-.4	20.0	
ICRF J105829.6+013358	1055+018	Q	.888	3.38	2.87		18.3	HP
ICRF J105843.3-800354	1057-797	Q				.6	19.3	
ICRF J110331.5-325116	1101-325	G	.354	.73	.80	-.4	16.3	S1
ICRF J110352.2-535700	1101-536	Q					17.9	
ICRF J110427.3+381231	1101+384	L	.031	.70	1.00	-.1	12.9	HP
ICRF J110708.6-444907	1104-445	Q	1.598	2.03	1.84*	.1	18.2	
ICRF J110712.6-682050	1105-680	Q	.588	1.37	1.14*	.3	18.4	
ICRF J111358.6+144226	1111+149	Q	.869	.60	.55*	.4	18.0	
ICRF J111826.9-463415	1116-462	Q	.713	1.31	1.62*	-.4	17.0	
ICRF J111857.3+123441	1116+128	Q	2.118	1.48	1.74	-.3	19.3	
ICRF J112027.8+142054	1117+146	G	.362			-.7	20.0	
ICRF J112553.7+261019	1123+264	Q	2.341	.83	.70	.8	18.0	
ICRF J112704.3-185717	1124-186	A	1.050		.60	.5	18.5	
ICRF J112813.3+592514	1125+596						20.0	
ICRF J113007.0-144927	1127-145	Q	1.187	7.31	6.43*	-.1	16.9	
ICRF J113053.2+381518	1128+385	Q	1.733	.77	.90	-.2	16.0	
ICRF J113130.5-050019	1128-047	G	.266		.90	.3	20.0	
ICRF J113143.2-581853	1129-580							
ICRF J113320.0+004052	1130+009	Q			.33		19.0	
ICRF J114608.1-244732	1143-245	Q	1.950	1.49	1.10	-.2	18.0	
ICRF J114658.2+395834	1144+402	Q	1.089	1.03	.90	-.2	18.0	
ICRF J114701.3-381211	1144-379	L	1.048	2.22	1.07*	-.2	16.2	HP
ICRF J114751.5-072441	1145-071	Q	1.342	1.21	.97	.2	18.0	
ICRF J115019.2+241753	1147+245	L		1.00	.83		15.7	HP
ICRF J115043.8-002354	1148-001	Q	1.980	1.90	2.51	-.4	17.6	
ICRF J115113.4-672811	1148-671					.3		
ICRF J115312.4+805829	1150+812	Q	1.250	1.18	1.20	-.1	18.5	
ICRF J115324.4+493108	1150+497	Q	.334	1.12	1.60	-.2	17.1	HP
ICRF J115825.7+245017	1155+251	G			1.06	-.3	17.5	
ICRF J115912.7-094052	1156-094	A			.87	-.2	17.5	
ICRF J115931.8+291443	1156+295	Q	.729	.89	1.30		14.4	HP
ICRF J120935.2-401613	1206-399	Q	.966	.53	.59*	-.2	17.0	
ICRF J121546.7-173145	1213-172	G			1.20	-.1	21.4	

Table III-2. (cont.) Physical characteristics of radio sources

ICRF Designation	IERS Des.	Tp (1)	Redsh. (2)	Flux (Jy) 6cm	15cm (3)	SP (4)	mv	cl. sp (5)
ICRF J121555.6+344815	1213+350	Q	.857	1.01	1.20	-.3	20.0	
ICRF J121752.0+300700	1215+303	L	.237	.42	.53		15.6	HP
ICRF J121806.2-460029	1215-457	G	.529	1.99	2.90*	-.6	20.3	
ICRF J121906.4+482956	1216+487	Q	1.076	1.08	.70	.2	18.5	
ICRF J122131.6+281358	1219+285	L	.102	.72	1.47		16.1	
ICRF J122222.5+041315	1219+044	Q	.965	.93	.65	-1.2	18.0	
ICRF J122340.4+804004	1221+809	L		.52	.40*	-.3	19.0	
ICRF J122452.4+033050	1222+037	Q	.960	.86	.96	.1	18.8	
ICRF J122454.3-831310	1221-829					.3		
ICRF J122847.4+370612	1226+373		1.515					
ICRF J122906.6+020308	1226+023	G	.158	43.41	41.44*		12.9	S1
ICRF J123049.4+122328	1228+126	G	.004	71.90		-.6	12.9	S
ICRF J123715.2-504623	1234-504							
ICRF J123924.5+073017	1236+077	Q	.400	.67	.65	.2	18.5	
ICRF J123943.0-102328	1237-101	Q	.750	1.53	1.63	-.2	18.1	
ICRF J123946.6-684530	1236-684	Q				-.4	18.5	
ICRF J123959.4-113722	1237-113	G	.002	.14	.10*		9.3	S1
ICRF J124251.3+375100	1240+381	Q	1.316	.58	.28*	1.2	19.4	
ICRF J124604.2-073046	1243-072	Q	1.286	.90	.72	.6	19.0	
ICRF J124646.8-254749	1244-255	Q	.638	2.32	1.36	.2	17.4	HP
ICRF J125359.5-405930	1251-407	Q	4.460	.22	.25*		19.9	
ICRF J125438.2+114105	1252+119	Q	.870	1.00	1.80	-.2	16.6	
ICRF J125459.9-713818	1251-713	Q				.2	21.5	
ICRF J125611.1-054721	1253-055	Q	.538	15.34	11.80	.1	17.8	HP
ICRF J125614.2+565225	1254+571	G	.041	.42	.17*		13.8	S1
ICRF J125759.0-315516	1255-316	Q	1.924	1.68	1.58	.2	18.7	
ICRF J130020.9+141718	1257+145	A			2.90	-.3	18.0	
ICRF J130252.4+574837	1300+580	Q				-.5		
ICRF J130533.0-103319	1302-102	G	.286	.77	1.03	.1	15.2	S1
ICRF J130933.9+115424	1307+121	L		1.13	.58*		18.5	
ICRF J131028.6+322043	1308+326	Q	.997	1.59	1.57*		15.2	HP
ICRF J131607.9-333859	1313-333	Q	1.210	1.32	1.23	.5	20.0	
ICRF J131736.4+342515	1315+346	Q	1.050	.56	.54*	-.1	19.0	
ICRF J132304.2-445233	1320-446					-.9		
ICRF J132527.6-430108	1322-427	G	.001			-.4	12.8	
ICRF J132616.5+315409	1323+321	G	.369		3.60	-.6	19.0	
ICRF J132700.8+221050	1324+224		1.400					
ICRF J133108.2+303032	1328+307	Q	.846	7.48	10.26*	-.5	17.3	
ICRF J133237.5-664650	1329-665							
ICRF J133739.7-125724	1334-127	Q	.539	2.84	1.94	.2	18.5	HP
ICRF J133752.4-650924	1334-649							
ICRF J134022.9+375443	1338+381	Q	3.103	.31			17.9	
ICRF J134345.9+660225	1342+662	Q	.766	.54	.51*	.1	20.0	
ICRF J134408.6+660611	1342+663	Q	1.351	.82	.61*	.5	18.6	
ICRF J134733.3+121724	1345+125	G	.121	2.92	4.30	-.4	17.0	S2
ICRF J134934.6+534117	1347+539	Q	.976	.96	.90	-.1	17.5	
ICRF J135256.5-441240	1349-439	L	.053	.76	.54*	.6	16.4	HP
ICRF J135406.8-020603	1351-018	Q	3.707	.82	.84	-.1	19.3	
ICRF J135546.6-632642	1352-632							
ICRF J135704.4+191907	1354+195	Q	.719	1.46	1.80	-.1	16.0	

Table III-2. (cont.) Physical characteristics of radio sources

ICRF Designation	IERS Des.	Tp (1)	Redsh. (2)	Flux (Jy) 6cm	Flux (Jy) 15cm (3)	SP (4)	mv	cl. sp (5)
ICRF J135711.2-152728	1354-152	Q	1.890	.84	1.17	.1	18.5	
ICRF J135755.3+764321	1357+769	Q				.7	19.0	
ICRF J135900.1-415252	1355-416	G	.313	1.44	3.10	-.8	15.9	S1
ICRF J140445.8-013021	1402-012	Q	2.522	.81	.88	.2	18.2	
ICRF J140501.1+041535	1402+044	Q	3.211	.71	.65	.1	19.0	
ICRF J140700.3+282714	1404+286	G	.077	2.90	1.70	.9	15.4	S1
ICRF J140856.4-075226	1406-076	Q	1.493	.82	1.30	.2	20.0	
ICRF J141154.8+213423	1409+218							
ICRF J141558.8+132023	1413+135	L	.247	1.20	.90	-.1	20.5	
ICRF J141908.1+062834	1416+067	Q	1.439	1.46	3.41	-.9	16.8	
ICRF J141946.5+542314	1418+546	L	.152	1.09	1.00	.2	15.7	HP
ICRF J141946.6+382148	1417+385	Q	1.832	.87	.51*		19.3	
ICRF J141959.2+270625	1417+273							
ICRF J142230.3+322310	1420+326	Q	.685	.43	.45*		17.5	
ICRF J142700.3+234800	1424+240	L		.31	.35*		15.0	HP
ICRF J142756.2-420619	1424-418	Q	1.522	2.17	2.22	-.4	17.7	HP
ICRF J143257.6-180135	1430-178	Q	2.331	.85	1.19	-.1	19.5	
ICRF J143439.7+195200	1432+200							
ICRF J143535.4+301224	1433+304							
ICRF J143645.8+633637	1435+638	Q	2.062	1.24	1.60	-.2	16.6	
ICRF J143809.4-220454	1435-218	Q	1.194	.68	.56*		17.9	
ICRF J144516.4+095836	1442+101	Q	3.535	1.15	2.01	-.6	17.8	
ICRF J144553.3-162901	1443-162					-.3		
ICRF J144815.0-162024	1445-161	Q	2.417	.80	1.01	-.5	18.9	
ICRF J144828.7+760111	1448+762	G	.899	.68	1.00	.5	22.3	
ICRF J145427.4-374733	1451-375	Q	.314	1.84	1.40	.4	16.7	
ICRF J145432.9-401232	1451-400	Q	1.810	.61	.71*	-.2	18.5	
ICRF J145907.5+714019	1458+718	Q	.904	3.76	6.90	-.5	16.8	
ICRF J150048.6+475115	1459+480				.50		17.1	
ICRF J150424.9+102939	1502+106	Q	1.833	2.53	2.03	.3	18.6	HP
ICRF J150506.4+032630	1502+036	G	.413	.62	.29	.4	18.6	
ICRF J150609.5+373051	1504+377	G	.674	1.10	1.10	.2	21.2	S2
ICRF J150704.7-165230	1504-166	Q	.876	2.84	2.20	-.4	18.5	HP
ICRF J151002.9+570243	1508+572	Q	4.301	.28			18.9	
ICRF J151250.5-090559	1510-089	Q	.360	4.36	3.14	.3	16.5	HP
ICRF J151344.8-101200	1511-100	Q	1.513	1.22	.88	.4	18.5	
ICRF J151656.7+193212	1514+197	L		.50	.50		18.7	
ICRF J151741.8-242219	1514-241	L	.048	1.94	1.90	-.1	14.8	HP
ICRF J152237.6-273010	1519-273	L		1.84	.99	.2	17.7	HP
ICRF J153452.4+013104	1532+016	Q	1.435	.92	1.19	-.3	18.0	HP
ICRF J154049.4+144745	1538+149	L	.605	1.95	1.50		17.3	HP
ICRF J154917.4+503805	1547+507	Q	2.169	.74	.69*	.1	18.5	
ICRF J154929.4+023701	1546+027	Q	.412	1.41	.79	.2	17.8	HP
ICRF J155035.2+052710	1548+056	Q	1.422	2.18	2.28	.3	19.5	HP
ICRF J155059.1-825806	1540-828					.1		
ICRF J155658.8-791404	1549-790	G	.149	3.54		-.2	18.5	S2
ICRF J155751.4-000150	1555+001	Q	1.772	2.18	.58	.2	19.0	
ICRF J155821.9-140959	1555-140	G	.097	.65	.70	.2	16.5	S2
ICRF J155930.9+030448	1557+032	Q	3.900	.48			19.8	
ICRF J160140.4+431647	1600+432	Q	1.610	.04			20.0	

Table III-2. (cont.) Physical characteristics of radio sources

ICRF Designation	IERS Des.	Tp (1)	Redsh. (2)	Flux (Jy) 6cm	Flux (Jy) 15cm (3)	SP (4)	mv	cl. sp (5)
ICRF J160140.5+431646	1600+431	Q	1.610					
ICRF J160207.2+332653	1600+335				2.70		23.2	
ICRF J160431.0-444131	1600-445							
ICRF J160734.7-333108	1604-333	Q			.57	.6	20.5	
ICRF J160846.2+102907	1606+106	Q	1.226	1.05	1.00	.7	18.0	
ICRF J160913.3+264129	1607+268	Q	.473		3.10	-.9	19.0	
ICRF J161341.0+341247	1611+343	Q	1.401	2.67	2.38*	.1	17.5	
ICRF J161637.5+045932	1614+051	Q	3.217	.85	.63	.4	19.5	
ICRF J161749.2-771718	1610-771	Q	1.710	5.55	3.80*	.8	19.0	HP
ICRF J161903.6+061302	1616+063	Q	2.086	.89	1.10	-.1	19.0	
ICRF J162418.4-680912	1619-680	Q	1.354	1.81	1.79*		18.0	
ICRF J162546.8-252738	1622-253	Q	.786	2.20	2.27*	-.1	20.6	
ICRF J162557.6+413440	1624+416	Q	2.550	1.58	1.50	-.3	22.0	
ICRF J162606.0-295126	1622-297	Q	.815	1.86	2.20	.2	17.0	
ICRF J163515.4+380804	1633+382	Q	1.814	4.08	2.10	.8	18.0	
ICRF J163813.4+572023	1637+574	Q	.751	1.44	1.40	.6	17.0	
ICRF J164029.6+394646	1638+398	Q	1.666	1.16	1.10	.1	16.5	HP
ICRF J164207.8+685639	1642+690	G	.751	1.43	1.70	-.3	20.5	HP
ICRF J164258.8+394836	1641+399	Q	.594	5.65	7.60		16.0	HP
ICRF J165039.5-294346	1647-296				1.80	-.6		
ICRF J165352.2+394536	1652+398	L	.033	1.31	1.45*		13.8	HP
ICRF J165801.4+344328	1656+348	Q	1.936	.60	.60	-.2	18.5	
ICRF J165802.7+473749	1656+477	Q	1.622	.92	.80	.2	18.0	
ICRF J165809.0+074127	1655+077	Q	.621	1.60	1.63	.4	20.0	
ICRF J165833.4+051516	1656+053	Q	.887	2.10	1.61	.5	16.5	HP
ICRF J170053.1-261051	1657-261				1.10	-.2		
ICRF J170717.7+453610	1705+456	Q	.646	.47	.66*		17.4	
ICRF J170734.4+014845	1705+018	Q	2.576	.54	.53*	.1	18.8	
ICRF J170934.3-172853	1706-174	A					17.5	
ICRF J171913.0+174506	1717+178	L		.94	1.00	.6	19.1	HP
ICRF J172341.0-650036	1718-649	G	.014	3.70	4.00*	-.1	15.5	S3
ICRF J172727.6+453039	1726+455	Q	.714	.63	.72*	-.2	19.0	
ICRF J172818.6+501310	1727+502	L	.055	.17	.23		16.0	
ICRF J172824.9+042704	1725+044	G	.293	1.21	.84	.8	17.0	S1
ICRF J173302.7-130449	1730-130	Q	.902	4.22	4.90*	-.1	18.5	
ICRF J173315.1-372232	1729-373							
ICRF J173420.5+385751	1732+389	Q	.976	1.15	.67*	.8	19.0	HP
ICRF J173549.0+504911	1734+508					.3		
ICRF J173735.7-563403	1733-565	G	.098	3.32	4.40*	-.5	17.0	S2
ICRF J173927.3+495503	1738+499	Q	1.545	.61	.53*		19.0	
ICRF J173957.1+473758	1738+476	L	.316	.90	.92	.1	17.5	
ICRF J174036.9+521143	1739+522	Q	1.379	1.99	1.93*		18.5	HP
ICRF J174358.8-035004	1741-038	Q	1.057	2.30	5.60	.3	18.6	HP
ICRF J174425.4-514443	1740-517	G						
ICRF J174535.2+172001	1743+173	Q	1.702	.94	.90	.1	19.5	
ICRF J174614.0+622654	1745+624	Q	3.889	.57	.59*		18.8	
ICRF J174726.6+465850	1746+470						21.3	
ICRF J174832.8+700550	1749+701	L	.770	1.09	1.10	.3	17.0	HP
ICRF J175132.8+093900	1749+096	Q	.320	1.89	1.07	-.2	16.8	HP
ICRF J175151.2-252400	1748-253							

Table III-2. (cont.) Physical characteristics of radio sources

ICRF Designation	IERS Des.	Tp (1)	Redsh. (2)	Flux (Jy) 6cm	15cm (3)	SP (4)	mv	cl. sp (5)
ICRF J175322.6+440945	1751+441	Q	.871	1.04	.80	.9	19.5	
ICRF J175342.4+284804	1751+288	Q			1.10		20.0	
ICRF J180024.7+384830	1758+388	Q	2.092	.92	.60	1.2	18.0	
ICRF J180045.6+782804	1803+784	L	.684	2.63	2.60	.3	16.4	HP
ICRF J180132.3+440421	1800+440	Q	.663	1.02	.79	.4	16.8	
ICRF J180323.4-650736	1758-651	G				.1	15.4	
ICRF J180650.6+694928	1807+698	L	.051	1.74	3.10	-.3	14.2	HP
ICRF J180821.8+454220	1806+456	Q	.830	.70	.50	1.5	19.3	
ICRF J180957.8-455241	1806-458				1.80	-.5		
ICRF J181935.0-634548	1814-637	G	.065	4.34	7.40*		16.0	S2
ICRF J181945.3-552120	1815-553	Q				-.1	19.3	
ICRF J182057.8-252812	1817-254							
ICRF J182314.1+793849	1826+796		.224					
ICRF J182402.8+104423	1821+107	Q	1.364	1.05	.95*	.5	17.3	
ICRF J182407.0+565101	1823+568	L	.664	1.67	1.60	.2	18.4	HP
ICRF J183250.1+283335	1830+285	Q	.594	1.07	1.30		17.2	
ICRF J183537.2-714958	1829-718							
ICRF J183728.7-710843	1831-711	Q	1.356	1.15	1.32*	-.2	17.4	
ICRF J184208.9+794617	1845+797	G	.057	4.48	7.30	-.6	15.4	S1
ICRF J184233.6+680925	1842+681	Q	.475	.81	1.20	-.4	17.9	
ICRF J184916.0+670541	1849+670	Q	.657	.59	.95*		18.0	
ICRF J185457.2+735119	1856+737	G	.460	.41	.41*		17.5	S1
ICRF J190255.9+315941	1901+319	Q	.635	1.81	3.10		17.5	
ICRF J191109.6-200655	1908-201				2.30			
ICRF J191240.0-801005	1903-802	Q	1.758	1.79	1.54*	.2	19.0	
ICRF J192332.1-210433	1920-211							
ICRF J192451.0-291430	1921-293	L	.352	10.00	4.60*		18.2	HP
ICRF J192559.6+210626	1923+210							
ICRF J192748.4+735801	1928+738	G	.303	3.34	3.00		16.1	S1
ICRF J192840.8+084848	1926+087							
ICRF J193006.1-605609	1925-610	Q				-.1	21.5	
ICRF J193124.9+224331	1929+226							
ICRF J193435.0+104340	1932+106							
ICRF J193510.4+203154	1932+204							
ICRF J193716.2-395801	1933-400	Q	.966	1.44	1.20*	.1	18.0	
ICRF J193925.0-634245	1934-638	G	.183	6.01	11.10*		18.4	S2
ICRF J193926.6-152543	1936-155	Q	1.657	.80	1.30	.2	19.4	HP
ICRF J193957.2-100241	1937-101	Q	3.787	.75	.90	-.3	17.0	
ICRF J194025.5-690756	1935-692	Q	3.170	.76	1.23*	-.6	18.8	
ICRF J194121.7-621121	1936-623	Q				-.3	22.5	
ICRF J194606.2+230004	1943+228							
ICRF J195330.8+353759	1951+355							
ICRF J195510.7-611519	1950-613							
ICRF J195542.7+513148	1954+513	Q	1.230	1.61	1.40	-.1	18.5	
ICRF J195740.5+333827	1955+335							
ICRF J195759.8-384506	1954-388	Q	.630	2.02	1.00		17.1	HP
ICRF J200057.0-174857	1958-179	Q	.650	2.70	1.12	.1	18.2	HP
ICRF J200324.1-325145	2000-330	Q	3.783	1.03	1.10	.8	17.3	
ICRF J200530.9+775243	2007+777	L	.342	1.28	1.20	.5	16.7	HP
ICRF J200617.6+642445	2005+642							

Table III-2. (cont.) Physical characteristics of radio sources

ICRF Designation	IERS Des.	Tp (1)	Redsh. (2)	Flux (Jy) 6cm	15cm (3)	SP (4)	mv	cl. sp (5)
ICRF J200744.9+402948	2005+403	Q	1.736	3.70	4.90		19.0	
ICRF J200925.3-484953	2005-489	L	.071	1.19	1.06*	.2	13.4	
ICRF J201114.2-064403	2008-068				2.10	-.7		
ICRF J201115.7-154640	2008-159	Q	1.180	.95	.60	1.0	18.3	
ICRF J201713.0+744047	2017+745	Q	2.191	.37	.34*		18.1	
ICRF J202206.6+613658	2021+614	G	.227	2.29	2.26	.1	19.0	S2
ICRF J202319.0+315302	2021+317							
ICRF J202510.8+334300	2023+335							
ICRF J203147.9+545503	2030+547				1.40			
ICRF J203154.9+121941	2029+121	L	1.215	1.29	1.10	.7	20.3	
ICRF J203837.0+511912	2037+511	Q	1.687	3.79	5.00		21.0	
ICRF J204008.7-250746	2037-253	Q	1.574	.66	.90	.3	18.5	
ICRF J205051.1+312727	2048+312	Q	3.198	.70	.58*		20.0	
ICRF J205133.7+744140	2051+745	L		.53	.43*		20.4	
ICRF J205616.3-471447	2052-474	Q	1.489	2.45	3.00*	-.3	19.1	
ICRF J205741.6-373402	2054-377							
ICRF J210138.8+034131	2059+034	Q	1.015	.77	.57	.5	17.8	
ICRF J210159.1-421916	2058-425	Q	.221	.68	.98*	-.5	17.2	
ICRF J210217.0+470216	2100+468							
ICRF J210544.9-782534	2059-786							
ICRF J210933.1-411020	2106-413	Q	1.055	2.28	2.11*	.2	21.0	
ICRF J211529.4+293338	2113+293	Q	1.514	1.45	1.12		19.5	
ICRF J211630.8-805355	2109-811	G				.2	20.0	
ICRF J211810.5-301911	2115-305	Q	.980	.86	1.50*		16.5	
ICRF J212344.5+053522	2121+053	Q	1.941	3.16	2.47	1.1	20.4	HP
ICRF J212912.1-153841	2126-158	Q	3.266	1.19	.90	.1	17.0	
ICRF J213032.8+050217	2128+048	G	.990			-.5		
ICRF J213135.2-120704	2128-123	G	.501	1.99	1.69	.1	16.1	S1
ICRF J213410.3-015317	2131-021	L	.557	2.06	2.20		18.7	HP
ICRF J213638.5+004154	2134+004	Q	1.932	11.49	6.50	.8	16.8	
ICRF J213901.3+142335	2136+141	Q	2.427	1.11	1.19		18.9	
ICRF J214622.9-152543	2143-156	Q	.700	.51	1.00	-.5	17.3	
ICRF J214710.1+092946	2144+092	Q	1.113	1.01	.78	.2	18.5	
ICRF J214712.7-753613	2142-758	Q	1.139	1.28	1.38*	-.1	17.3	
ICRF J214805.4+065738	2145+067	Q	.999	4.41	3.10	.5	16.5	
ICRF J215137.8+055212	2149+056	G	.740	1.04	1.06	.3	19.5	S1
ICRF J215155.5-302753	2149-307	Q	2.345	1.15	1.35	-.2	17.9	
ICRF J215203.1-780706	2146-783					-.1		
ICRF J215224.8+173437	2150+173	L		1.02	1.10	-.1	17.9	HP
ICRF J215705.9-694123	2152-699	G	.028	13.40	16.10*		13.8	S1
ICRF J215806.2-150109	2155-152	Q	.672	1.72	1.80	-.1	19.4	HP
ICRF J215852.0-301332	2155-304	L	.116	.31	.35	-.2	13.1	HP
ICRF J220243.2+421639	2200+420	L	.069	2.96	4.20	-.5	14.7	HP
ICRF J220314.9+314538	2201+315	Q	.298	2.31	2.02	.2	15.6	
ICRF J220743.7-534633	2204-540	Q	1.206	2.82	2.70*	.7	18.0	
ICRF J221205.9+235540	2209+236	A			.70	.2	19.0	
ICRF J221302.4-252930	2210-257	Q	1.833	.82	.90	.1	19.0	
ICRF J221438.5-383545	2211-388							
ICRF J221620.0+351814	2214+350	Q	.510	.82	1.00	.2	18.5	
ICRF J221852.0-033536	2216-038	Q	.901	1.63	1.62	.7	16.4	

Table III-2. (cont.) Physical characteristics of radio sources

ICRF Designation	IERS Des.	Tp (1)	Redsh. (2)	Flux 6cm	(Jy) 15cm (3)	SP (4)	mv	cl. sp (5)
ICRF J222547.2-045701	2223-052	Q	1.404	4.07	5.20	-.1	18.4	HP
ICRF J222940.0-083254	2227-088	Q	1.562	1.41	1.30	-.1	17.5	HP
ICRF J223036.4+694628	2229+695	?L		.81	.62*	.4	19.6	
ICRF J223040.2-394252	2227-399	Q	.323	1.02	1.02*		17.9	
ICRF J223236.4+114350	2230+114	Q	1.037	3.65	4.93*	-.5	17.3	HP
ICRF J223513.2-483558	2232-488	Q	.510	.87	.81*	.1	17.2	
ICRF J223622.4+282857	2234+282	Q	.795	1.06	.91		19.0	HP
ICRF J223634.0-143322	2233-148	?L	.325	.60	.50*	.3	19.0	
ICRF J224618.2-120651	2243-123	Q	.630	2.66	2.74*	-.2	16.5	HP
ICRF J224838.6-323552	2245-328	Q	2.268	1.80	2.01*	-.2	18.6	
ICRF J225357.7+160853	2251+158	Q	.859	10.03	10.50	1.3	16.1	HP
ICRF J225504.2-084404	2252-090		.606			.1		
ICRF J225536.7+420252	2253+417	Q	1.476	.99	1.50	-.3	18.8	
ICRF J225717.3+074312	2254+074	L	.190	.48	.88	.9	16.4	HP
ICRF J225717.5+024317	2254+024	Q	2.089	.51	.46*	.2	18.0	
ICRF J225805.9-275821	2255-282	Q	.926	2.13	1.38*	.4	16.8	
ICRF J230223.8-371806	2259-375							
ICRF J230305.8-303011	2300-307	Q			.31	-.5	16.0	
ICRF J230343.5-680737	2300-683	Q	.512	.34	.43*		16.4	
ICRF J231409.3-445549	2311-452	Q	2.883	1.43	1.91*	-.5	19.0	
ICRF J231448.5-313839	2312-319	G	.284	.58	.71*	-.3	18.5	
ICRF J232044.8+051349	2318+049	Q	.623	1.13	1.23*	-.2	19.0	
ICRF J232159.8+273246	2319+272	Q	1.253	1.07	1.10		19.0	
ICRF J232225.9+505751	2320+506				.80			
ICRF J232331.9-031705	2320-035	Q	1.411	.39	.79	-.1	19.0	
ICRF J232747.9-144755	2325-150	Q	2.465	.91	1.10	.2	19.0	
ICRF J232917.7-473019	2326-477	Q	1.306	2.06	2.40*		16.8	
ICRF J233040.8+110018	2328+107	Q	1.489	.96	1.05	-.1	18.1	
ICRF J233138.6-155657	2329-162	Q	1.153	1.88	1.20	.1	20.0	
ICRF J233159.4-381147	2329-384	Q	1.195	.67	.78*	-.2	17.0	
ICRF J233355.2-234340	2331-240	G	.048	.91	.90		16.5	S2
ICRF J233612.1-523621	2333-528					-.1		
ICRF J233757.3-023057	2335-027	Q	1.072	.65	.65	.2	19.3	
ICRF J234029.0+264156	2337+264	A			1.00		20.0	
ICRF J234636.8+093045	2344+092	G	.673	1.38	1.90	-.2	16.0	S1
ICRF J234802.6-163112	2345-167	Q	.576	3.48	4.08*	-.3	18.4	HP
ICRF J235421.6+455304	2351+456	Q	1.992	1.48	1.41*	-.1	20.6	
ICRF J235430.1-151311	2351-154	Q	2.675	.97	1.08*	-.2	18.8	
ICRF J235509.4+495008	2352+495	G	.237		2.30	-.3	19.0	
ICRF J235600.6-682003	2353-686	Q	1.716	1.07	.94*		17.0	
ICRF J235753.2-531113	2355-534	Q	1.006	1.66	1.31*	.4	17.8	
ICRF J235810.8-102008	2355-106	Q	1.622	1.62	.47*	.5	18.5	
ICRF J235933.1+385042	2356+385	Q	2.704	.69	.50	.3	18.0	

Notes: (1) Type of Object: Q = quasar, G = galaxy, L = BL Lac, ?L = BL Lac candidate, A = other
(2) Asterisk indicates that the reported value is the flux at 11 cm.
(3) Redshift (unitless), ">" prefix means the value given is a lower limit.
(4) Spectral index from Preston *et al.*
(5) Classification of Spectrum: S = Seyfert spectrum, S1 = Seyfert 1 spectrum, S2 = Seyfert 2 spectrum, S3 = Seyfert 3 or liner, HP = high optical polarization (>3%)

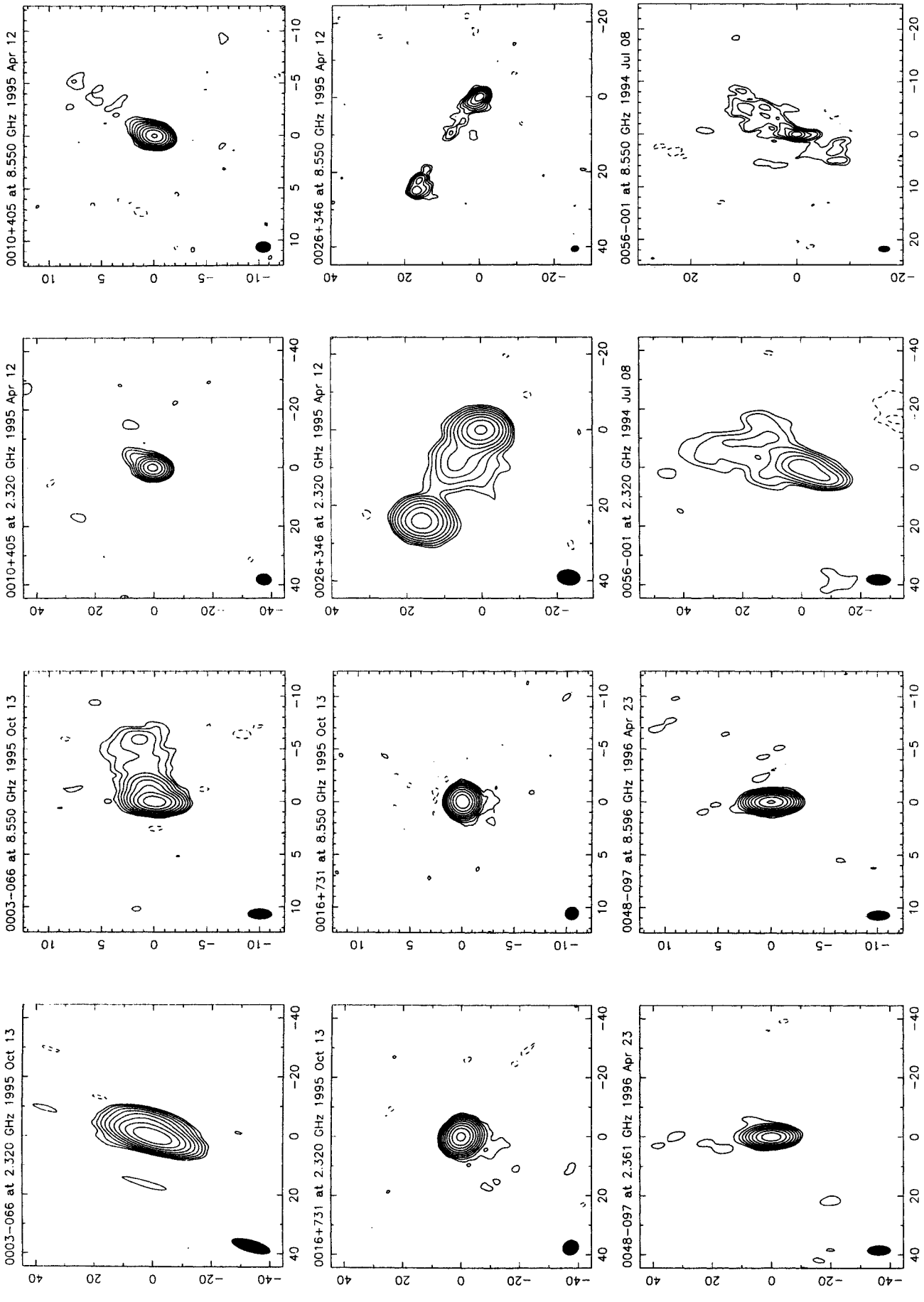
3. Dual-frequency VLBA images and structure corrections for 193 sources

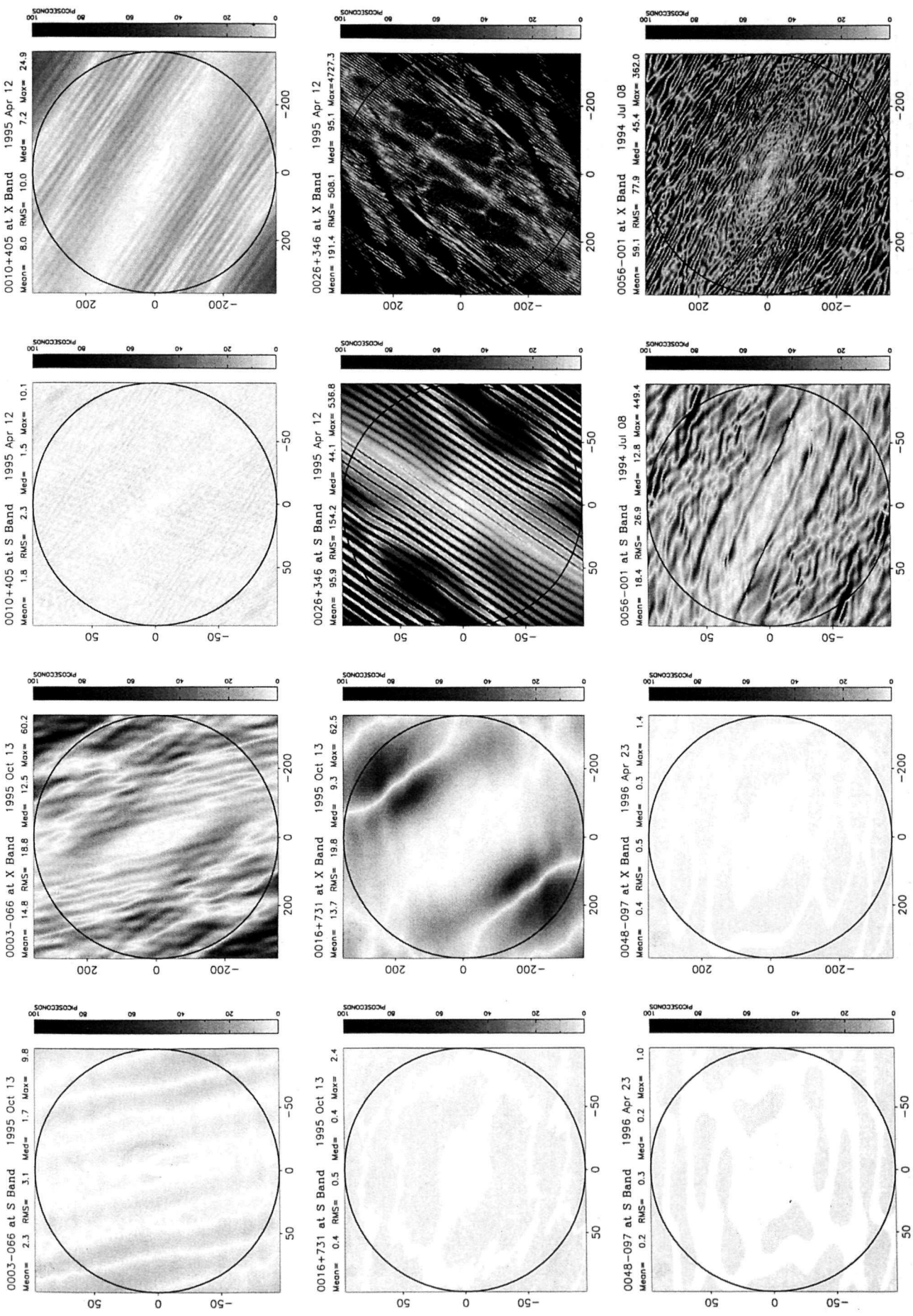
A.L. Fey [1], P. Charlot [2]

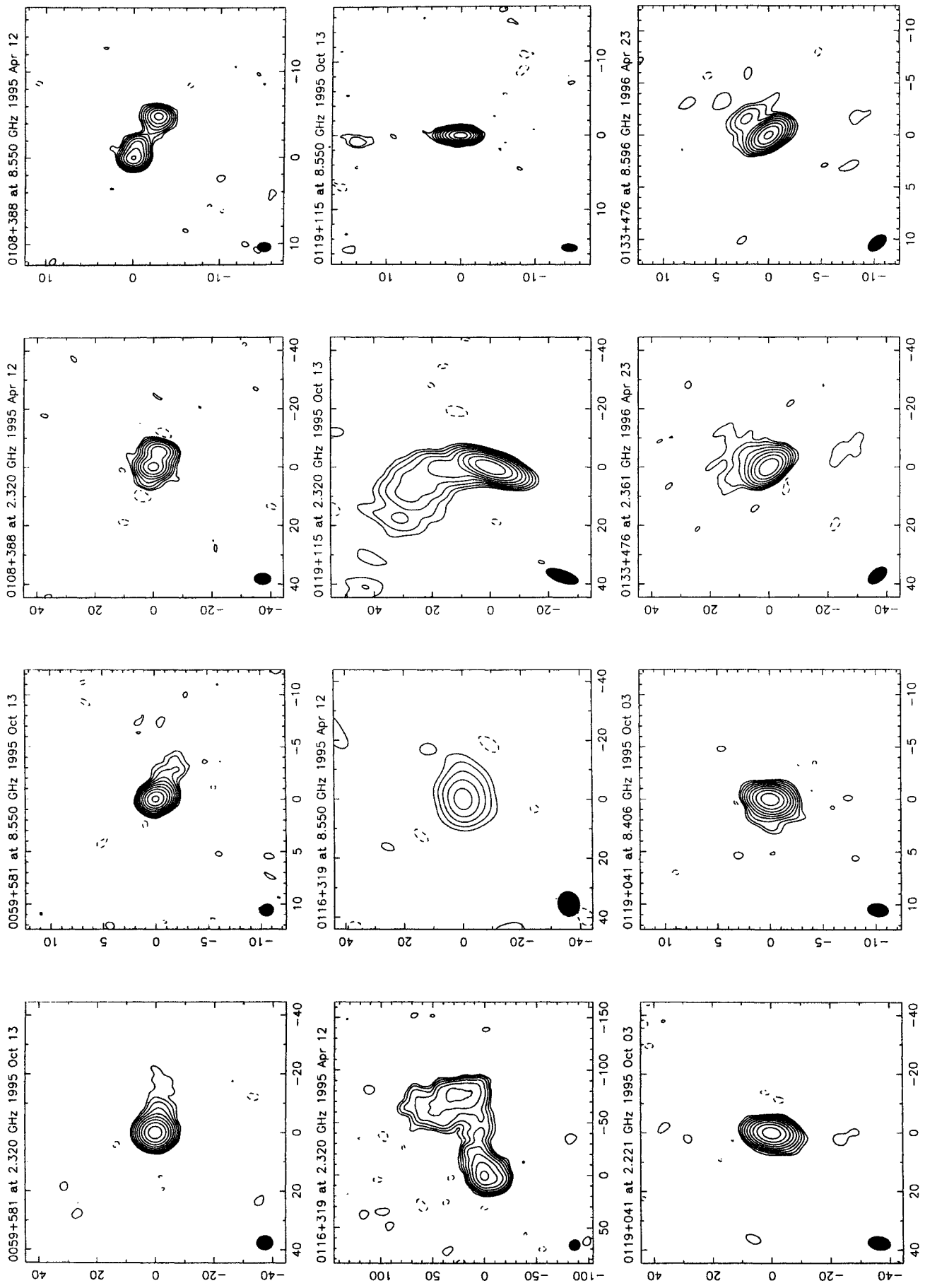
1. U.S. Naval Observatory
2. Central Bureau of IERS, Observatoire de Paris/CNRS URA1125

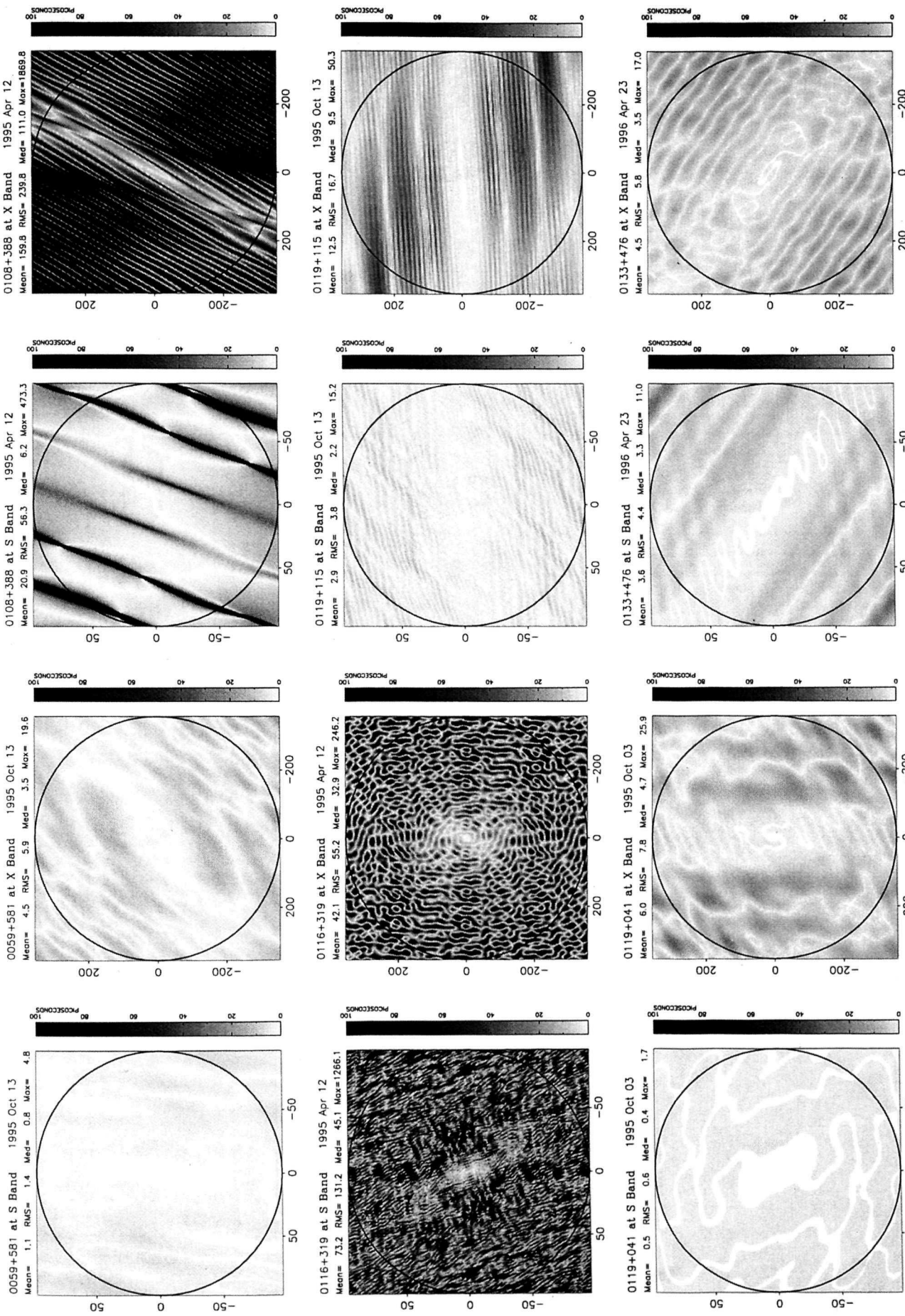
Very Long Baseline Interferometry observations of 193 extragalactic radio sources were made during six 24-hr periods on 1994 July 8-9, 1995 April 12-13, 1995 July 24-25, 1995 October 2-3, 1995 October 12-13, and on 1996 April 23-24 using the Very Long Baseline Array (VLBA) telescope of the National Radio Astronomy Observatory (NRAO). All observations were made in a dual-frequency bandwidth synthesis mode to facilitate delay measurements for astrometry. A total of eight IFs (frequency channels) were recorded, with four at S band (2 GHz) and four at X band (8 GHz). Channel bandwidth was either 4 MHz or 8 MHz. The raw data bits were correlated with the VLBA correlator at the Array Operations Center in Socorro, New Mexico. The correlated data were calibrated and corrected for residual delay and delay rate using the NRAO Astronomical Image Processing System (AIPS). The visibility data for each frequency band were self-calibrated, Fourier inverted, and CLEANed using the California Institute of Technology difference mapping program, DIFMAP. The data were self-calibrated following the hybrid-mapping technique to correct for residual amplitude and phase errors. Contour plots of the final naturally weighted images of these 193 sources at both S band and X band are shown in the following pages. The scale of each image is in milliarcseconds. The FWHM Gaussian restoring beam applied to the images is shown as a hatched ellipse in the lower left of each panel. For convenience, the images for each band are labeled only by a single fiducial frequency even though they were made using the data from all frequency channels.

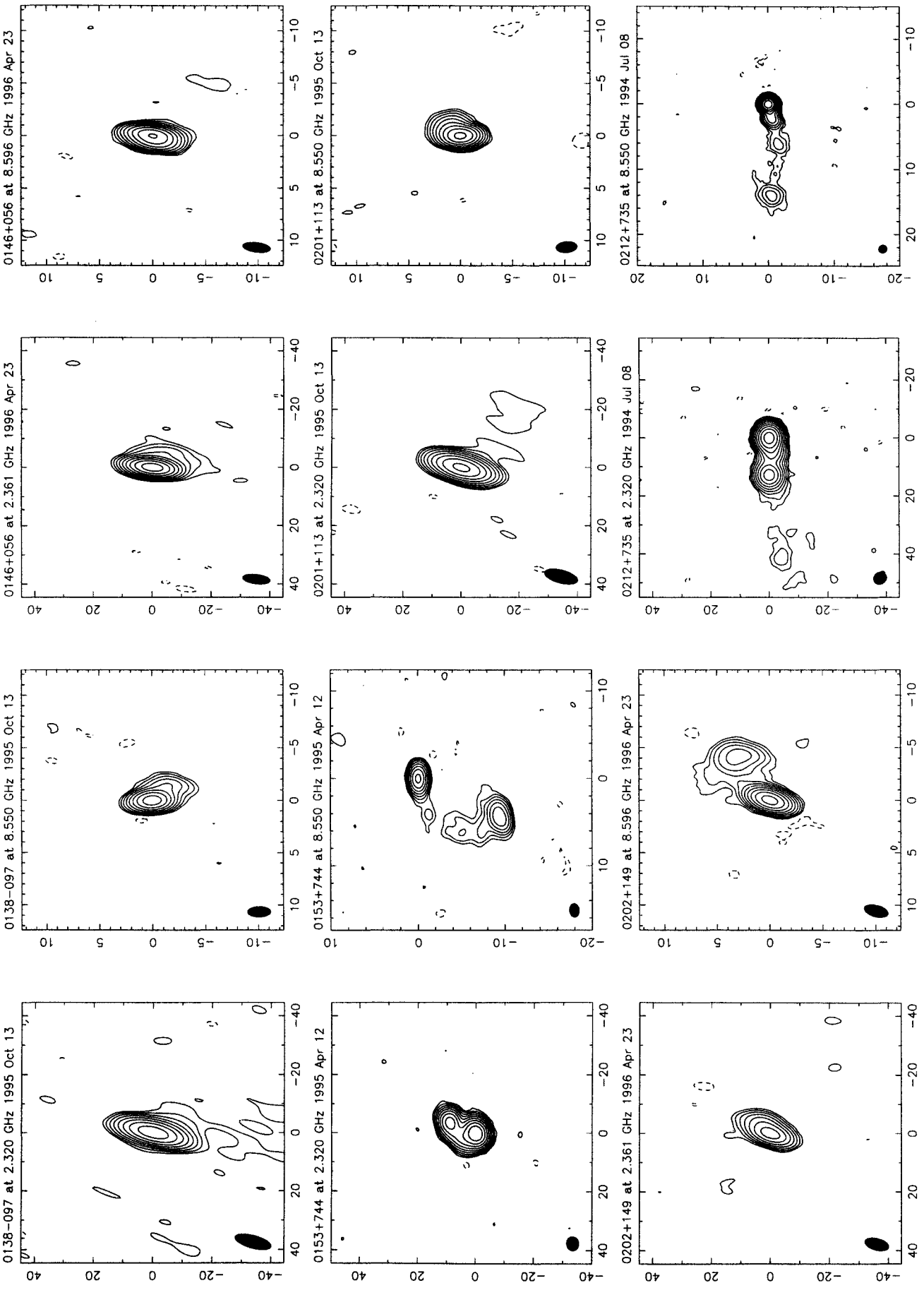
With these dual-frequency images, source structure corrections in the bandwidth synthesis delay measurements used in VLBI astrometry and geodesy can be calculated. These corrections vary as a function of the interferometer resolution through the coordinates u and v, which are the coordinates of the VLBI baseline projected on the plane of the sky. To obtain an estimate of the magnitude of intrinsic source structure effects on a hypothetical bandwidth synthesis delay measurement, we have calculated structure corrections (absolute values) for all pixels of a 512 X 512 u,v grid with u_{max} and v_{max} equal to one Earth diameter. The calculation was done separately for the S band and X band VLBA images. Structure corrections were then scaled by 0.08 at S band and 1.08 at X band. These numbers correspond to the factors used in the linear combination of the S band and X band observables to get the dual-frequency calibrated bandwidth synthesis delay. Without scaling, the S band corrections are very large (because the structures at S band are generally more extended) and do not reflect the actual contribution to the dual-frequency calibrated bandwidth synthesis delay. Results of these calculations for the 193 sources with VLBA images discussed above are represented as gray-scale plots in the following figures, each page of S and X band structure correction plots facing the corresponding page of S and X band VLBA images. The linear scale in each structure correction plot is in millions of wavelengths. The gray-scale is identical in each panel and ranges from 0 to 100 picoseconds (ps). All structure corrections larger than 100 ps are plotted as black. The circle drawn in these plots has a radius equal to one Earth diameter, corresponding to the longest baselines that can be theoretically observed with Earth-based VLBI. The mean, rms, median and maximum values of the structure corrections for all baselines contained within this circle have also been calculated and are indicated (in picoseconds) above each panel. Note that the median serves to define the structure index classes. For a precise definition of the structure index and more details about the source structure effect calculation, see Fey and Charlot (1997), referenced p. I-17, this volume.

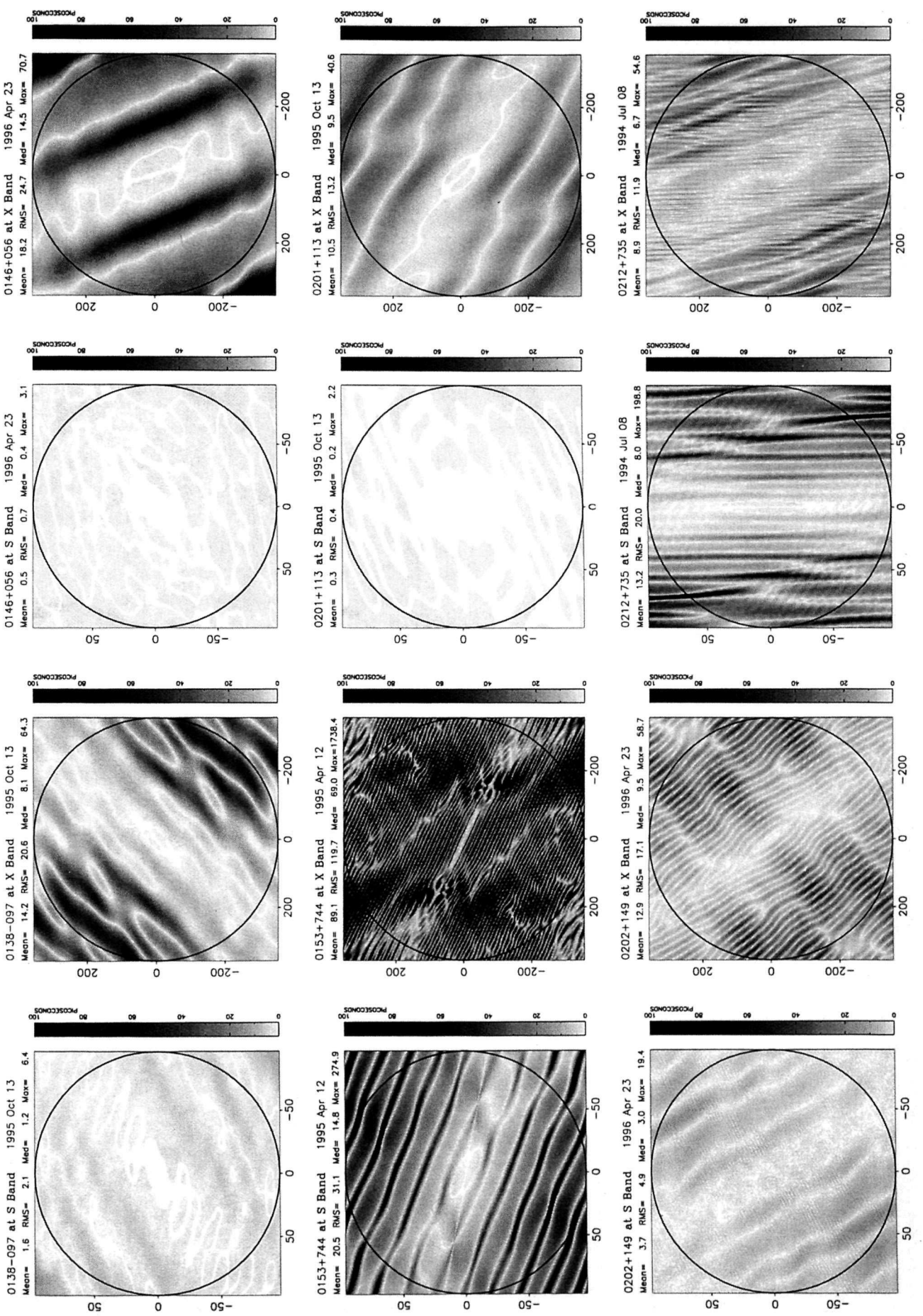

0010+405 at 8.550 GHz 1995 Apr 12
0026+346 at 8.550 GHz 1995 Apr 12
0056–001 at 8.550 GHz 1994 Jul 08
0010+405 at 2.320 GHz 1995 Apr 12
0026+346 at 2.320 GHz 1995 Apr 12
0056–001 at 2.320 GHz 1994 Jul 08
0003–066 at 8.550 GHz 1995 Oct 13
0016+731 at 8.550 GHz 1995 Oct 13
0048–097 at 8.596 GHz 1996 Apr 23
0003–066 at 2.320 GHz 1995 Oct 13
0016+731 at 2.320 GHz 1995 Oct 13
0048–097 at 2.361 GHz 1996 Apr 23

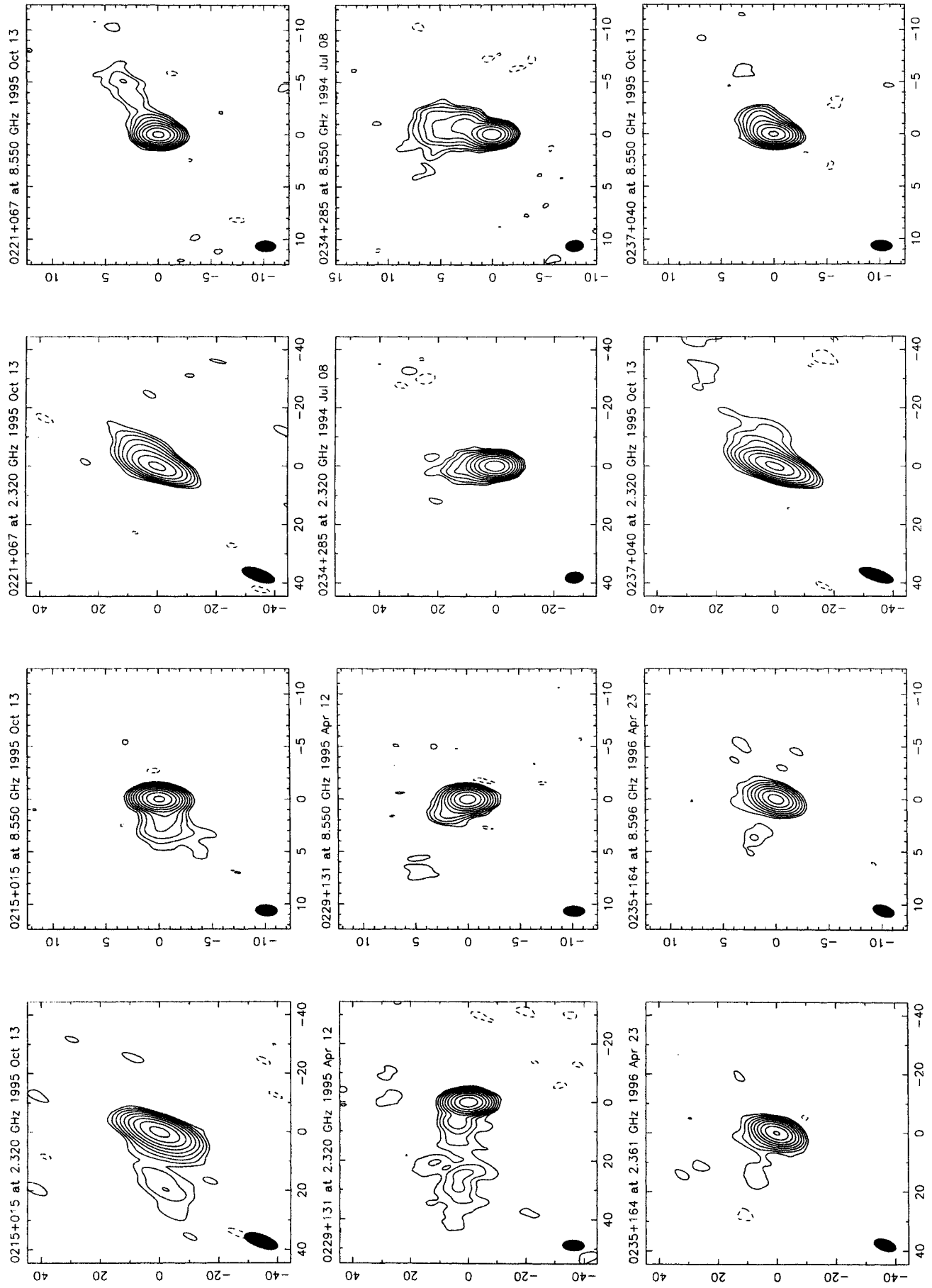

0010+405 at X Band 1995 Apr 12
Mean= 8.0 RMS= 10.0 Med= 7.2 Max= 24.9
0026+346 at X Band 1995 Apr 12
Mean= 191.4 RMS= 508.1 Med= 95.1 Max=4727.3
0056-001 at X Band 1994 Jul 08
Mean= 59.1 RMS= 77.9 Med= 45.4 Max= 362.0
0010+405 at S Band 1995 Apr 12
Mean= 1.8 RMS= 2.3 Med= 1.5 Max= 10.1
0026+346 at S Band 1995 Apr 12
Mean= 95.9 RMS= 154.2 Med= 44.1 Max= 536.8
0056-001 at S Band 1994 Jul 08
Mean= 18.4 RMS= 26.9 Med= 12.8 Max= 449.4
0003-066 at X Band 1995 Oct 13
Mean= 14.8 RMS= 18.8 Med= 12.5 Max= 60.2
0016+731 at X Band 1995 Oct 13
Mean= 13.7 RMS= 19.8 Med= 9.3 Max= 62.5
0048-097 at X Band 1996 Apr 23
Mean= 0.4 RMS= 0.5 Med= 0.3 Max= 1.4
0003-066 at S Band 1995 Oct 13
Mean= 2.3 RMS= 3.1 Med= 1.7 Max= 9.8
0016+731 at S Band 1995 Oct 13
Mean= 0.4 RMS= 0.5 Med= 0.4 Max= 2.4
0048-097 at S Band 1996 Apr 23
Mean= 0.2 RMS= 0.3 Med= 0.2 Max= 1.0
PICOSECONDS

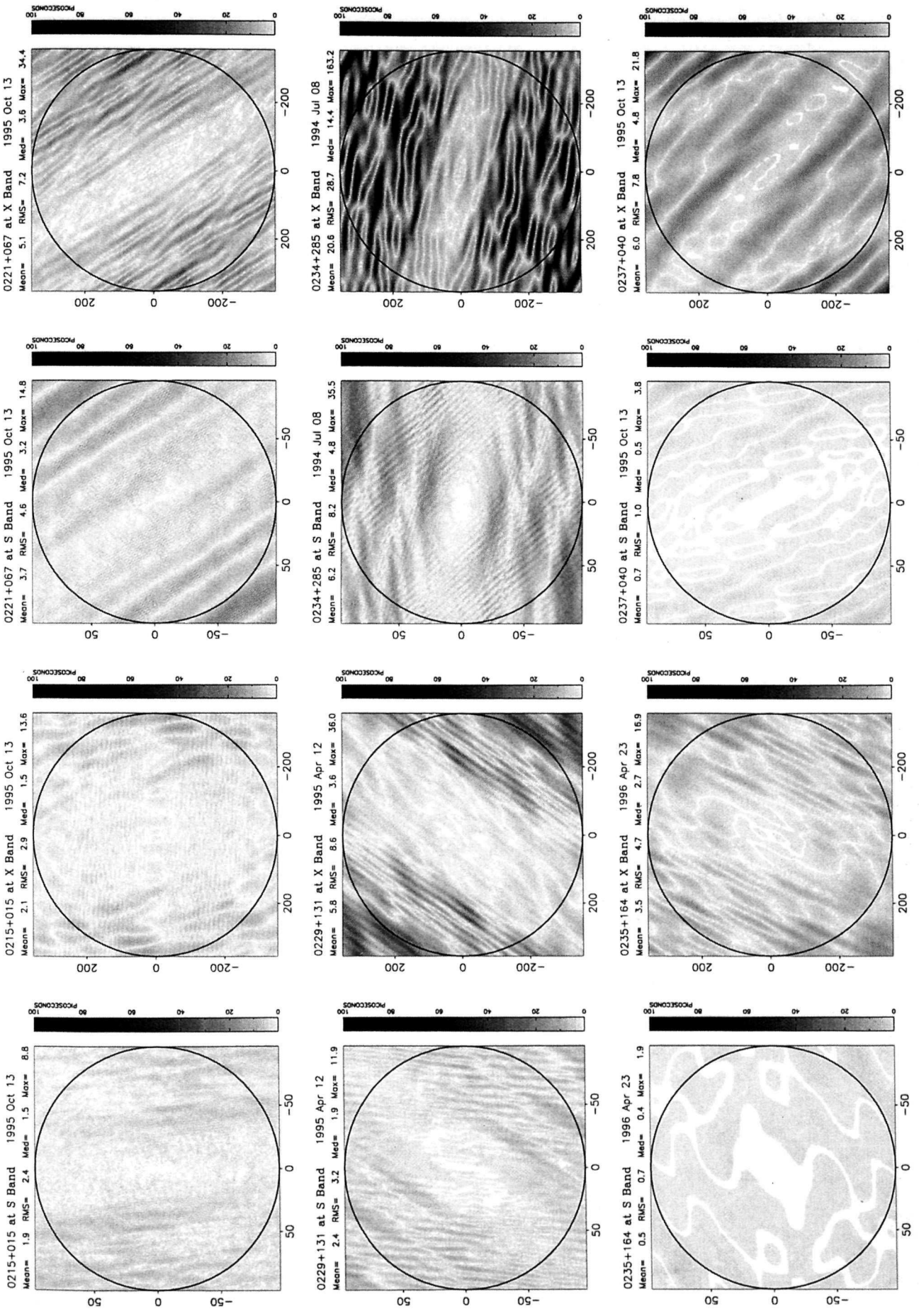

0059+581 at 2.320 GHz 1995 Oct 13
0059+581 at 8.550 GHz 1995 Oct 13
0108+388 at 2.320 GHz 1995 Apr 12
0108+388 at 8.550 GHz 1995 Apr 12
0116+319 at 2.320 GHz 1995 Apr 12
0116+319 at 8.550 GHz 1995 Apr 12
0119+041 at 2.221 GHz 1995 Oct 03
0119+041 at 8.406 GHz 1995 Oct 03
0119+115 at 2.320 GHz 1995 Oct 13
0119+115 at 8.550 GHz 1995 Oct 13
0133+476 at 2.361 GHz 1996 Apr 23
0133+476 at 8.596 GHz 1996 Apr 23

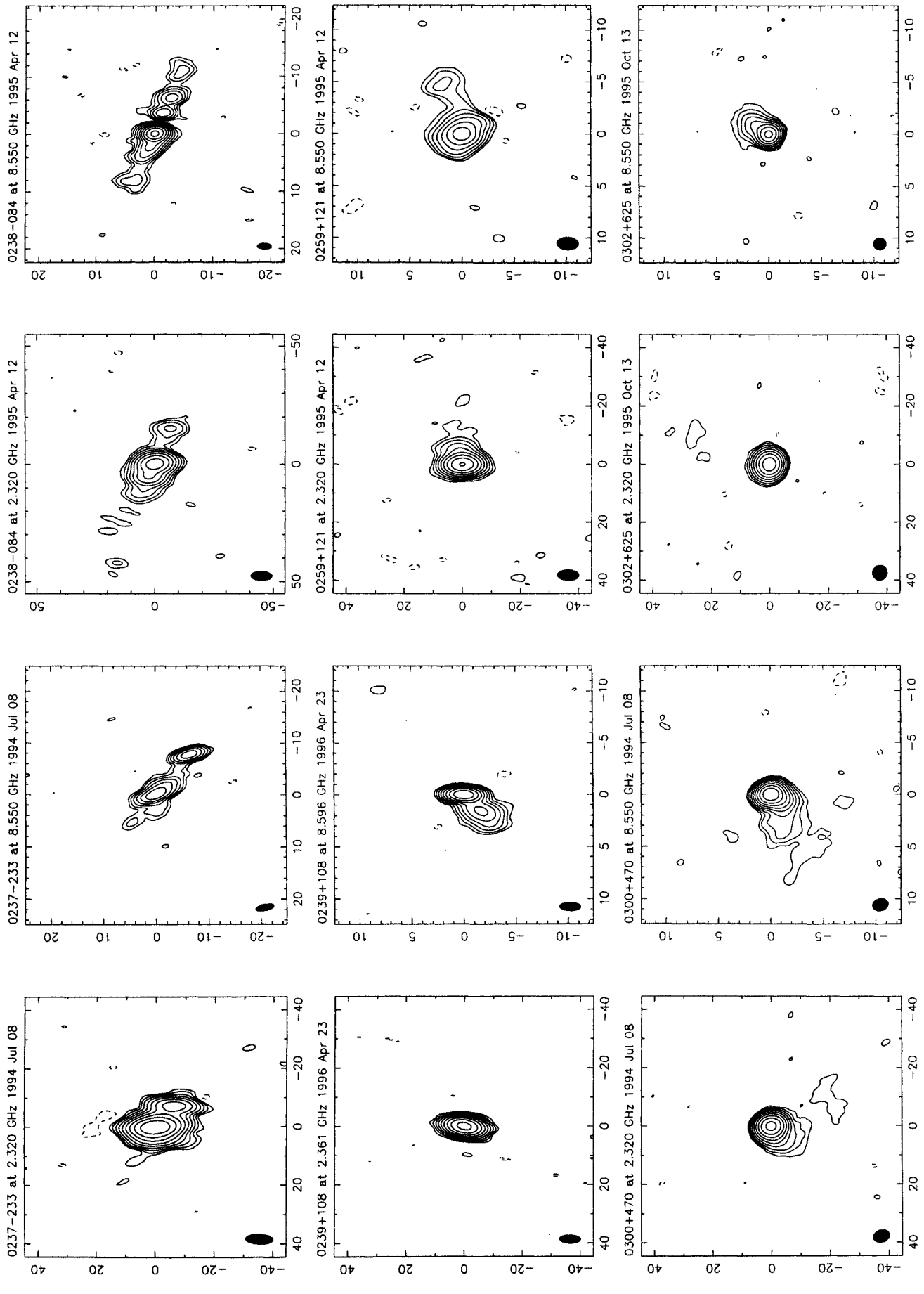

0108+388 at X Band 1995 Apr 12
Mean= 159.8 RMS= 239.8 Med= 111.0 Max=1869.8
0119+115 at X Band 1995 Oct 13
Mean= 12.5 RMS= 16.7 Med= 9.5 Max= 50.3
0133+476 at X Band 1996 Apr 23
Mean= 4.5 RMS= 5.8 Med= 3.5 Max= 17.0
0108+388 at S Band 1995 Apr 12
Mean= 20.9 RMS= 56.3 Med= 6.2 Max= 473.3
0119+115 at S Band 1995 Oct 13
Mean= 2.9 RMS= 3.8 Med= 2.2 Max= 15.2
0133+476 at S Band 1996 Apr 23
Mean= 3.6 RMS= 4.4 Med= 3.3 Max= 11.0
0059+581 at X Band 1995 Oct 13
Mean= 4.5 RMS= 5.9 Med= 3.5 Max= 19.6
0116+319 at X Band 1995 Apr 12
Mean= 42.1 RMS= 55.2 Med= 32.9 Max= 246.2
0119+041 at X Band 1995 Oct 03
Mean= 6.0 RMS= 7.8 Med= 4.7 Max= 25.9
0059+581 at S Band 1995 Oct 13
Mean= 1.1 RMS= 1.4 Med= 0.8 Max= 4.8
0116+319 at S Band 1995 Apr 12
Mean= 73.2 RMS= 131.2 Med= 45.1 Max=1266.1
0119+041 at S Band 1995 Oct 03
Mean= 0.5 RMS= 0.6 Med= 0.4 Max= 1.7
PICOSECONDS

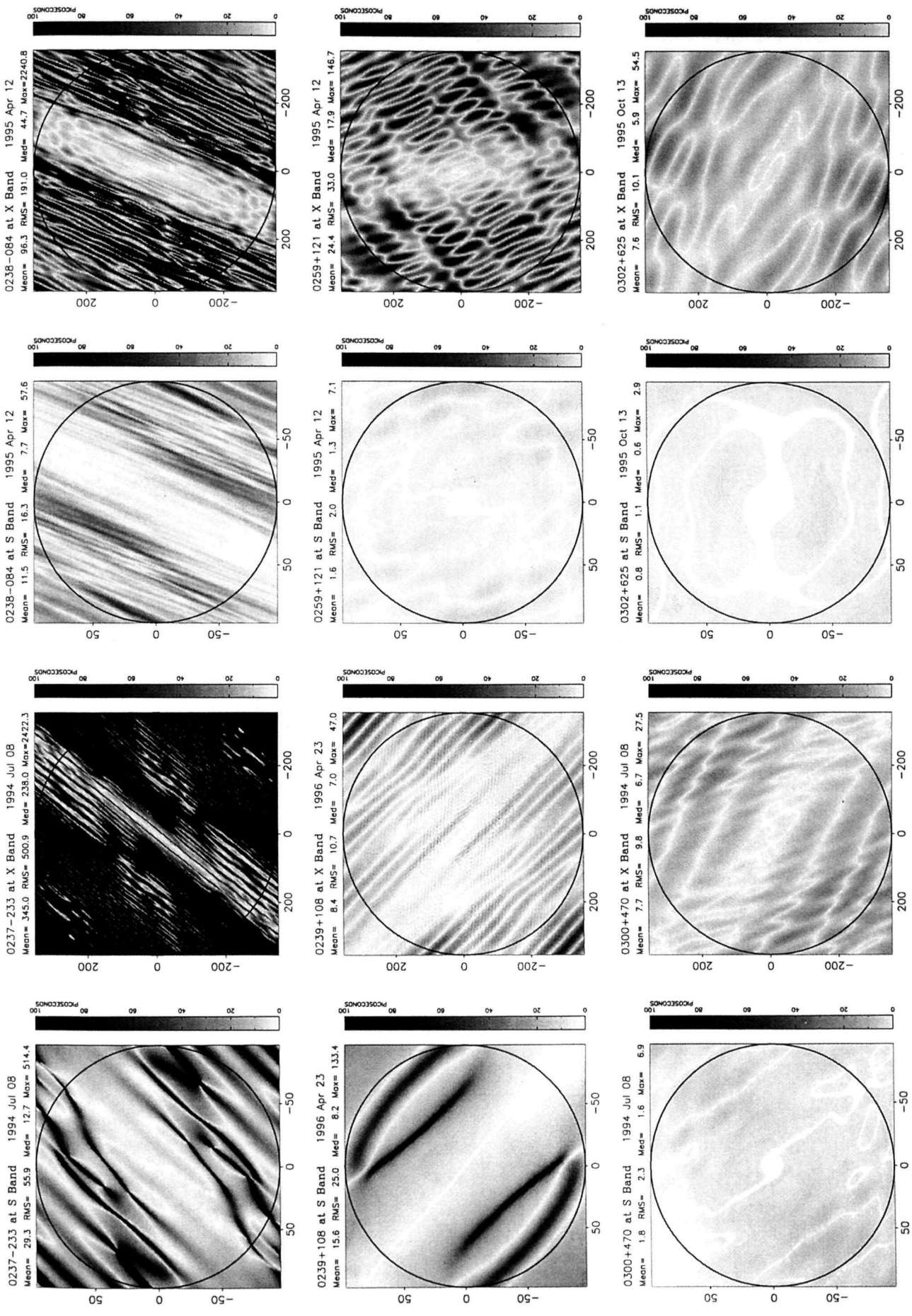

0138−097 at 2.320 GHz 1995 Oct 13
0138−097 at 8.550 GHz 1995 Oct 13
0146+056 at 2.361 GHz 1996 Apr 23
0146+056 at 8.596 GHz 1996 Apr 23
0153+744 at 2.320 GHz 1995 Apr 12
0153+744 at 8.550 GHz 1995 Apr 12
0201+113 at 2.320 GHz 1995 Oct 13
0201+113 at 8.550 GHz 1995 Oct 13
0202+149 at 2.361 GHz 1996 Apr 23
0202+149 at 8.596 GHz 1996 Apr 23
0212+735 at 2.320 GHz 1994 Jul 08
0212+735 at 8.550 GHz 1994 Jul 08

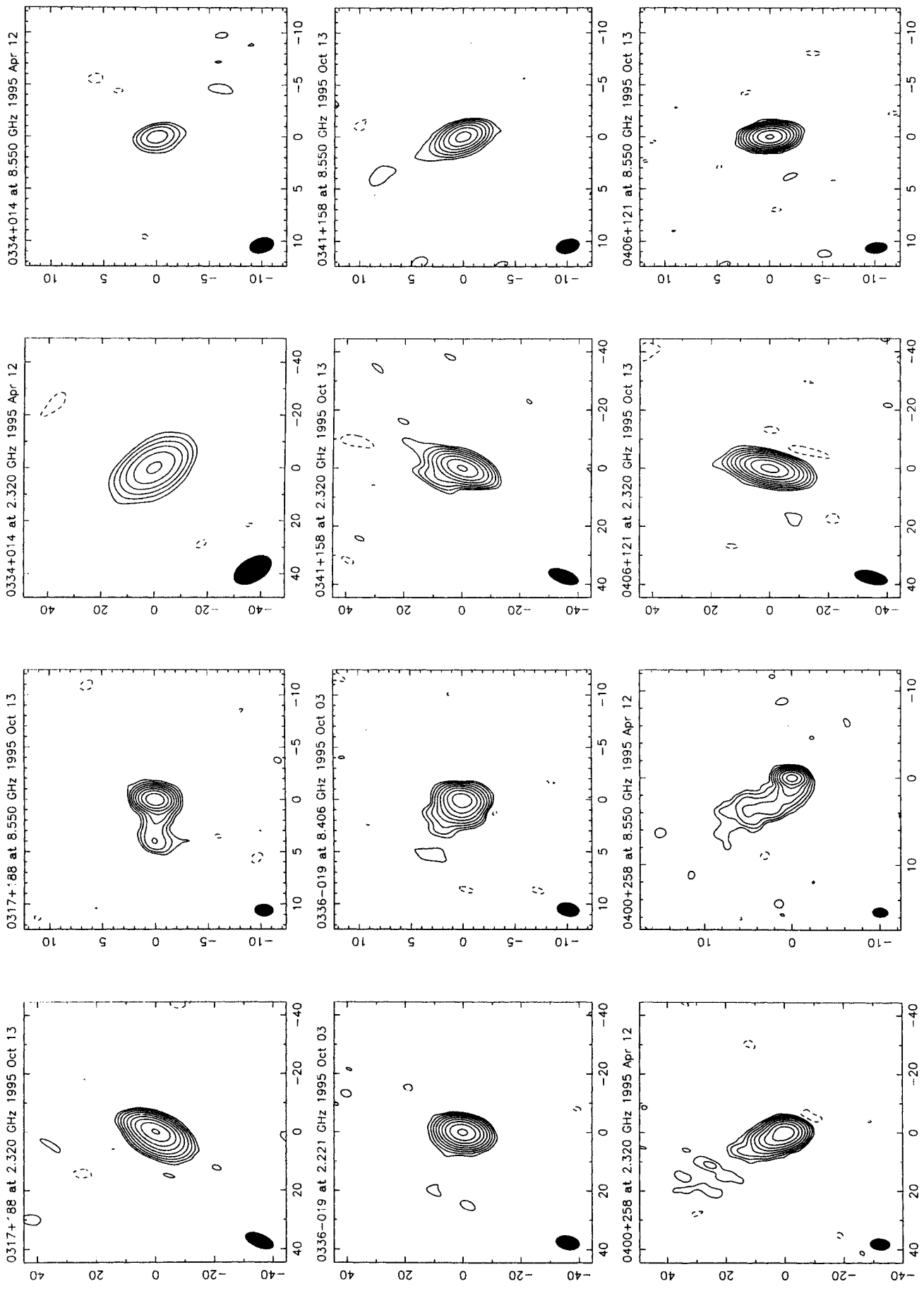

0146+056 at X Band 1996 Apr 23
Mean= 18.2 RMS= 24.7 Med= 14.5 Max= 70.7
0201+113 at X Band 1995 Oct 13
Mean= 10.5 RMS= 13.2 Med= 9.5 Max= 40.6
0212+735 at X Band 1994 Jul 08
Mean= 8.9 RMS= 11.9 Med= 6.7 Max= 54.6
0146+056 at S Band 1996 Apr 23
Mean= 0.5 RMS= 0.7 Med= 0.4 Max= 3.1
0201+113 at S Band 1995 Oct 13
Mean= 0.3 RMS= 0.4 Med= 0.2 Max= 2.2
0212+735 at S Band 1994 Jul 08
Mean= 13.2 RMS= 20.0 Med= 8.0 Max= 198.8
0138-097 at X Band 1995 Oct 13
Mean= 14.2 RMS= 20.6 Med= 8.1 Max= 64.3
0153+744 at X Band 1995 Apr 12
Mean= 89.1 RMS= 119.7 Med= 69.0 Max=1736.4
0202+149 at X Band 1996 Apr 23
Mean= 12.9 RMS= 17.1 Med= 9.5 Max= 58.7
0138-097 at S Band 1995 Oct 13
Mean= 1.6 RMS= 2.1 Med= 1.2 Max= 6.4
0153+744 at S Band 1995 Apr 12
Mean= 20.5 RMS= 31.1 Med= 14.8 Max= 274.9
0202+149 at S Band 1996 Apr 23
Mean= 3.7 RMS= 4.9 Med= 3.0 Max= 19.4
PICOSECONDS

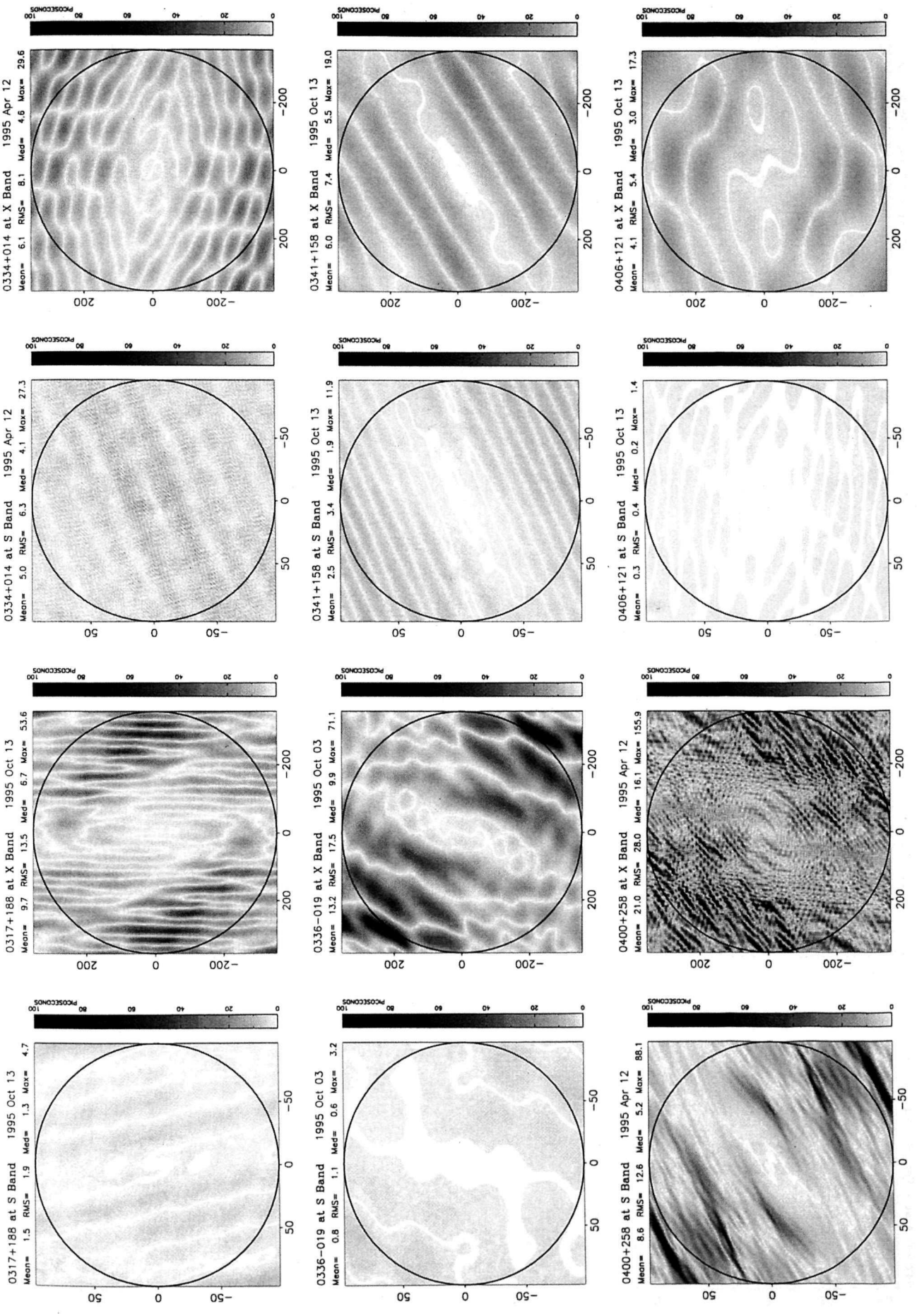

0221+067 at 8.550 GHz 1995 Oct 13
0234+285 at 8.550 GHz 1994 Jul 08
0237+040 at 8.550 GHz 1995 Oct 13
0221+067 at 2.320 GHz 1995 Oct 13
0234+285 at 2.320 GHz 1994 Jul 08
0237+040 at 2.320 GHz 1995 Oct 13
0215+015 at 8.550 GHz 1995 Oct 13
0229+131 at 8.550 GHz 1995 Apr 12
0235+164 at 8.596 GHz 1996 Apr 23
0215+015 at 2.320 GHz 1995 Oct 13
0229+131 at 2.320 GHz 1995 Apr 12
0235+164 at 2.361 GHz 1996 Apr 23

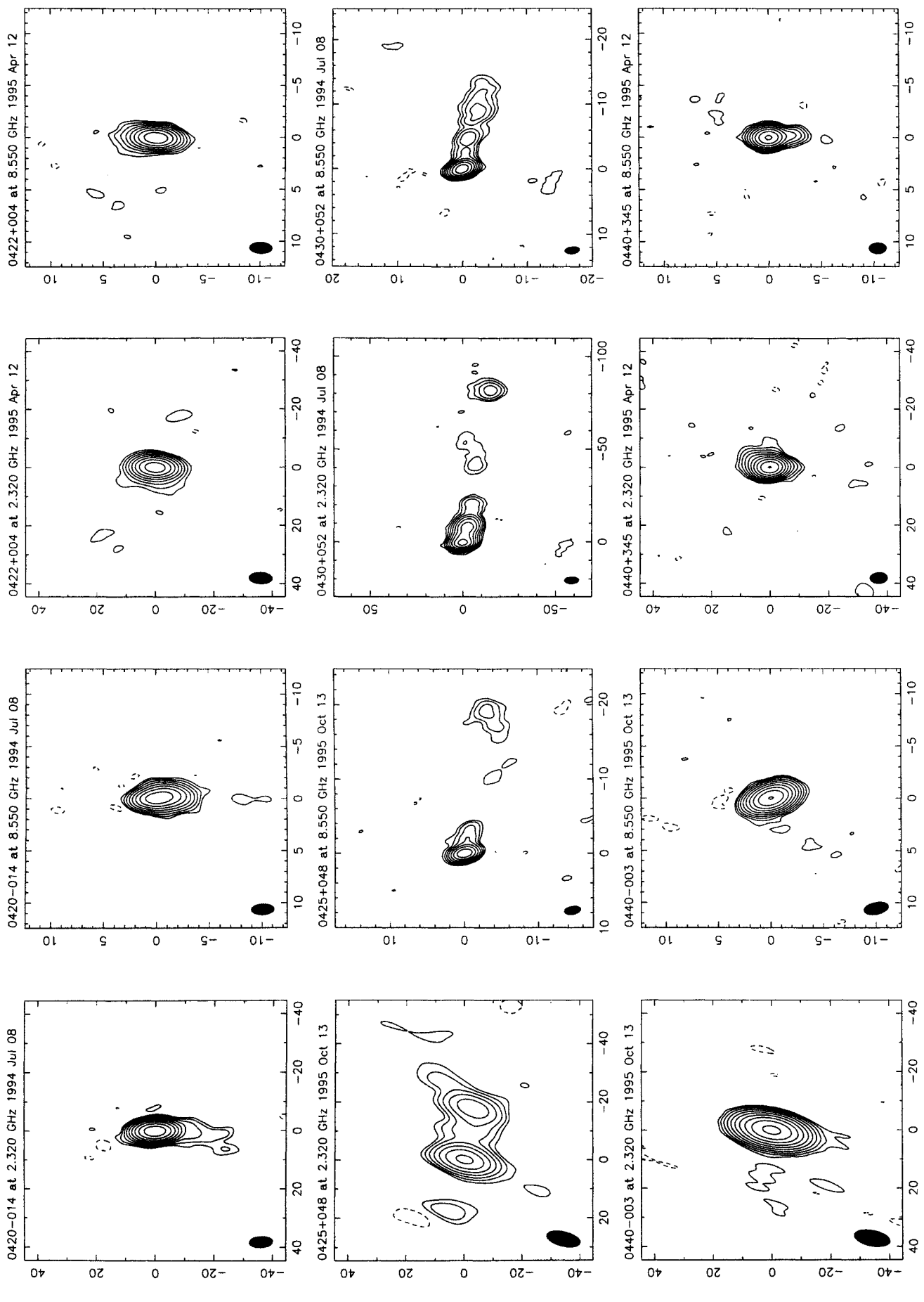

0221+067 at X Band 1995 Oct 13
Mean= 5.1 RMS= 7.2 Med= 3.6 Max= 34.4
0234+285 at X Band 1994 Jul 08
Mean= 20.6 RMS= 28.7 Med= 14.4 Max= 163.2
0237+040 at X Band 1995 Oct 13
Mean= 6.0 RMS= 7.8 Med= 4.8 Max= 21.8
0221+067 at S Band 1995 Oct 13
Mean= 3.7 RMS= 4.6 Med= 3.2 Max= 14.8
0234+285 at S Band 1994 Jul 08
Mean= 6.2 RMS= 8.2 Med= 4.8 Max= 35.5
0237+040 at S Band 1995 Oct 13
Mean= 0.7 RMS= 1.0 Med= 0.5 Max= 3.8
0215+015 at X Band 1995 Oct 13
Mean= 2.1 RMS= 2.9 Med= 1.5 Max= 13.6
0229+131 at X Band 1995 Apr 12
Mean= 5.8 RMS= 8.6 Med= 3.6 Max= 36.0
0235+164 at X Band 1996 Apr 23
Mean= 3.5 RMS= 4.7 Med= 2.7 Max= 16.9
0215+015 at S Band 1995 Oct 13
Mean= 1.9 RMS= 2.4 Med= 1.5 Max= 8.8
0229+131 at S Band 1995 Apr 12
Mean= 2.4 RMS= 3.2 Med= 1.9 Max= 11.9
0235+164 at S Band 1996 Apr 23
Mean= 0.5 RMS= 0.7 Med= 0.4 Max= 1.9
PICOSECONDS

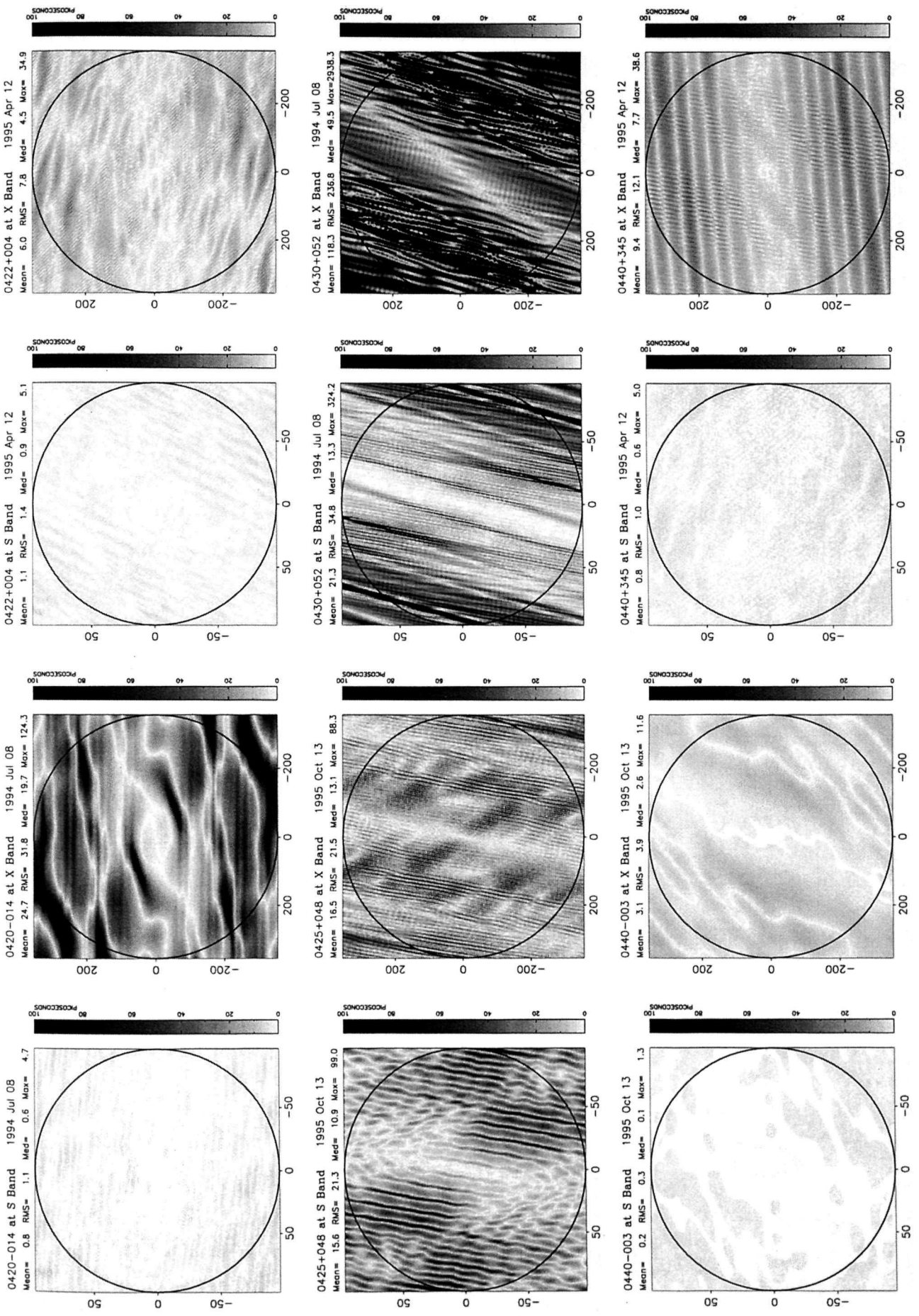

0238−084 at 8.550 GHz 1995 Apr 12
0259+121 at 8.550 GHz 1995 Apr 12
0302+625 at 8.550 GHz 1995 Oct 13
0238−084 at 2.320 GHz 1995 Apr 12
0259+121 at 2.320 GHz 1995 Apr 12
0302+625 at 2.320 GHz 1995 Oct 13
0237−233 at 8.550 GHz 1994 Jul 08
0239+108 at 8.596 GHz 1996 Apr 23
0300+470 at 8.550 GHz 1994 Jul 08
0237−233 at 2.320 GHz 1994 Jul 08
0239+108 at 2.361 GHz 1996 Apr 23
0300+470 at 2.320 GHz 1994 Jul 08

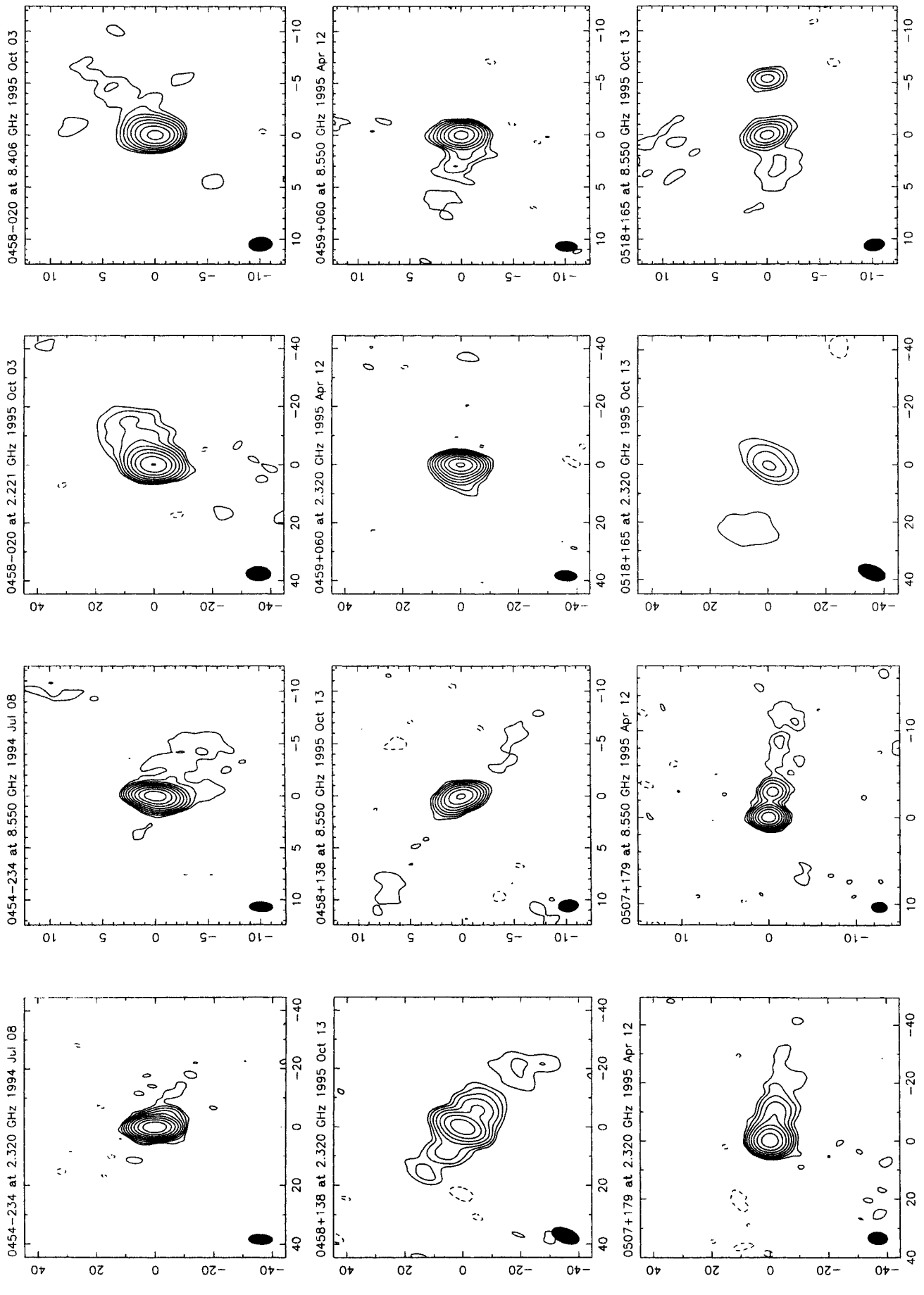

0238-084 at X Band 1995 Apr 12
Mean= 96.3 RMS= 191.0 Med= 44.7 Max=2240.8
0259+121 at X Band 1995 Apr 12
Mean= 24.4 RMS= 33.0 Med= 17.9 Max= 146.7
0302+625 at X Band 1995 Oct 13
Mean= 7.6 RMS= 10.1 Med= 5.9 Max= 54.5
0238-084 at S Band 1995 Apr 12
Mean= 11.5 RMS= 16.3 Med= 7.7 Max= 57.6
0259+121 at S Band 1995 Apr 12
Mean= 1.6 RMS= 2.0 Med= 1.3 Max= 7.1
0302+625 at S Band 1995 Oct 13
Mean= 0.8 RMS= 1.1 Med= 0.6 Max= 2.9
0237-233 at X Band 1994 Jul 08
Mean= 345.0 RMS= 500.9 Med= 238.0 Max=2422.3
0239+108 at X Band 1996 Apr 23
Mean= 8.4 RMS= 10.7 Med= 7.0 Max= 47.0
0300+470 at X Band 1994 Jul 08
Mean= 7.7 RMS= 9.8 Med= 6.7 Max= 27.5
0237-233 at S Band 1994 Jul 08
Mean= 29.3 RMS= 55.9 Med= 12.7 Max= 514.4
0239+108 at S Band 1996 Apr 23
Mean= 15.6 RMS= 25.0 Med= 8.2 Max= 133.4
0300+470 at S Band 1994 Jul 08
Mean= 1.8 RMS= 2.3 Med= 1.6 Max= 6.9
PICOSECONDS

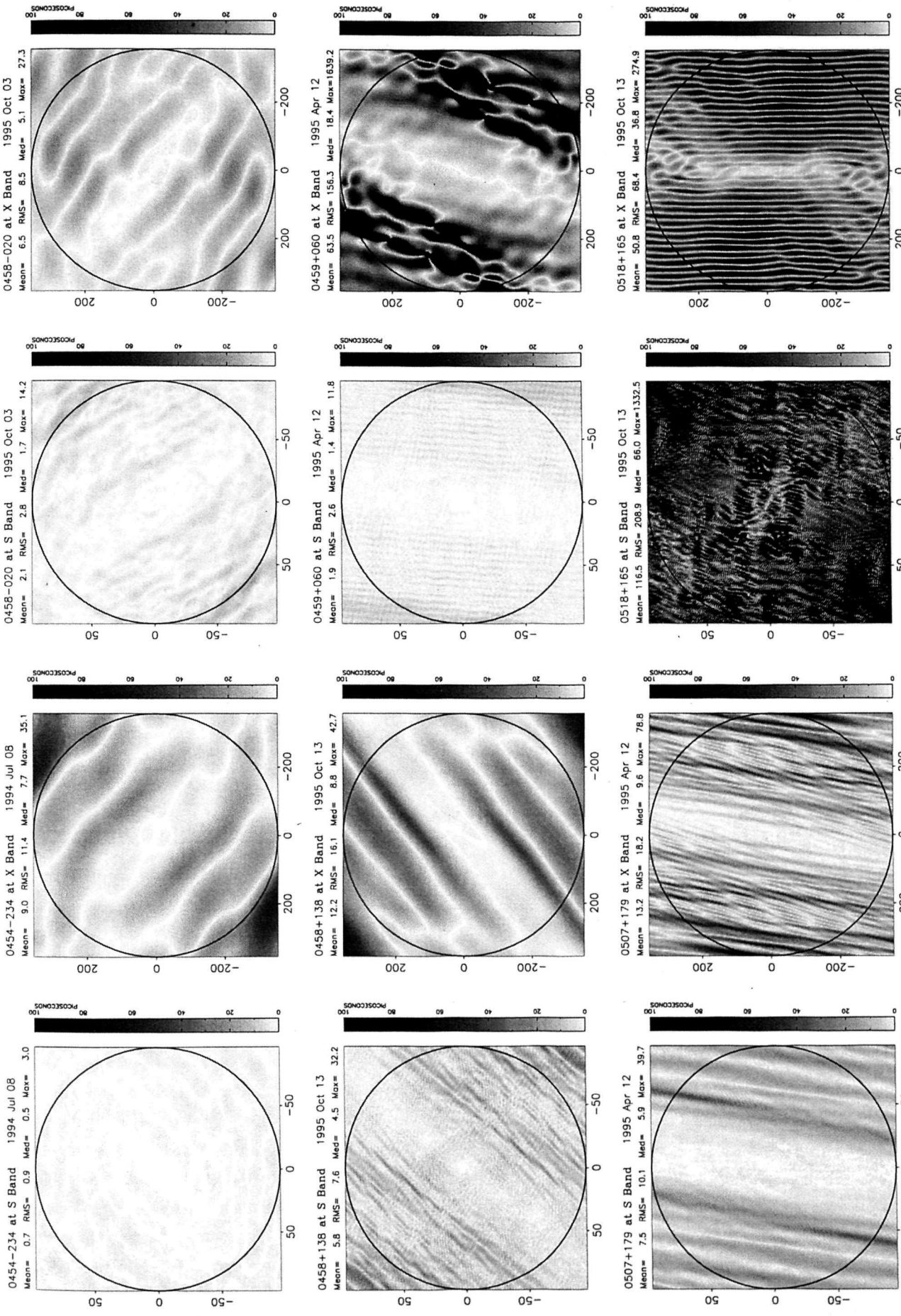

0317+'88 at 2.320 GHz 1995 Oct 13
0317+'88 at 8.550 GHz 1995 Oct 13
0334+014 at 2.320 GHz 1995 Apr 12
0334+014 at 8.550 GHz 1995 Apr 12
0336−019 at 2.221 GHz 1995 Oct 03
0336−019 at 8.406 GHz 1995 Oct 03
0341+158 at 2.320 GHz 1995 Oct 13
0341+158 at 8.550 GHz 1995 Oct 13
0400+258 at 2.320 GHz 1995 Apr 12
0400+258 at 8.550 GHz 1995 Apr 12
0406+121 at 2.320 GHz 1995 Oct 13
0406+121 at 8.550 GHz 1995 Oct 13

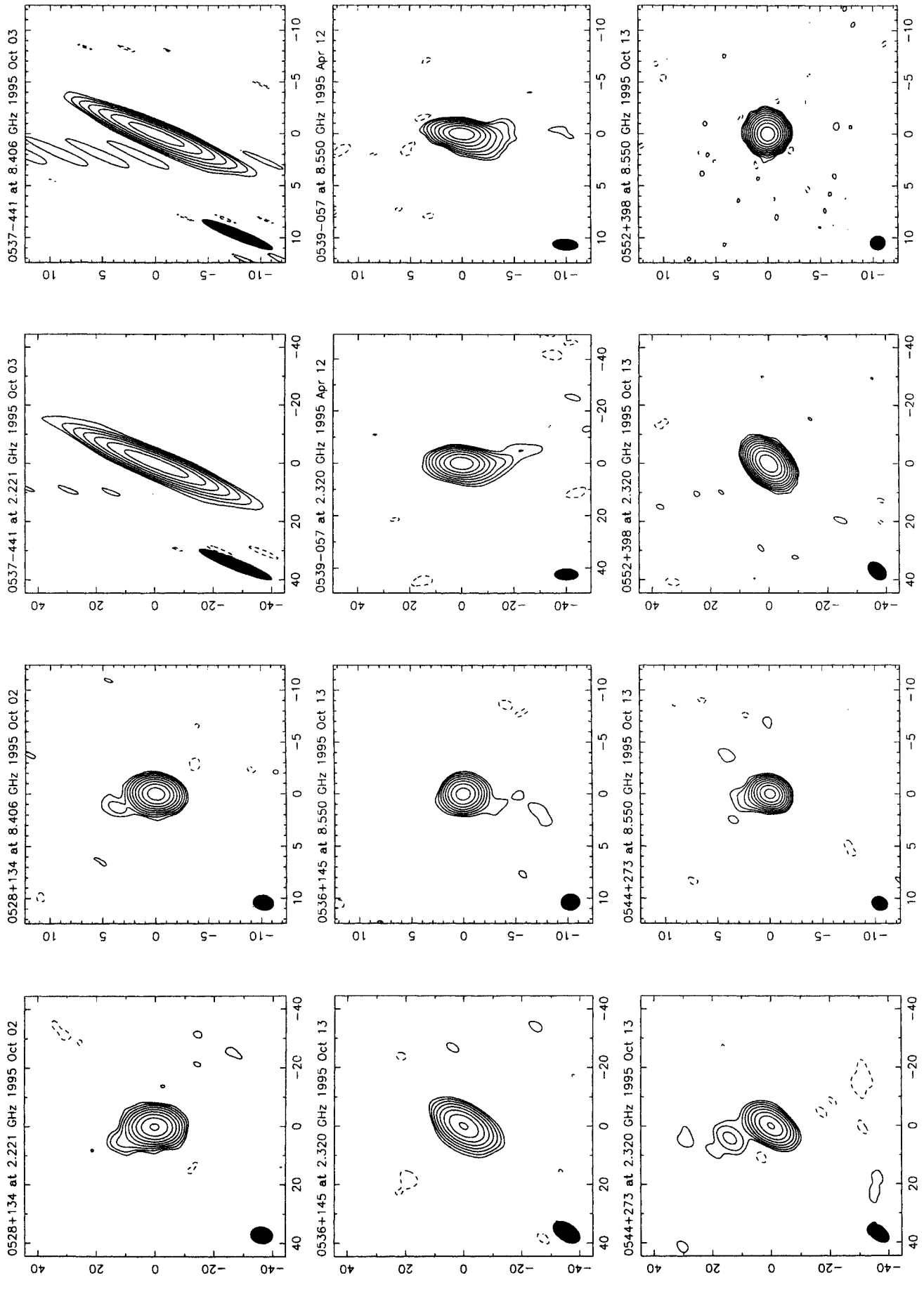

0334+014 at X Band 1995 Apr 12
Mean= 6.1 RMS= 8.1 Med= 4.6 Max= 29.6
0341+158 at X Band 1995 Oct 13
Mean= 6.0 RMS= 7.4 Med= 5.5 Max= 19.0
0406+121 at X Band 1995 Oct 13
Mean= 4.1 RMS= 5.4 Med= 3.0 Max= 17.3
0334+014 at S Band 1995 Apr 12
Mean= 5.0 RMS= 6.3 Med= 4.1 Max= 27.3
0341+158 at S Band 1995 Oct 13
Mean= 2.5 RMS= 3.4 Med= 1.9 Max= 11.9
0406+121 at S Band 1995 Oct 13
Mean= 0.3 RMS= 0.4 Med= 0.2 Max= 1.4
0317+188 at X Band 1995 Oct 13
Mean= 9.7 RMS= 13.5 Med= 6.7 Max= 53.6
0336-019 at X Band 1995 Oct 03
Mean= 13.2 RMS= 17.5 Med= 9.9 Max= 71.1
0400+258 at X Band 1995 Apr 12
Mean= 21.0 RMS= 28.0 Med= 16.1 Max= 155.9
0317+188 at S Band 1995 Oct 13
Mean= 1.5 RMS= 1.9 Med= 1.3 Max= 4.7
0336-019 at S Band 1995 Oct 03
Mean= 0.8 RMS= 1.1 Med= 0.6 Max= 3.2
0400+258 at S Band 1995 Apr 12
Mean= 8.6 RMS= 12.6 Med= 5.2 Max= 88.1
PICOSECONDS

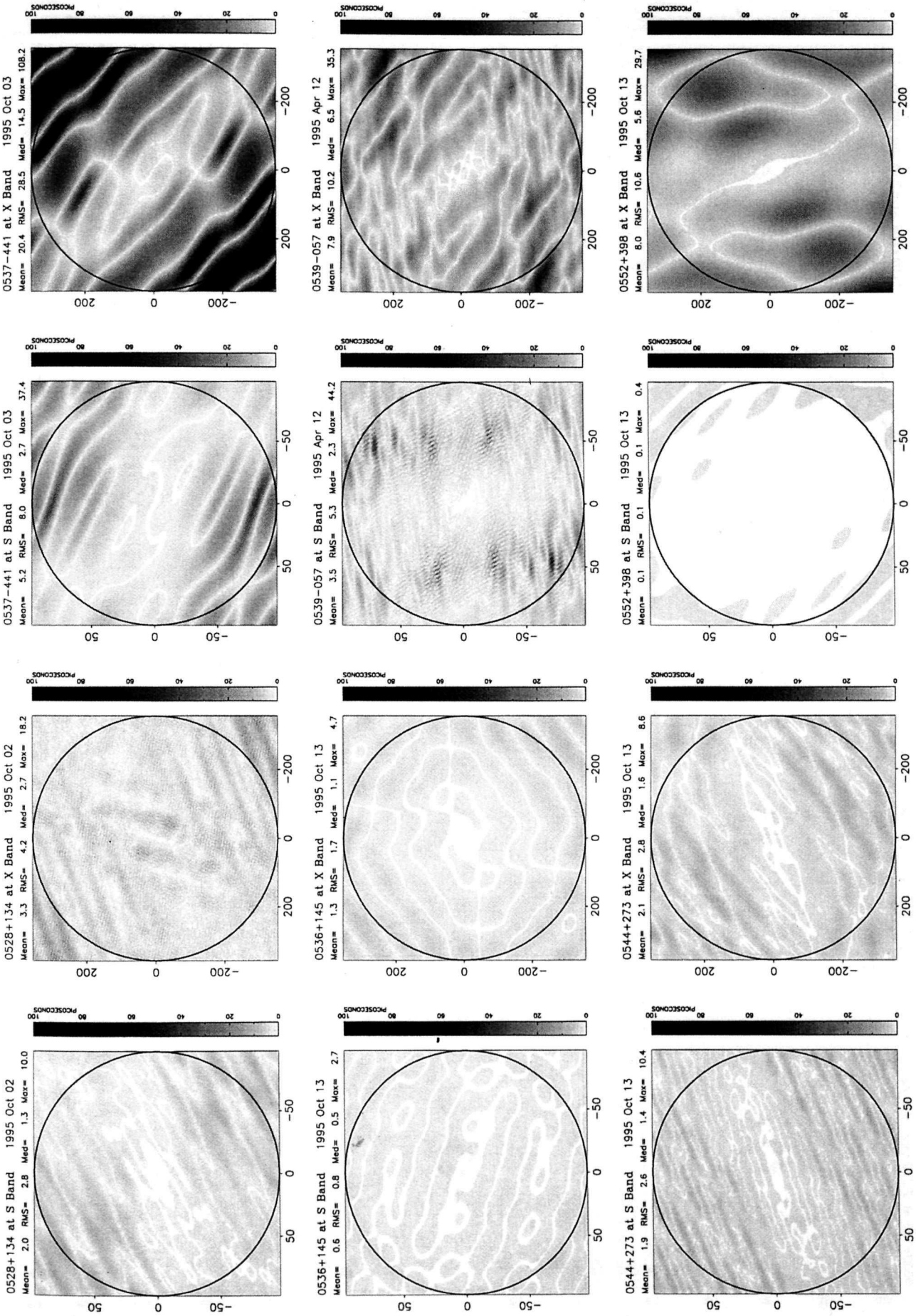

0420−014 at 2.320 GHz 1994 Jul 08
0420−014 at 8.550 GHz 1994 Jul 08
0422+004 at 2.320 GHz 1995 Apr 12
0422+004 at 8.550 GHz 1995 Apr 12
0425+048 at 2.320 GHz 1995 Oct 13
0425+048 at 8.550 GHz 1995 Oct 13
0430+052 at 2.320 GHz 1994 Jul 08
0430+052 at 8.550 GHz 1994 Jul 08
0440−003 at 2.320 GHz 1995 Oct 13
0440−003 at 8.550 GHz 1995 Oct 13
0440+345 at 2.320 GHz 1995 Apr 12
0440+345 at 8.550 GHz 1995 Apr 12

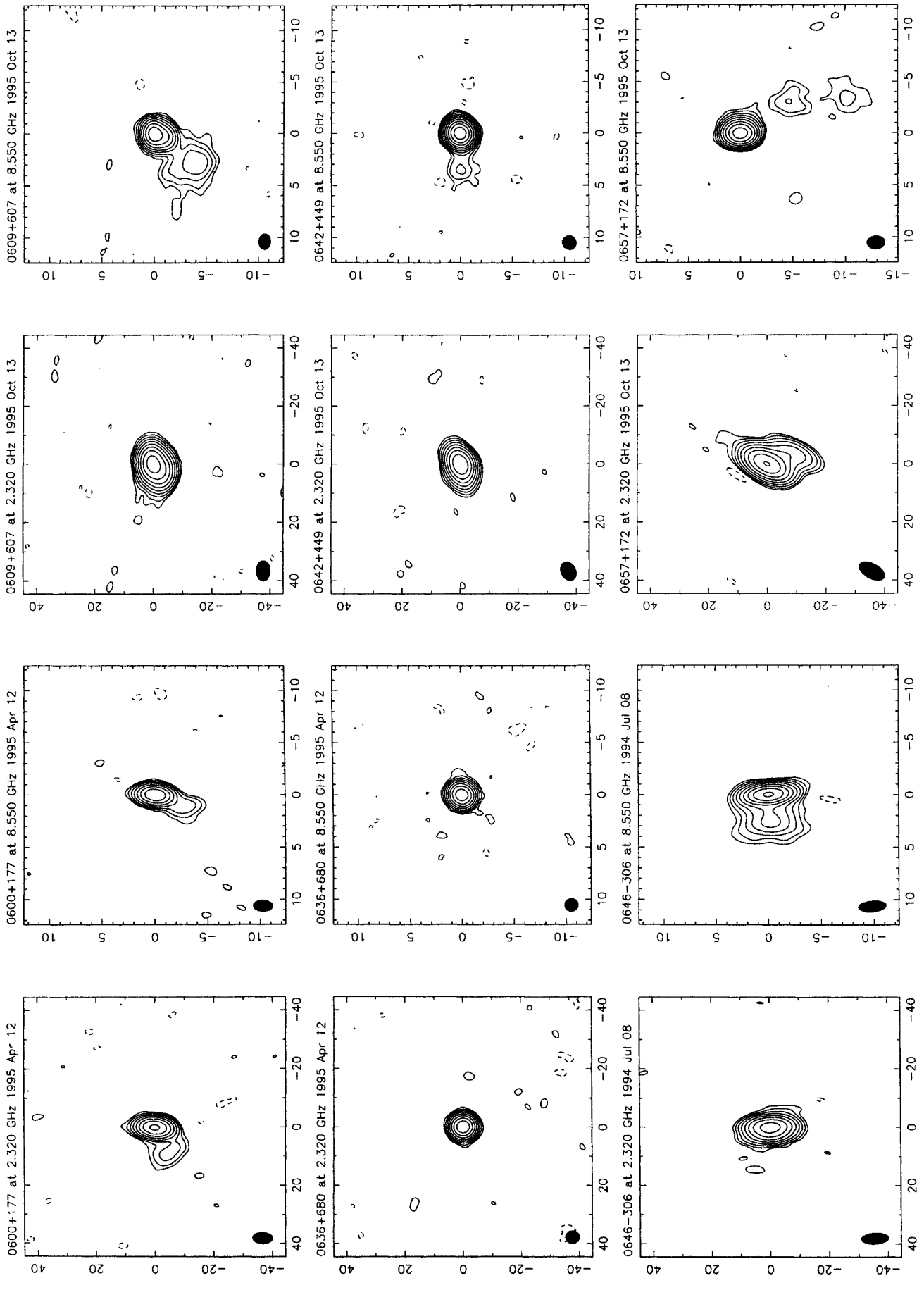

0422+004 at X Band 1995 Apr 12
Mean= 6.0 RMS= 7.8 Med= 4.5 Max= 34.9
0430+052 at X Band 1994 Jul 08
Mean= 118.3 RMS= 236.8 Med= 49.5 Max=2938.3
0440+345 at X Band 1995 Apr 12
Mean= 9.4 RMS= 12.1 Med= 7.7 Max= 38.6
0422+004 at S Band 1995 Apr 12
Mean= 1.1 RMS= 1.4 Med= 0.9 Max= 5.1
0430+052 at S Band 1994 Jul 08
Mean= 21.3 RMS= 34.8 Med= 13.3 Max= 324.2
0440+345 at S Band 1995 Apr 12
Mean= 0.8 RMS= 1.0 Med= 0.6 Max= 5.0
0420-014 at X Band 1994 Jul 08
Mean= 24.7 RMS= 31.8 Med= 19.7 Max= 124.3
0425+048 at X Band 1995 Oct 13
Mean= 16.5 RMS= 21.5 Med= 13.1 Max= 88.3
0440-003 at X Band 1995 Oct 13
Mean= 3.1 RMS= 3.9 Med= 2.6 Max= 11.6
0420-014 at S Band 1994 Jul 08
Mean= 0.8 RMS= 1.1 Med= 0.6 Max= 4.7
0425+048 at S Band 1995 Oct 13
Mean= 15.6 RMS= 21.3 Med= 10.9 Max= 99.0
0440-003 at S Band 1995 Oct 13
Mean= 0.2 RMS= 0.3 Med= 0.1 Max= 1.3
PICOSECONDS

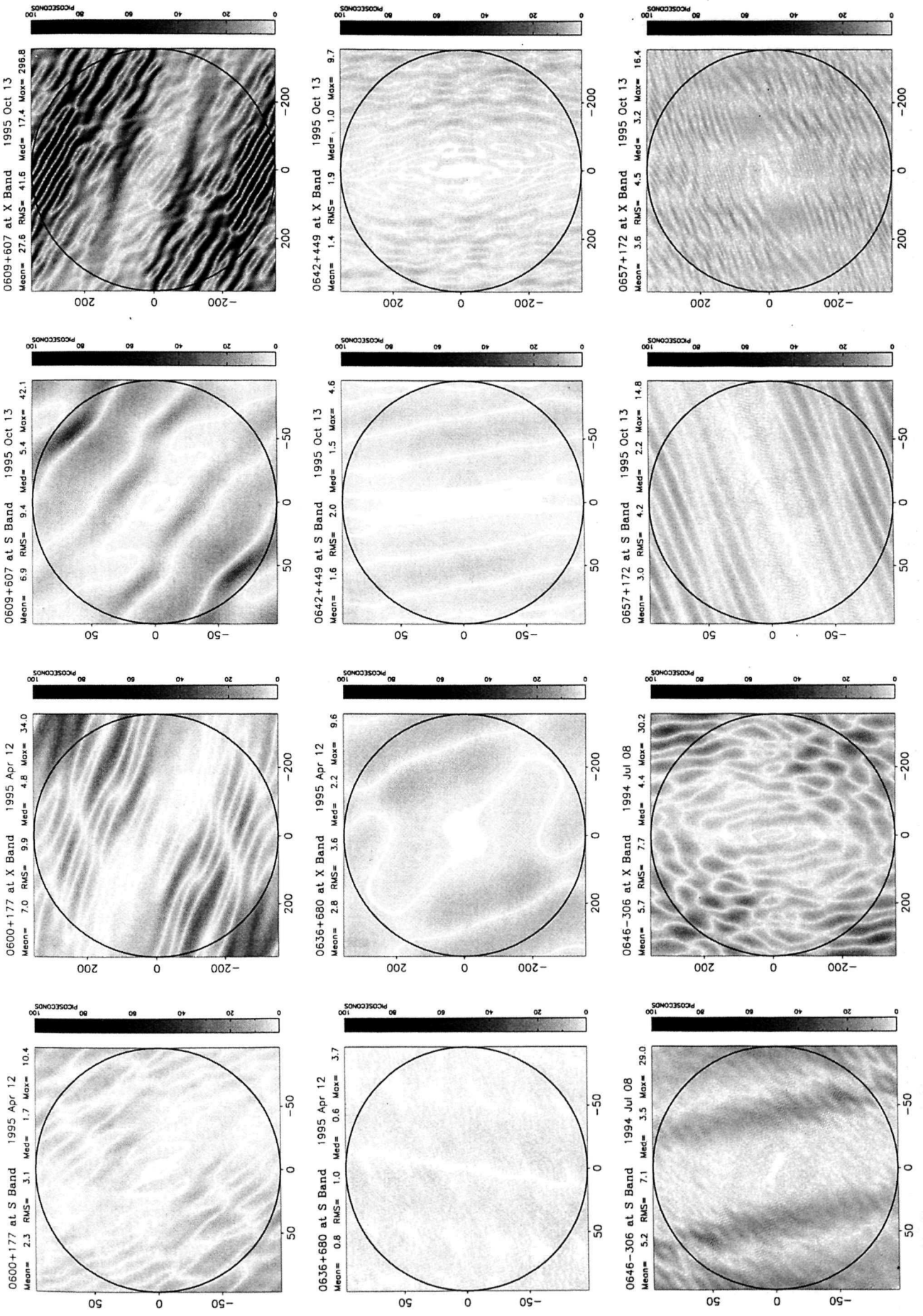

0454−234 at 2.320 GHz 1994 Jul 08
0454−234 at 8.550 GHz 1994 Jul 08
0458−020 at 2.221 GHz 1995 Oct 03
0458−020 at 8.406 GHz 1995 Oct 03
0458+138 at 2.320 GHz 1995 Oct 13
0458+138 at 8.550 GHz 1995 Oct 13
0459+060 at 2.320 GHz 1995 Apr 12
0459+060 at 8.550 GHz 1995 Apr 12
0507+179 at 2.320 GHz 1995 Apr 12
0507+179 at 8.550 GHz 1995 Apr 12
0518+165 at 2.320 GHz 1995 Oct 13
0518+165 at 8.550 GHz 1995 Oct 13

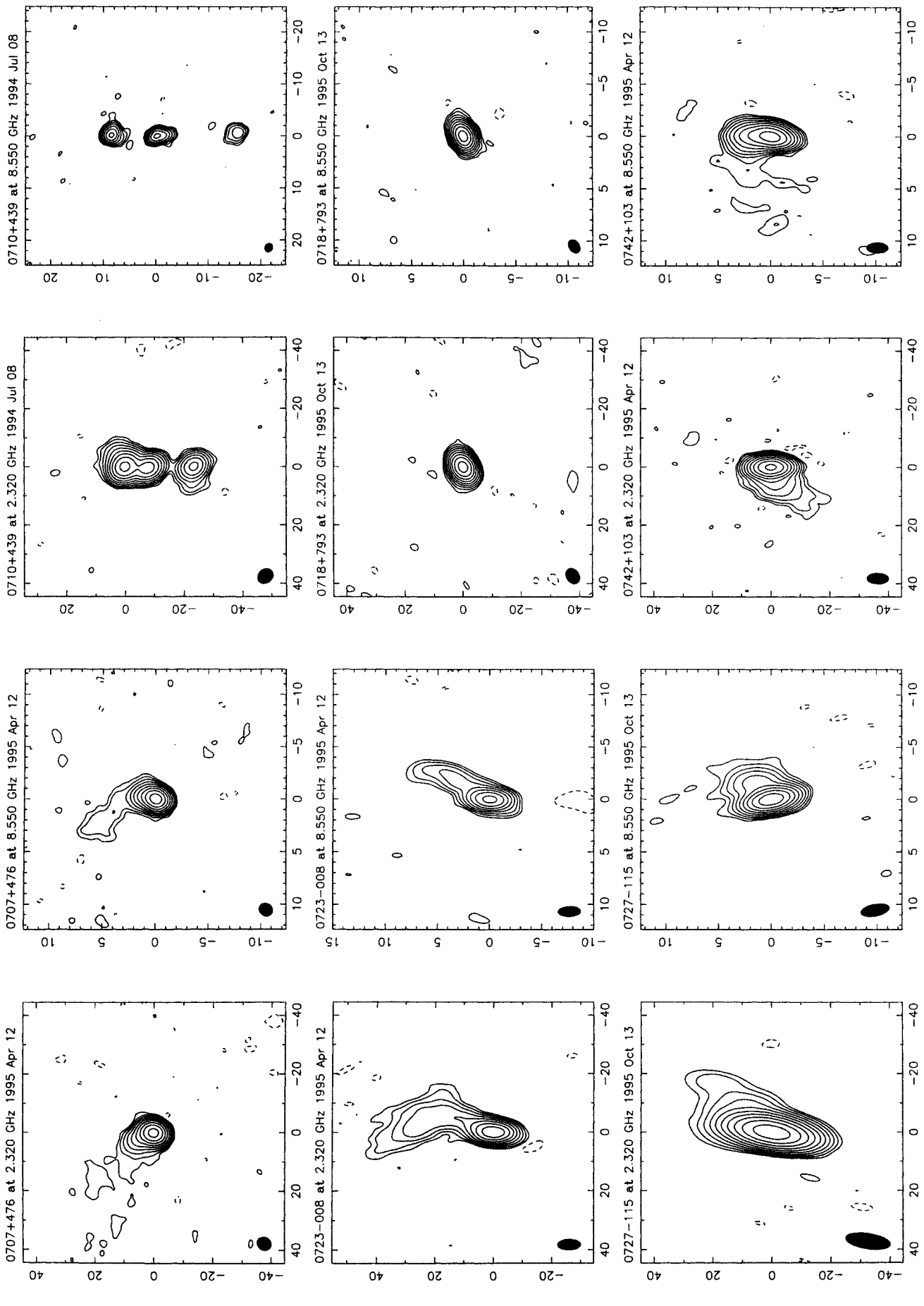

0458-020 at X Band 1995 Oct 03
Mean= 6.5 RMS= 8.5 Med= 5.1 Max= 27.3
0459+060 at X Band 1995 Apr 12
Mean= 63.5 RMS= 156.3 Med= 18.4 Max=1639.2
0518+165 at X Band 1995 Oct 13
Mean= 50.8 RMS= 68.4 Med= 36.8 Max= 274.9
0458-020 at S Band 1995 Oct 03
Mean= 2.1 RMS= 2.8 Med= 1.7 Max= 14.2
0459+060 at S Band 1995 Apr 12
Mean= 1.9 RMS= 2.6 Med= 1.4 Max= 11.8
0518+165 at S Band 1995 Oct 13
Mean= 116.5 RMS= 208.9 Med= 66.0 Max=1332.5
0454-234 at X Band 1994 Jul 08
Mean= 9.0 RMS= 11.4 Med= 7.7 Max= 35.1
0458+138 at X Band 1995 Oct 13
Mean= 12.2 RMS= 16.1 Med= 8.8 Max= 42.7
0507+179 at X Band 1995 Apr 12
Mean= 13.2 RMS= 18.2 Med= 9.6 Max= 78.8
0454-234 at S Band 1994 Jul 08
Mean= 0.7 RMS= 0.9 Med= 0.5 Max= 3.0
0458+138 at S Band 1995 Oct 13
Mean= 5.8 RMS= 7.6 Med= 4.5 Max= 32.2
0507+179 at S Band 1995 Apr 12
Mean= 7.5 RMS= 10.1 Med= 5.9 Max= 39.7
PICOSECONDS

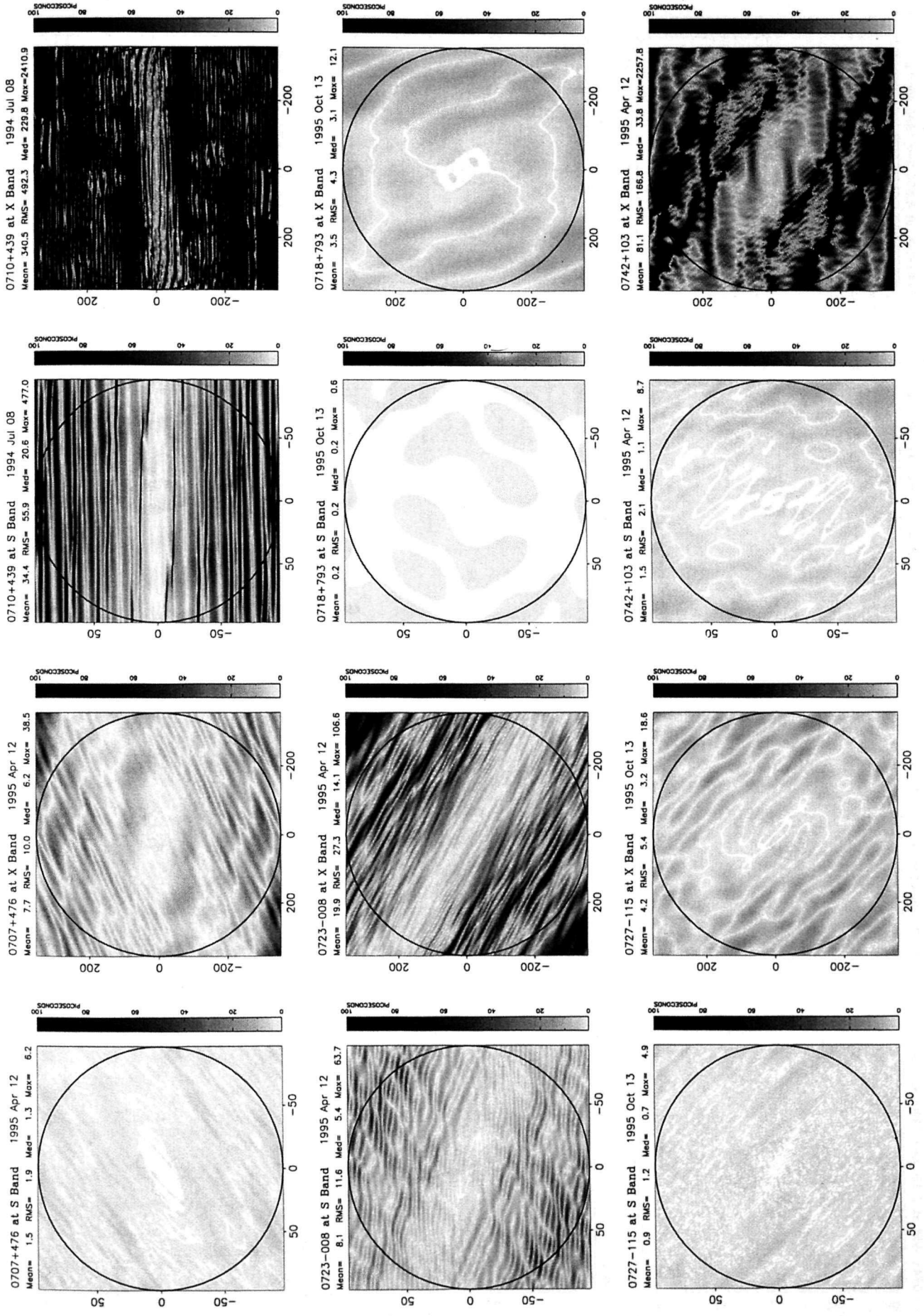

0528+134 at 2.221 GHz 1995 Oct 02
0528+134 at 8.406 GHz 1995 Oct 02
0537−441 at 2.221 GHz 1995 Oct 03
0537−441 at 8.406 GHz 1995 Oct 03
0536+145 at 2.320 GHz 1995 Oct 13
0536+145 at 8.550 GHz 1995 Oct 13
0539−057 at 2.320 GHz 1995 Apr 12
0539−057 at 8.550 GHz 1995 Apr 12
0544+273 at 2.320 GHz 1995 Oct 13
0544+273 at 8.550 GHz 1995 Oct 13
0552+398 at 2.320 GHz 1995 Oct 13
0552+398 at 8.550 GHz 1995 Oct 13

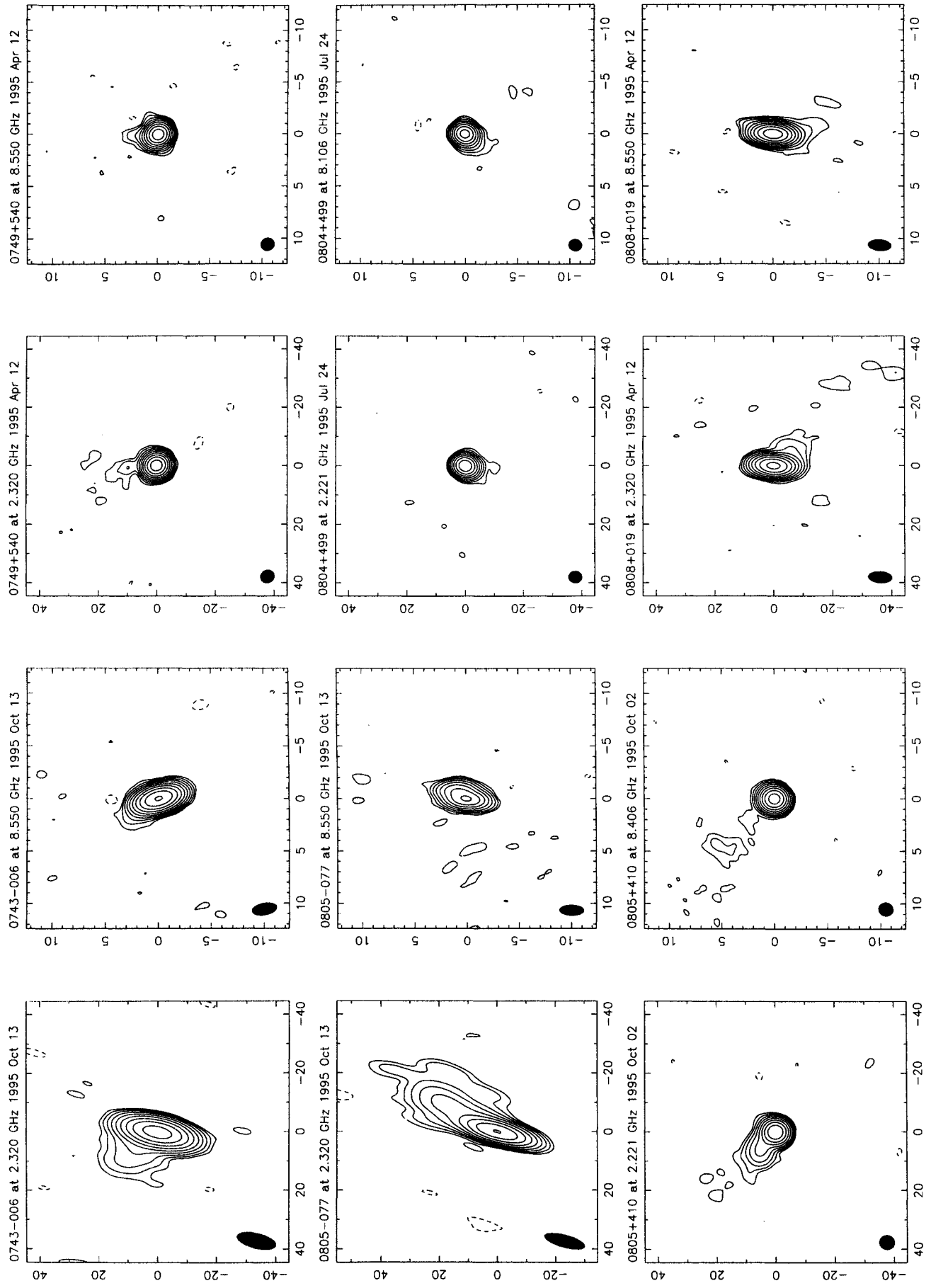

0537−441 at X Band 1995 Oct 03
Mean= 20.4 RMS= 28.5 Med= 14.5 Max= 108.2
0539−057 at X Band 1995 Apr 12
Mean= 7.9 RMS= 10.2 Med= 6.5 Max= 35.3
0552+398 at X Band 1995 Oct 13
Mean= 8.0 RMS= 10.6 Med= 5.6 Max= 29.7
0537−441 at S Band 1995 Oct 03
Mean= 5.2 RMS= 8.0 Med= 2.7 Max= 37.4
0539−057 at S Band 1995 Apr 12
Mean= 3.5 RMS= 5.3 Med= 2.3 Max= 44.2
0552+398 at S Band 1995 Oct 13
Mean= 0.1 RMS= 0.1 Med= 0.1 Max= 0.4
0528+134 at X Band 1995 Oct 02
Mean= 3.3 RMS= 4.2 Med= 2.7 Max= 18.2
0536+145 at X Band 1995 Oct 13
Mean= 1.3 RMS= 1.7 Med= 1.1 Max= 4.7
0544+273 at X Band 1995 Oct 13
Mean= 2.1 RMS= 2.8 Med= 1.6 Max= 8.6
0528+134 at S Band 1995 Oct 02
Mean= 2.0 RMS= 2.8 Med= 1.3 Max= 10.0
0536+145 at S Band 1995 Oct 13
Mean= 0.6 RMS= 0.8 Med= 0.5 Max= 2.7
0544+273 at S Band 1995 Oct 13
Mean= 1.9 RMS= 2.6 Med= 1.4 Max= 10.4
PICOSECONDS

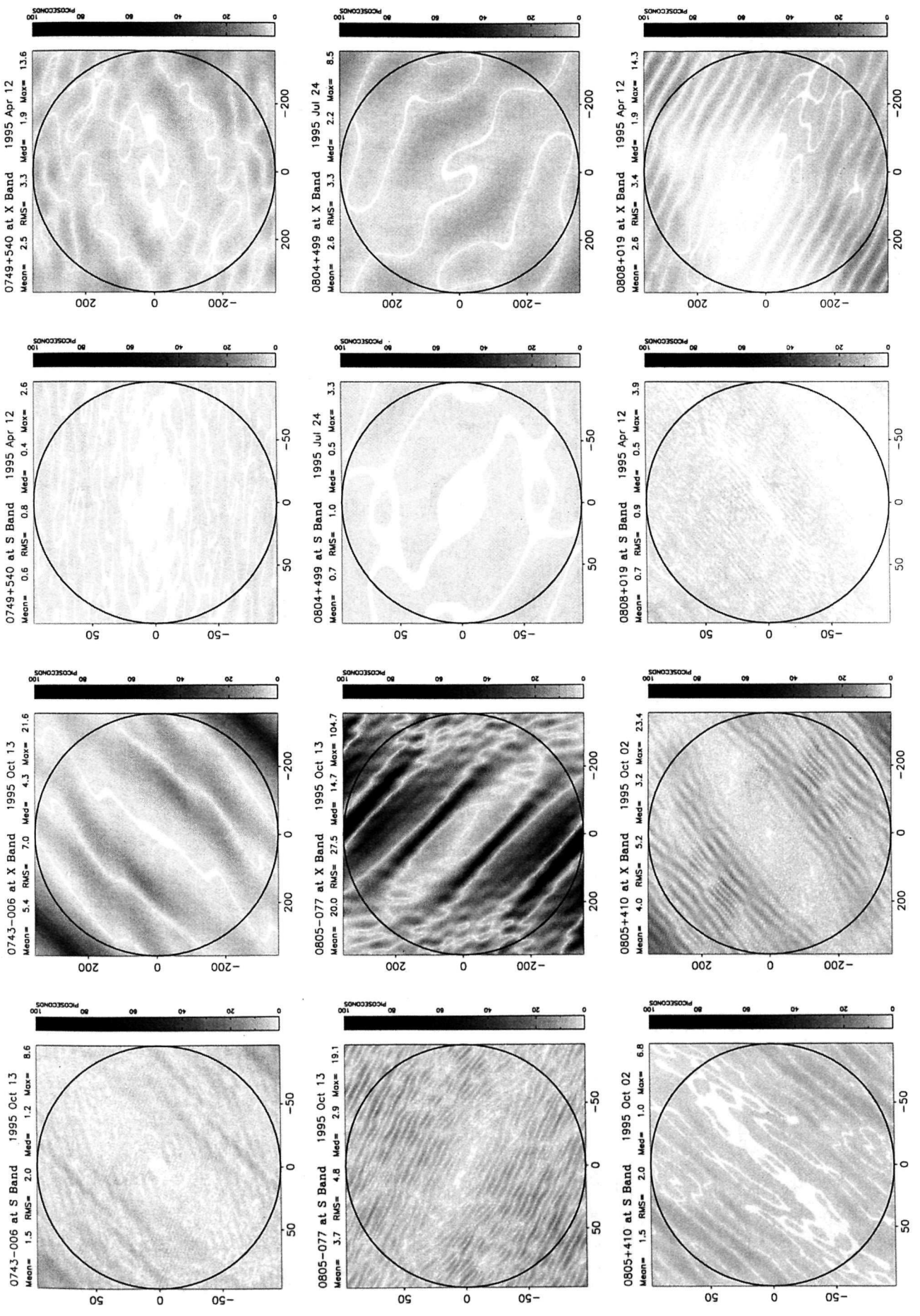

0600+177 at 2.320 GHz 1995 Apr 12
0600+177 at 8.550 GHz 1995 Apr 12
0609+607 at 2.320 GHz 1995 Oct 13
0609+607 at 8.550 GHz 1995 Oct 13
0636+680 at 2.320 GHz 1995 Apr 12
0636+680 at 8.550 GHz 1995 Apr 12
0642+449 at 2.320 GHz 1995 Oct 13
0642+449 at 8.550 GHz 1995 Oct 13
0646−306 at 2.320 GHz 1994 Jul 08
0646−306 at 8.550 GHz 1994 Jul 08
0657+172 at 2.320 GHz 1995 Oct 13
0657+172 at 8.550 GHz 1995 Oct 13

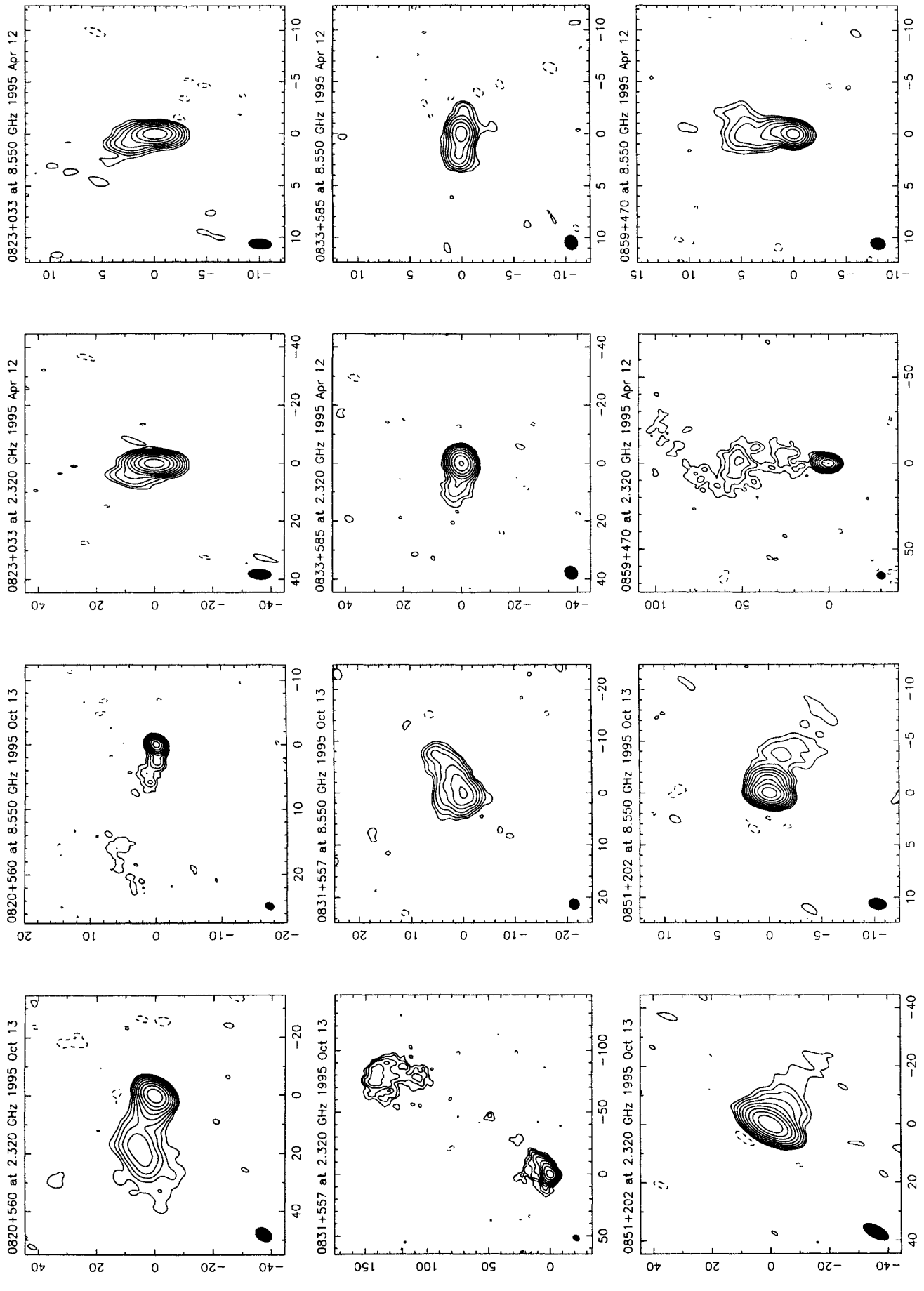

0609+607 at X Band 1995 Oct 13
Mean= 27.6 RMS= 41.6 Med= 17.4 Max= 296.8
0642+449 at X Band 1995 Oct 13
Mean= 1.4 RMS= 1.9 Med= 1.0 Max= 9.7
0657+172 at X Band 1995 Oct 13
Mean= 3.6 RMS= 4.5 Med= 3.2 Max= 16.4
0609+607 at S Band 1995 Oct 13
Mean= 6.9 RMS= 9.4 Med= 5.4 Max= 42.1
0642+449 at S Band 1995 Oct 13
Mean= 1.6 RMS= 2.0 Med= 1.5 Max= 4.6
0657+172 at S Band 1995 Oct 13
Mean= 3.0 RMS= 4.2 Med= 2.2 Max= 14.8
0600+177 at X Band 1995 Apr 12
Mean= 7.0 RMS= 9.9 Med= 4.8 Max= 34.0
0636+680 at X Band 1995 Apr 12
Mean= 2.8 RMS= 3.6 Med= 2.2 Max= 9.6
0646-306 at X Band 1994 Jul 08
Mean= 5.7 RMS= 7.7 Med= 4.4 Max= 30.2
0600+177 at S Band 1995 Apr 12
Mean= 2.3 RMS= 3.1 Med= 1.7 Max= 10.4
0636+680 at S Band 1995 Apr 12
Mean= 0.8 RMS= 1.0 Med= 0.6 Max= 3.7
0646-306 at S Band 1994 Jul 08
Mean= 5.2 RMS= 7.1 Med= 3.5 Max= 29.0
PICOSECONDS

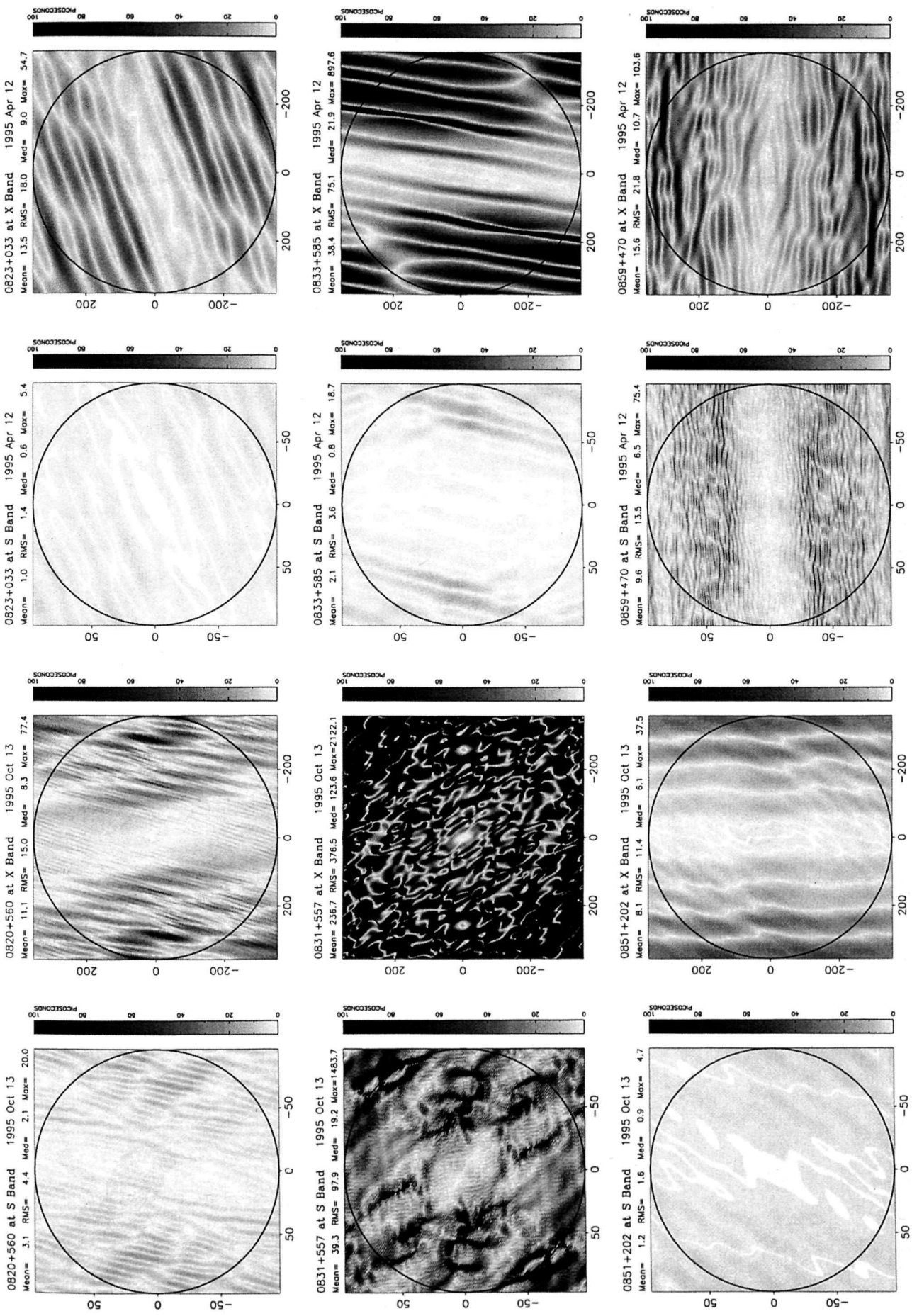

0707+476 at 2.320 GHz 1995 Apr 12
0707+476 at 8.550 GHz 1995 Apr 12
0710+439 at 2.320 GHz 1994 Jul 08
0710+439 at 8.550 GHz 1994 Jul 08
0723−008 at 2.320 GHz 1995 Apr 12
0723−008 at 8.550 GHz 1995 Apr 12
0718+793 at 2.320 GHz 1995 Oct 13
0718+793 at 8.550 GHz 1995 Oct 13
0727−115 at 2.320 GHz 1995 Oct 13
0727−115 at 8.550 GHz 1995 Oct 13
0742+103 at 2.320 GHz 1995 Apr 12
0742+103 at 8.550 GHz 1995 Apr 12

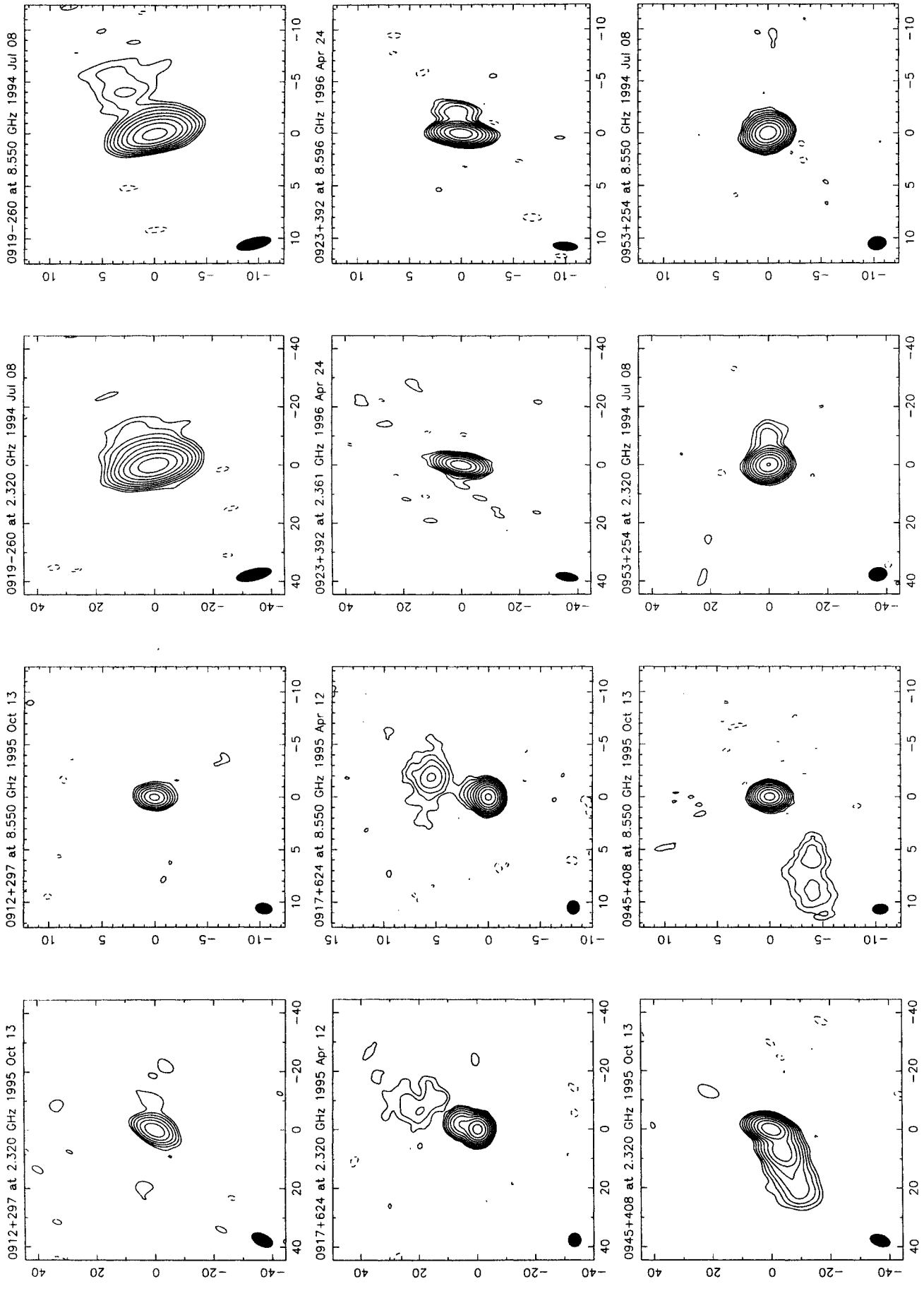

0710+439 at X Band 1994 Jul 08
Mean= 340.5 RMS= 492.3 Med= 229.8 Max=2410.9
0718+793 at X Band 1995 Oct 13
Mean= 3.5 RMS= 4.3 Med= 3.1 Max= 12.1
0742+103 at X Band 1995 Apr 12
Mean= 81.1 RMS= 166.8 Med= 33.8 Max=2257.8
0710+439 at S Band 1994 Jul 08
Mean= 34.4 RMS= 55.9 Med= 20.6 Max= 477.0
0718+793 at S Band 1995 Oct 13
Mean= 0.2 RMS= 0.2 Med= 0.2 Max= 0.6
0742+103 at S Band 1995 Apr 12
Mean= 1.5 RMS= 2.1 Med= 1.1 Max= 8.7
0707+476 at X Band 1995 Apr 12
Mean= 7.7 RMS= 10.0 Med= 6.2 Max= 38.5
0723-008 at X Band 1995 Apr 12
Mean= 19.9 RMS= 27.3 Med= 14.1 Max= 106.6
0727-115 at X Band 1995 Oct 13
Mean= 4.2 RMS= 5.4 Med= 3.2 Max= 18.6
0707+476 at S Band 1995 Apr 12
Mean= 1.5 RMS= 1.9 Med= 1.3 Max= 6.2
0723-008 at S Band 1995 Apr 12
Mean= 8.1 RMS= 11.6 Med= 5.4 Max= 63.7
0727-115 at S Band 1995 Oct 13
Mean= 0.9 RMS= 1.2 Med= 0.7 Max= 4.9
PICOSECONDS

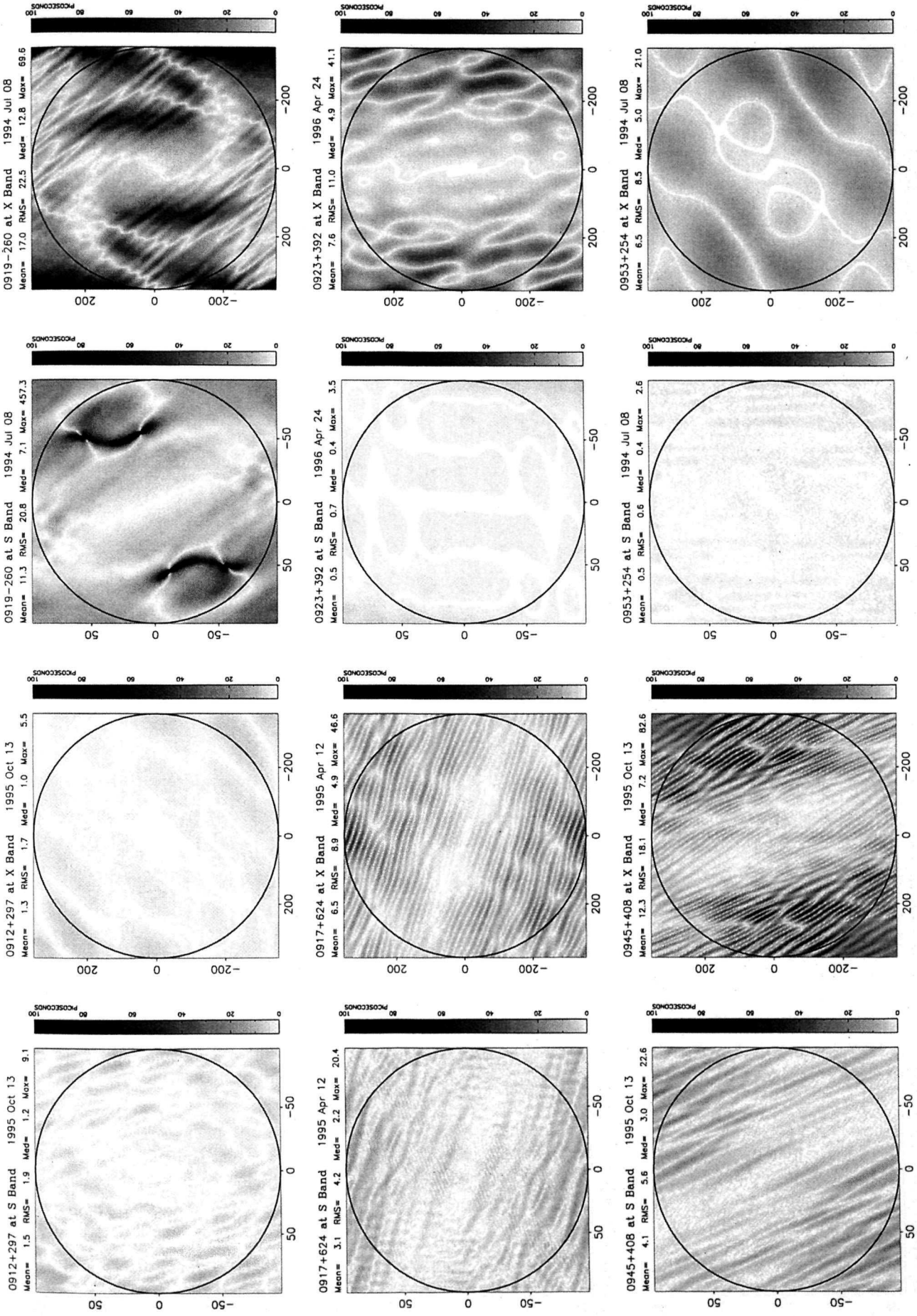

0743−006 at 2.320 GHz 1995 Oct 13
0743−006 at 8.550 GHz 1995 Oct 13
0749+540 at 2.320 GHz 1995 Apr 12
0749+540 at 8.550 GHz 1995 Apr 12
0804+499 at 2.221 GHz 1995 Jul 24
0804+499 at 8.106 GHz 1995 Jul 24
0805−077 at 2.320 GHz 1995 Oct 13
0805−077 at 8.550 GHz 1995 Oct 13
0805+410 at 2.221 GHz 1995 Oct 02
0805+410 at 8.406 GHz 1995 Oct 02
0808+019 at 2.320 GHz 1995 Apr 12
0808+019 at 8.550 GHz 1995 Apr 12

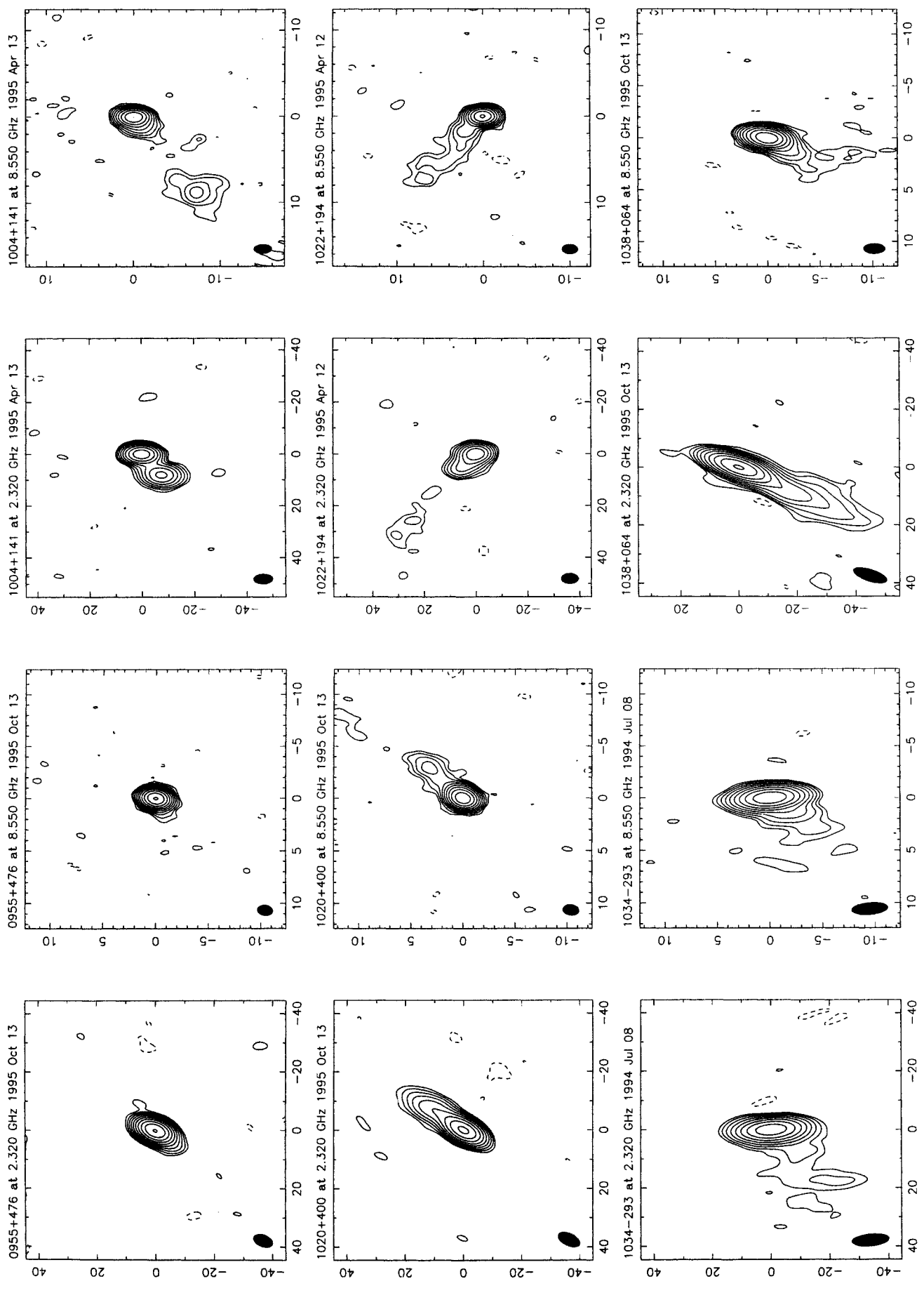

0749+540 at X Band 1995 Apr 12
Mean= 2.5 RMS= 3.3 Med= 1.9 Max= 13.6
0804+499 at X Band 1995 Jul 24
Mean= 2.6 RMS= 3.3 Med= 2.2 Max= 8.5
0808+019 at X Band 1995 Apr 12
Mean= 2.6 RMS= 3.4 Med= 1.9 Max= 14.3
0749+540 at S Band 1995 Apr 12
Mean= 0.6 RMS= 0.8 Med= 0.4 Max= 2.6
0804+499 at S Band 1995 Jul 24
Mean= 0.7 RMS= 1.0 Med= 0.5 Max= 3.3
0808+019 at S Band 1995 Apr 12
Mean= 0.7 RMS= 0.9 Med= 0.5 Max= 3.9
0743-006 at X Band 1995 Oct 13
Mean= 5.4 RMS= 7.0 Med= 4.3 Max= 21.6
0805-077 at X Band 1995 Oct 13
Mean= 20.0 RMS= 27.5 Med= 14.7 Max= 104.7
0805+410 at X Band 1995 Oct 02
Mean= 4.0 RMS= 5.2 Med= 3.2 Max= 23.4
0743-006 at S Band 1995 Oct 13
Mean= 1.5 RMS= 2.0 Med= 1.2 Max= 8.6
0805-077 at S Band 1995 Oct 13
Mean= 3.7 RMS= 4.8 Med= 2.9 Max= 19.1
0805+410 at S Band 1995 Oct 02
Mean= 1.5 RMS= 2.0 Med= 1.0 Max= 6.8
PICOSECONDS

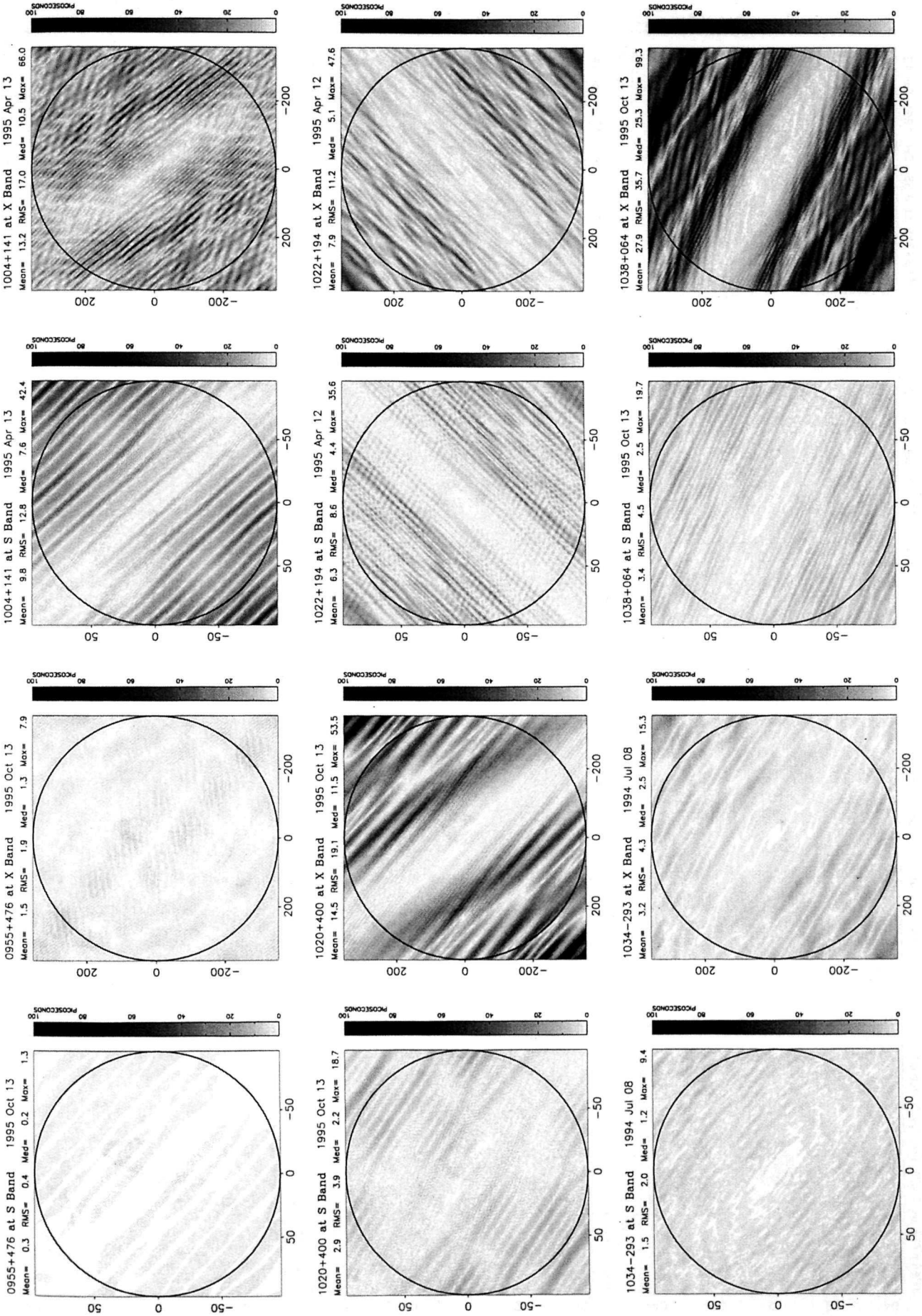

0820+560 at 2.320 GHz 1995 Oct 13
0820+560 at 8.550 GHz 1995 Oct 13
0823+033 at 2.320 GHz 1995 Apr 12
0823+033 at 8.550 GHz 1995 Apr 12
0831+557 at 2.320 GHz 1995 Oct 13
0831+557 at 8.550 GHz 1995 Oct 13
0833+585 at 2.320 GHz 1995 Apr 12
0833+585 at 8.550 GHz 1995 Apr 12
0851+202 at 2.320 GHz 1995 Oct 13
0851+202 at 8.550 GHz 1995 Oct 13
0859+470 at 2.320 GHz 1995 Apr 12
0859+470 at 8.550 GHz 1995 Apr 12

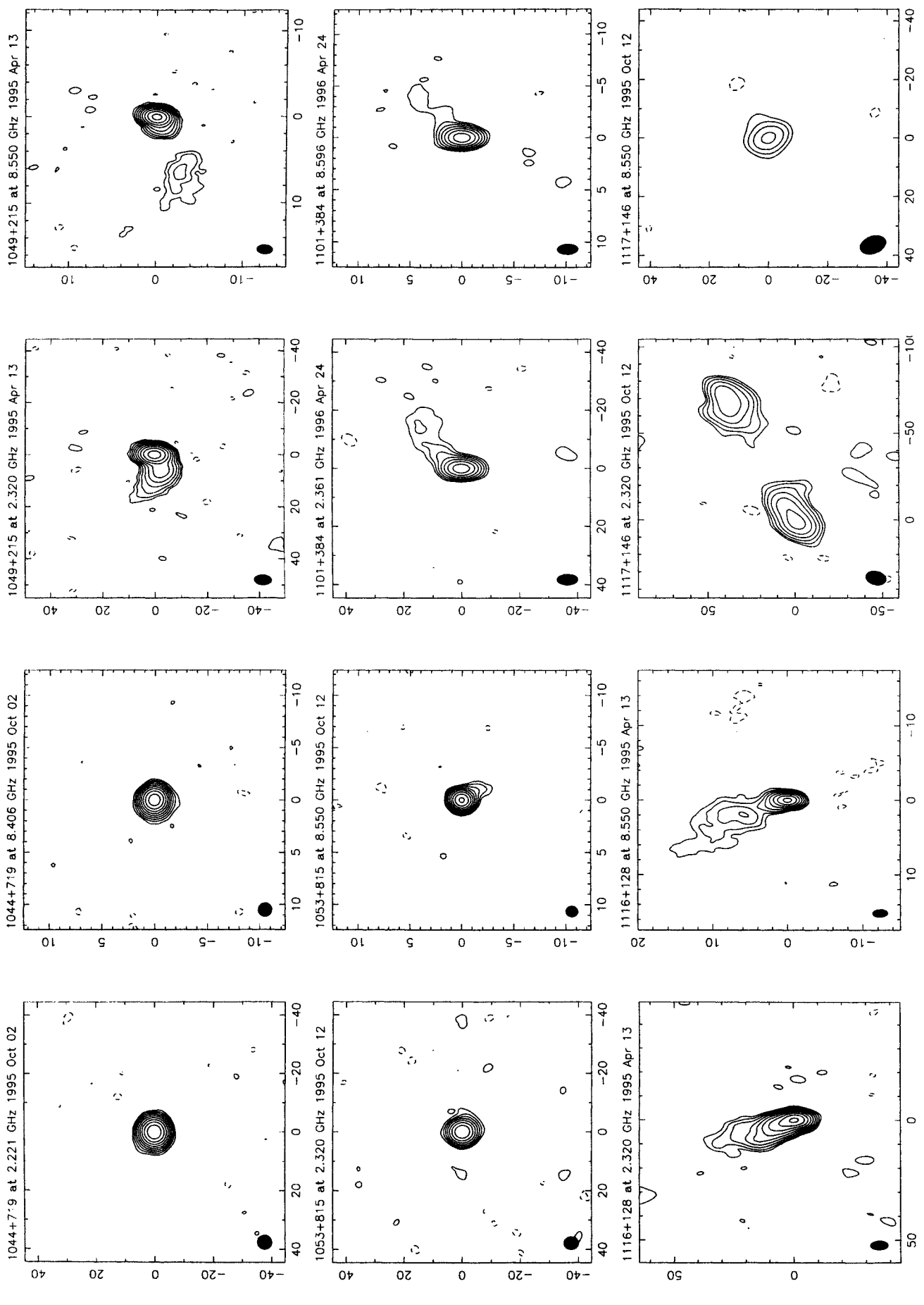

0823+033 at X Band 1995 Apr 12
Mean= 13.5 RMS= 18.0 Med= 9.0 Max= 54.7
0833+585 at X Band 1995 Apr 12
Mean= 38.4 RMS= 75.1 Med= 21.9 Max= 897.6
0859+470 at X Band 1995 Apr 12
Mean= 15.6 RMS= 21.8 Med= 10.7 Max= 103.6
0823+033 at S Band 1995 Apr 12
Mean= 1.0 RMS= 1.4 Med= 0.6 Max= 5.4
0833+585 at S Band 1995 Apr 12
Mean= 2.1 RMS= 3.6 Med= 0.8 Max= 18.7
0859+470 at S Band 1995 Apr 12
Mean= 9.6 RMS= 13.5 Med= 6.5 Max= 75.4
0820+560 at X Band 1995 Oct 13
Mean= 11.1 RMS= 15.0 Med= 8.3 Max= 77.4
0831+557 at X Band 1995 Oct 13
Mean= 236.7 RMS= 376.5 Med= 123.6 Max=2122.1
0851+202 at X Band 1995 Oct 13
Mean= 8.1 RMS= 11.4 Med= 6.1 Max= 37.5
0820+560 at S Band 1995 Oct 13
Mean= 3.1 RMS= 4.4 Med= 2.1 Max= 20.0
0831+557 at S Band 1995 Oct 13
Mean= 39.3 RMS= 97.9 Med= 19.2 Max=1483.7
0851+202 at S Band 1995 Oct 13
Mean= 1.2 RMS= 1.6 Med= 0.9 Max= 4.7
PICOSECONDS

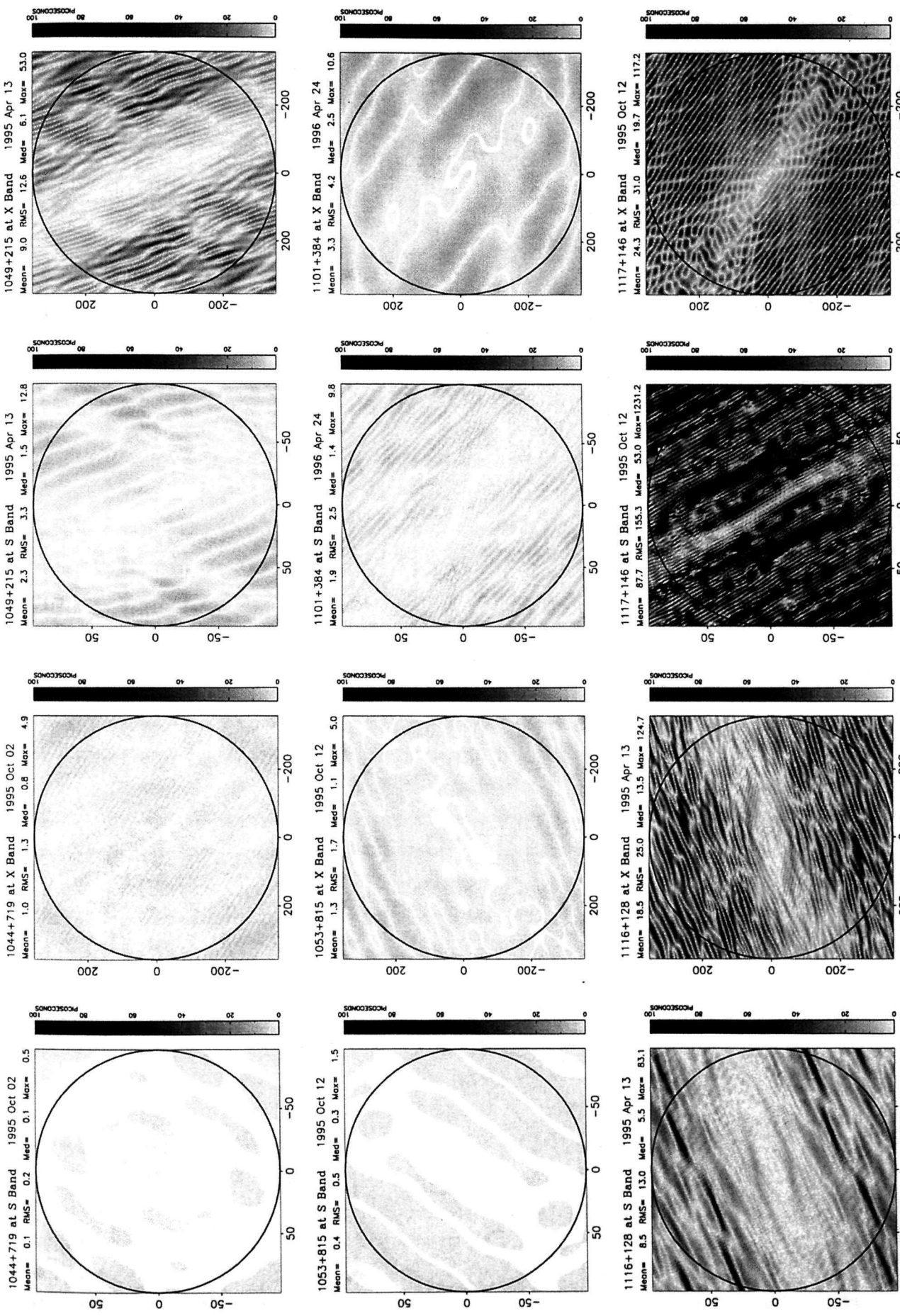

0912+297 at 2.320 GHz 1995 Oct 13
0912+297 at 8.550 GHz 1995 Oct 13
0917+624 at 2.320 GHz 1995 Apr 12
0917+624 at 8.550 GHz 1995 Apr 12
0919−260 at 2.320 GHz 1994 Jul 08
0919−260 at 8.550 GHz 1994 Jul 08
0923+392 at 2.361 GHz 1996 Apr 24
0923+392 at 8.596 GHz 1996 Apr 24
0945+408 at 2.320 GHz 1995 Oct 13
0945+408 at 8.550 GHz 1995 Oct 13
0953+254 at 2.320 GHz 1994 Jul 08
0953+254 at 8.550 GHz 1994 Jul 08

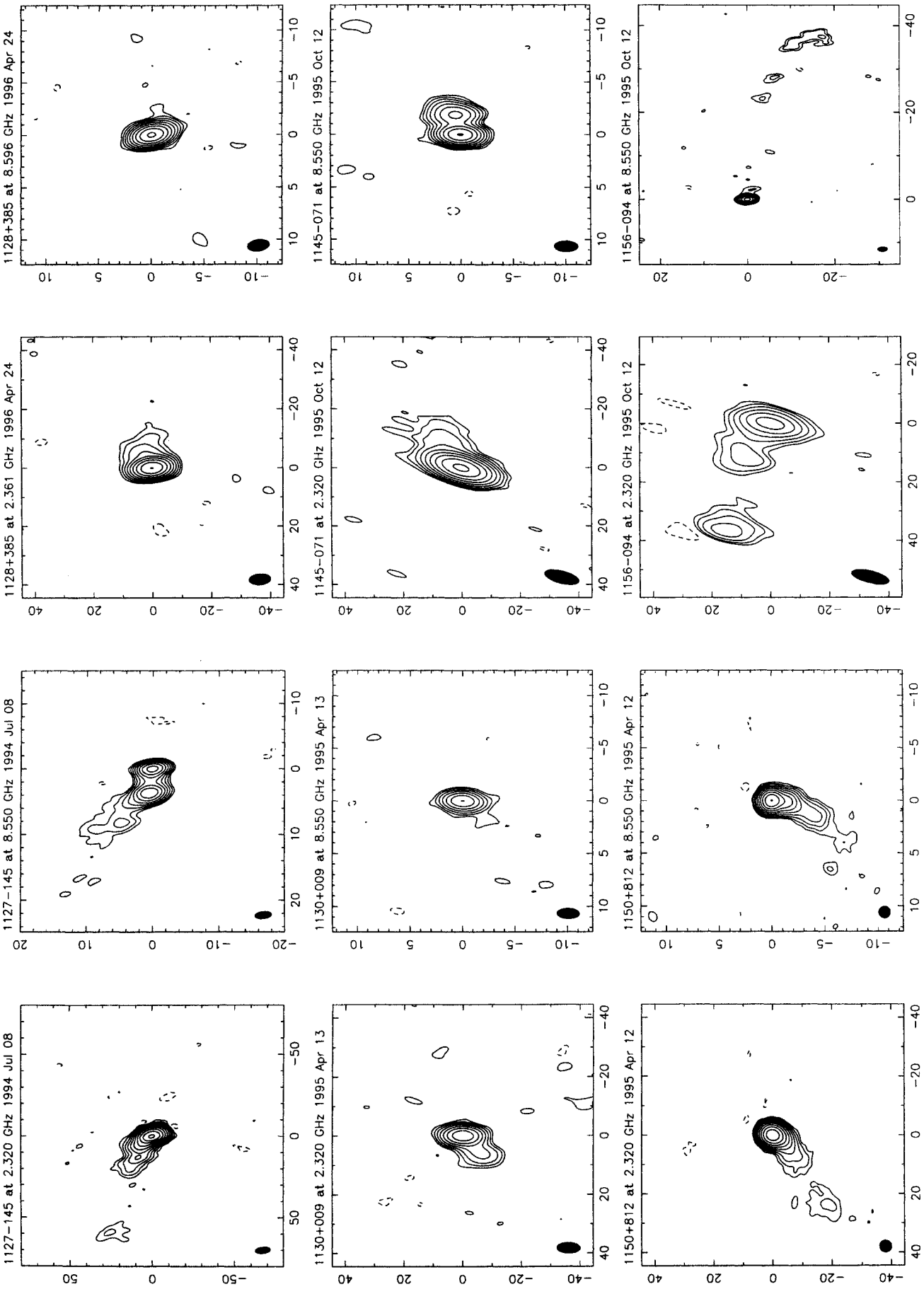

0919-260 at X Band 1994 Jul 08
Mean= 17.0 RMS= 22.5 Med= 12.8 Max= 69.6
0923+392 at X Band 1996 Apr 24
Mean= 7.6 RMS= 11.0 Med= 4.9 Max= 41.1
0953+254 at X Band 1994 Jul 08
Mean= 6.5 RMS= 8.5 Med= 5.0 Max= 21.0
0919-260 at S Band 1994 Jul 08
Mean= 11.3 RMS= 20.8 Med= 7.1 Max= 457.3
0923+392 at S Band 1996 Apr 24
Mean= 0.5 RMS= 0.7 Med= 0.4 Max= 3.5
0953+254 at S Band 1994 Jul 08
Mean= 0.5 RMS= 0.6 Med= 0.4 Max= 2.6
0912+297 at X Band 1995 Oct 13
Mean= 1.3 RMS= 1.7 Med= 1.0 Max= 5.5
0917+624 at X Band 1995 Apr 12
Mean= 6.5 RMS= 8.9 Med= 4.9 Max= 46.6
0945+408 at X Band 1995 Oct 13
Mean= 12.3 RMS= 18.1 Med= 7.2 Max= 82.6
0912+297 at S Band 1995 Oct 13
Mean= 1.5 RMS= 1.9 Med= 1.2 Max= 9.1
0917+624 at S Band 1995 Apr 12
Mean= 3.1 RMS= 4.2 Med= 2.2 Max= 20.4
0945+408 at S Band 1995 Oct 13
Mean= 4.1 RMS= 5.6 Med= 3.0 Max= 22.6
PICOSECONDS

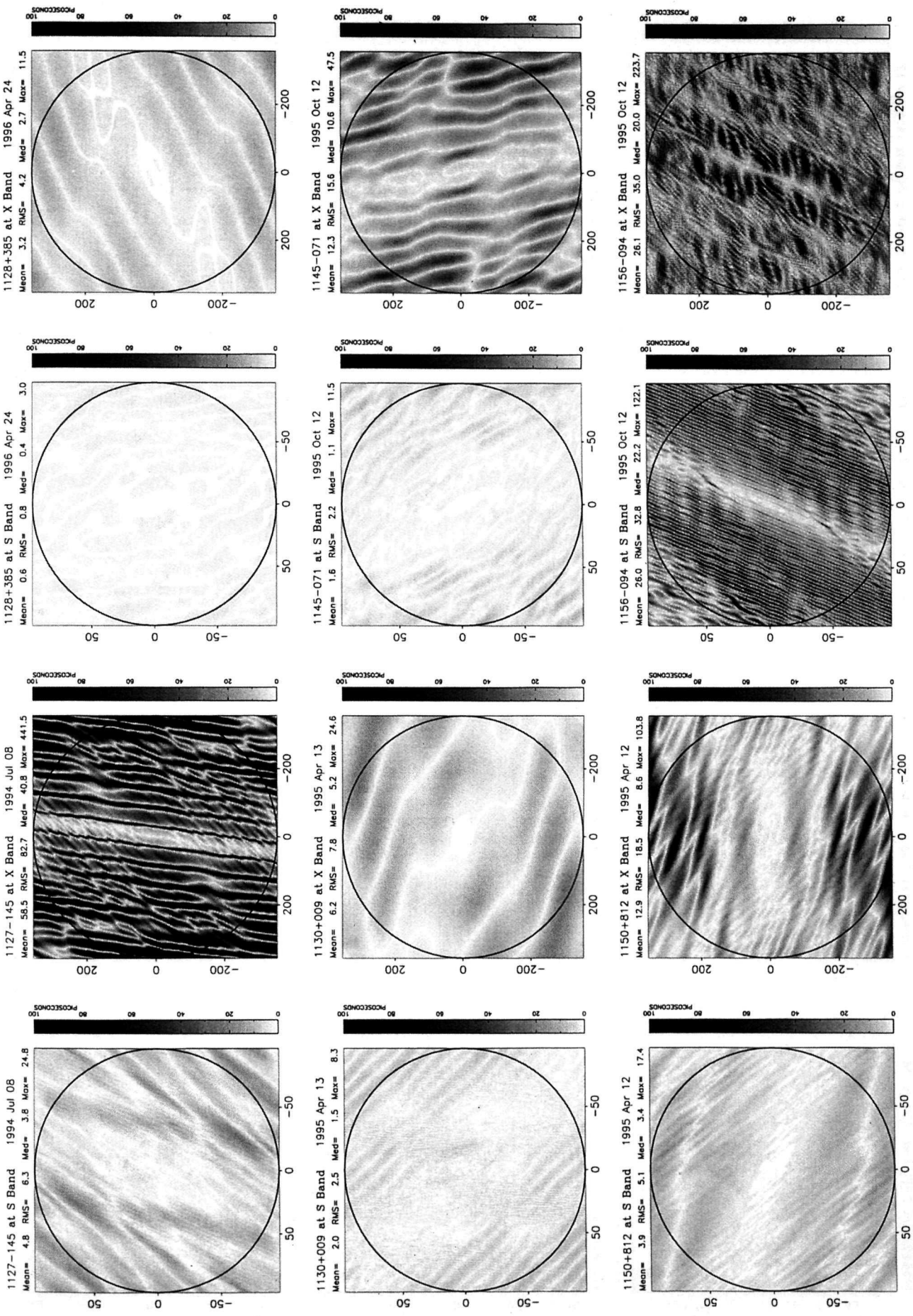

0955+476 at 2.320 GHz 1995 Oct 13
1004+141 at 2.320 GHz 1995 Apr 13
1020+400 at 2.320 GHz 1995 Oct 13
1022+194 at 2.320 GHz 1995 Apr 12
1034−293 at 2.320 GHz 1994 Jul 08
1038+064 at 2.320 GHz 1995 Oct 13
0955+476 at 8.550 GHz 1995 Oct 13
1004+141 at 8.550 GHz 1995 Apr 13
1020+400 at 8.550 GHz 1995 Oct 13
1022+194 at 8.550 GHz 1995 Apr 12
1034−293 at 8.550 GHz 1994 Jul 08
1038+064 at 8.550 GHz 1995 Oct 13

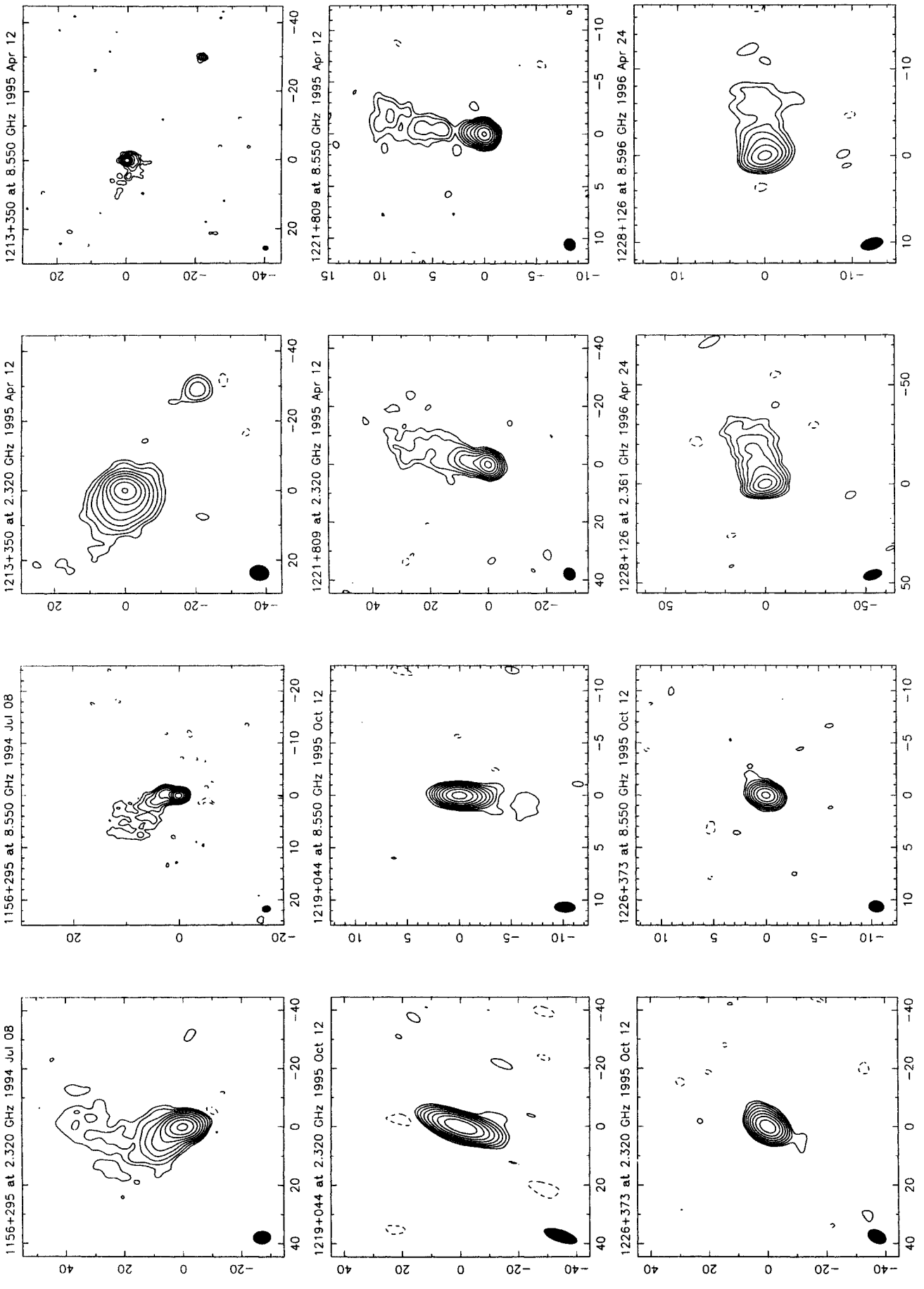

1004+141 at X Band 1995 Apr 13
Mean= 13.2 RMS= 17.0 Med= 10.5 Max= 66.0
1022+194 at X Band 1995 Apr 12
Mean= 7.9 RMS= 11.2 Med= 5.1 Max= 47.6
1038+064 at X Band 1995 Oct 13
Mean= 27.9 RMS= 35.7 Med= 25.3 Max= 99.3
1004+141 at S Band 1995 Apr 13
Mean= 9.8 RMS= 12.8 Med= 7.6 Max= 42.4
1022+194 at S Band 1995 Apr 12
Mean= 6.3 RMS= 8.6 Med= 4.4 Max= 35.6
1038+064 at S Band 1995 Oct 13
Mean= 3.4 RMS= 4.5 Med= 2.5 Max= 19.7
0955+476 at X Band 1995 Oct 13
Mean= 1.5 RMS= 1.9 Med= 1.3 Max= 7.9
1020+400 at X Band 1995 Oct 13
Mean= 14.5 RMS= 19.1 Med= 11.5 Max= 53.5
1034-293 at X Band 1994 Jul 08
Mean= 3.2 RMS= 4.3 Med= 2.5 Max= 15.3
0955+476 at S Band 1995 Oct 13
Mean= 0.3 RMS= 0.4 Med= 0.2 Max= 1.3
1020+400 at S Band 1995 Oct 13
Mean= 2.9 RMS= 3.9 Med= 2.2 Max= 18.7
1034-293 at S Band 1994 Jul 08
Mean= 1.5 RMS= 2.0 Med= 1.2 Max= 9.4
PICOSECONDS

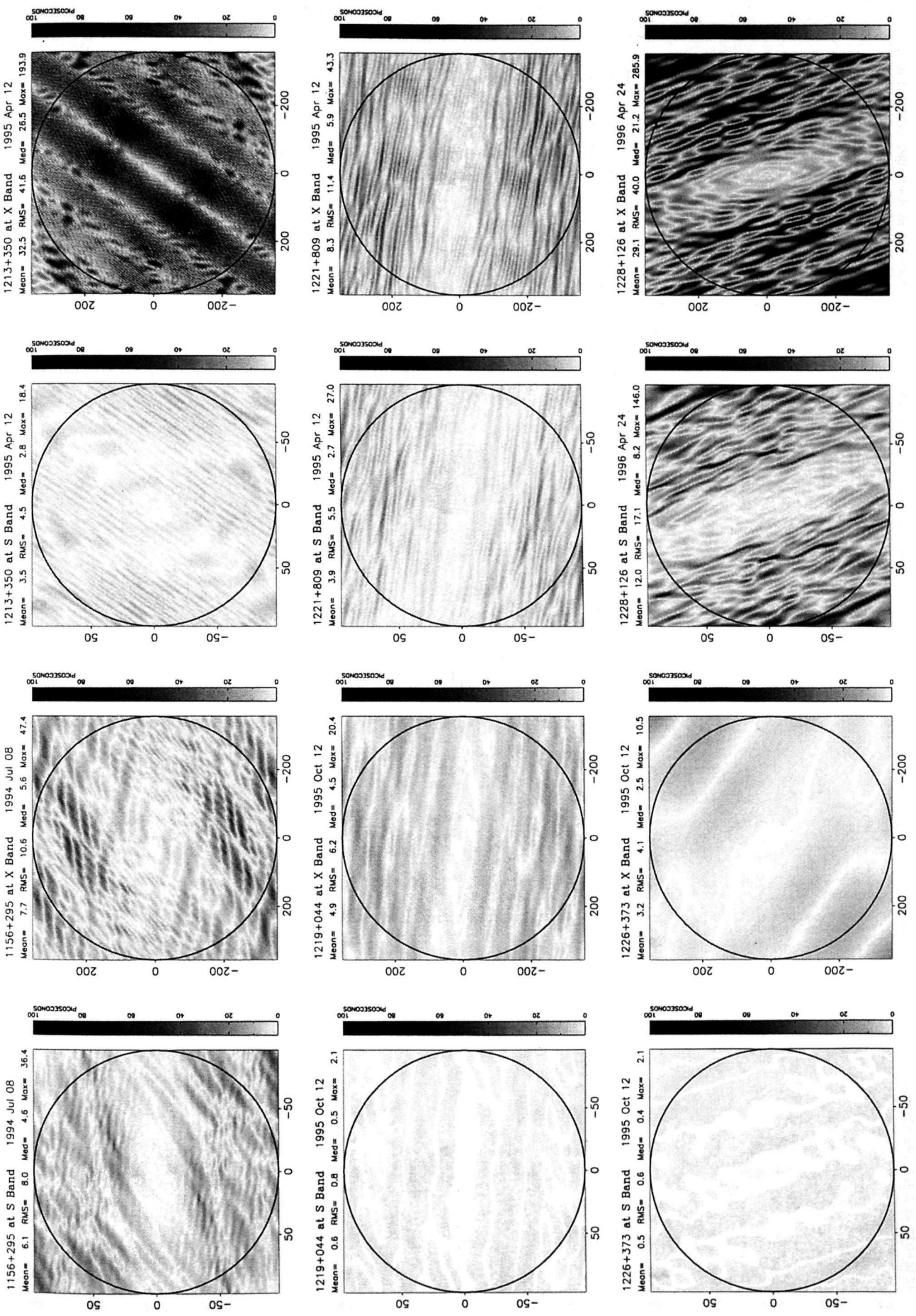

1044+719 at 2.221 GHz 1995 Oct 02
1044+719 at 8.406 GHz 1995 Oct 02
1049+215 at 2.320 GHz 1995 Apr 13
1049+215 at 8.550 GHz 1995 Apr 13
1053+815 at 2.320 GHz 1995 Oct 12
1053+815 at 8.550 GHz 1995 Oct 12
1101+384 at 2.361 GHz 1996 Apr 24
1101+384 at 8.596 GHz 1996 Apr 24
1116+128 at 2.320 GHz 1995 Apr 13
1116+128 at 8.550 GHz 1995 Apr 13
1117+146 at 2.320 GHz 1995 Oct 12
1117+146 at 8.550 GHz 1995 Oct 12

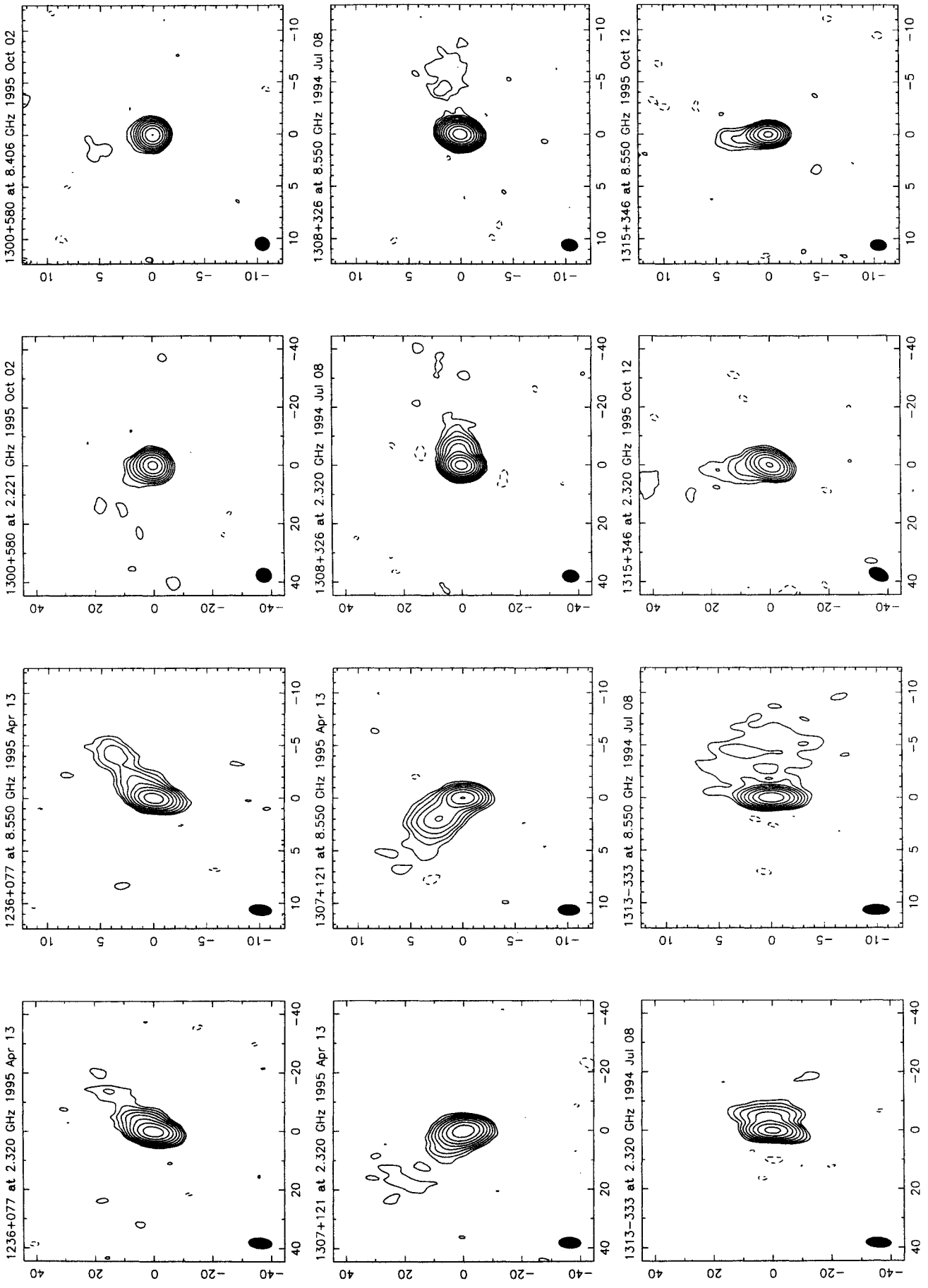

1049+215 at X Band 1995 Apr 13
Mean= 9.0 RMS= 12.6 Med= 6.1 Max= 53.0
1101+384 at X Band 1996 Apr 24
Mean= 3.3 RMS= 4.2 Med= 2.5 Max= 10.6
1117+146 at X Band 1995 Oct 12
Mean= 24.3 RMS= 31.0 Med= 19.7 Max= 117.2
1049+215 at S Band 1995 Apr 13
Mean= 2.3 RMS= 3.3 Med= 1.5 Max= 12.8
1101+384 at S Band 1996 Apr 24
Mean= 1.9 RMS= 2.5 Med= 1.4 Max= 9.8
1117+146 at S Band 1995 Oct 12
Mean= 87.7 RMS= 155.3 Med= 53.0 Max=1231.2
1044+719 at X Band 1995 Oct 02
Mean= 1.0 RMS= 1.3 Med= 0.8 Max= 4.9
1053+815 at X Band 1995 Oct 12
Mean= 1.3 RMS= 1.7 Med= 1.1 Max= 5.0
1116+128 at X Band 1995 Apr 13
Mean= 18.5 RMS= 25.0 Med= 13.5 Max= 124.7
1044+719 at S Band 1995 Oct 02
Mean= 0.1 RMS= 0.2 Med= 0.1 Max= 0.5
1053+815 at S Band 1995 Oct 12
Mean= 0.4 RMS= 0.5 Med= 0.3 Max= 1.5
1116+128 at S Band 1995 Apr 13
Mean= 8.5 RMS= 13.0 Med= 5.5 Max= 83.1
PICOSECONDS

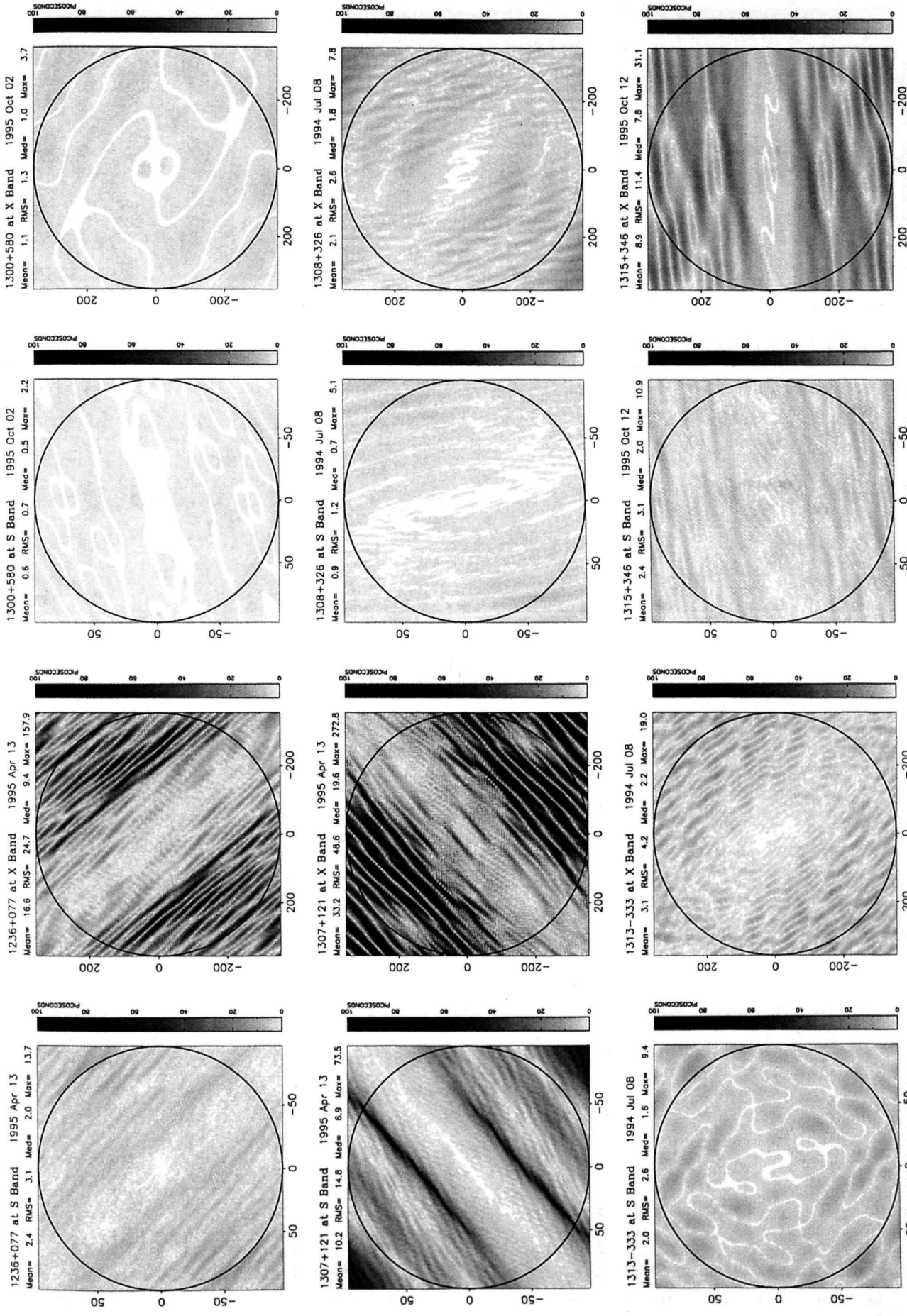

1127−145 at 2.320 GHz 1994 Jul 08
1127−145 at 8.550 GHz 1994 Jul 08
1128+385 at 2.361 GHz 1996 Apr 24
1128+385 at 8.596 GHz 1996 Apr 24
1130+009 at 2.320 GHz 1995 Apr 13
1130+009 at 8.550 GHz 1995 Apr 13
1145−071 at 2.320 GHz 1995 Oct 12
1145−071 at 8.550 GHz 1995 Oct 12
1150+812 at 2.320 GHz 1995 Apr 12
1150+812 at 8.550 GHz 1995 Apr 12
1156−094 at 2.320 GHz 1995 Oct 12
1156−094 at 8.550 GHz 1995 Oct 12

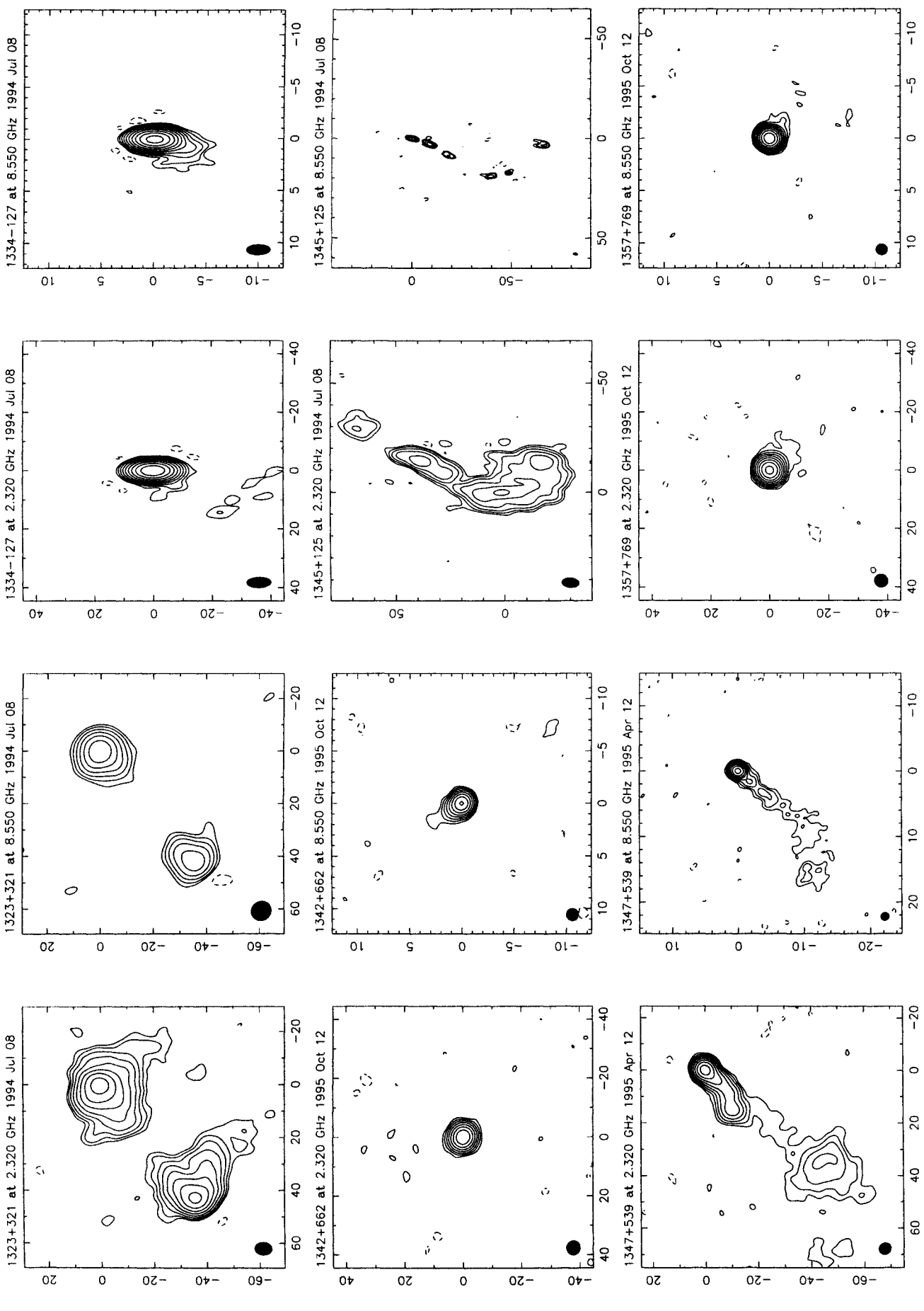

1128+385 at X Band 1996 Apr 24
Mean= 3.2 RMS= 4.2 Med= 2.7 Max= 11.5
1145-071 at X Band 1995 Oct 12
Mean= 12.3 RMS= 15.6 Med= 10.6 Max= 47.5
1156-094 at X Band 1995 Oct 12
Mean= 26.1 RMS= 35.0 Med= 20.0 Max= 223.7
1128+385 at S Band 1996 Apr 24
Mean= 0.6 RMS= 0.8 Med= 0.4 Max= 3.0
1145-071 at S Band 1995 Oct 12
Mean= 1.6 RMS= 2.2 Med= 1.1 Max= 11.5
1156-094 at S Band 1995 Oct 12
Mean= 26.0 RMS= 32.8 Med= 22.2 Max= 122.1
1127-145 at X Band 1994 Jul 08
Mean= 58.5 RMS= 82.7 Med= 40.8 Max= 441.5
1130+009 at X Band 1995 Apr 13
Mean= 6.2 RMS= 7.8 Med= 5.2 Max= 24.6
1150+812 at X Band 1995 Apr 12
Mean= 12.9 RMS= 18.5 Med= 8.6 Max= 103.8
1127-145 at S Band 1994 Jul 08
Mean= 4.8 RMS= 6.3 Med= 3.8 Max= 24.8
1130+009 at S Band 1995 Apr 13
Mean= 2.0 RMS= 2.5 Med= 1.5 Max= 8.3
1150+812 at S Band 1995 Apr 12
Mean= 3.9 RMS= 5.1 Med= 3.4 Max= 17.4
PICOSECONDS

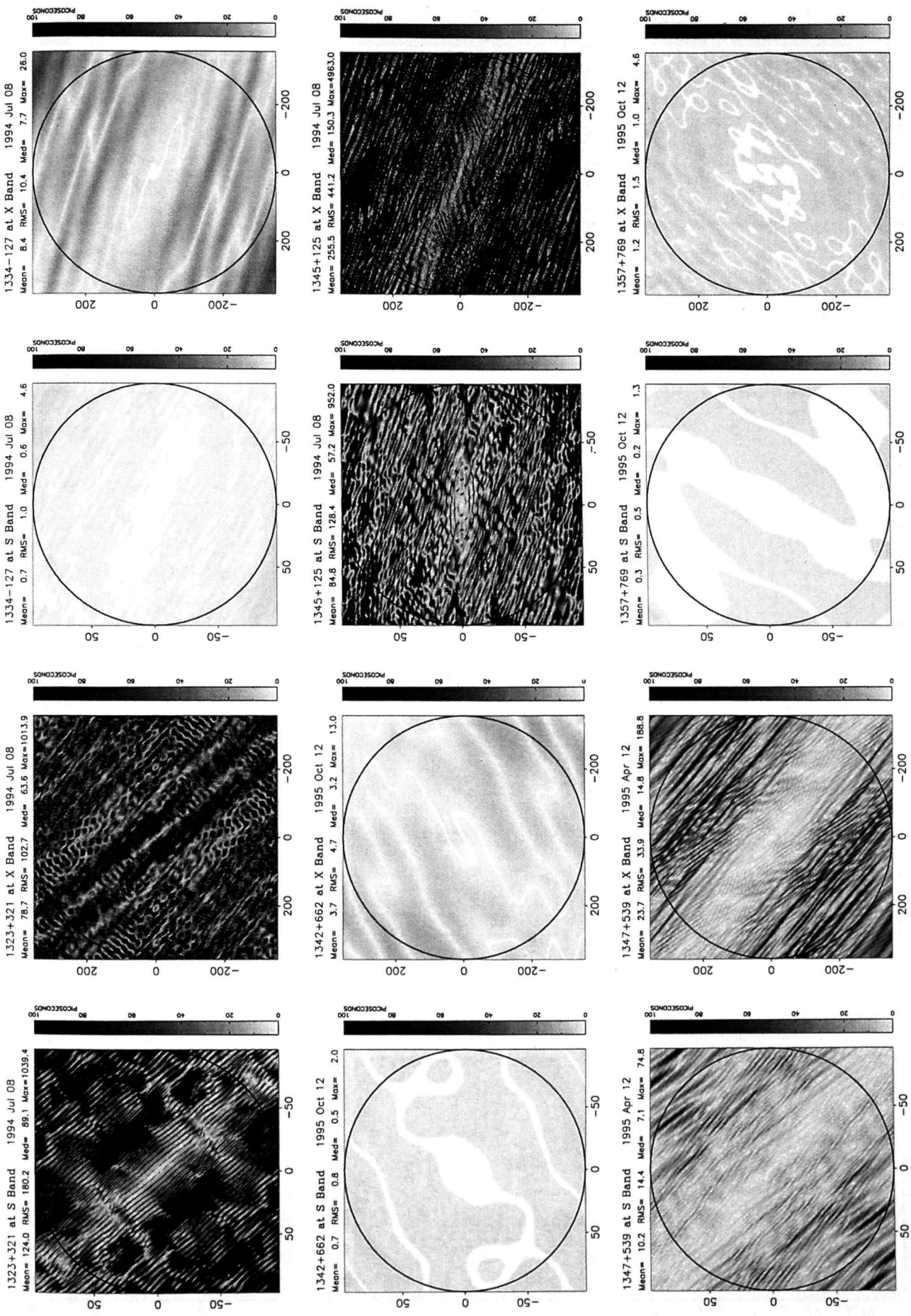

1156+295 at 2.320 GHz 1994 Jul 08
1156+295 at 8.550 GHz 1994 Jul 08
1213+350 at 2.320 GHz 1995 Apr 12
1213+350 at 8.550 GHz 1995 Apr 12
1219+044 at 2.320 GHz 1995 Oct 12
1219+044 at 8.550 GHz 1995 Oct 12
1221+809 at 2.320 GHz 1995 Apr 12
1221+809 at 8.550 GHz 1995 Apr 12
1226+373 at 2.320 GHz 1995 Oct 12
1226+373 at 8.550 GHz 1995 Oct 12
1228+126 at 2.361 GHz 1996 Apr 24
1228+126 at 8.596 GHz 1996 Apr 24

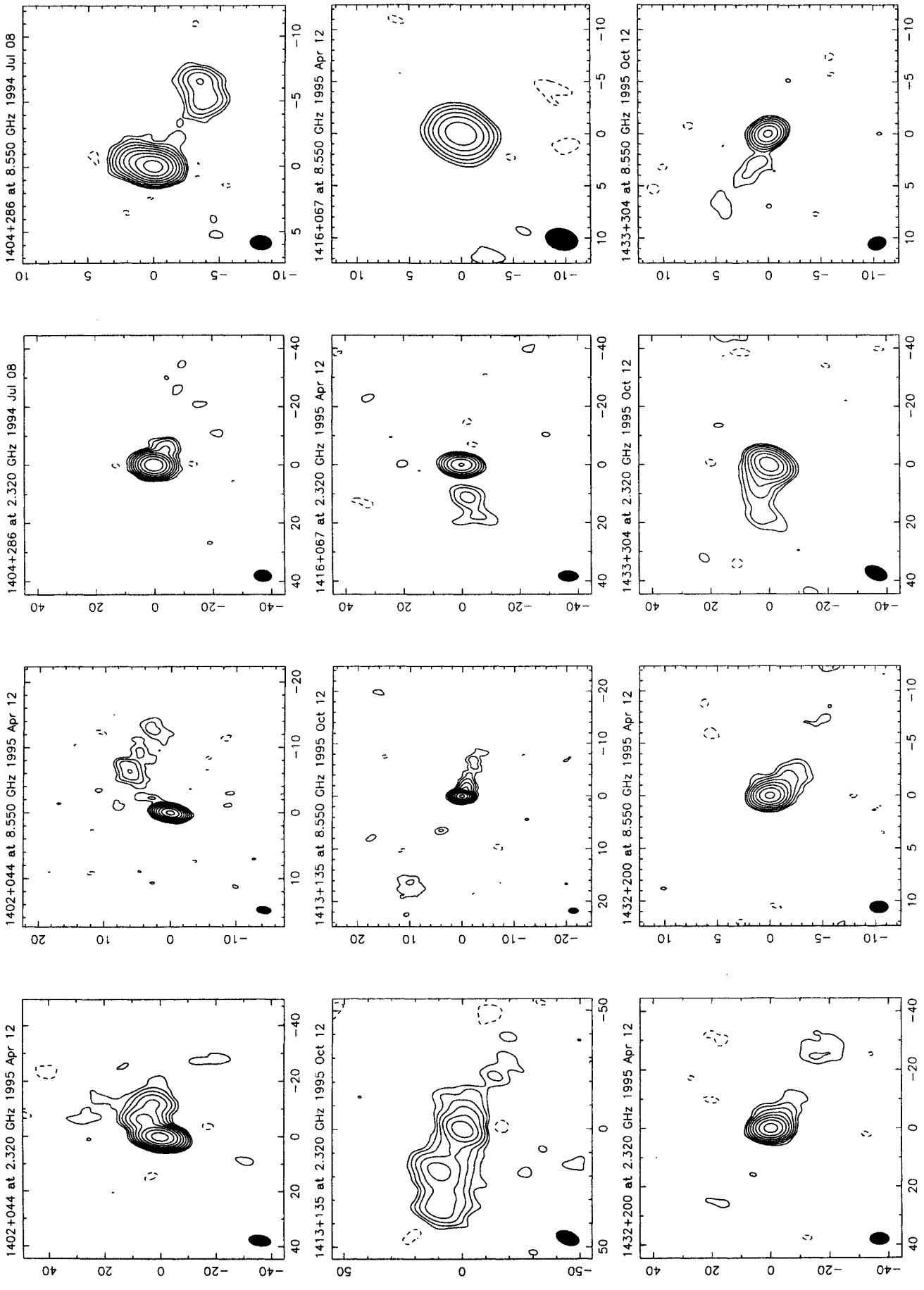

1213+350 at X Band 1995 Apr 12
Mean= 32.5 RMS= 41.6 Med= 26.5 Max= 193.9
1221+809 at X Band 1995 Apr 12
Mean= 8.3 RMS= 11.4 Med= 5.9 Max= 43.3
1228+126 at X Band 1996 Apr 24
Mean= 29.1 RMS= 40.0 Med= 21.2 Max= 285.9
1213+350 at S Band 1995 Apr 12
Mean= 3.5 RMS= 4.5 Med= 2.8 Max= 18.4
1221+809 at S Band 1995 Apr 12
Mean= 3.9 RMS= 5.5 Med= 2.7 Max= 27.0
1228+126 at S Band 1996 Apr 24
Mean= 12.0 RMS= 17.1 Med= 8.2 Max= 146.0
1156+295 at X Band 1994 Jul 08
Mean= 7.7 RMS= 10.6 Med= 5.6 Max= 47.4
1219+044 at X Band 1995 Oct 12
Mean= 4.9 RMS= 6.2 Med= 4.5 Max= 20.4
1226+373 at X Band 1995 Oct 12
Mean= 3.2 RMS= 4.1 Med= 2.5 Max= 10.5
1156+295 at S Band 1994 Jul 08
Mean= 6.1 RMS= 8.0 Med= 4.6 Max= 36.4
1219+044 at S Band 1995 Oct 12
Mean= 0.6 RMS= 0.8 Med= 0.5 Max= 2.1
1226+373 at S Band 1995 Oct 12
Mean= 0.5 RMS= 0.6 Med= 0.4 Max= 2.1
PICOSECONDS

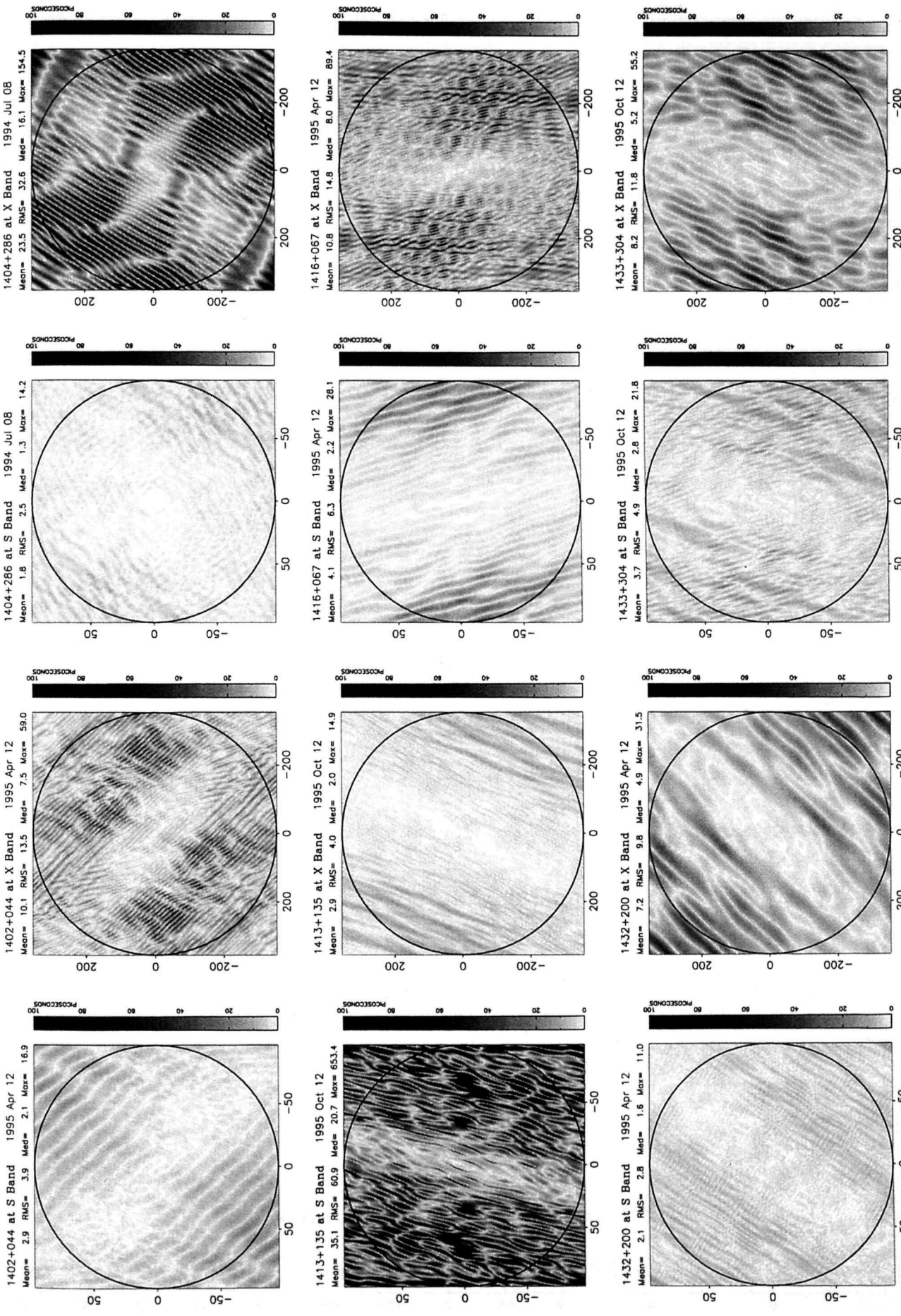

1236+077 at 2.320 GHz 1995 Apr 13
1307+121 at 2.320 GHz 1995 Apr 13
1313−333 at 2.320 GHz 1994 Jul 08
1300+580 at 2.221 GHz 1995 Oct 02
1308+326 at 2.320 GHz 1994 Jul 08
1315+346 at 2.320 GHz 1995 Oct 12
1236+077 at 8.550 GHz 1995 Apr 13
1307+121 at 8.550 GHz 1995 Apr 13
1313−333 at 8.550 GHz 1994 Jul 08
1300+580 at 8.406 GHz 1995 Oct 02
1308+326 at 8.550 GHz 1994 Jul 08
1315+346 at 8.550 GHz 1995 Oct 12

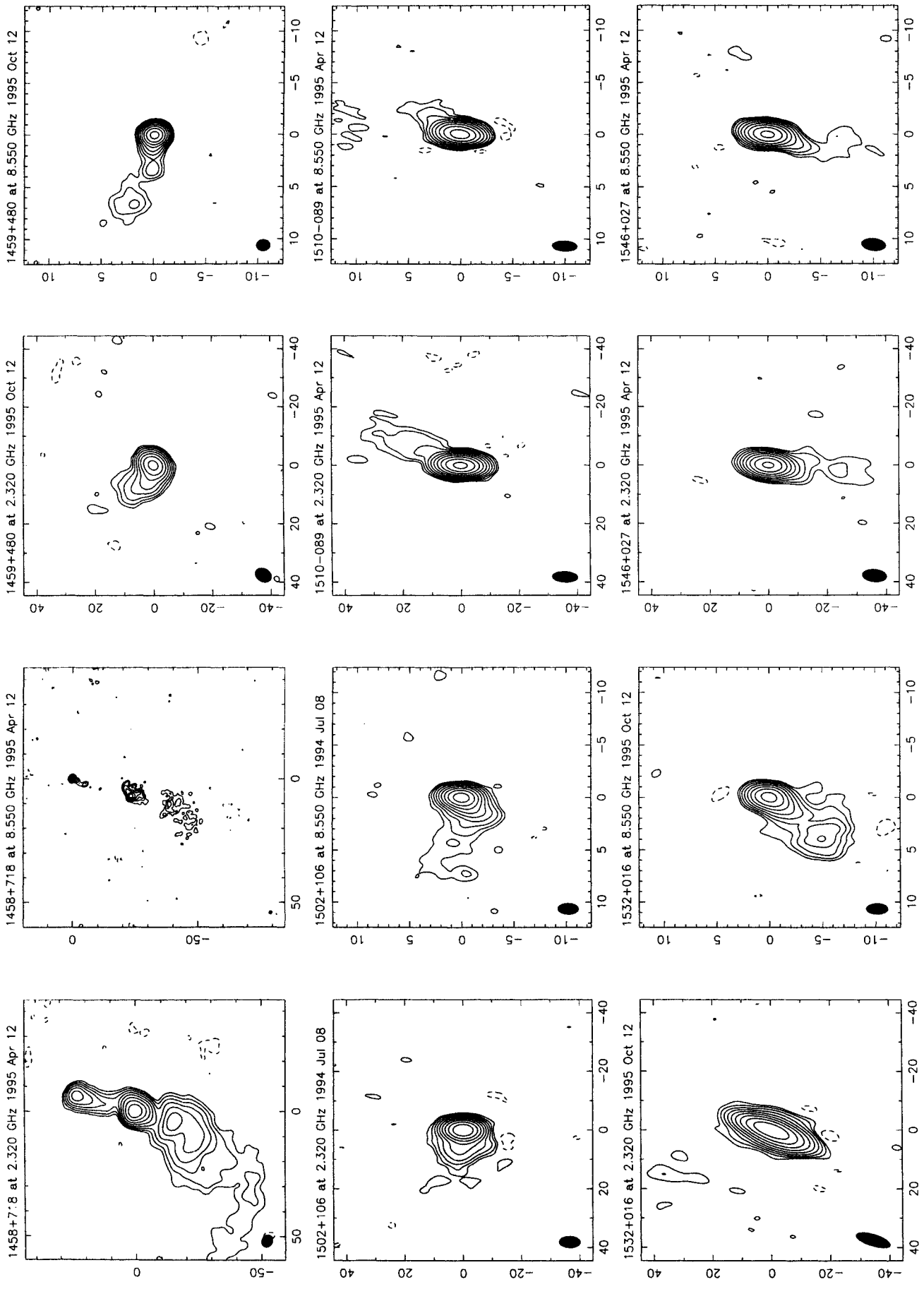

1300+580 at X Band 1995 Oct 02
Mean= 1.1 RMS= 1.3 Med= 1.0 Max= 3.7
1308+326 at X Band 1994 Jul 08
Mean= 2.1 RMS= 2.6 Med= 1.8 Max= 7.8
1315+346 at X Band 1995 Oct 12
Mean= 8.9 RMS= 11.4 Med= 7.8 Max= 31.1
1300+580 at S Band 1995 Oct 02
Mean= 0.6 RMS= 0.7 Med= 0.5 Max= 2.2
1308+326 at S Band 1994 Jul 08
Mean= 0.9 RMS= 1.2 Med= 0.7 Max= 5.1
1315+346 at S Band 1995 Oct 12
Mean= 2.4 RMS= 3.1 Med= 2.0 Max= 10.9
1236+077 at X Band 1995 Apr 13
Mean= 16.6 RMS= 24.7 Med= 9.4 Max= 157.9
1307+121 at X Band 1995 Apr 13
Mean= 33.2 RMS= 48.6 Med= 19.6 Max= 272.8
1313−333 at X Band 1994 Jul 08
Mean= 3.1 RMS= 4.2 Med= 2.2 Max= 19.0
1236+077 at S Band 1995 Apr 13
Mean= 2.4 RMS= 3.1 Med= 2.0 Max= 13.7
1307+121 at S Band 1995 Apr 13
Mean= 10.2 RMS= 14.8 Med= 6.9 Max= 73.5
1313−333 at S Band 1994 Jul 08
Mean= 2.0 RMS= 2.6 Med= 1.6 Max= 9.4
PICOSECONDS

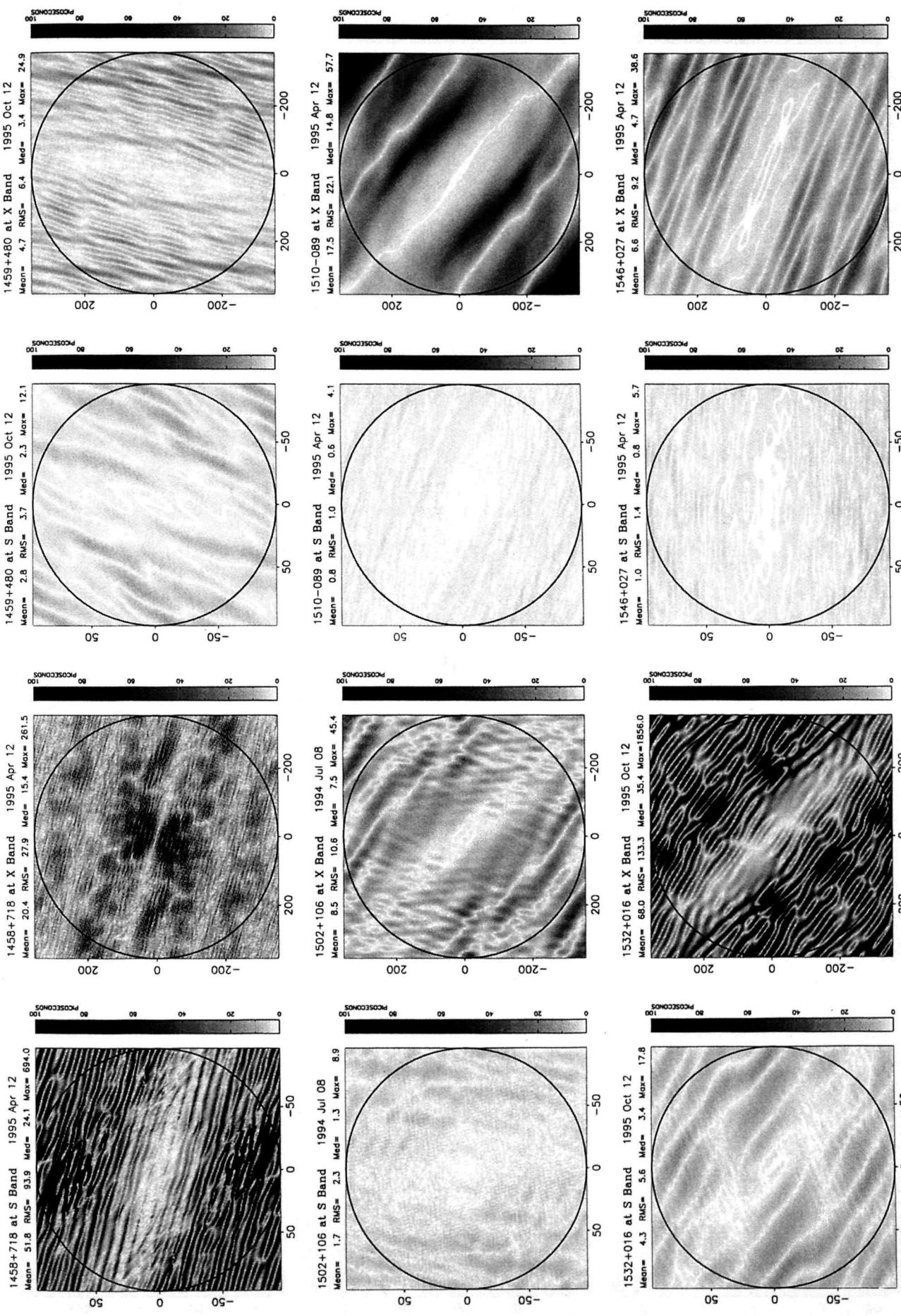

1323+321 at 2.320 GHz 1994 Jul 08
1323+321 at 8.550 GHz 1994 Jul 08
1342+662 at 2.320 GHz 1995 Oct 12
1342+662 at 8.550 GHz 1995 Oct 12
1347+539 at 2.320 GHz 1995 Apr 12
1347+539 at 8.550 GHz 1995 Apr 12
1334−127 at 2.320 GHz 1994 Jul 08
1334−127 at 8.550 GHz 1994 Jul 08
1345+125 at 2.320 GHz 1994 Jul 08
1345+125 at 8.550 GHz 1994 Jul 08
1357+769 at 2.320 GHz 1995 Oct 12
1357+769 at 8.550 GHz 1995 Oct 12

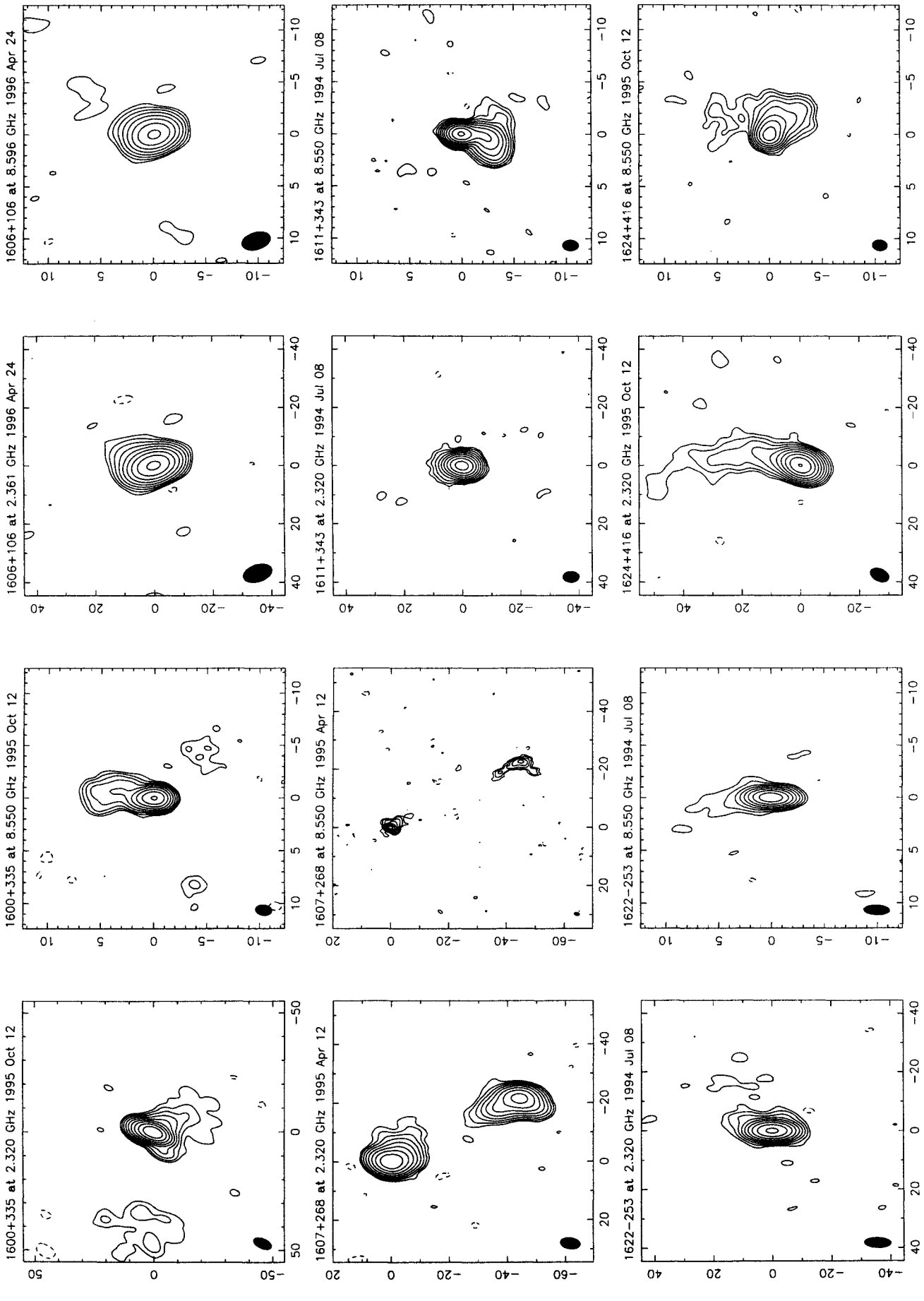

1323+321 at S Band 1994 Jul 08
Mean= 124.0 RMS= 180.2 Med= 89.1 Max=1039.4
1323+321 at X Band 1994 Jul 08
Mean= 78.7 RMS= 102.7 Med= 63.6 Max=1013.9
1334-127 at S Band 1994 Jul 08
Mean= 0.7 RMS= 1.0 Med= 0.6 Max= 4.6
1334-127 at X Band 1994 Jul 08
Mean= 8.4 RMS= 10.4 Med= 7.7 Max= 26.0
1342+662 at S Band 1995 Oct 12
Mean= 0.7 RMS= 0.8 Med= 0.5 Max= 2.0
1342+662 at X Band 1995 Oct 12
Mean= 3.7 RMS= 4.7 Med= 3.2 Max= 13.0
1345+125 at S Band 1994 Jul 08
Mean= 84.8 RMS= 128.4 Med= 57.2 Max= 952.0
1345+125 at X Band 1994 Jul 08
Mean= 255.5 RMS= 441.2 Med= 150.3 Max=4963.0
1347+539 at S Band 1995 Apr 12
Mean= 10.2 RMS= 14.4 Med= 7.1 Max= 74.8
1347+539 at X Band 1995 Apr 12
Mean= 23.7 RMS= 33.9 Med= 14.8 Max= 188.8
1357+769 at S Band 1995 Oct 12
Mean= 0.3 RMS= 0.5 Med= 0.2 Max= 1.3
1357+769 at X Band 1995 Oct 12
Mean= 1.2 RMS= 1.5 Med= 1.0 Max= 4.6
PICOSECONDS

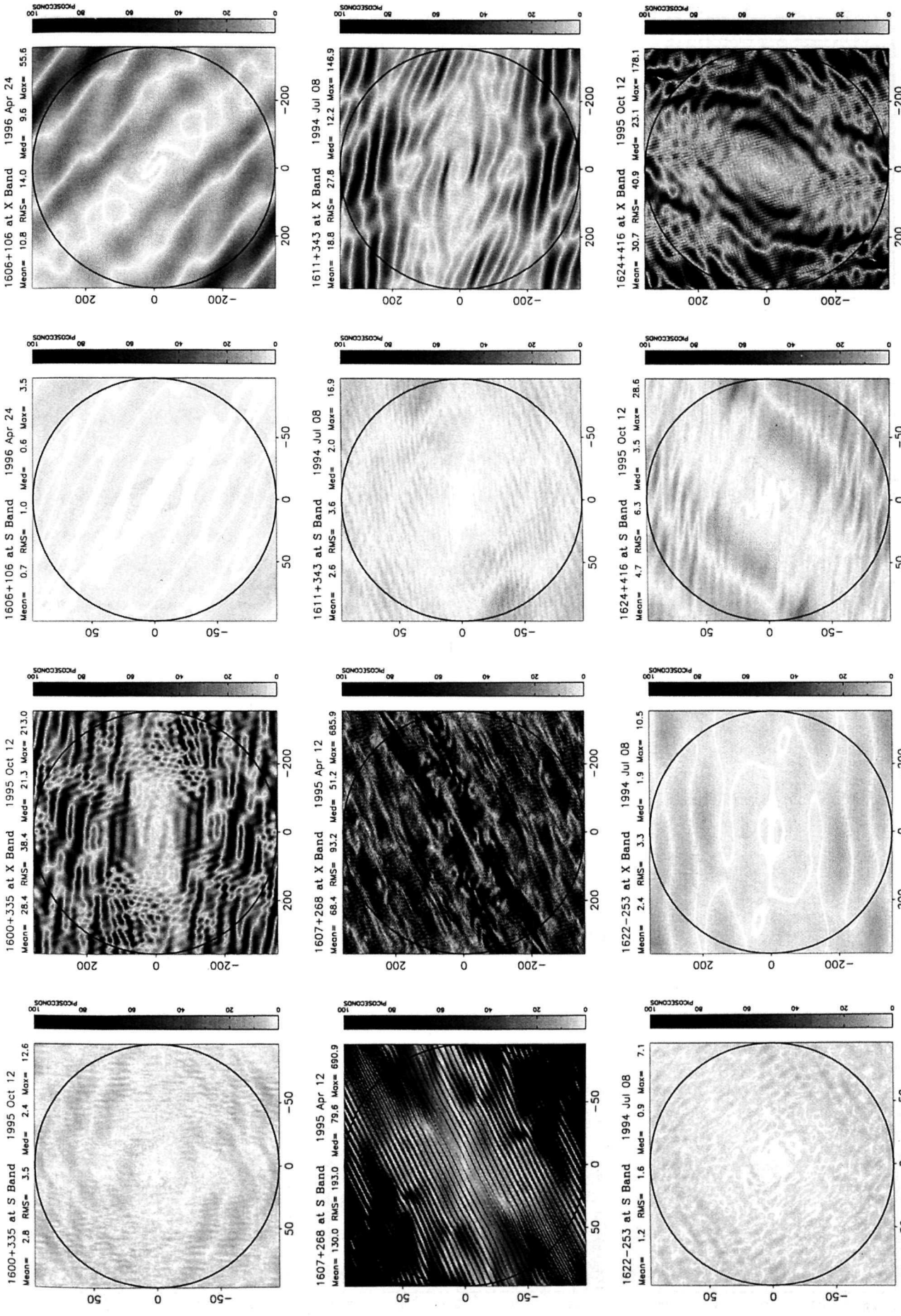

1402+044 at 2.320 GHz 1995 Apr 12
1413+135 at 2.320 GHz 1995 Oct 12
1432+200 at 2.320 GHz 1995 Apr 12
1402+044 at 8.550 GHz 1995 Apr 12
1413+135 at 8.550 GHz 1995 Oct 12
1432+200 at 8.550 GHz 1995 Apr 12
1404+286 at 2.320 GHz 1994 Jul 08
1416+067 at 2.320 GHz 1995 Apr 12
1433+304 at 2.320 GHz 1995 Oct 12
1404+286 at 8.550 GHz 1994 Jul 08
1416+067 at 8.550 GHz 1995 Apr 12
1433+304 at 8.550 GHz 1995 Oct 12

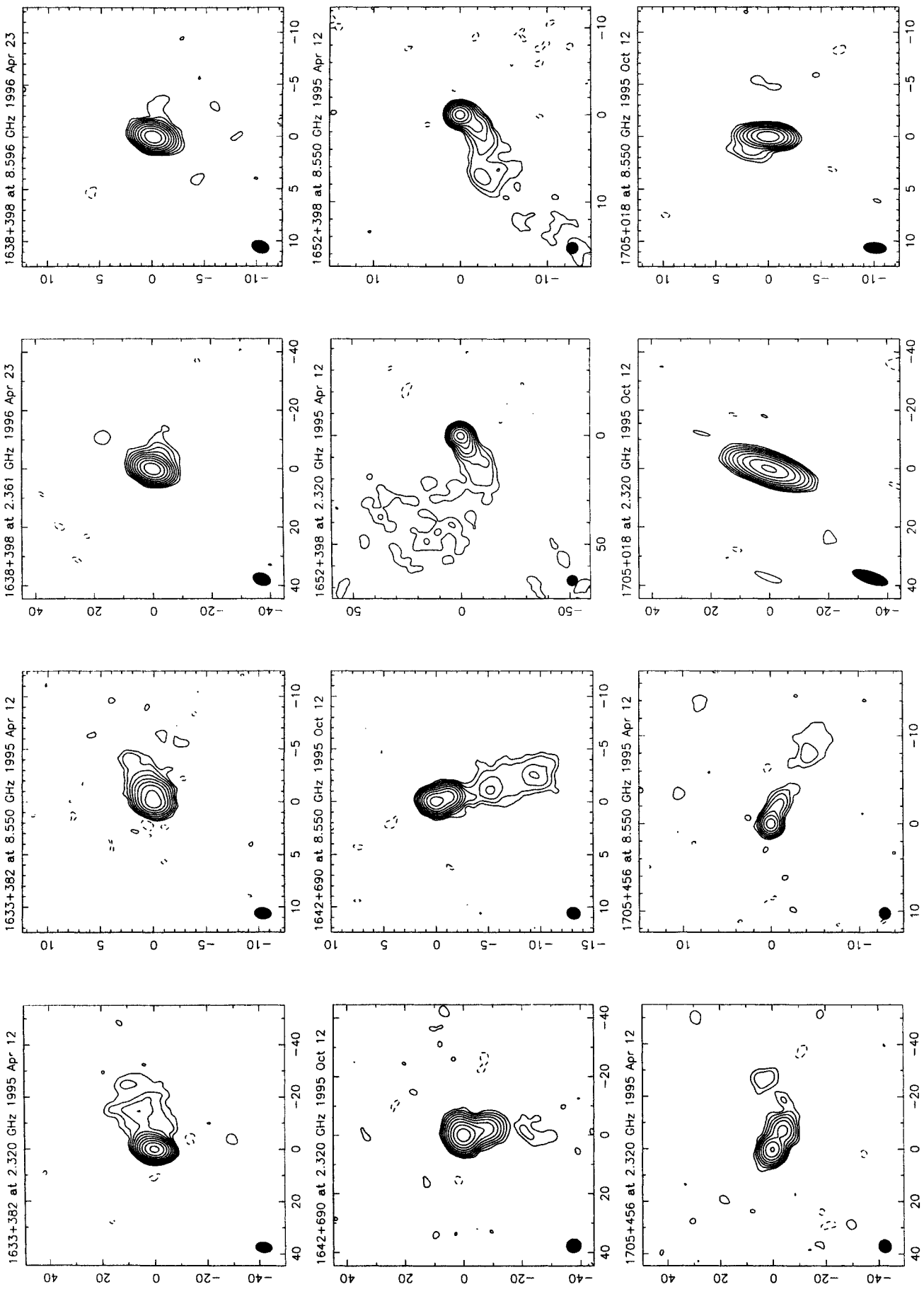

1404+286 at X Band 1994 Jul 08
Mean= 23.5 RMS= 32.6 Med= 16.1 Max= 154.5
1416+067 at X Band 1995 Apr 12
Mean= 10.8 RMS= 14.8 Med= 8.0 Max= 89.4
1433+304 at X Band 1995 Oct 12
Mean= 8.2 RMS= 11.8 Med= 5.2 Max= 55.2
1404+286 at S Band 1994 Jul 08
Mean= 1.8 RMS= 2.5 Med= 1.3 Max= 14.2
1416+067 at S Band 1995 Apr 12
Mean= 4.1 RMS= 6.3 Med= 2.2 Max= 28.1
1433+304 at S Band 1995 Oct 12
Mean= 3.7 RMS= 4.9 Med= 2.8 Max= 21.8
1402+044 at X Band 1995 Apr 12
Mean= 10.1 RMS= 13.5 Med= 7.5 Max= 59.0
1413+135 at X Band 1995 Oct 12
Mean= 2.9 RMS= 4.0 Med= 2.0 Max= 14.9
1432+200 at X Band 1995 Apr 12
Mean= 7.2 RMS= 9.8 Med= 4.9 Max= 31.5
1402+044 at S Band 1995 Apr 12
Mean= 2.9 RMS= 3.9 Med= 2.1 Max= 16.9
1413+135 at S Band 1995 Oct 12
Mean= 35.1 RMS= 60.9 Med= 20.7 Max= 653.4
1432+200 at S Band 1995 Apr 12
Mean= 2.1 RMS= 2.8 Med= 1.6 Max= 11.0
PICOSECONDS

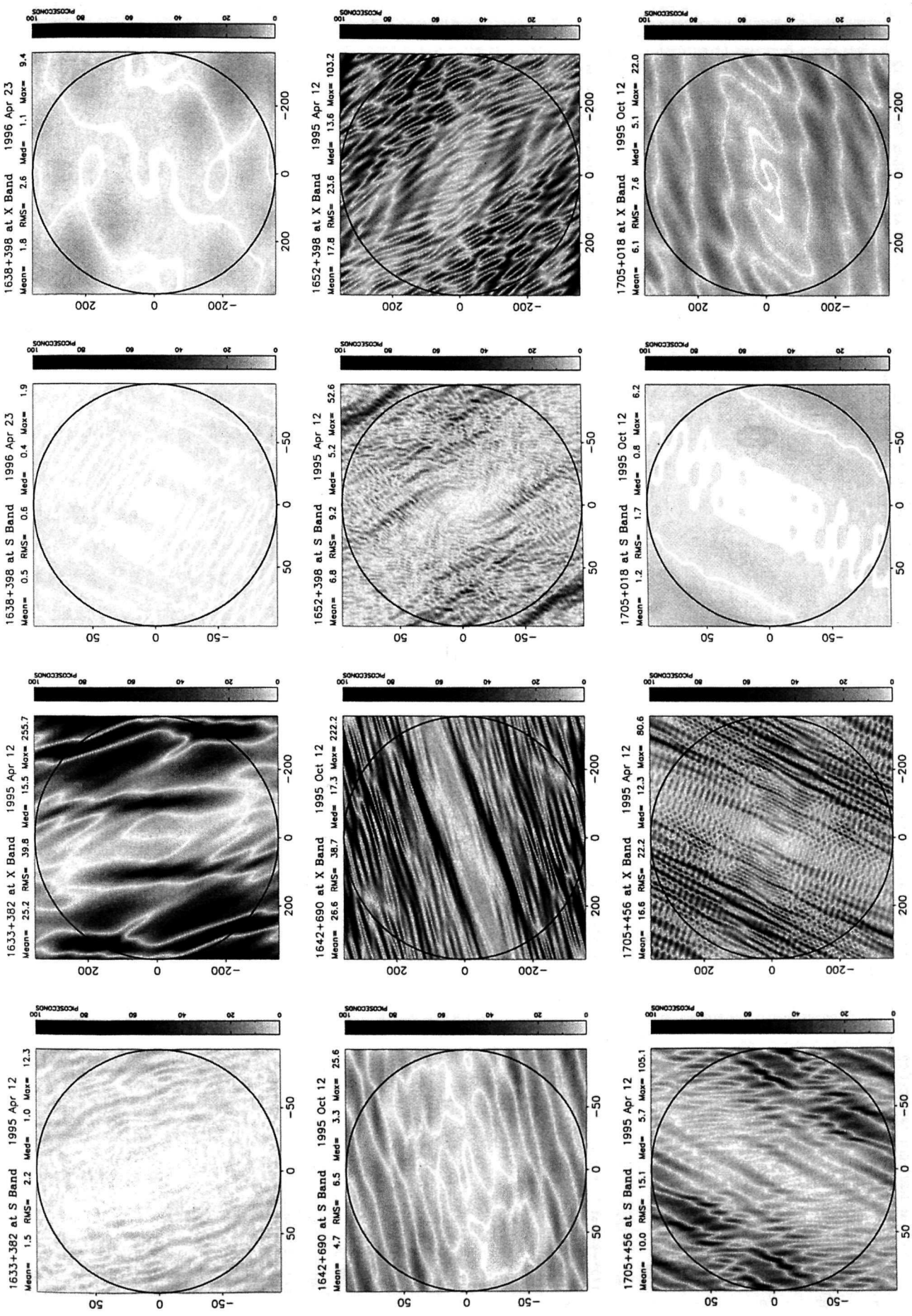

1458+718 at 2.320 GHz 1995 Apr 12
1458+718 at 8.550 GHz 1995 Apr 12
1459+480 at 2.320 GHz 1995 Oct 12
1459+480 at 8.550 GHz 1995 Oct 12
1502+106 at 2.320 GHz 1994 Jul 08
1502+106 at 8.550 GHz 1994 Jul 08
1510−089 at 2.320 GHz 1995 Apr 12
1510−089 at 8.550 GHz 1995 Apr 12
1532+016 at 2.320 GHz 1995 Oct 12
1532+016 at 8.550 GHz 1995 Oct 12
1546+027 at 2.320 GHz 1995 Apr 12
1546+027 at 8.550 GHz 1995 Apr 12

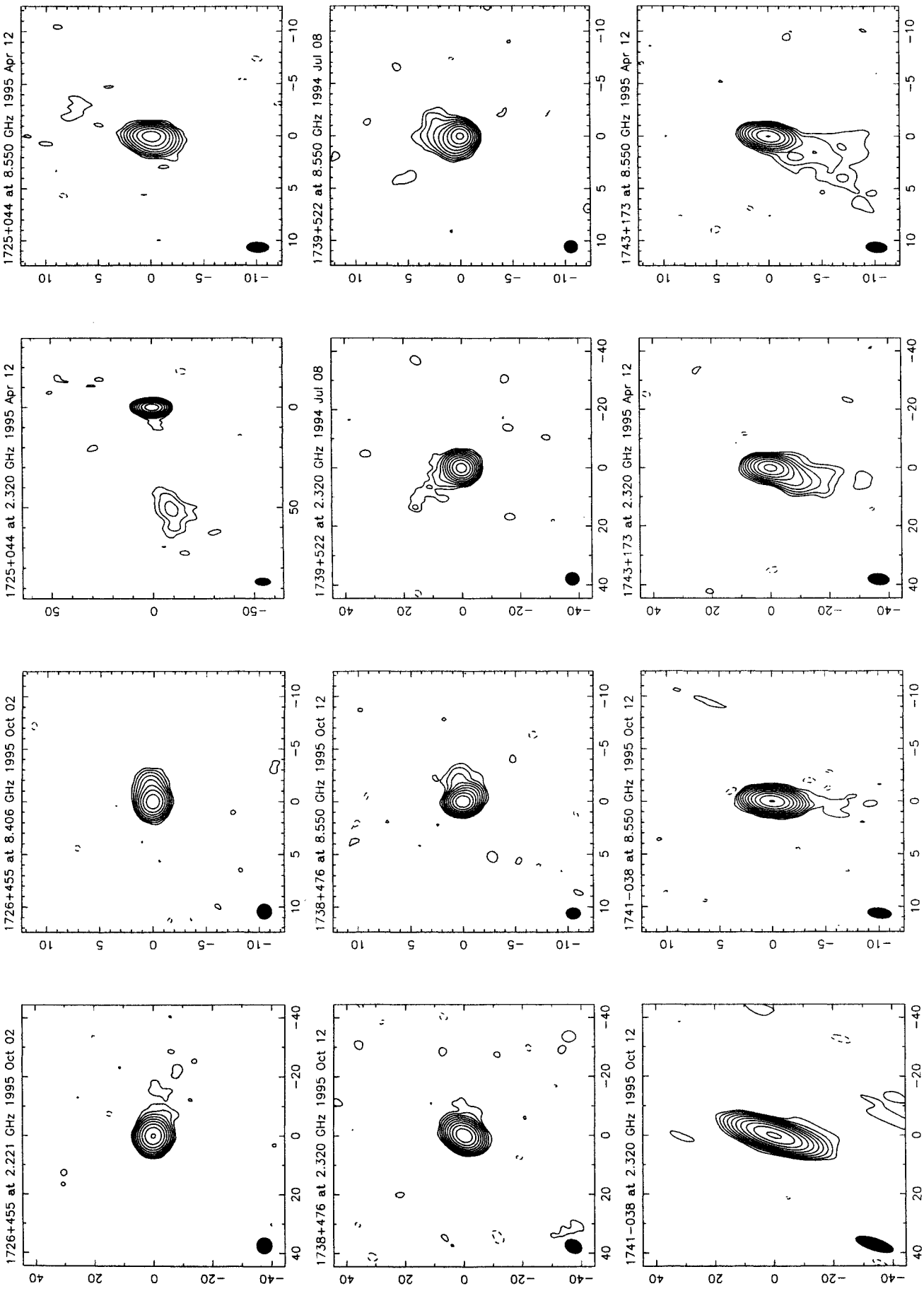

1459+480 at X Band 1995 Oct 12
Mean= 4.7 RMS= 6.4 Med= 3.4 Max= 24.9
1510-089 at X Band 1995 Apr 12
Mean= 17.5 RMS= 22.1 Med= 14.8 Max= 57.7
1546+027 at X Band 1995 Apr 12
Mean= 6.6 RMS= 9.2 Med= 4.7 Max= 38.6
1459+480 at S Band 1995 Oct 12
Mean= 2.8 RMS= 3.7 Med= 2.3 Max= 12.1
1510-089 at S Band 1995 Apr 12
Mean= 0.8 RMS= 1.0 Med= 0.6 Max= 4.1
1546+027 at S Band 1995 Apr 12
Mean= 1.0 RMS= 1.4 Med= 0.8 Max= 5.7
1458+718 at X Band 1995 Apr 12
Mean= 20.4 RMS= 27.9 Med= 15.4 Max= 261.5
1502+106 at X Band 1994 Jul 08
Mean= 8.5 RMS= 10.6 Med= 7.5 Max= 45.4
1532+016 at X Band 1995 Oct 12
Mean= 68.0 RMS= 133.3 Med= 35.4 Max=1856.0
1458+718 at S Band 1995 Apr 12
Mean= 51.8 RMS= 93.9 Med= 24.1 Max= 694.0
1502+106 at S Band 1994 Jul 08
Mean= 1.7 RMS= 2.3 Med= 1.3 Max= 8.9
1532+016 at S Band 1995 Oct 12
Mean= 4.3 RMS= 5.6 Med= 3.4 Max= 17.8
PICOSECONDS

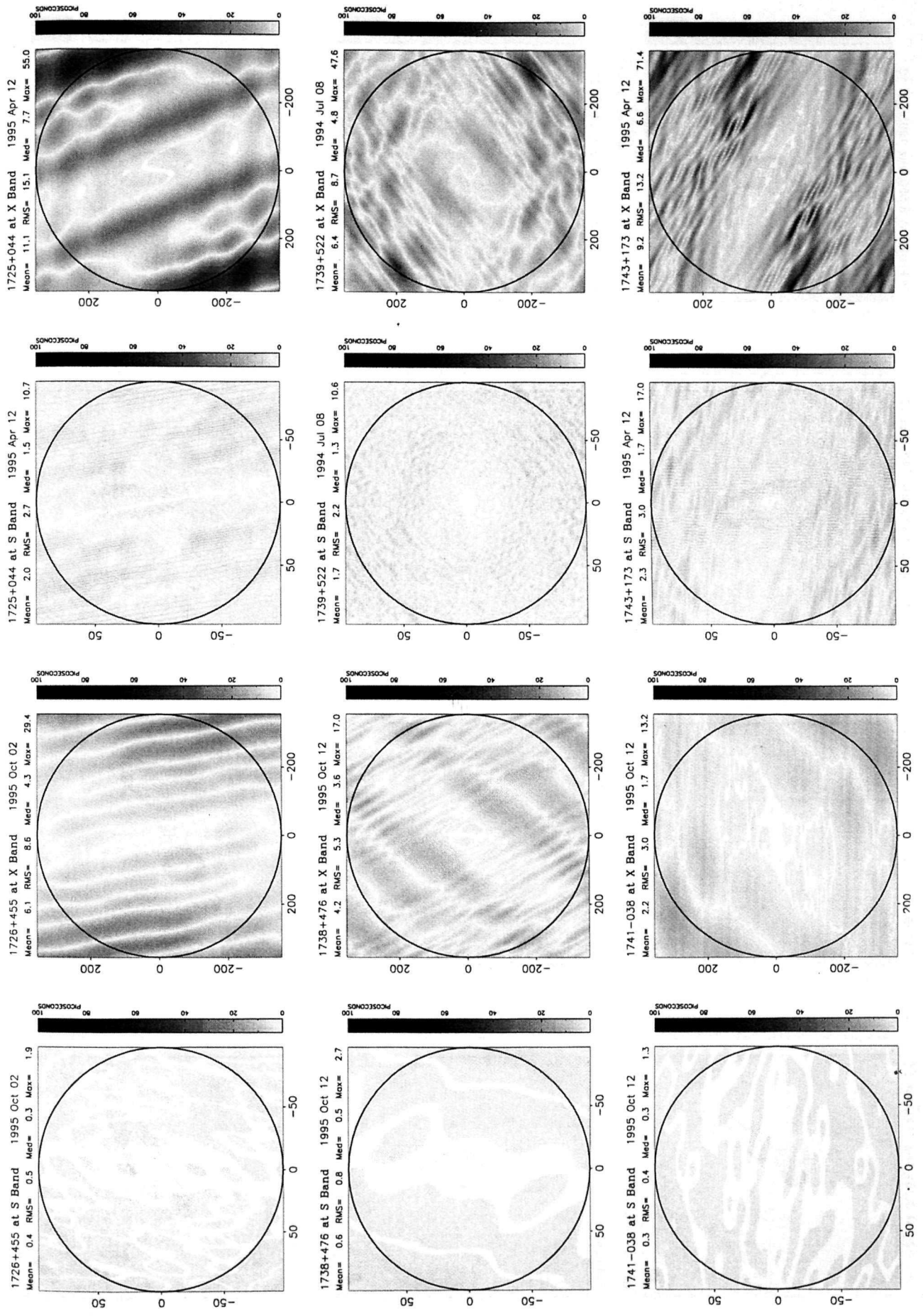

1606+106 at 8.596 GHz 1996 Apr 24
1611+343 at 8.550 GHz 1994 Jul 08
1624+416 at 8.550 GHz 1995 Oct 12
1606+106 at 2.361 GHz 1996 Apr 24
1611+343 at 2.320 GHz 1994 Jul 08
1624+416 at 2.320 GHz 1995 Oct 12
1600+335 at 8.550 GHz 1995 Oct 12
1607+268 at 8.550 GHz 1995 Apr 12
1622−253 at 8.550 GHz 1994 Jul 08
1600+335 at 2.320 GHz 1995 Oct 12
1607+268 at 2.320 GHz 1995 Apr 12
1622−253 at 2.320 GHz 1994 Jul 08

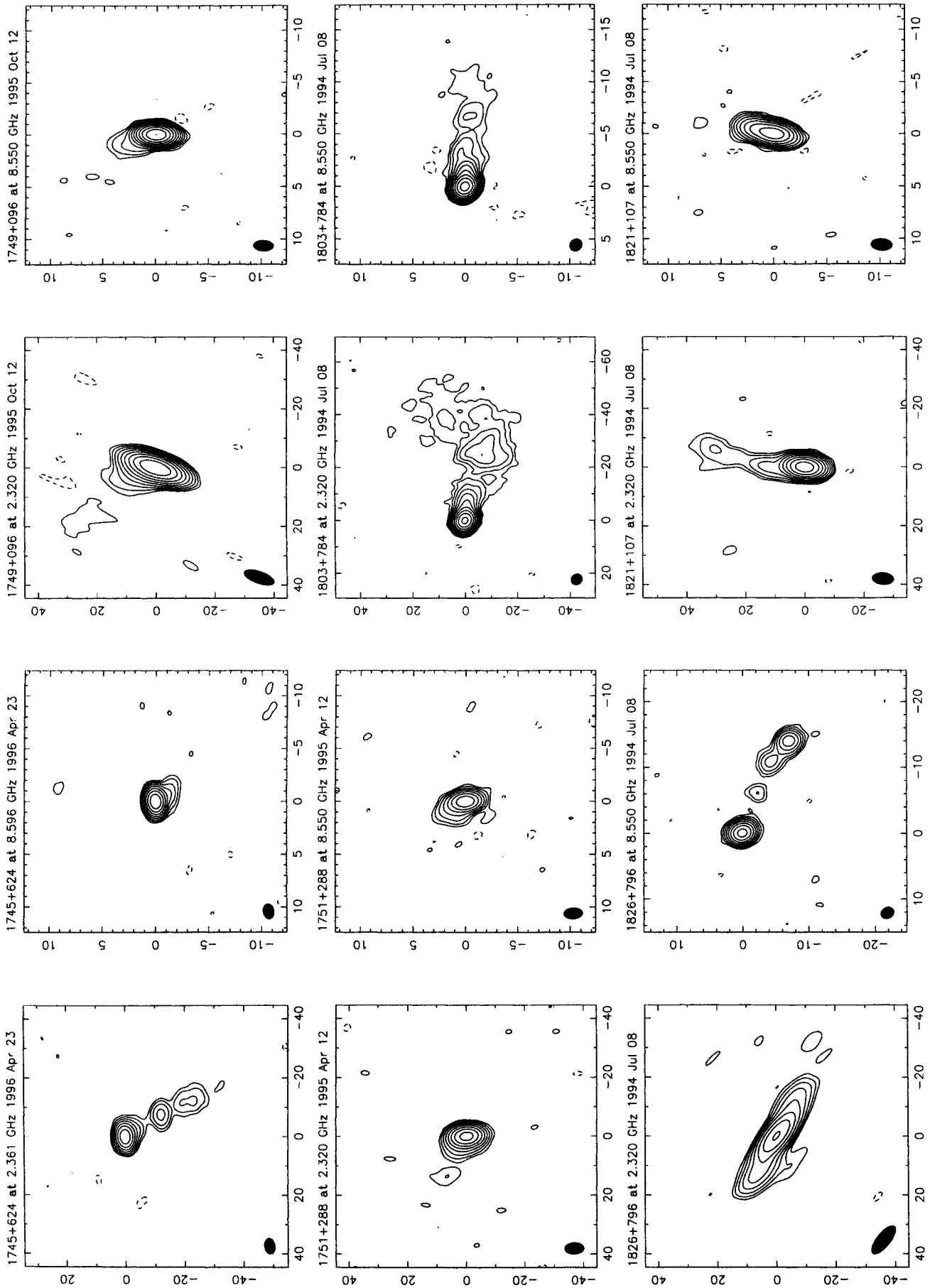

1606+106 at X Band 1996 Apr 24
Mean= 10.8 RMS= 14.0 Med= 9.6 Max= 55.6
1611+343 at X Band 1994 Jul 08
Mean= 18.8 RMS= 27.8 Med= 12.2 Max= 146.9
1624+416 at X Band 1995 Oct 12
Mean= 30.7 RMS= 40.9 Med= 23.1 Max= 178.1
1606+106 at S Band 1996 Apr 24
Mean= 0.7 RMS= 1.0 Med= 0.6 Max= 3.5
1611+343 at S Band 1994 Jul 08
Mean= 2.6 RMS= 3.6 Med= 2.0 Max= 16.9
1624+416 at S Band 1995 Oct 12
Mean= 4.7 RMS= 6.3 Med= 3.5 Max= 28.6
1600+335 at X Band 1995 Oct 12
Mean= 28.4 RMS= 38.4 Med= 21.3 Max= 213.0
1607+268 at X Band 1995 Apr 12
Mean= 68.4 RMS= 93.2 Med= 51.2 Max= 685.9
1622-253 at X Band 1994 Jul 08
Mean= 2.4 RMS= 3.3 Med= 1.9 Max= 10.5
1600+335 at S Band 1995 Oct 12
Mean= 2.8 RMS= 3.5 Med= 2.4 Max= 12.6
1607+268 at S Band 1995 Apr 12
Mean= 130.0 RMS= 193.0 Med= 79.6 Max= 690.9
1622-253 at S Band 1994 Jul 08
Mean= 1.2 RMS= 1.6 Med= 0.9 Max= 7.1
PICOSECONDS

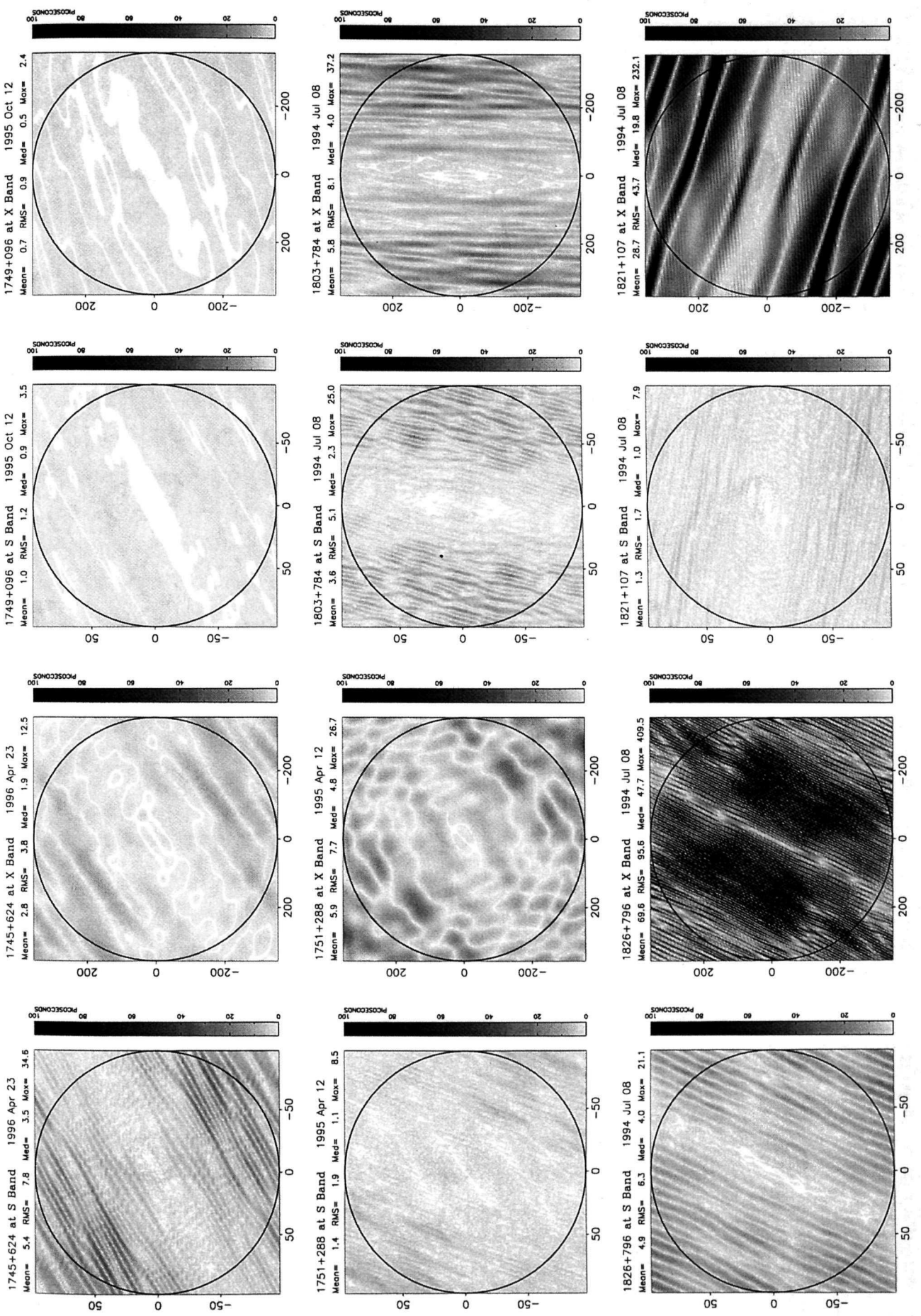

1633+382 at 2.320 GHz 1995 Apr 12
1633+382 at 8.550 GHz 1995 Apr 12
1638+398 at 2.361 GHz 1996 Apr 23
1638+398 at 8.596 GHz 1996 Apr 23
1642+690 at 2.320 GHz 1995 Oct 12
1642+690 at 8.550 GHz 1995 Oct 12
1652+398 at 2.320 GHz 1995 Apr 12
1652+398 at 8.550 GHz 1995 Apr 12
1705+456 at 2.320 GHz 1995 Apr 12
1705+456 at 8.550 GHz 1995 Apr 12
1705+018 at 2.320 GHz 1995 Oct 12
1705+018 at 8.550 GHz 1995 Oct 12

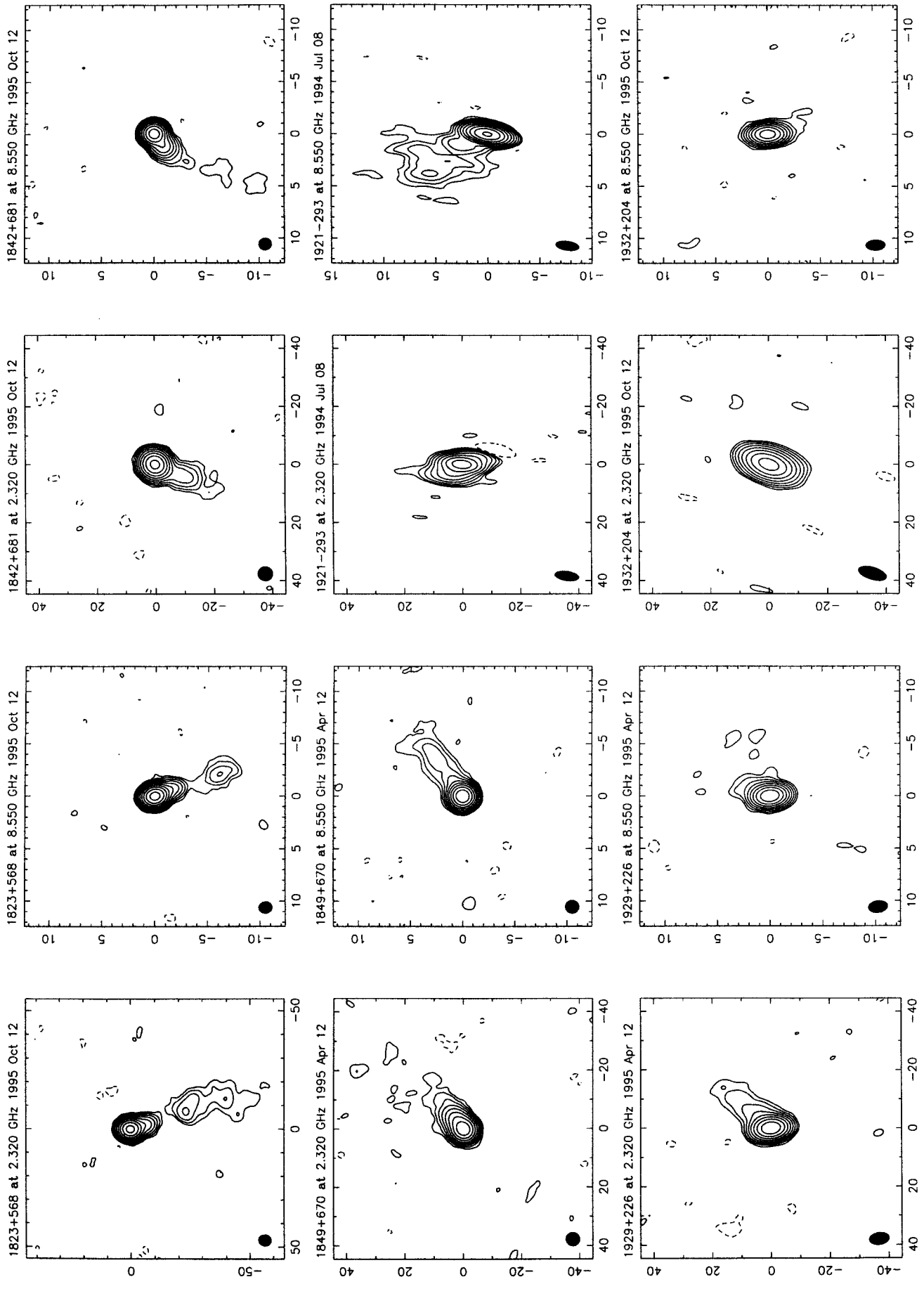

1638+398 at X Band 1996 Apr 23
Mean= 1.8 RMS= 2.6 Med= 1.1 Max= 9.4
1652+398 at X Band 1995 Apr 12
Mean= 17.8 RMS= 23.6 Med= 13.6 Max= 103.2
1705+018 at X Band 1995 Oct 12
Mean= 6.1 RMS= 7.6 Med= 5.1 Max= 22.0
1638+398 at S Band 1996 Apr 23
Mean= 0.5 RMS= 0.6 Med= 0.4 Max= 1.9
1652+398 at S Band 1995 Apr 12
Mean= 6.8 RMS= 9.2 Med= 5.2 Max= 52.6
1705+018 at S Band 1995 Oct 12
Mean= 1.2 RMS= 1.7 Med= 0.8 Max= 6.2
1633+382 at X Band 1995 Apr 12
Mean= 25.2 RMS= 39.8 Med= 15.5 Max= 255.7
1642+690 at X Band 1995 Oct 12
Mean= 26.6 RMS= 38.7 Med= 17.3 Max= 222.2
1705+456 at X Band 1995 Apr 12
Mean= 16.6 RMS= 22.2 Med= 12.3 Max= 80.6
1633+382 at S Band 1995 Apr 12
Mean= 1.5 RMS= 2.2 Med= 1.0 Max= 12.3
1642+690 at S Band 1995 Oct 12
Mean= 4.7 RMS= 6.5 Med= 3.3 Max= 25.6
1705+456 at S Band 1995 Apr 12
Mean= 10.0 RMS= 15.1 Med= 5.7 Max= 105.1
PICOSECONDS

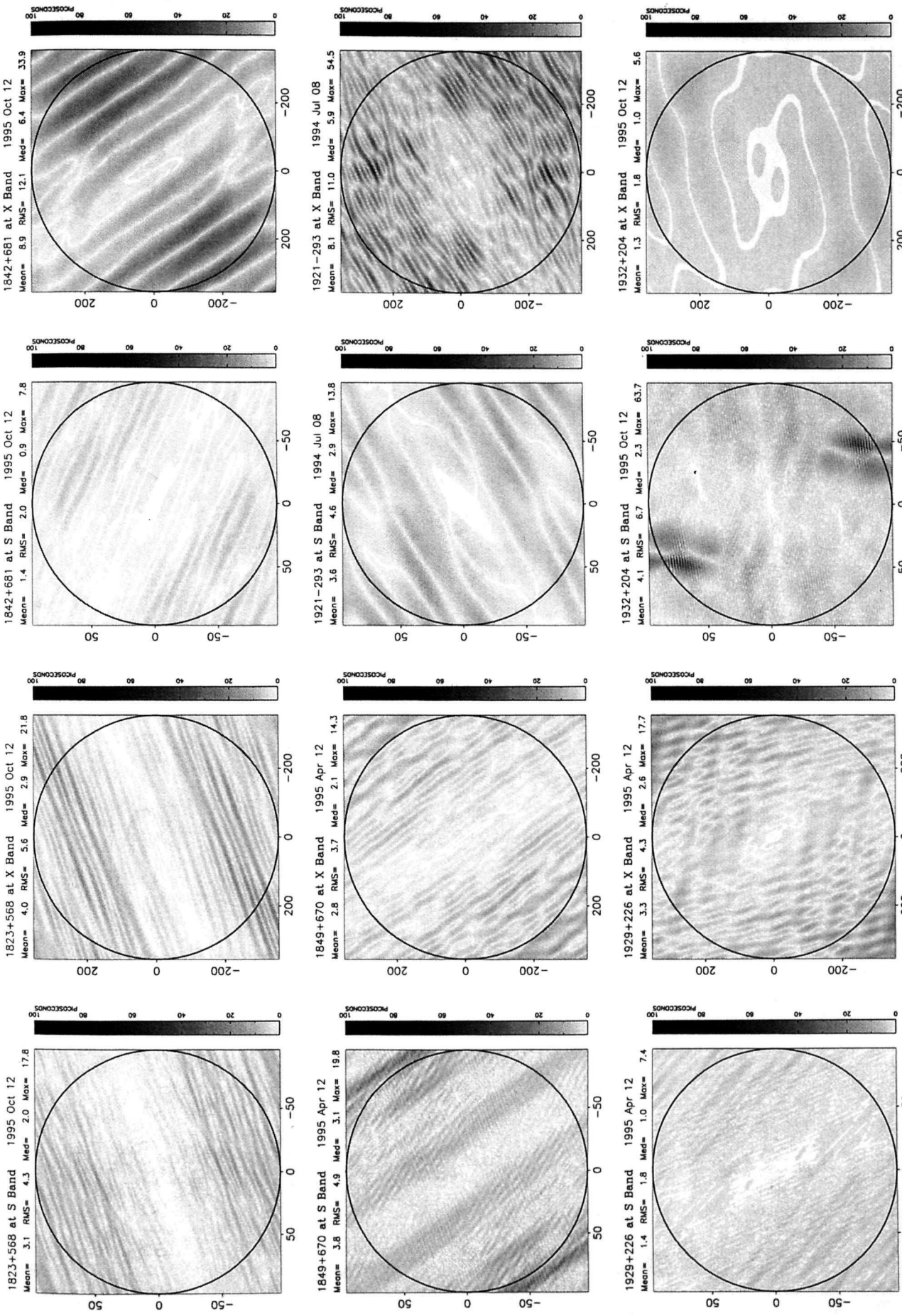

1726+455 at 2.221 GHz 1995 Oct 02
1726+455 at 8.406 GHz 1995 Oct 02
1725+044 at 2.320 GHz 1995 Apr 12
1725+044 at 8.550 GHz 1995 Apr 12
1738+476 at 2.320 GHz 1995 Oct 12
1738+476 at 8.550 GHz 1995 Oct 12
1739+522 at 2.320 GHz 1994 Jul 08
1739+522 at 8.550 GHz 1994 Jul 08
1741−038 at 2.320 GHz 1995 Oct 12
1741−038 at 8.550 GHz 1995 Oct 12
1743+173 at 2.320 GHz 1995 Apr 12
1743+173 at 8.550 GHz 1995 Apr 12

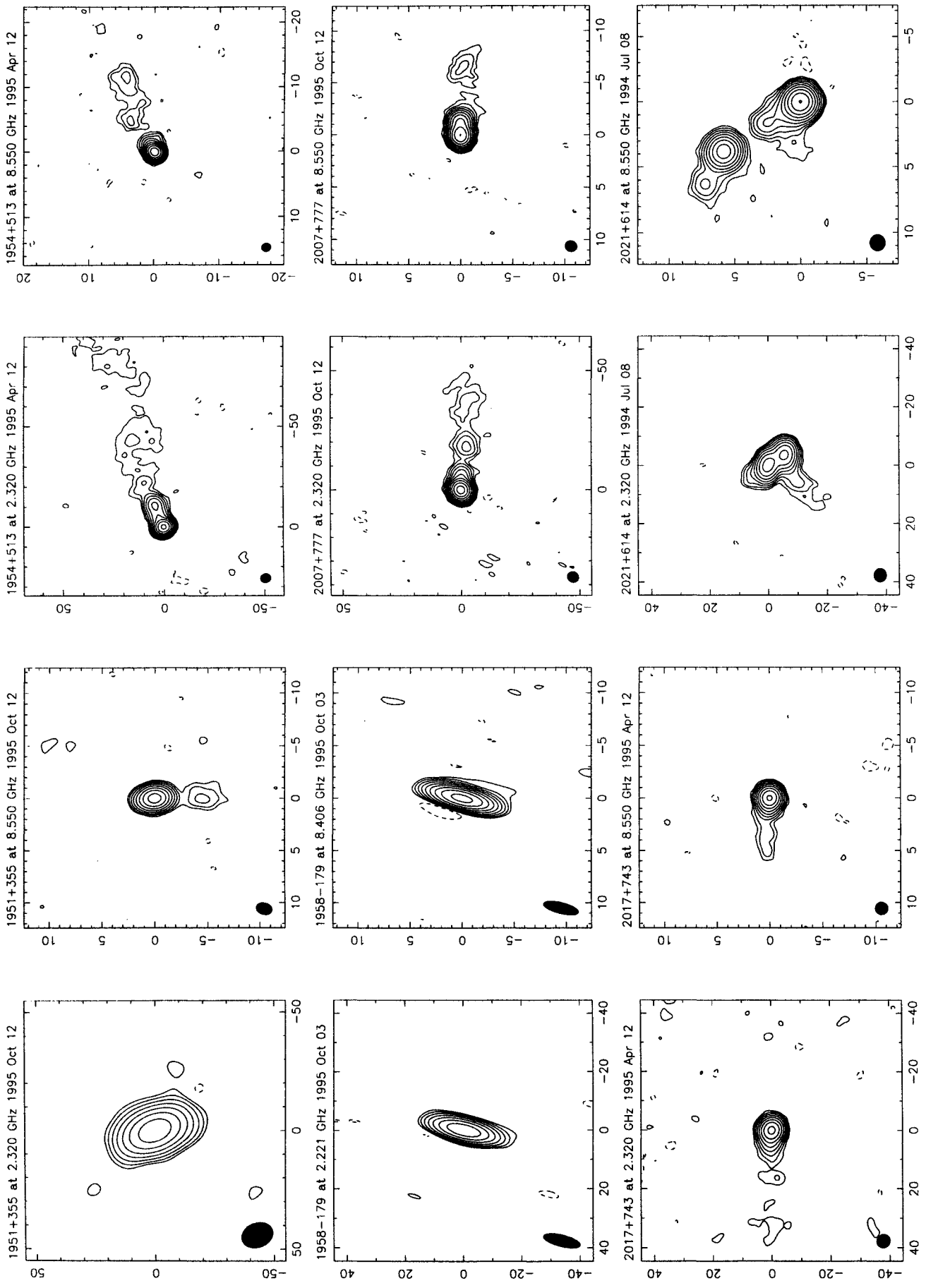

1725+044 at X Band 1995 Apr 12
Mean= 11.1 RMS= 15.1 Med= 7.7 Max= 55.0
1739+522 at X Band 1994 Jul 08
Mean= 6.4 RMS= 8.7 Med= 4.8 Max= 47.6
1743+173 at X Band 1995 Apr 12
Mean= 9.2 RMS= 13.2 Med= 6.6 Max= 71.4
1725+044 at S Band 1995 Apr 12
Mean= 2.0 RMS= 2.7 Med= 1.5 Max= 10.7
1739+522 at S Band 1994 Jul 08
Mean= 1.7 RMS= 2.2 Med= 1.3 Max= 10.6
1743+173 at S Band 1995 Apr 12
Mean= 2.3 RMS= 3.0 Med= 1.7 Max= 17.0
1726+455 at X Band 1995 Oct 02
Mean= 6.1 RMS= 8.6 Med= 4.3 Max= 29.4
1738+476 at X Band 1995 Oct 12
Mean= 4.2 RMS= 5.3 Med= 3.6 Max= 17.0
1741-038 at X Band 1995 Oct 12
Mean= 2.2 RMS= 3.0 Med= 1.7 Max= 13.2
1726+455 at S Band 1995 Oct 02
Mean= 0.4 RMS= 0.5 Med= 0.3 Max= 1.9
1738+476 at S Band 1995 Oct 12
Mean= 0.6 RMS= 0.8 Med= 0.5 Max= 2.7
1741-038 at S Band 1995 Oct 12
Mean= 0.3 RMS= 0.4 Med= 0.3 Max= 1.3
PICOSECONDS

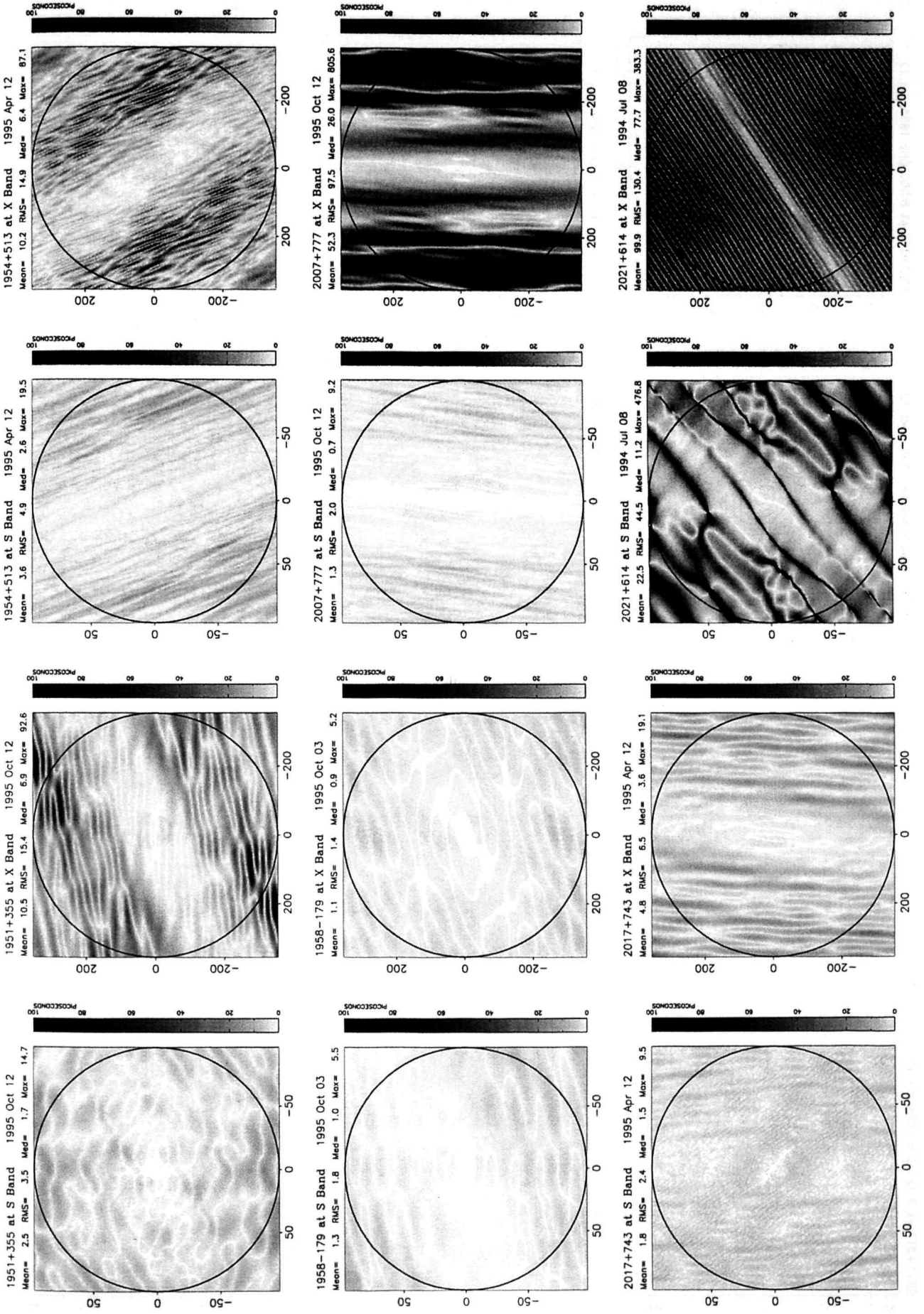

1749+096 at 8.550 GHz 1995 Oct 12
1803+784 at 8.550 GHz 1994 Jul 08
1821+107 at 8.550 GHz 1994 Jul 08
1749+096 at 2.320 GHz 1995 Oct 12
1803+784 at 2.320 GHz 1994 Jul 08
1821+107 at 2.320 GHz 1994 Jul 08
1745+624 at 8.596 GHz 1996 Apr 23
1751+288 at 8.550 GHz 1995 Apr 12
1826+796 at 8.550 GHz 1994 Jul 08
1745+624 at 2.361 GHz 1996 Apr 23
1751+288 at 2.320 GHz 1995 Apr 12
1826+796 at 2.320 GHz 1994 Jul 08

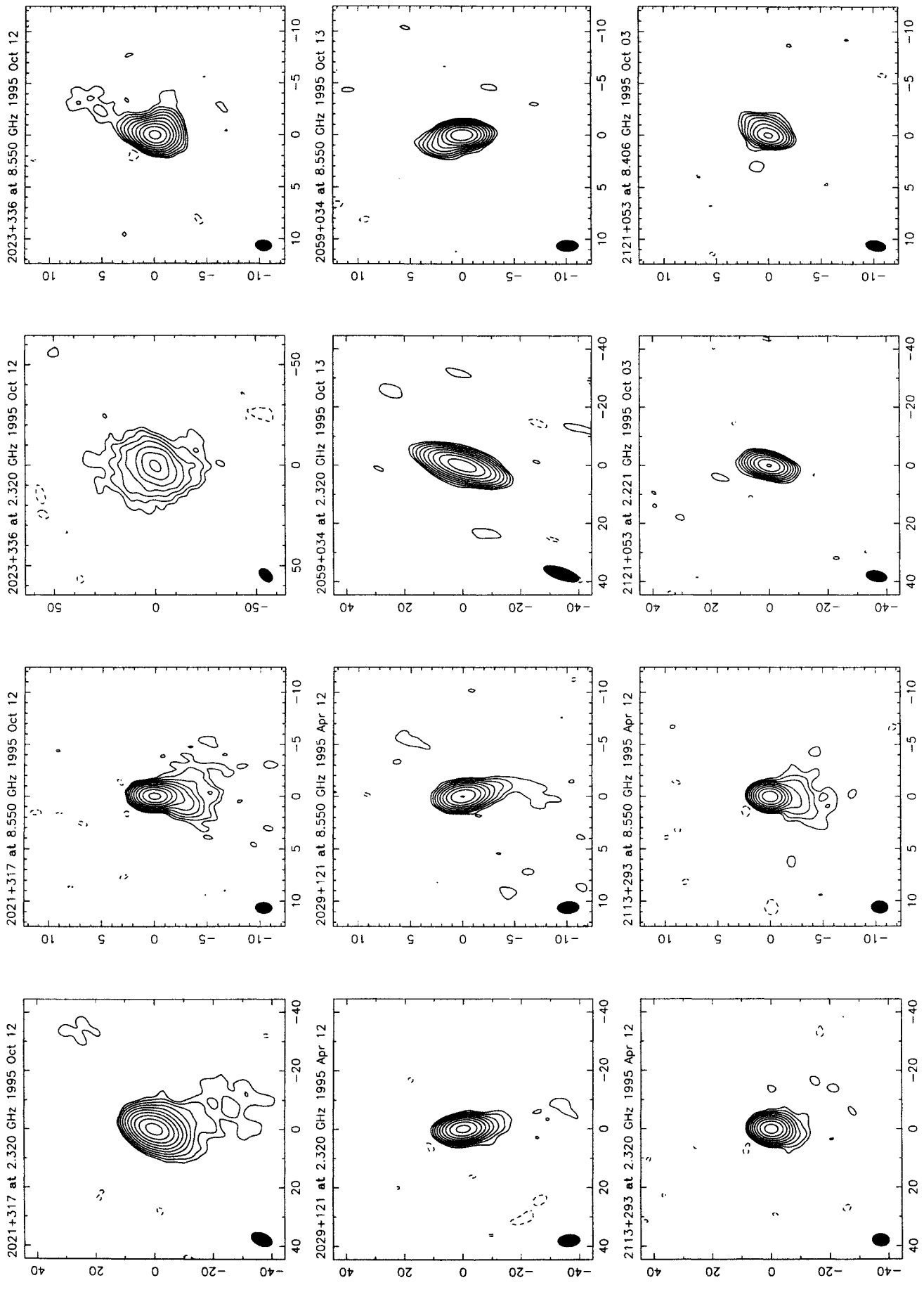

1749+096 at X Band 1995 Oct 12
Mean= 0.7 RMS= 0.9 Med= 0.5 Max= 2.4
1803+784 at X Band 1994 Jul 08
Mean= 5.8 RMS= 8.1 Med= 4.0 Max= 37.2
1821+107 at X Band 1994 Jul 08
Mean= 28.7 RMS= 43.7 Med= 19.8 Max= 232.1
1749+096 at S Band 1995 Oct 12
Mean= 1.0 RMS= 1.2 Med= 0.9 Max= 3.5
1803+784 at S Band 1994 Jul 08
Mean= 3.6 RMS= 5.1 Med= 2.3 Max= 25.0
1821+107 at S Band 1994 Jul 08
Mean= 1.3 RMS= 1.7 Med= 1.0 Max= 7.9
1745+624 at X Band 1996 Apr 23
Mean= 2.8 RMS= 3.8 Med= 1.9 Max= 12.5
1751+288 at X Band 1995 Apr 12
Mean= 5.9 RMS= 7.7 Med= 4.8 Max= 26.7
1826+796 at X Band 1994 Jul 08
Mean= 69.6 RMS= 95.6 Med= 47.7 Max= 409.5
1745+624 at S Band 1996 Apr 23
Mean= 5.4 RMS= 7.8 Med= 3.5 Max= 34.6
1751+288 at S Band 1995 Apr 12
Mean= 1.4 RMS= 1.9 Med= 1.1 Max= 8.5
1826+796 at S Band 1994 Jul 08
Mean= 4.9 RMS= 6.3 Med= 4.0 Max= 21.1
PICOSECONDS

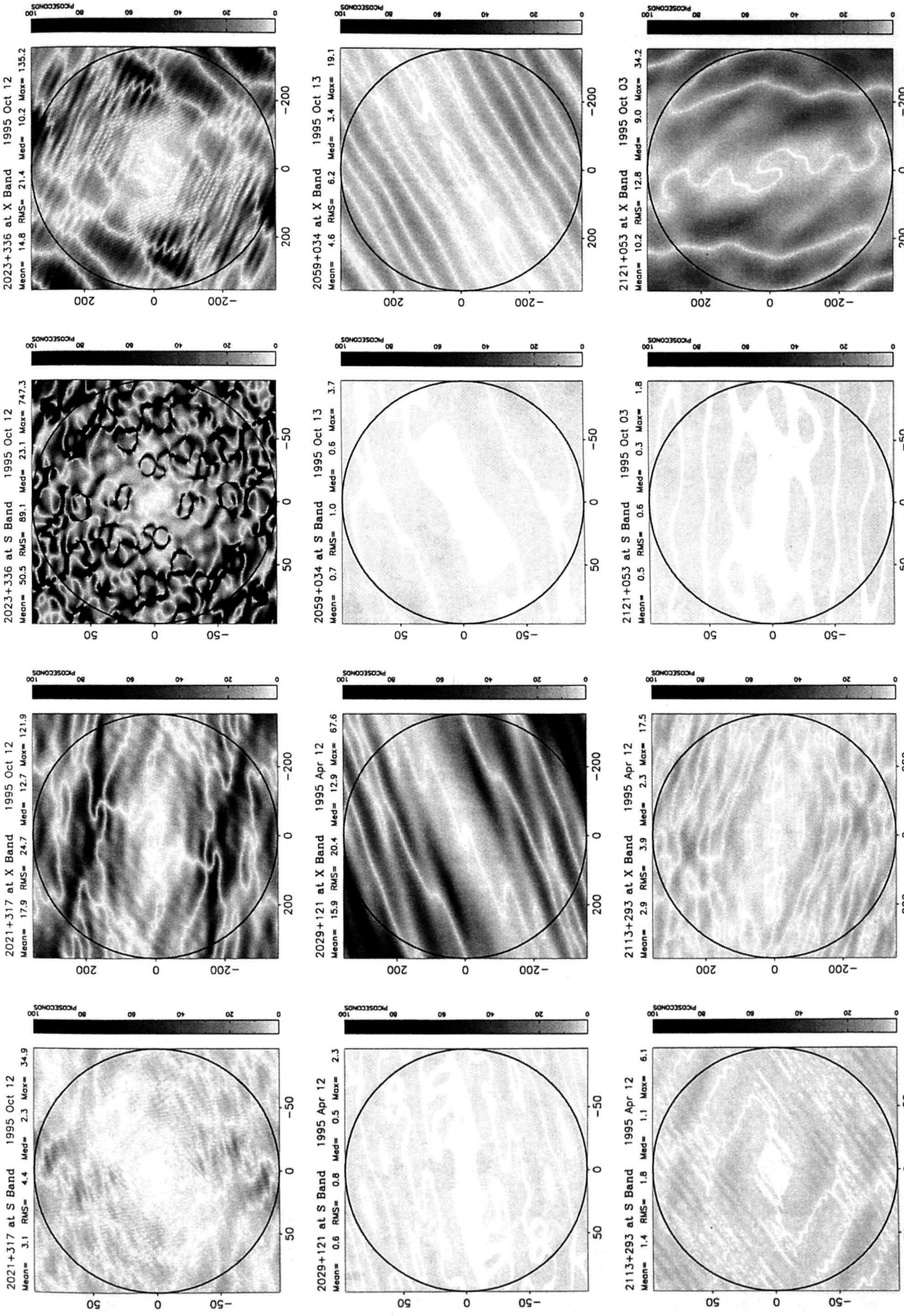

1823+568 at 2.320 GHz 1995 Oct 12
1823+568 at 8.550 GHz 1995 Oct 12
1842+681 at 2.320 GHz 1995 Oct 12
1842+681 at 8.550 GHz 1995 Oct 12
1849+670 at 2.320 GHz 1995 Apr 12
1849+670 at 8.550 GHz 1995 Apr 12
1921−293 at 2.320 GHz 1994 Jul 08
1921−293 at 8.550 GHz 1994 Jul 08
1929+226 at 2.320 GHz 1995 Apr 12
1929+226 at 8.550 GHz 1995 Apr 12
1932+204 at 2.320 GHz 1995 Oct 12
1932+204 at 8.550 GHz 1995 Oct 12

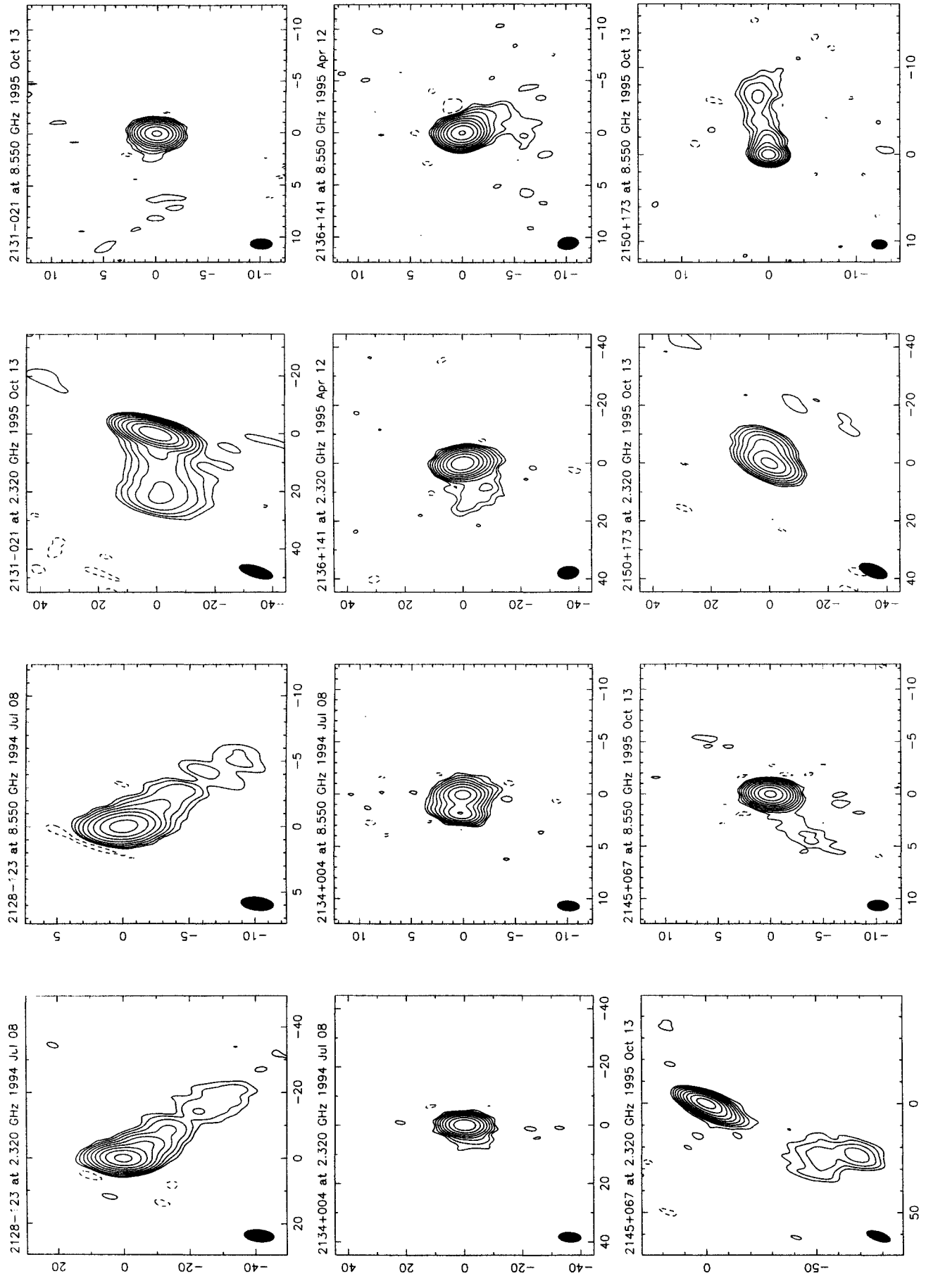

1842+681 at X Band 1995 Oct 12
Mean= 8.9 RMS= 12.1 Med= 6.4 Max= 33.9
1921-293 at X Band 1994 Jul 08
Mean= 8.1 RMS= 11.0 Med= 5.9 Max= 54.5
1932+204 at X Band 1995 Oct 12
Mean= 1.3 RMS= 1.8 Med= 1.0 Max= 5.6
1842+681 at S Band 1995 Oct 12
Mean= 1.4 RMS= 2.0 Med= 0.9 Max= 7.8
1921-293 at S Band 1994 Jul 08
Mean= 3.6 RMS= 4.6 Med= 2.9 Max= 13.8
1932+204 at S Band 1995 Oct 12
Mean= 4.1 RMS= 6.7 Med= 2.3 Max= 63.7
1823+568 at X Band 1995 Oct 12
Mean= 4.0 RMS= 5.6 Med= 2.9 Max= 21.8
1849+670 at X Band 1995 Apr 12
Mean= 2.8 RMS= 3.7 Med= 2.1 Max= 14.3
1929+226 at X Band 1995 Apr 12
Mean= 3.3 RMS= 4.3 Med= 2.6 Max= 17.7
1823+568 at S Band 1995 Oct 12
Mean= 3.1 RMS= 4.3 Med= 2.0 Max= 17.8
1849+670 at S Band 1995 Apr 12
Mean= 3.8 RMS= 4.9 Med= 3.1 Max= 19.8
1929+226 at S Band 1995 Apr 12
Mean= 1.4 RMS= 1.8 Med= 1.0 Max= 7.4
PICOSECONDS

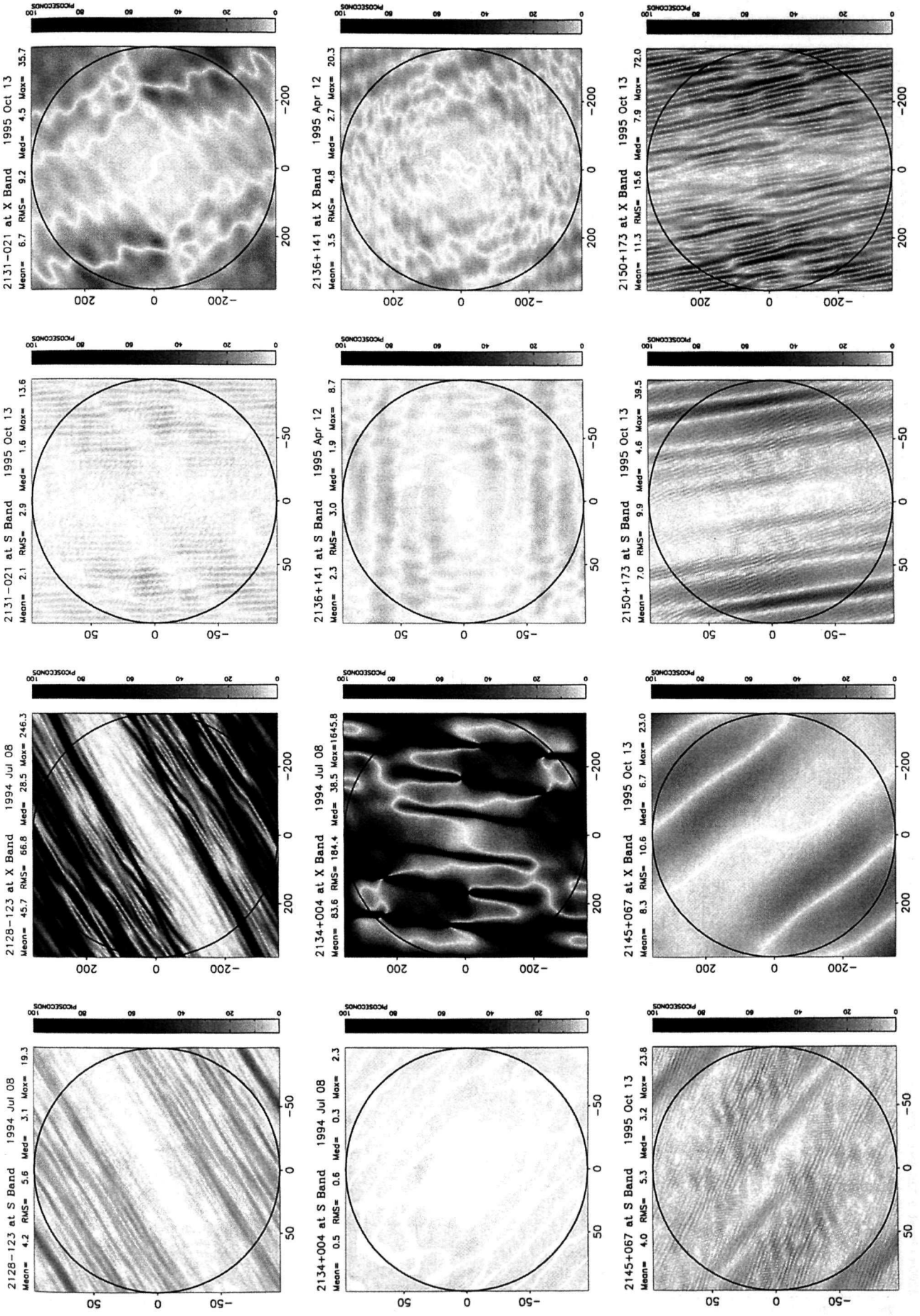

1951+355 at 2.320 GHz 1995 Oct 12
1951+355 at 8.550 GHz 1995 Oct 12
1954+513 at 2.320 GHz 1995 Apr 12
1954+513 at 8.550 GHz 1995 Apr 12
1958−179 at 2.221 GHz 1995 Oct 03
1958−179 at 8.406 GHz 1995 Oct 03
2007+777 at 2.320 GHz 1995 Oct 12
2007+777 at 8.550 GHz 1995 Oct 12
2017+743 at 2.320 GHz 1995 Apr 12
2017+743 at 8.550 GHz 1995 Apr 12
2021+614 at 2.320 GHz 1994 Jul 08
2021+614 at 8.550 GHz 1994 Jul 08

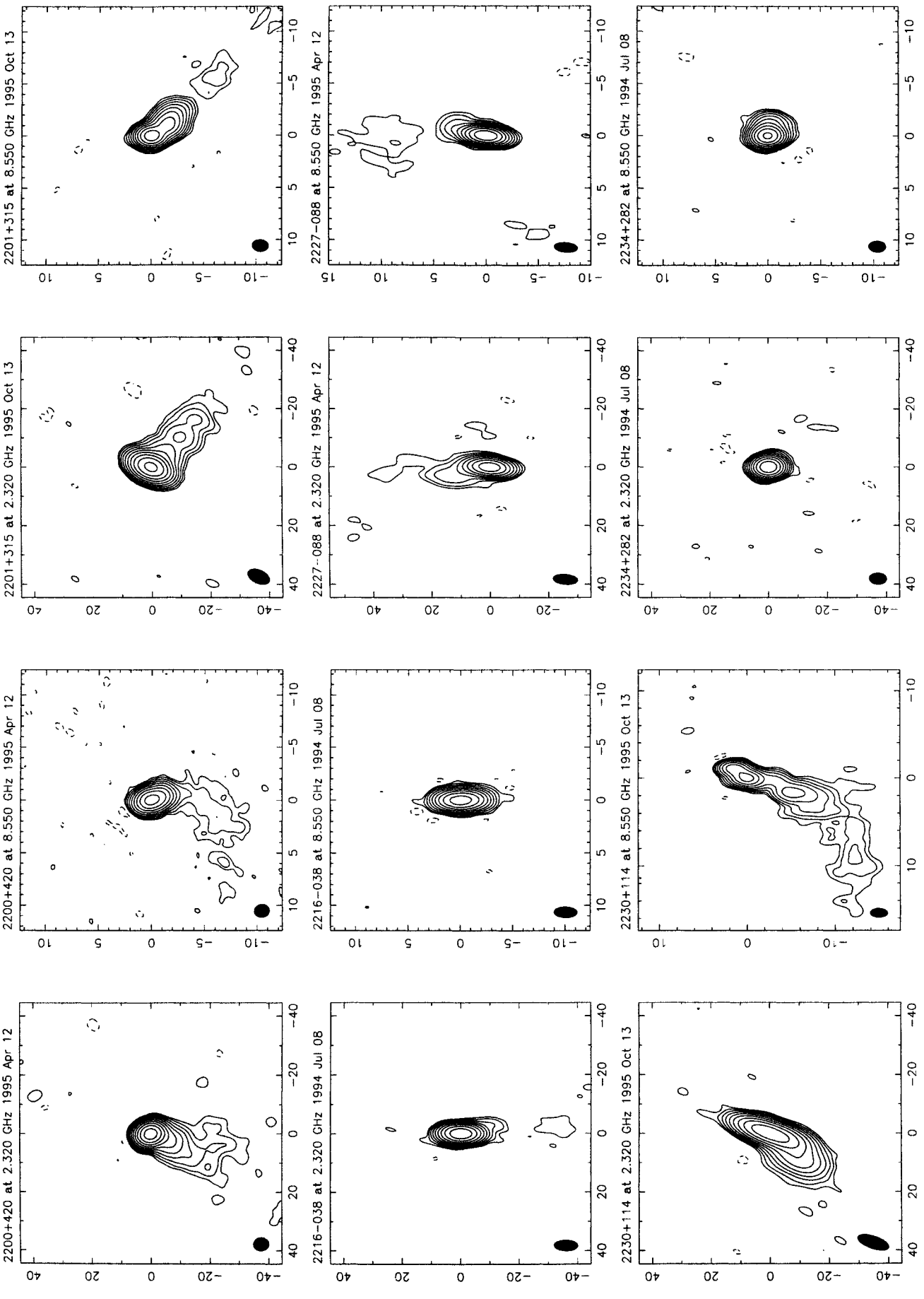

1954+513 at X Band 1995 Apr 12
Mean= 10.2 RMS= 14.9 Med= 6.4 Max= 87.1
2007+777 at X Band 1995 Oct 12
Mean= 52.3 RMS= 97.5 Med= 26.0 Max= 805.6
2021+614 at X Band 1994 Jul 08
Mean= 99.9 RMS= 130.4 Med= 77.7 Max= 383.3
1954+513 at S Band 1995 Apr 12
Mean= 3.6 RMS= 4.9 Med= 2.6 Max= 19.5
2007+777 at S Band 1995 Oct 12
Mean= 1.3 RMS= 2.0 Med= 0.7 Max= 9.2
2021+614 at S Band 1994 Jul 08
Mean= 22.5 RMS= 44.5 Med= 11.2 Max= 476.8
1951+355 at X Band 1995 Oct 12
Mean= 10.5 RMS= 15.4 Med= 6.9 Max= 92.6
1958-179 at X Band 1995 Oct 03
Mean= 1.1 RMS= 1.4 Med= 0.9 Max= 5.2
2017+743 at X Band 1995 Apr 12
Mean= 4.8 RMS= 6.5 Med= 3.6 Max= 19.1
1951+355 at S Band 1995 Oct 12
Mean= 2.5 RMS= 3.5 Med= 1.7 Max= 14.7
1958-179 at S Band 1995 Oct 03
Mean= 1.3 RMS= 1.8 Med= 1.0 Max= 5.5
2017+743 at S Band 1995 Apr 12
Mean= 1.8 RMS= 2.4 Med= 1.5 Max= 9.5
PICOSECONDS

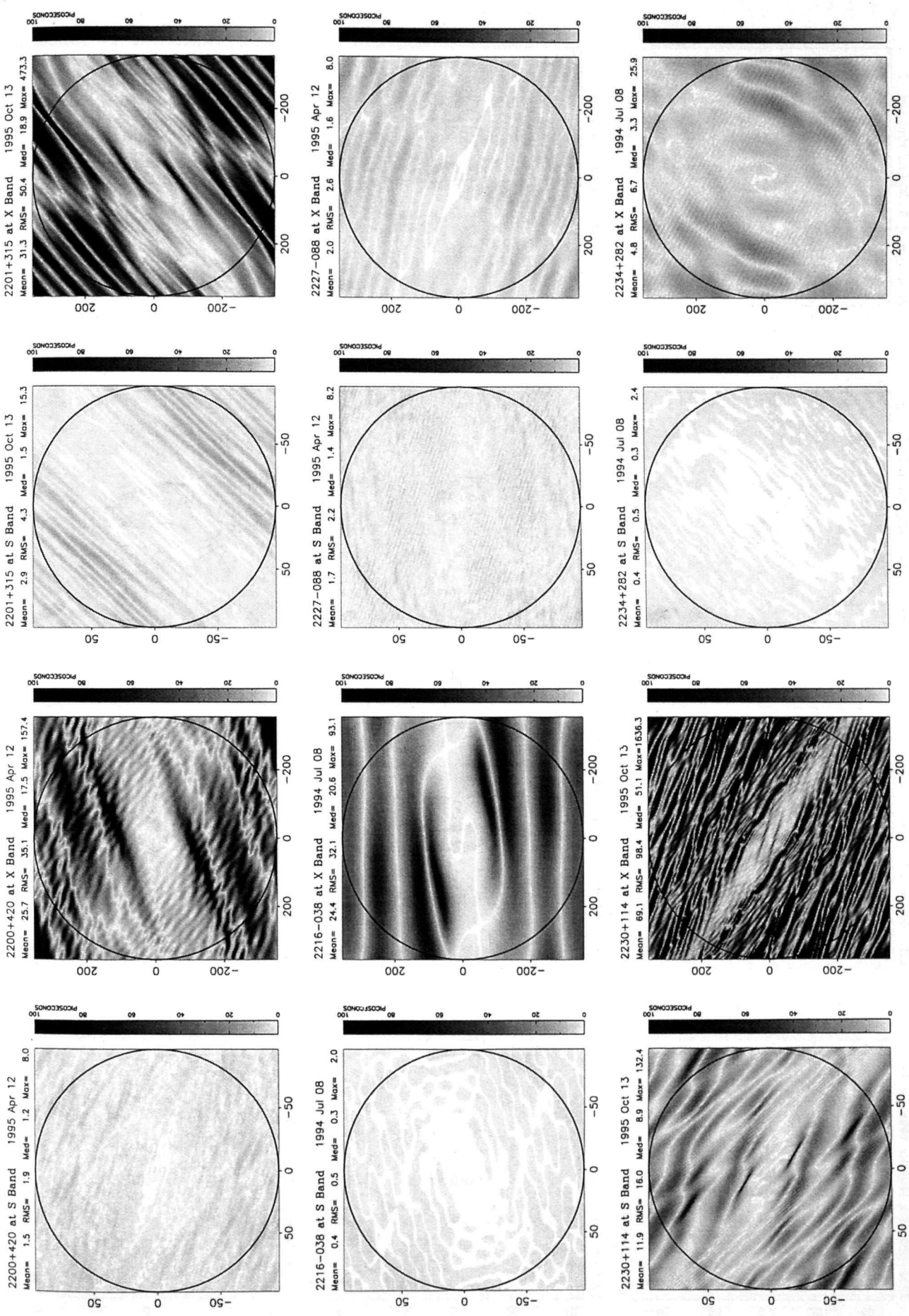

2021+317 at 2.320 GHz 1995 Oct 12
2021+317 at 8.550 GHz 1995 Oct 12
2023+336 at 2.320 GHz 1995 Oct 12
2023+336 at 8.550 GHz 1995 Oct 12
2029+121 at 2.320 GHz 1995 Apr 12
2029+121 at 8.550 GHz 1995 Apr 12
2059+034 at 2.320 GHz 1995 Oct 13
2059+034 at 8.550 GHz 1995 Oct 13
2113+293 at 2.320 GHz 1995 Apr 12
2113+293 at 8.550 GHz 1995 Apr 12
2121+053 at 2.221 GHz 1995 Oct 03
2121+053 at 8.406 GHz 1995 Oct 03

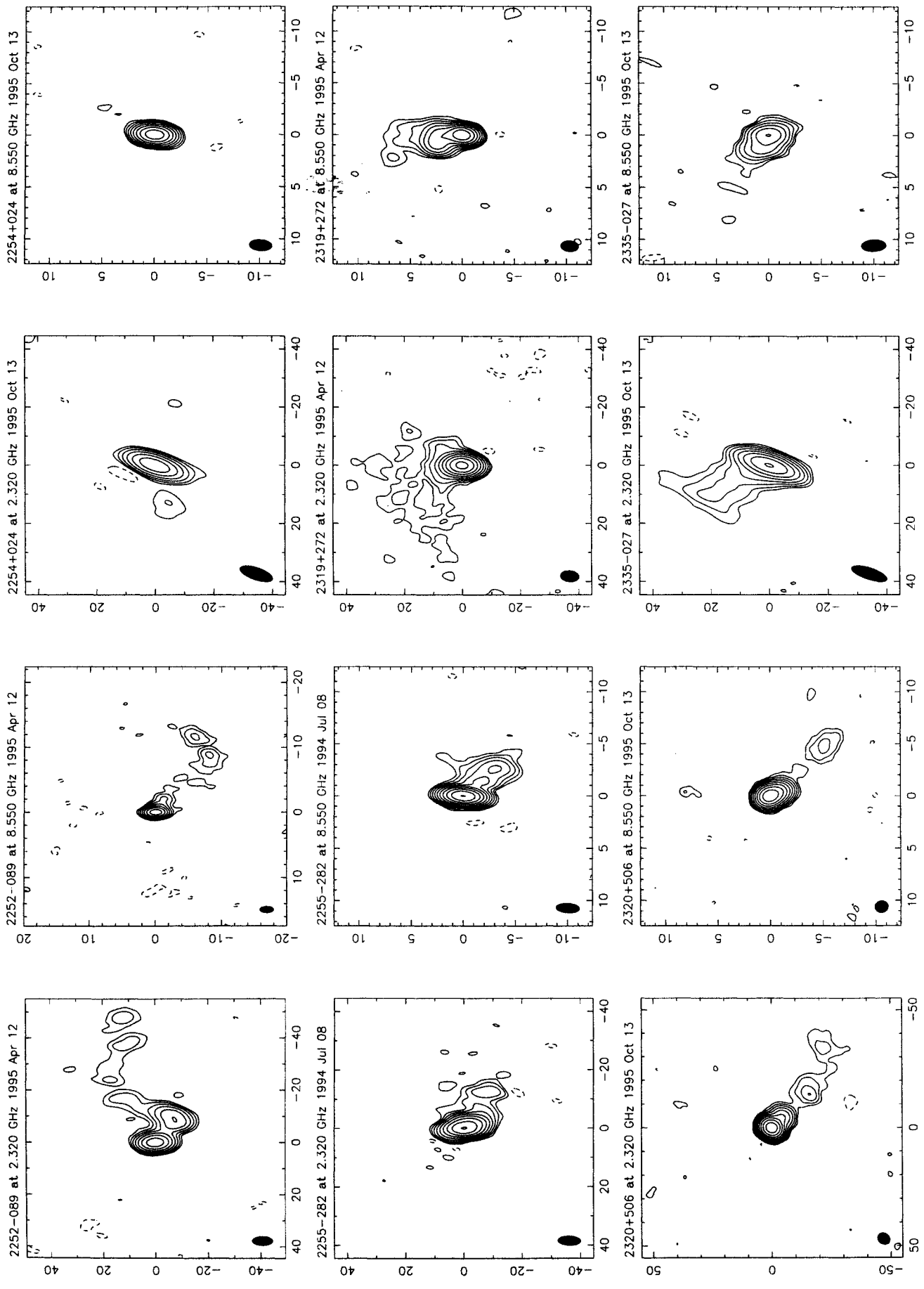

2023+336 at X Band 1995 Oct 12
Mean= 14.8 RMS= 21.4 Med= 10.2 Max= 135.2
2059+034 at X Band 1995 Oct 13
Mean= 4.6 RMS= 6.2 Med= 3.4 Max= 19.1
2121+053 at X Band 1995 Oct 03
Mean= 10.2 RMS= 12.8 Med= 9.0 Max= 34.2
2023+336 at S Band 1995 Oct 12
Mean= 50.5 RMS= 89.1 Med= 23.1 Max= 747.3
2059+034 at S Band 1995 Oct 13
Mean= 0.7 RMS= 1.0 Med= 0.6 Max= 3.7
2121+053 at S Band 1995 Oct 03
Mean= 0.5 RMS= 0.6 Med= 0.3 Max= 1.8
2021+317 at X Band 1995 Oct 12
Mean= 17.9 RMS= 24.7 Med= 12.7 Max= 121.9
2029+121 at X Band 1995 Apr 12
Mean= 15.9 RMS= 20.4 Med= 12.9 Max= 67.6
2113+293 at X Band 1995 Apr 12
Mean= 2.9 RMS= 3.9 Med= 2.3 Max= 17.5
2021+317 at S Band 1995 Oct 12
Mean= 3.1 RMS= 4.4 Med= 2.3 Max= 34.9
2029+121 at S Band 1995 Apr 12
Mean= 0.6 RMS= 0.8 Med= 0.5 Max= 2.3
2113+293 at S Band 1995 Apr 12
Mean= 1.4 RMS= 1.8 Med= 1.1 Max= 6.1
PICOSECONDS

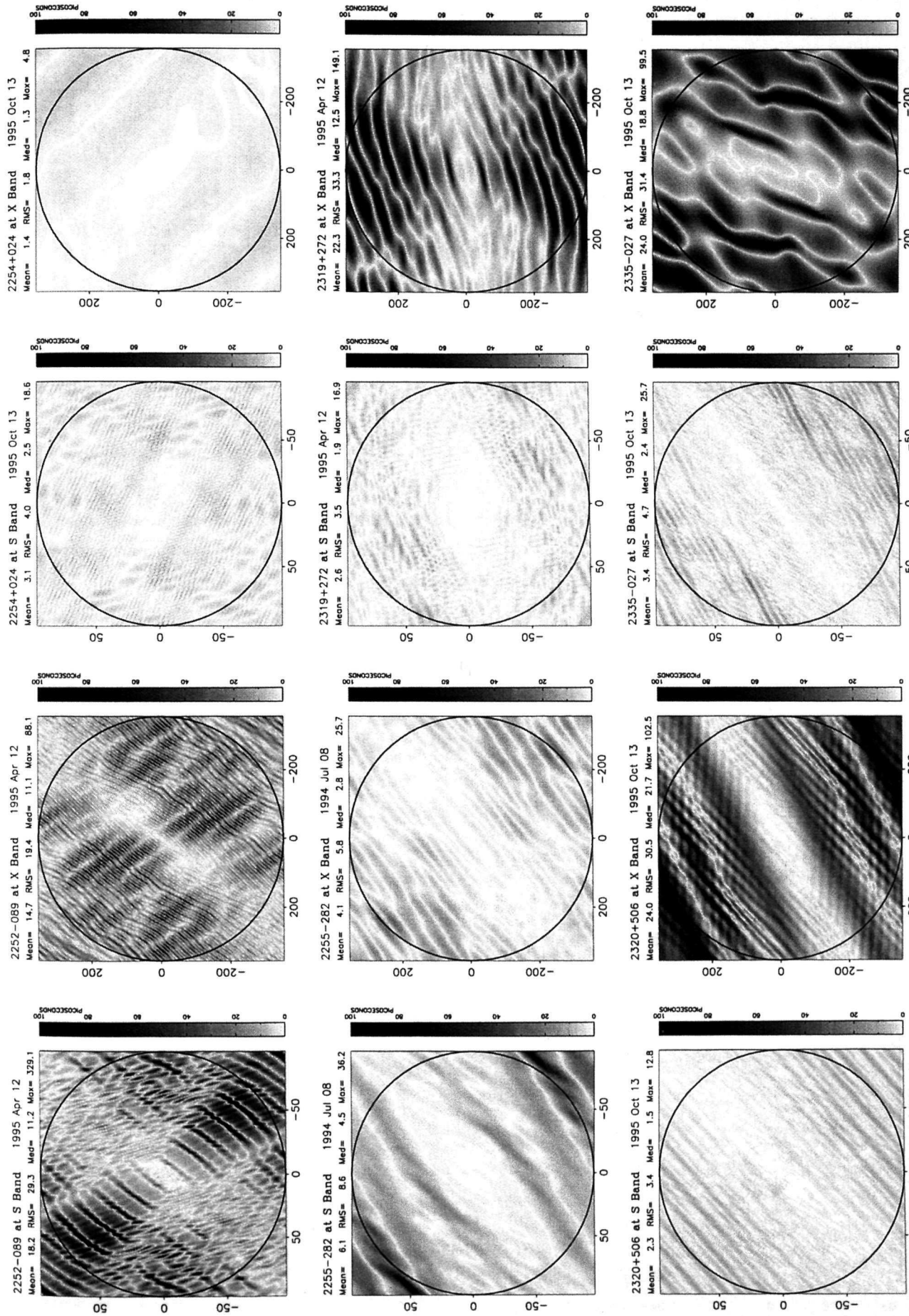

2128−123 at 2.320 GHz 1994 Jul 08
2128−123 at 8.550 GHz 1994 Jul 08
2131−021 at 2.320 GHz 1995 Oct 13
2131−021 at 8.550 GHz 1995 Oct 13
2134+004 at 2.320 GHz 1994 Jul 08
2134+004 at 8.550 GHz 1994 Jul 08
2136+141 at 2.320 GHz 1995 Apr 12
2136+141 at 8.550 GHz 1995 Apr 12
2145+067 at 2.320 GHz 1995 Oct 13
2145+067 at 8.550 GHz 1995 Oct 13
2150+173 at 2.320 GHz 1995 Oct 13
2150+173 at 8.550 GHz 1995 Oct 13

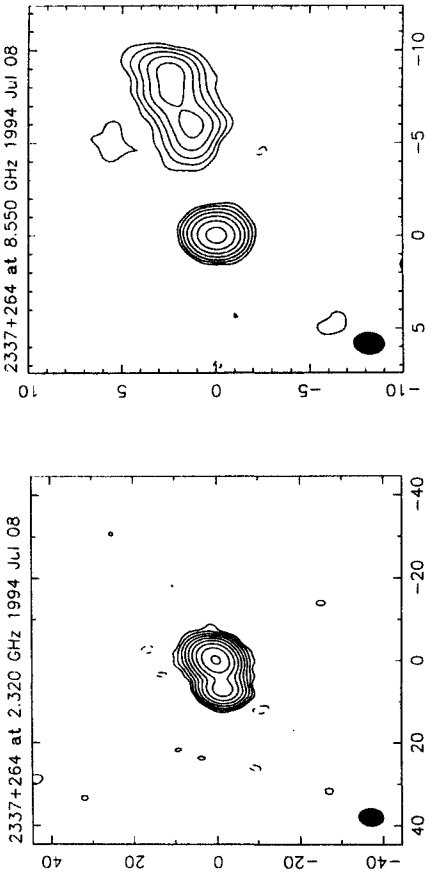

2131-021 at X Band 1995 Oct 13
Mean= 6.7 RMS= 9.2 Med= 4.5 Max= 35.7
2136+141 at X Band 1995 Apr 12
Mean= 3.5 RMS= 4.8 Med= 2.7 Max= 20.3
2150+173 at X Band 1995 Oct 13
Mean= 11.3 RMS= 15.6 Med= 7.9 Max= 72.0
2131-021 at S Band 1995 Oct 13
Mean= 2.1 RMS= 2.9 Med= 1.6 Max= 13.6
2136+141 at S Band 1995 Apr 12
Mean= 2.3 RMS= 3.0 Med= 1.9 Max= 8.7
2150+173 at S Band 1995 Oct 13
Mean= 7.0 RMS= 9.9 Med= 4.6 Max= 39.5
2128-123 at X Band 1994 Jul 08
Mean= 45.7 RMS= 66.8 Med= 28.5 Max= 246.3
2134+004 at X Band 1994 Jul 08
Mean= 83.6 RMS= 184.4 Med= 38.5 Max=1645.8
2145+067 at X Band 1995 Oct 13
Mean= 8.3 RMS= 10.6 Med= 6.7 Max= 23.0
2128-123 at S Band 1994 Jul 08
Mean= 4.2 RMS= 5.6 Med= 3.1 Max= 19.3
2134+004 at S Band 1994 Jul 08
Mean= 0.5 RMS= 0.6 Med= 0.3 Max= 2.3
2145+067 at S Band 1995 Oct 13
Mean= 4.0 RMS= 5.3 Med= 3.2 Max= 23.8
PICOSECONDS

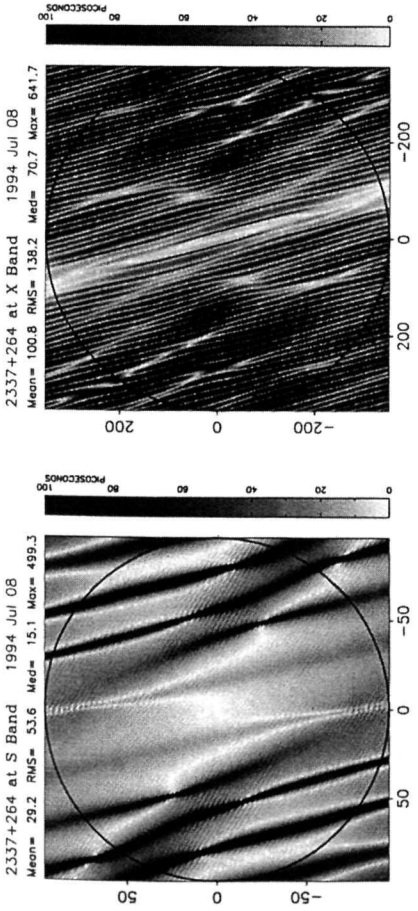

2200+420 at 2.320 GHz 1995 Apr 12
2200+420 at 8.550 GHz 1995 Apr 12
2201+315 at 2.320 GHz 1995 Oct 13
2201+315 at 8.550 GHz 1995 Oct 13
2216−038 at 2.320 GHz 1994 Jul 08
2216−038 at 8.550 GHz 1994 Jul 08
2227−088 at 2.320 GHz 1995 Apr 12
2227−088 at 8.550 GHz 1995 Apr 12
2230+114 at 2.320 GHz 1995 Oct 13
2230+114 at 8.550 GHz 1995 Oct 13
2234+282 at 2.320 GHz 1994 Jul 08
2234+282 at 8.550 GHz 1994 Jul 08


2201+315 at X Band 1995 Oct 13
Mean= 31.3 RMS= 50.4 Med= 18.9 Max= 473.3
2227−088 at X Band 1995 Apr 12
Mean= 2.0 RMS= 2.6 Med= 1.6 Max= 8.0
2234+282 at X Band 1994 Jul 08
Mean= 4.8 RMS= 6.7 Med= 3.3 Max= 25.9
2201+315 at S Band 1995 Oct 13
Mean= 2.9 RMS= 4.3 Med= 1.5 Max= 15.3
2227−088 at S Band 1995 Apr 12
Mean= 1.7 RMS= 2.2 Med= 1.4 Max= 8.2
2234+282 at S Band 1994 Jul 08
Mean= 0.4 RMS= 0.5 Med= 0.3 Max= 2.4
2200+420 at X Band 1995 Apr 12
Mean= 25.7 RMS= 35.1 Med= 17.5 Max= 157.4
2216−038 at X Band 1994 Jul 08
Mean= 24.4 RMS= 32.1 Med= 20.6 Max= 93.1
2230+114 at X Band 1995 Oct 13
Mean= 69.1 RMS= 98.4 Med= 51.1 Max=1636.3
2200+420 at S Band 1995 Apr 12
Mean= 1.5 RMS= 1.9 Med= 1.2 Max= 8.0
2216−038 at S Band 1994 Jul 08
Mean= 0.4 RMS= 0.5 Med= 0.3 Max= 2.0
2230+114 at S Band 1995 Oct 13
Mean= 11.9 RMS= 16.0 Med= 8.9 Max= 132.4
PICOSECONDS


2252−089 at 2.320 GHz 1995 Apr 12
2252−089 at 8.550 GHz 1995 Apr 12
2254+024 at 2.320 GHz 1995 Oct 13
2254+024 at 8.550 GHz 1995 Oct 13
2255−282 at 2.320 GHz 1994 Jul 08
2255−282 at 8.550 GHz 1994 Jul 08
2319+272 at 2.320 GHz 1995 Apr 12
2319+272 at 8.550 GHz 1995 Apr 12
2320+506 at 2.320 GHz 1995 Oct 13
2320+506 at 8.550 GHz 1995 Oct 13
2335−027 at 2.320 GHz 1995 Oct 13
2335−027 at 8.550 GHz 1995 Oct 13


2254+024 at X Band 1995 Oct 13
Mean= 1.4 RMS= 1.8 Med= 1.3 Max= 4.8
2319+272 at X Band 1995 Apr 12
Mean= 22.3 RMS= 33.3 Med= 12.5 Max= 149.1
2335-027 at X Band 1995 Oct 13
Mean= 24.0 RMS= 31.4 Med= 18.8 Max= 99.5
2254+024 at S Band 1995 Oct 13
Mean= 3.1 RMS= 4.0 Med= 2.5 Max= 18.6
2319+272 at S Band 1995 Apr 12
Mean= 2.6 RMS= 3.5 Med= 1.9 Max= 16.9
2335-027 at S Band 1995 Oct 13
Mean= 3.4 RMS= 4.7 Med= 2.4 Max= 25.7
2252-089 at X Band 1995 Apr 12
Mean= 14.7 RMS= 19.4 Med= 11.1 Max= 88.1
2255-282 at X Band 1994 Jul 08
Mean= 4.1 RMS= 5.8 Med= 2.8 Max= 25.7
2320+506 at X Band 1995 Oct 13
Mean= 24.0 RMS= 30.5 Med= 21.7 Max= 102.5
2252-089 at S Band 1995 Apr 12
Mean= 18.2 RMS= 29.3 Med= 11.2 Max= 329.1
2255-282 at S Band 1994 Jul 08
Mean= 6.1 RMS= 8.6 Med= 4.5 Max= 36.2
2320+506 at S Band 1995 Oct 13
Mean= 2.3 RMS= 3.4 Med= 1.5 Max= 12.8
PICOSECONDS


2337+264 at 8.550 GHz 1994 Jul 08
10
5
0
−5
−10
10
5
0
−5
−10
2337+264 at 2.320 GHz 1994 Jul 08
40
20
0
−20
−40
40
20
0
−20
−40


2337+264 at X Band 1994 Jul 08
Mean= 100.8 RMS= 138.2 Med= 70.7 Max= 641.7
2337+264 at S Band 1994 Jul 08
Mean= 29.2 RMS= 53.6 Med= 15.1 Max= 499.3
PICOSECONDS

4. Stability of the ICRF source positions

M. Eubanks, U.S. Naval Observatory

An indication of the stability of the International Celestial Reference Frame (ICRF) source positions can be obtained from "arc" source position fits, in which a separate source position is estimated for each Very Long Baseline Interferometry (VLBI) observing session with observations of the source. This section provides arc source results for 379 source in the ICRF. Because of software limitations, it was not possible to obtain these estimates from one solution to the ICRF VLBI data. Instead the total ICRF source list was divided into six subsets in a quasi-random fashion (by sorting on the last digit of the IERS name), and a series of six solutions was performed, each similar to the grand ICRF solution except for the sources used to derive arc position estimates. The total set of arc position estimates from the six solutions therefore provided data from each ICRF source. Further details of the solution methodology can be obtained from Part II of this Technical Note.

In the arc solutions, the remaining sources, with only one global position estimated, form a fixed reference frame, making it possible to evaluate the repeatability of the source position estimates for each arc source. Extensive numerical tests involving different sets of arc sources show that this method does reliably reproduce changes in source position due to source structure. Because many sources were held fixed in each solution, these arc estimates are not, however, suitable for investigating global sky deformations. More rigorous estimates for the apparent motion of these sources were obtained from proper motion solutions using the original VLBI data. The simultaneous solution for apparent proper motions of all ICRF sources shows that there is a net rotation rate of about 10 micro arc seconds per year between the ICRF and a no-net rotation frame defined by averaging over all of the source proper motions. These small residual rotations were not removed from the results presented in this Part.

The quality of the arc position estimates varied widely. In certain experiments, some sources only had one successful observation, which can easily lead to position formal errors at the arc second level, while other arc position estimates can be based on hundreds of observations with positional formal errors below 0.1 mas. As the observed variations in source position due to structure changes are generally well below the level of one mas, and never much larger than a few mas, only the better arc position estimates are useful in characterizing such changes in source position. In Figure III.4, we present time series plots for each ICRF source where there are at least two or more arc position estimates, each with positional formal errors < 1 mas in both Right Ascension and Declination, there being 379 ICRF sources that fulfilled these criteria. In Table III.4, summary statistics for the scatter of the plotted residuals are provided. In both the Figure and the Table, the Right Ascension residuals are scaled by the cosine of the declination to provide true arc lengths on the sky. The complete set of ICRF arc position estimates, including those not of sufficient quality to be displayed here, are available over the World Wide Web as described in page v of this Technical Note.

Table III.4 Summary information on ICRF Sources.

This table contains, for each source in Figure III.4, the name, the range of dates of observations used, the red-shift (Z), the number of arc estimates used, the weighted rms, unweighted rms and χ^2 per degree of freedom for the residuals in both R.A. and Declination, and the total χ^2 per degree of freedom for both components together, including the correlation between R.A. and Declination. The R.A. residuals were multiplied by the cosine of the declination to provide true arc lengths on the sky.

IAU NAME ALT NAME	FIRST OBS	LAST OBS	Z	NUM EXP	α cos δ WRMS mas	α cos δ RMS mas	α cos δ χ^2/df	δ WRMS mas	δ RMS MAS	δ χ^2/df	TOTAL χ^2/df
0003+380	1992.269	1994.552	.229	2	.576	1.17	3.48	.096	.13	.09	1.8
0003-066	1988.041	1994.398	.347	2	.518	.72	1.85	.575	1.02	1.84	1.8
0007+171	1990.107	1994.612	1.601	3	.474	.64	1.10	.375	.48	.33	.7
0008-264	1994.123	1995.198	1.093	2	.339	.54	.71	.152	.22	.33	.5
0010+405	1993.305	1995.279	.256	3	.125	.32	.27	.118	.22	.18	.2
0013-005	1993.302	1993.538	1.574	2	.131	.20	.28	.097	.12	.05	.2
0014+813	1988.339	1995.581	3.384	76	.252	.37	.90	.277	.38	1.06	1.0
0016+731	1988.012	1995.089	1.781	375	.234	.38	.94	.237	.36	.95	.9
0039+230	1991.194	1994.494		3	.062	.08	.03	.295	.53	.44	.2
0047-579	1992.096	1993.074	1.797	4	.425	.86	1.64	1.033	1.23	3.33	2.5
0048-097	1987.121	1995.562		206	.333	.48	1.49	.447	.66	1.58	1.5
0059+581	1992.269	1995.565		232	.210	.37	1.06	.238	.54	1.26	1.2
0104-408	1992.276	1995.562	.584	23	.464	.84	2.05	.461	.50	1.26	1.7
0106+013	1981.886	1995.162	2.107	231	.507	.58	1.78	.723	.93	1.32	1.5
0108+388	1993.305	1995.279	.669	3	.939	1.59	11.65	.413	.54	2.29	7.0
0109+224	1991.486	1995.050		5	.424	.79	.95	.903	1.10	1.75	1.4
0112-017	1989.212	1991.194	1.365	2	.595	1.15	2.26	.208	.40	.31	1.3
0119+115	1990.116	1993.094	.570	5	.379	.46	.95	.561	.66	.69	.8
0119+041	1989.212	1995.562	.637	671	.348	.47	1.25	.436	.62	1.22	1.2
0123+257	1991.194	1994.839	2.358	4	.312	.34	.66	.379	.68	.53	.6
0131-522	1992.665	1993.937	.020	2	.237	.38	.81	1.286	1.83	6.15	3.5
0133+476	1988.972	1995.089	.859	111	.364	.58	1.04	.335	.45	.68	.9
0135-247	1989.434	1995.198	.831	2	.059	.08	.01	.043	.07	.02	.0
0146+056	1990.533	1993.094	2.345	2	.159	.22	.23	.062	.09	.01	.1
0148+274	1991.194	1994.839	1.260	5	.462	.55	1.10	.281	.30	.39	.7

Table III.4 (cont.) Summary information on ICRF Sources.

IAU NAME	ALT NAME	FIRST OBS	LAST OBS	z	NUM EXP	α cos δ WRMS mas	α cos δ RMS mas	α cos δ χ^2/df	δ WRMS mas	δ RMS MAS	δ χ^2/df	TOTAL χ^2/df
0149+218		1987.497	1993.538	1.320	10	.600	.84	1.22	1.008	1.16	2.58	1.9
0153+744		1988.127	1995.279	2.338	7	.430	.75	.76	.692	1.07	3.58	2.2
0159+723		1988.309	1994.861		14	.362	.49	.52	.523	.67	1.27	.9
0201+113		1990.658	1995.565	3.560	39	.297	.36	.75	.509	.62	1.09	.9
0202+149		1987.494	1995.565	.833	139	.297	.43	.99	.351	.56	1.03	1.0
0202-172		1989.434	1995.198	1.740	5	.315	.38	.44	.562	.97	1.44	.9
0202+319		1987.494	1995.050	1.466	13	.350	.53	.73	.583	.63	.97	.8
0208-512		1990.393	1995.562	1.001	75	.416	.63	1.49	.556	.69	1.48	1.5
0212+735		1981.886	1995.581	2.367	1031	.271	.38	.93	.283	.38	1.08	1.0
0215+015		1991.194	1994.532	1.715	5	.117	.14	.12	.325	.49	.56	.3
0219+428		1992.077	1994.552	.444	5	.706	.78	3.66	.494	.61	1.21	2.4
0220-349		1994.123	1995.488	1.490	3	.206	.31	.49	.341	.42	.78	.6
0224+671	4C67.05	1979.592	1994.676		23	.380	.40	.83	.511	.70	.99	.9
0230-790		1992.347	1995.485	1.070	5	.627	.76	1.52	.518	.61	.96	1.2
0229+131		1982.962	1995.562	2.065	951	.316	.38	1.19	.412	.63	1.13	1.2
0234+285		1980.567	1995.510	1.207	608	.235	.33	.90	.357	.50	1.25	1.1
0235+164		1980.570	1995.089	.940	78	.332	.42	.98	.413	.63	1.08	1.0
0237+040		1992.514	1993.302	.978	2	.082	.12	.08	.215	.39	.21	.1
0237-233		1994.123	1994.517	2.228	2	1.999	4.38	64.29	1.405	1.79	15.53	39.9
0238-084	NGC1052	1994.354	1995.562	.005	20	.376	.49	1.03	.514	.53	1.31	1.2
0248+430		1990.107	1994.922	1.316	10	.348	.43	.86	.376	.45	.60	.7
0252-549		1992.347	1993.937	.537	2	.135	.20	.21	.513	.73	.71	.5
0300+470		1982.956	1995.050		571	.264	.38	.91	.318	.41	1.11	1.0
0302-623		1992.096	1995.491		12	.359	.46	.92	.260	.30	.45	.7
0302+625		1992.220	1995.488		12	.531	.65	1.24	.488	.59	.89	1.1
0306+102		1993.730	1994.861	.863	2	.247	.50	.82	.196	.32	.20	.5
0308-611		1991.888	1995.491		47	.341	.40	1.09	.467	.57	1.37	1.2
0309+411		1988.471	1995.357	.136	12	.346	.62	.68	.476	.52	.59	.6
0316+413	3C84	1979.592	1994.449	.017	24	1.020	1.63	7.18	1.614	1.87	10.01	8.6
0319+121		1988.127	1995.198	2.670	7	.533	.57	2.67	.398	.49	.69	1.7

Table III.4 (cont.) Summary information on ICRF Sources.

IAU NAME	ALT NAME	FIRST OBS	LAST OBS	Z	NUM EXP	α cos δ WRMS mas	α cos δ RMS mas	α cos δ χ^2/df	δ WRMS mas	δ RMS MAS	δ χ^2/df	TOTAL χ^2/df
0326+277	0326+278	1990.061	1994.935	1.533	3	1.001	1.60	4.44	.338	.53	.33	2.4
0332-403		1989.309	1995.198	1.445	4	.570	.72	.88	.369	.51	.53	.7
0333+321	NRAO140	1988.012	1994.612	1.258	31	.509	.62	1.47	.490	.55	.89	1.2
0336-019	CTA26	1987.494	1995.565	.852	196	.300	.42	1.31	.354	.56	1.16	1.2
0338-214		1988.027	1994.123	.048	2	.641	1.77	4.45	.235	.30	1.00	2.7
0342+147		1990.828	1993.727		6	.399	.48	.86	.548	.65	.93	.9
0355+508	NRAO150	1979.592	1993.919		54	.445	.60	1.25	.569	.66	1.62	1.4
0400-319		1994.123	1994.354	1.288	2	.669	1.01	3.32	.254	.41	.63	2.0
0400+258		1988.127	1995.279	2.109	7	.250	.37	.45	.497	.66	1.16	.8
0402-362		1992.201	1995.562	1.417	15	.612	1.30	2.92	.869	1.24	3.49	3.2
0403-132		1988.041	1994.815	.571	2	.119	.45	.26	.231	.54	1.12	.7
0406+121		1987.497	1993.516		3	.425	.60	.77	.770	.97	1.24	1.0
0414-189		1988.027	1995.524	1.536	3	.376	.46	.81	.101	.15	.08	.4
0420-014		1984.664	1995.198	.915	696	.398	.45	1.80	.545	.76	1.39	1.6
0420+417		1989.113	1994.935		10	.645	.88	1.55	.426	.50	.62	1.1
0426-380		1989.309	1994.929	1.030	3	.404	.65	.71	.264	.32	.33	.5
0430+052	3C120	1987.494	1994.517	.033	4	.984	1.57	11.61	.215	.34	.25	5.9
0434-188		1988.027	1995.488	2.702	17	.332	.45	.62	.820	.73	2.91	1.8
0437-454		1995.488	1995.491		2	.160	.23	.68	.457	.65	1.06	.9
0438-436		1993.625	1995.491	2.852	6	.261	.51	.69	.731	.96	1.41	1.0
0440+345		1994.398	1995.412		3	.353	.87	4.11	.126	.20	.39	2.3
0446+112		1994.552	1995.373		2	.186	.25	.35	.648	1.45	3.03	1.7
0454-810		1991.359	1995.485	.444	9	.425	.59	1.63	.372	.45	1.32	1.5
0454-234		1986.053	1995.562	1.009	318	.390	.51	1.26	.533	.75	1.53	1.4
0457+024		1993.305	1995.437	2.384	9	.405	.51	1.29	.381	.57	.79	1.0
0458-020		1990.697	1995.562	2.286	392	.268	.37	1.09	.320	.45	.96	1.0
0459+060		1994.935	1995.279		2	.223	.43	1.05	.590	1.28	2.21	1.6
0500+019		1992.452	1993.538	.583	2	.218	.32	.50	.603	.88	.96	.7
0502+049		1993.209	1994.861	.954	2	.251	.41	.55	1.119	1.61	2.81	1.7
0506-612		1991.359	1994.497	1.093	6	.347	.42	.77	.842	1.05	4.13	2.4

Table III.4 (cont.) Summary information on ICRF Sources.

IAU NAME	ALT NAME	FIRST OBS	LAST OBS	z	NUM EXP	α cos δ WRMS mas	α cos δ RMS mas	α cos δ χ^2/df	δ WRMS mas	δ RMS MAS	δ χ^2/df	TOTAL χ^2/df
0454+844		1989.642	1994.708	.112	31	.290	.35	.67	.307	.42	.65	.7
0507+179		1990.828	1995.279		6	.256	.37	.64	.372	.68	.74	.7
0516-621		1992.369	1995.562		7	.401	.71	1.65	.454	.48	1.03	1.3
0530-727		1991.962	1995.491		9	.492	.58	.98	.538	.73	.77	.9
0528-250		1989.309	1994.200	2.765	4	.616	.98	1.78	.674	1.24	3.54	2.7
0528+134		1981.886	1995.565	2.070	1197	.311	.38	1.20	.419	.66	1.25	1.2
0537-441		1990.395	1995.542	.894	74	.442	.62	1.57	.596	.78	1.67	1.6
0537-286		1991.886	1993.779	3.119	3	1.231	1.47	3.18	.513	.60	.79	2.0
0539-057		1993.768	1995.279	.839	3	.386	.53	2.74	.348	.46	.82	1.8
0538+498	3C147	1992.452	1994.494	.545	3	.385	.57	.70	.156	.27	.11	.4
0552+398		1979.902	1995.581	2.365	1736	.238	.33	1.00	.280	.43	1.05	1.0
0605-085		1987.121	1994.603	.870	2	.046	.08	.03	.057	.08	.04	.0
0607-157		1994.123	1995.198	.324	2	.045	.06	.04	.070	.10	.16	.1
0609+607		1987.589	1994.398	2.690	13	.495	.62	.93	.752	.81	1.86	1.4
0620+389		1994.105	1994.922	3.470	4	.364	.78	1.69	.377	.62	1.23	1.5
0615+820		1989.113	1994.968	.710	18	.322	.45	.67	.401	.63	.95	.8
0637-752		1990.393	1995.562	.653	108	.492	.71	2.19	.434	.66	1.49	1.8
0636+680		1991.275	1995.279	3.174	13	.315	.48	.46	.529	.72	1.19	.8
0642+449		1984.069	1995.581	3.406	67	.267	.40	1.01	.261	.38	.73	.9
0646-306		1989.434	1994.517	.455	2	.096	.19	.16	.748	1.05	3.62	1.9
0648-165		1987.217	1994.661		2	.392	.55	1.91	.429	.94	2.08	2.0
0650+371		1991.645	1995.089	1.982	12	.354	.46	1.23	.506	.57	.59	.9
0657+172		1989.592	1994.929		55	.388	.41	1.01	.562	.65	1.27	1.1
0707+476		1987.497	1995.279	1.292	8	.199	.25	.36	.546	.72	2.04	1.2
0710+439		1992.514	1994.708	.518	5	.771	.87	3.16	.294	.38	.28	1.7
0711+356		1988.127	1994.861	1.620	4	.268	.45	.45	.703	.77	1.63	1.0
0716+714		1989.362	1995.089		31	.279	.34	.43	.391	.54	.65	.5
0722+145		1992.361	1994.935		2	.236	.43	.90	.025	.04	.00	.5
0723-008		1987.121	1995.279	.127	3	.158	.33	.43	.387	.52	1.27	.9
0718+792	0718+793	1990.907	1995.562		31	.308	.47	.76	.307	.45	.92	.8

Table III.4 (cont.) Summary information on ICRF Sources.

IAU NAME	ALT NAME	FIRST OBS	LAST OBS	Z	NUM EXP	α cos δ WRMS mas	α cos δ RMS mas	α cos δ χ^2/df	δ WRMS mas	δ RMS MAS	δ χ^2/df	TOTAL χ^2/df
0727-115		1986.026	1995.562		675	.352	.46	1.55	.466	.80	1.51	1.5
0735+178		1988.471	1995.581		365	.300	.38	1.29	.311	.51	1.03	1.2
0738-674		1993.937	1995.491	1.663	5	.362	.51	1.28	.692	1.25	2.05	1.7
0738+313		1988.127	1995.357	.630	14	.409	.56	1.37	.552	.82	2.63	2.0
0742+103		1986.195	1995.279		153	.348	.39	1.13	.510	.64	1.18	1.2
0745+241		1989.592	1992.632	.409	44	.629	.78	1.43	.546	.63	.77	1.1
0748+126		1988.012	1994.839	.899	6	.436	.61	2.05	.556	1.12	2.33	2.2
0749+540		1984.206	1995.562	.200	33	.164	.30	.52	.226	.49	.88	.7
0754+100		1986.195	1995.198	.660	5	.319	.37	.72	.356	.56	.78	.7
0805-077		1988.041	1995.198	1.837	2	.077	.09	.05	.133	.20	.33	.2
0804+499		1988.012	1995.565	1.433	146	.174	.34	.66	.212	.34	.90	.8
0805+410		1992.269	1995.562	1.420	34	.167	.25	.52	.236	.38	.90	.7
0808+019		1993.538	1995.279		2	.066	.14	.17	.003	.00	.00	.1
0812+367		1988.471	1994.552	1.025	4	.450	.57	1.05	.524	.59	.94	1.0
0814+425		1984.069	1994.922	.258	74	.488	.70	1.16	.518	.58	1.20	1.2
0818-128		1988.958	1995.412		3	.405	.43	.83	.482	.69	1.93	1.4
0820+560		1987.497	1995.357	1.417	44	.358	.49	2.39	.206	.32	.92	1.7
0821+394		1990.828	1994.612	1.216	9	.640	1.00	1.70	.716	.98	1.51	1.6
0823+033		1988.217	1995.562	.506	236	.270	.41	1.17	.352	.54	1.25	1.2
0826-373		1994.469	1995.491		4	.340	.68	1.10	.844	1.06	2.43	1.8
0827+243		1988.339	1994.708	2.046	6	.338	.50	.75	.644	.68	1.42	1.1
0829+046		1993.209	1994.494	.180	3	.302	.38	.84	.440	.60	.76	.8
0828+493		1990.907	1994.398	.548	6	.404	.49	1.23	.605	.75	1.48	1.4
0834-201		1994.354	1994.815	2.756	2	.107	.24	.12	.526	.83	1.02	.6
0833+585		1987.497	1995.279	2.101	7	.464	.69	.97	.336	.65	.84	.9
0836+710		1987.497	1994.968	2.160	7	.237	.38	.64	.394	.57	1.60	1.1
0839+187		1990.357	1994.839	1.270	7	.645	.82	1.76	.738	.85	1.01	1.4
0850+581		1992.269	1994.494	1.322	3	.163	.32	.18	.357	.68	.93	.6
0851+202	OJ287	1980.281	1995.565	.306	1433	.285	.36	1.11	.383	.55	1.14	1.1
0859-140		1987.217	1994.123	1.327	2	.336	.70	1.26	.434	.74	3.23	2.2

Table III.4 (cont.) Summary information on ICRF Sources.

IAU NAME	ALT NAME	FIRST OBS	LAST OBS	Z	NUM EXP	α cos δ WRMS mas	α cos δ RMS mas	α cos δ χ^2/df	δ WRMS mas	δ RMS MAS	δ χ^2/df	TOTAL χ^2/df
0859+470		1988.320	1995.279	1.462	23	.262	.38	.46	.384	.51	.48	.5
0912+297		1993.519	1994.839		3	.535	.99	1.92	.925	1.24	2.51	2.2
0917+449		1987.497	1994.612	2.180	19	.199	.33	.39	.645	.70	1.19	.8
0919-260		1992.058	1995.491	2.300	21	.299	.37	.84	.653	.69	1.14	1.0
0917+624		1987.497	1995.279	1.446	10	.199	.27	.51	.147	.18	.25	.4
0920+390		1995.050	1995.527		11	.278	.37	.69	.329	.41	.58	.6
0923+392	4C39.25	1980.281	1995.565	.699	1578	.304	.40	1.61	.282	.42	1.03	1.3
0945+408		1990.107	1994.839	1.252	9	.234	.40	.38	.561	.85	1.67	1.0
0951+693	M81	1993.650	1995.581	.001	7	.295	.40	1.05	.196	.41	.50	.8
0953+254	OK290	1989.423	1995.562	.712	162	.349	.51	1.70	.327	.49	1.18	1.4
0955+476		1992.269	1995.565	1.873	298	.176	.26	.64	.204	.30	.72	.7
0955+326		1990.533	1994.552	.533	5	.475	.54	1.31	.730	.85	1.65	1.5
0954+658		1987.494	1995.581	.368	157	.276	.41	.97	.300	.40	.90	.9
1004+141		1988.309	1995.510	2.707	10	.290	.31	1.04	.485	.77	1.98	1.5
1012+232		1990.831	1993.727	.565	3	.587	.90	2.84	.305	.34	.38	1.6
1020+400		1988.471	1994.935	1.250	7	.651	.96	2.80	.592	.75	1.62	2.2
1021-006		1993.302	1994.922	2.547	2	.538	.94	3.16	.148	.24	.08	1.6
1022+194		1994.861	1995.279	.828	2	.091	.15	.26	.462	.88	3.22	1.7
1030+415		1988.127	1992.249	1.120	4	.737	.78	1.51	.711	.86	1.40	1.5
1032-199		1988.041	1995.198	2.198	2	1.115	1.80	4.79	.976	1.92	8.61	6.7
1034-293		1987.108	1995.562	.312	98	.465	.75	1.54	.663	1.02	2.43	2.0
1038+064		1991.771	1993.094	1.270	2	.060	.09	.04	.443	.67	.62	.3
1038+528	1038+52A	1991.828	1995.581	.678	32	.257	.37	.70	.355	.64	.89	.8
1038+529	1038+52B	1994.839	1995.453	2.296	2	.095	.15	.04	.077	.12	.02	.0
1040+123	3C245	1989.362	1995.198	1.029	5	.425	.51	.69	.319	.40	.34	.5
1039+811		1989.870	1994.935	1.260	27	.313	.36	.94	.174	.22	.30	.6
1045-188		1988.041	1994.123	.595	2	.629	1.97	4.68	.915	2.37	10.57	7.6
1044+719		1990.578	1995.581	1.150	95	.277	.47	1.15	.271	.48	1.03	1.1
1049+215		1990.107	1995.279	1.300	5	.197	.40	.63	.496	.72	2.30	1.5
1053+704		1993.420	1995.581	2.492	16	.549	.78	2.05	.409	.59	1.12	1.6

Table III.4 (cont.) Summary information on ICRF Sources.

IAU NAME	ALT NAME	FIRST OBS	LAST OBS	Z	NUM EXP	α cos δ WRMS mas	α cos δ RMS mas	α cos δ χ^2/df	δ WRMS mas	δ RMS MAS	δ χ^2/df	TOTAL χ^2/df
1053+815		1989.870	1995.357	.706	60	.361	.44	.89	.434	.55	1.37	1.1
1055+018		1986.195	1993.727	.888	89	.319	.40	1.05	.763	.91	1.58	1.3
1057-797		1990.393	1995.530		102	.358	.45	.94	.385	.63	1.15	1.0
1101-536		1991.359	1995.562		17	.303	.55	.83	.686	.77	1.84	1.3
1101+384		1994.456	1994.922	.030	2	.330	.67	1.15	.075	.15	.04	.6
1104-445		1990.491	1995.530	1.598	64	.414	.57	1.25	.622	.68	1.47	1.4
1111+149		1988.320	1992.452	.869	3	.162	.20	.15	.618	.74	.86	.5
1116+128		1988.309	1995.279	2.118	5	.382	.54	1.76	.315	.45	.56	1.2
1123+264		1987.497	1994.929	2.341	53	.487	.60	1.31	.454	.61	.96	1.1
1124-186		1987.217	1995.491	1.050	9	.570	.74	2.14	.489	.50	1.09	1.6
1127-145		1994.517	1995.198	1.187	3	.566	1.01	5.38	.413	.50	2.12	3.8
1128+385		1987.494	1995.565	1.733	150	.188	.27	.65	.276	.40	1.12	.9
1144+402		1984.069	1994.612	1.089	54	.436	.59	1.35	.605	.69	1.70	1.5
1144-379		1992.058	1995.530	1.048	15	.303	.50	.62	.403	.43	.56	.6
1145-071		1988.041	1995.277	1.345	24	.494	.67	1.36	.324	.42	.61	1.0
1147+245		1992.269	1994.494		2	.018	.02	.00	.128	.19	.13	.1
1148-671		1992.665	1993.074		2	.762	1.23	6.75	.303	.44	.71	3.7
1150+812		1987.494	1995.279	1.250	39	.263	.33	.87	.269	.39	.80	.8
1150+497		1990.107	1994.935	.334	5	.235	.28	.32	.401	.49	.81	.6
1155+251		1992.968	1993.730		2	.986	1.49	3.88	.191	.27	.13	2.0
1156+295		1987.497	1995.357	.729	159	.263	.42	.93	.326	.48	1.03	1.0
1213-172		1987.121	1995.412		3	.061	.15	.04	.247	.44	.38	.2
1213+350		1990.828	1995.279	.851	7	.587	1.00	1.78	.542	1.02	1.18	1.5
1215+303		1991.486	1994.861	.237	4	.362	.44	.86	.587	.75	.91	.9
1216+487		1987.497	1995.050	1.073	9	.242	.45	.37	.330	.41	.68	.5
1219+285		1980.567	1992.813	.102	5	.742	.82	2.09	.383	.39	.35	1.2
1219+044		1991.332	1995.565	.965	194	.234	.33	.89	.319	.48	1.01	.9
1221+809		1990.907	1995.279		7	.613	.97	2.91	.361	.70	.87	1.9
1226+373		1991.332	1995.089	1.515	5	.396	.54	1.44	.275	.36	.78	1.1
1226+023	3C273B	1981.886	1995.092	.158	228	.685	.73	3.48	.879	1.17	2.71	3.1

Table III.4 (cont.) Summary information on ICRF Sources.

IAU NAME	ALT NAME	FIRST OBS	LAST OBS	z	NUM EXP	α cos δ WRMS mas	α cos δ RMS mas	α cos δ χ^2/df	δ WRMS mas	δ RMS MAS	δ χ^2/df	TOTAL χ^2/df
1228+126	3C274	1988.263	1995.565	.004	33	.360	.49	1.22	.422	.62	1.00	1.1
1236+077		1993.302	1995.279	.400	3	.256	.43	1.08	.148	.23	.18	.6
1240+381		1994.209	1995.089	1.316	2	.900	1.42	5.48	.153	.21	.37	2.9
1244-255		1991.878	1994.929	.633	28	.416	.54	.87	.477	.58	1.04	1.0
1252+119		1992.077	1994.209	.871	6	.533	1.01	1.60	.288	.54	.39	1.0
1251-713		1991.359	1993.088		10	.339	.52	1.03	.422	.57	1.27	1.2
1253-055	3C279	1987.190	1995.450	.538	49	.605	.61	2.00	1.128	1.25	2.46	2.2
1255-316		1989.434	1995.491	1.924	4	.481	.61	.98	.711	.95	1.35	1.2
1300+580		1994.190	1995.562		14	.486	.73	2.58	.518	.82	2.55	2.6
1302-102		1988.041	1994.968	.286	4	.503	.73	1.84	.141	.20	.16	1.0
1307+121		1993.305	1995.279		2	.097	.35	.19	.218	.53	.37	.3
1308+326		1985.349	1995.565	.996	744	.250	.42	1.01	.292	.44	1.11	1.1
1313-333		1991.878	1995.491	1.210	11	.319	.59	.76	.390	.45	.51	.6
1315+346	OP326	1990.283	1994.922	1.050	4	.302	.42	1.06	1.079	1.73	3.76	2.4
1334-127		1987.121	1995.562	.539	478	.379	.45	1.65	.549	.83	1.84	1.7
1342+662		1990.357	1994.708	.776	5	.438	.66	1.25	.608	.78	2.87	2.1
1342+663		1989.213	1995.357	1.347	22	.351	.41	.65	.361	.47	.64	.6
1347+539		1990.107	1995.279	.976	8	.300	.47	.65	.354	.48	.70	.7
1349-439		1992.369	1994.929	.053	2	.321	.51	.82	.855	1.33	2.97	1.9
1351-018		1993.453	1995.562	3.709	15	.313	.43	.86	.478	.53	1.06	1.0
1354+195		1984.518	1994.968	.720	38	.584	.80	2.03	.680	.87	2.11	2.1
1354-152		1987.217	1994.968	1.890	7	.694	.78	1.91	.702	.74	2.56	2.2
1357+769		1988.309	1995.565		176	.165	.32	.61	.193	.31	.80	.7
1402+044		1993.453	1995.279	3.208	13	.359	.69	1.02	.565	.68	1.27	1.1
1404+286	OQ208	1980.281	1994.935	.077	718	.388	.49	1.47	.633	.85	1.71	1.6
1406-076		1988.041	1995.198	1.493	2	.519	.91	2.07	.222	.36	.82	1.4
1418+546		1982.461	1995.357	.152	98	.498	.59	1.13	.497	.65	1.11	1.1
1424-418		1990.393	1995.491	1.522	34	.324	.48	.81	.748	.87	1.70	1.3
1435+638		1988.339	1994.708	2.060	10	.394	.60	.80	.572	.72	1.53	1.2
1442+101	OQ172	1993.453	1994.922	3.544	4	1.107	1.49	3.59	.956	1.22	2.64	3.1

Table III.4 (cont.) Summary information on ICRF Sources.

IAU NAME	ALT NAME	FIRST OBS	LAST OBS	z	NUM EXP	α cos δ WRMS mas	α cos δ RMS mas	α cos δ χ^2/df	δ WRMS mas	δ RMS MAS	δ χ^2/df	TOTAL χ^2/df
1448+762		1988.127	1993.845	.899	3	1.118	1.46	3.08	.368	.44	.89	2.0
1451-375		1993.074	1994.815	.314	3	.264	.37	.77	.592	.69	1.83	1.3
1451-400		1994.200	1995.198	1.810	6	.405	.61	.81	.761	.83	2.72	1.8
1458+718	3C309.1	1990.828	1995.279	.905	9	.706	1.34	3.73	.714	1.50	3.42	3.6
1459+480		1989.335	1994.552		6	.463	.77	1.20	.200	.25	.14	.7
1502+106		1984.664	1994.517	1.833	305	.408	.53	1.36	.650	.80	1.35	1.4
1504+377		1987.497	1994.708	.674	10	.443	.56	1.95	.398	.73	1.08	1.5
1504-166		1987.121	1993.351	.876	4	.820	1.08	1.44	.859	1.14	2.27	1.9
1508+572		1994.516	1995.546	4.300	9	.189	.24	.54	.190	.21	.37	.5
1510-089		1987.217	1995.279	.361	91	.388	.43	1.32	.648	.73	1.32	1.3
1511-100		1987.217	1994.123	1.513	2	.401	.70	1.24	.725	1.59	6.42	3.8
1514+197		1991.486	1994.494		4	.519	.57	1.98	.363	.48	.52	1.3
1514-241		1991.665	1995.488	.049	5	.267	.60	.42	.719	.91	1.43	.9
1519-273		1987.217	1995.488		40	.431	.48	1.01	.379	.44	.65	.8
1538+149		1989.113	1995.198	.605	4	.284	.39	.34	.404	.76	.72	.5
1547+507		1987.828	1994.398	2.169	7	.427	.56	1.12	.526	.81	1.23	1.2
1546+027		1993.730	1995.279	.412	2	.134	.26	.61	.268	.61	1.11	.9
1548+056		1984.518	1994.968	1.422	150	.341	.40	1.02	.555	.73	1.52	1.3
1549-790		1991.359	1995.485	.149	10	.280	.50	1.15	.209	.26	.57	.9
1557+032		1994.661	1994.922	3.900	3	.377	.72	2.21	.451	.68	1.76	2.0
1606+106		1990.061	1995.565	1.226	418	.232	.32	.94	.303	.48	1.07	1.0
1607+268	CTD93	1994.922	1995.279	.473	2	.197	.28	.84	.880	1.25	7.17	4.0
1611+343		1981.461	1995.565	1.401	717	.223	.34	.85	.320	.42	1.10	1.0
1614+051		1991.886	1995.510	3.210	18	.348	.51	.84	.384	.62	.67	.8
1610-771		1990.393	1995.562	1.710	92	.381	.44	1.27	.453	.62	1.48	1.4
1616+063		1993.302	1993.538	2.086	2	.260	.37	.59	.242	.32	.18	.4
1619-680		1992.347	1993.074	1.354	2	.141	.22	.44	.573	.84	2.51	1.5
1622-253		1987.121	1995.562	.786	212	.454	.65	1.68	.658	.85	2.05	1.9
1624+416		1987.494	1995.453	2.550	7	.351	.48	.85	.345	.44	.73	.8
1622-297		1989.309	1994.123	.815	3	.576	.89	.99	.407	.60	.72	.9

Table III.4 (cont.) Summary information on ICRF Sources.

IAU NAME	ALT NAME	FIRST OBS	LAST OBS	z	NUM EXP	α cos δ WRMS mas	α cos δ RMS mas	α cos δ χ^2/df	δ WRMS mas	δ RMS MAS	δ χ^2/df	TOTAL χ^2/df
1633+382	1633+38	1981.461	1995.279	1.814	301	.367	.52	1.52	.411	.59	1.26	1.4
1637+574		1982.458	1994.922	.745	116	.293	.38	.88	.426	.59	1.28	1.1
1638+398	NRAO512	1990.787	1995.581	1.666	197	.199	.29	.78	.246	.42	.99	.9
1642+690		1980.281	1995.357	.751	64	.422	.59	1.05	.475	.63	1.13	1.1
1641+399	3C345	1980.281	1995.581	.594	546	.487	.55	2.46	.467	.60	1.22	1.8
1652+398	DA426	1987.494	1995.527	.034	14	.355	.49	1.39	.514	.72	1.69	1.5
1656+348		1993.730	1995.453	1.936	3	.378	.50	.44	.225	.33	.16	.3
1656+477		1993.538	1994.398	1.622	2	.602	1.00	4.13	.281	.45	.91	2.5
1655+077		1993.727	1994.839	.621	3	.220	.27	.35	.355	.44	.44	.4
1656+053		1988.471	1994.209	.879	7	.358	.46	.90	.199	.31	.21	.6
1657-261		1988.027	1994.815		9	.659	.84	1.01	.477	.79	1.02	1.0
1705+018		1993.302	1994.968	2.568	15	.512	.68	1.98	.571	.69	1.66	1.8
1717+178		1988.309	1994.861		6	.581	.81	1.57	1.209	1.52	3.67	2.6
1726+455		1992.269	1995.562	.714	107	.234	.39	.90	.217	.40	.68	.8
1725+044		1993.519	1995.279	.293	2	.152	.30	.61	.396	.79	1.67	1.1
1730-130	NRAO530	1986.026	1994.922	.902	125	.433	.53	1.64	.622	.93	1.79	1.7
1732+389		1988.339	1994.214	.976	14	.249	.37	.50	.633	.72	1.59	1.0
1738+499		1994.190	1995.089	1.545	3	.394	.49	1.90	.229	.28	.68	1.3
1738+476		1989.073	1995.357	.316	9	.354	.55	.72	.585	.59	1.39	1.1
1739+522		1988.012	1995.562	1.375	858	.216	.34	.87	.235	.35	.88	.9
1741-038		1985.647	1995.565	1.054	880	.287	.38	1.11	.407	.67	1.19	1.2
1743+173		1988.471	1995.279	1.702	5	.277	.51	1.12	.339	.64	.90	1.0
1745+624		1992.804	1995.565	3.886	56	.224	.33	.81	.292	.59	1.14	1.0
1746+470		1994.190	1995.089		3	.179	.22	.42	.271	.34	.94	.7
1749+701		1991.771	1995.565	.760	7	.539	.49	1.02	.384	.46	.55	.8
1749+096		1984.664	1995.565	.322	568	.257	.37	.96	.331	.52	1.05	1.0
1751+441		1990.107	1994.494	.871	6	.223	.32	.26	.428	.65	1.13	.7
1751+288		1988.127	1995.357		5	.447	.54	1.81	.476	.69	.96	1.4
1758+388		1994.209	1995.297	2.092	4	.117	.14	.34	.165	.23	.61	.5
1803+784		1982.461	1995.546	.680	1319	.239	.34	.90	.264	.35	1.09	1.0

Table III.4 (cont.) Summary information on ICRF Sources.

IAU NAME	ALT NAME	FIRST OBS	LAST OBS	z	NUM EXP	α cos δ WRMS mas	α cos δ RMS mas	α cos δ χ^2/df	δ WRMS mas	δ RMS MAS	δ χ^2/df	TOTAL χ^2/df
1800+440		1991.278	1994.839	.663	4	.490	.61	1.15	.325	.42	.33	.7
1758-651		1992.369	1995.491		4	.274	.40	.60	.671	.89	2.01	1.3
1807+698	3C371	1988.012	1995.450	.051	38	.307	.39	.81	.320	.40	.82	.8
1806+456		1994.190	1994.532	.830	2	.211	.31	1.07	.004	.00	.00	.5
1815-553		1990.395	1995.488		14	.933	.98	2.77	.634	.73	1.18	2.0
1817-254		1994.123	1995.316		2	.022	.03	.01	.073	.18	.06	.0
1826+796		1990.533	1994.517	.224	5	.463	.80	1.19	.407	.74	.98	1.1
1821+107		1989.642	1995.198	1.360	6	.338	.47	.94	.743	1.13	2.14	1.5
1823+568		1987.494	1995.089	.664	19	.357	.48	1.25	.384	.66	1.15	1.2
1830+285		1991.275	1994.968	.594	3	.107	.24	.14	.173	.44	.34	.2
1831-711		1992.096	1994.929	1.356	12	.207	.36	.38	.383	.59	.94	.7
1845+797	3C390.3	1989.642	1994.839	.057	9	.527	.72	1.02	.448	.54	.70	.9
1842+681		1988.012	1994.935	.475	8	.454	.53	.95	.320	.31	.53	.7
1849+670		1992.074	1995.279	.657	4	.376	.50	2.66	.190	.30	.67	1.7
1856+737	1856+736	1988.309	1994.861	.460	5	.298	.33	.38	.202	.21	.16	.3
1901+319	3C395	1991.486	1995.105	.635	11	.413	.61	1.65	.530	.93	1.89	1.8
1908-201		1992.257	1995.198		4	.223	.33	.28	.267	.34	.65	.5
1921-293		1987.108	1995.562	.352	212	.438	.64	1.90	.635	.92	2.41	2.2
1923+210		1989.362	1994.456		36	.560	.69	1.40	.541	.71	.87	1.1
1928+738		1981.458	1994.708	.302	48	.379	.53	1.21	.424	.51	1.34	1.3
1929+226		1994.494	1995.510		3	.080	.14	.11	.198	.31	.42	.3
1933-400		1992.276	1992.970	.966	4	.819	.96	1.34	.545	.64	1.24	1.3
1937-101		1994.123	1994.815	3.787	2	.200	.28	.62	.353	.50	2.70	1.7
1935-692		1991.359	1995.485	3.170	4	1.256	1.76	5.74	.744	.94	1.53	3.6
1954+513		1987.497	1995.279	1.230	29	.336	.38	1.02	.312	.44	.68	.8
1954-388		1993.074	1995.530	.630	8	.417	.51	2.52	.608	.80	1.53	2.0
1958-179		1987.217	1995.562	.650	145	.352	.49	1.04	.579	.77	1.48	1.3
2007+777		1986.195	1995.581	.342	210	.276	.38	1.30	.209	.33	.80	1.1
2005+642		1994.190	1995.220		3	.665	.91	5.84	.093	.10	.13	3.0
2017+745	2017+743	1990.088	1995.279	2.200	17	.312	.52	.66	.309	.40	.73	.7

Table III.4 (cont.) Summary information on ICRF Sources.

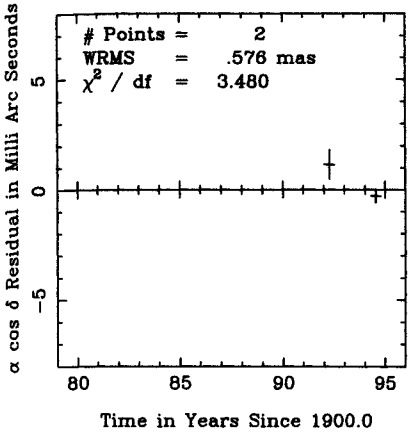
IAU NAME	ALT NAME	FIRST OBS	LAST OBS	Z	NUM EXP	α cos δ WRMS mas	α cos δ RMS mas	α cos δ χ^2/df	δ WRMS mas	δ RMS MAS	δ χ^2/df	TOTAL χ^2/df
2021+614		1988.012	1994.676	.227	19	.673	.74	3.97	.865	1.03	5.53	4.8
2021+317		1988.471	1994.708		9	.463	.77	1.90	.411	.60	.89	1.4
2030+547		1988.339	1994.839		3	.090	.13	.06	.399	.47	.51	.3
2029+121		1988.127	1995.357	1.215	8	.130	.20	.15	.590	.82	1.39	.8
2037+511	3C418	1984.069	1995.050	1.686	99	.379	.59	1.15	.420	.60	1.12	1.1
2037-253		1989.434	1994.815	1.574	2	.362	.51	.28	.461	.65	1.00	.6
2051+745		1991.977	1993.730		3	.243	.29	.23	.179	.26	.15	.2
2052-474		1992.096	1995.530	1.489	6	.345	.40	.88	.729	1.12	1.47	1.2
2059+034		1991.486	1994.494	1.013	3	.102	.12	.07	.440	.73	.63	.4
2059-786		1992.347	1993.937		2	.131	.23	.11	.388	.65	1.03	.6
2106-413		1992.096	1995.488	1.055	4	.341	.36	1.53	.318	.35	.31	.9
2113+293		1987.497	1995.279	1.514	17	.317	.58	1.05	.380	.56	.90	1.0
2109-811		1992.369	1995.491		6	.243	.26	.27	.486	.61	1.61	.9
2121+053		1986.195	1995.562	1.878	338	.498	.61	2.13	.480	.69	1.17	1.7
2126-158		1992.593	1995.198	3.270	6	.359	.47	.90	.359	.44	.47	.7
2128-123		1987.108	1995.562	.501	159	.450	.51	1.59	.765	.96	1.98	1.8
2131-021		1988.041	1993.538	1.285	4	.114	.12	.09	1.107	1.25	2.41	1.3
2134+004	2134+00	1981.461	1995.092	1.936	88	.530	.59	1.41	.927	1.09	1.67	1.5
2136+141		1987.497	1995.357	2.427	10	.410	.57	1.77	.359	.46	.79	1.3
2144+092		1987.494	1993.727	1.113	10	.365	.46	.69	.403	.53	.67	.7
2145+067		1984.518	1995.565	.990	793	.287	.42	1.18	.369	.59	1.27	1.2
2149+056		1989.362	1993.730	.740	2	.137	.17	.27	.989	1.87	5.50	2.9
2146-783		1992.347	1993.937		2	.643	.90	2.20	.222	.31	.29	1.2
2150+173		1988.127	1994.283		7	.867	.89	2.53	.461	.52	.40	1.5
2155-152		1987.108	1994.968	.672	5	1.124	1.70	5.12	1.281	1.78	5.34	5.2
2200+420	VR422201	1980.281	1995.453	.070	568	.381	.47	1.27	.531	.65	1.35	1.3
2201+315		1987.497	1995.453	.298	158	.251	.36	1.17	.350	.53	1.52	1.3
2204-540		1992.347	1993.074	1.206	2	.287	.47	1.71	.371	.67	1.06	1.4
2209+236		1990.828	1995.357		9	.696	.88	3.25	.716	1.04	1.45	2.4
2216-038		1985.371	1994.532	.901	193	.369	.41	1.14	.664	.87	1.63	1.4

Table III.4 (cont.) Summary information on ICRF Sources.

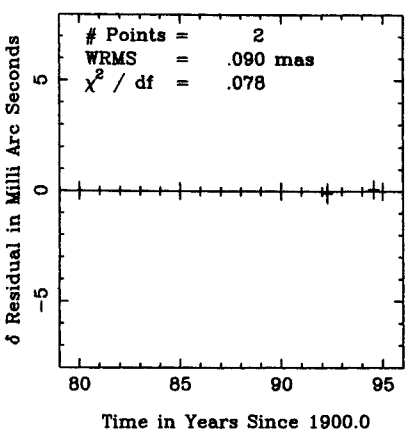
IAU NAME	ALT NAME	FIRST OBS	LAST OBS	Z	NUM EXP	α cos δ WRMS mas	α cos δ RMS mas	α cos δ χ^2/df	δ WRMS mas	δ RMS MAS	δ χ^2/df	TOTAL χ^2/df
2227-088		1987.217	1995.279	1.562	2	.109	.40	.41	.092	.23	.13	.3
2229+695		1989.213	1994.676		8	.488	.58	.79	.191	.21	.12	.5
2230+114	CTA102	1987.494	1993.516	1.037	43	.657	.76	1.42	.931	.99	1.62	1.5
2232-488		1994.497	1994.756	.510	2	.430	.68	1.18	.471	.72	.59	.9
2234+282		1984.320	1995.565	.795	866	.346	.48	1.43	.393	.53	1.30	1.4
2243-123		1987.121	1995.562	.630	41	.273	.34	.78	.570	.59	2.06	1.4
2251+158	3C454.3	1980.281	1994.996	.859	404	.491	.58	2.80	.525	.76	1.42	2.1
2253+417		1988.127	1994.708	1.476	9	.599	.72	1.52	.560	.65	.99	1.3
2254+024		1993.519	1993.538	2.090	2	.292	.38	.63	.847	1.18	1.72	1.2
2255-282		1989.309	1995.562	.926	121	.497	.72	1.93	.684	.98	2.33	2.1
2318+049		1989.423	1993.730	.623	5	.537	1.08	1.67	.692	.75	1.33	1.5
2319+272		1989.870	1995.279	1.253	2	.220	.53	1.49	.263	.59	1.34	1.4
2320+506		1992.269	1994.398		2	.038	.05	.03	.439	.65	3.47	1.8
2326-477		1993.074	1994.756	1.306	2	.611	.91	4.07	.120	.17	.06	2.1
2328+107		1988.320	1994.708	1.489	7	.429	.50	1.11	.528	.61	.66	.9
2329-162		1988.041	1994.815	1.153	2	.238	.47	.50	.173	.35	.55	.5
2331-240		1991.380	1994.123	.048	4	.578	.72	1.02	.424	.67	.87	.9
2337+264		1992.074	1995.357		4	.962	1.60	6.67	.635	.89	1.97	4.3
2344+092	2344+09A	1990.533	1994.661	.673	3	.092	.11	.06	.261	.32	.23	.1
2345-167		1986.026	1993.351	.576	16	.721	.85	1.34	.567	.64	1.01	1.2
2351+456		1988.309	1994.708	1.992	12	.473	.50	.82	.463	.50	.63	.7
2352+495		1988.127	1994.839	.237	5	1.158	1.28	3.12	1.347	1.52	4.34	3.7
2355-534		1990.393	1993.088	1.006	5	.571	.65	1.78	.651	.81	.99	1.4
2355-106		1992.039	1994.469	1.622	18	.595	.81	1.61	.489	.63	1.26	1.4

Figure III.4. shows the time evolution of the astrometric position in right ascension and declination for 379 ICRF sources, every ICRF source with two or more arc position estimates with formal errors less than 1 mas in both components of position. In each case the observed right ascension residual was multiplied by the cosine of the declination to provide true arc lengths on the sky.

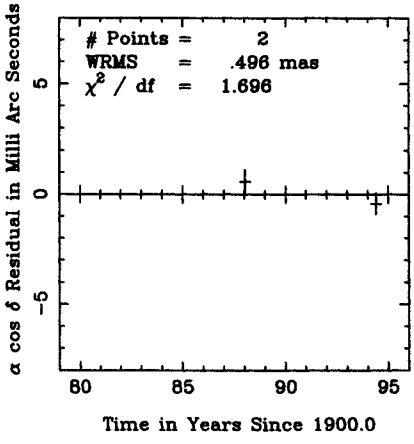
Arc Solution for 0003+380 : $\alpha \cos \delta$



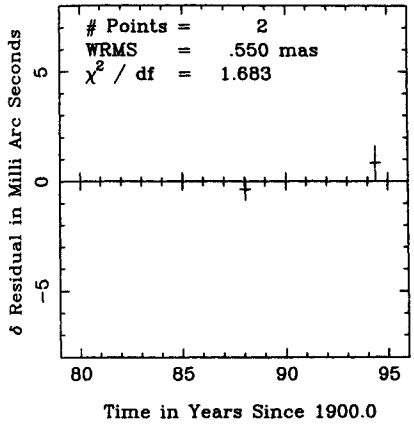
Arc Solution for 0003+380 : δ



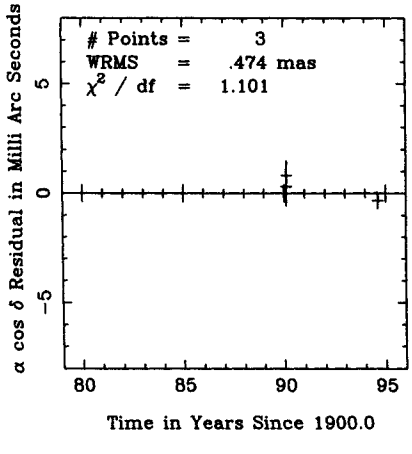
Arc Solution for 0003−066 : $\alpha \cos \delta$



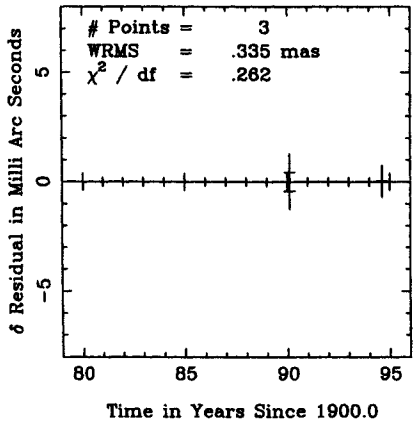
Arc Solution for 0003−066 : δ



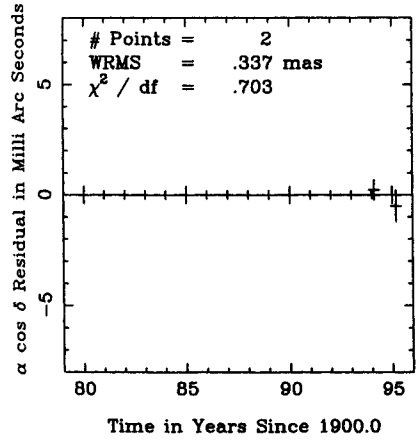
Arc Solution for 0007+171 : $\alpha \cos \delta$



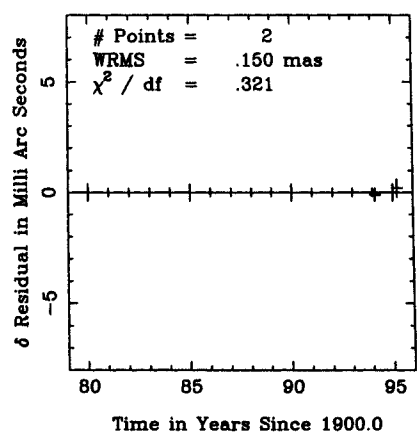
Arc Solution for 0007+171 : δ



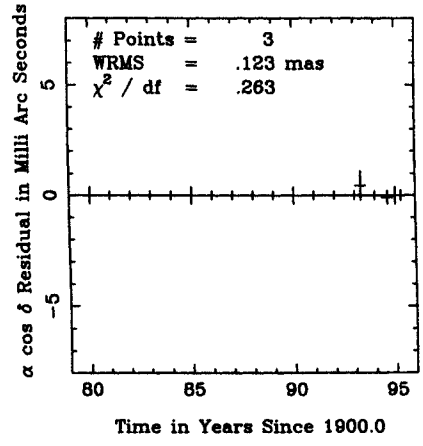
Arc Solution for 0008−264 : $\alpha \cos \delta$



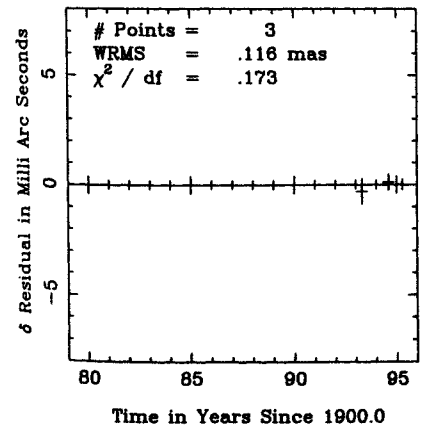
Arc Solution for 0008−264 : δ



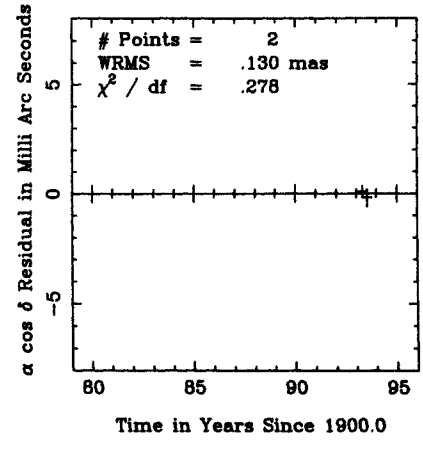
Arc Solution for 0010+405 : $\alpha \cos \delta$



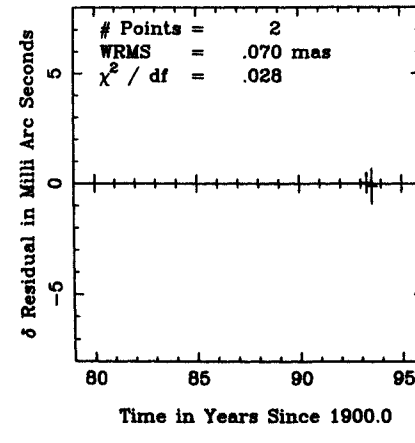
Arc Solution for 0010+405 : δ



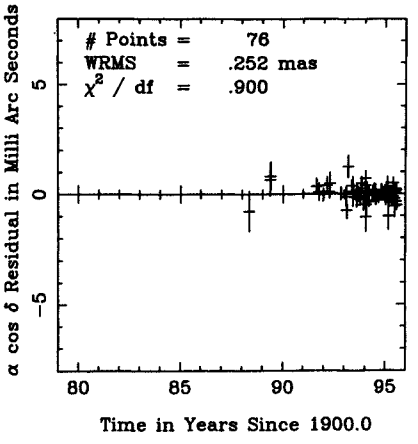
Arc Solution for 0013−005 : $\alpha \cos \delta$



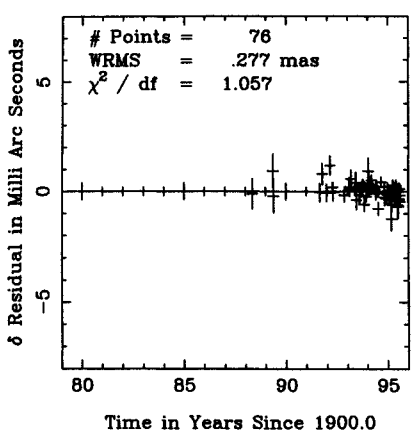
Arc Solution for 0013−005 : δ



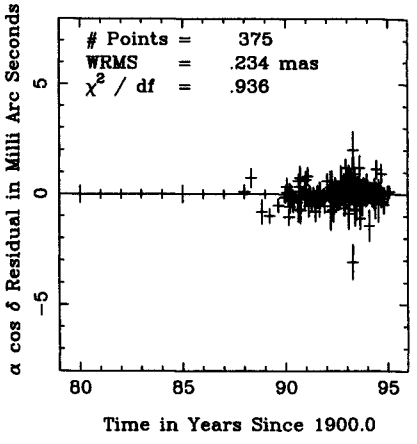
Arc Solution for 0014+813 : α cos δ



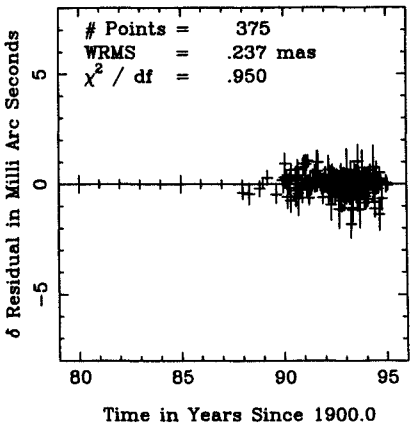
Arc Solution for 0014+813 : δ



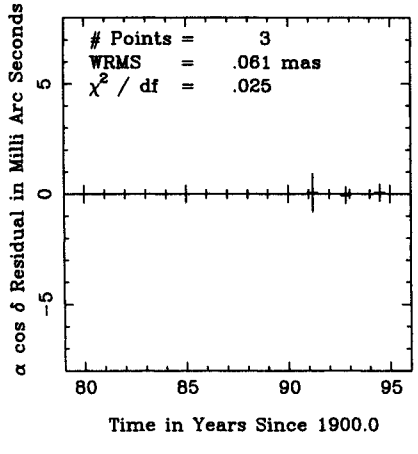
Arc Solution for 0016+731 : α cos δ



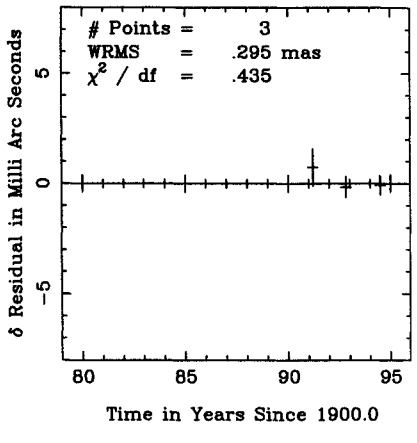
Arc Solution for 0016+731 : δ



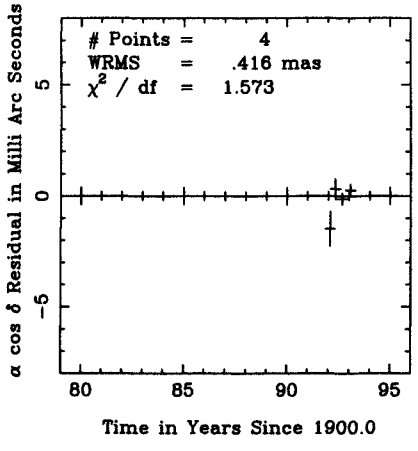
Arc Solution for 0039+230 : α cos δ



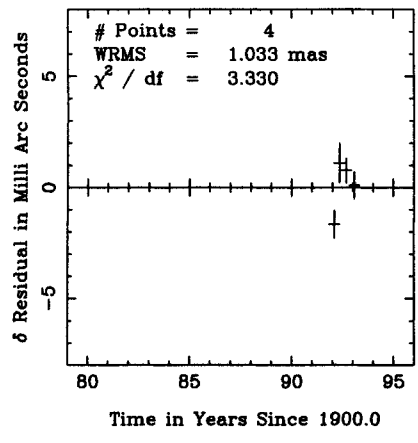
Arc Solution for 0039+230 : δ



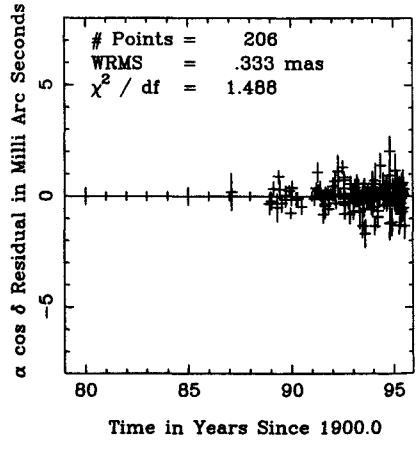
Arc Solution for 0047−579 : α cos δ



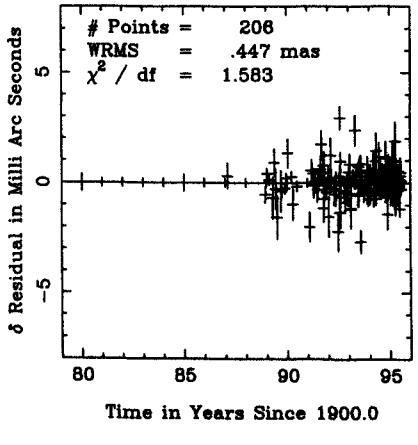
Arc Solution for 0047−579 : δ



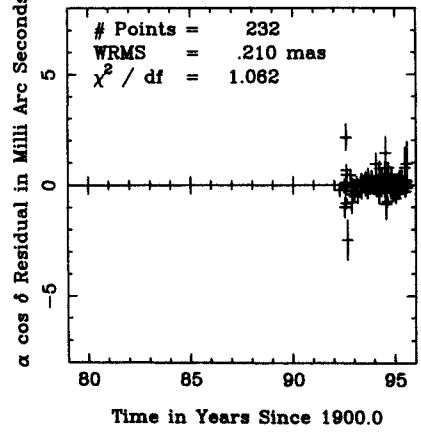
Arc Solution for 0048−097 : α cos δ



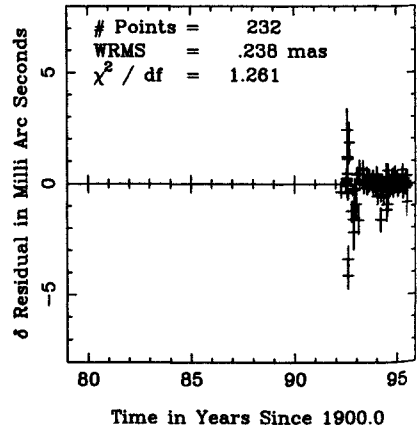
Arc Solution for 0048−097 : δ



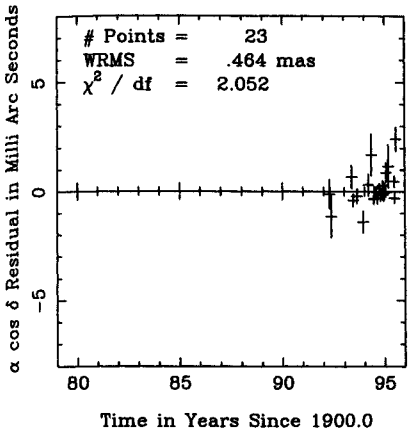
Arc Solution for 0059+581 : α cos δ



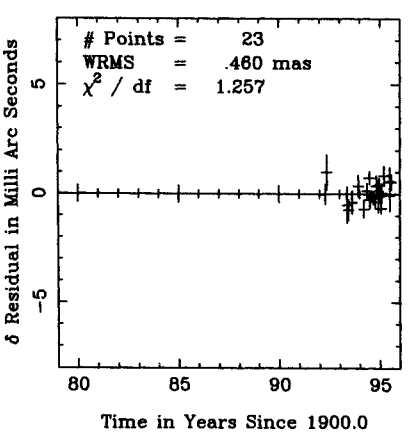
Arc Solution for 0059+581 : δ



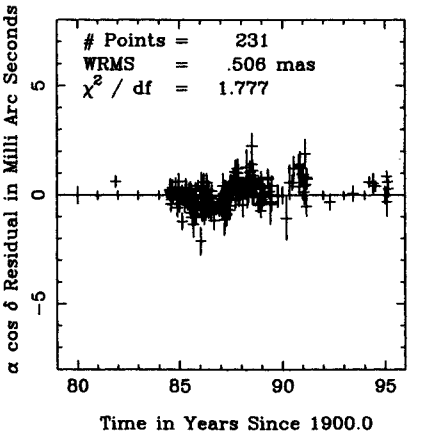
Arc Solution for 0104−408 : α cos δ



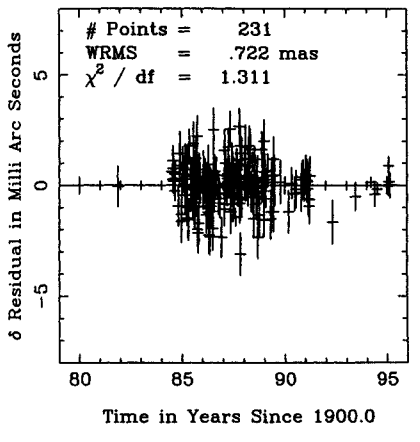
Arc Solution for 0104−408 : δ



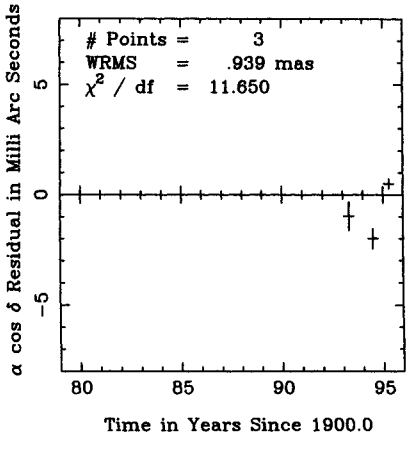
Arc Solution for 0106+013 : α cos δ



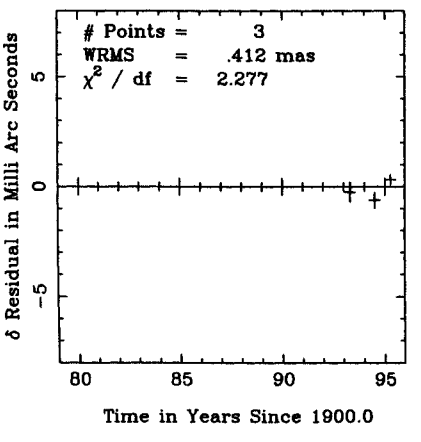
Arc Solution for 0106+013 : δ



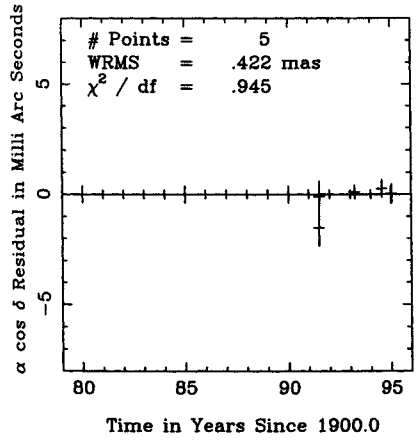
Arc Solution for 0108+388 : α cos δ



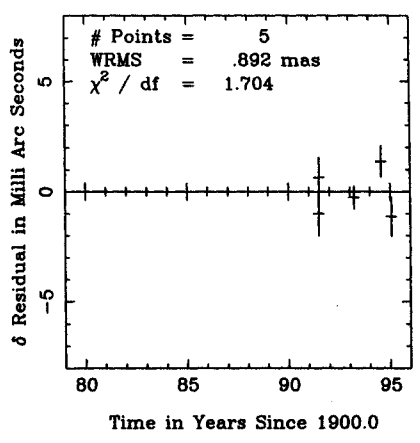
Arc Solution for 0108+388 : δ



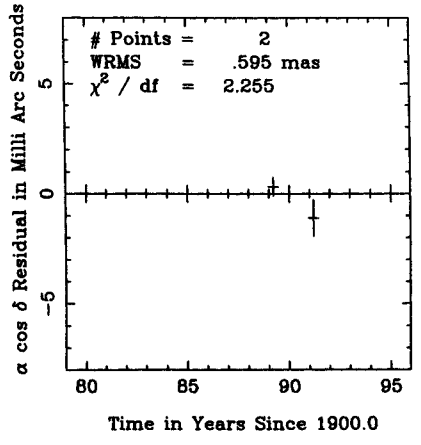
Arc Solution for 0109+224 : α cos δ



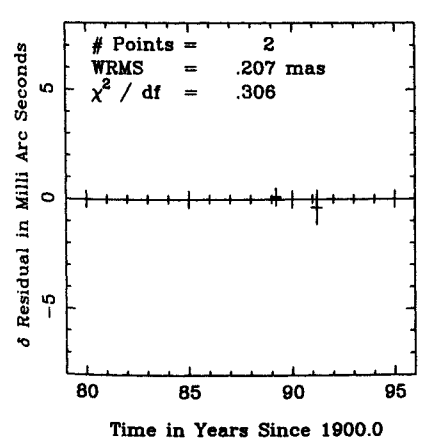
Arc Solution for 0109+224 : δ



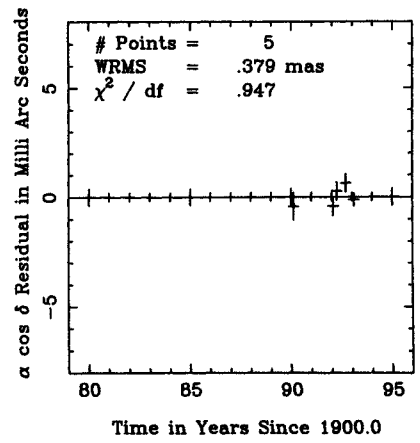
Arc Solution for 0112−017 : α cos δ



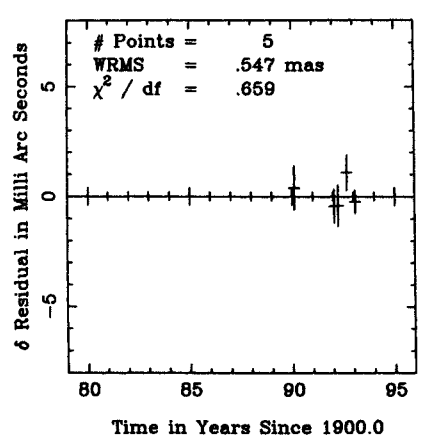
Arc Solution for 0112−017 : δ



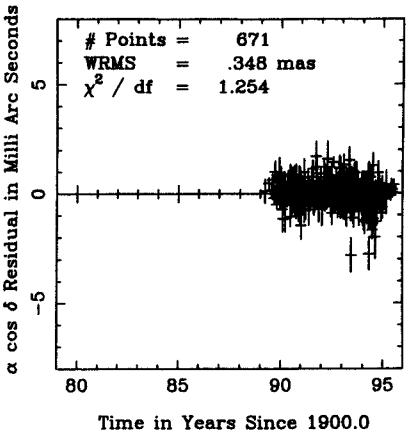
Arc Solution for 0119+115 : α cos δ



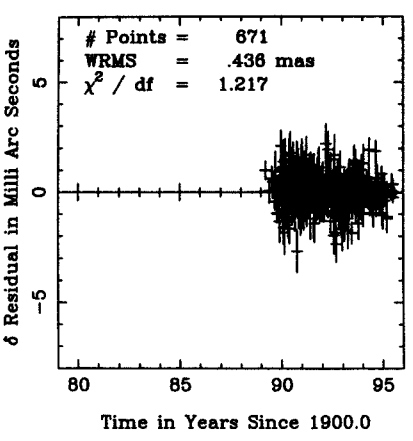
Arc Solution for 0119+115 : δ



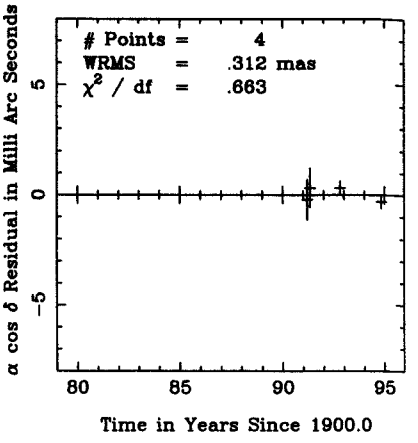
Arc Solution for 0119+041 : α cos δ



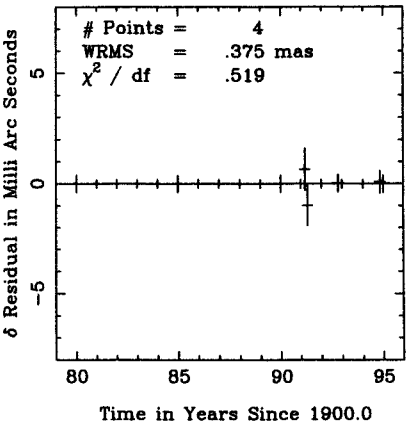
Arc Solution for 0119+041 : δ



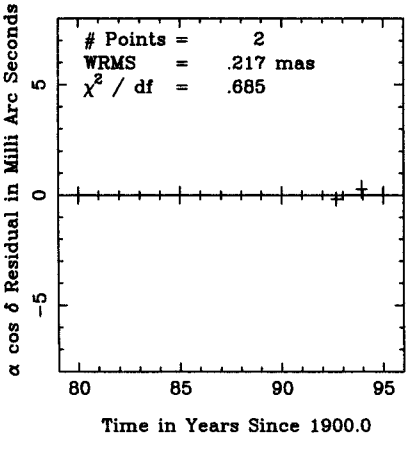
Arc Solution for 0123+257 : α cos δ



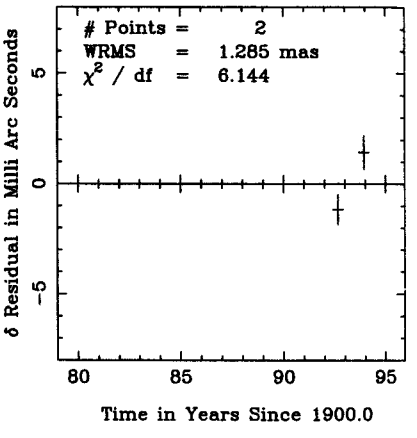
Arc Solution for 0123+257 : δ



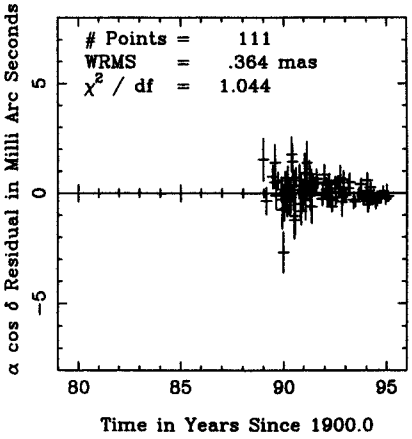
Arc Solution for 0131−522 : α cos δ



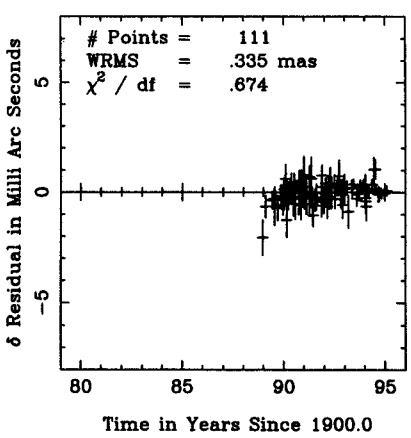
Arc Solution for 0131−522 : δ



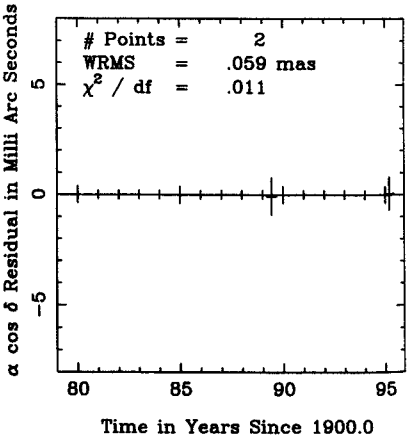
Arc Solution for 0133+476 : α cos δ



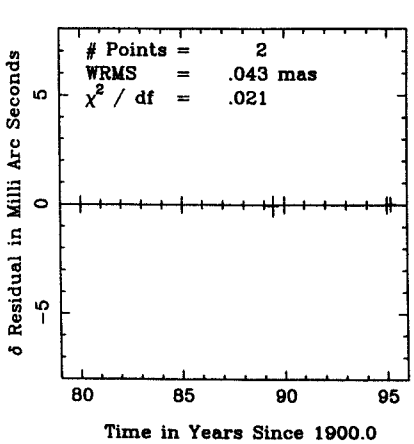
Arc Solution for 0133+476 : δ



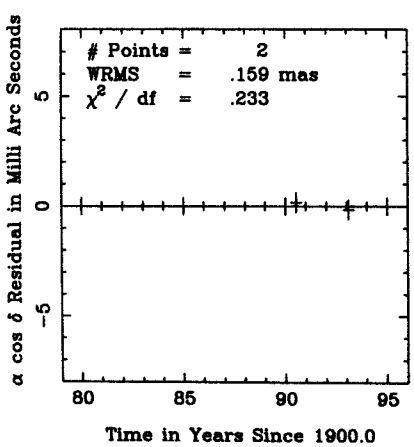
Arc Solution for 0135−247 : α cos δ



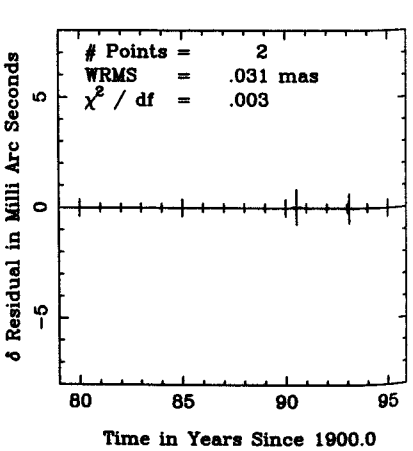
Arc Solution for 0135−247 : δ



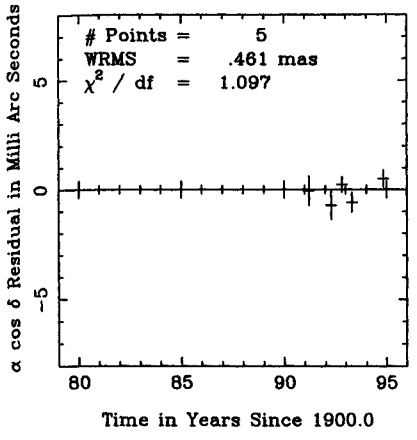
Arc Solution for 0146+056 : α cos δ



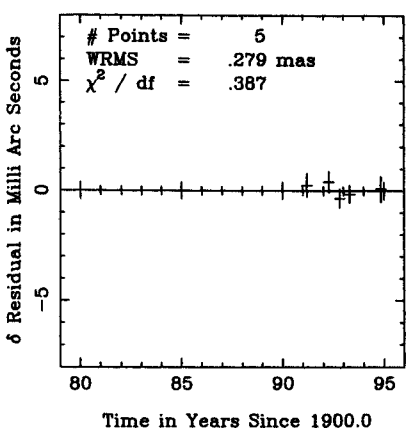
Arc Solution for 0146+056 : δ



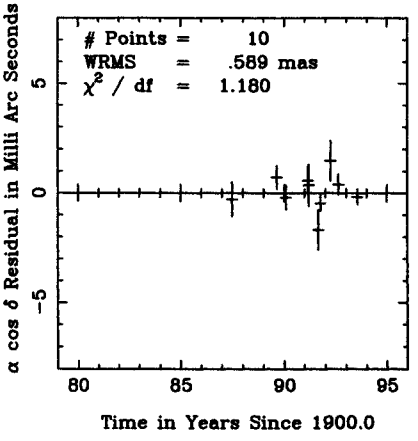
Arc Solution for 0148+274 : α cos δ



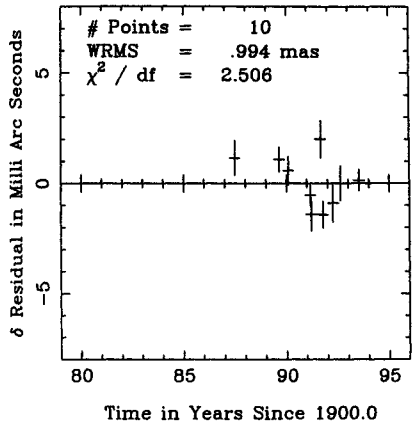
Arc Solution for 0148+274 : δ



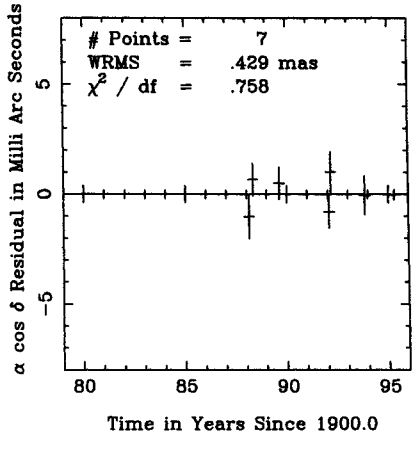
Arc Solution for 0149+218 : α cos δ



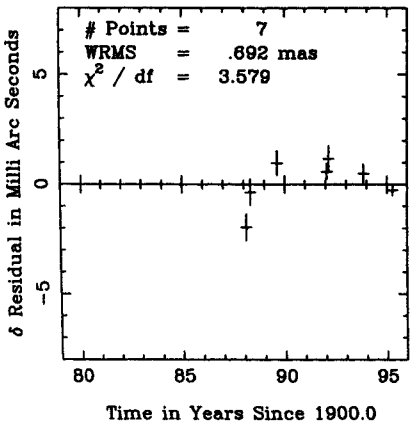
Arc Solution for 0149+218 : δ



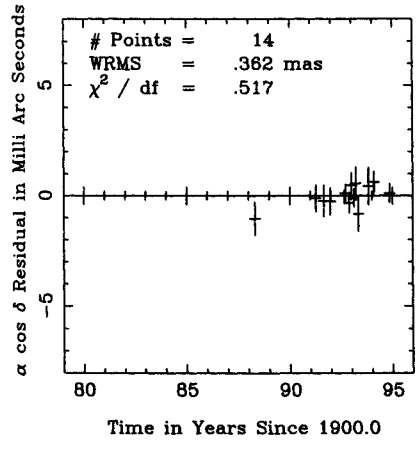
Arc Solution for 0153+744 : α cos δ



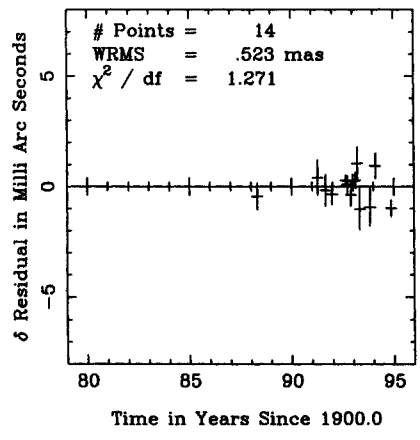
Arc Solution for 0153+744 : δ



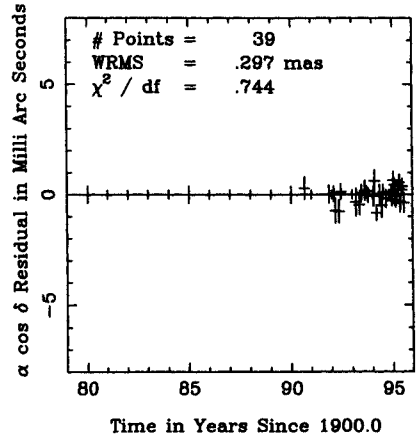
Arc Solution for 0159+723 : α cos δ



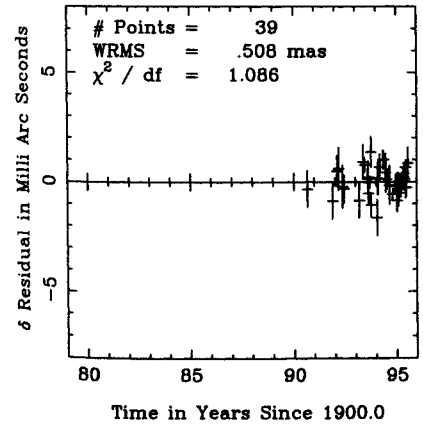
Arc Solution for 0159+723 : δ



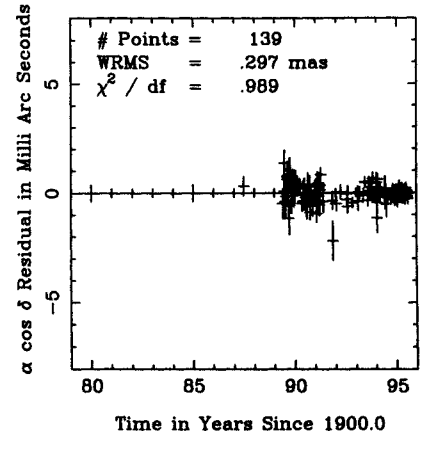
Arc Solution for 0201+113 : α cos δ



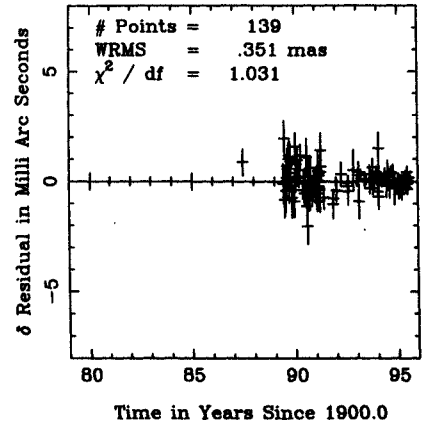
Arc Solution for 0201+113 : δ



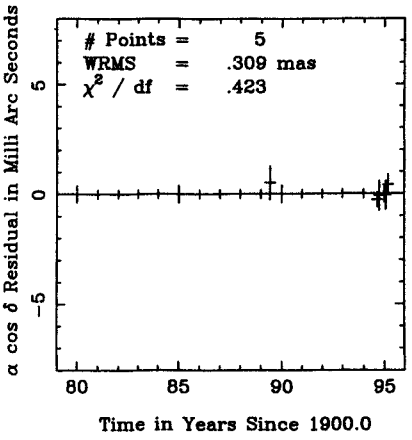
Arc Solution for 0202+149 : α cos δ



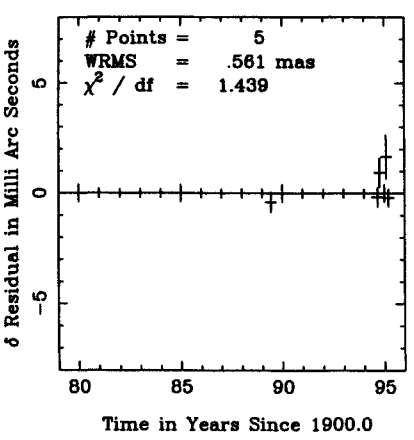
Arc Solution for 0202+149 : δ



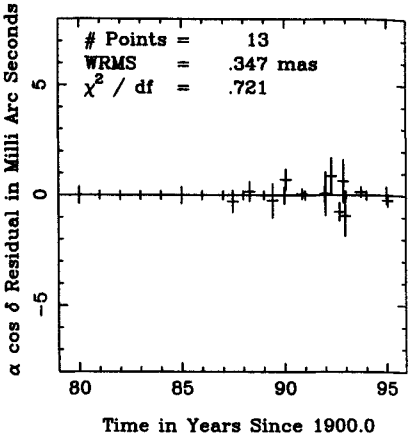
Arc Solution for 0202−172 : α cos δ



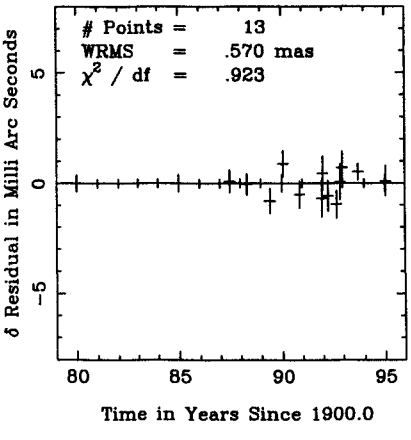
Arc Solution for 0202−172 : δ



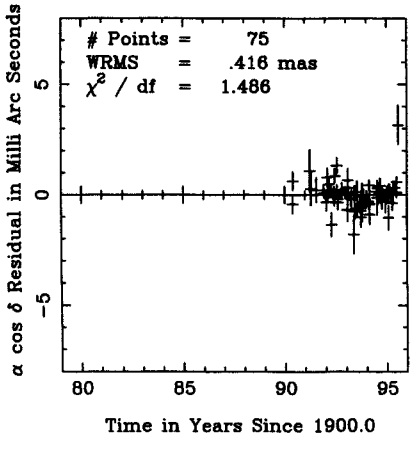
Arc Solution for 0202+319 : α cos δ



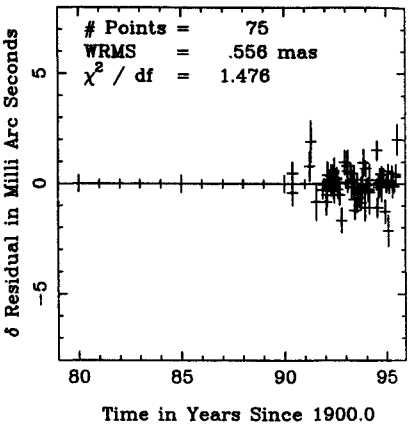
Arc Solution for 0202+319 : δ



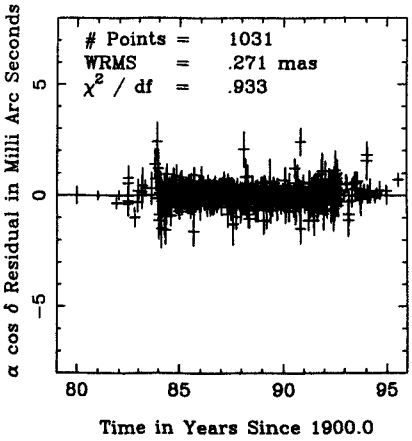
Arc Solution for 0208−512 : α cos δ



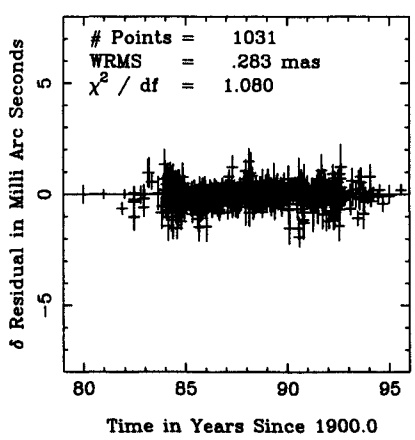
Arc Solution for 0208−512 : δ



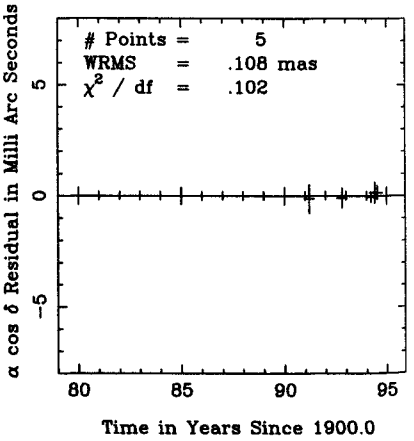
Arc Solution for 0212+735 : α cos δ



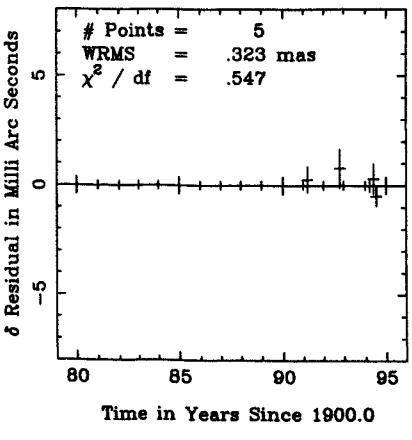
Arc Solution for 0212+735 : δ



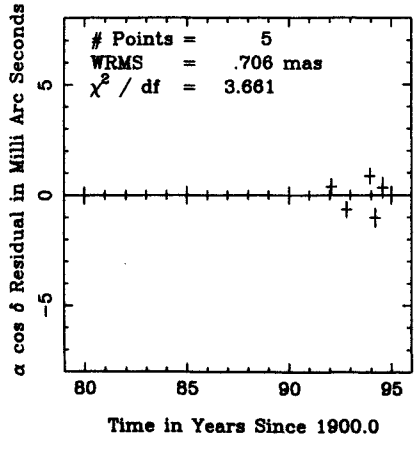
Arc Solution for 0215+015 : α cos δ



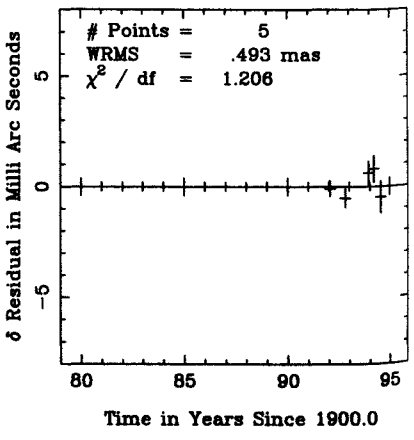
Arc Solution for 0215+015 : δ



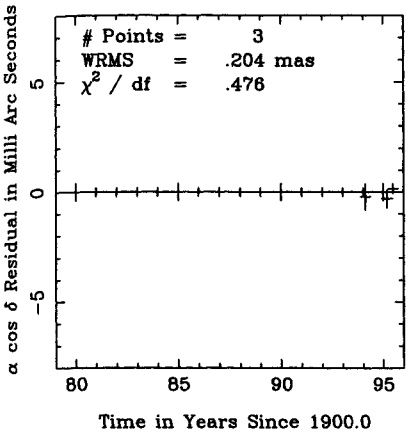
Arc Solution for 0219+428 : α cos δ



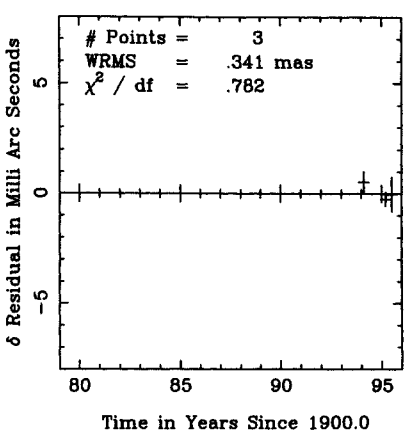
Arc Solution for 0219+428 : δ



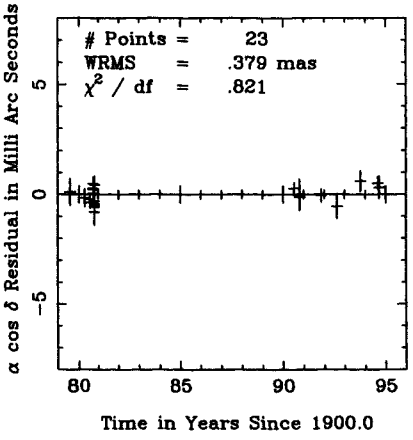
Arc Solution for 0220−349 : α cos δ



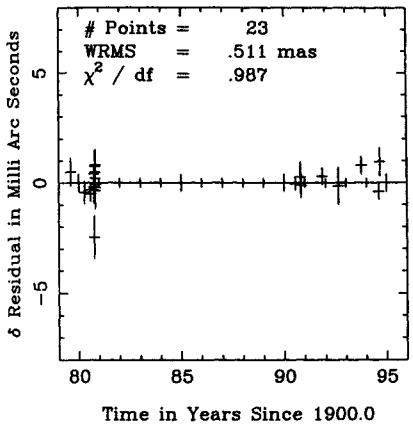
Arc Solution for 0220−349 : δ



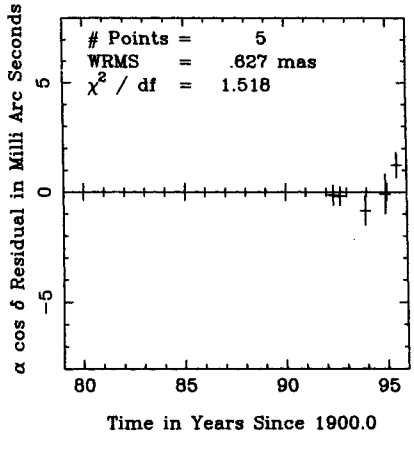
Arc Solution for 0224+671 : α cos δ



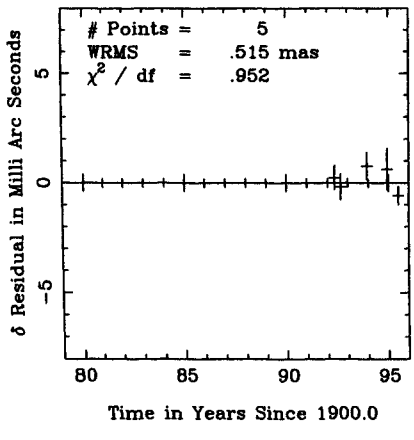
Arc Solution for 0224+671 : δ



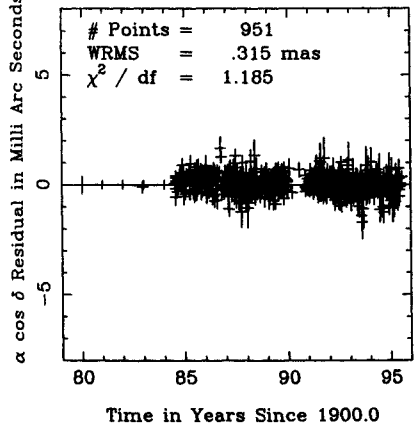
Arc Solution for 0230−790 : α cos δ



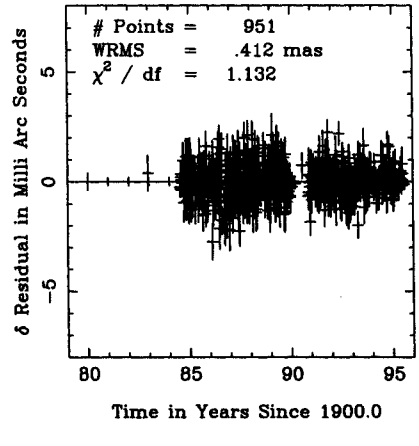
Arc Solution for 0230−790 : δ



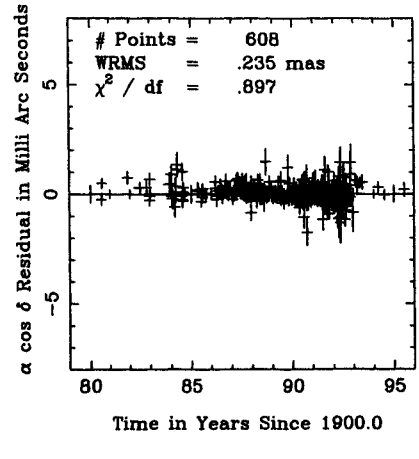
Arc Solution for 0229+131 : α cos δ



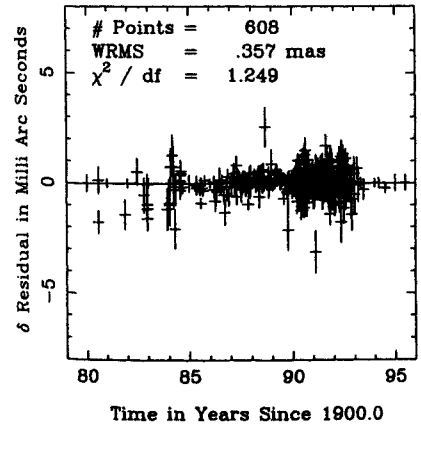
Arc Solution for 0229+131 : δ



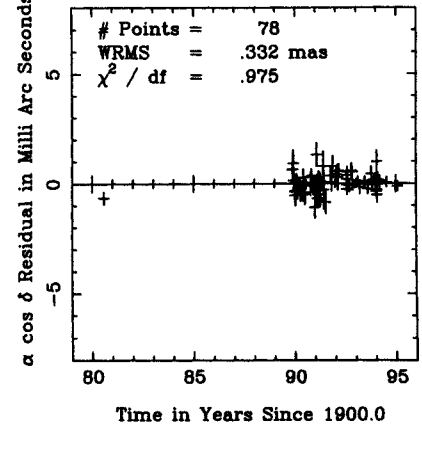
Arc Solution for 0234+285 : α cos δ



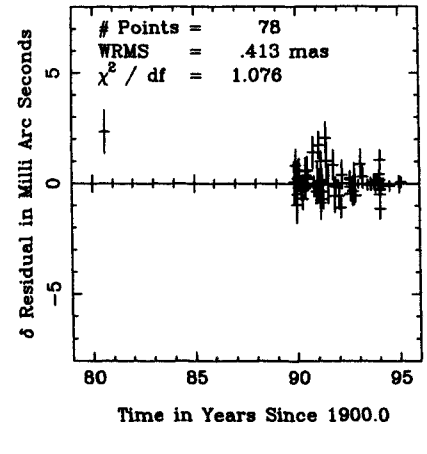
Arc Solution for 0234+285 : δ



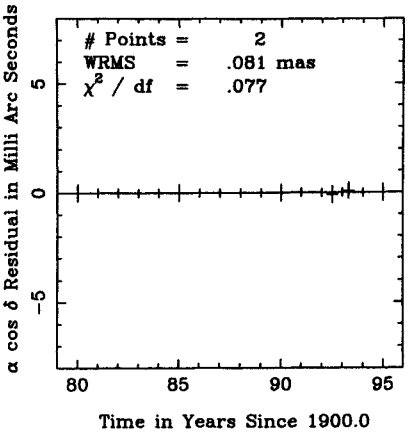
Arc Solution for 0235+164 : α cos δ



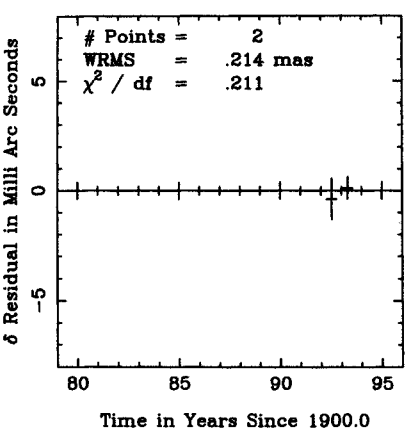
Arc Solution for 0235+164 : δ



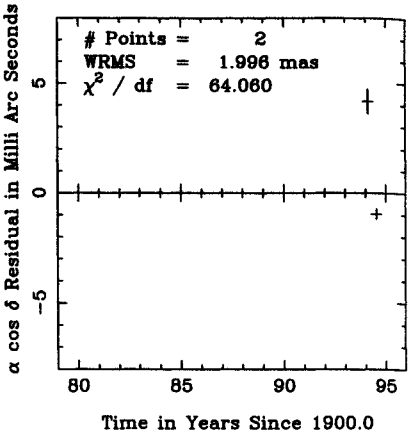
Arc Solution for 0237+040 : α cos δ



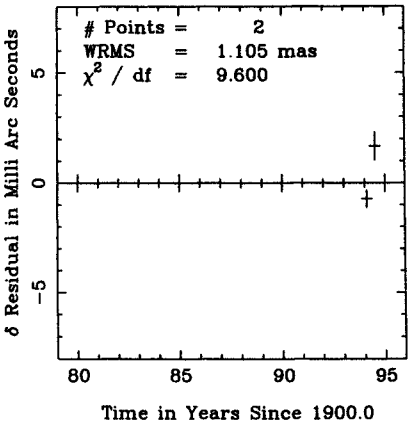
Arc Solution for 0237+040 : δ



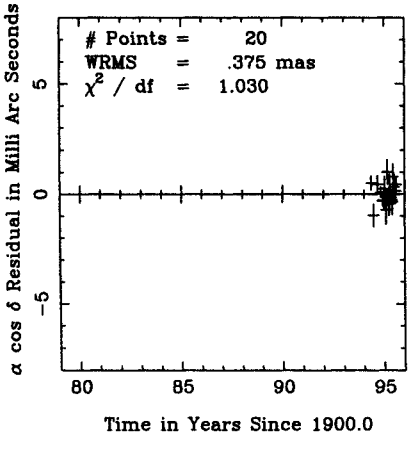
Arc Solution for 0237−233 : α cos δ



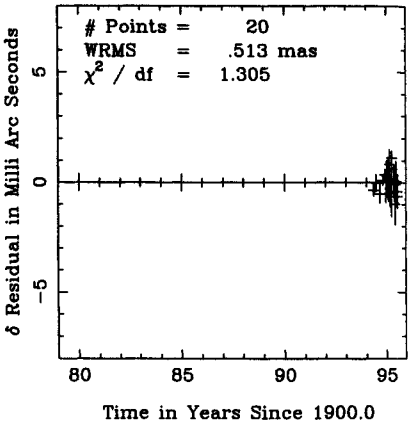
Arc Solution for 0237−233 : δ



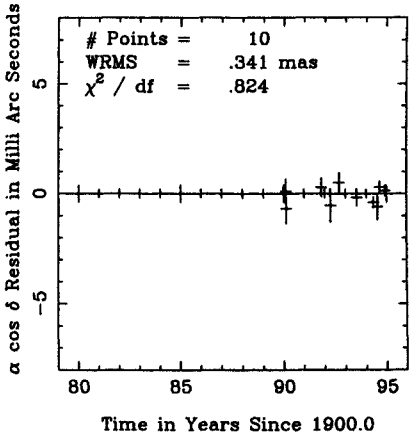
Arc Solution for 0238−084 : α cos δ



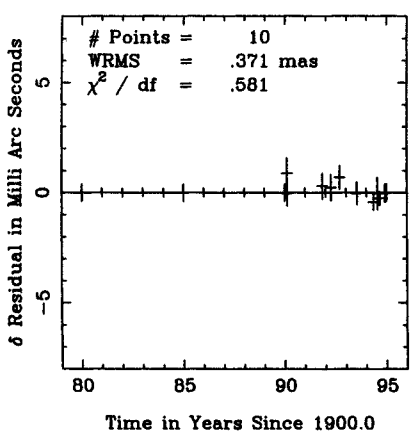
Arc Solution for 0238−084 : δ



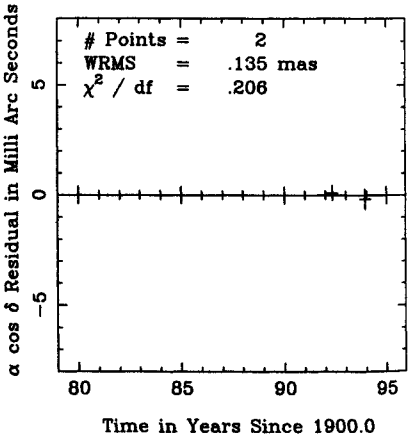
Arc Solution for 0248+430 : α cos δ



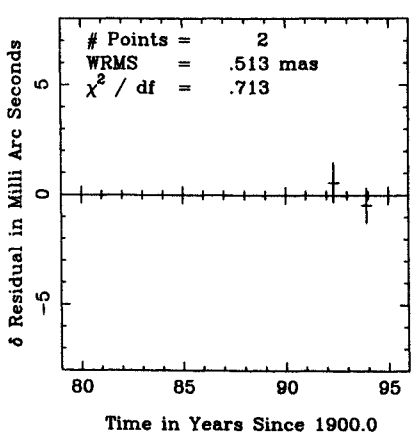
Arc Solution for 0248+430 : δ



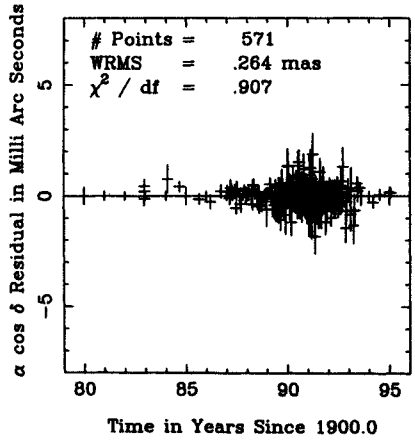
Arc Solution for 0252−549 : α cos δ



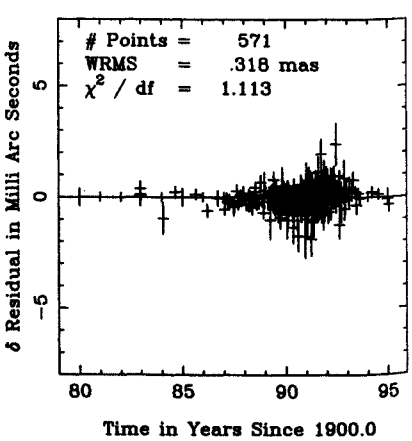
Arc Solution for 0252−549 : δ



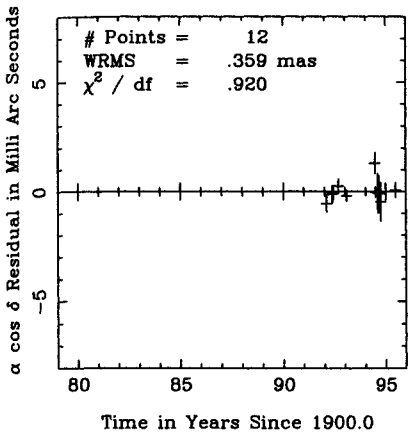
Arc Solution for 0300+470 : α cos δ



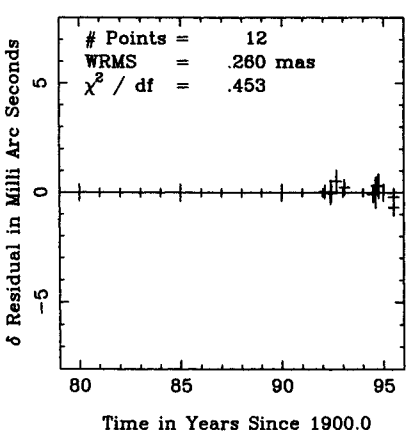
Arc Solution for 0300+470 : δ



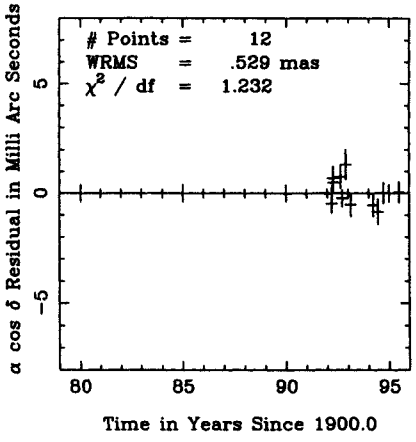
Arc Solution for 0302−623 : α cos δ



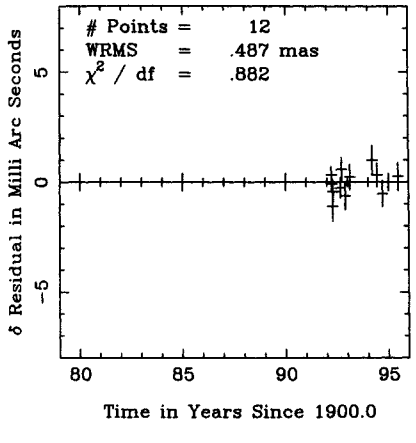
Arc Solution for 0302−623 : δ



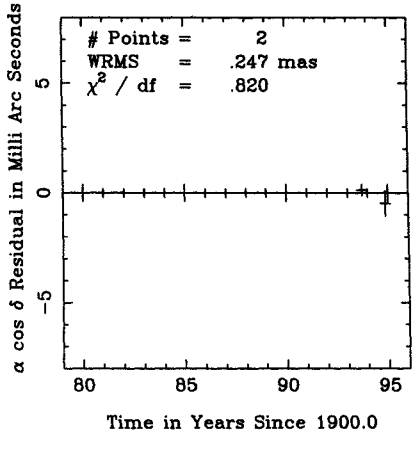
Arc Solution for 0302+625 : α cos δ



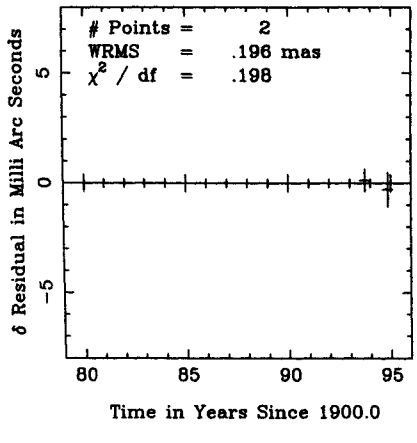
Arc Solution for 0302+625 : δ



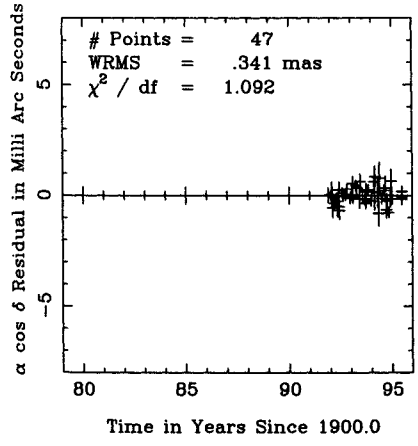
Arc Solution for 0306+102 : α cos δ



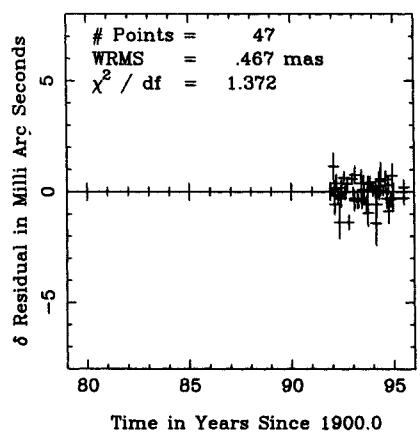
Arc Solution for 0306+102 : δ



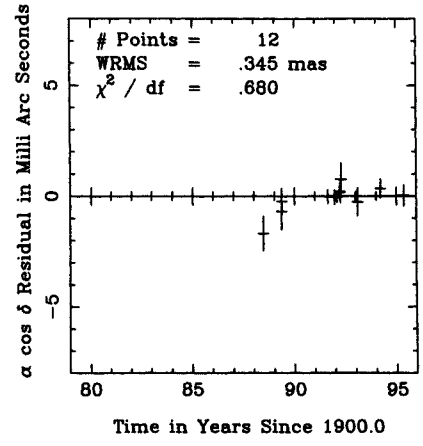
Arc Solution for 0308−611 : α cos δ



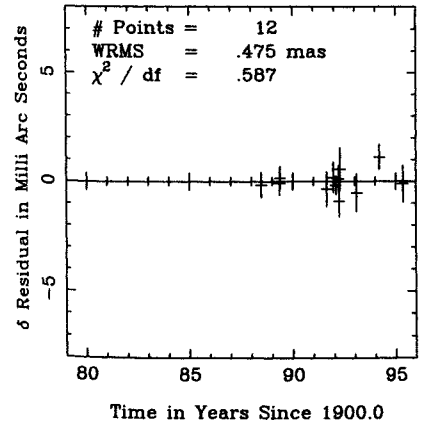
Arc Solution for 0308−611 : δ



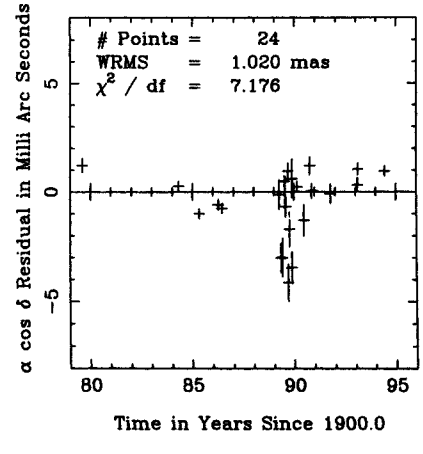
Arc Solution for 0309+411 : α cos δ



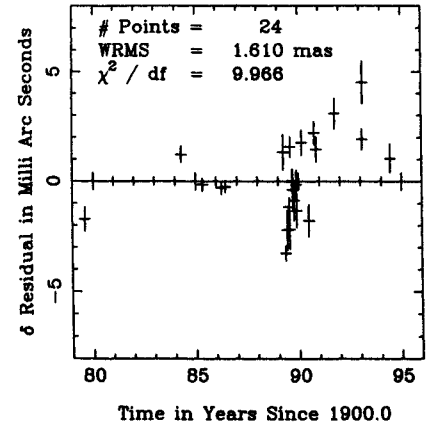
Arc Solution for 0309+411 : δ



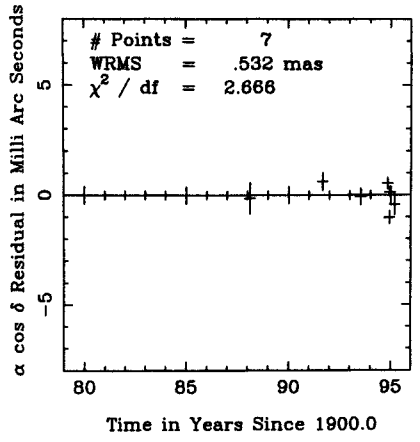
Arc Solution for 0316+413 : α cos δ



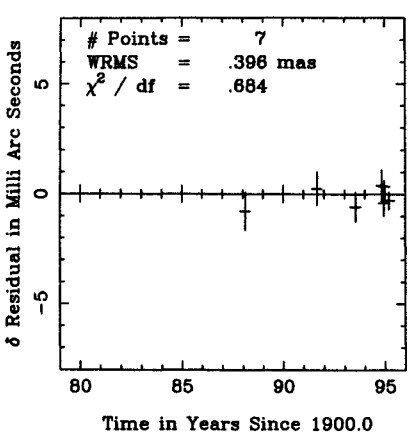
Arc Solution for 0316+413 : δ



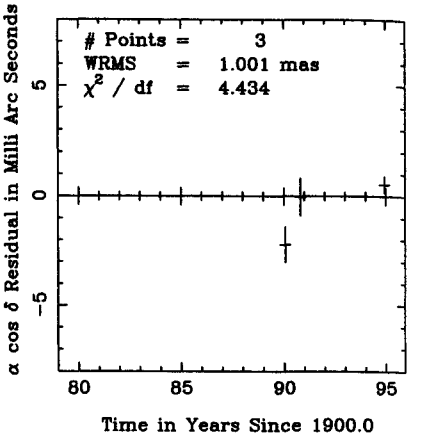
Arc Solution for 0319+121 : $\alpha \cos \delta$



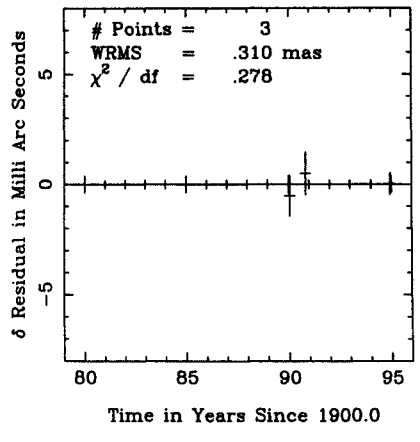
Arc Solution for 0319+121 : δ



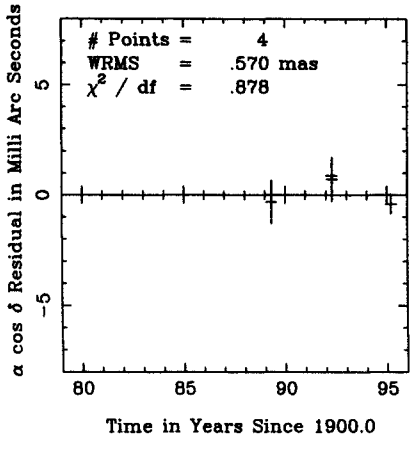
Arc Solution for 0326+277 : $\alpha \cos \delta$



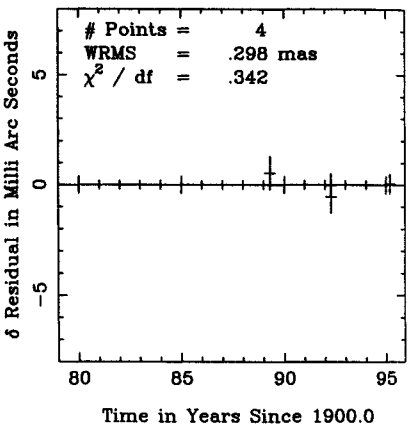
Arc Solution for 0326+277 : δ



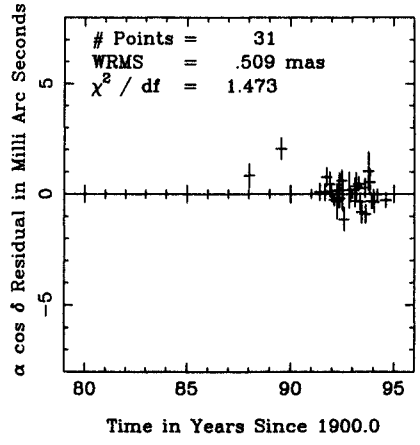
Arc Solution for 0332−403 : $\alpha \cos \delta$



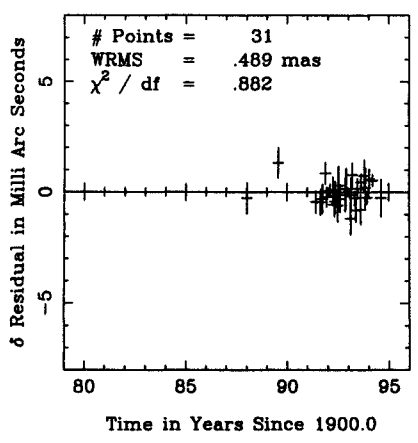
Arc Solution for 0332−403 : δ



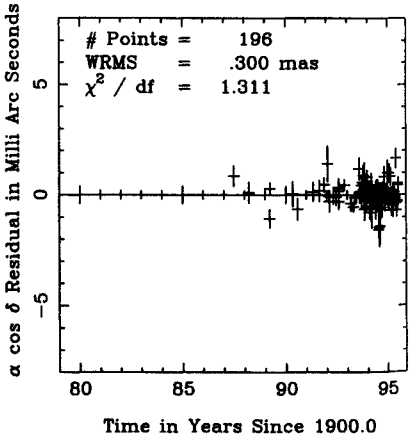
Arc Solution for 0333+321 : $\alpha \cos \delta$



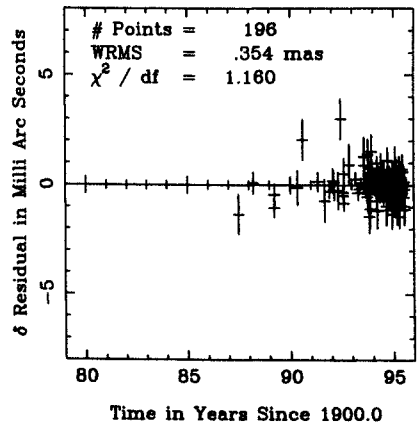
Arc Solution for 0333+321 : δ



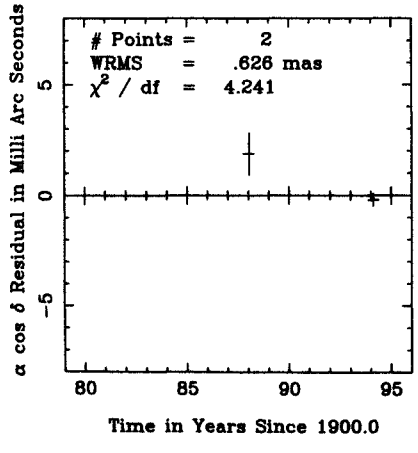
Arc Solution for 0336−019 : $\alpha \cos \delta$



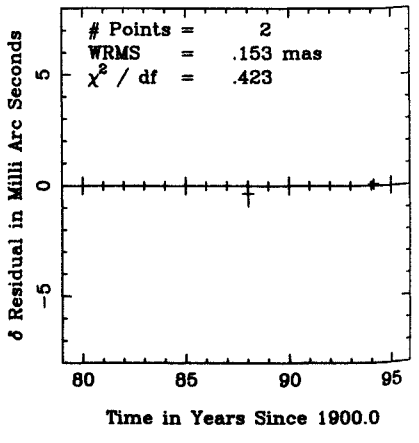
Arc Solution for 0336−019 : δ



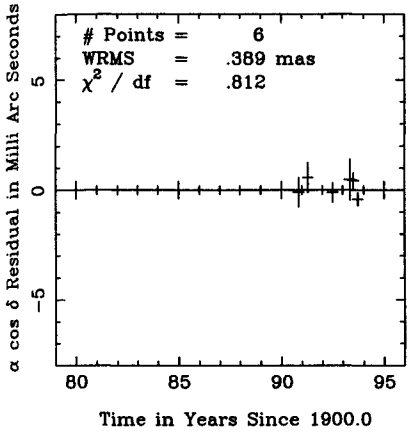
Arc Solution for 0338−214 : $\alpha \cos \delta$



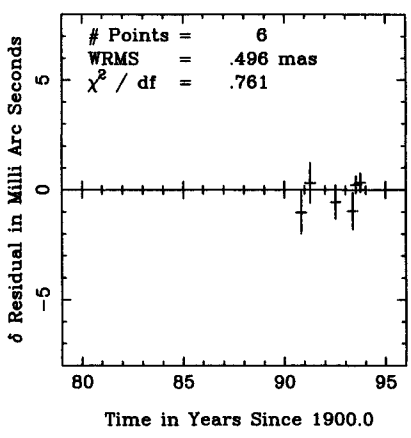
Arc Solution for 0338−214 : δ



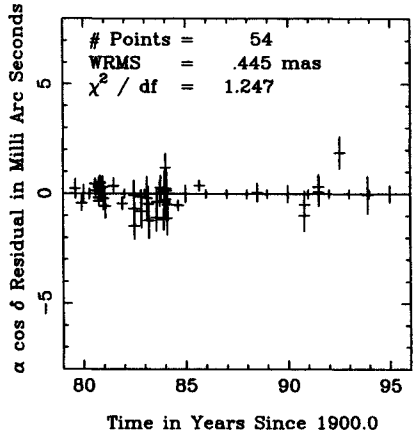
Arc Solution for 0342+147 : α cos δ



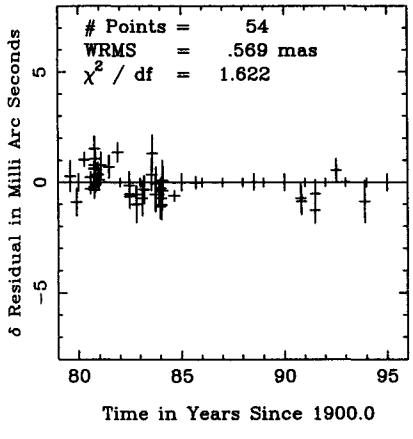
Arc Solution for 0342+147 : δ



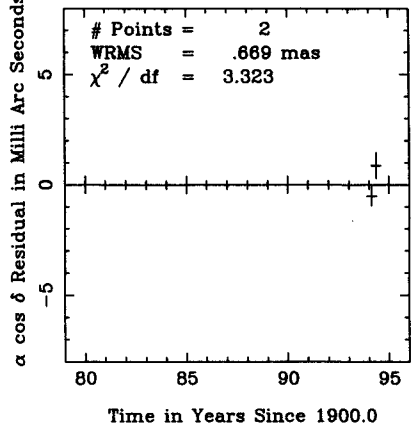
Arc Solution for 0355+508 : α cos δ



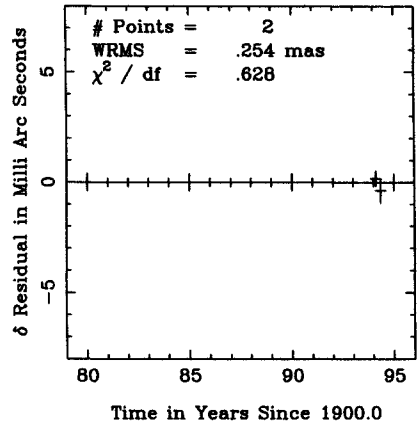
Arc Solution for 0355+508 : δ



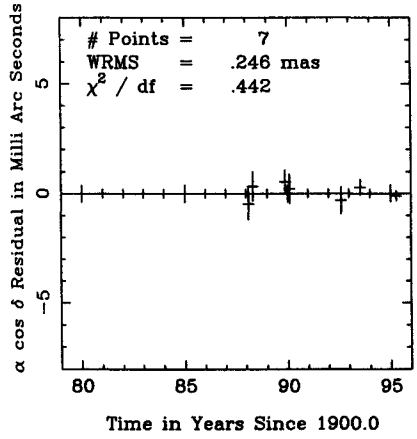
Arc Solution for 0400−319 : α cos δ



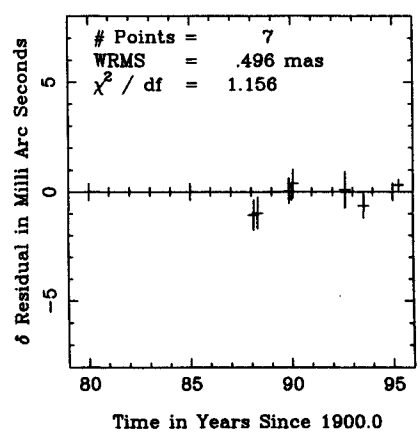
Arc Solution for 0400−319 : δ



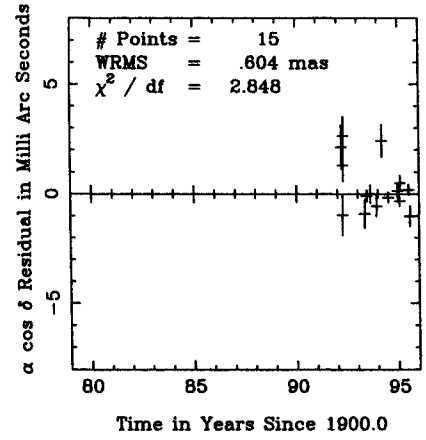
Arc Solution for 0400+258 : α cos δ



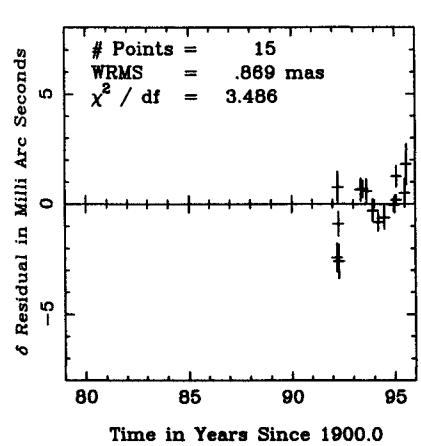
Arc Solution for 0400+258 : δ



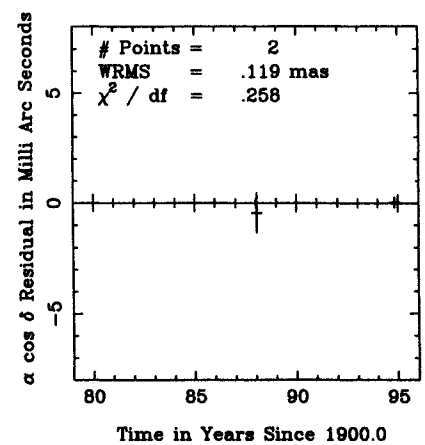
Arc Solution for 0402−362 : α cos δ



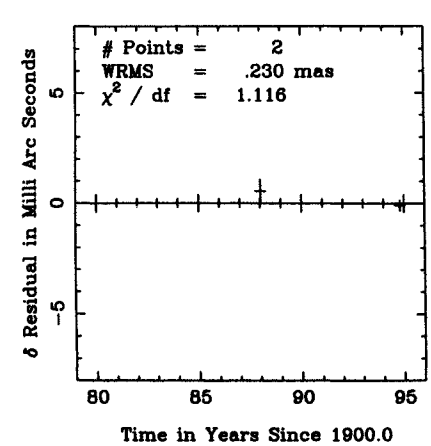
Arc Solution for 0402−362 : δ



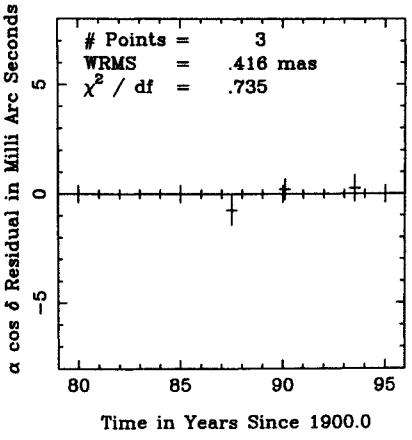
Arc Solution for 0403−132 : α cos δ



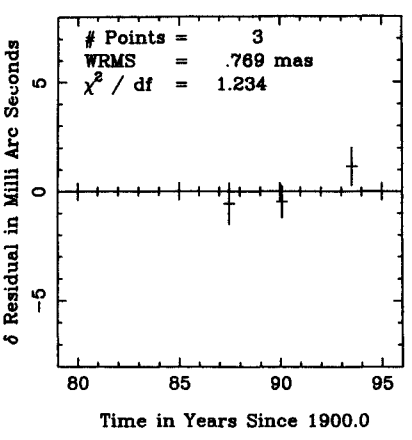
Arc Solution for 0403−132 : δ



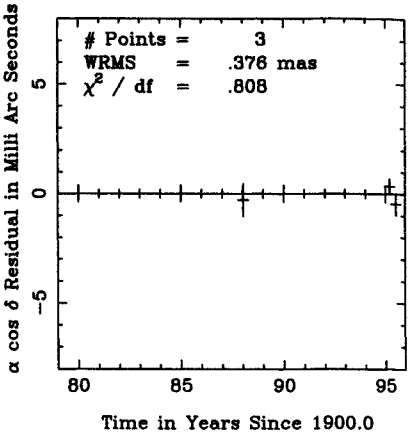
Arc Solution for 0406+121 : $\alpha \cos \delta$



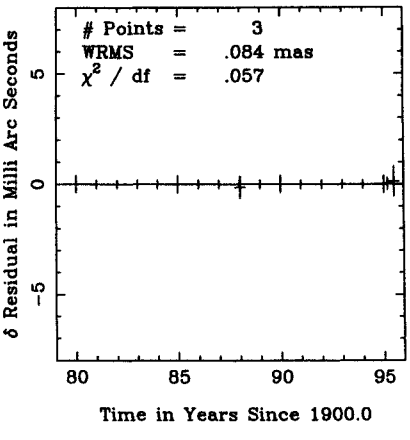
Arc Solution for 0406+121 : δ



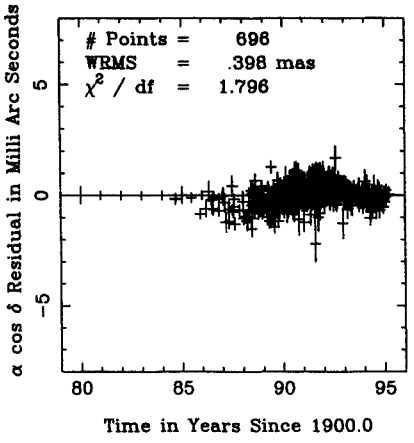
Arc Solution for 0414−189 : $\alpha \cos \delta$



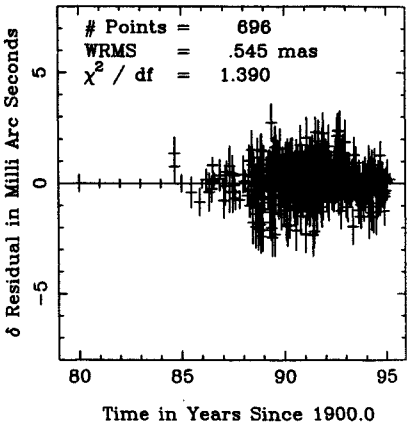
Arc Solution for 0414−189 : δ



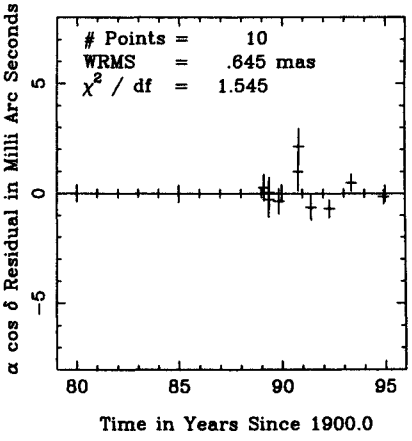
Arc Solution for 0420−014 : $\alpha \cos \delta$



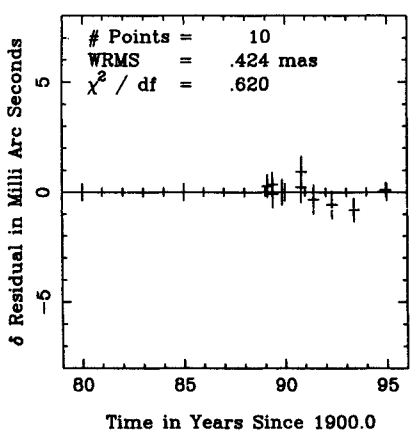
Arc Solution for 0420−014 : δ



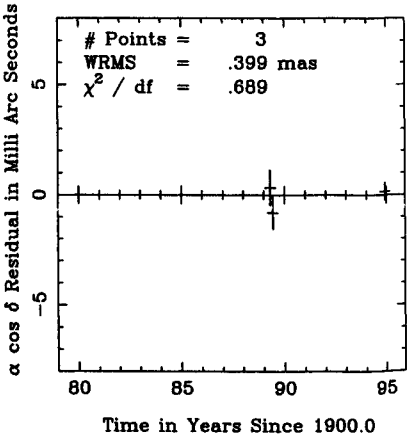
Arc Solution for 0420+417 : $\alpha \cos \delta$



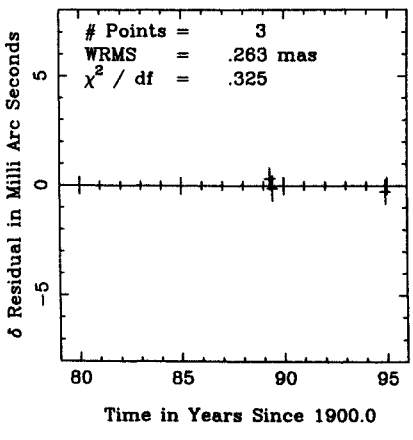
Arc Solution for 0420+417 : δ



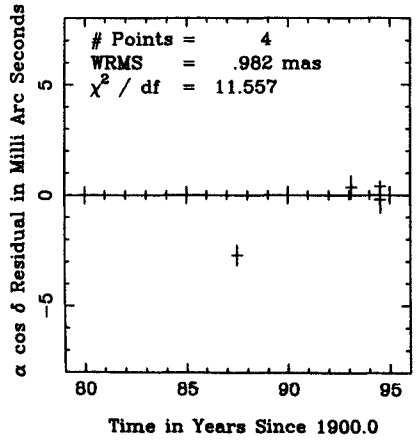
Arc Solution for 0426−380 : $\alpha \cos \delta$



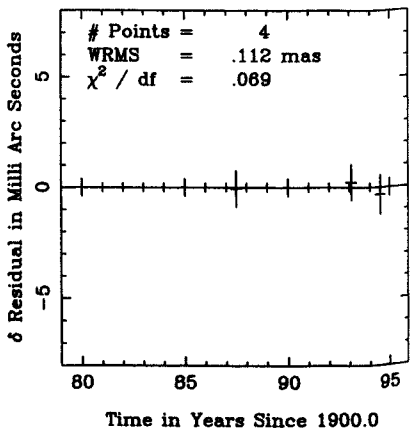
Arc Solution for 0426−380 : δ



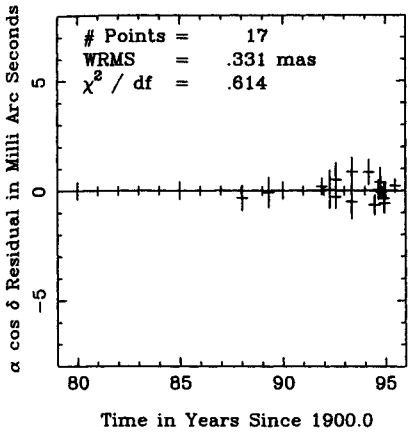
Arc Solution for 0430+052 : $\alpha \cos \delta$



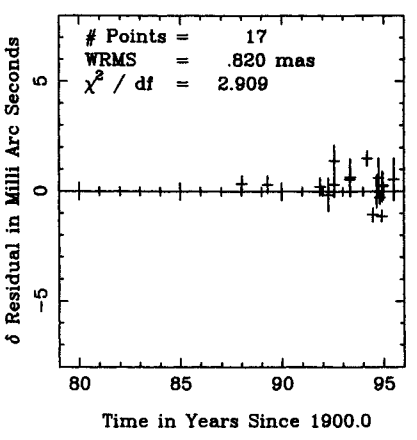
Arc Solution for 0430+052 : δ



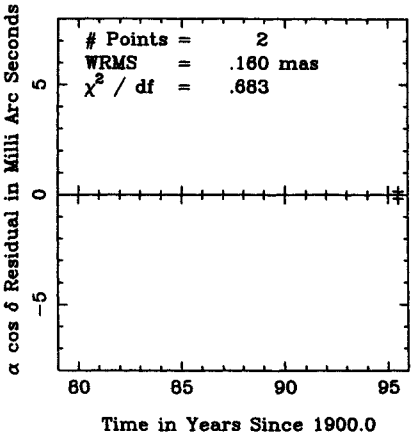
Arc Solution for 0434−188 : α cos δ



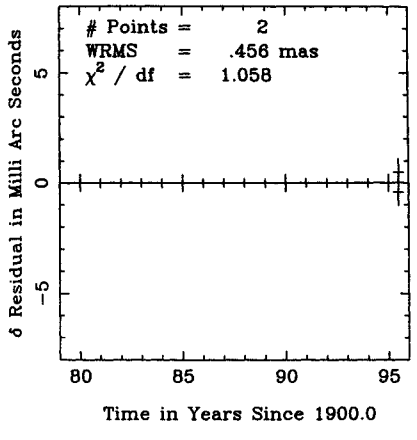
Arc Solution for 0434−188 : δ



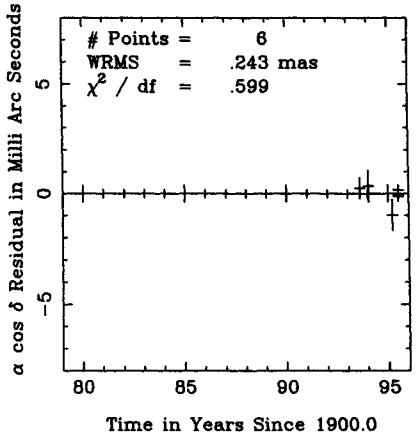
Arc Solution for 0437−454 : α cos δ



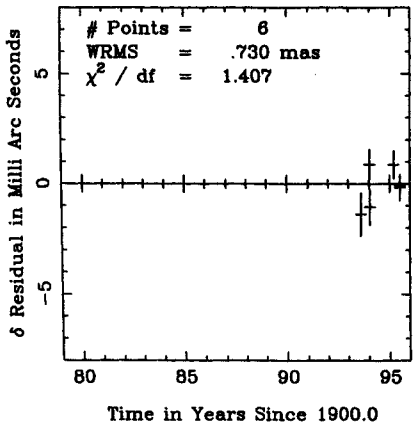
Arc Solution for 0437−454 : δ



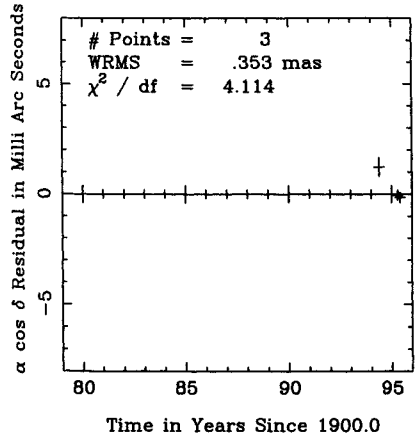
Arc Solution for 0438−436 : α cos δ



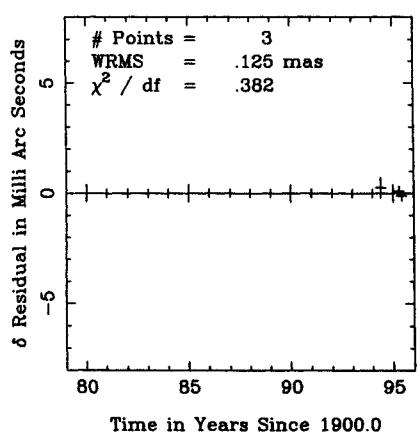
Arc Solution for 0438−436 : δ



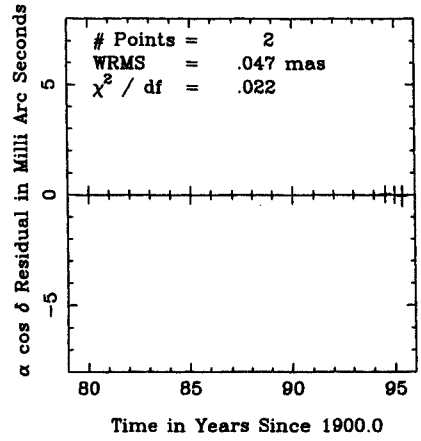
Arc Solution for 0440+345 : α cos δ



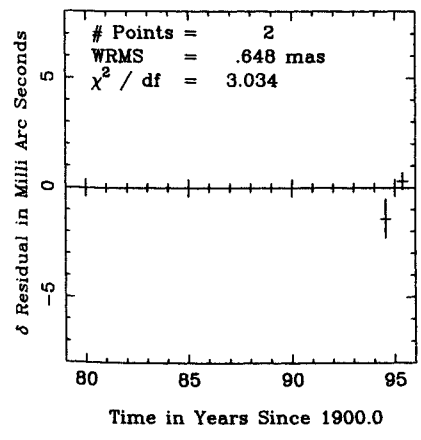
Arc Solution for 0440+345 : δ



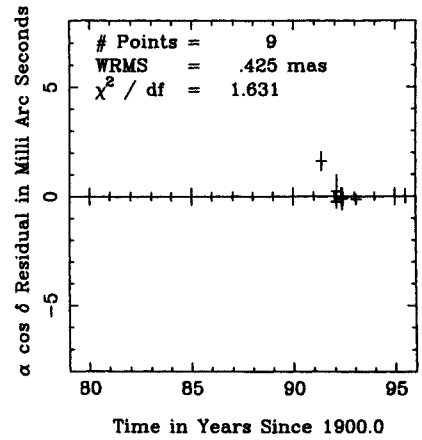
Arc Solution for 0446+112 : α cos δ



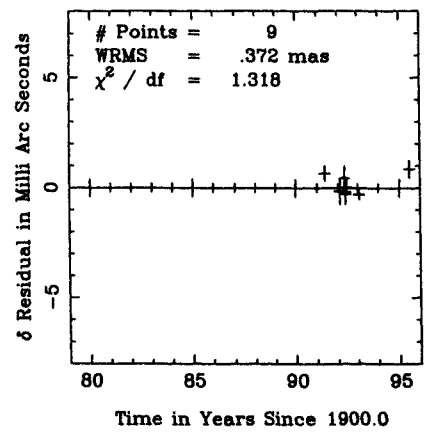
Arc Solution for 0446+112 : δ



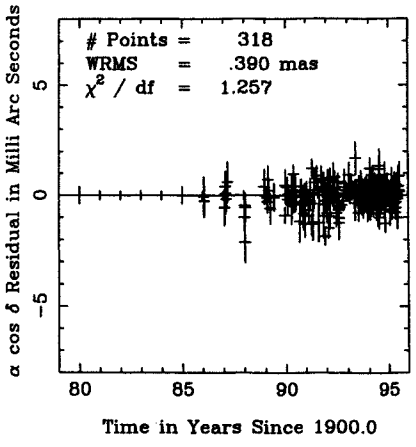
Arc Solution for 0454−810 : α cos δ



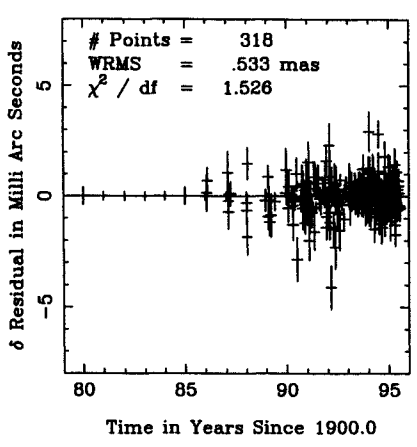
Arc Solution for 0454−810 : δ



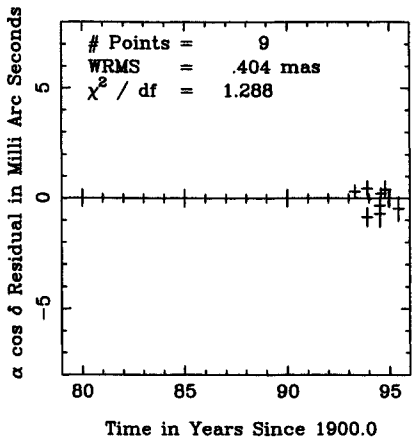
Arc Solution for 0454−234 : α cos δ



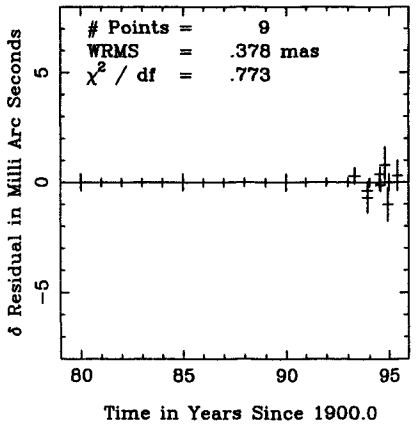
Arc Solution for 0454−234 : δ



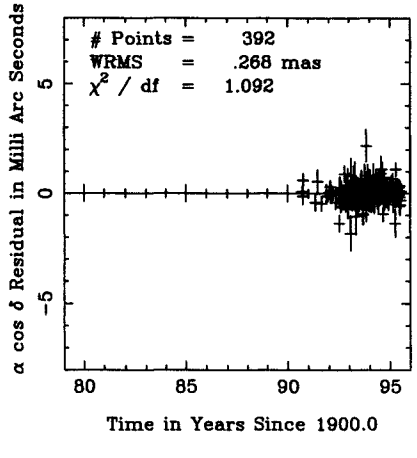
Arc Solution for 0457+024 : α cos δ



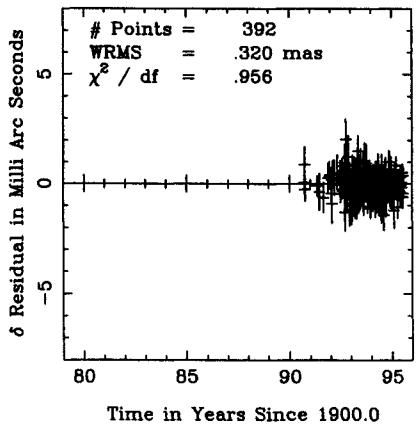
Arc Solution for 0457+024 : δ



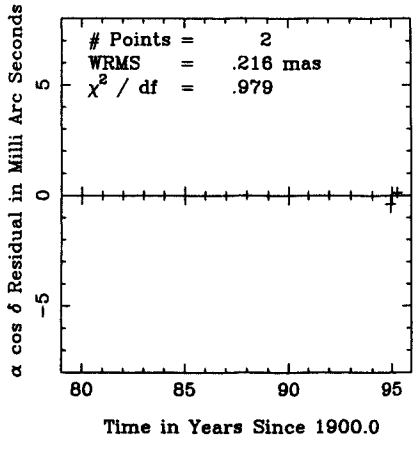
Arc Solution for 0458−020 : α cos δ



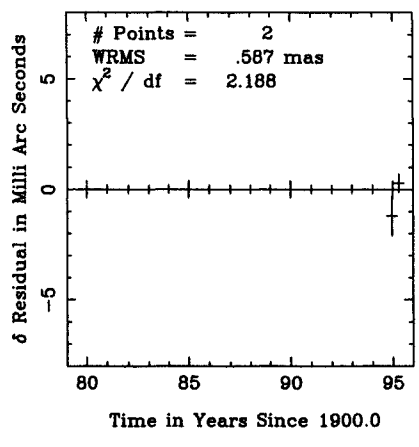
Arc Solution for 0458−020 : δ



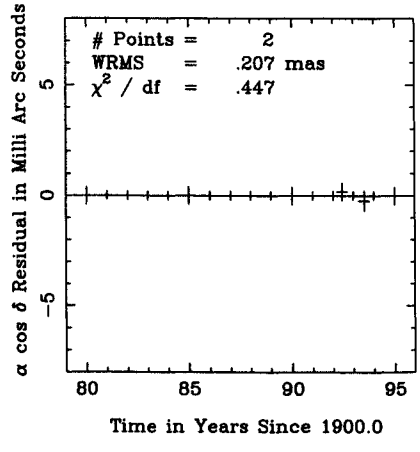
Arc Solution for 0459+060 : α cos δ



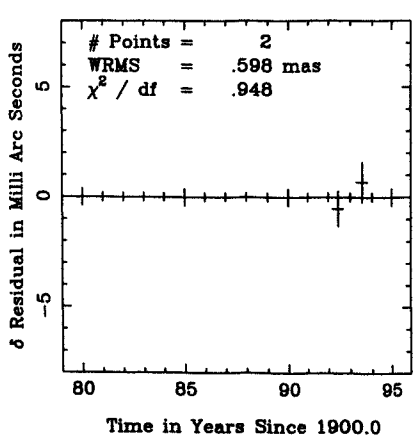
Arc Solution for 0459+060 : δ



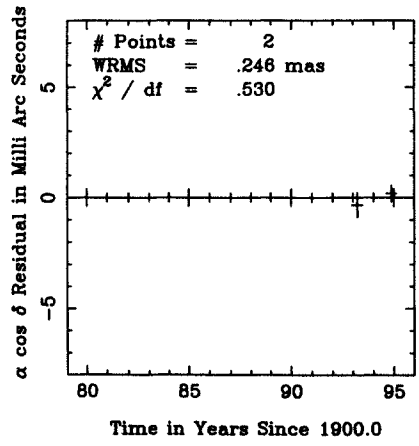
Arc Solution for 0500+019 : α cos δ



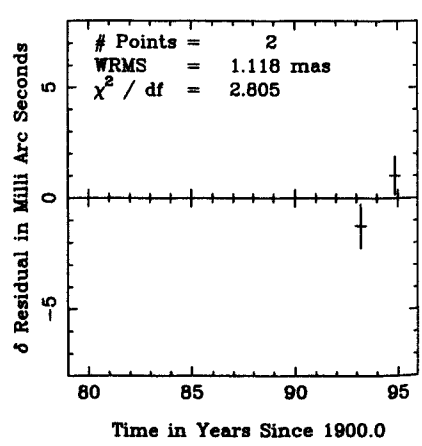
Arc Solution for 0500+019 : δ



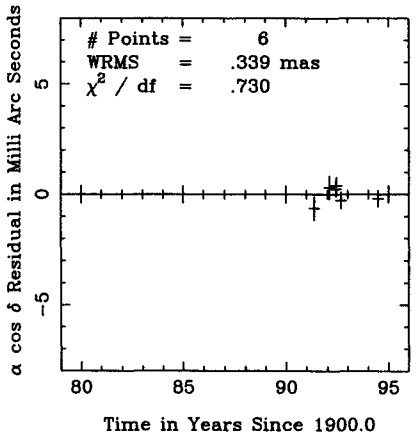
Arc Solution for 0502+049 : α cos δ



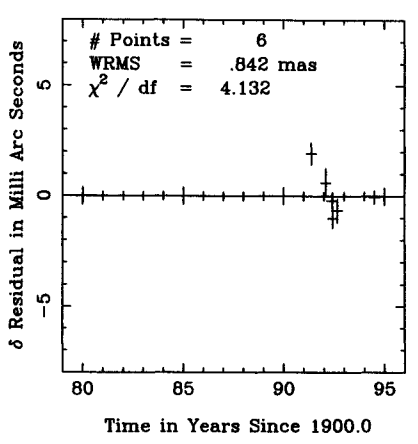
Arc Solution for 0502+049 : δ



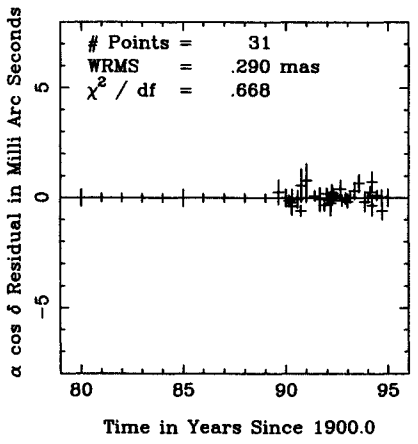
Arc Solution for 0506−612 : α cos δ



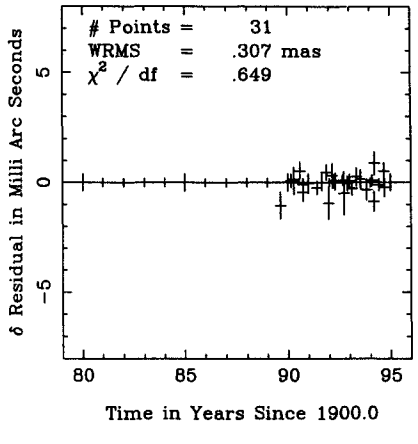
Arc Solution for 0506−612 : δ



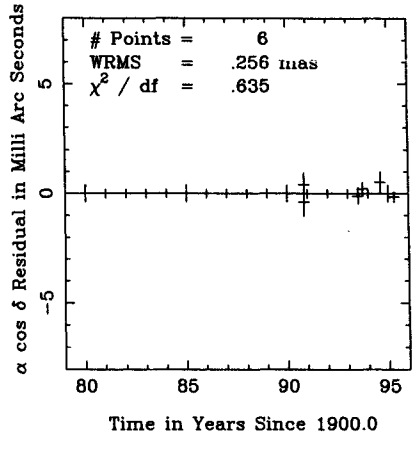
Arc Solution for 0454+844 : α cos δ



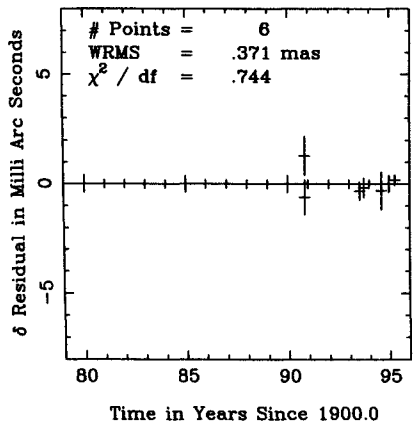
Arc Solution for 0454+844 : δ



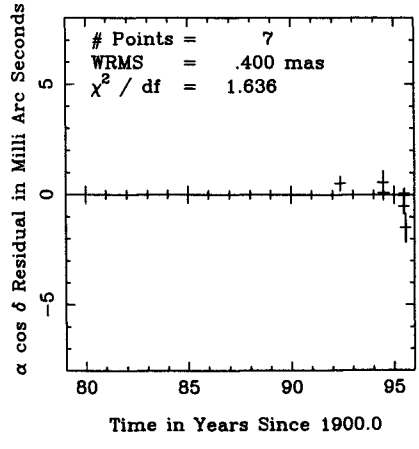
Arc Solution for 0507+179 : α cos δ



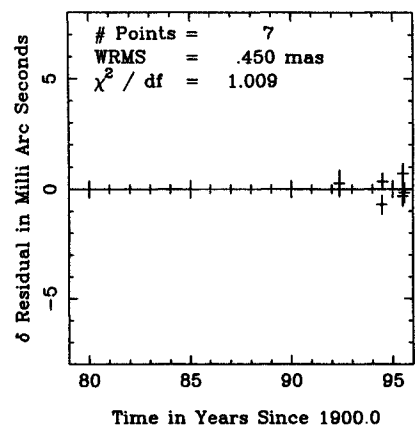
Arc Solution for 0507+179 : δ



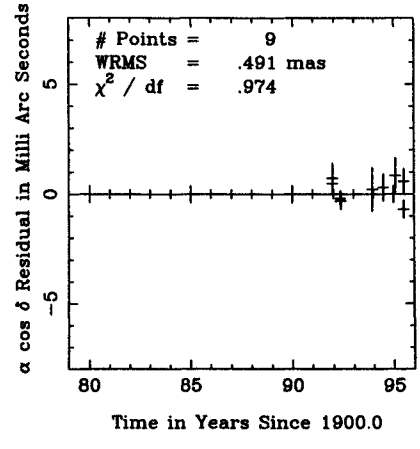
Arc Solution for 0516−621 : α cos δ



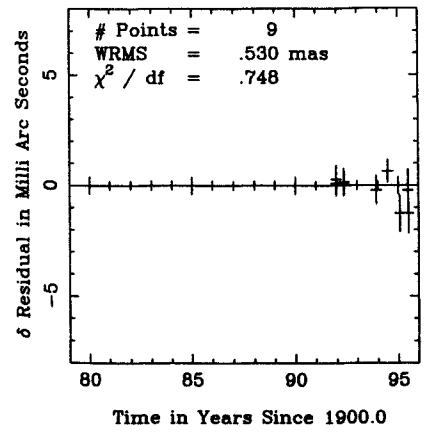
Arc Solution for 0516−621 : δ



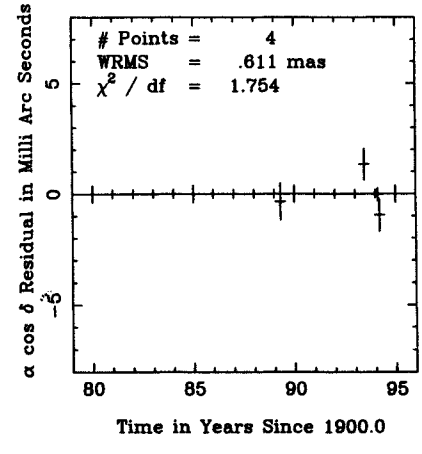
Arc Solution for 0530−727 : α cos δ



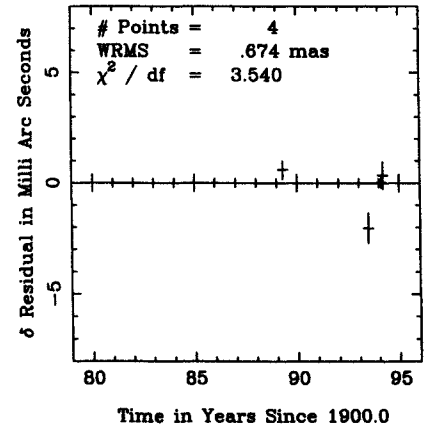
Arc Solution for 0530−727 : δ



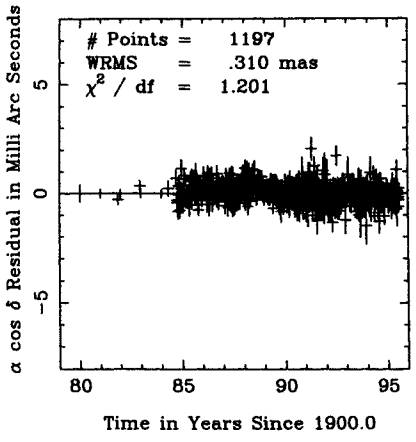
Arc Solution for 0528−250 : α cos δ



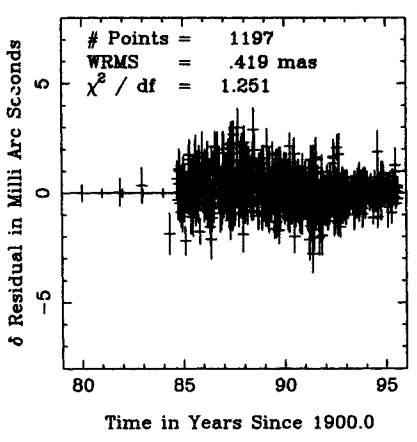
Arc Solution for 0528−250 : δ



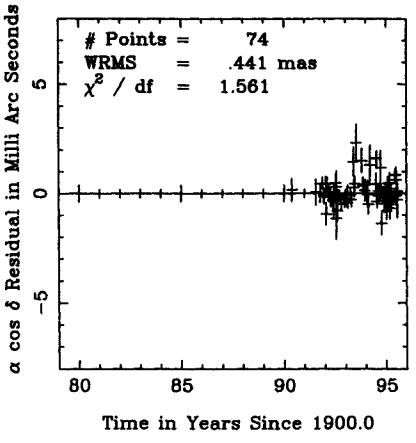
Arc Solution for 0528+134 : α cos δ



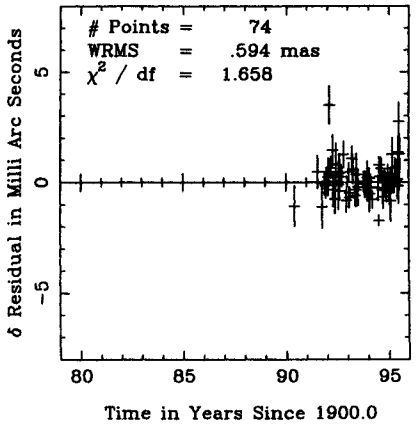
Arc Solution for 0528+134 : δ



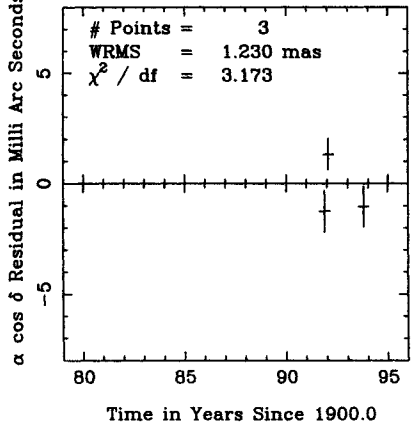
Arc Solution for 0537−441 : α cos δ



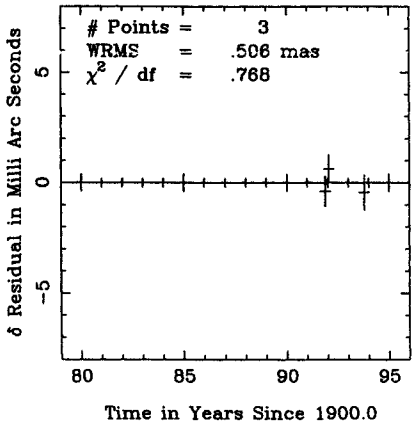
Arc Solution for 0537−441 : δ



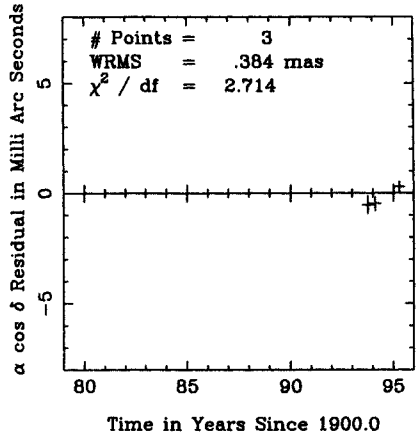
Arc Solution for 0537−286 : α cos δ



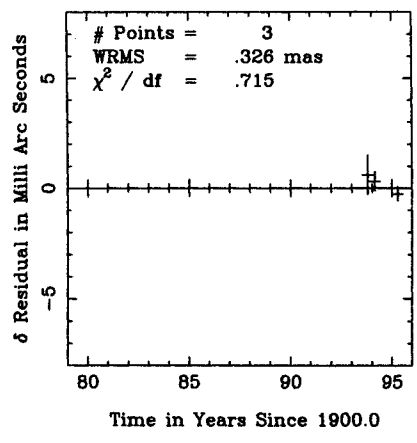
Arc Solution for 0537−286 : δ



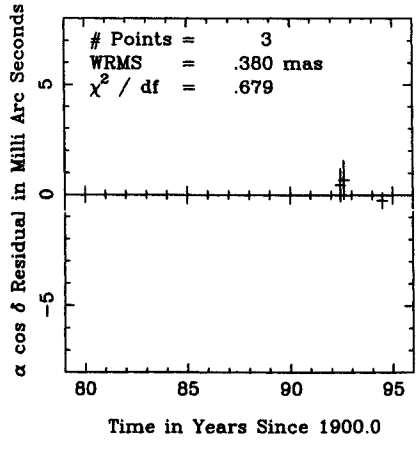
Arc Solution for 0539−057 : α cos δ



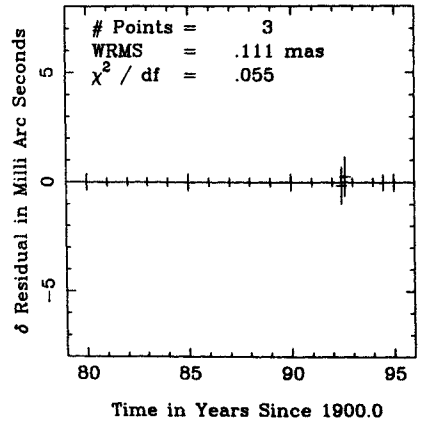
Arc Solution for 0539−057 : δ



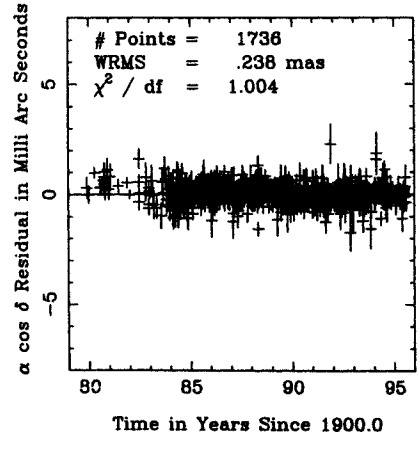
Arc Solution for 0538+498 : α cos δ



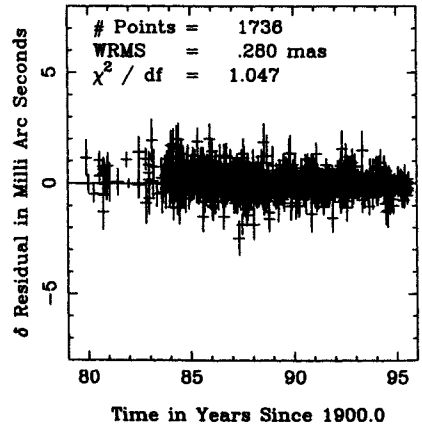
Arc Solution for 0538+498 : δ



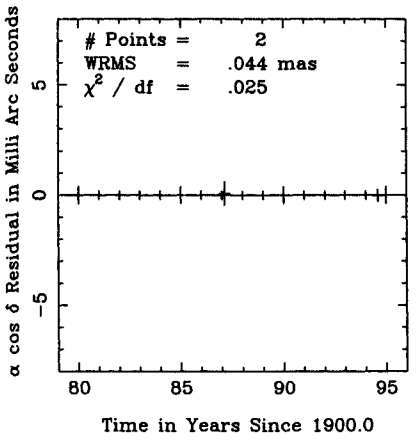
Arc Solution for 0552+398 : α cos δ



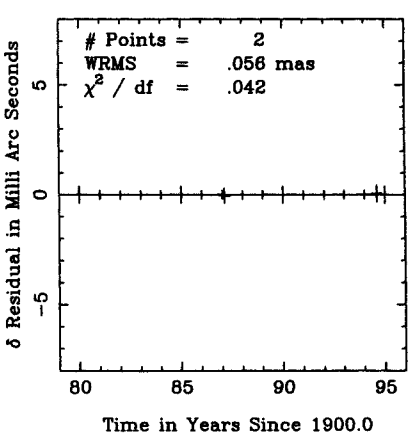
Arc Solution for 0552+398 : δ



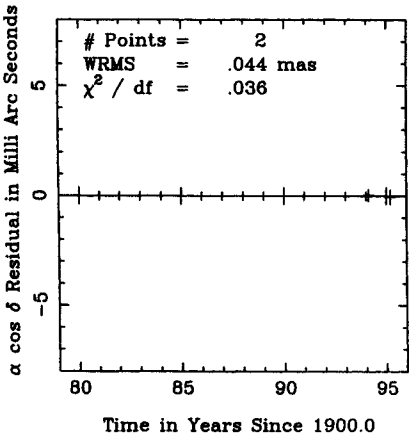
Arc Solution for 0605−085 : α cos δ



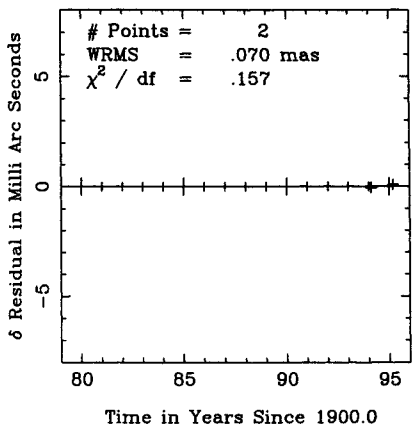
Arc Solution for 0605−085 : δ



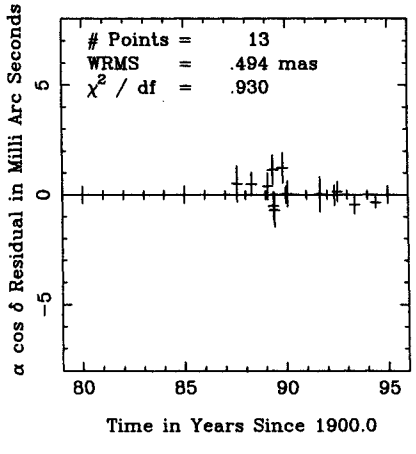
Arc Solution for 0607−157 : α cos δ



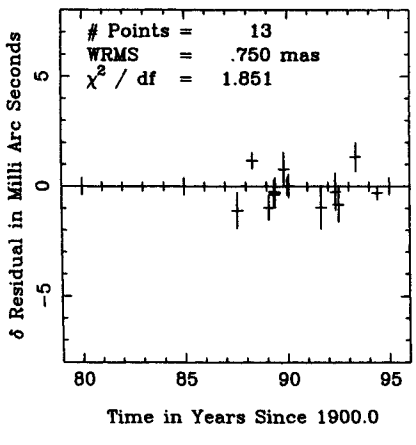
Arc Solution for 0607−157 : δ



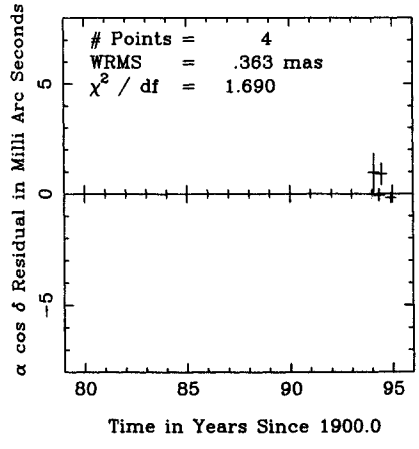
Arc Solution for 0609+607 : α cos δ



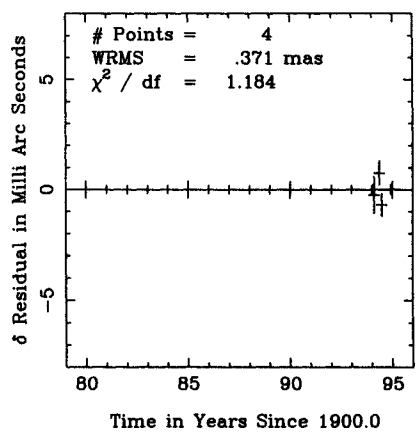
Arc Solution for 0609+607 : δ



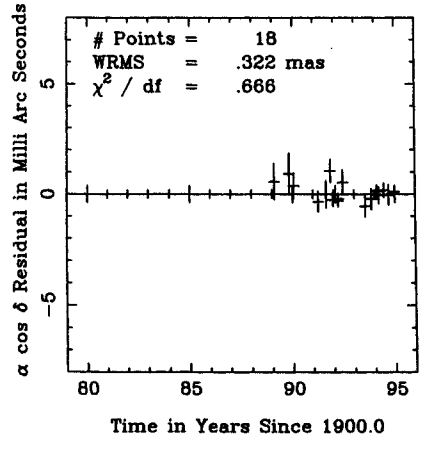
Arc Solution for 0620+389 : α cos δ



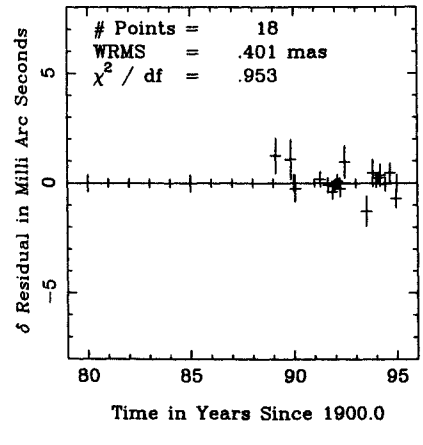
Arc Solution for 0620+389 : δ



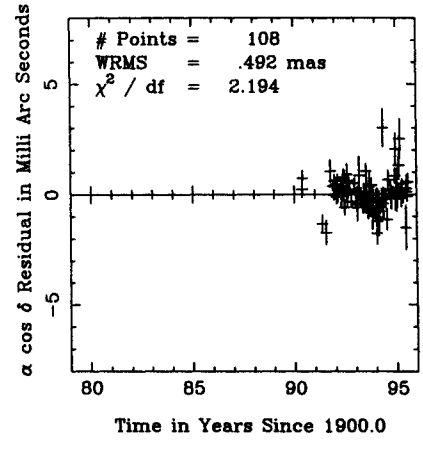
Arc Solution for 0615+820 : α cos δ



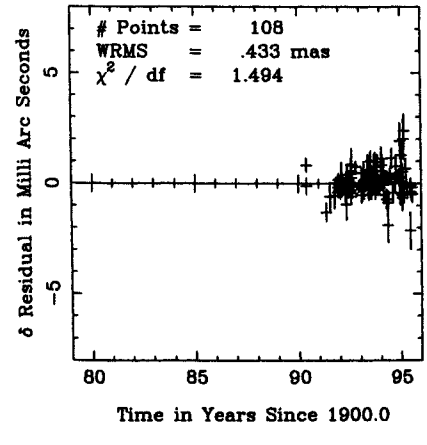
Arc Solution for 0615+820 : δ



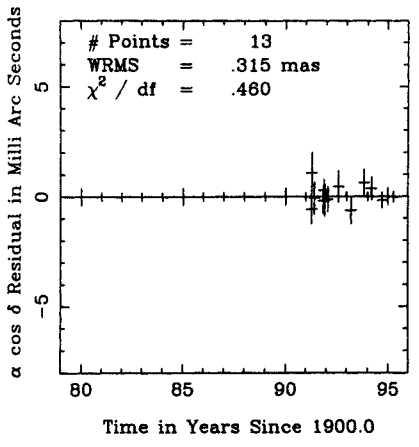
Arc Solution for 0637−752 : α cos δ



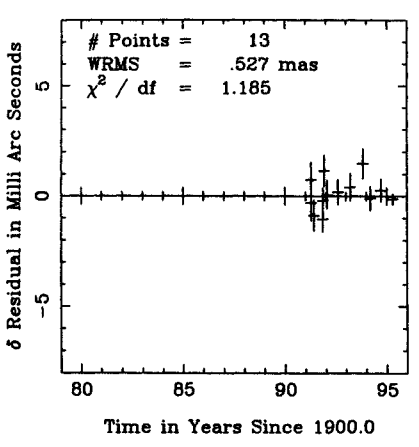
Arc Solution for 0637−752 : δ



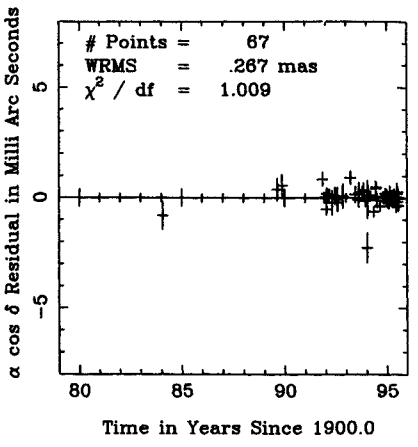
Arc Solution for 0636+680 : $\alpha \cos \delta$



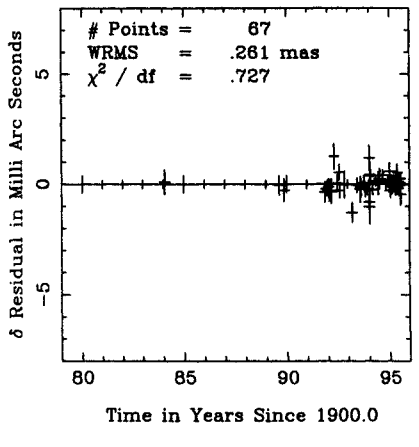
Arc Solution for 0636+680 : δ



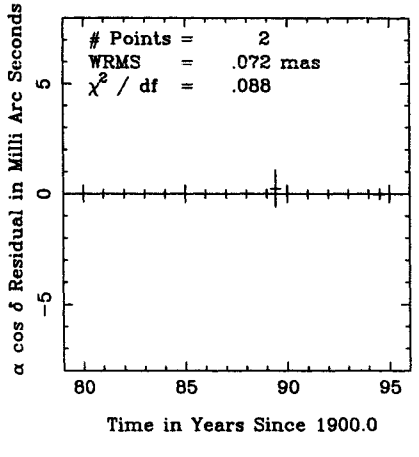
Arc Solution for 0642+449 : $\alpha \cos \delta$



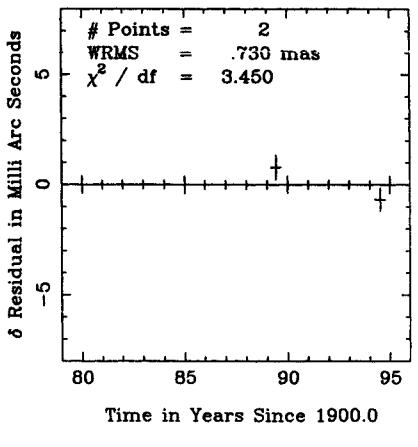
Arc Solution for 0642+449 : δ



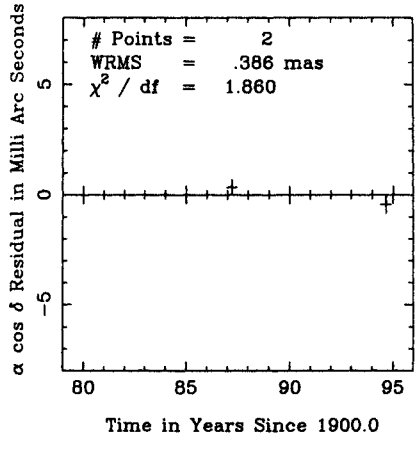
Arc Solution for 0646−306 : $\alpha \cos \delta$



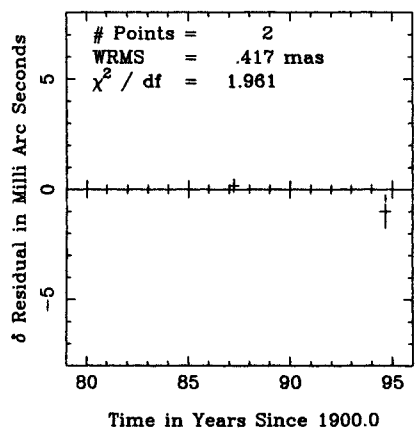
Arc Solution for 0646−306 : δ



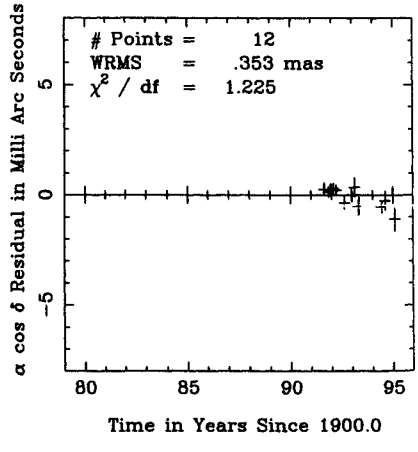
Arc Solution for 0648−165 : $\alpha \cos \delta$



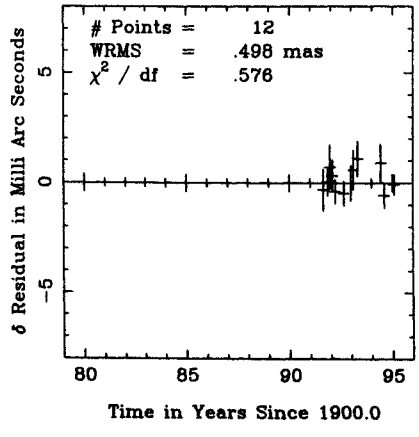
Arc Solution for 0648−165 : δ



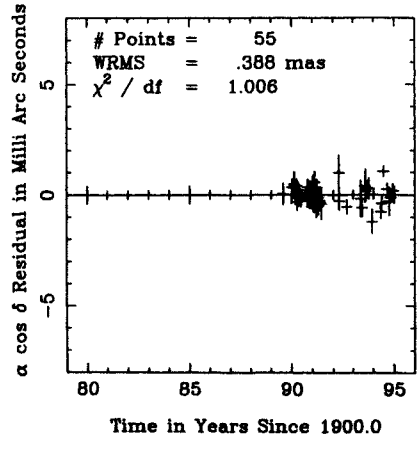
Arc Solution for 0650+371 : $\alpha \cos \delta$



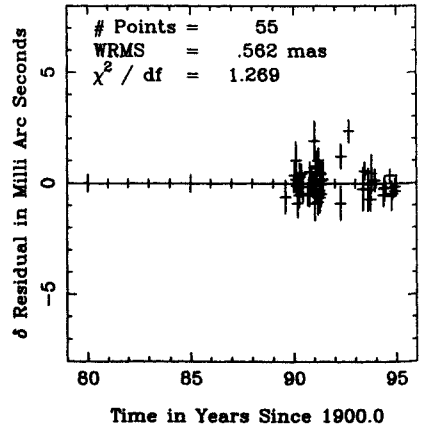
Arc Solution for 0650+371 : δ



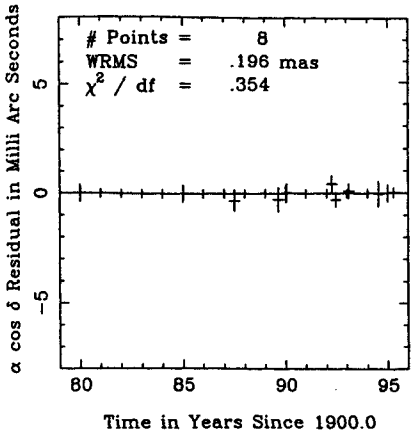
Arc Solution for 0657+172 : $\alpha \cos \delta$



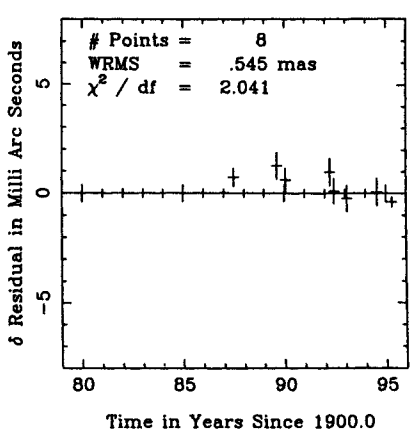
Arc Solution for 0657+172 : δ



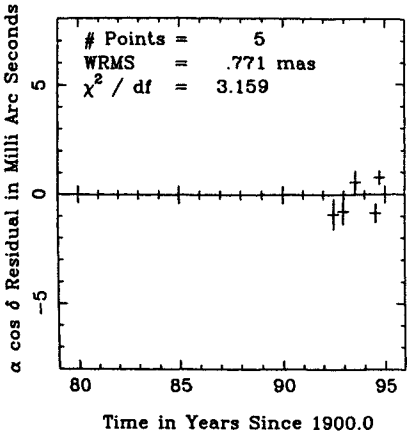
Arc Solution for 0707+476 : α cos δ



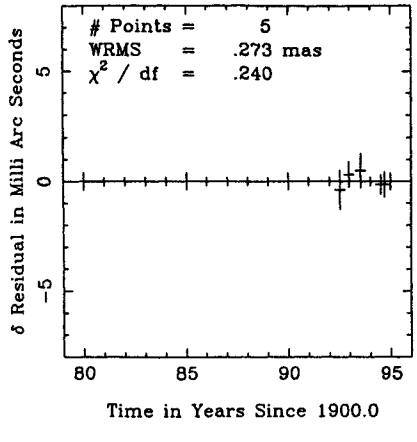
Arc Solution for 0707+476 : δ



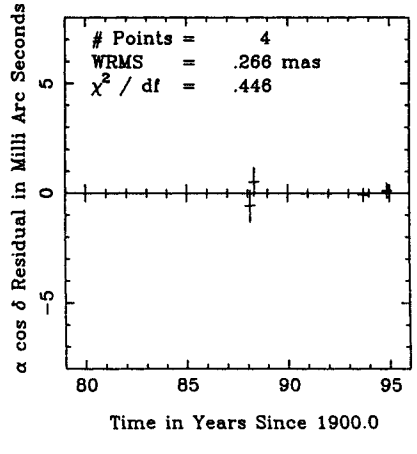
Arc Solution for 0710+439 : α cos δ



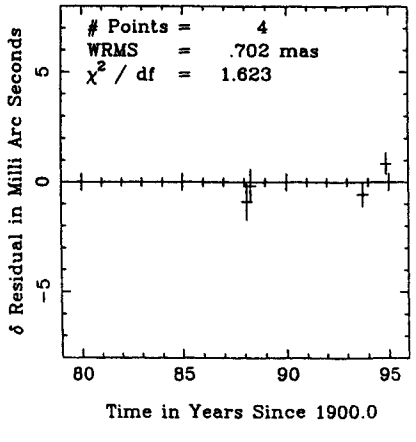
Arc Solution for 0710+439 : δ



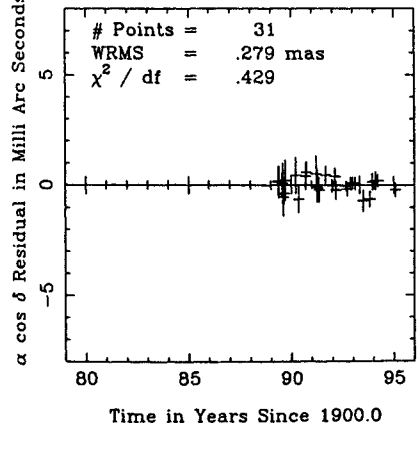
Arc Solution for 0711+356 : α cos δ



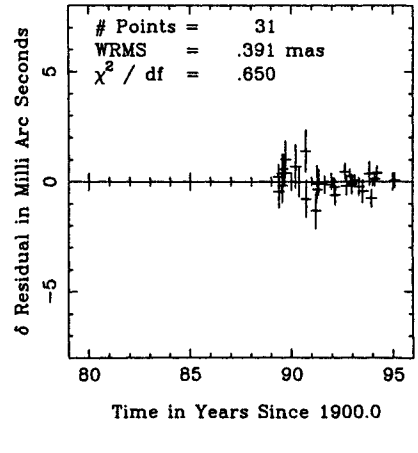
Arc Solution for 0711+356 : δ



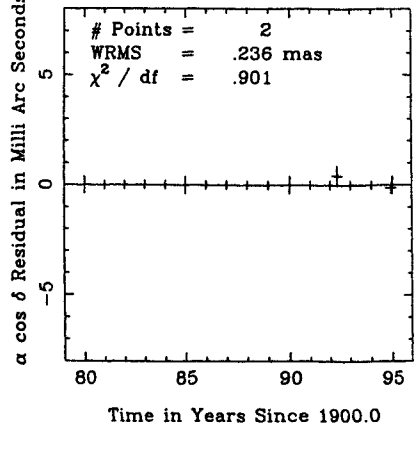
Arc Solution for 0716+714 : α cos δ



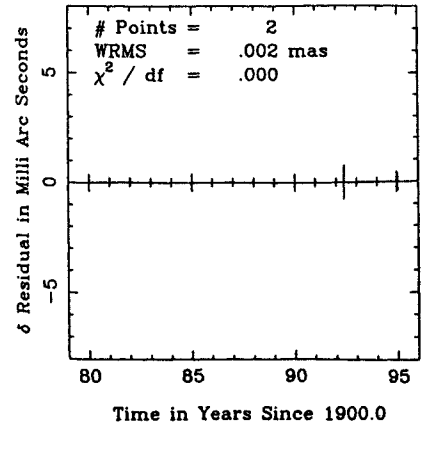
Arc Solution for 0716+714 : δ



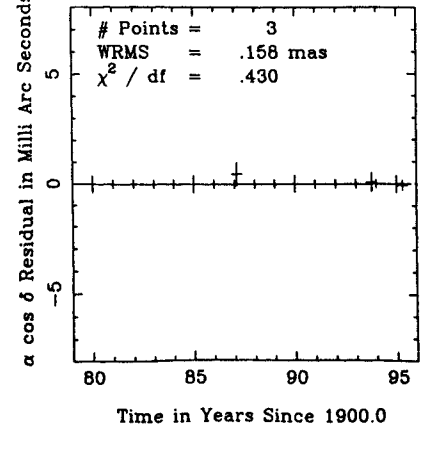
Arc Solution for 0722+145 : α cos δ



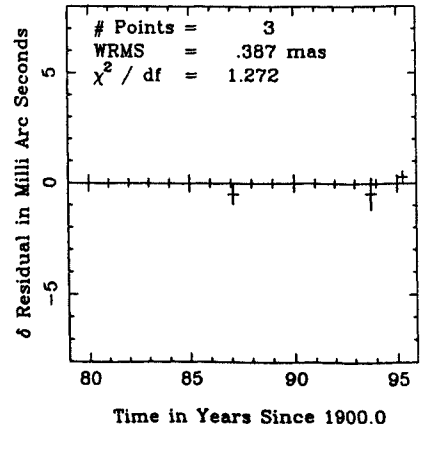
Arc Solution for 0722+145 : δ



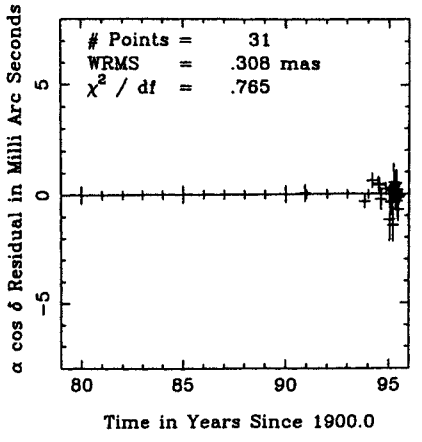
Arc Solution for 0723−008 : α cos δ



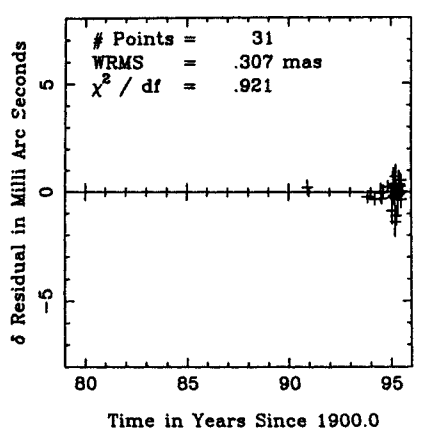
Arc Solution for 0723−008 : δ



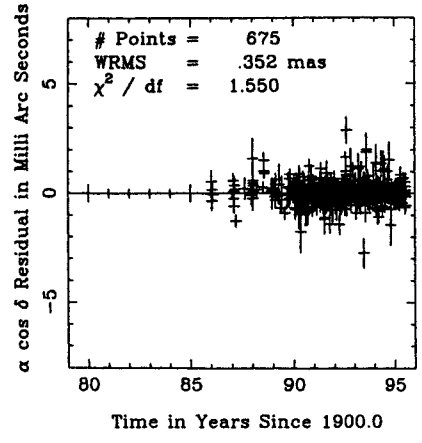
Arc Solution for 0718+792 : $\alpha \cos \delta$



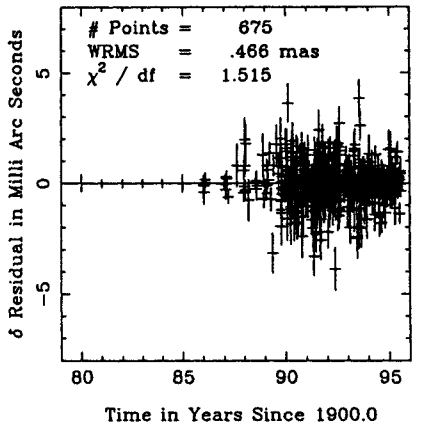
Arc Solution for 0718+792 : δ



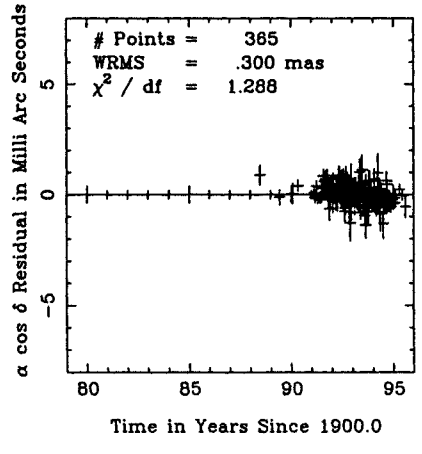
Arc Solution for 0727−115 : $\alpha \cos \delta$



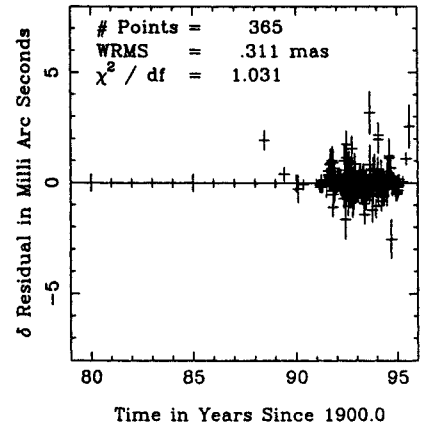
Arc Solution for 0727−115 : δ



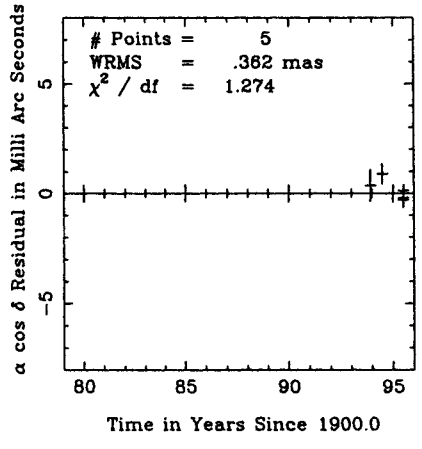
Arc Solution for 0735+178 : $\alpha \cos \delta$



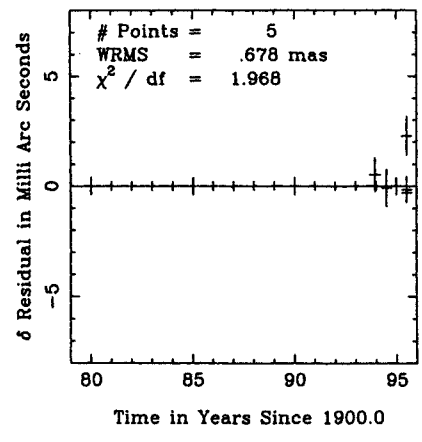
Arc Solution for 0735+178 : δ



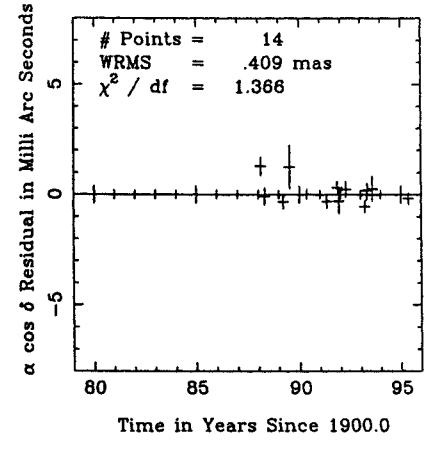
Arc Solution for 0738−674 : $\alpha \cos \delta$



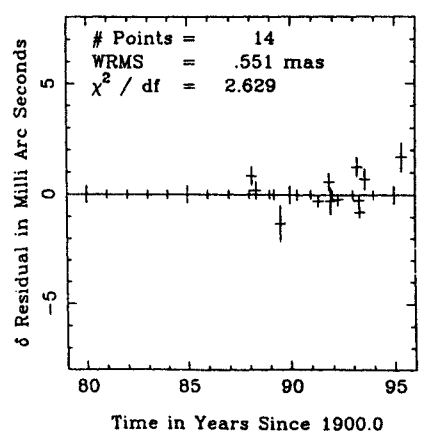
Arc Solution for 0738−674 : δ



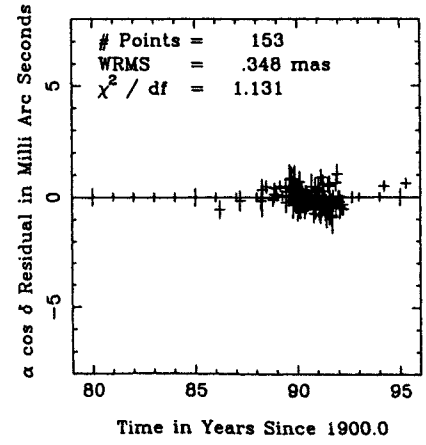
Arc Solution for 0738+313 : $\alpha \cos \delta$



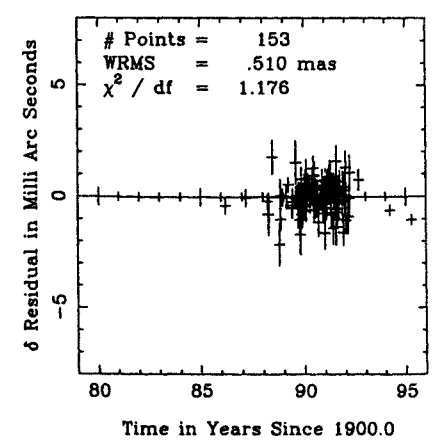
Arc Solution for 0738+313 : δ

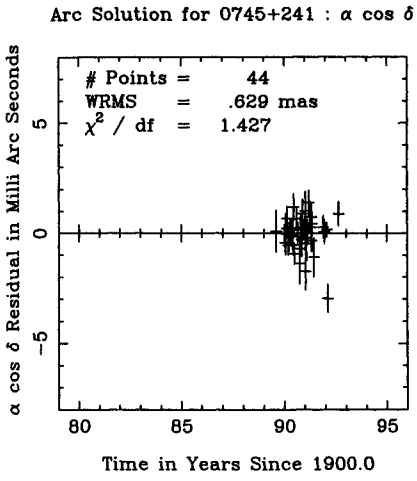


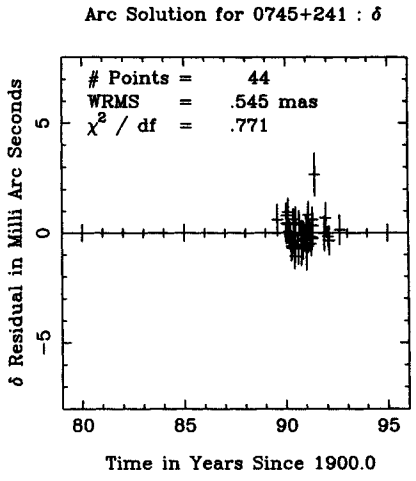
Arc Solution for 0742+103 : $\alpha \cos \delta$

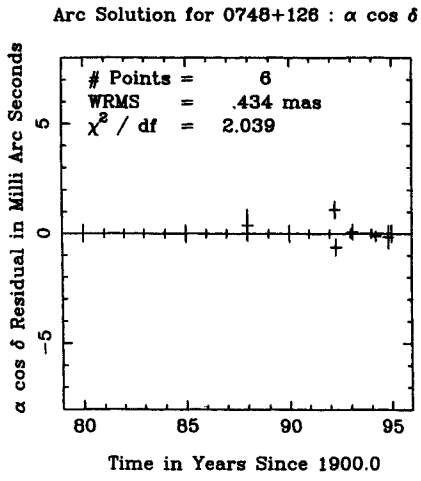


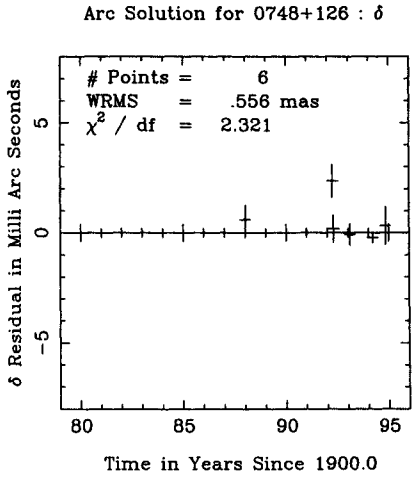
Arc Solution for 0742+103 : δ

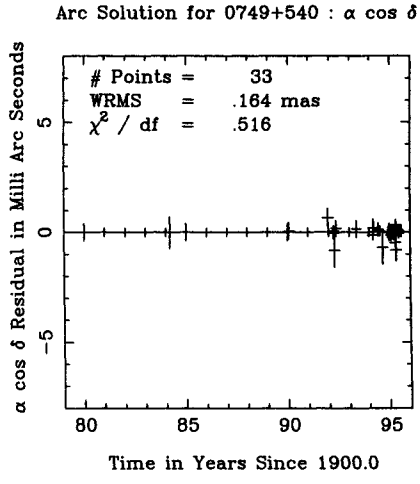


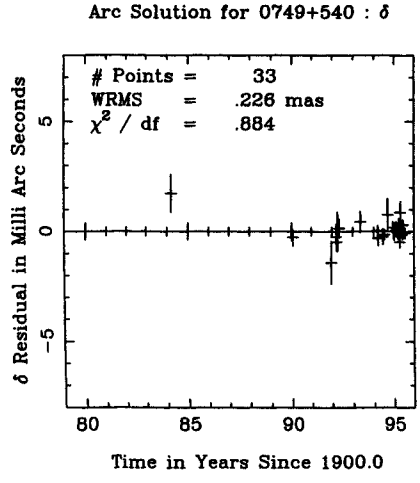

Arc Solution for 0745+241 : α cos δ
# Points = 44
WRMS = .629 mas
χ² / df = 1.427
α cos δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

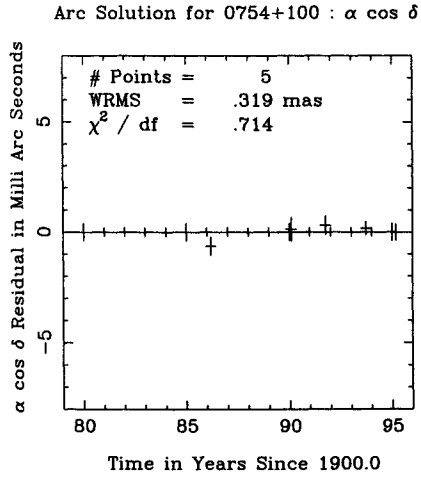

Arc Solution for 0745+241 : δ
# Points = 44
WRMS = .545 mas
χ² / df = .771
δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

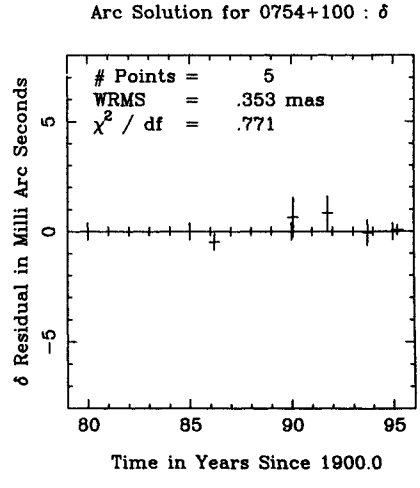

Arc Solution for 0748+126 : α cos δ
# Points = 6
WRMS = .434 mas
χ² / df = 2.039
α cos δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

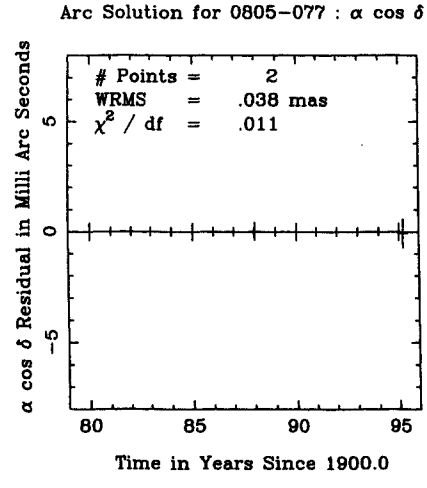

Arc Solution for 0748+126 : δ
# Points = 6
WRMS = .556 mas
χ² / df = 2.321
δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

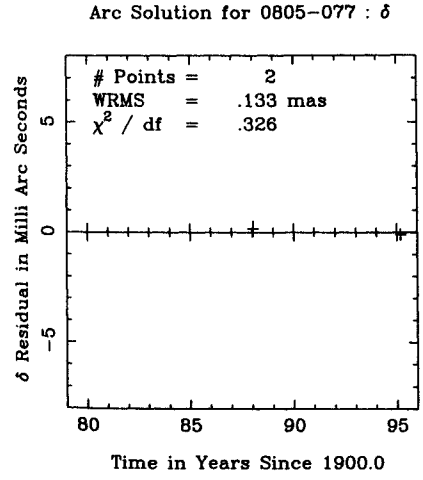

Arc Solution for 0749+540 : α cos δ
# Points = 33
WRMS = .164 mas
χ² / df = .516
α cos δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

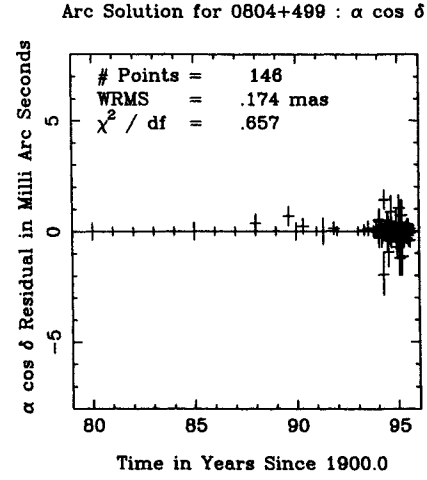

Arc Solution for 0749+540 : δ
# Points = 33
WRMS = .226 mas
χ² / df = .884
δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

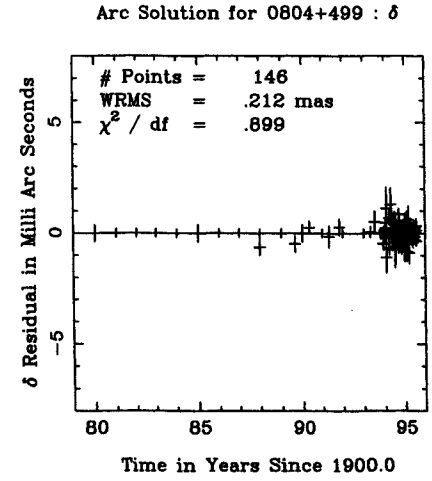

Arc Solution for 0754+100 : α cos δ
# Points = 5
WRMS = .319 mas
χ² / df = .714
α cos δ Residual in Milli Arc Seconds
Time in Years Since 1900.0


Arc Solution for 0754+100 : δ
# Points = 5
WRMS = .353 mas
χ² / df = .771
δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

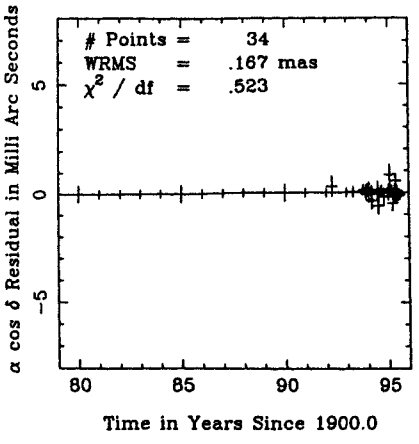

Arc Solution for 0805−077 : α cos δ
# Points = 2
WRMS = .038 mas
χ² / df = .011
α cos δ Residual in Milli Arc Seconds
Time in Years Since 1900.0


Arc Solution for 0805−077 : δ
# Points = 2
WRMS = .133 mas
χ² / df = .326
δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

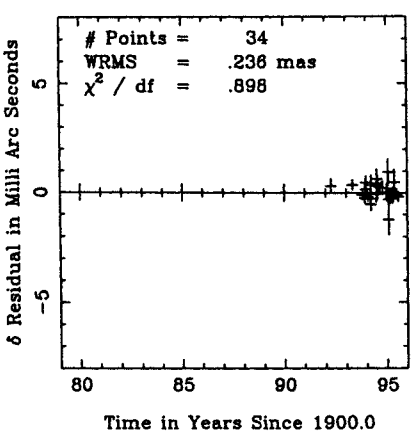

Arc Solution for 0804+499 : α cos δ
# Points = 146
WRMS = .174 mas
χ² / df = .657
α cos δ Residual in Milli Arc Seconds
Time in Years Since 1900.0


Arc Solution for 0804+499 : δ
# Points = 146
WRMS = .212 mas
χ² / df = .899
δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

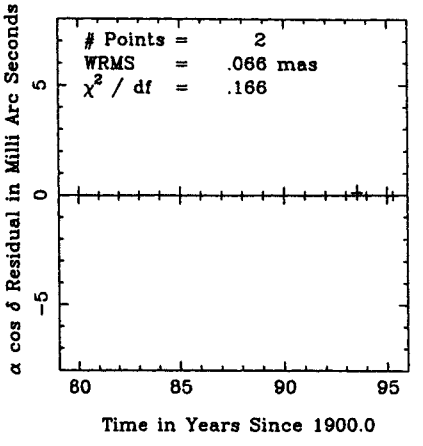
Arc Solution for 0805+410 : $\alpha \cos \delta$



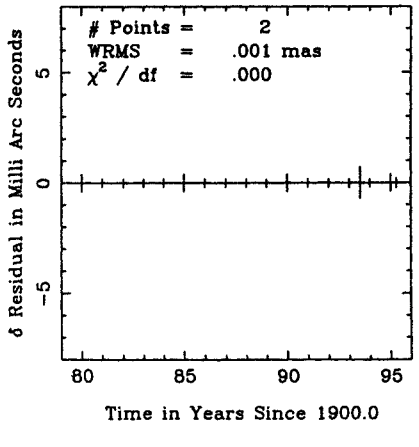
Arc Solution for 0805+410 : δ



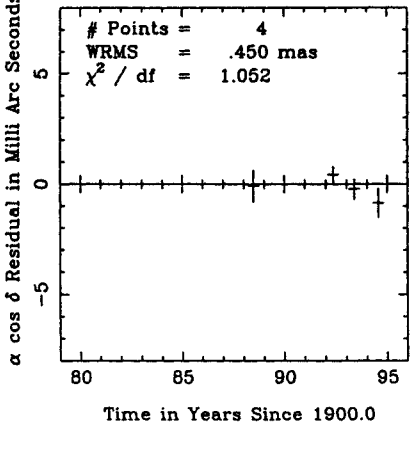
Arc Solution for 0808+019 : $\alpha \cos \delta$



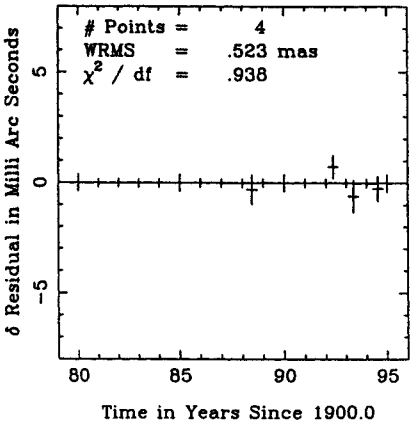
Arc Solution for 0808+019 : δ



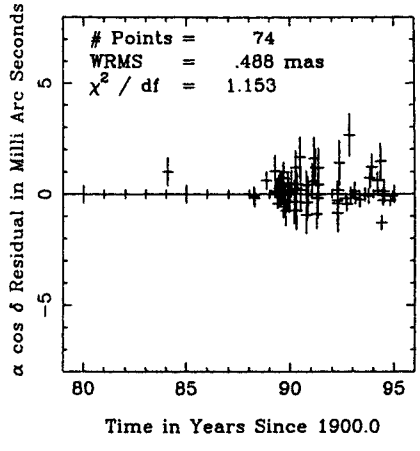
Arc Solution for 0812+367 : $\alpha \cos \delta$



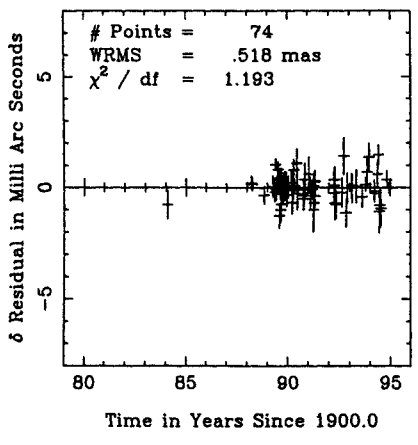
Arc Solution for 0812+367 : δ



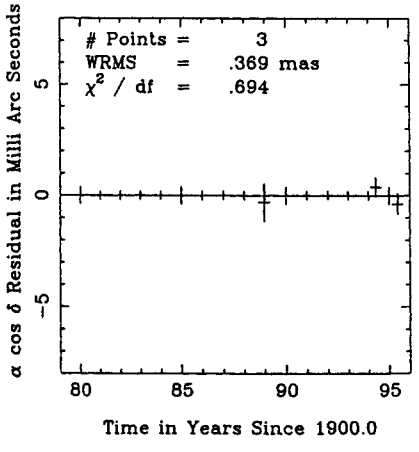
Arc Solution for 0814+425 : $\alpha \cos \delta$



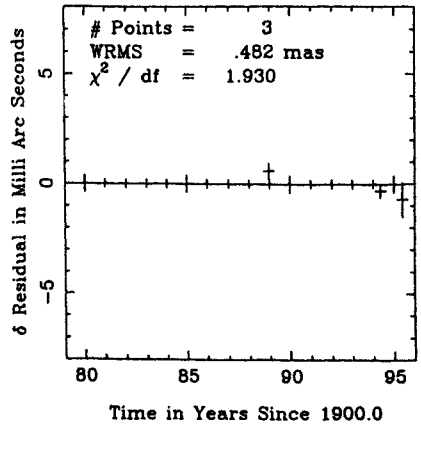
Arc Solution for 0814+425 : δ



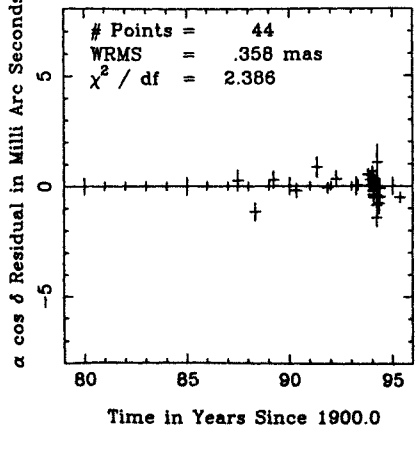
Arc Solution for 0818−128 : $\alpha \cos \delta$



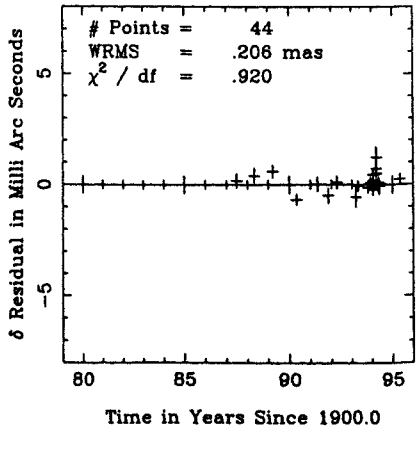
Arc Solution for 0818−128 : δ



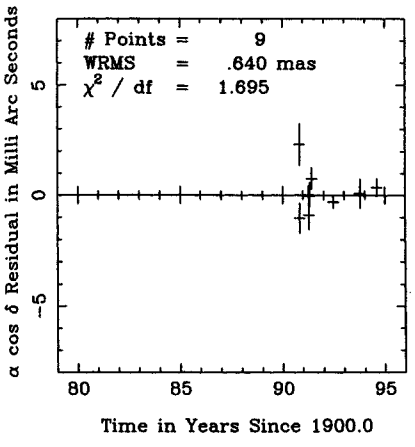
Arc Solution for 0820+560 : $\alpha \cos \delta$



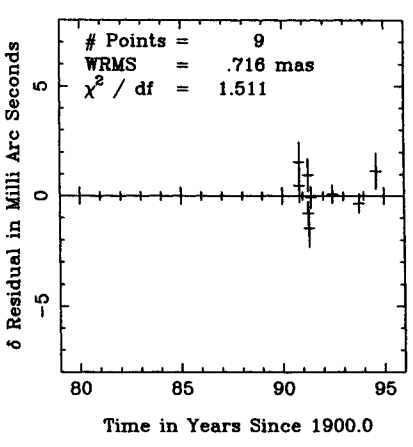
Arc Solution for 0820+560 : δ



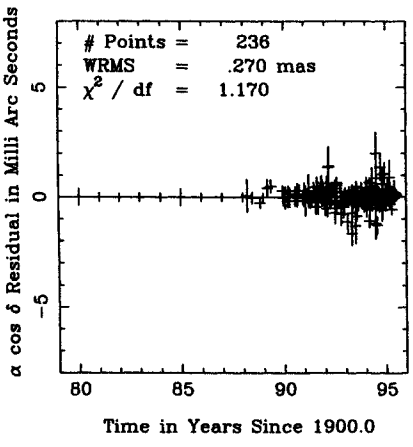
Arc Solution for 0821+394 : $\alpha \cos \delta$



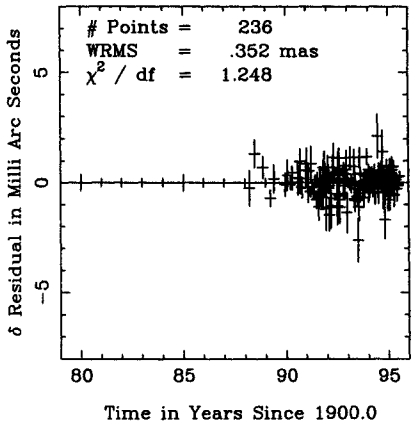
Arc Solution for 0821+394 : δ



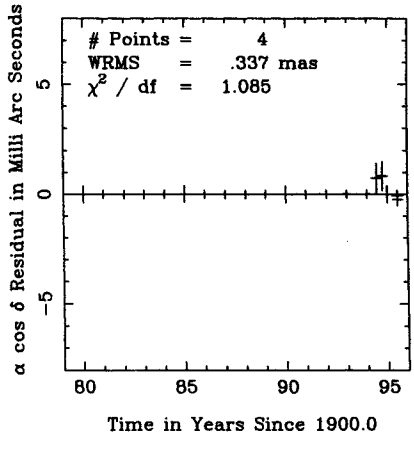
Arc Solution for 0823+033 : $\alpha \cos \delta$



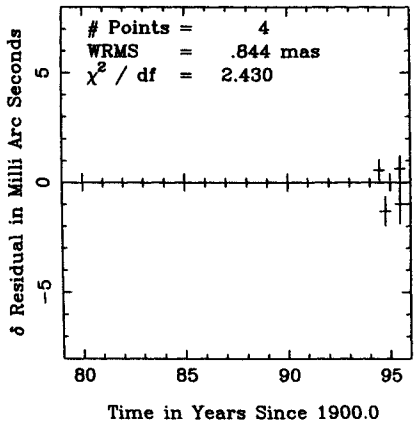
Arc Solution for 0823+033 : δ



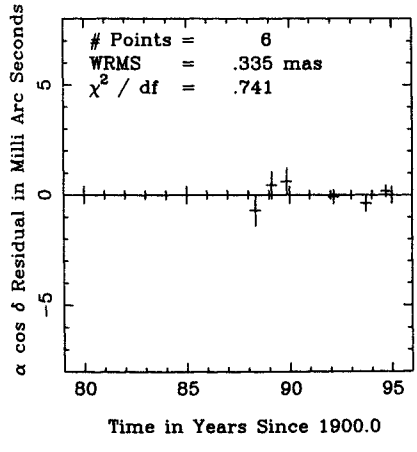
Arc Solution for 0826−373 : $\alpha \cos \delta$



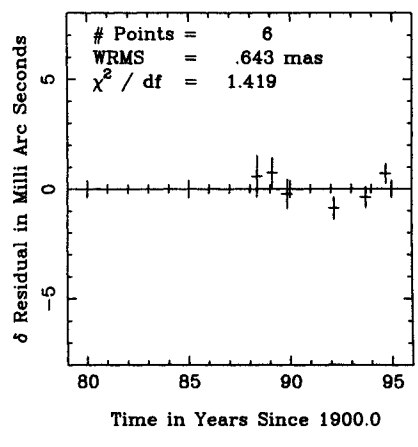
Arc Solution for 0826−373 : δ



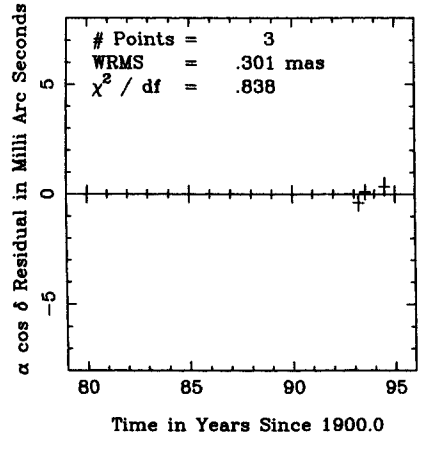
Arc Solution for 0827+243 : $\alpha \cos \delta$



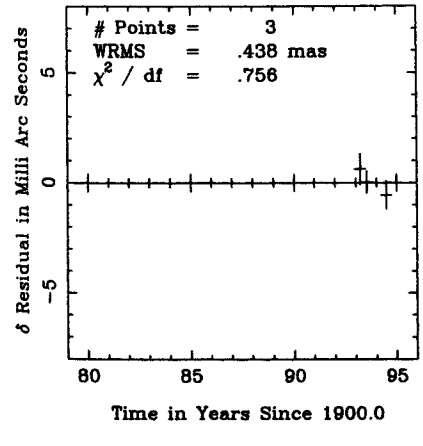
Arc Solution for 0827+243 : δ



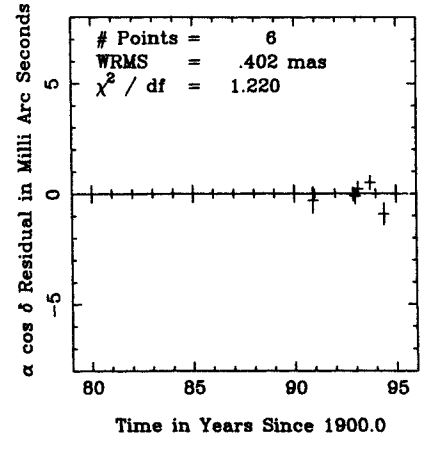
Arc Solution for 0829+046 : $\alpha \cos \delta$



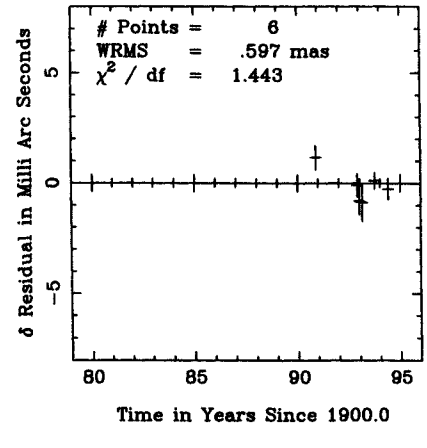
Arc Solution for 0829+046 : δ



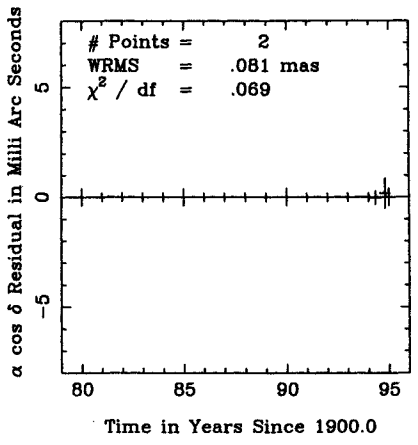
Arc Solution for 0828+493 : $\alpha \cos \delta$



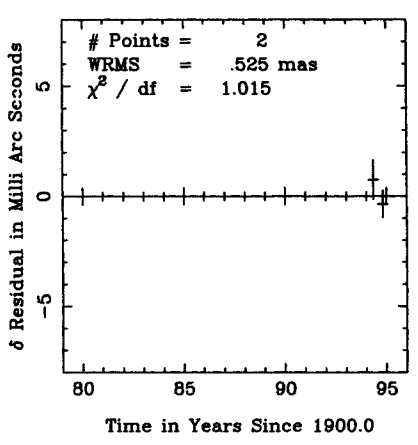
Arc Solution for 0828+493 : δ



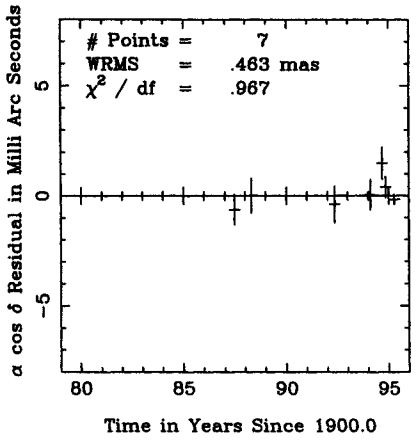
Arc Solution for 0834−201 : α cos δ



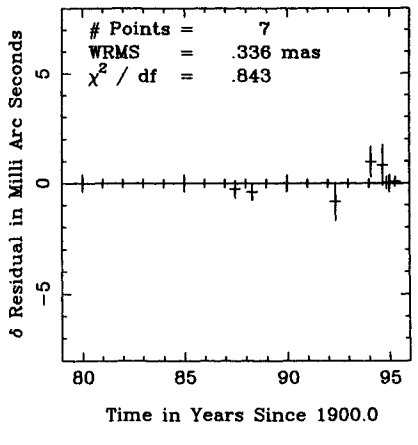
Arc Solution for 0834−201 : δ



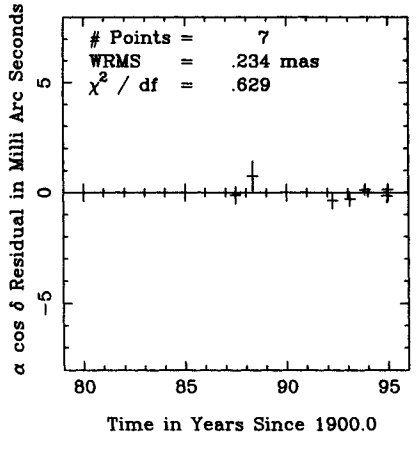
Arc Solution for 0833+585 : α cos δ



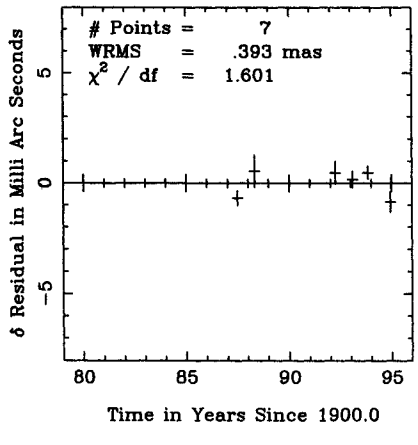
Arc Solution for 0833+585 : δ



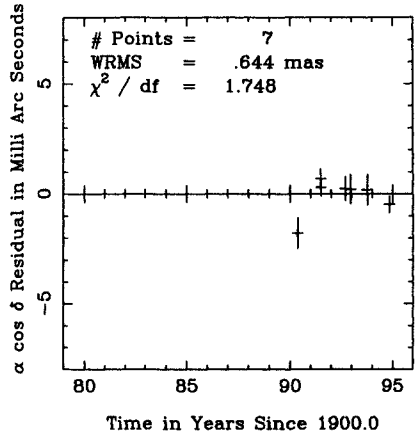
Arc Solution for 0836+710 : α cos δ



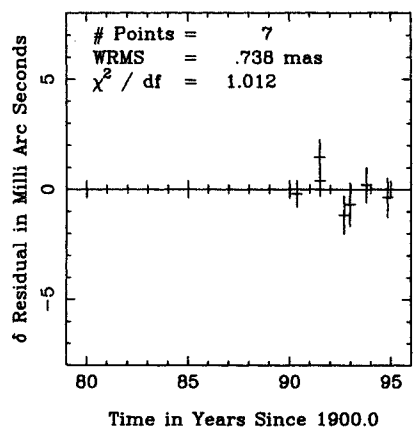
Arc Solution for 0836+710 : δ



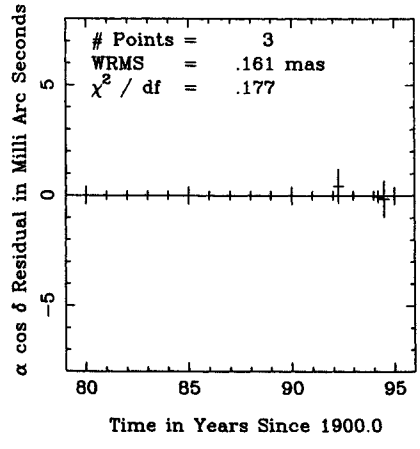
Arc Solution for 0839+187 : α cos δ



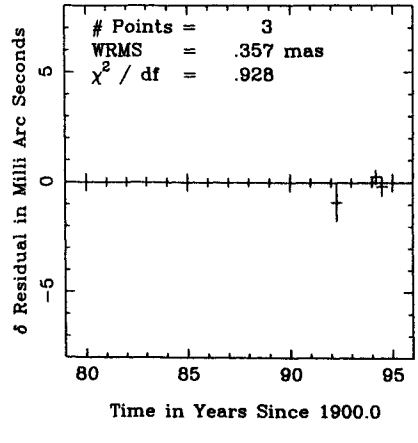
Arc Solution for 0839+187 : δ



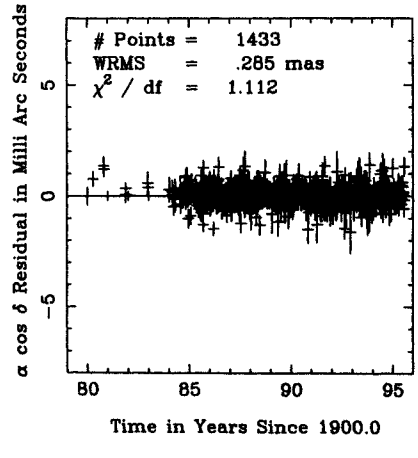
Arc Solution for 0850+581 : α cos δ



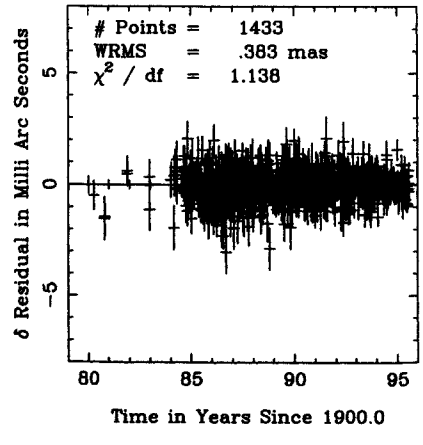
Arc Solution for 0850+581 : δ



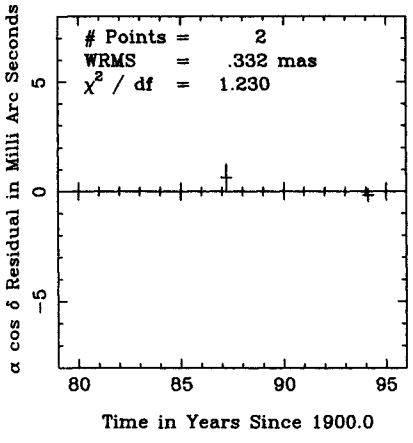
Arc Solution for 0851+202 : α cos δ



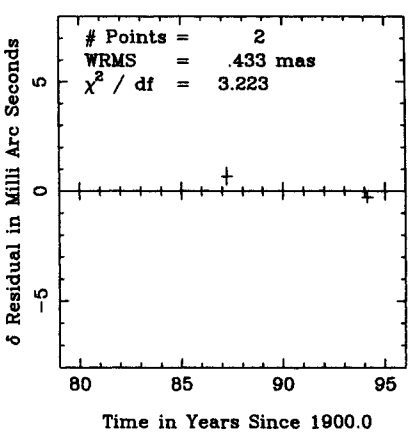
Arc Solution for 0851+202 : δ



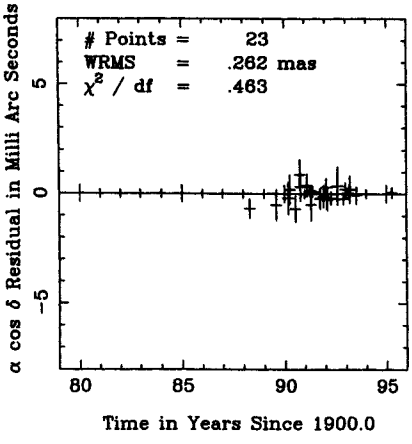
Arc Solution for 0859−140 : α cos δ



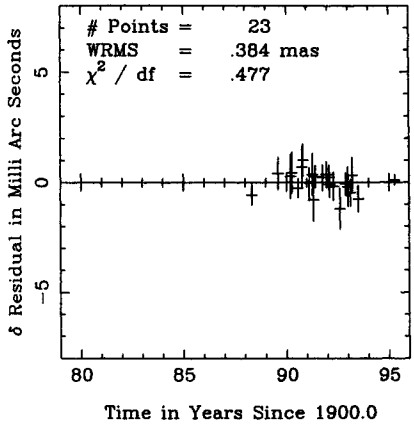
Arc Solution for 0859−140 : δ



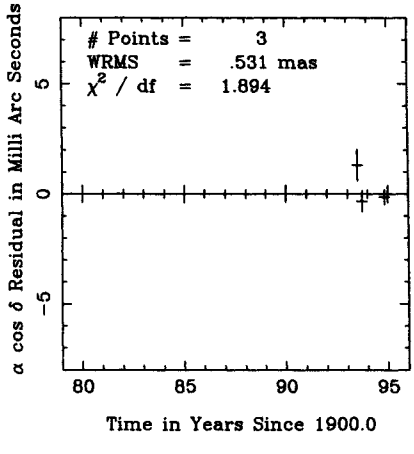
Arc Solution for 0859+470 : α cos δ



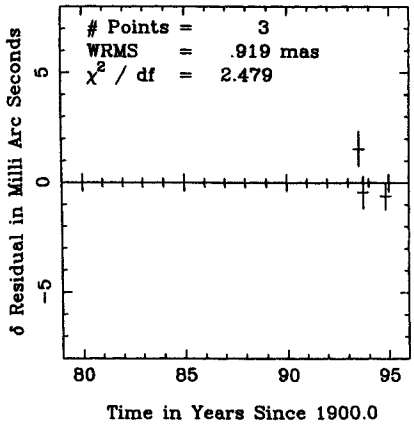
Arc Solution for 0859+470 : δ



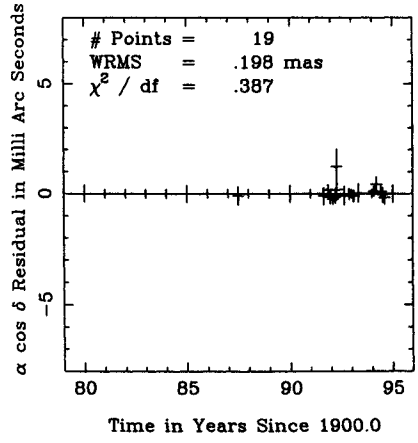
Arc Solution for 0912+297 : α cos δ



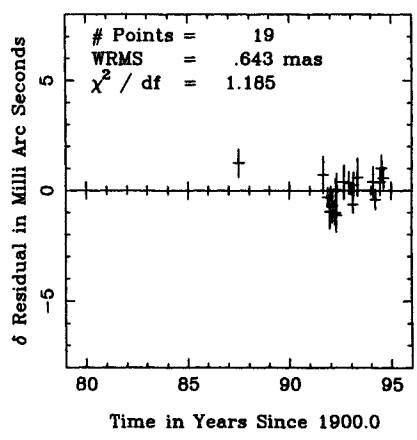
Arc Solution for 0912+297 : δ



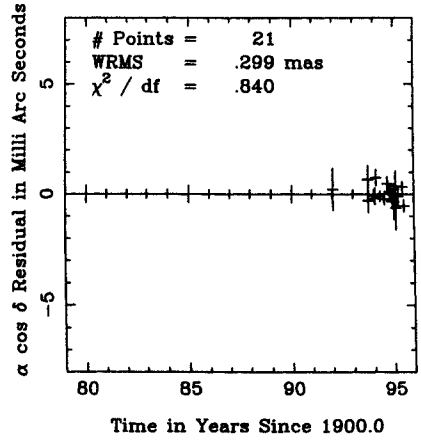
Arc Solution for 0917+449 : α cos δ



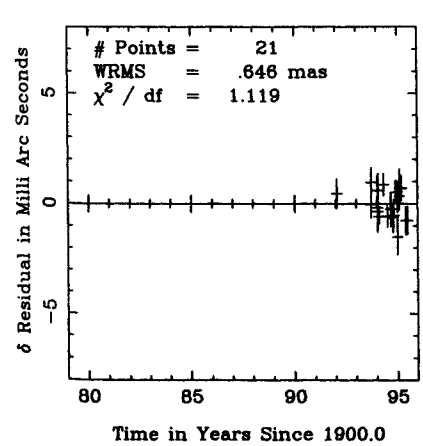
Arc Solution for 0917+449 : δ



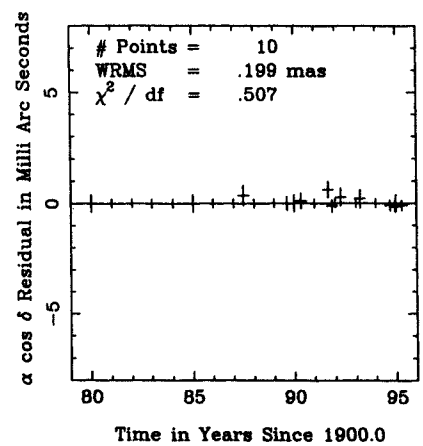
Arc Solution for 0919−260 : α cos δ



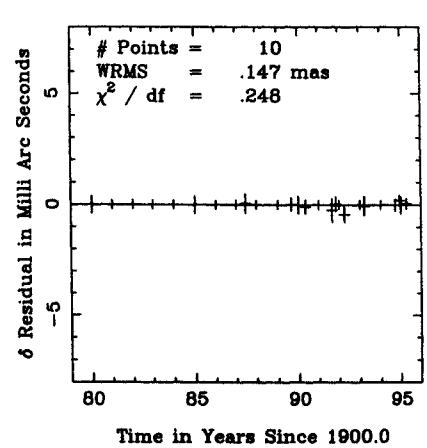
Arc Solution for 0919−260 : δ



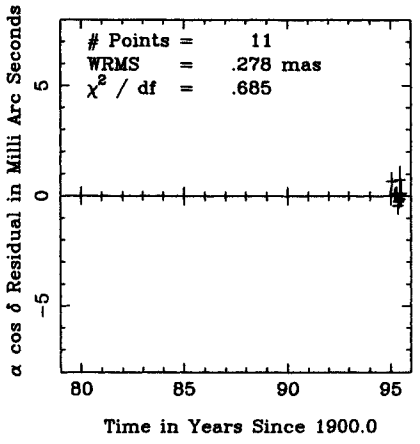
Arc Solution for 0917+624 : α cos δ



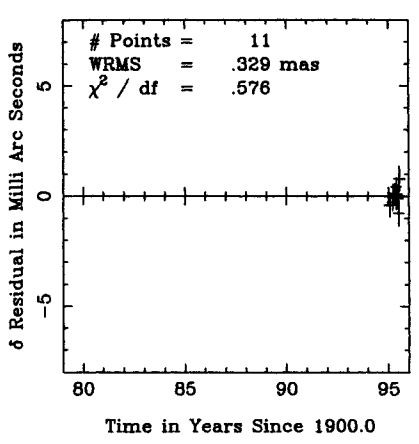
Arc Solution for 0917+624 : δ



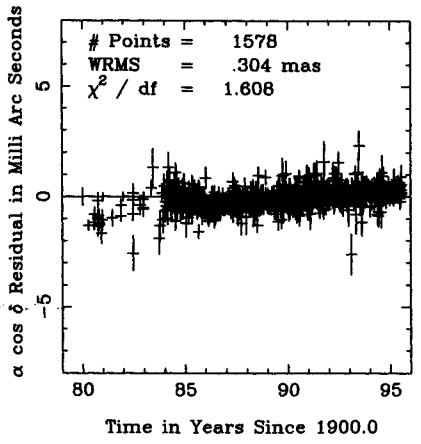
Arc Solution for 0920+390 : α cos δ



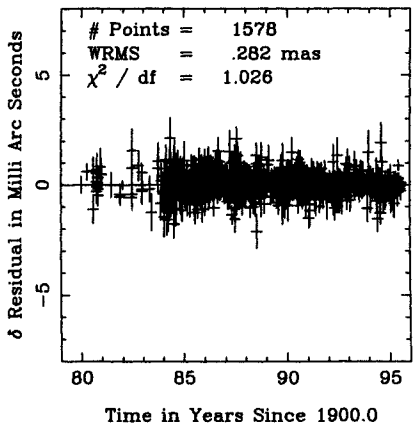
Arc Solution for 0920+390 : δ



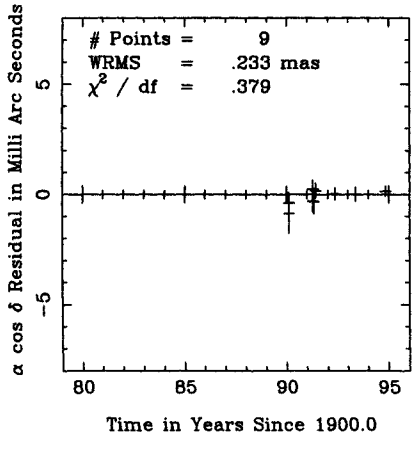
Arc Solution for 0923+392 : α cos δ



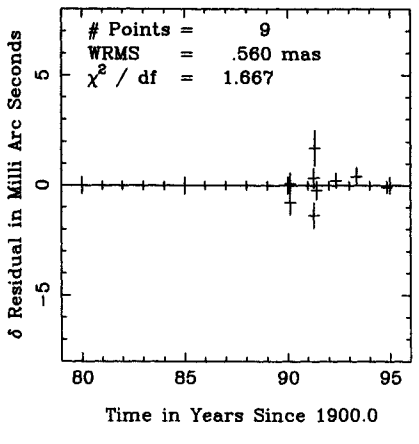
Arc Solution for 0923+392 : δ



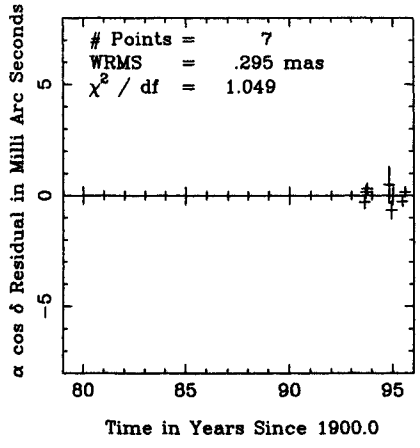
Arc Solution for 0945+408 : α cos δ



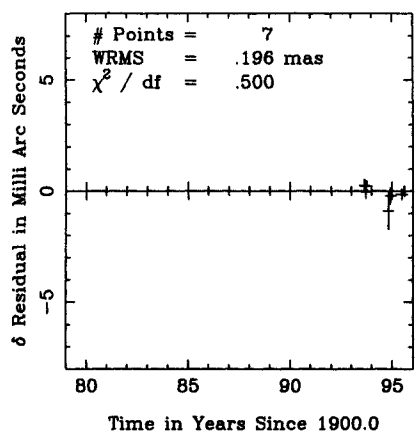
Arc Solution for 0945+408 : δ



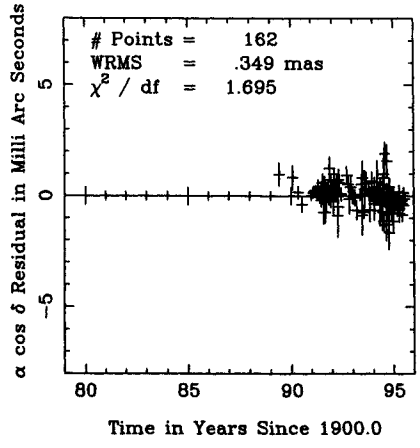
Arc Solution for 0951+693 : α cos δ



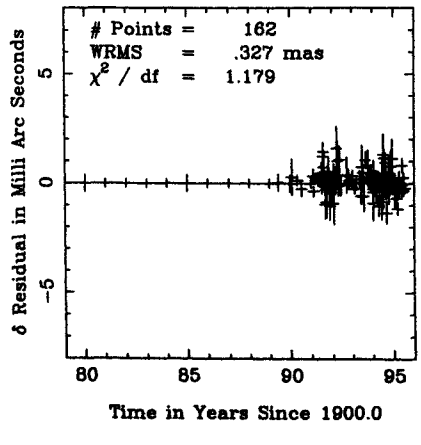
Arc Solution for 0951+693 : δ



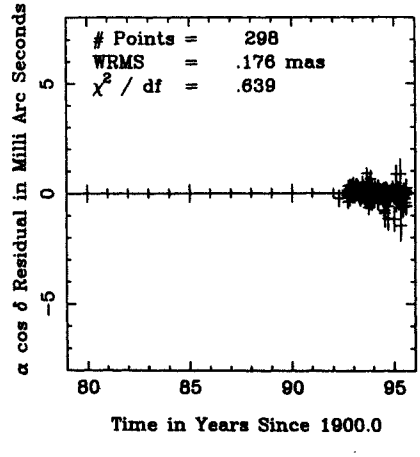
Arc Solution for 0953+254 : α cos δ



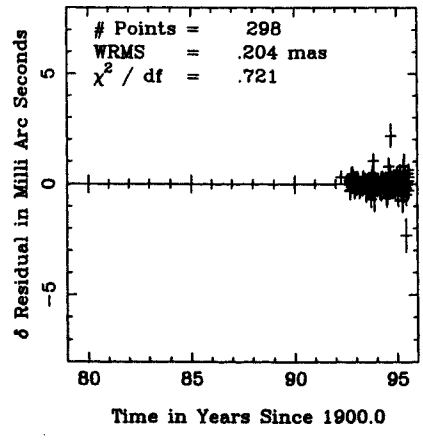
Arc Solution for 0953+254 : δ



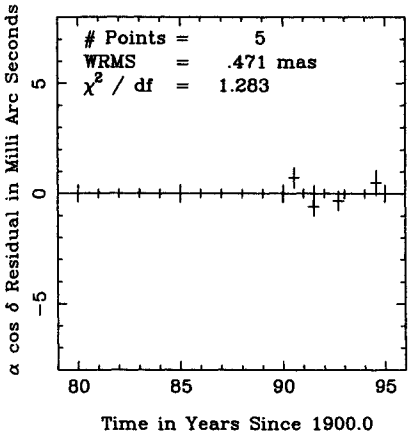
Arc Solution for 0955+476 : α cos δ



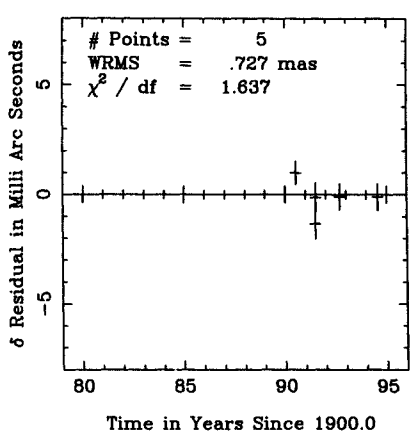
Arc Solution for 0955+476 : δ



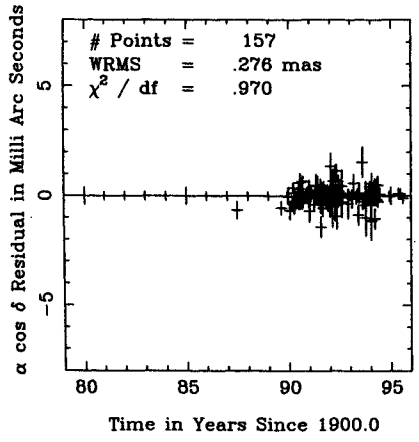
Arc Solution for 0955+326 : α cos δ



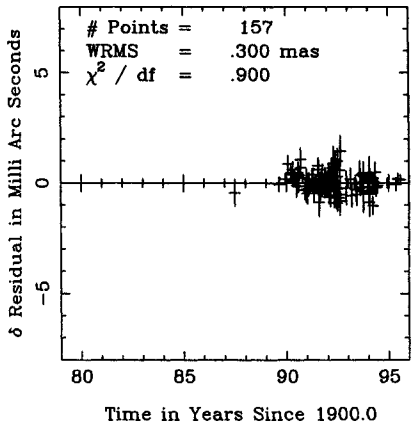
Arc Solution for 0955+326 : δ



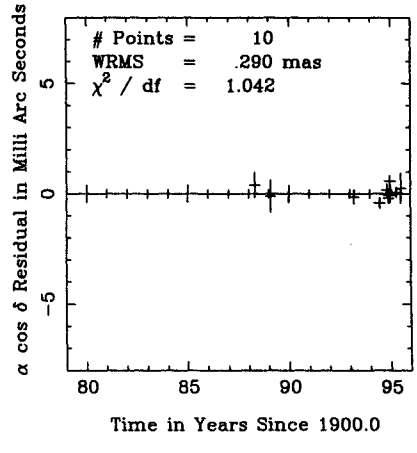
Arc Solution for 0954+658 : α cos δ



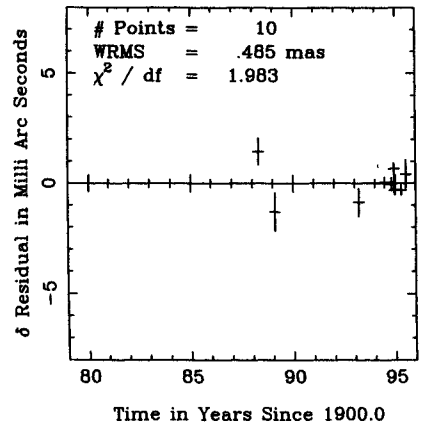
Arc Solution for 0954+658 : δ



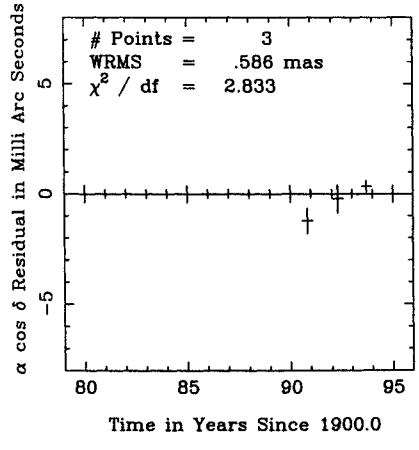
Arc Solution for 1004+141 : α cos δ



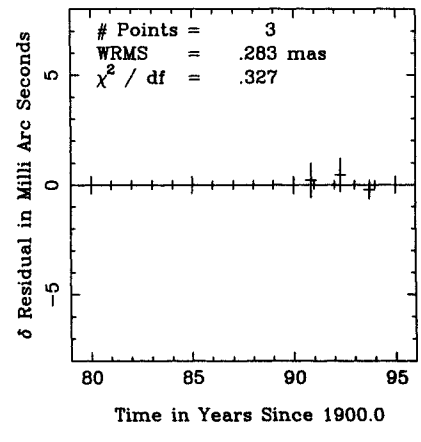
Arc Solution for 1004+141 : δ



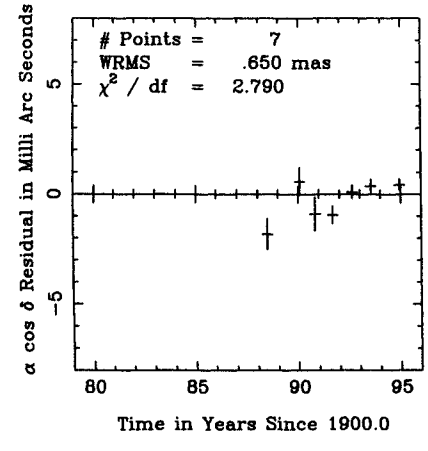
Arc Solution for 1012+232 : α cos δ



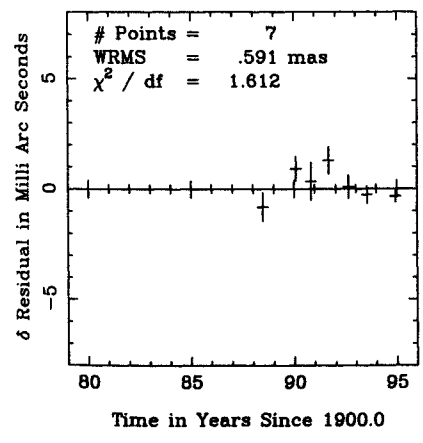
Arc Solution for 1012+232 : δ



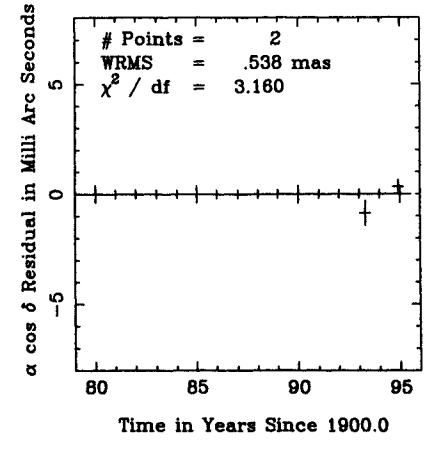
Arc Solution for 1020+400 : α cos δ



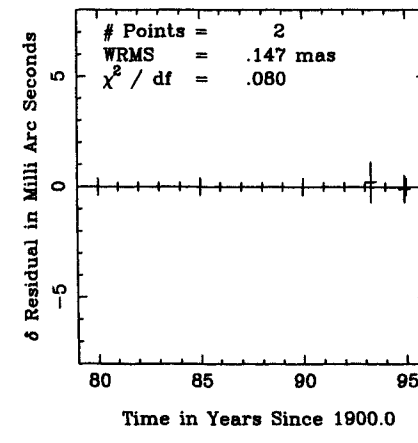
Arc Solution for 1020+400 : δ



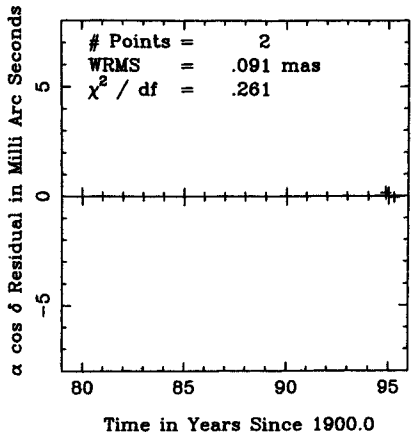
Arc Solution for 1021−006 : α cos δ



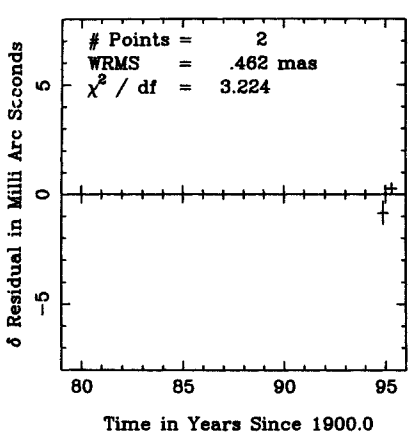
Arc Solution for 1021−006 : δ



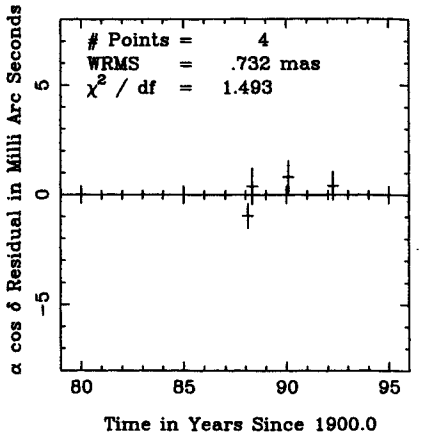
Arc Solution for 1022+194 : α cos δ



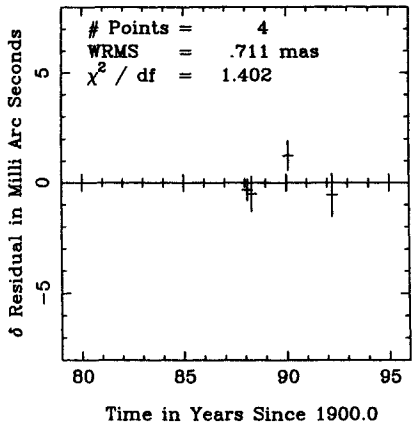
Arc Solution for 1022+194 : δ



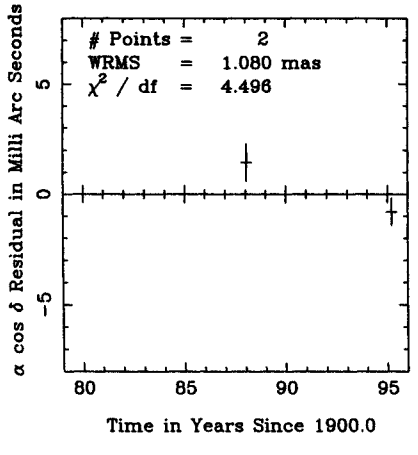
Arc Solution for 1030+415 : α cos δ



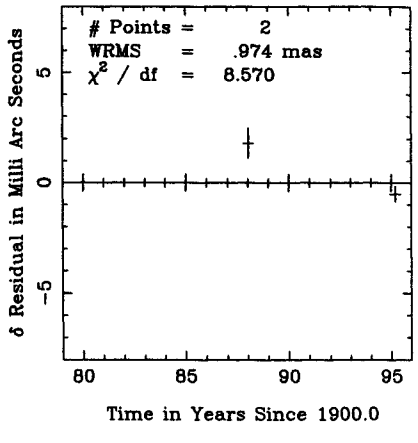
Arc Solution for 1030+415 : δ



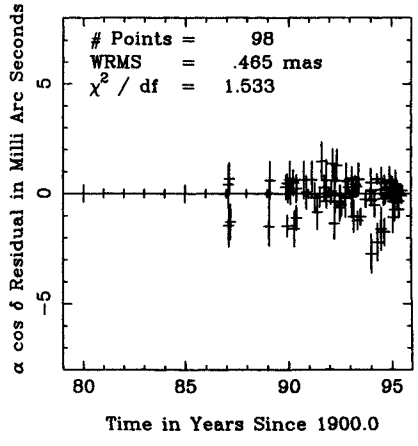
Arc Solution for 1032−199 : α cos δ



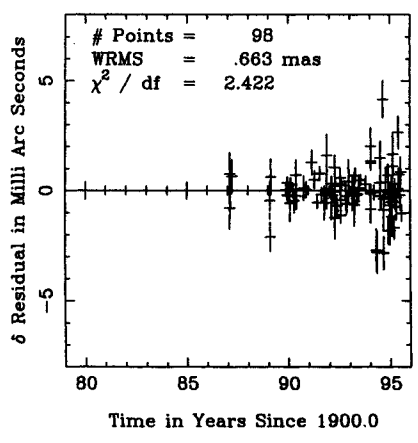
Arc Solution for 1032−199 : δ



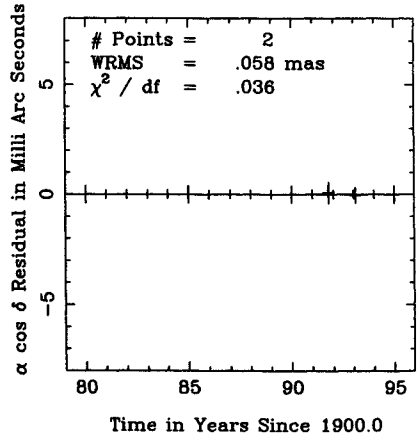
Arc Solution for 1034−293 : α cos δ



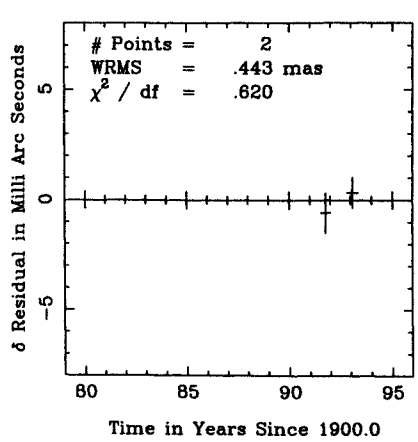
Arc Solution for 1034−293 : δ



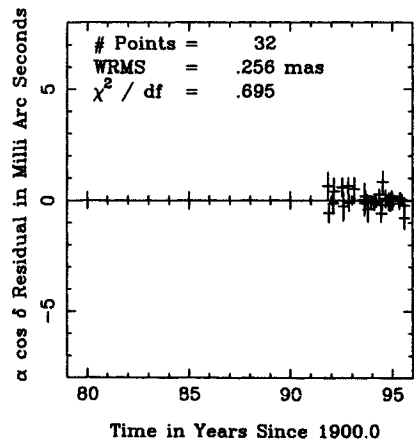
Arc Solution for 1038+064 : α cos δ



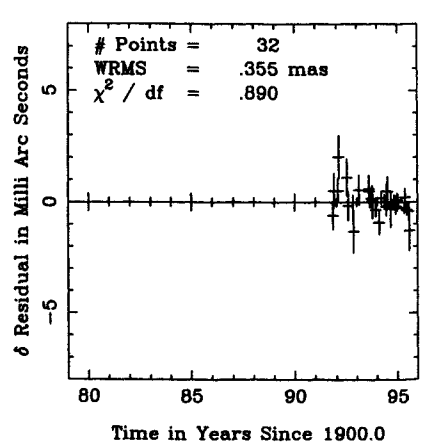
Arc Solution for 1038+064 : δ



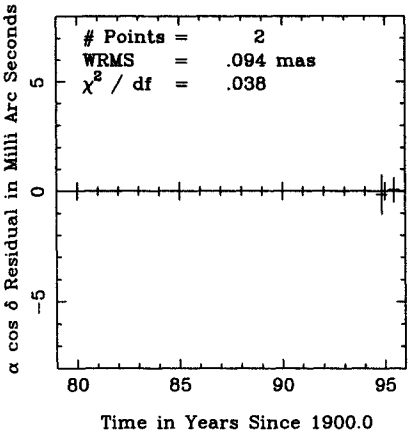
Arc Solution for 1038+528 : α cos δ



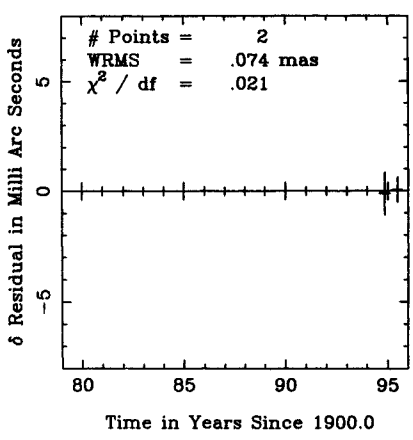
Arc Solution for 1038+528 : δ



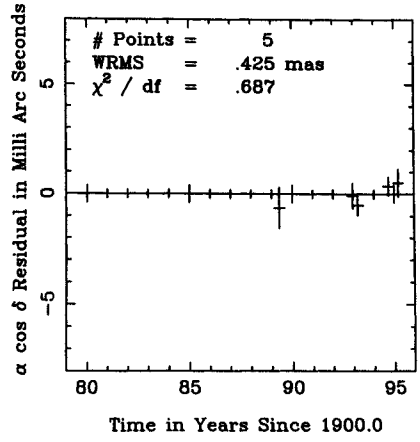
Arc Solution for 1038+529 : $\alpha \cos \delta$



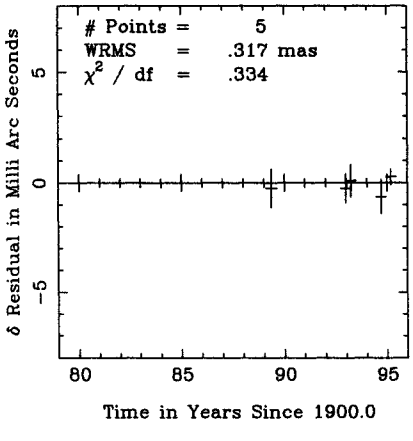
Arc Solution for 1038+529 : δ



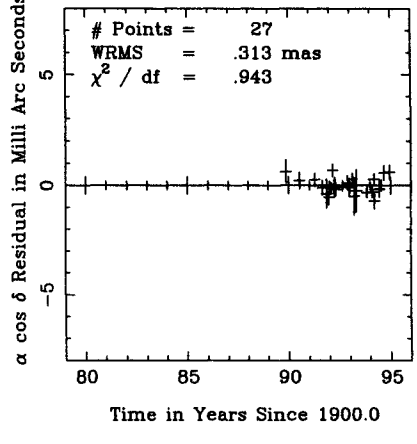
Arc Solution for 1040+123 : $\alpha \cos \delta$



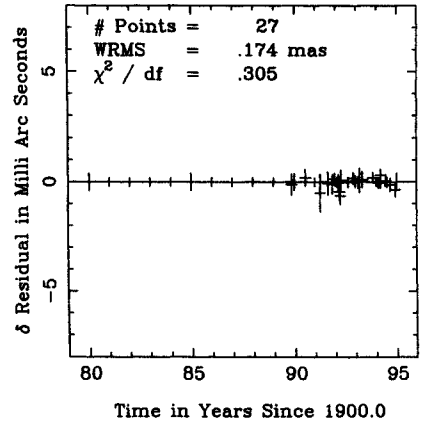
Arc Solution for 1040+123 : δ



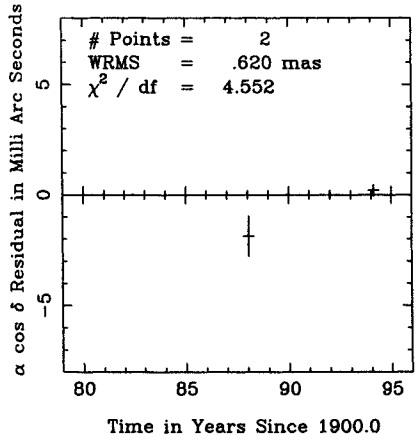
Arc Solution for 1039+811 : $\alpha \cos \delta$



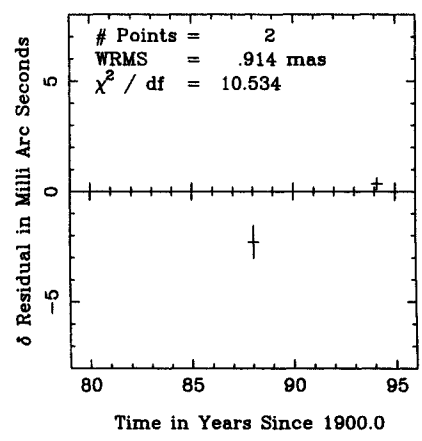
Arc Solution for 1039+811 : δ



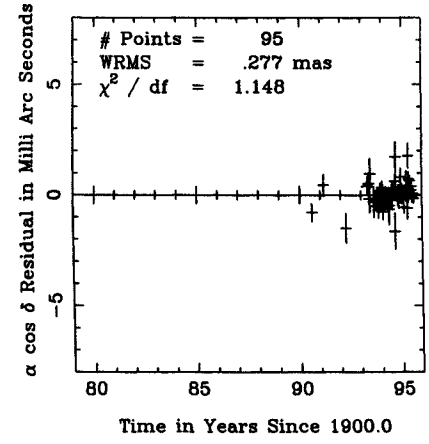
Arc Solution for 1045−188 : $\alpha \cos \delta$



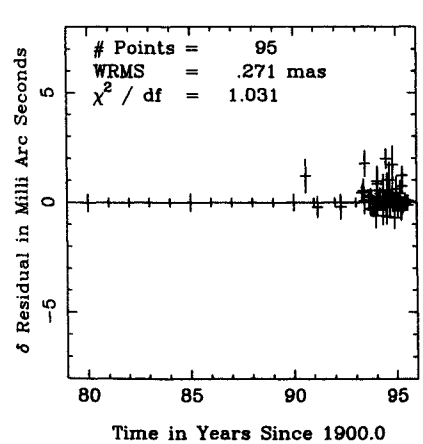
Arc Solution for 1045−188 : δ



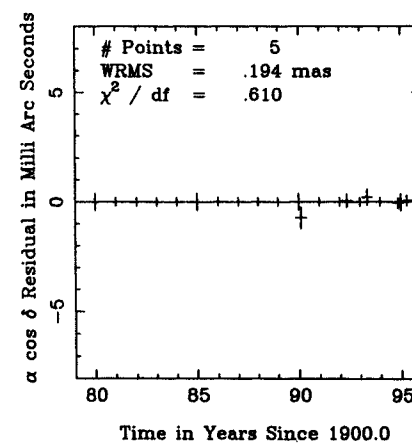
Arc Solution for 1044+719 : $\alpha \cos \delta$



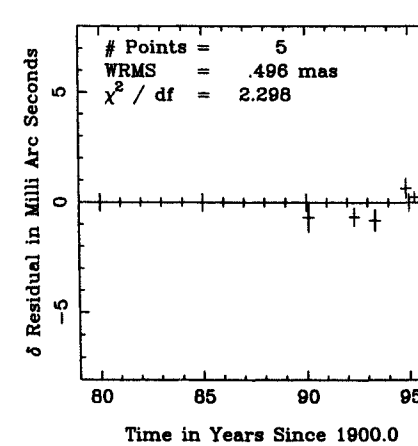
Arc Solution for 1044+719 : δ



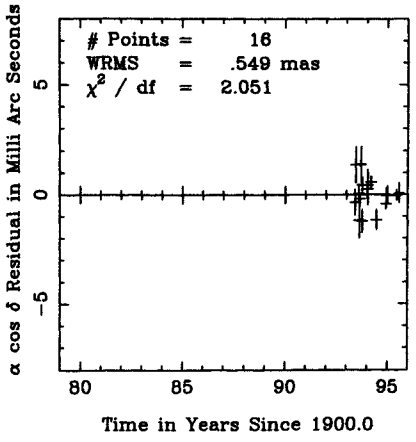
Arc Solution for 1049+215 : $\alpha \cos \delta$



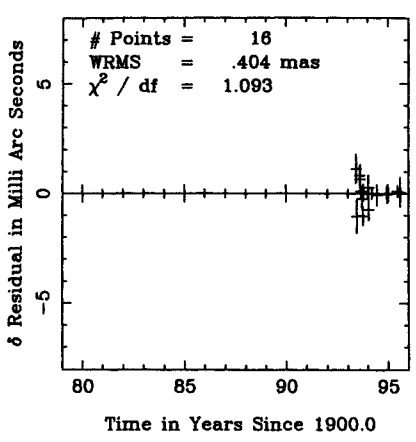
Arc Solution for 1049+215 : δ



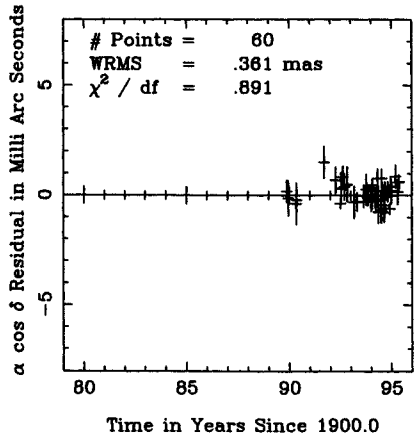
Arc Solution for 1053+704 : α cos δ



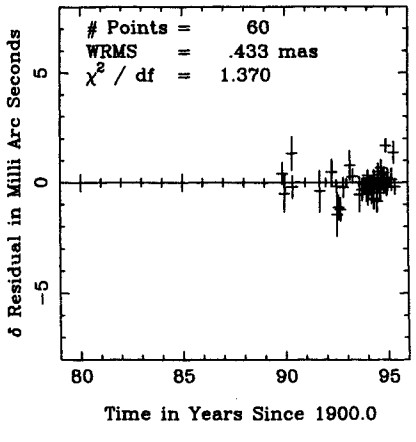
Arc Solution for 1053+704 : δ



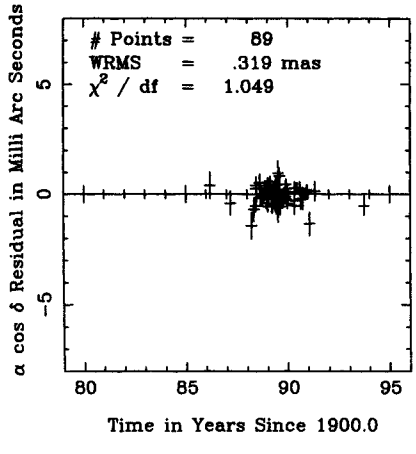
Arc Solution for 1053+815 : α cos δ



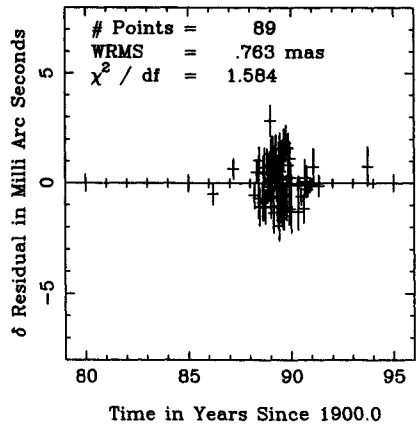
Arc Solution for 1053+815 : δ



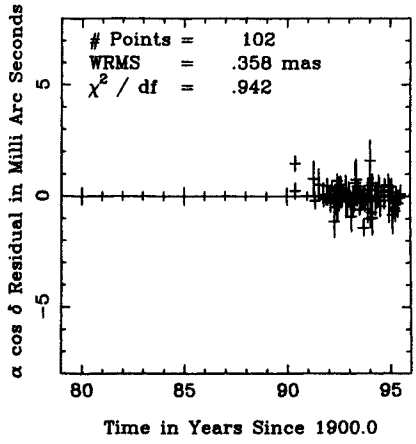
Arc Solution for 1055+018 : α cos δ



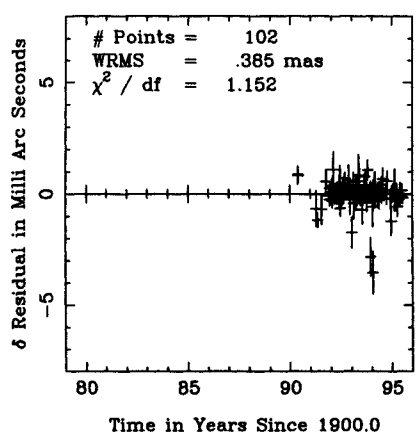
Arc Solution for 1055+018 : δ



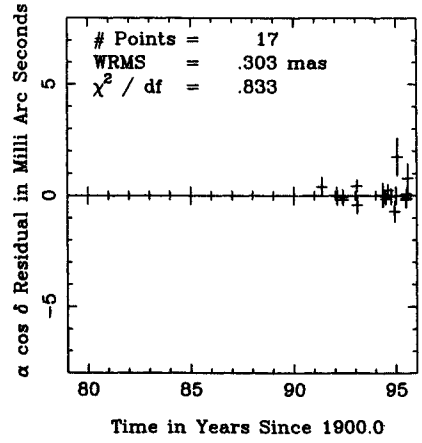
Arc Solution for 1057−797 : α cos δ



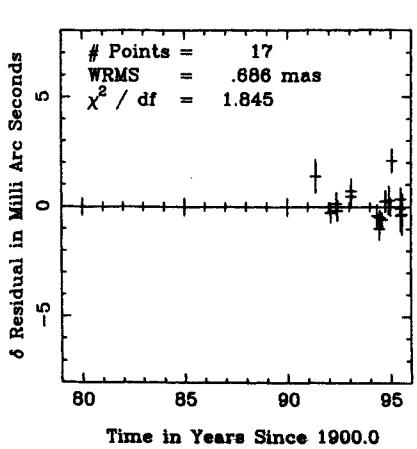
Arc Solution for 1057−797 : δ



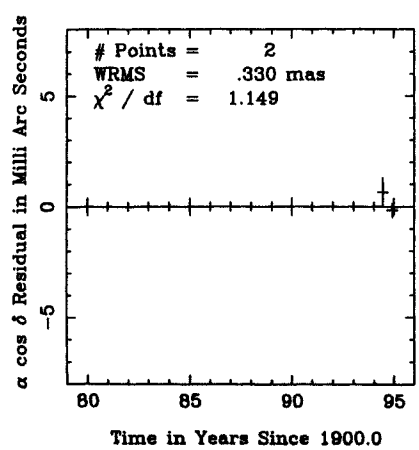
Arc Solution for 1101−536 : α cos δ



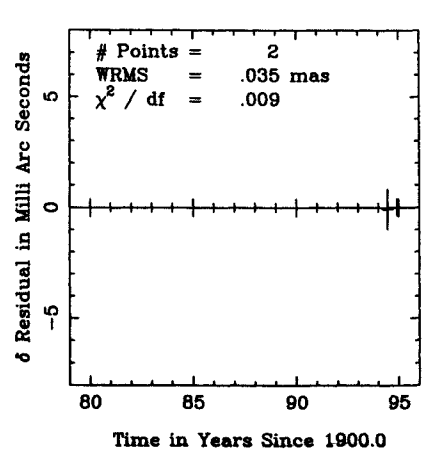
Arc Solution for 1101−536 : δ



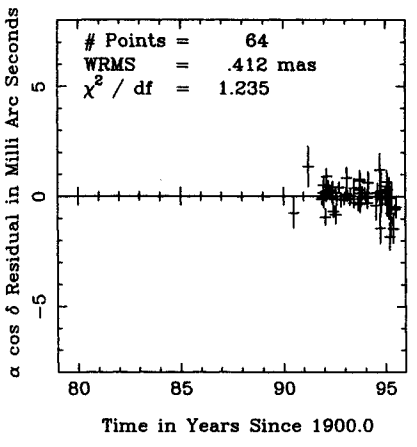
Arc Solution for 1101+384 : α cos δ



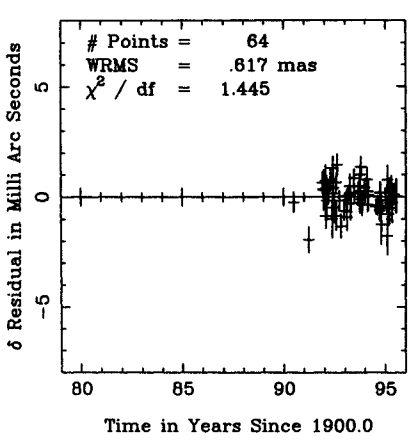
Arc Solution for 1101+384 : δ



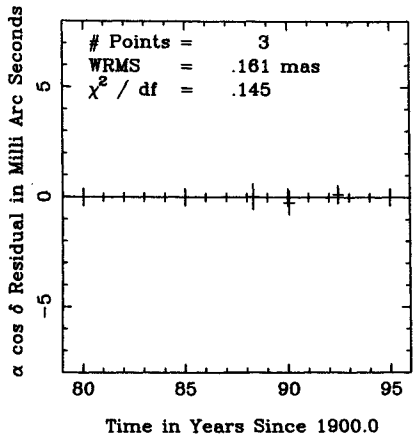
Arc Solution for 1104−445 : α cos δ



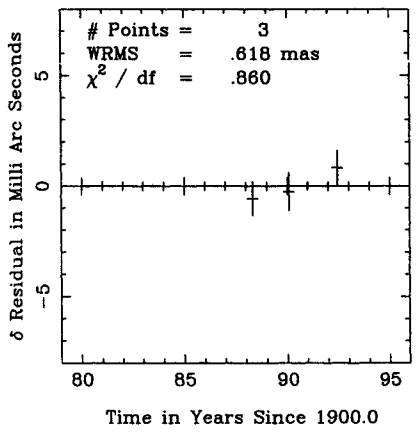
Arc Solution for 1104−445 : δ



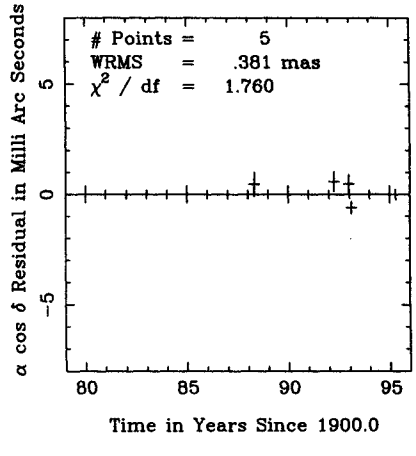
Arc Solution for 1111+149 : α cos δ



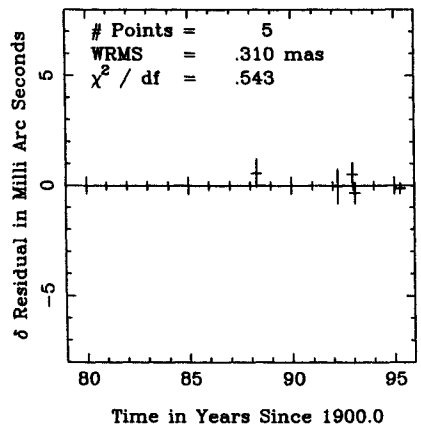
Arc Solution for 1111+149 : δ



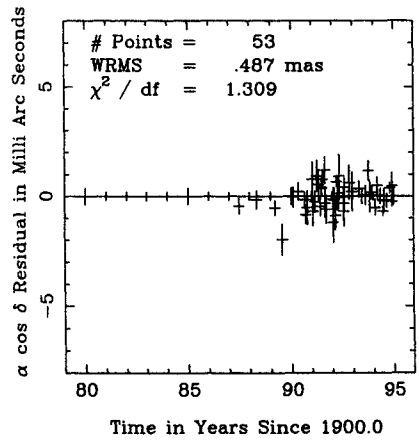
Arc Solution for 1116+128 : α cos δ



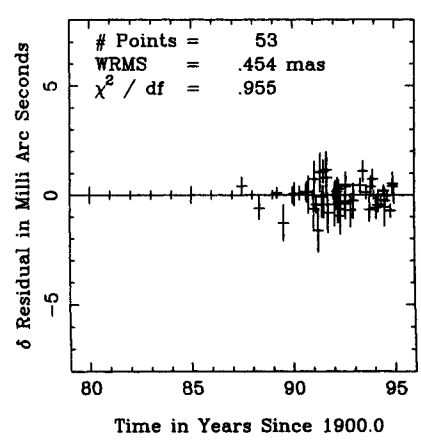
Arc Solution for 1116+128 : δ



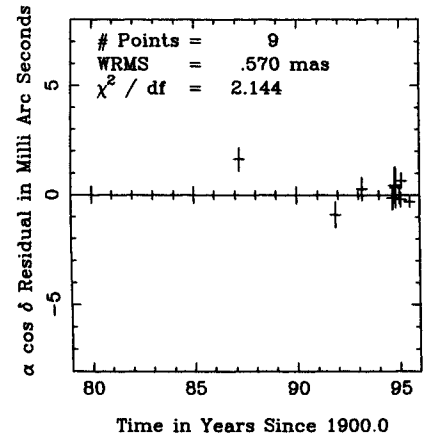
Arc Solution for 1123+264 : α cos δ



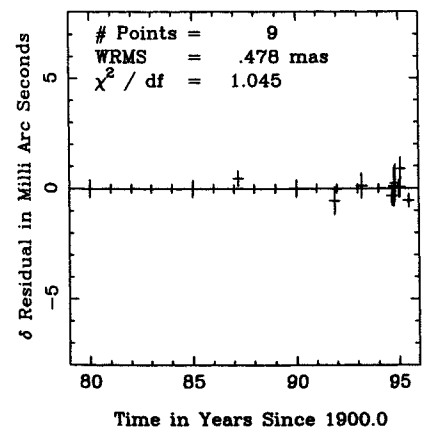
Arc Solution for 1123+264 : δ



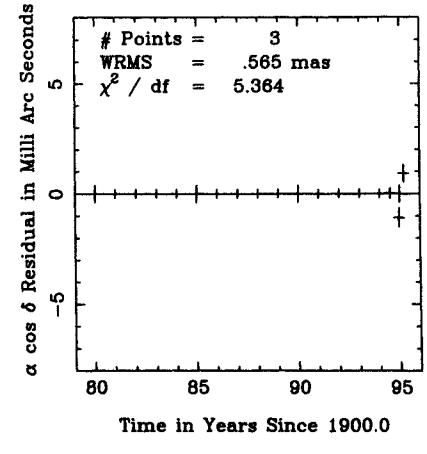
Arc Solution for 1124−186 : α cos δ



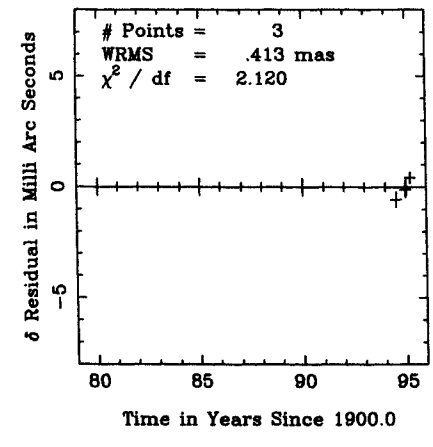
Arc Solution for 1124−186 : δ

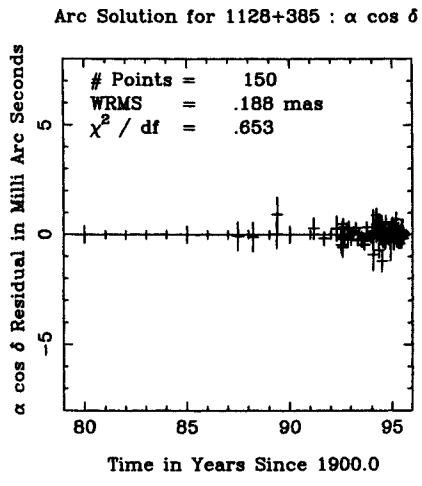


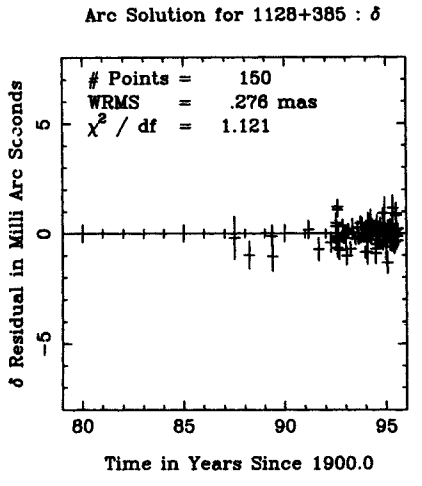
Arc Solution for 1127−145 : α cos δ

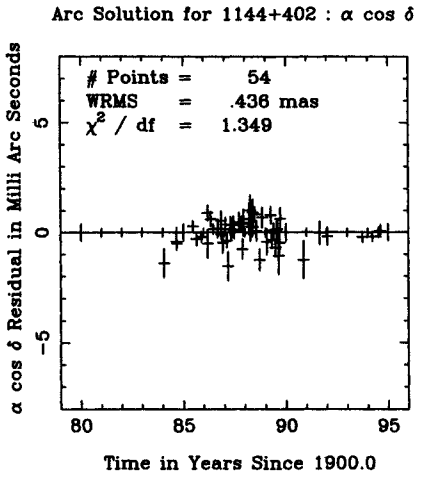


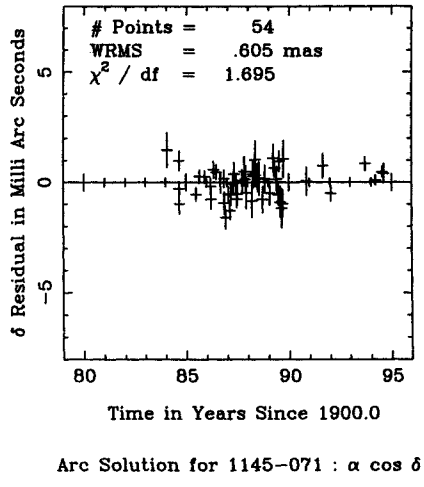
Arc Solution for 1127−145 : δ

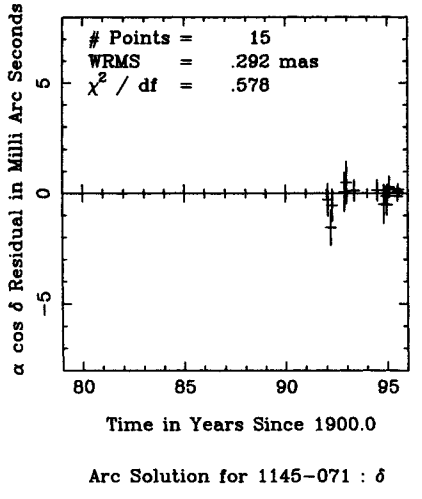


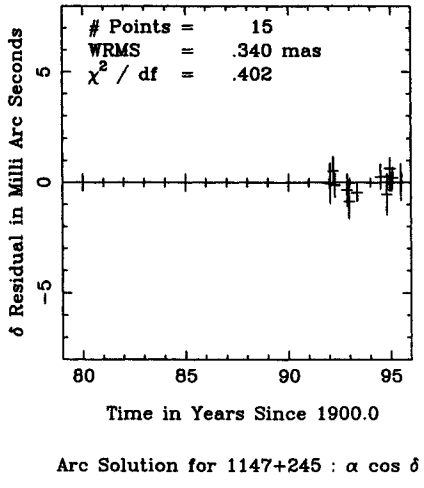

Arc Solution for 1128+385 : α cos δ
# Points = 150
WRMS = .188 mas
χ² / df = .653
α cos δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

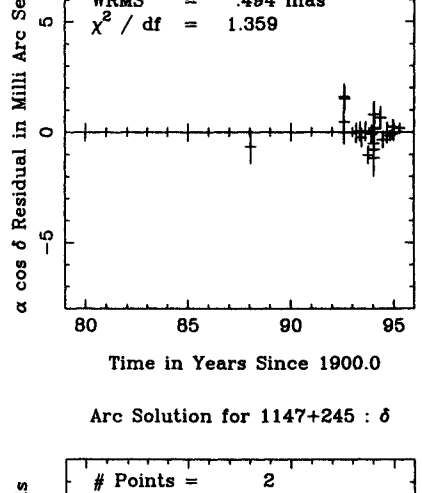

Arc Solution for 1128+385 : δ
# Points = 150
WRMS = .276 mas
χ² / df = 1.121
δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

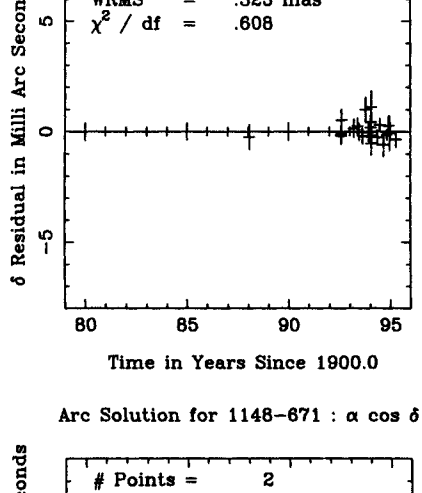

Arc Solution for 1144+402 : α cos δ
# Points = 54
WRMS = .436 mas
χ² / df = 1.349
α cos δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

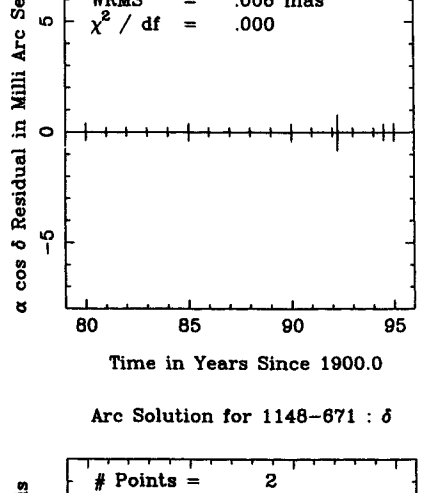

Arc Solution for 1144+402 : δ
# Points = 54
WRMS = .605 mas
χ² / df = 1.695
δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

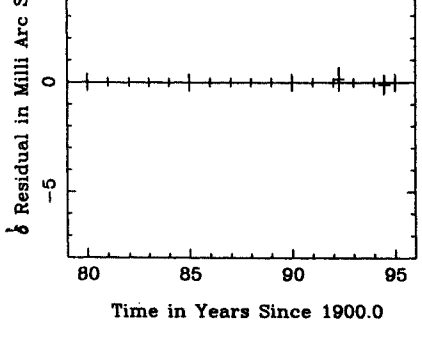

Arc Solution for 1144−379 : α cos δ
# Points = 15
WRMS = .292 mas
χ² / df = .578
α cos δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

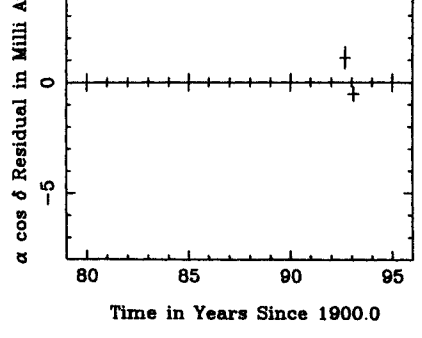

Arc Solution for 1144−379 : δ
# Points = 15
WRMS = .340 mas
χ² / df = .402
δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

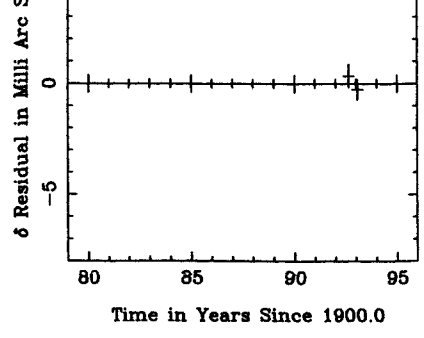

Arc Solution for 1145−071 : α cos δ
# Points = 24
WRMS = .494 mas
χ² / df = 1.359
α cos δ Residual in Milli Arc Seconds
Time in Years Since 1900.0


Arc Solution for 1145−071 : δ
# Points = 24
WRMS = .323 mas
χ² / df = .608
δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

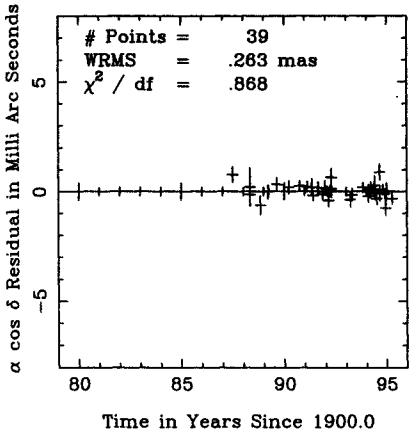

Arc Solution for 1147+245 : α cos δ
# Points = 2
WRMS = .006 mas
χ² / df = .000
α cos δ Residual in Milli Arc Seconds
Time in Years Since 1900.0


Arc Solution for 1147+245 : δ
# Points = 2
WRMS = .128 mas
χ² / df = .130
δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

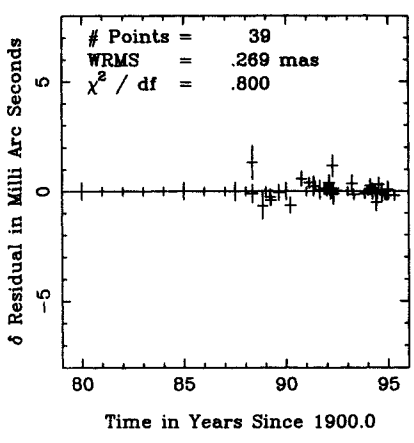

Arc Solution for 1148−671 : α cos δ
# Points = 2
WRMS = .762 mas
χ² / df = 6.753
α cos δ Residual in Milli Arc Seconds
Time in Years Since 1900.0


Arc Solution for 1148−671 : δ
# Points = 2
WRMS = .301 mas
χ² / df = .702
δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

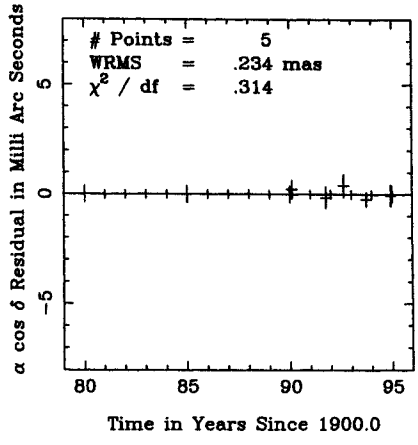
Arc Solution for 1150+812 : $\alpha \cos \delta$



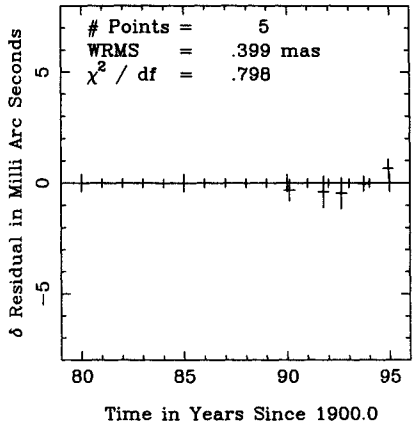
Arc Solution for 1150+812 : δ



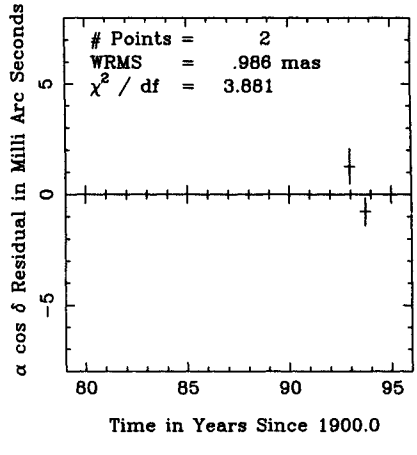
Arc Solution for 1150+497 : $\alpha \cos \delta$



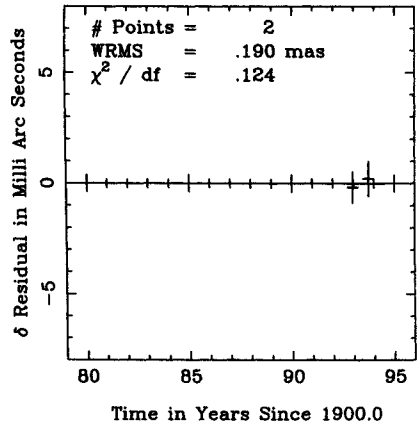
Arc Solution for 1150+497 : δ



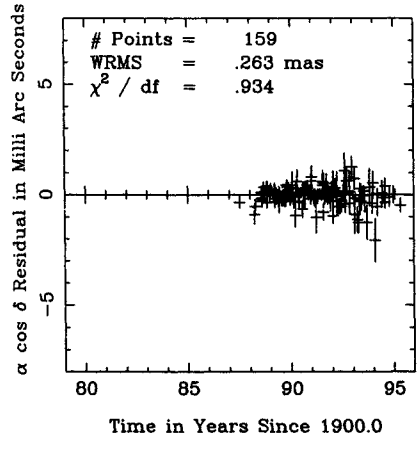
Arc Solution for 1155+251 : $\alpha \cos \delta$



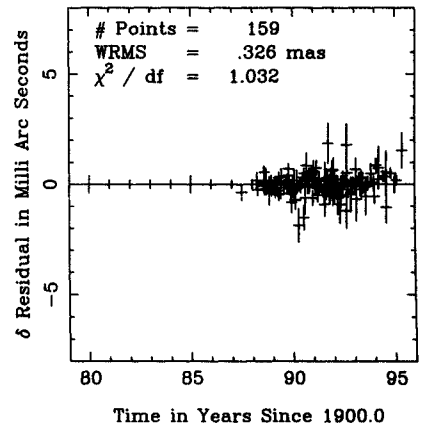
Arc Solution for 1155+251 : δ



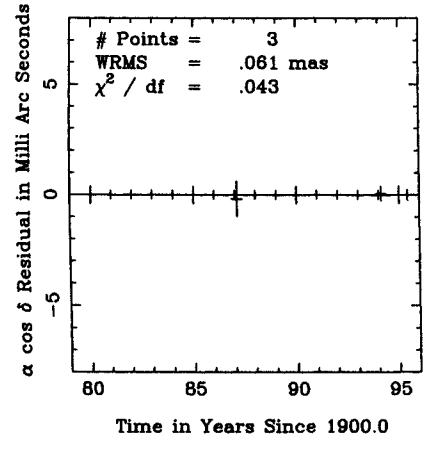
Arc Solution for 1156+295 : $\alpha \cos \delta$



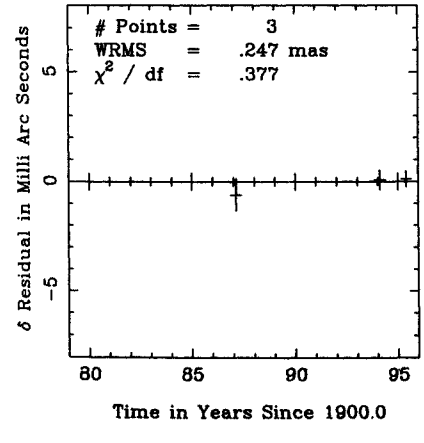
Arc Solution for 1156+295 : δ



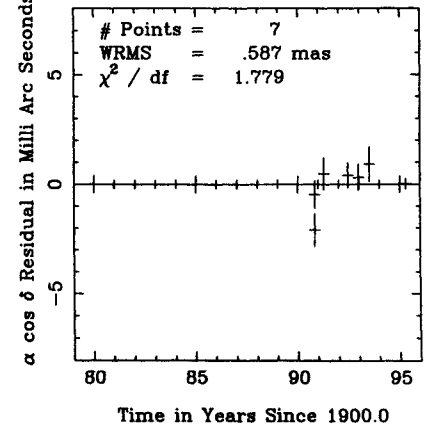
Arc Solution for 1213−172 : $\alpha \cos \delta$



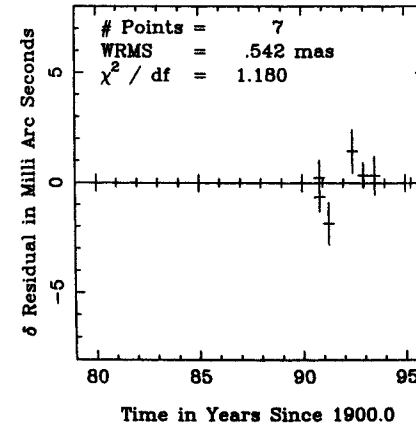
Arc Solution for 1213−172 : δ



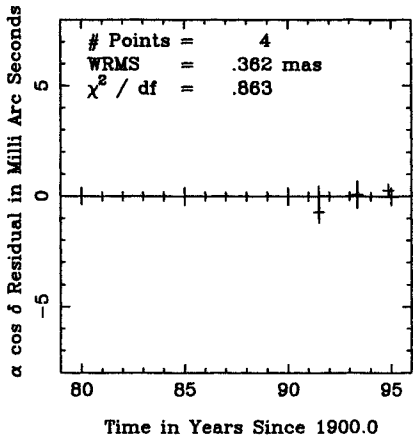
Arc Solution for 1213+350 : $\alpha \cos \delta$



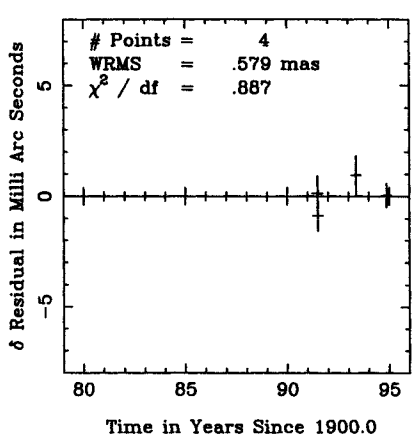
Arc Solution for 1213+350 : δ



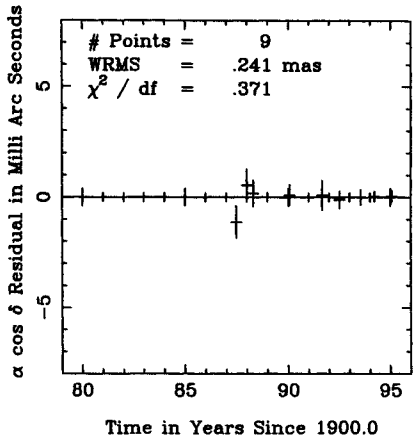
Arc Solution for 1215+303 : α cos δ



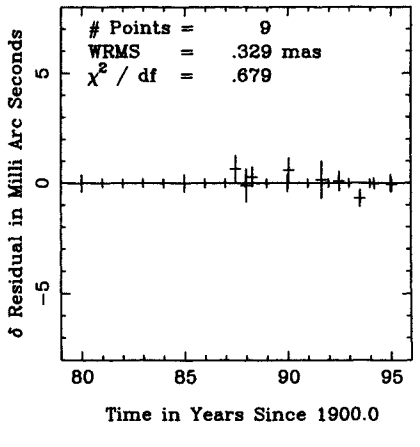
Arc Solution for 1215+303 : δ



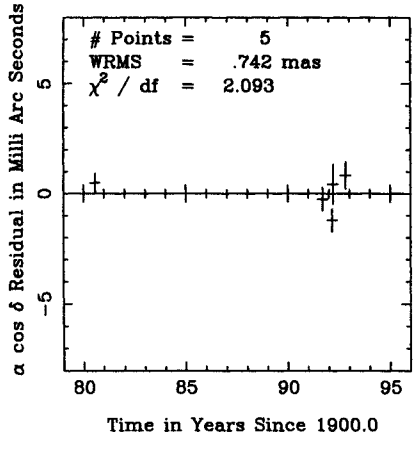
Arc Solution for 1216+487 : α cos δ



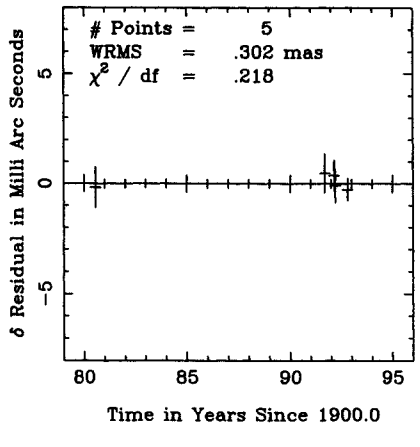
Arc Solution for 1216+487 : δ



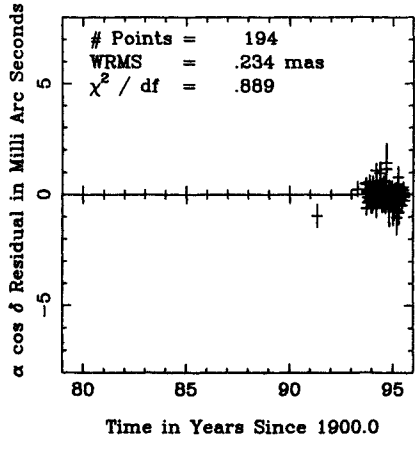
Arc Solution for 1219+285 : α cos δ



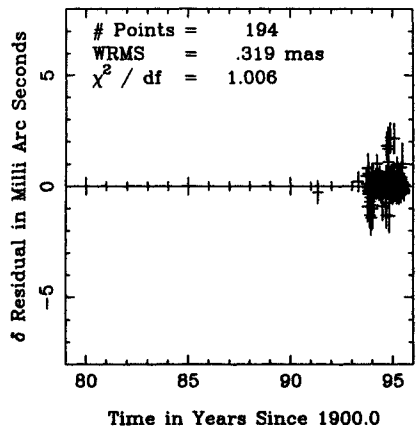
Arc Solution for 1219+285 : δ



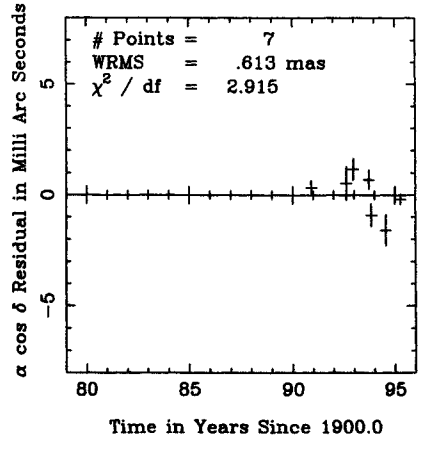
Arc Solution for 1219+044 : α cos δ



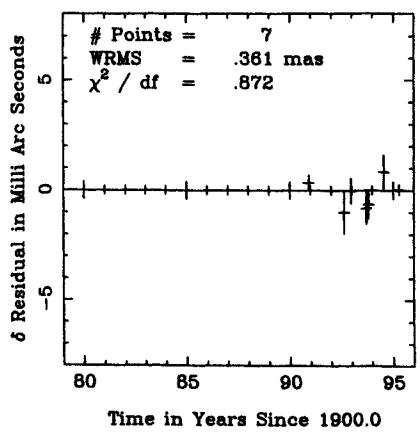
Arc Solution for 1219+044 : δ



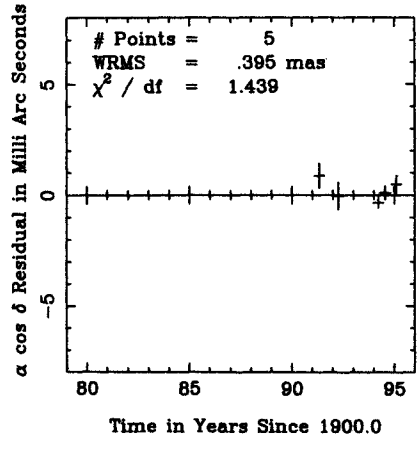
Arc Solution for 1221+809 : α cos δ



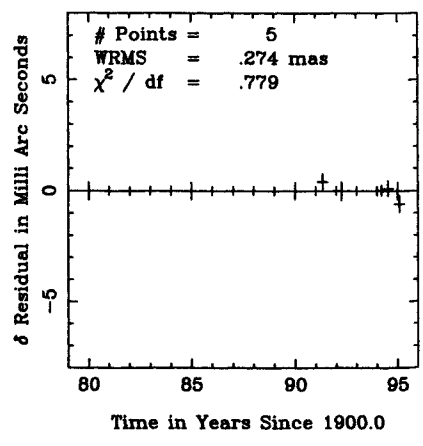
Arc Solution for 1221+809 : δ



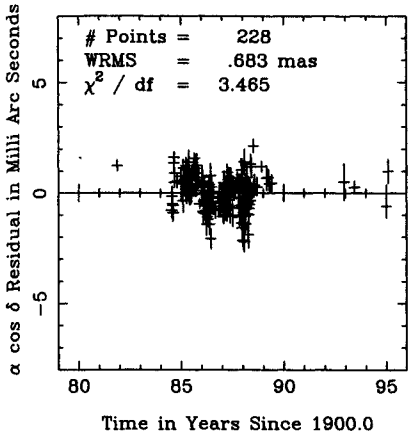
Arc Solution for 1226+373 : α cos δ



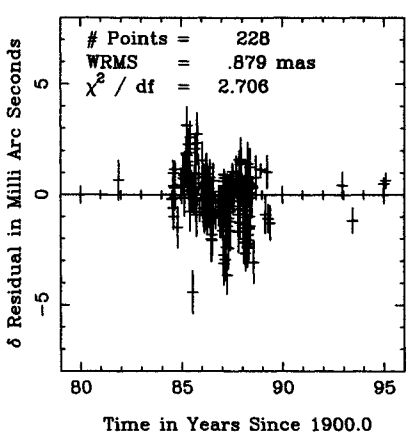
Arc Solution for 1226+373 : δ



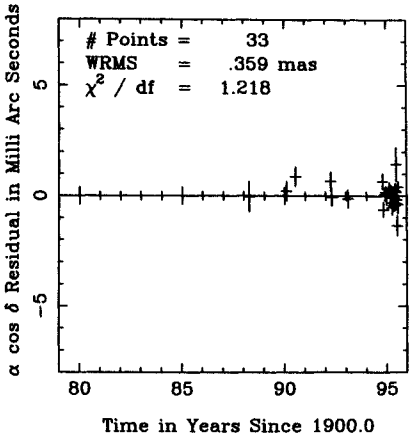
Arc Solution for 1226+023 : α cos δ



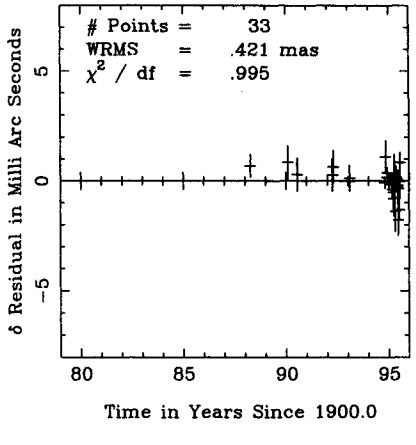
Arc Solution for 1226+023 : δ



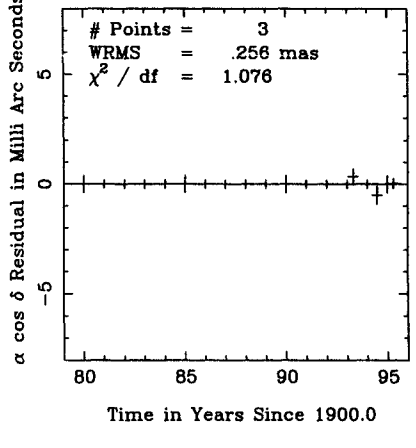
Arc Solution for 1228+126 : α cos δ



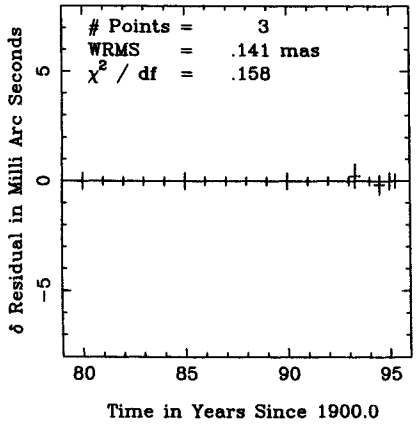
Arc Solution for 1228+126 : δ



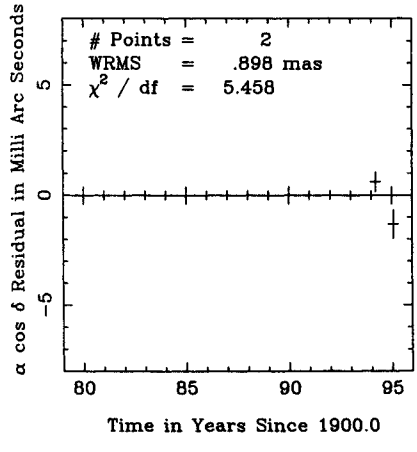
Arc Solution for 1236+077 : α cos δ



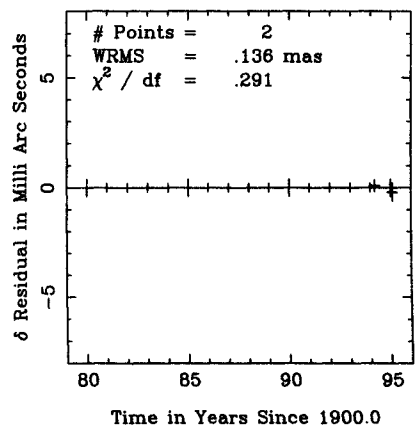
Arc Solution for 1236+077 : δ



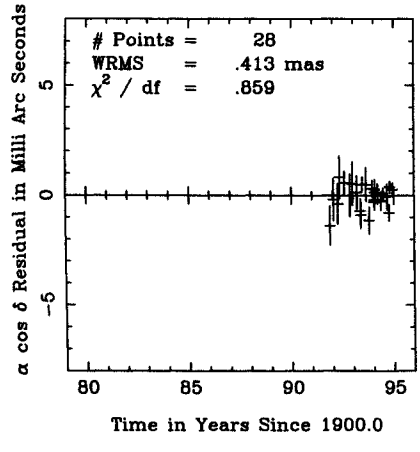
Arc Solution for 1240+381 : α cos δ



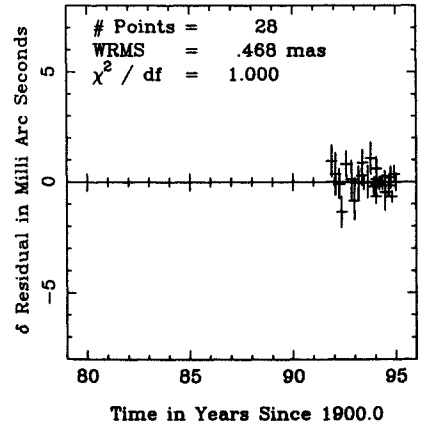
Arc Solution for 1240+381 : δ



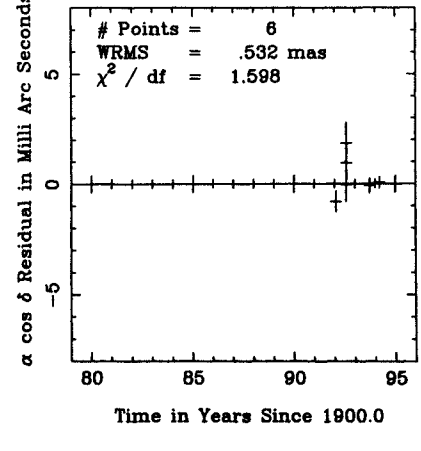
Arc Solution for 1244−255 : α cos δ



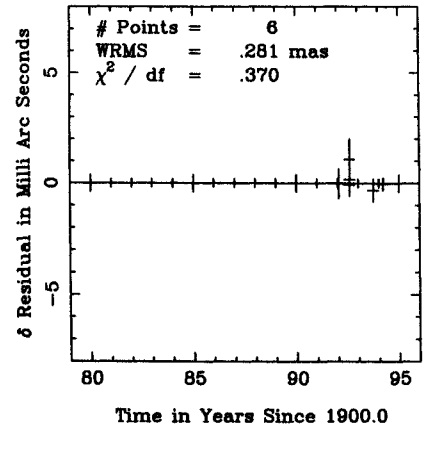
Arc Solution for 1244−255 : δ



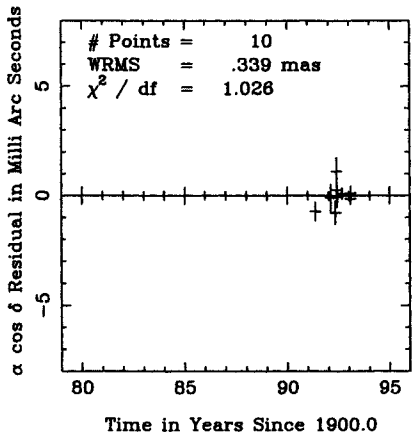
Arc Solution for 1252+119 : α cos δ



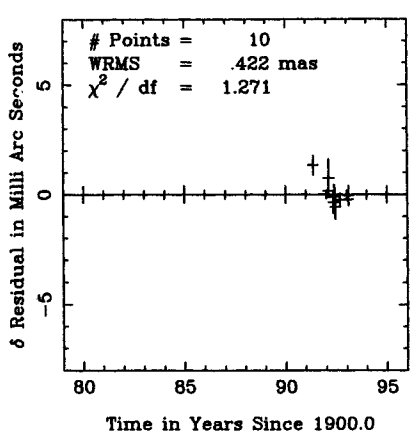
Arc Solution for 1252+119 : δ



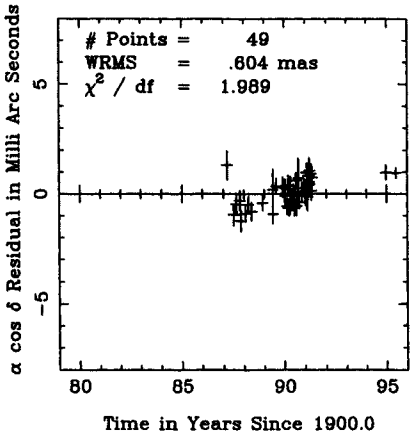
Arc Solution for 1251−713 : α cos δ



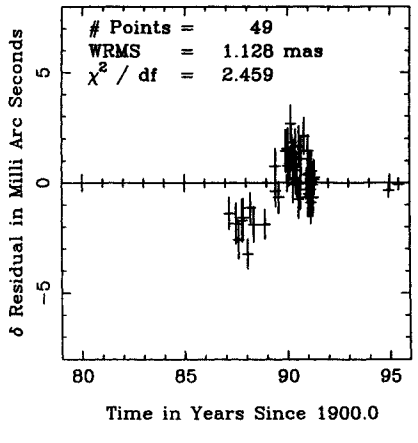
Arc Solution for 1251−713 : δ



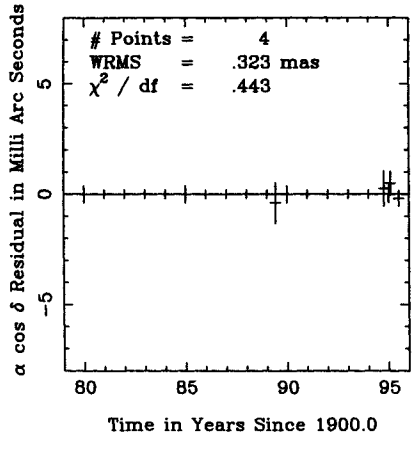
Arc Solution for 1253−055 : α cos δ



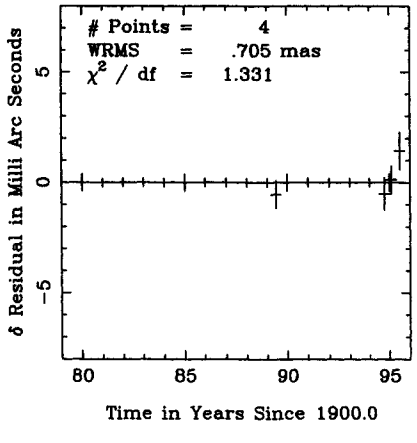
Arc Solution for 1253−055 : δ



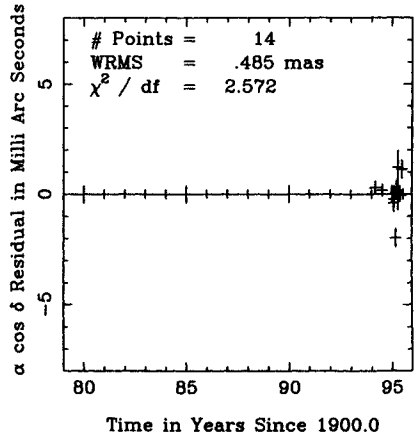
Arc Solution for 1255−316 : α cos δ



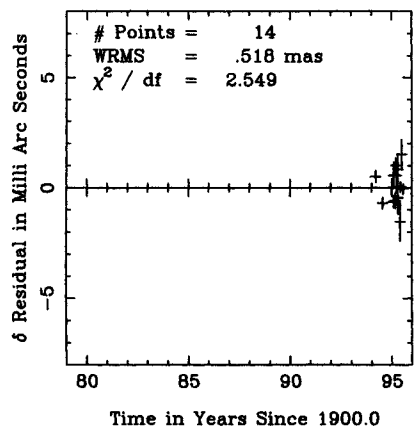
Arc Solution for 1255−316 : δ



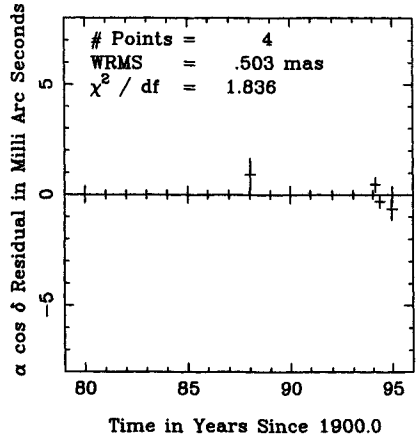
Arc Solution for 1300+580 : α cos δ



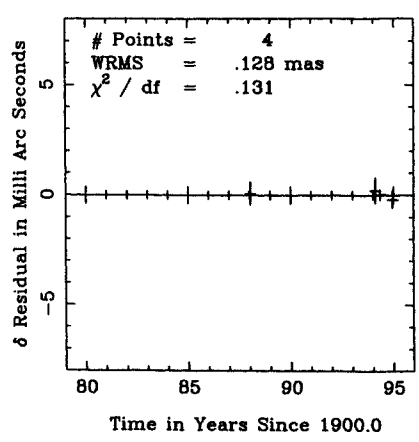
Arc Solution for 1300+580 : δ



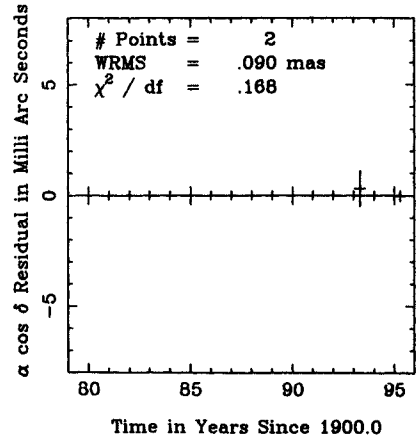
Arc Solution for 1302−102 : α cos δ



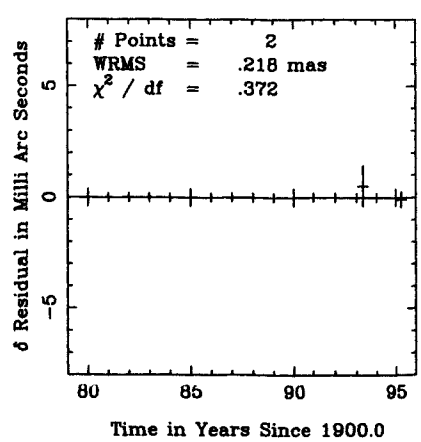
Arc Solution for 1302−102 : δ



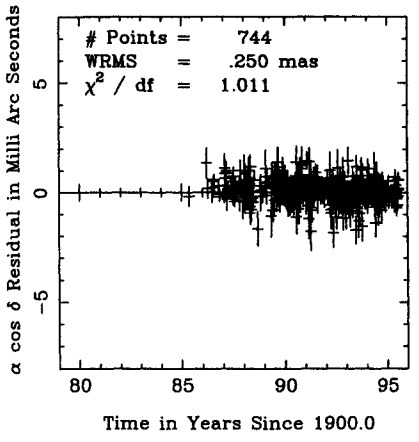
Arc Solution for 1307+121 : α cos δ



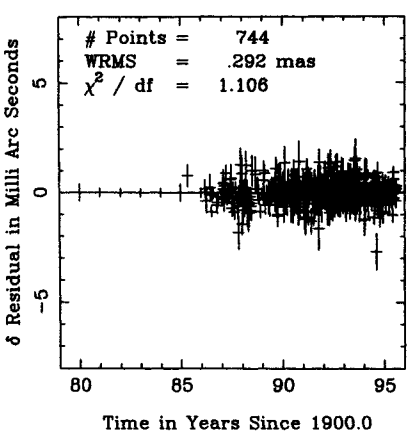
Arc Solution for 1307+121 : δ



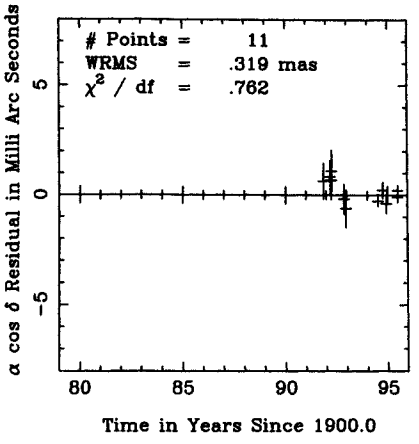
Arc Solution for 1308+326 : α cos δ



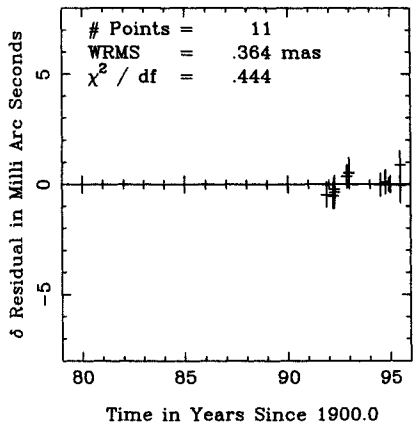
Arc Solution for 1308+326 : δ



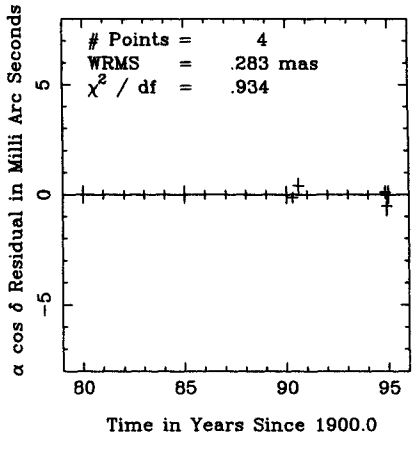
Arc Solution for 1313−333 : α cos δ



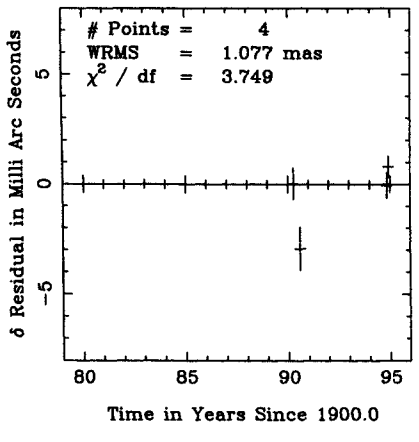
Arc Solution for 1313−333 : δ



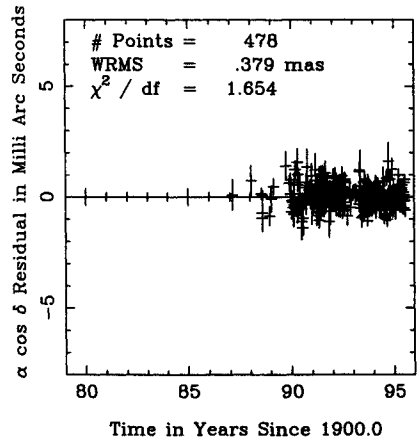
Arc Solution for 1315+346 : α cos δ



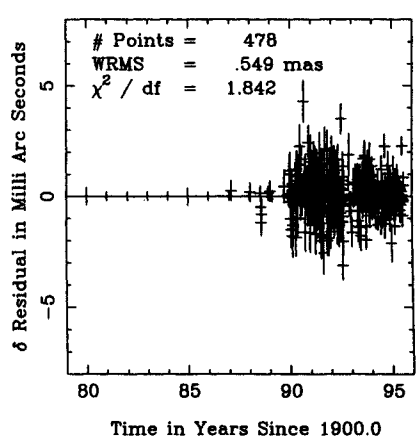
Arc Solution for 1315+346 : δ



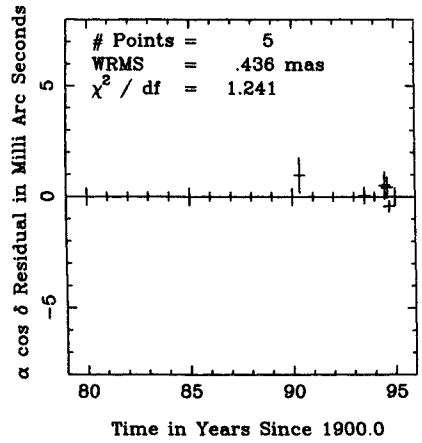
Arc Solution for 1334−127 : α cos δ



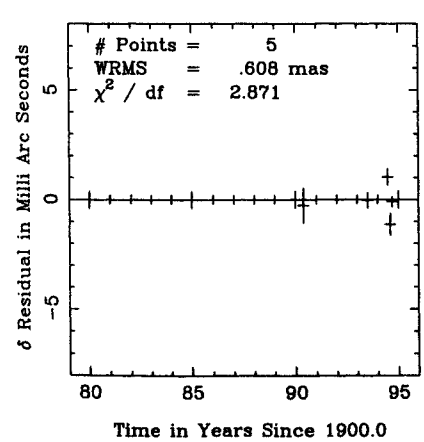
Arc Solution for 1334−127 : δ



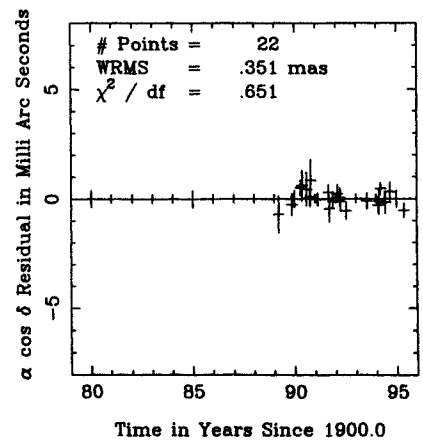
Arc Solution for 1342+662 : α cos δ



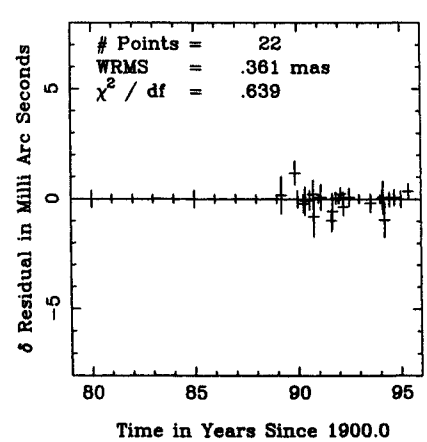
Arc Solution for 1342+662 : δ



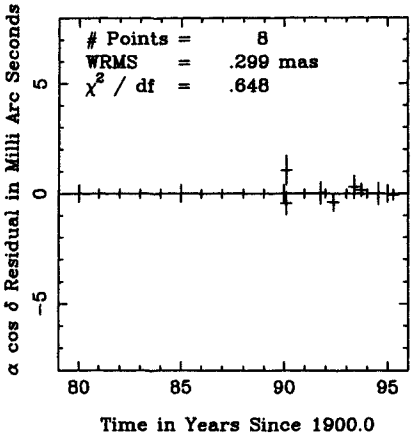
Arc Solution for 1342+663 : α cos δ



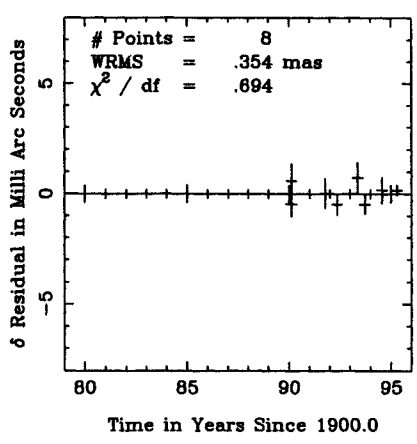
Arc Solution for 1342+663 : δ



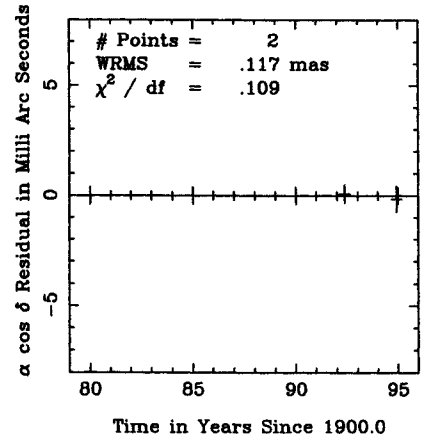
Arc Solution for 1347+539 : $\alpha \cos \delta$



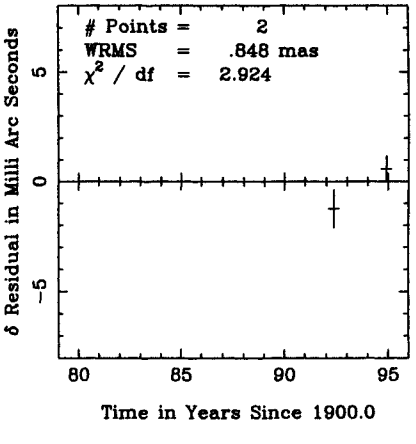
Arc Solution for 1347+539 : δ



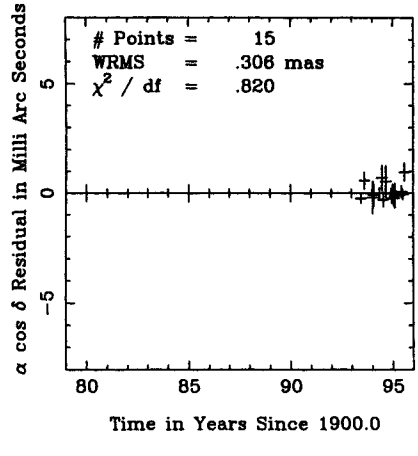
Arc Solution for 1349−439 : $\alpha \cos \delta$



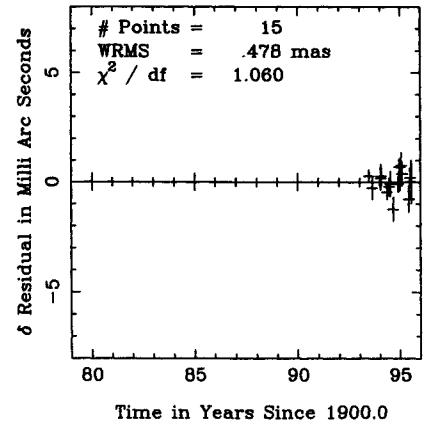
Arc Solution for 1349−439 : δ



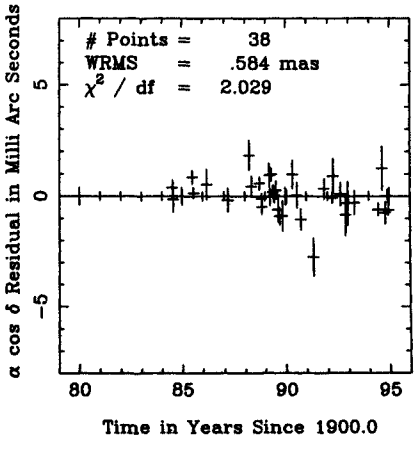
Arc Solution for 1351−018 : $\alpha \cos \delta$



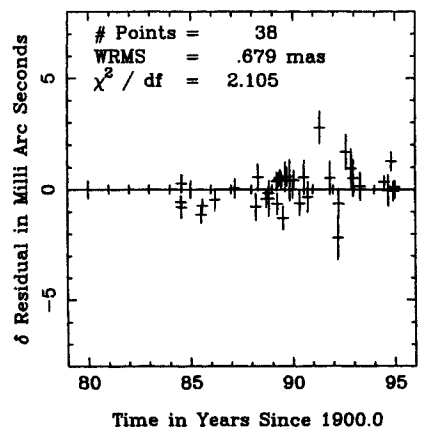
Arc Solution for 1351−018 : δ



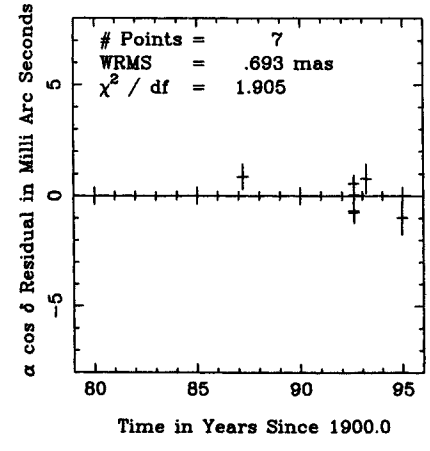
Arc Solution for 1354+195 : $\alpha \cos \delta$



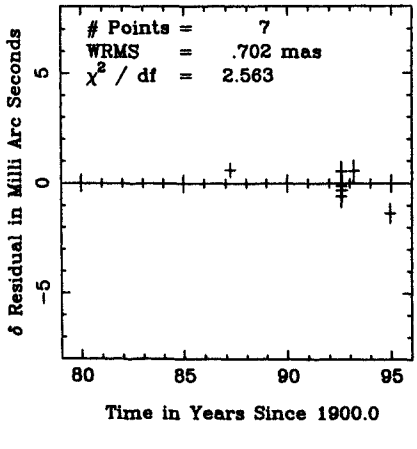
Arc Solution for 1354+195 : δ



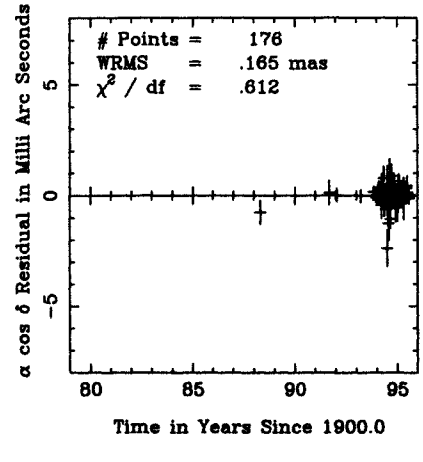
Arc Solution for 1354−152 : $\alpha \cos \delta$



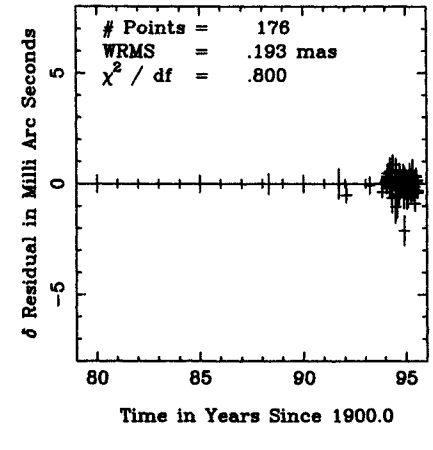
Arc Solution for 1354−152 : δ



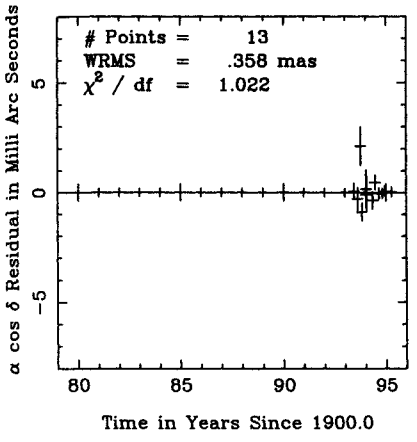
Arc Solution for 1357+769 : $\alpha \cos \delta$



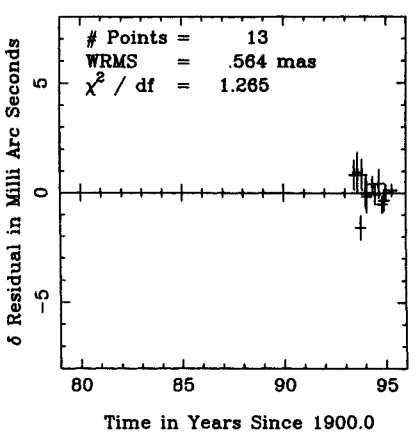
Arc Solution for 1357+769 : δ



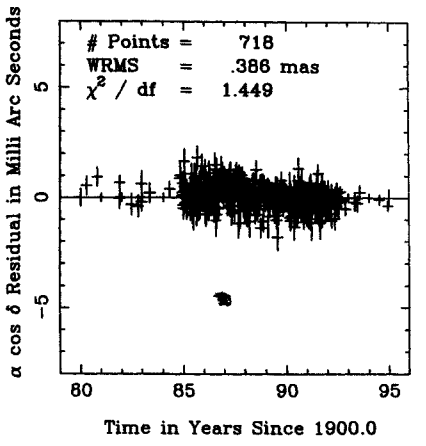
Arc Solution for 1402+044 : α cos δ



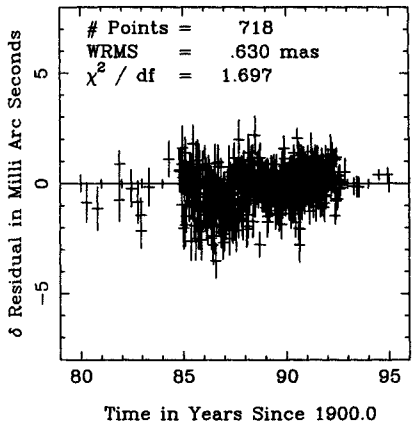
Arc Solution for 1402+044 : δ



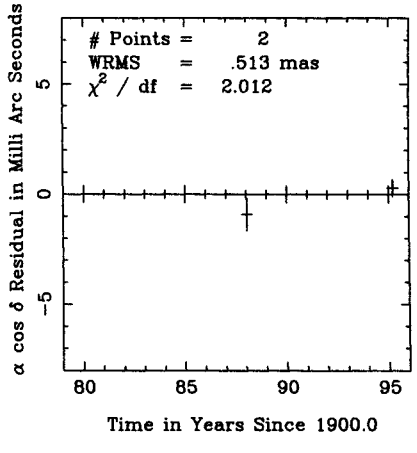
Arc Solution for 1404+286 : α cos δ



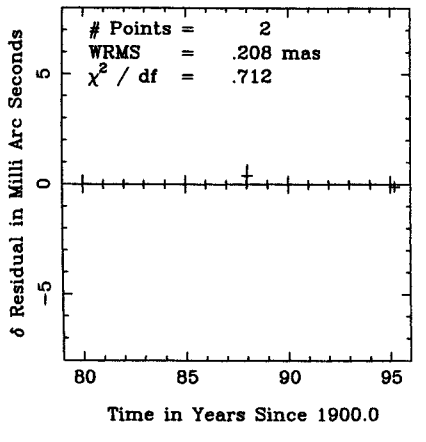
Arc Solution for 1404+286 : δ



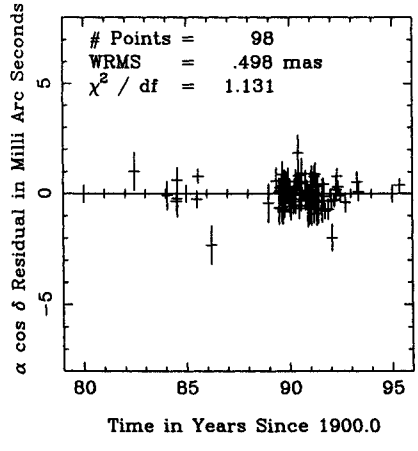
Arc Solution for 1406−076 : α cos δ



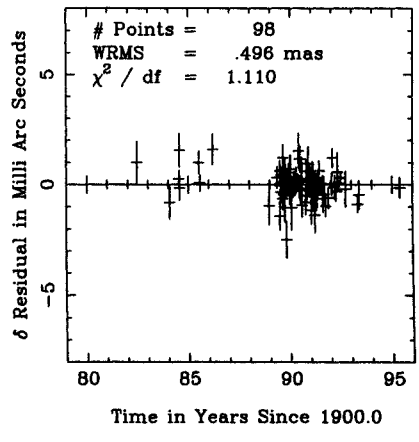
Arc Solution for 1406−076 : δ



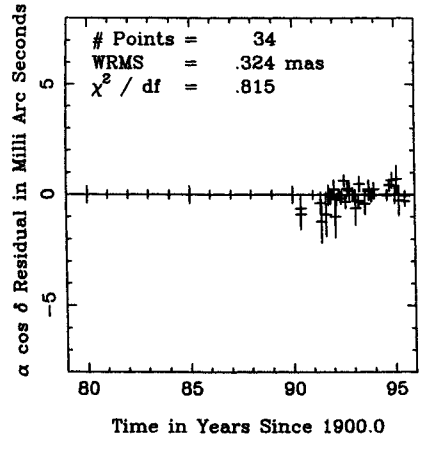
Arc Solution for 1418+546 : α cos δ



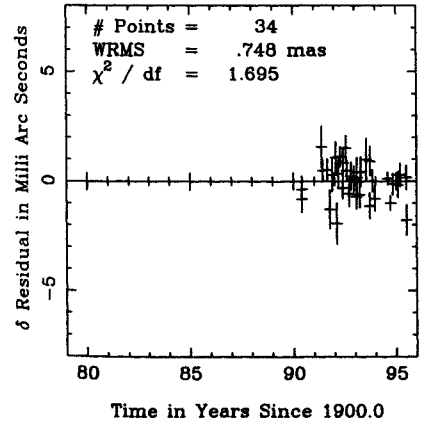
Arc Solution for 1418+546 : δ



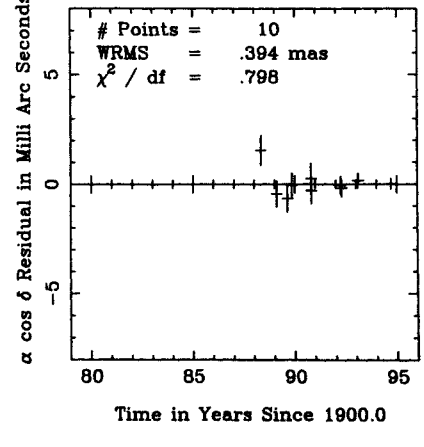
Arc Solution for 1424−418 : α cos δ



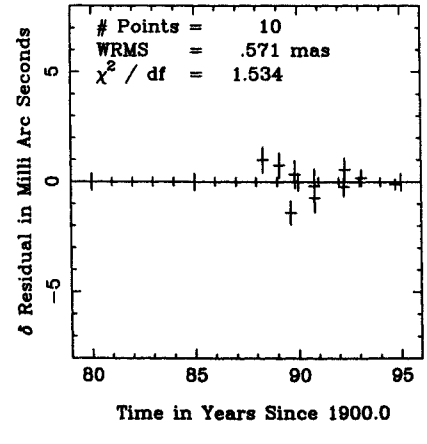
Arc Solution for 1424−418 : δ



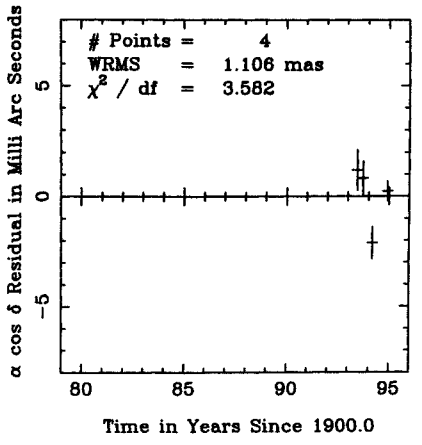
Arc Solution for 1435+638 : α cos δ



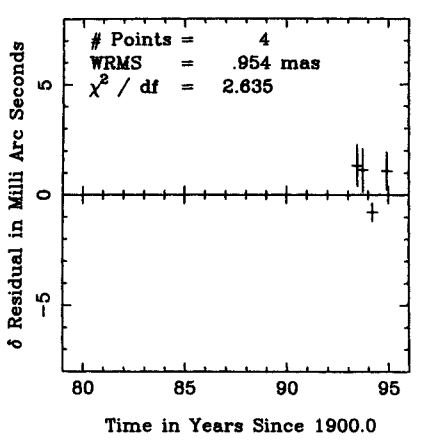
Arc Solution for 1435+638 : δ



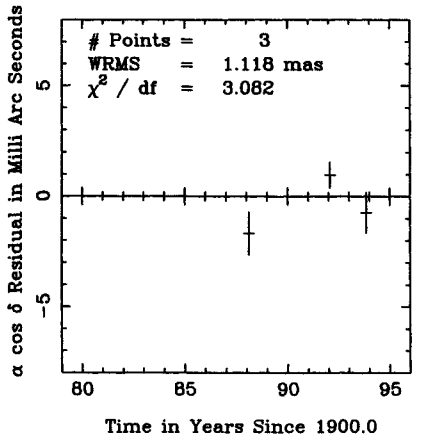
Arc Solution for 1442+101 : $\alpha \cos \delta$



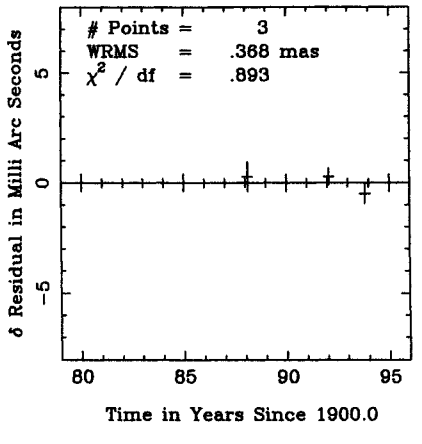
Arc Solution for 1442+101 : δ



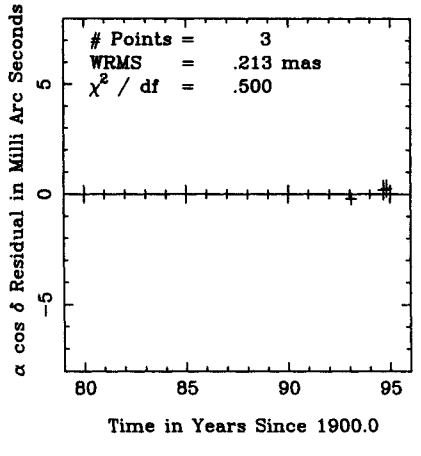
Arc Solution for 1448+762 : $\alpha \cos \delta$



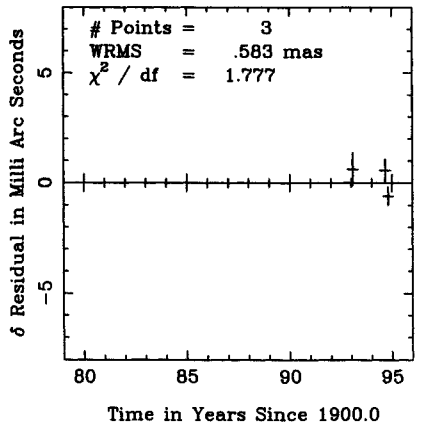
Arc Solution for 1448+762 : δ



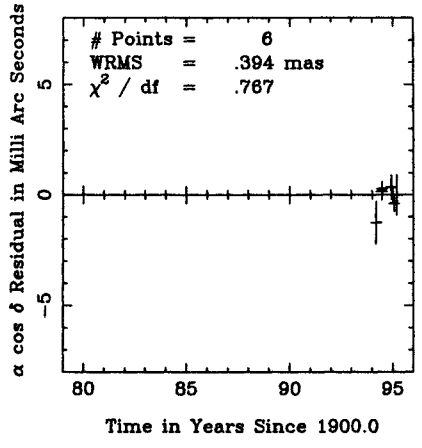
Arc Solution for 1451−375 : $\alpha \cos \delta$



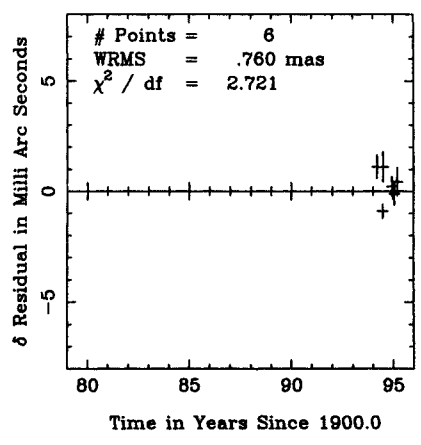
Arc Solution for 1451−375 : δ



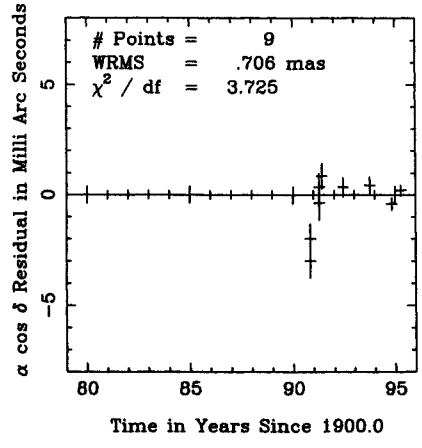
Arc Solution for 1451−400 : $\alpha \cos \delta$



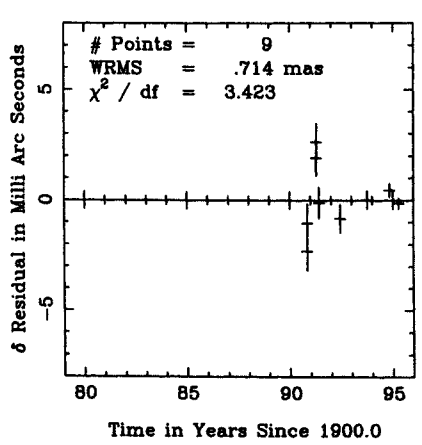
Arc Solution for 1451−400 : δ



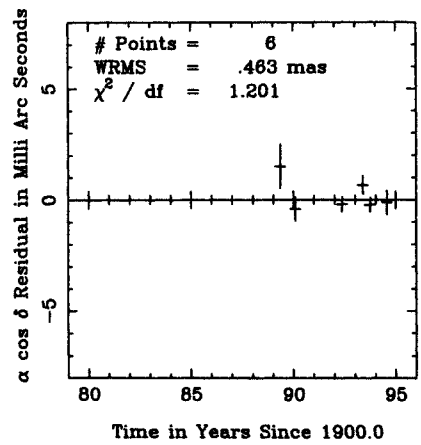
Arc Solution for 1458+718 : $\alpha \cos \delta$



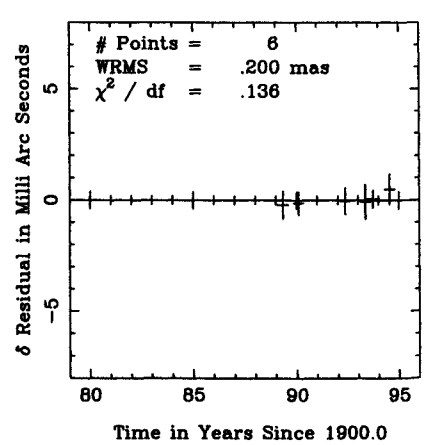
Arc Solution for 1458+718 : δ



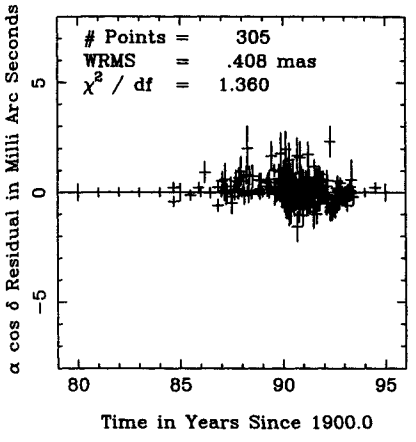
Arc Solution for 1459+480 : $\alpha \cos \delta$



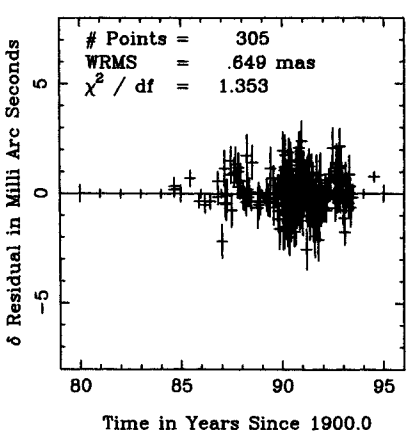
Arc Solution for 1459+480 : δ



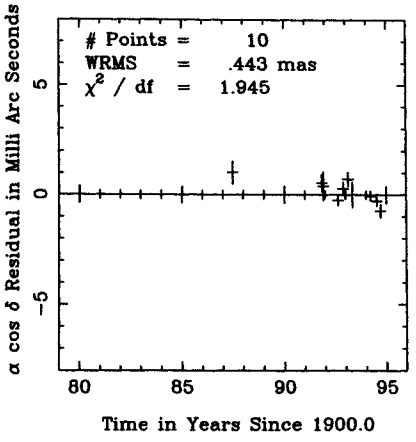
Arc Solution for 1502+106 : α cos δ



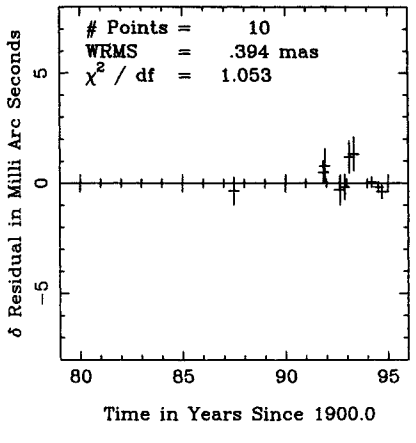
Arc Solution for 1502+106 : δ



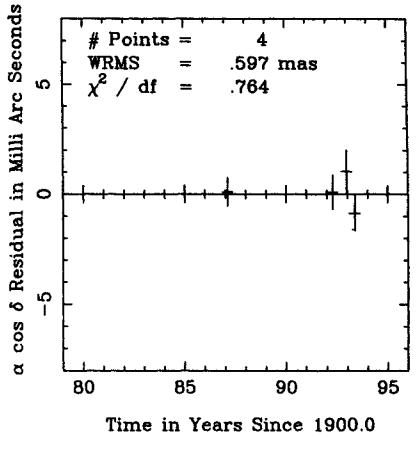
Arc Solution for 1504+377 : α cos δ



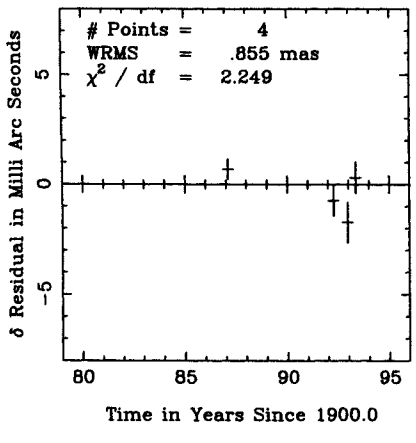
Arc Solution for 1504+377 : δ



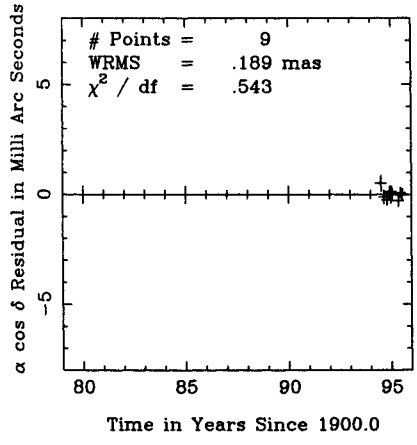
Arc Solution for 1504−166 : α cos δ



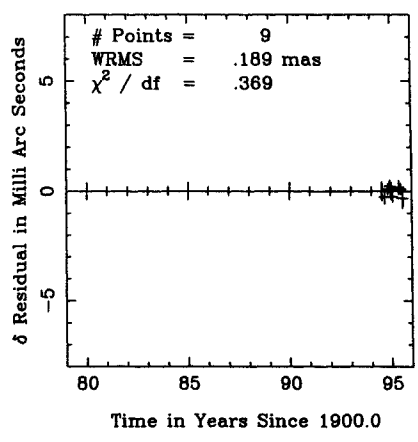
Arc Solution for 1504−166 : δ



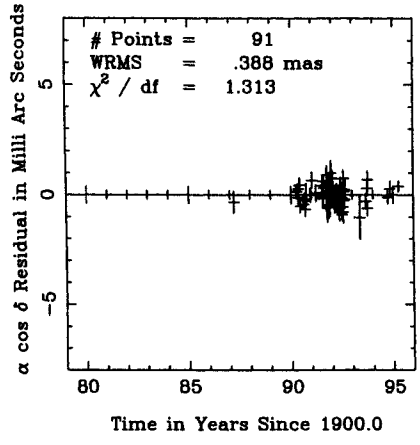
Arc Solution for 1508+572 : α cos δ



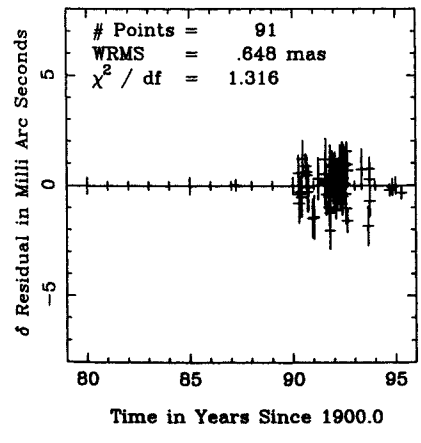
Arc Solution for 1508+572 : δ



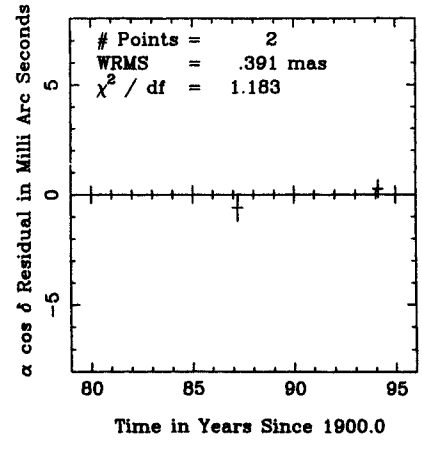
Arc Solution for 1510−089 : α cos δ



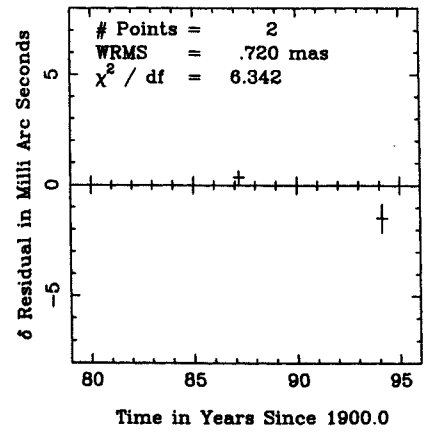
Arc Solution for 1510−089 : δ



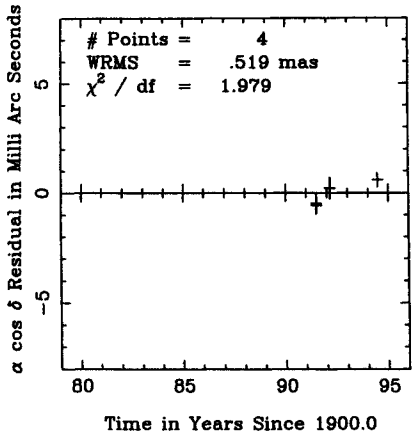
Arc Solution for 1511−100 : α cos δ



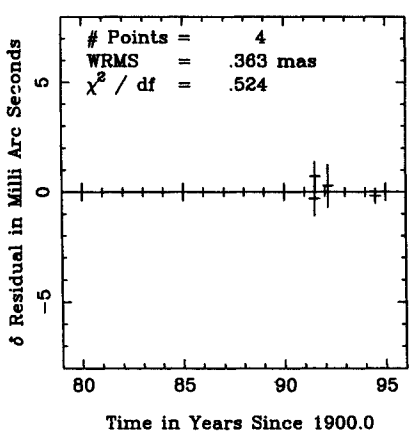
Arc Solution for 1511−100 : δ



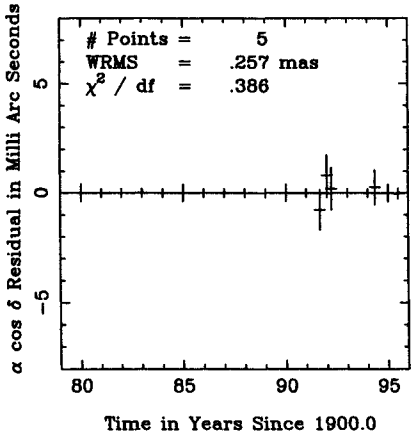
Arc Solution for 1514+197 : $\alpha \cos \delta$



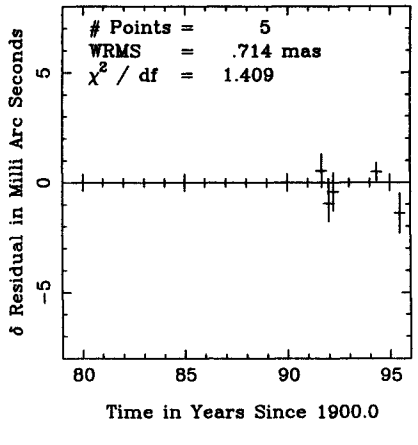
Arc Solution for 1514+197 : δ



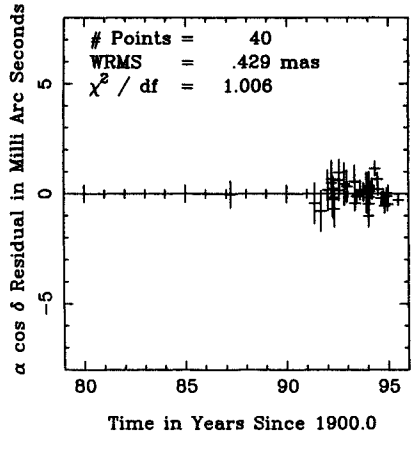
Arc Solution for 1514−241 : $\alpha \cos \delta$



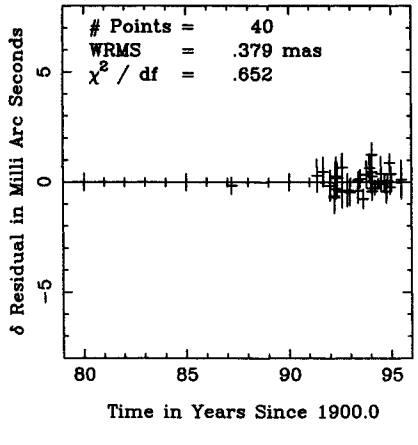
Arc Solution for 1514−241 : δ



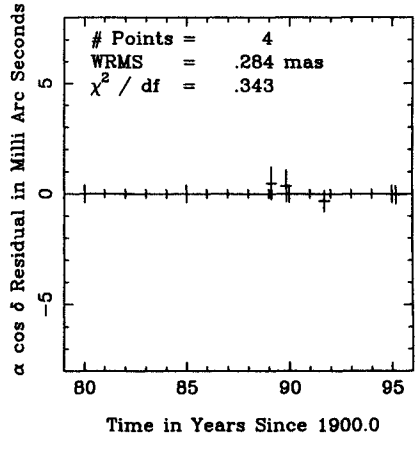
Arc Solution for 1519−273 : $\alpha \cos \delta$



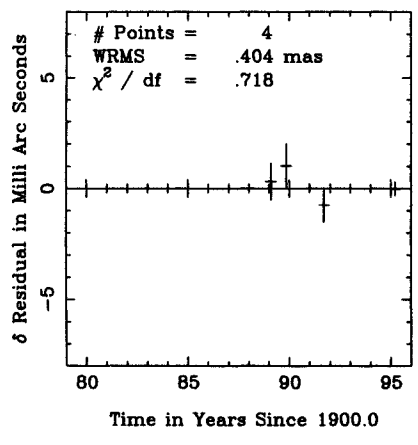
Arc Solution for 1519−273 : δ



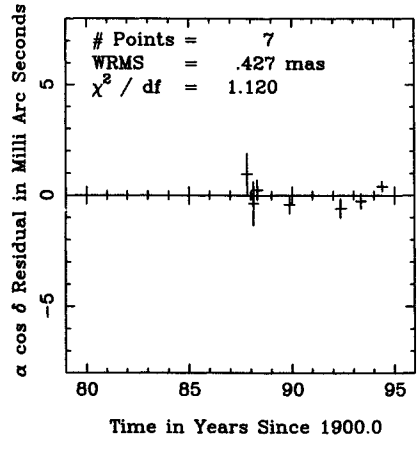
Arc Solution for 1538+149 : $\alpha \cos \delta$



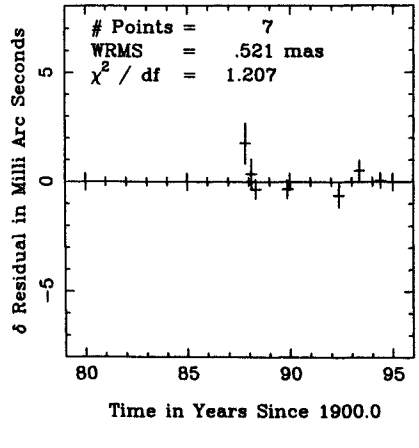
Arc Solution for 1538+149 : δ



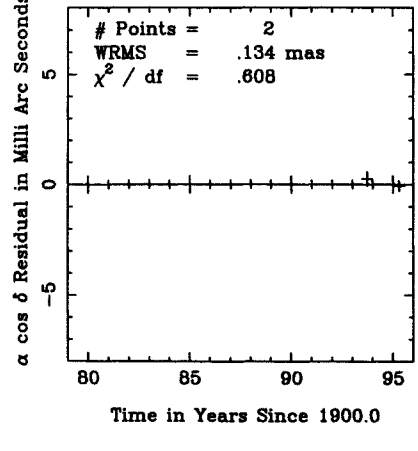
Arc Solution for 1547+507 : $\alpha \cos \delta$



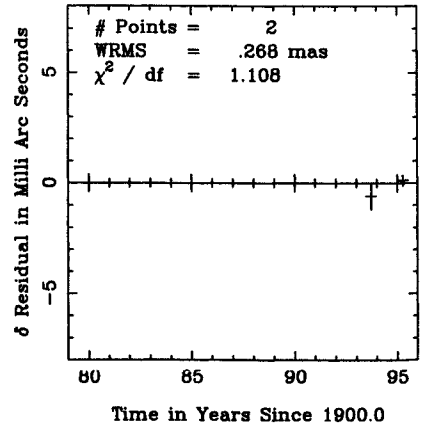
Arc Solution for 1547+507 : δ



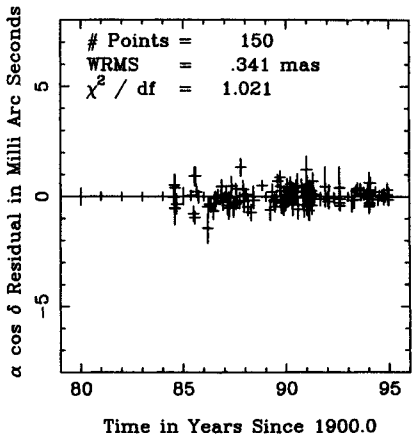
Arc Solution for 1546+027 : $\alpha \cos \delta$



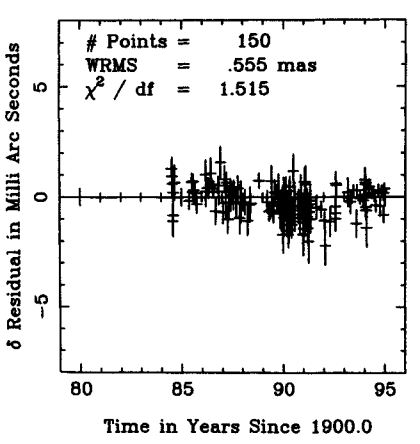
Arc Solution for 1546+027 : δ



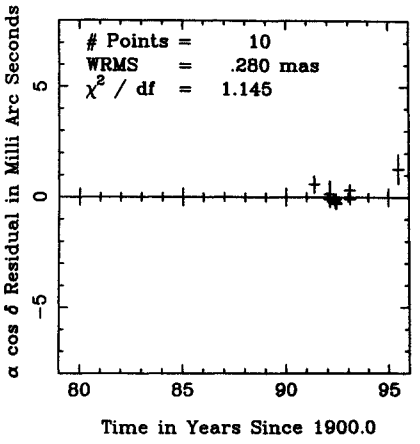
Arc Solution for 1548+056 : $\alpha \cos \delta$



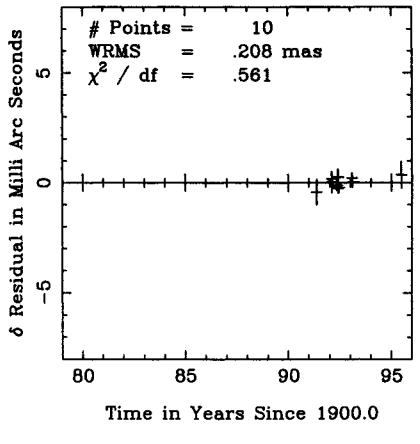
Arc Solution for 1548+056 : δ



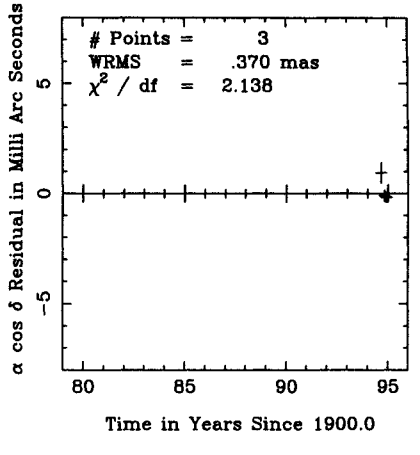
Arc Solution for 1549−790 : $\alpha \cos \delta$



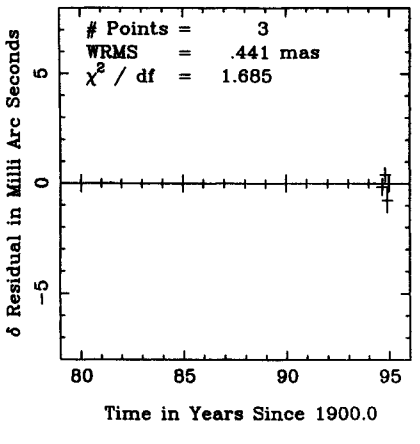
Arc Solution for 1549−790 : δ



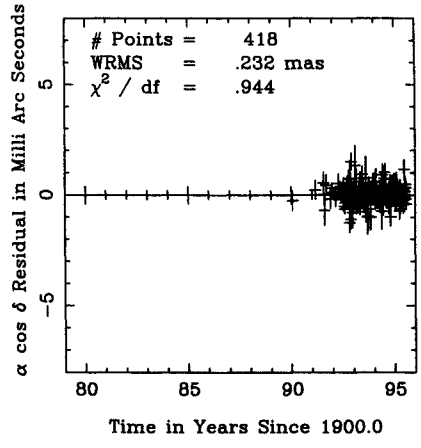
Arc Solution for 1557+032 : $\alpha \cos \delta$



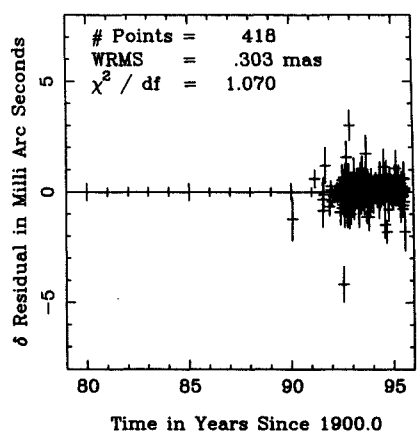
Arc Solution for 1557+032 : δ



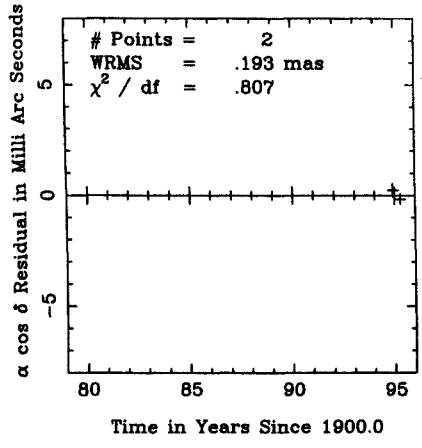
Arc Solution for 1606+106 : $\alpha \cos \delta$



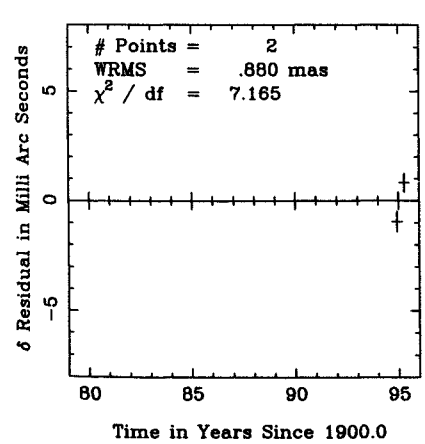
Arc Solution for 1606+106 : δ



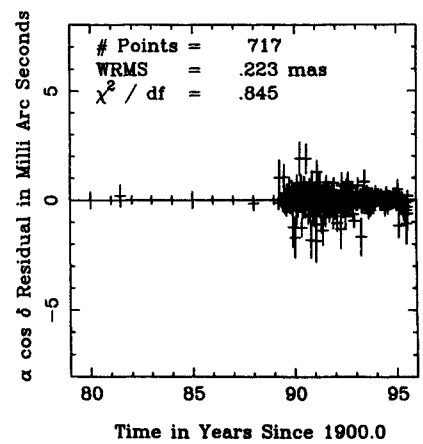
Arc Solution for 1607+268 : $\alpha \cos \delta$



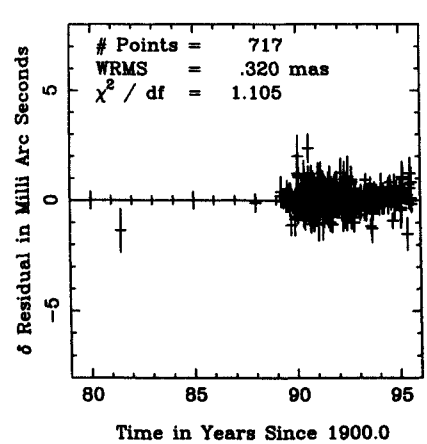
Arc Solution for 1607+268 : δ

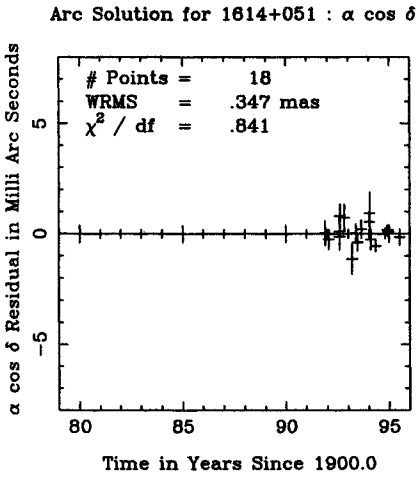


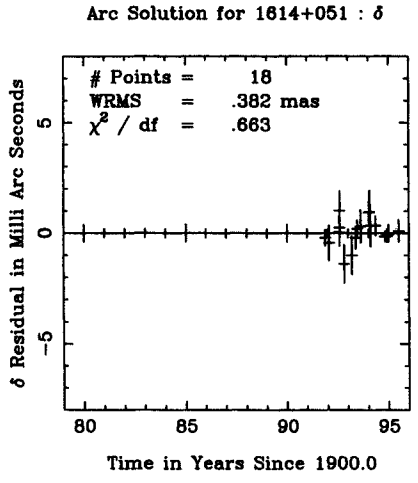
Arc Solution for 1611+343 : $\alpha \cos \delta$

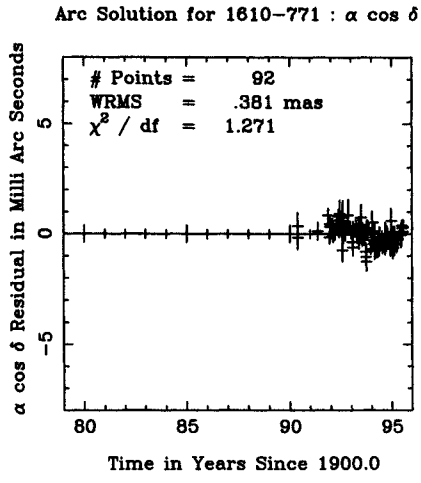


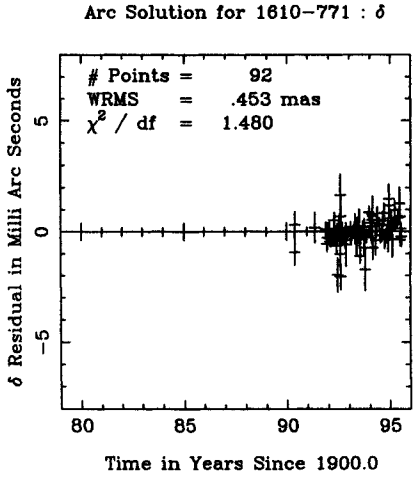
Arc Solution for 1611+343 : δ

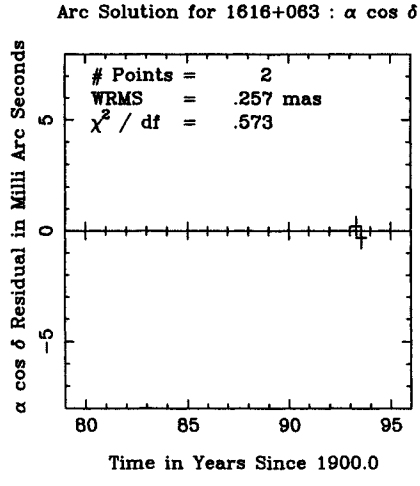


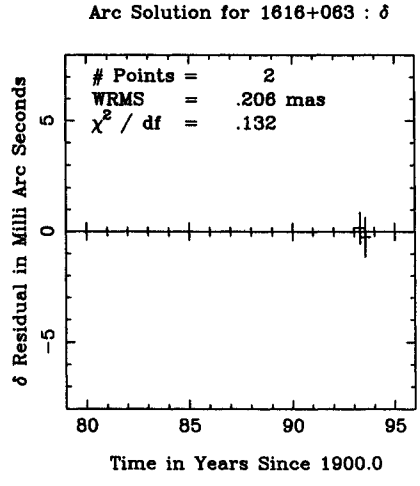

Arc Solution for 1614+051 : α cos δ
# Points = 18
WRMS = .347 mas
χ² / df = .841
α cos δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

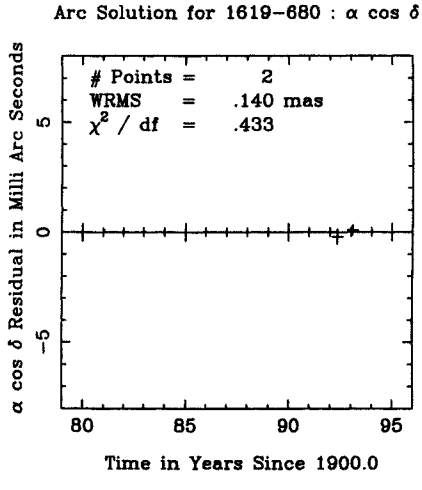

Arc Solution for 1614+051 : δ
# Points = 18
WRMS = .382 mas
χ² / df = .663
δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

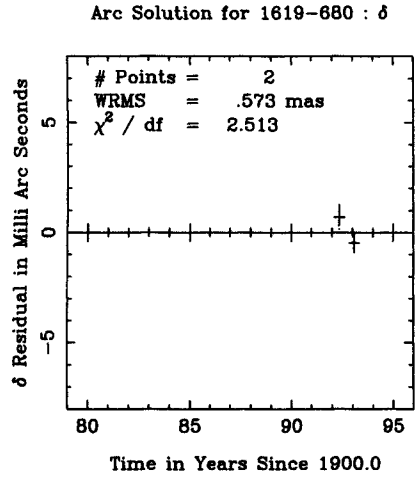

Arc Solution for 1610−771 : α cos δ
# Points = 92
WRMS = .381 mas
χ² / df = 1.271
α cos δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

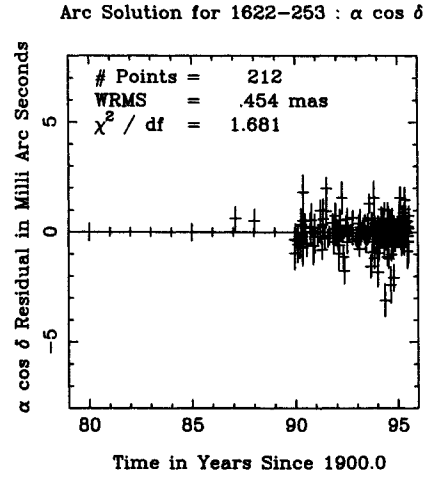

Arc Solution for 1610−771 : δ
# Points = 92
WRMS = .453 mas
χ² / df = 1.480
δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

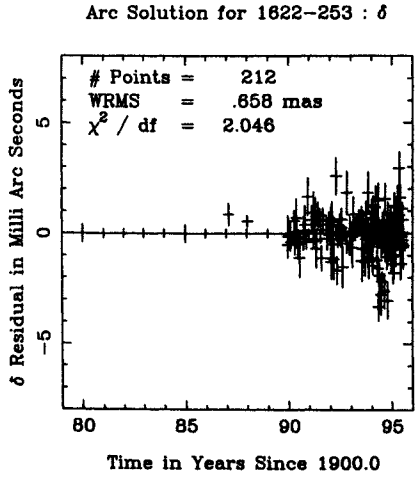

Arc Solution for 1616+063 : α cos δ
# Points = 2
WRMS = .257 mas
χ² / df = .573
α cos δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

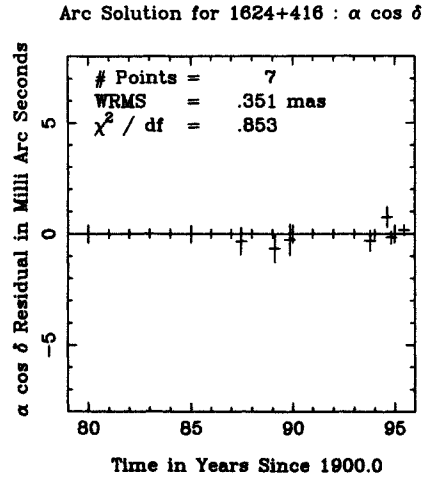

Arc Solution for 1616+063 : δ
# Points = 2
WRMS = .206 mas
χ² / df = .132
δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

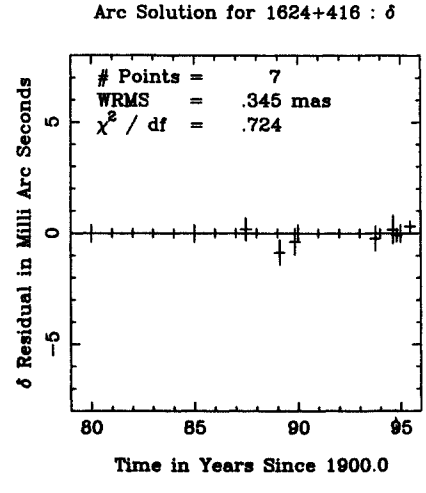

Arc Solution for 1619−680 : α cos δ
# Points = 2
WRMS = .140 mas
χ² / df = .433
α cos δ Residual in Milli Arc Seconds
Time in Years Since 1900.0


Arc Solution for 1619−680 : δ
# Points = 2
WRMS = .573 mas
χ² / df = 2.513
δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

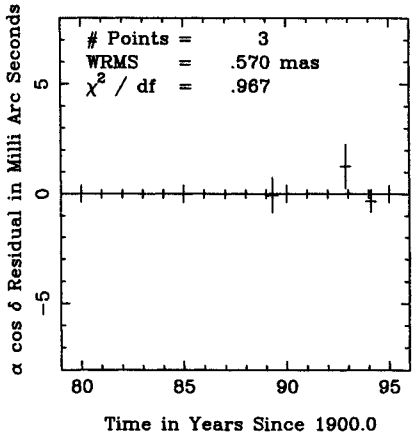

Arc Solution for 1622−253 : α cos δ
# Points = 212
WRMS = .454 mas
χ² / df = 1.681
α cos δ Residual in Milli Arc Seconds
Time in Years Since 1900.0


Arc Solution for 1622−253 : δ
# Points = 212
WRMS = .658 mas
χ² / df = 2.046
δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

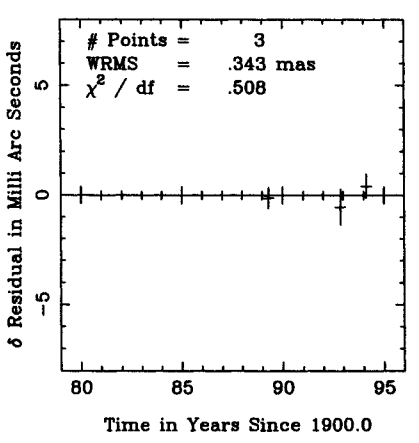

Arc Solution for 1624+416 : α cos δ
# Points = 7
WRMS = .351 mas
χ² / df = .853
α cos δ Residual in Milli Arc Seconds
Time in Years Since 1900.0


Arc Solution for 1624+416 : δ
# Points = 7
WRMS = .345 mas
χ² / df = .724
δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

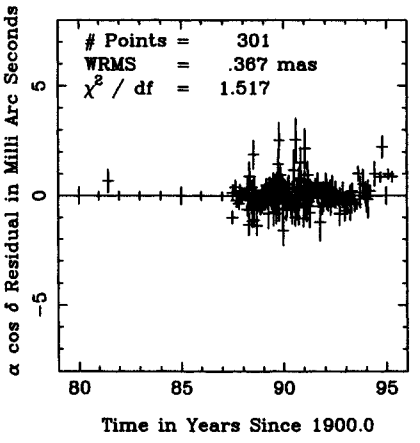
Arc Solution for 1622−297 : α cos δ



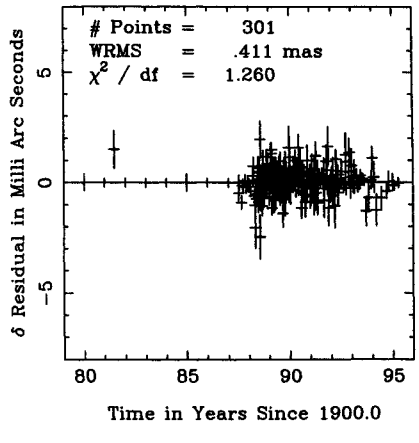
Arc Solution for 1622−297 : δ



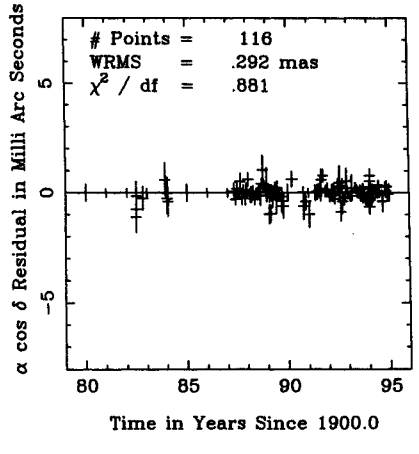
Arc Solution for 1633+382 : α cos δ



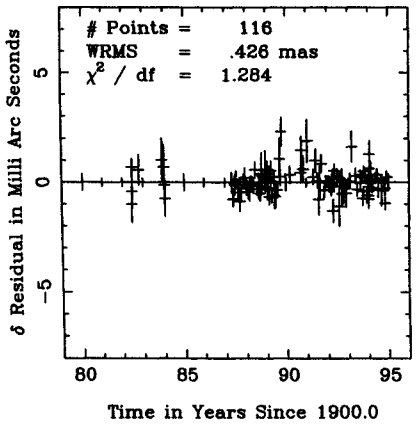
Arc Solution for 1633+382 : δ



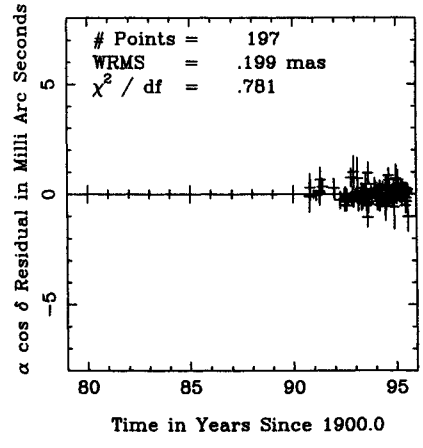
Arc Solution for 1637+574 : α cos δ



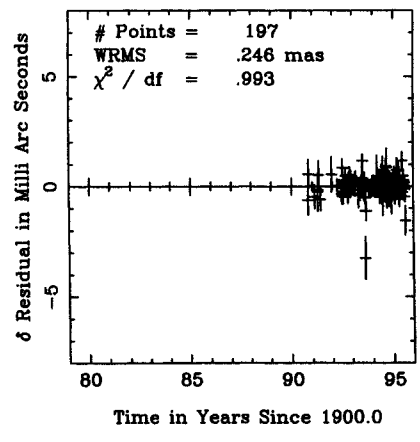
Arc Solution for 1637+574 : δ



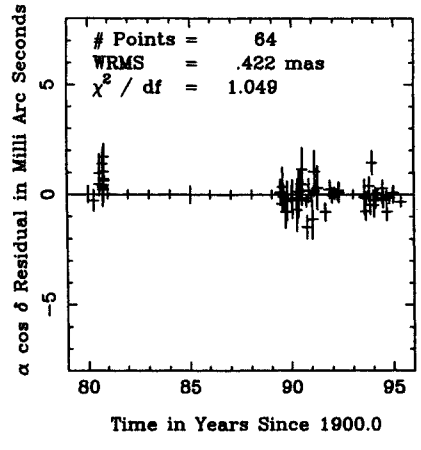
Arc Solution for 1638+398 : α cos δ



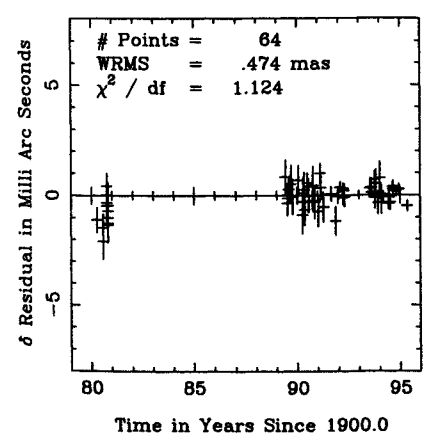
Arc Solution for 1638+398 : δ



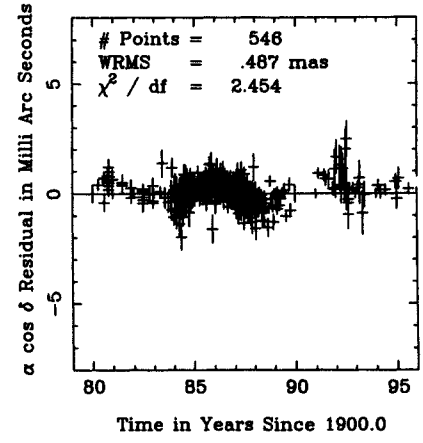
Arc Solution for 1642+690 : α cos δ



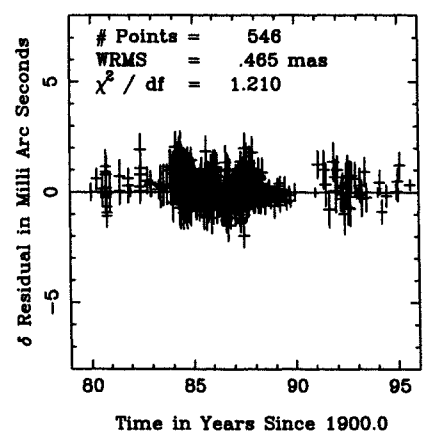
Arc Solution for 1642+690 : δ



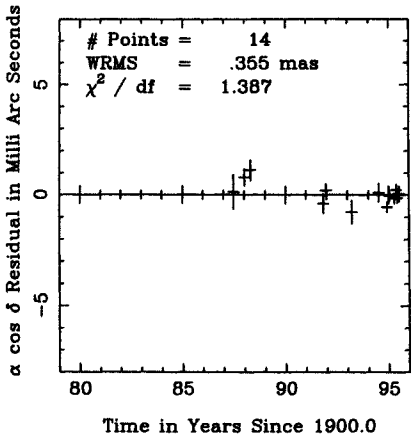
Arc Solution for 1641+399 : α cos δ



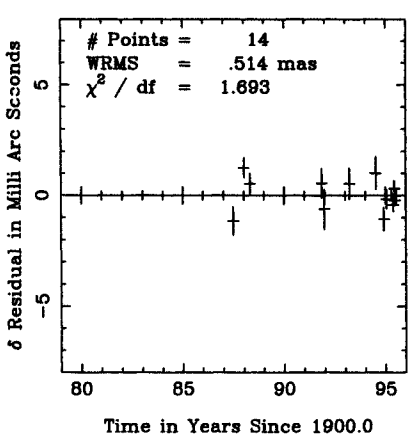
Arc Solution for 1641+399 : δ



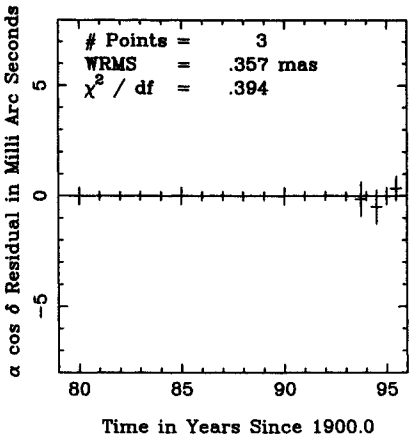
Arc Solution for 1652+398 : α cos δ



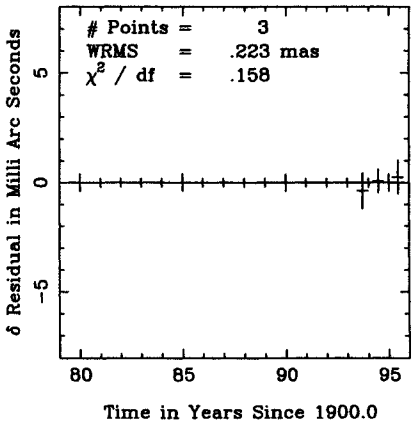
Arc Solution for 1652+398 : δ



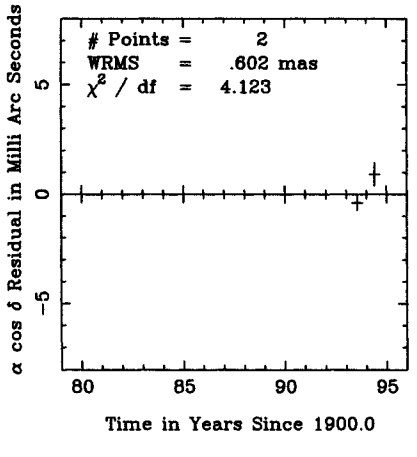
Arc Solution for 1656+348 : α cos δ



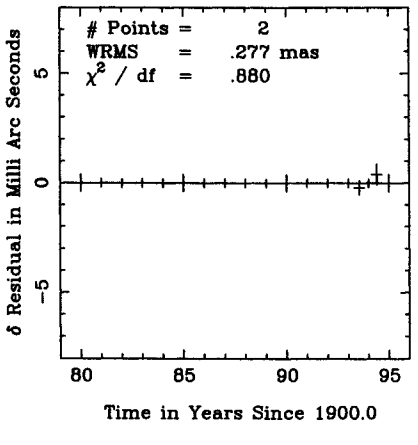
Arc Solution for 1656+348 : δ



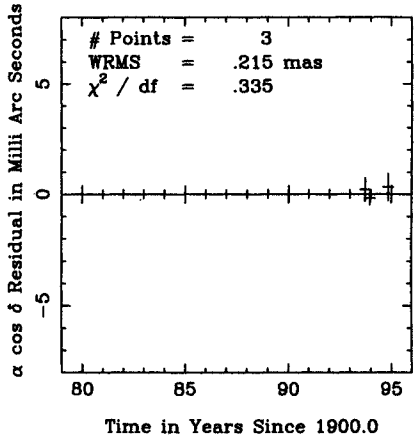
Arc Solution for 1656+477 : α cos δ



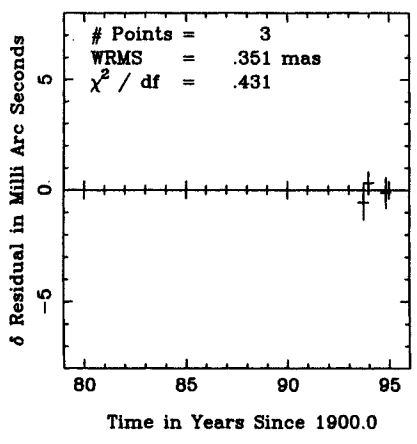
Arc Solution for 1656+477 : δ



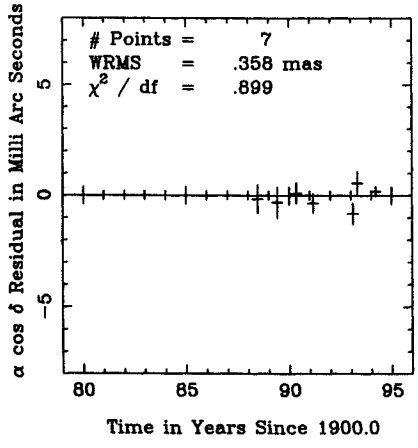
Arc Solution for 1655+077 : α cos δ



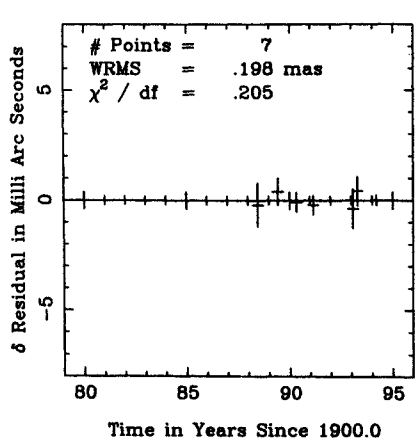
Arc Solution for 1655+077 : δ



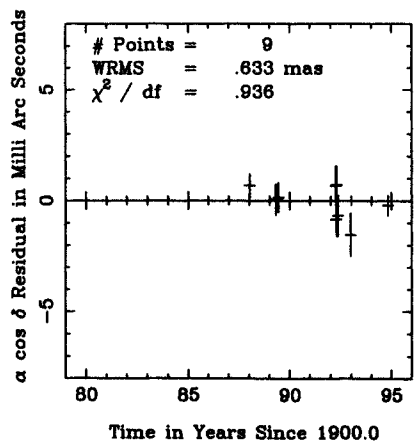
Arc Solution for 1656+053 : α cos δ



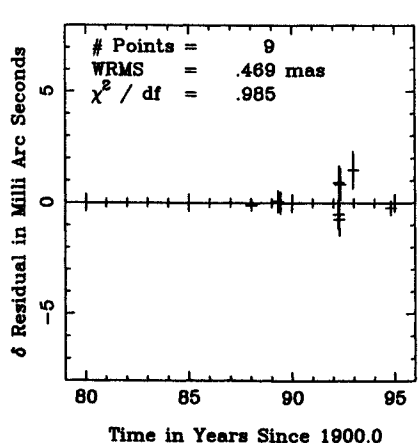
Arc Solution for 1656+053 : δ



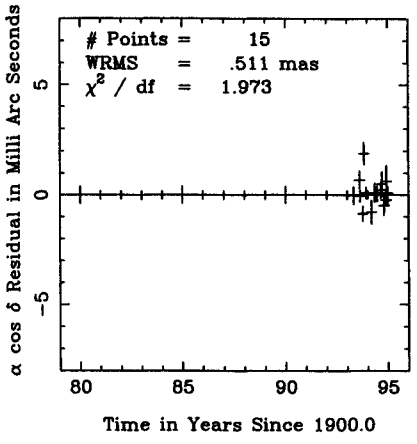
Arc Solution for 1657−261 : α cos δ



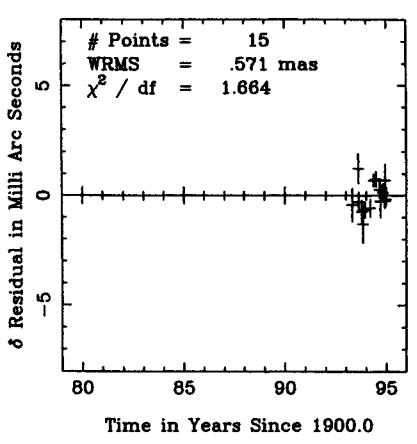
Arc Solution for 1657−261 : δ



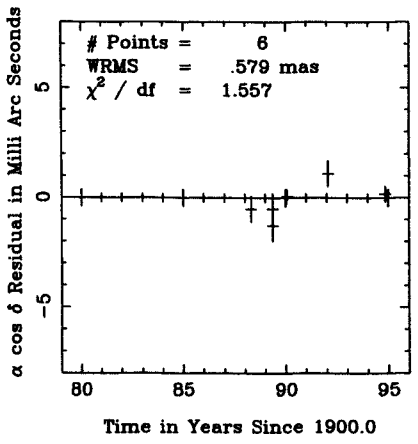
Arc Solution for 1705+018 : $\alpha \cos \delta$



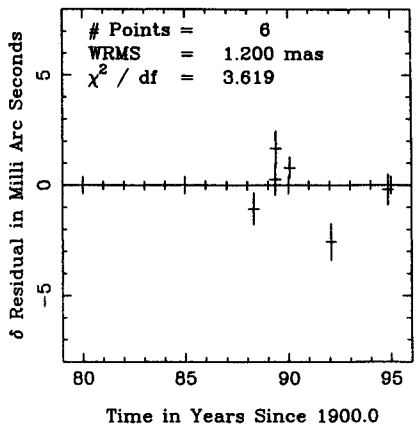
Arc Solution for 1705+018 : δ



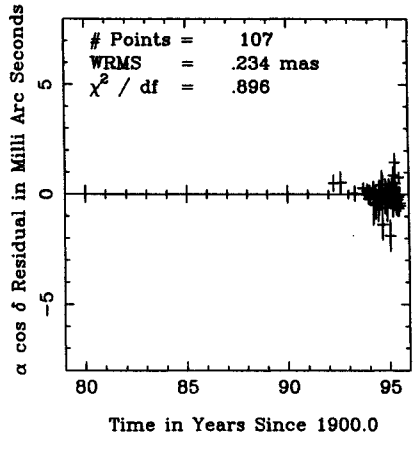
Arc Solution for 1717+178 : $\alpha \cos \delta$



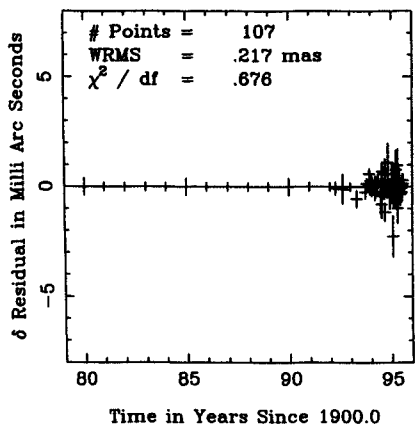
Arc Solution for 1717+178 : δ



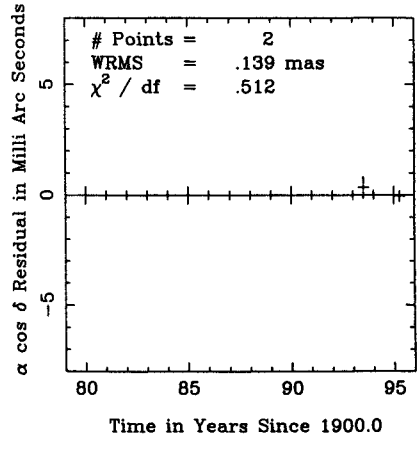
Arc Solution for 1726+455 : $\alpha \cos \delta$



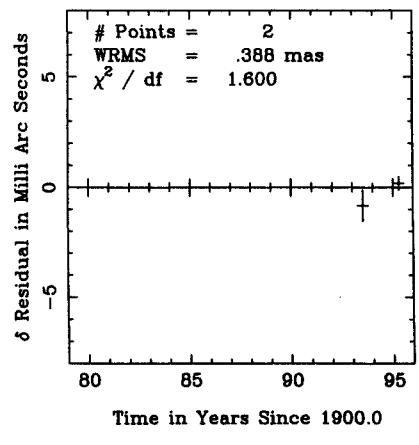
Arc Solution for 1726+455 : δ



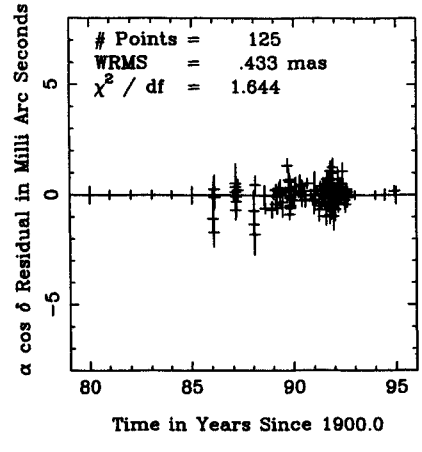
Arc Solution for 1725+044 : $\alpha \cos \delta$



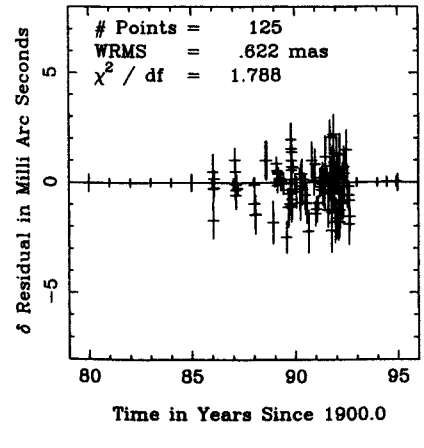
Arc Solution for 1725+044 : δ



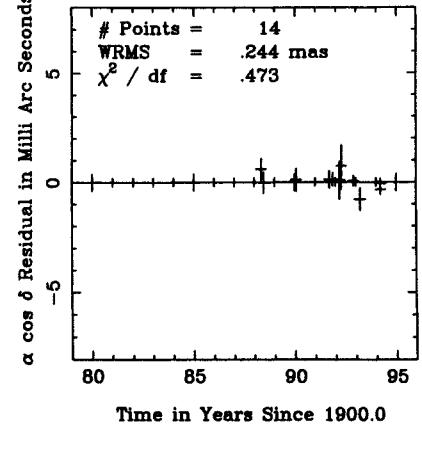
Arc Solution for 1730−130 : $\alpha \cos \delta$



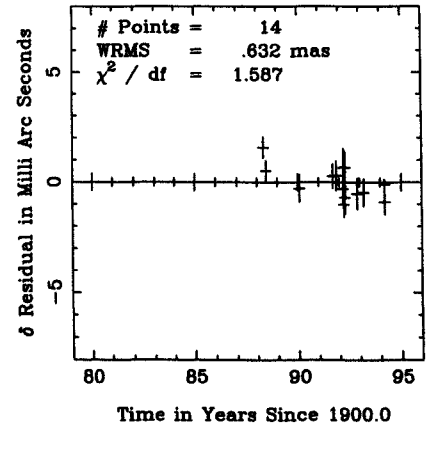
Arc Solution for 1730−130 : δ



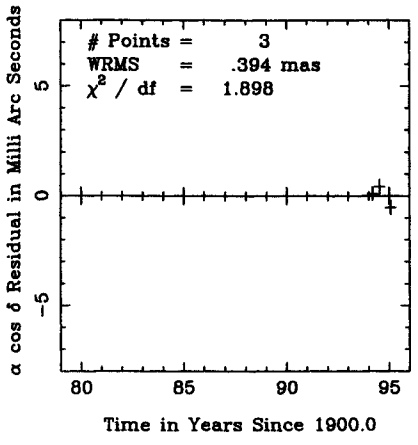
Arc Solution for 1732+389 : $\alpha \cos \delta$



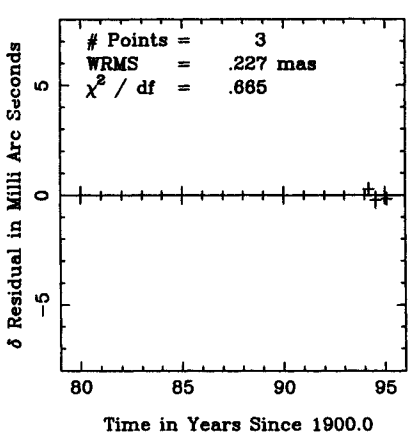
Arc Solution for 1732+389 : δ



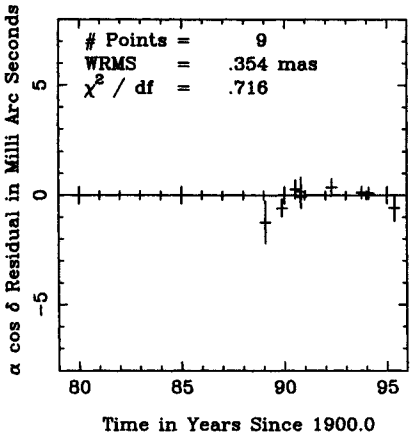
Arc Solution for 1738+499 : α cos δ



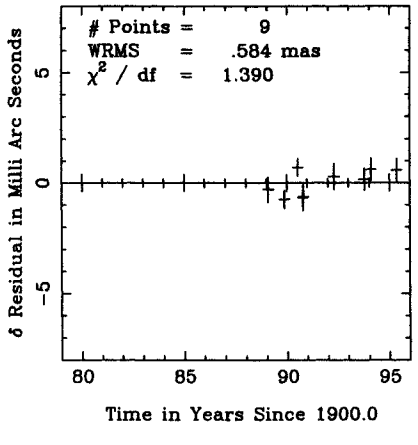
Arc Solution for 1738+499 : δ



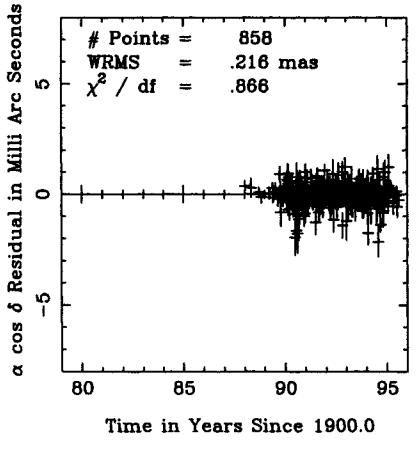
Arc Solution for 1738+476 : α cos δ



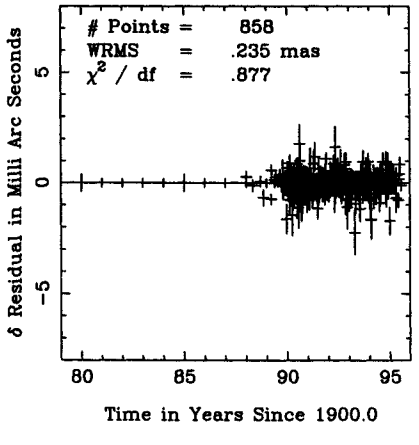
Arc Solution for 1738+476 : δ



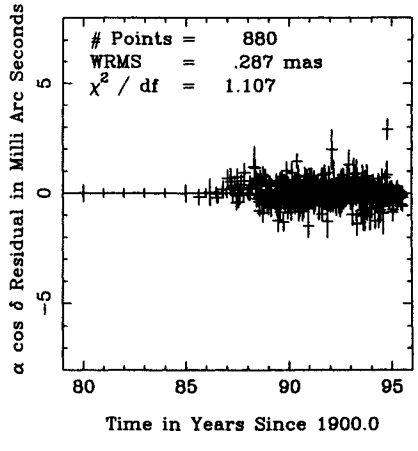
Arc Solution for 1739+522 : α cos δ



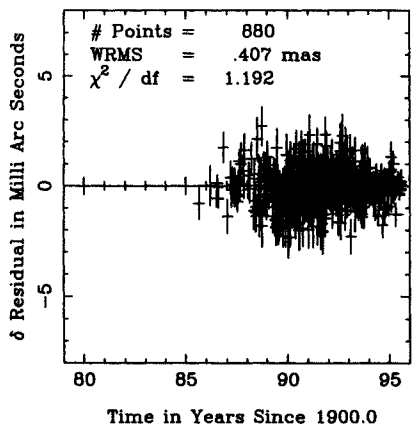
Arc Solution for 1739+522 : δ



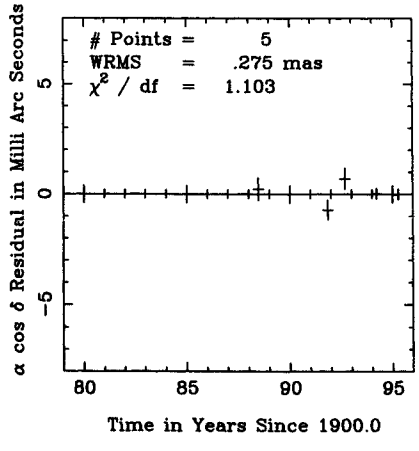
Arc Solution for 1741−038 : α cos δ



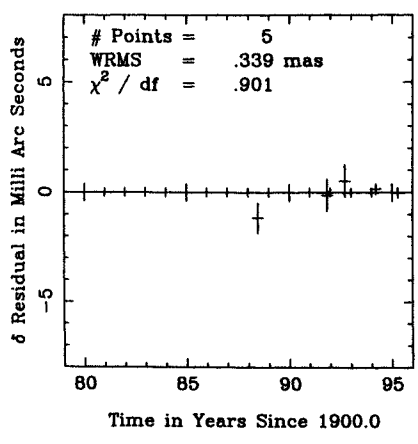
Arc Solution for 1741−038 : δ



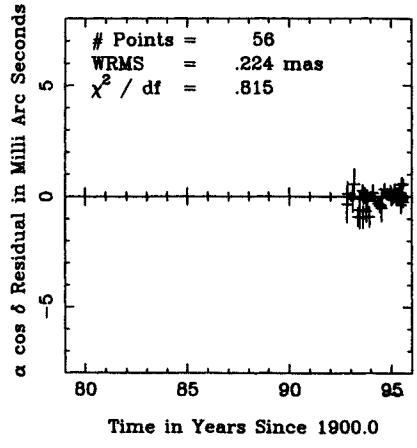
Arc Solution for 1743+173 : α cos δ



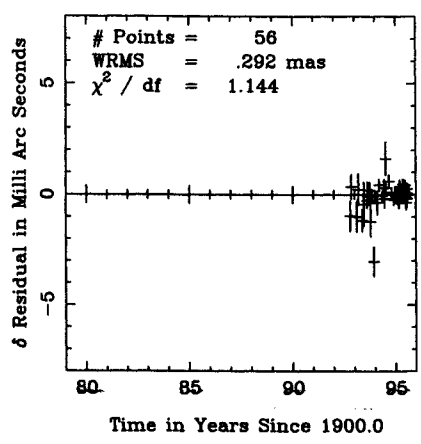
Arc Solution for 1743+173 : δ



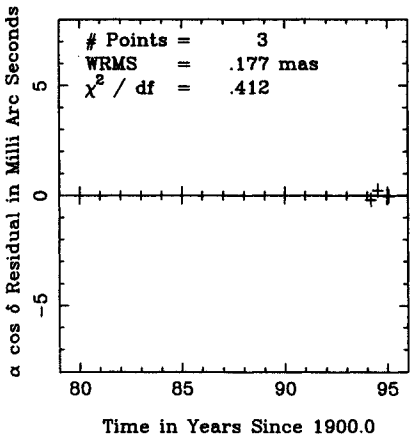
Arc Solution for 1745+624 : α cos δ



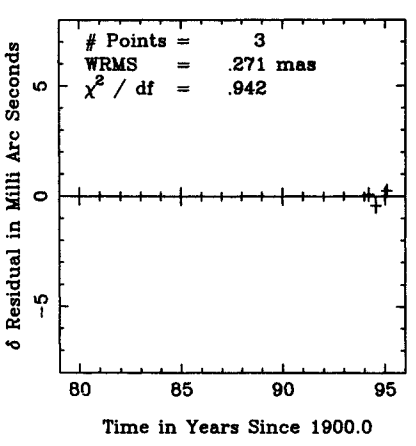
Arc Solution for 1745+624 : δ



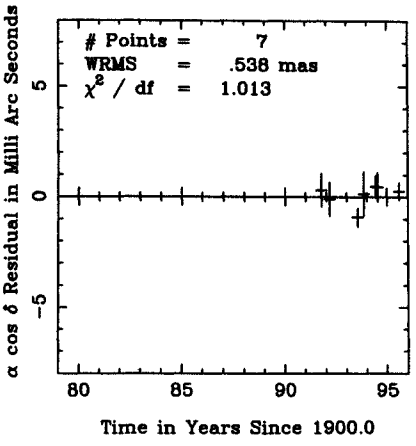
Arc Solution for 1746+470 : $\alpha \cos \delta$



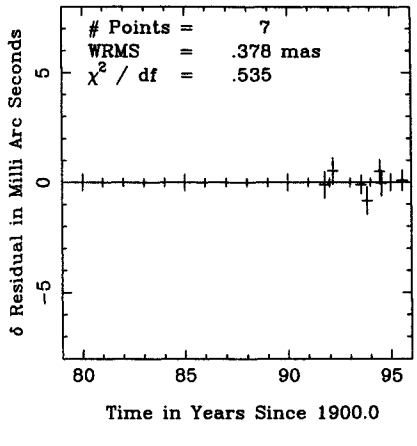
Arc Solution for 1746+470 : δ



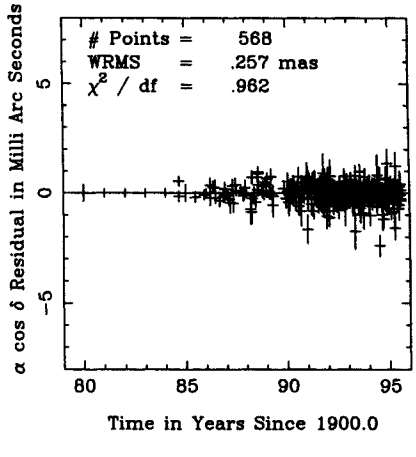
Arc Solution for 1749+701 : $\alpha \cos \delta$



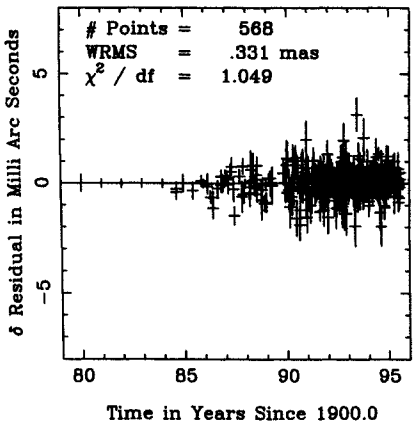
Arc Solution for 1749+701 : δ



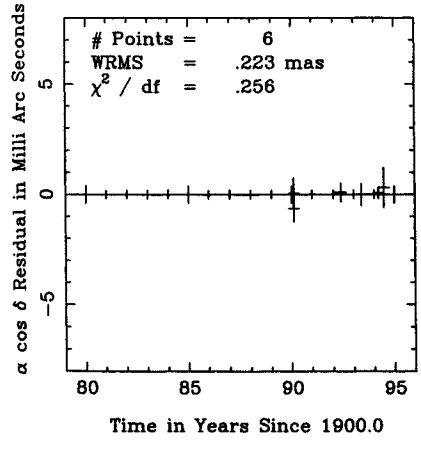
Arc Solution for 1749+096 : $\alpha \cos \delta$



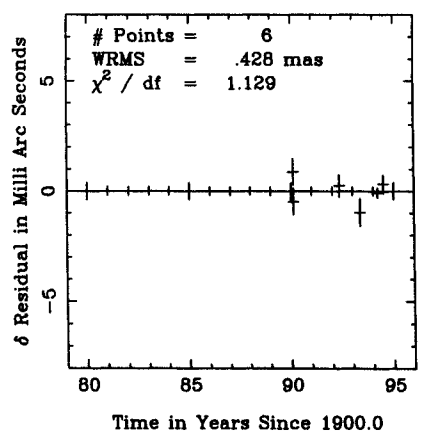
Arc Solution for 1749+096 : δ



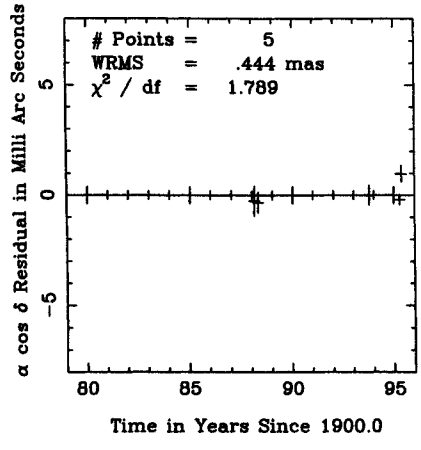
Arc Solution for 1751+441 : $\alpha \cos \delta$



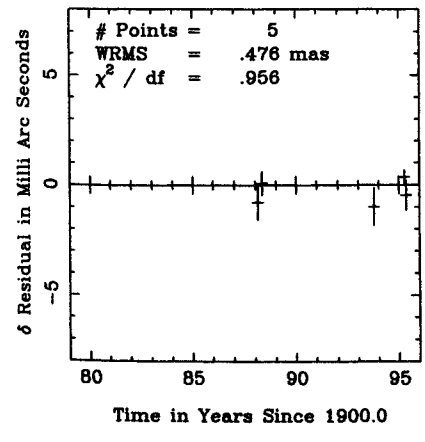
Arc Solution for 1751+441 : δ



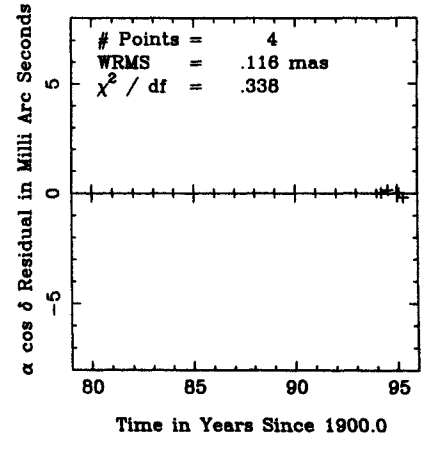
Arc Solution for 1751+288 : $\alpha \cos \delta$



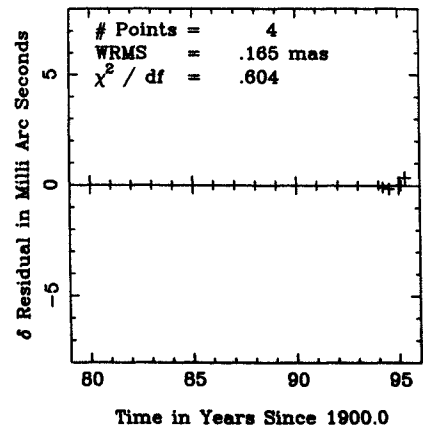
Arc Solution for 1751+288 : δ



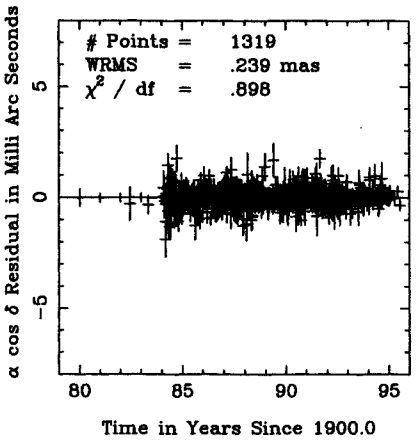
Arc Solution for 1758+388 : $\alpha \cos \delta$



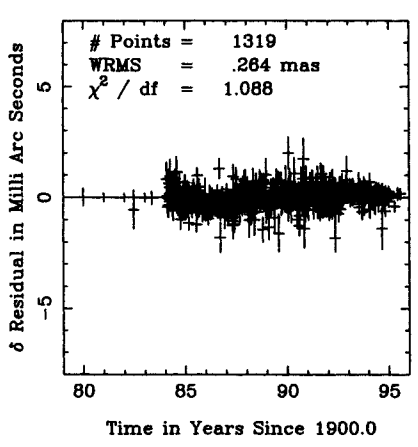
Arc Solution for 1758+388 : δ



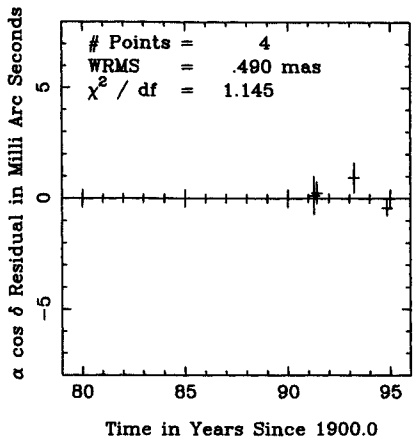
Arc Solution for 1803+784 : α cos δ



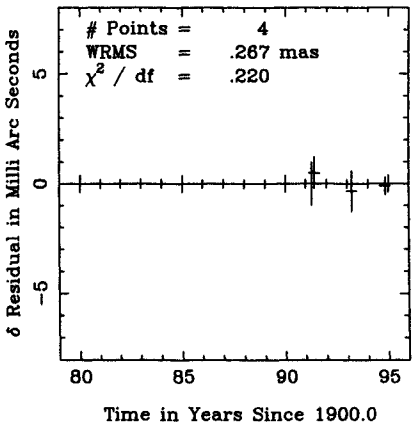
Arc Solution for 1803+784 : δ



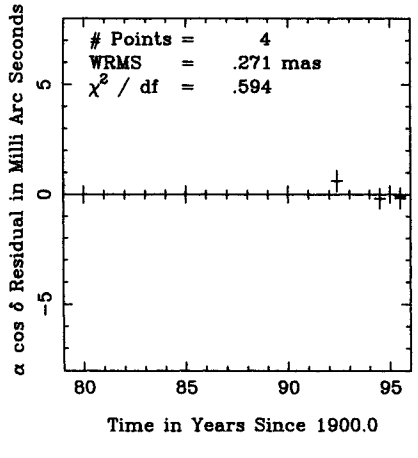
Arc Solution for 1800+440 : α cos δ



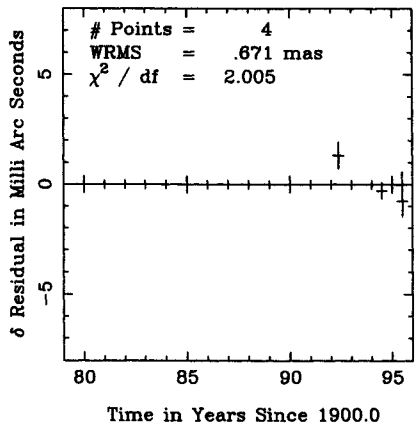
Arc Solution for 1800+440 : δ



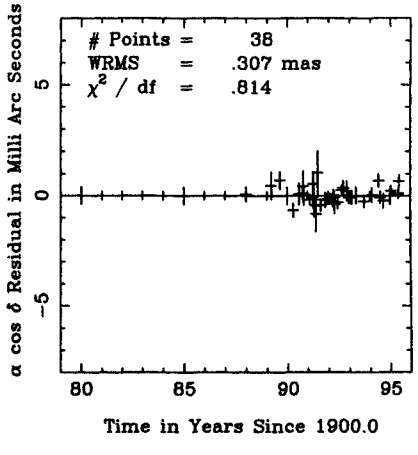
Arc Solution for 1758−651 : α cos δ



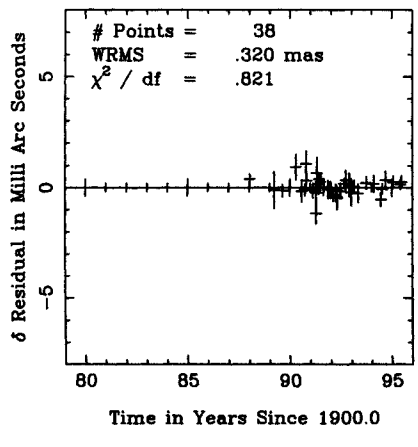
Arc Solution for 1758−651 : δ



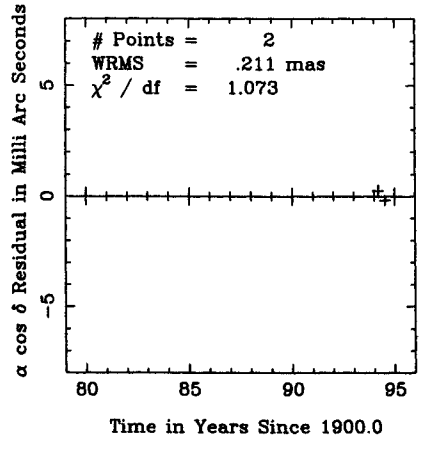
Arc Solution for 1807+698 : α cos δ



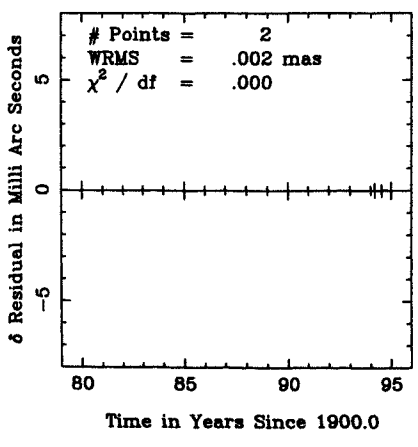
Arc Solution for 1807+698 : δ



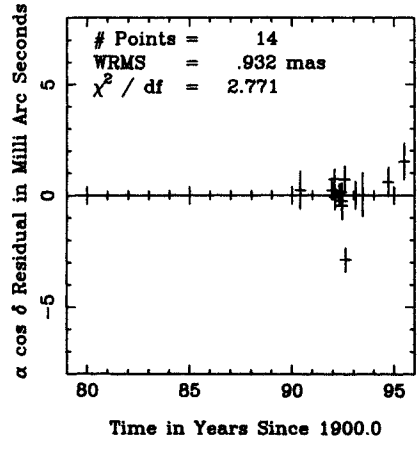
Arc Solution for 1806+456 : α cos δ



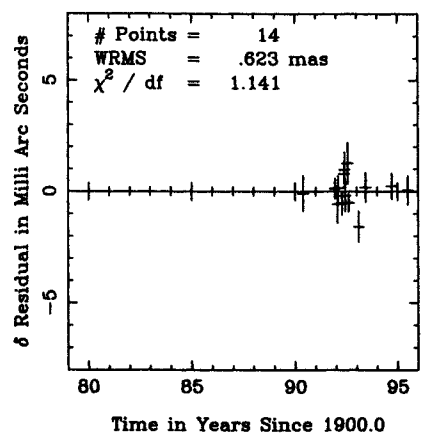
Arc Solution for 1806+456 : δ



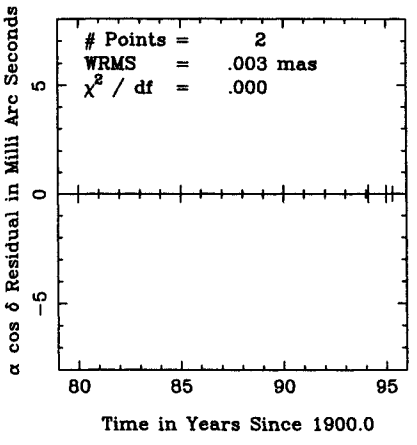
Arc Solution for 1815−553 : α cos δ



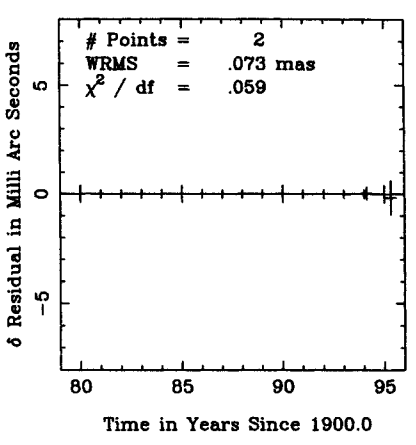
Arc Solution for 1815−553 : δ



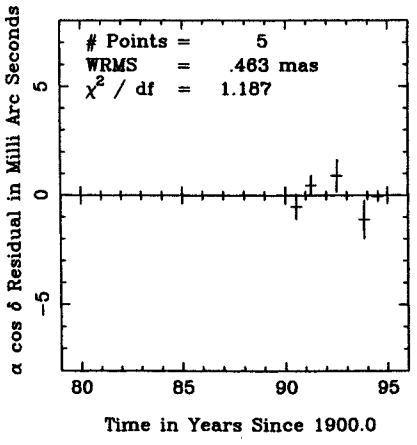
Arc Solution for 1817−254 : α cos δ



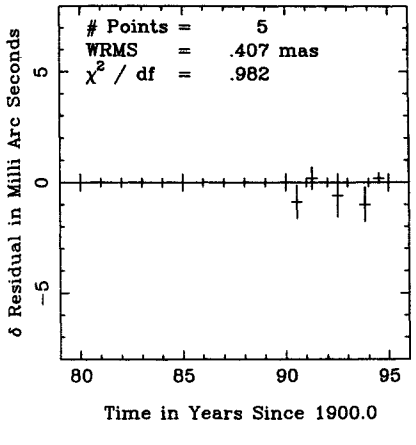
Arc Solution for 1817−254 : δ



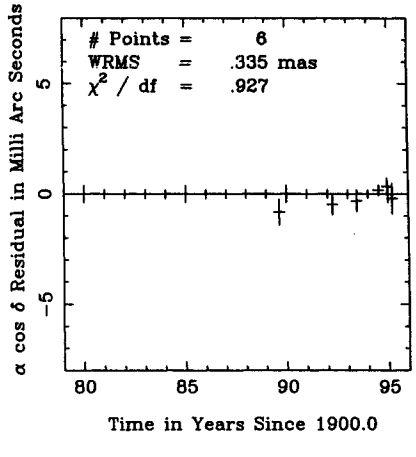
Arc Solution for 1826+796 : α cos δ



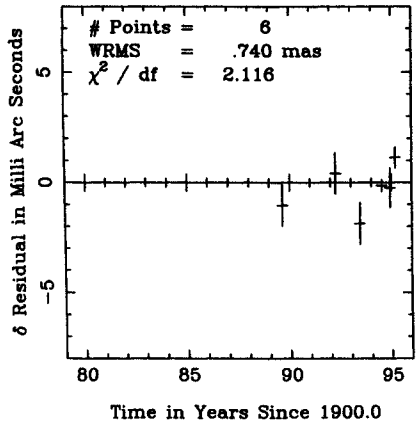
Arc Solution for 1826+796 : δ



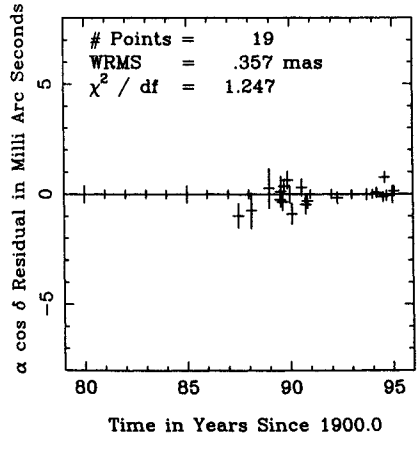
Arc Solution for 1821+107 : α cos δ



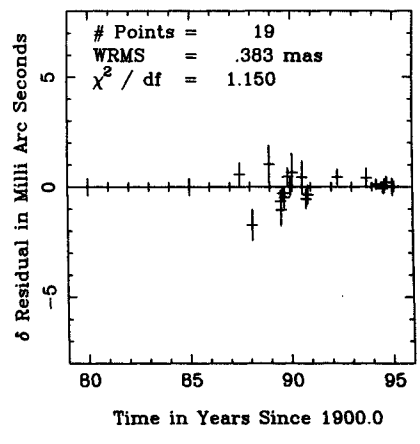
Arc Solution for 1821+107 : δ



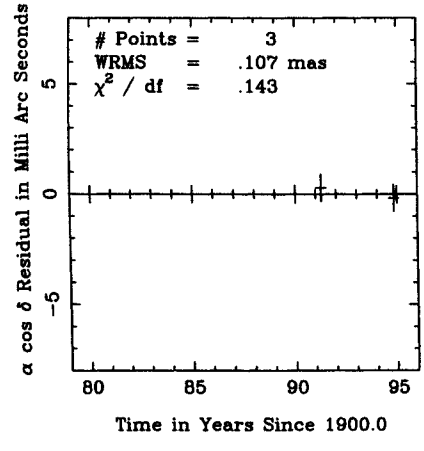
Arc Solution for 1823+568 : α cos δ



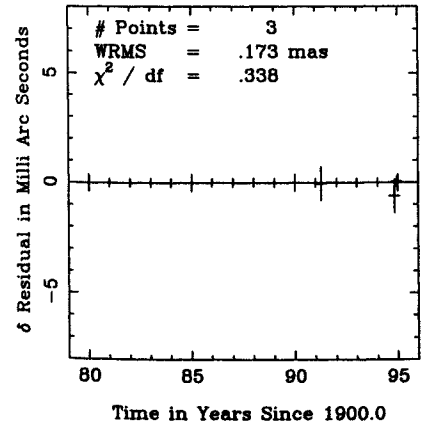
Arc Solution for 1823+568 : δ



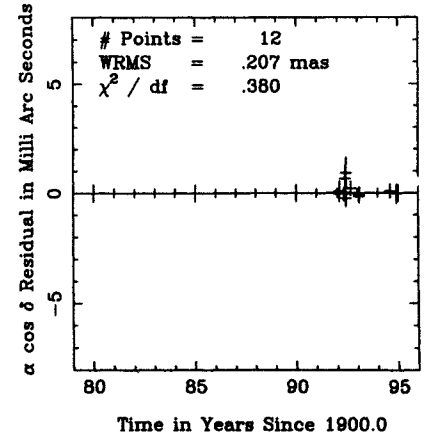
Arc Solution for 1830+285 : α cos δ



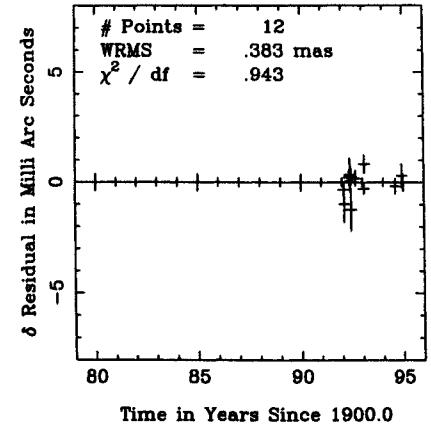
Arc Solution for 1830+285 : δ



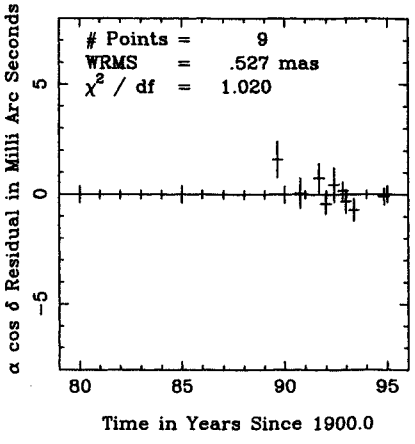
Arc Solution for 1831−711 : α cos δ



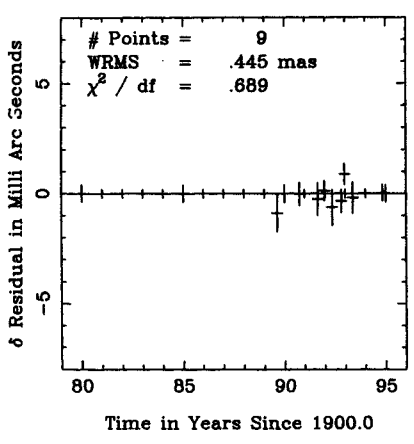
Arc Solution for 1831−711 : δ



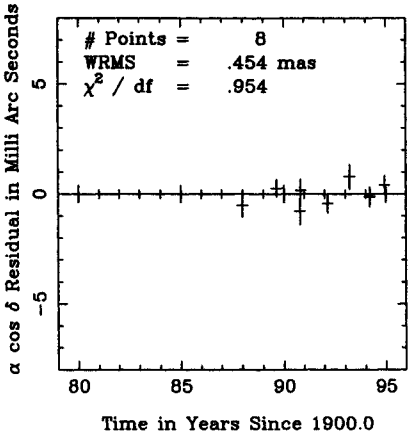
Arc Solution for 1845+797 : $\alpha \cos \delta$



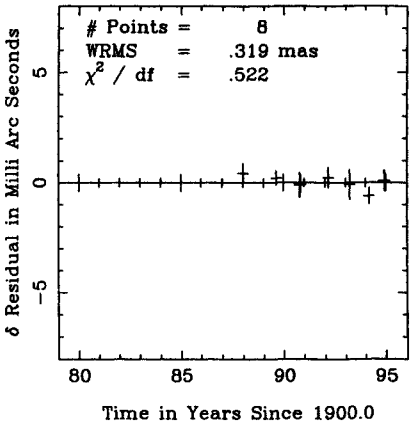
Arc Solution for 1845+797 : δ



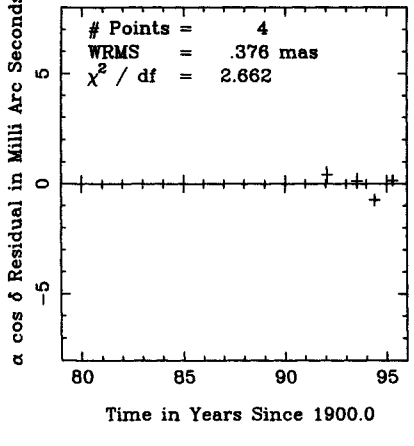
Arc Solution for 1842+681 : $\alpha \cos \delta$



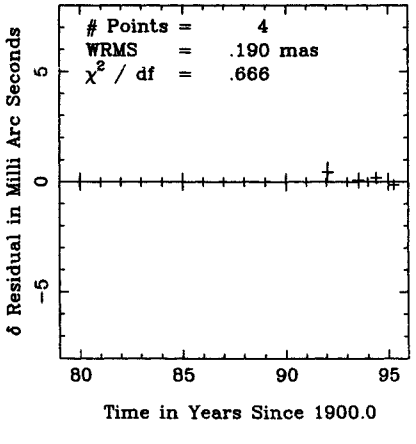
Arc Solution for 1842+681 : δ



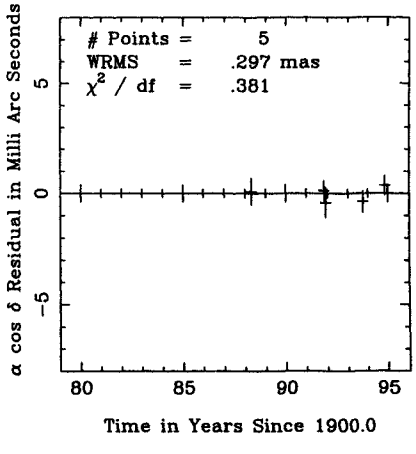
Arc Solution for 1849+670 : $\alpha \cos \delta$



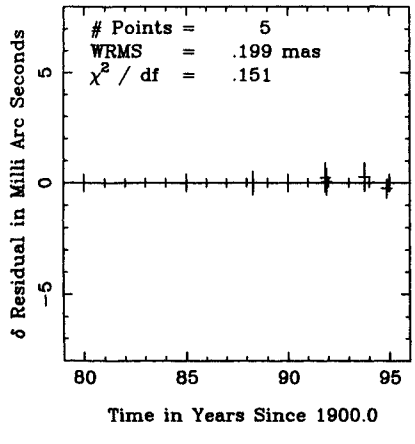
Arc Solution for 1849+670 : δ



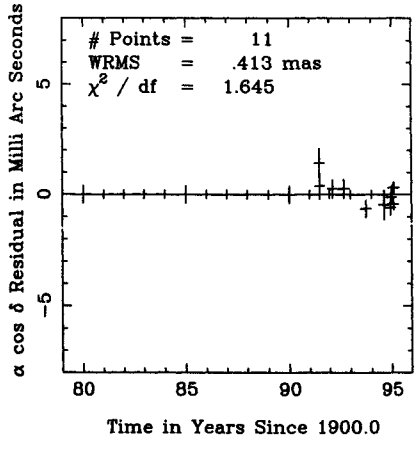
Arc Solution for 1856+737 : $\alpha \cos \delta$



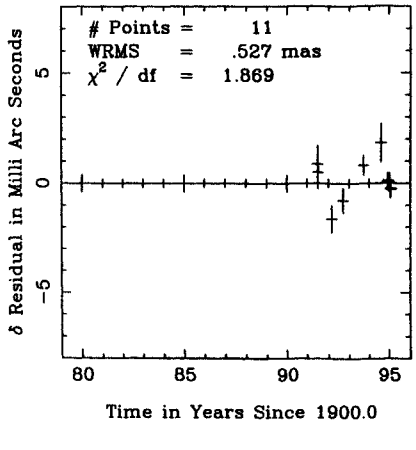
Arc Solution for 1856+737 : δ



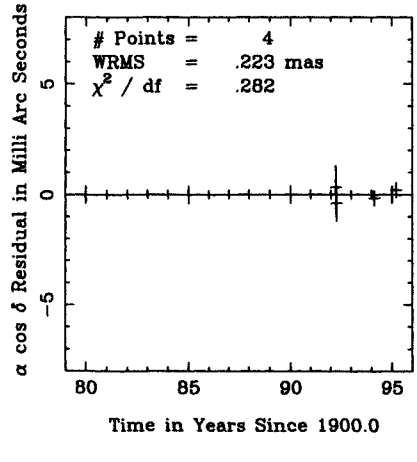
Arc Solution for 1901+319 : $\alpha \cos \delta$



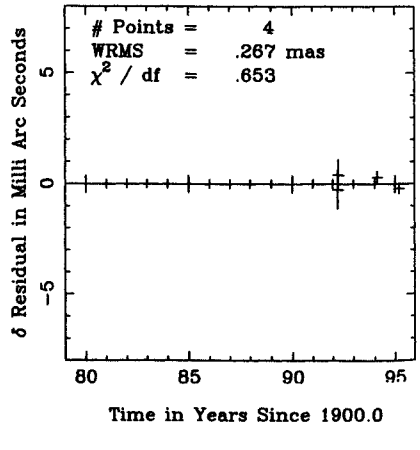
Arc Solution for 1901+319 : δ



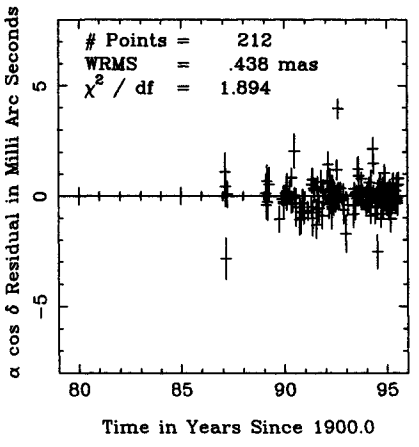
Arc Solution for 1908-201 : $\alpha \cos \delta$



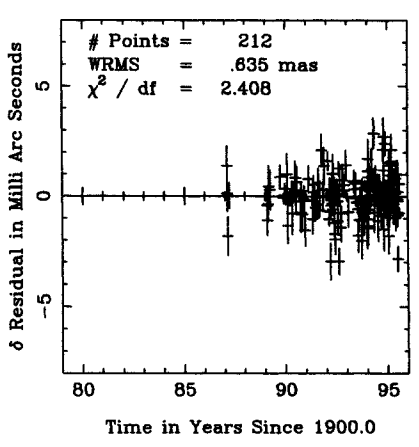
Arc Solution for 1908-201 : δ



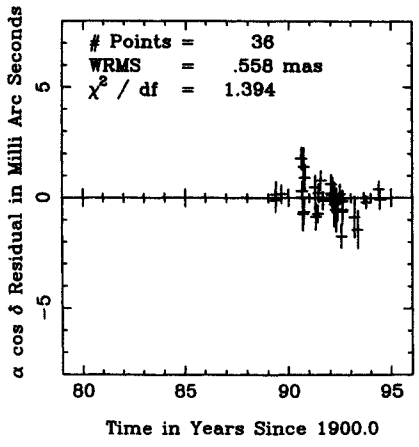
Arc Solution for 1921−293 : α cos δ



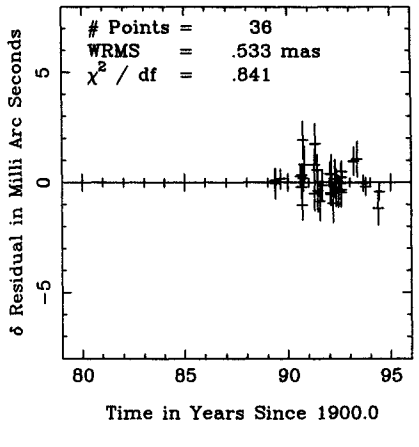
Arc Solution for 1921−293 : δ



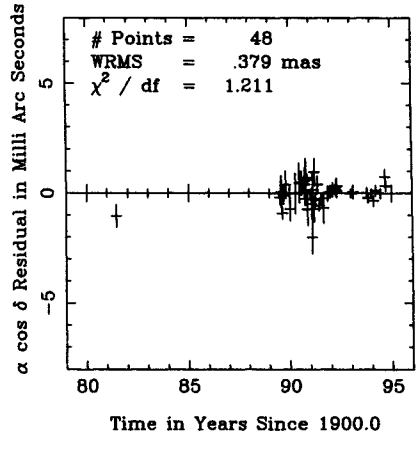
Arc Solution for 1923+210 : α cos δ



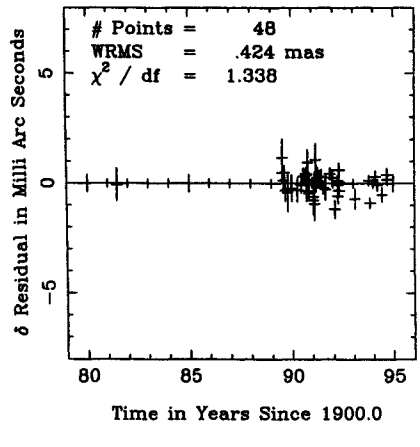
Arc Solution for 1923+210 : δ



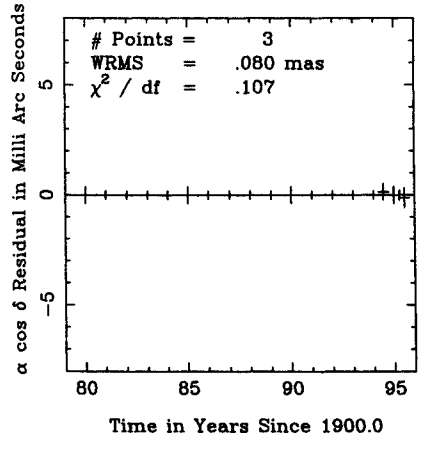
Arc Solution for 1928+738 : α cos δ



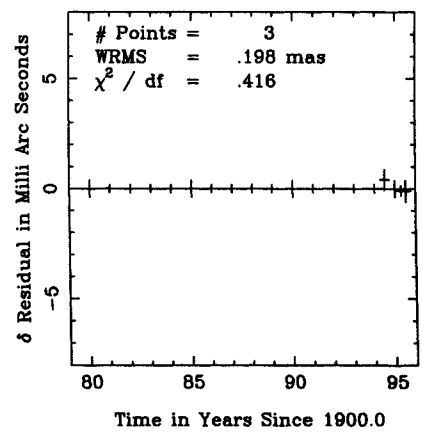
Arc Solution for 1928+738 : δ



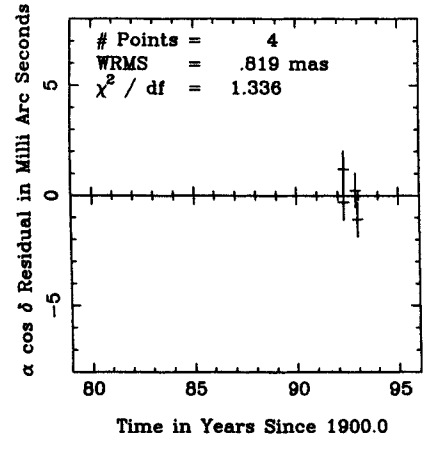
Arc Solution for 1929+226 : α cos δ



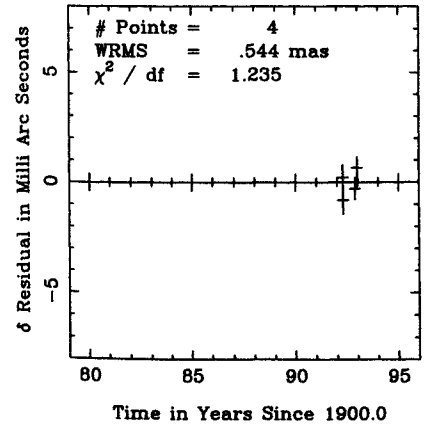
Arc Solution for 1929+226 : δ



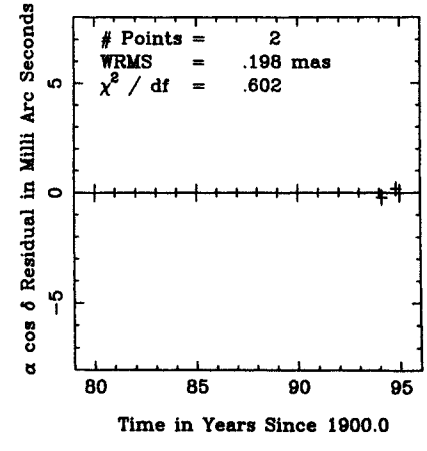
Arc Solution for 1933−400 : α cos δ



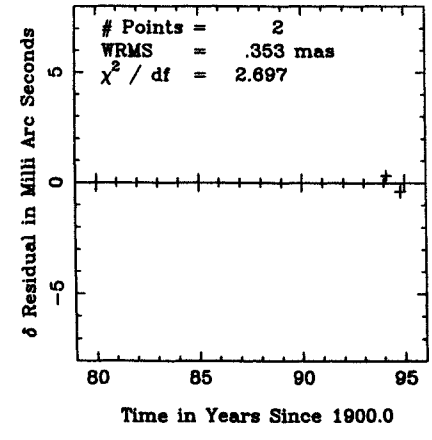
Arc Solution for 1933−400 : δ

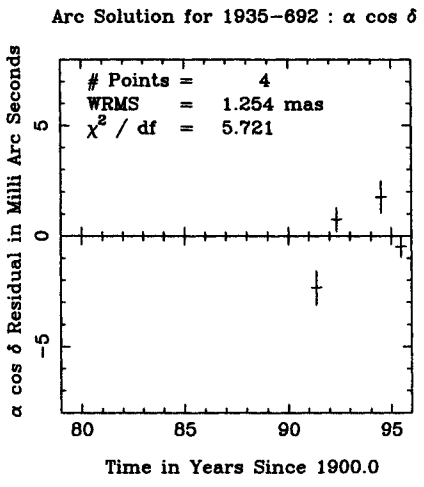


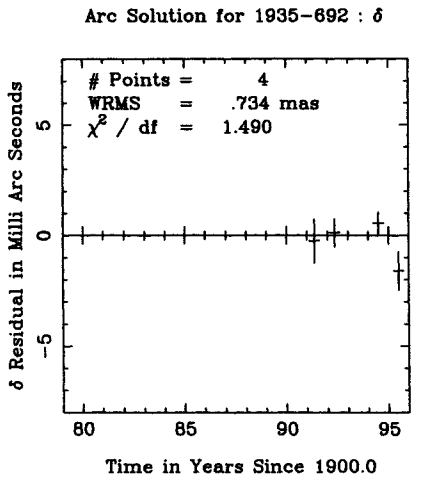
Arc Solution for 1937−101 : α cos δ

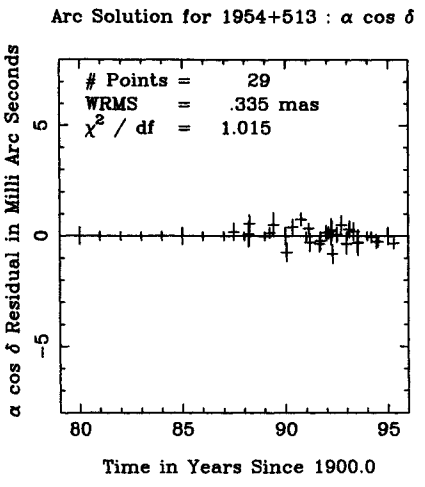


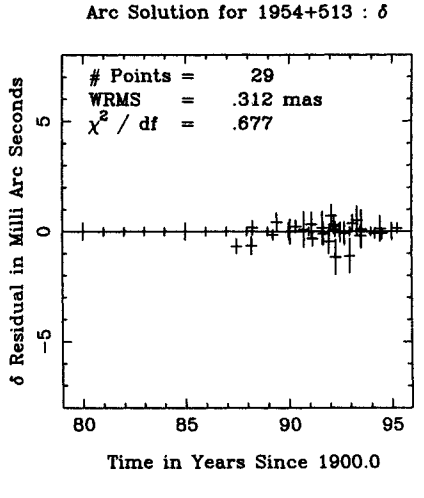
Arc Solution for 1937−101 : δ

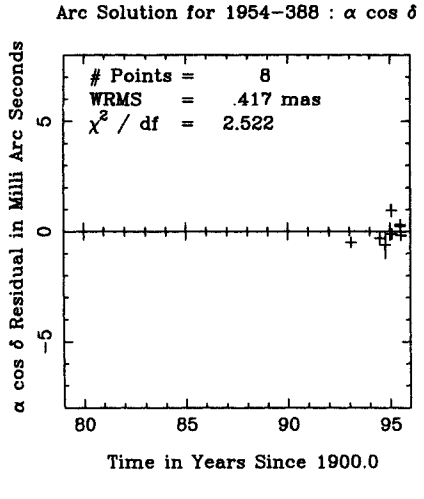


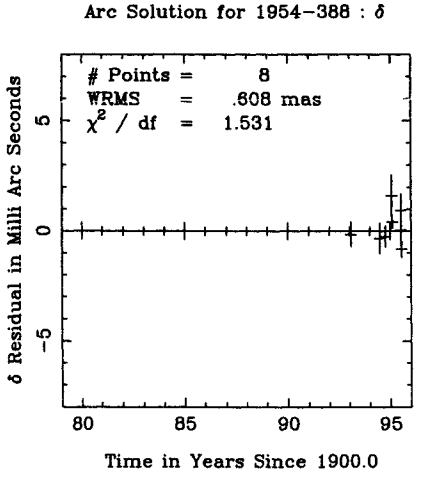

Arc Solution for 1935−692 : α cos δ
# Points = 4
WRMS = 1.254 mas
χ² / df = 5.721
α cos δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

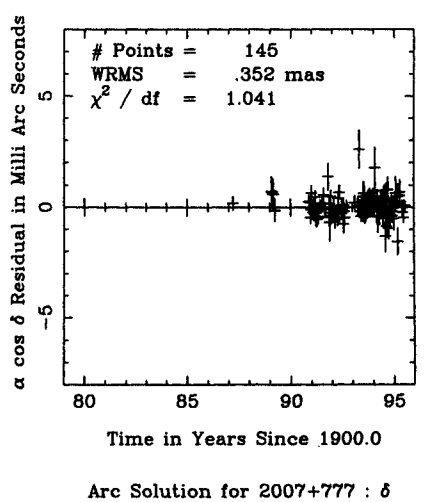

Arc Solution for 1935−692 : δ
# Points = 4
WRMS = .734 mas
χ² / df = 1.490
δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

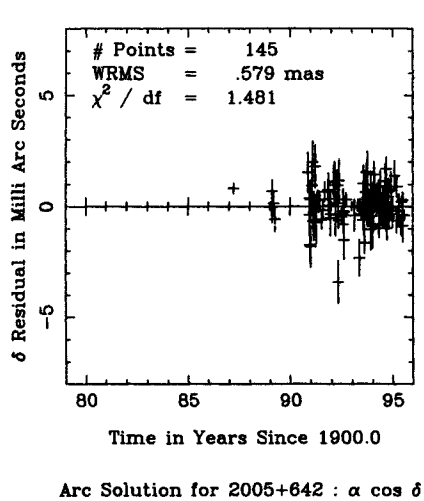

Arc Solution for 1954+513 : α cos δ
# Points = 29
WRMS = .335 mas
χ² / df = 1.015
α cos δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

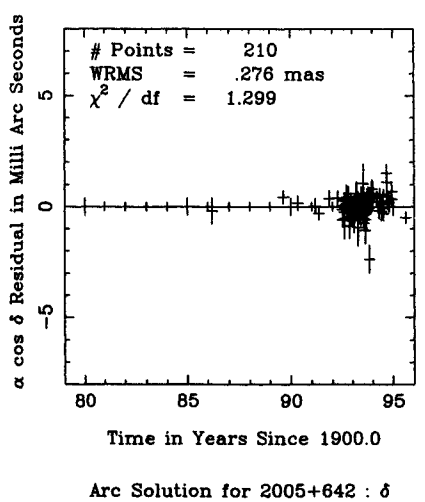

Arc Solution for 1954+513 : δ
# Points = 29
WRMS = .312 mas
χ² / df = .677
δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

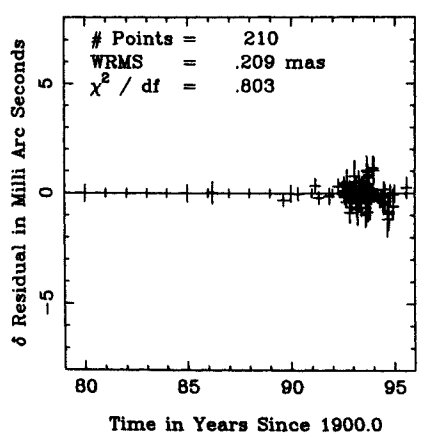

Arc Solution for 1954−388 : α cos δ
# Points = 8
WRMS = .417 mas
χ² / df = 2.522
α cos δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

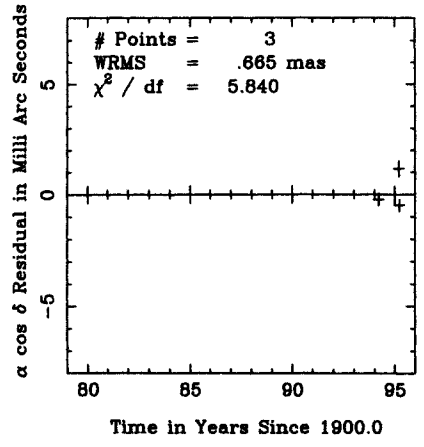

Arc Solution for 1954−388 : δ
# Points = 8
WRMS = .608 mas
χ² / df = 1.531
δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

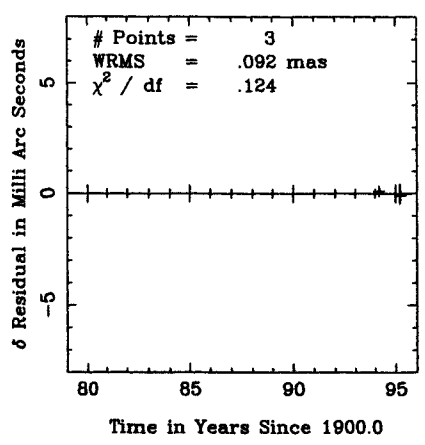

Arc Solution for 1958−179 : α cos δ
# Points = 145
WRMS = .352 mas
χ² / df = 1.041
α cos δ Residual in Milli Arc Seconds
Time in Years Since 1900.0


Arc Solution for 1958−179 : δ
# Points = 145
WRMS = .579 mas
χ² / df = 1.481
δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

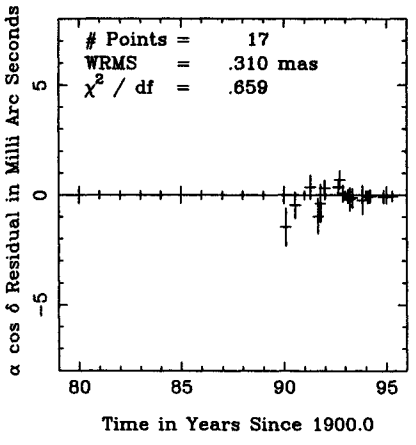

Arc Solution for 2007+777 : α cos δ
# Points = 210
WRMS = .276 mas
χ² / df = 1.299
α cos δ Residual in Milli Arc Seconds
Time in Years Since 1900.0


Arc Solution for 2007+777 : δ
# Points = 210
WRMS = .209 mas
χ² / df = .803
δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

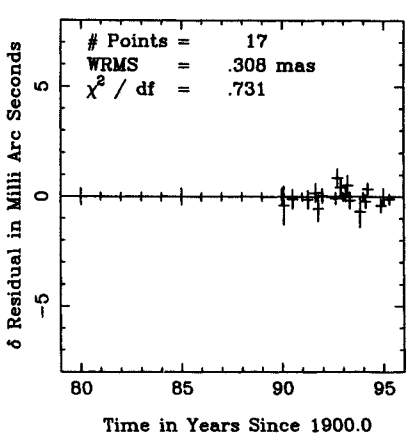

Arc Solution for 2005+642 : α cos δ
# Points = 3
WRMS = .665 mas
χ² / df = 5.840
α cos δ Residual in Milli Arc Seconds
Time in Years Since 1900.0


Arc Solution for 2005+642 : δ
# Points = 3
WRMS = .092 mas
χ² / df = .124
δ Residual in Milli Arc Seconds
Time in Years Since 1900.0

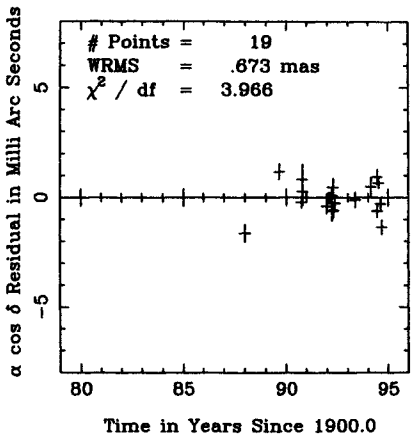
Arc Solution for 2017+745 : α cos δ



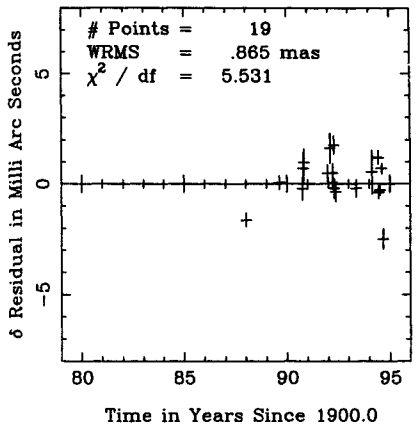
Arc Solution for 2017+745 : δ



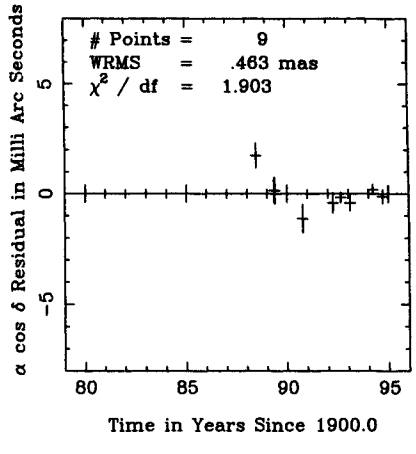
Arc Solution for 2021+614 : α cos δ



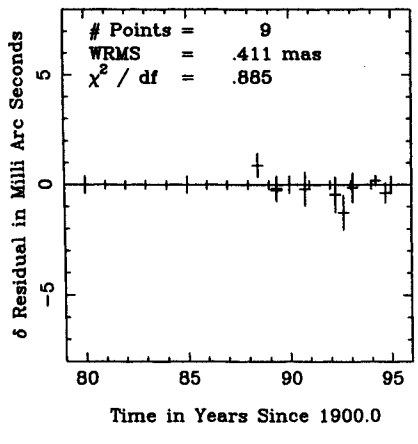
Arc Solution for 2021+614 : δ



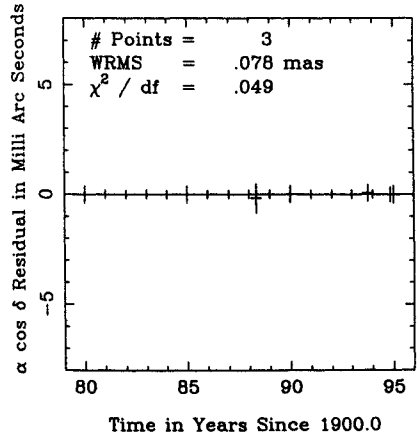
Arc Solution for 2021+317 : α cos δ



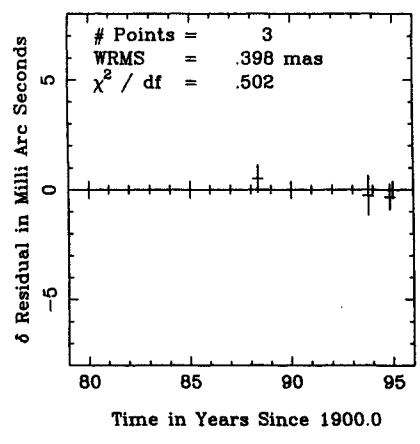
Arc Solution for 2021+317 : δ



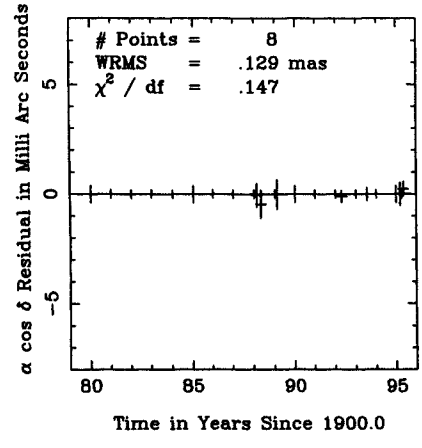
Arc Solution for 2030+547 : α cos δ



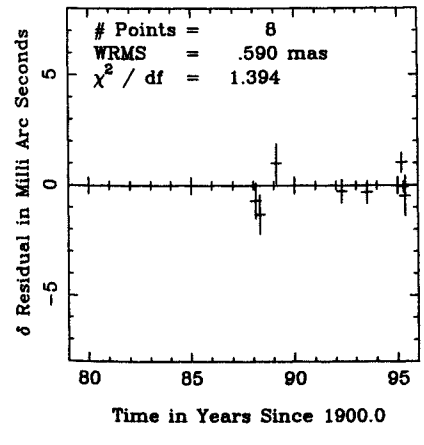
Arc Solution for 2030+547 : δ



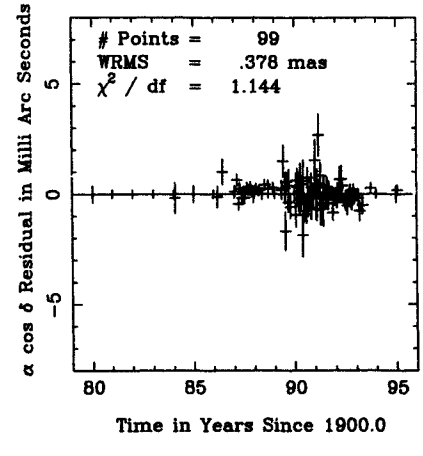
Arc Solution for 2029+121 : α cos δ



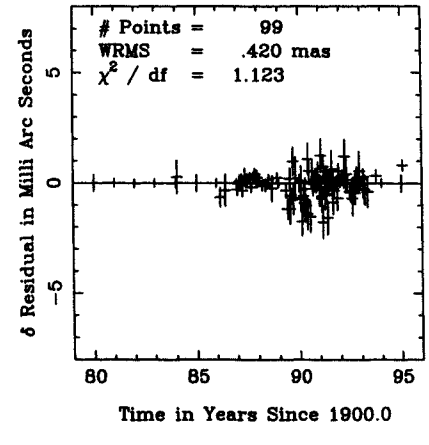
Arc Solution for 2029+121 : δ



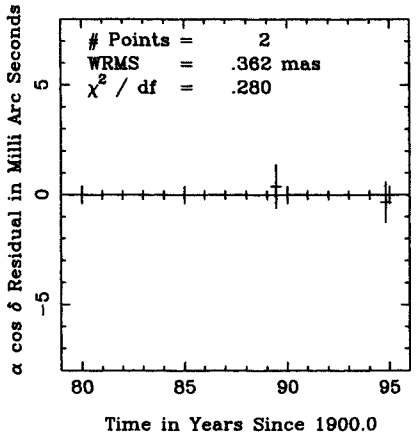
Arc Solution for 2037+511 : α cos δ



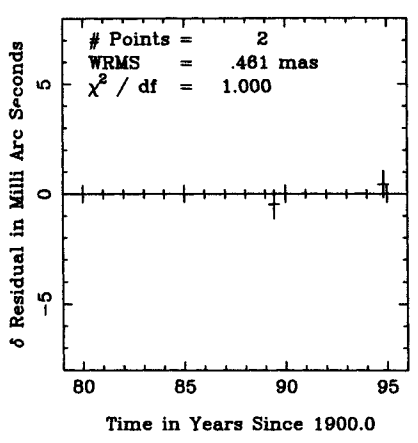
Arc Solution for 2037+511 : δ



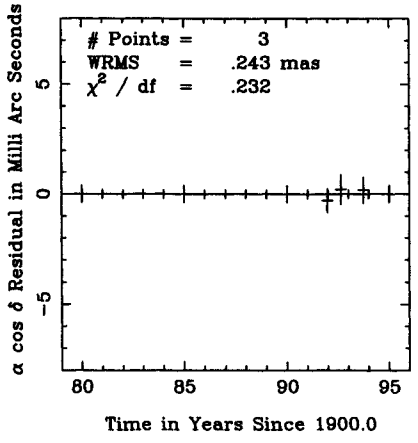
Arc Solution for 2037−253 : α cos δ



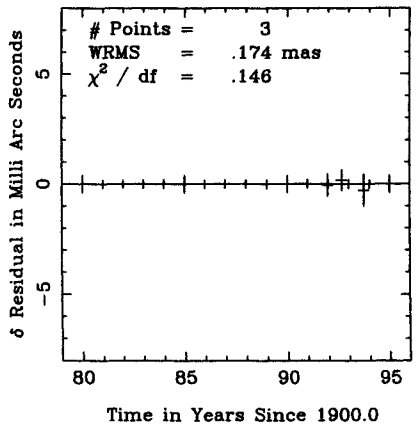
Arc Solution for 2037−253 : δ



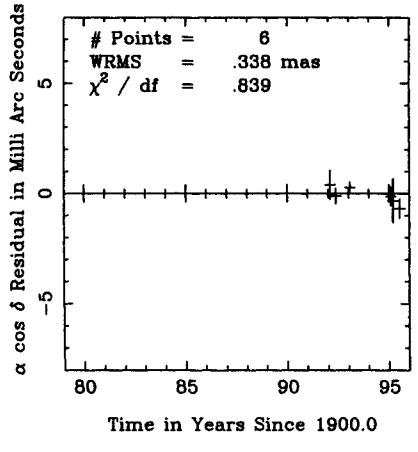
Arc Solution for 2051+745 : α cos δ



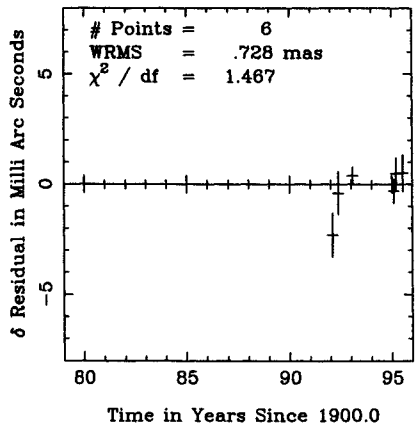
Arc Solution for 2051+745 : δ



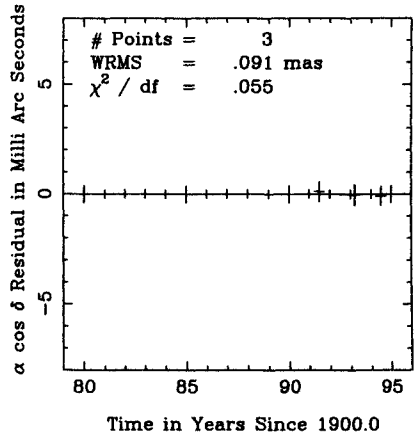
Arc Solution for 2052−474 : α cos δ



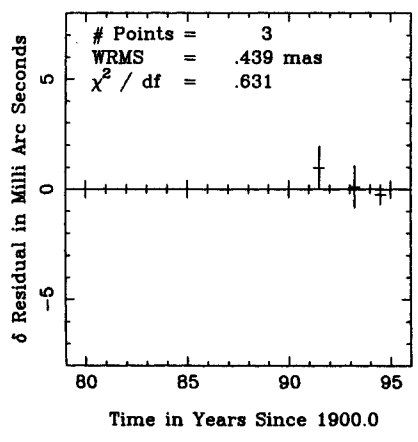
Arc Solution for 2052−474 : δ



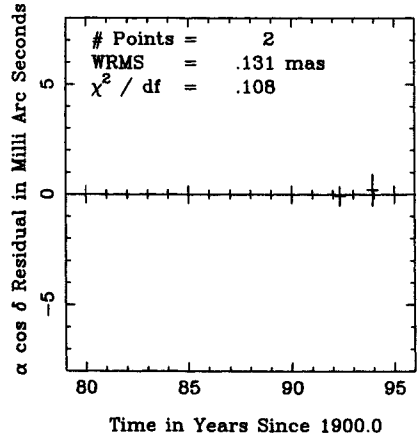
Arc Solution for 2059+034 : α cos δ



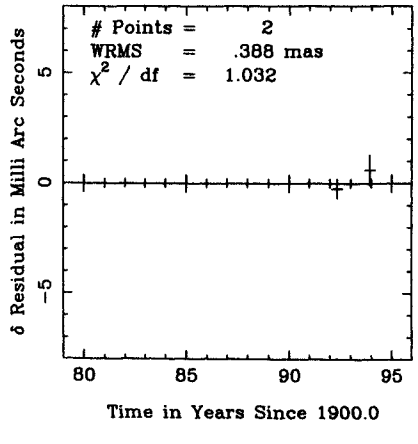
Arc Solution for 2059+034 : δ



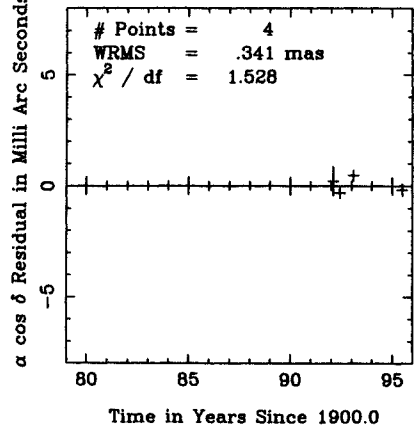
Arc Solution for 2059−786 : α cos δ



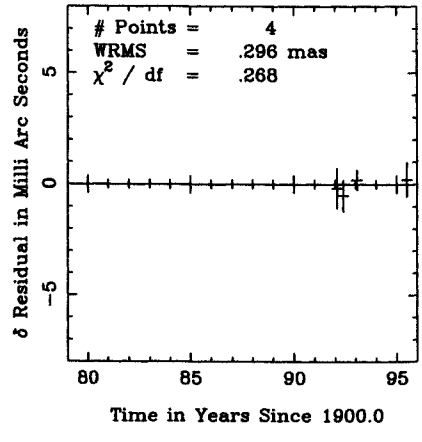
Arc Solution for 2059−786 : δ



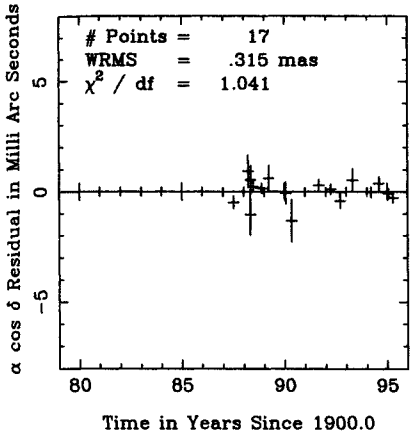
Arc Solution for 2106−413 : α cos δ



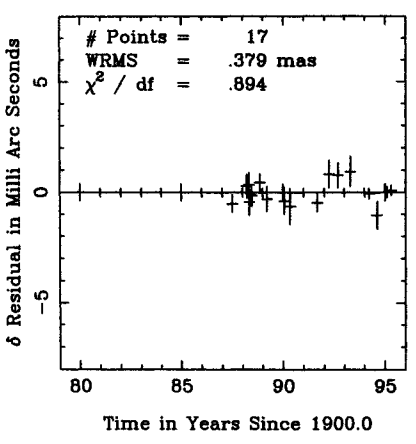
Arc Solution for 2106−413 : δ



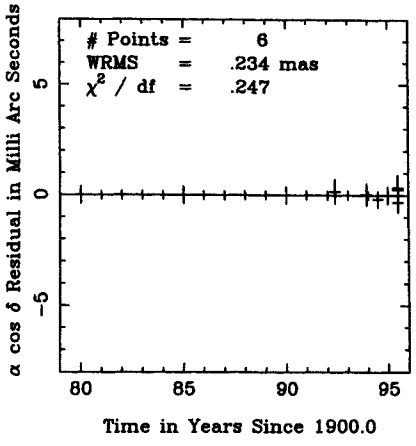
Arc Solution for 2113+293 : α cos δ



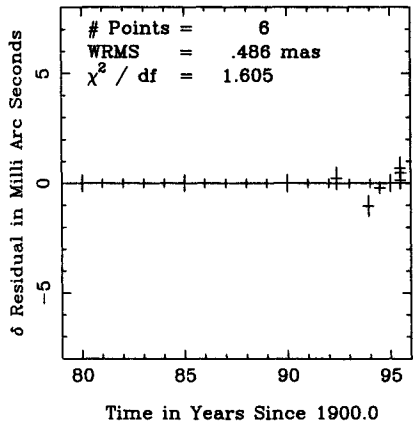
Arc Solution for 2113+293 : δ



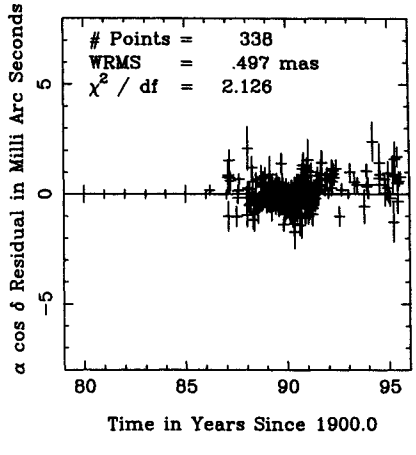
Arc Solution for 2109−811 : α cos δ



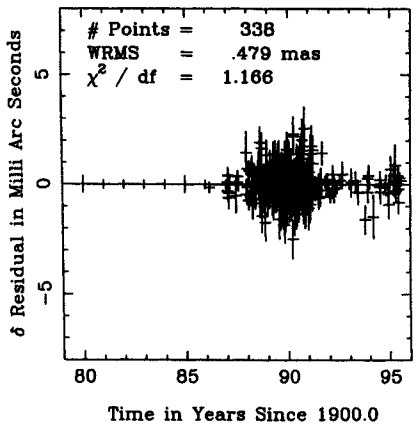
Arc Solution for 2109−811 : δ



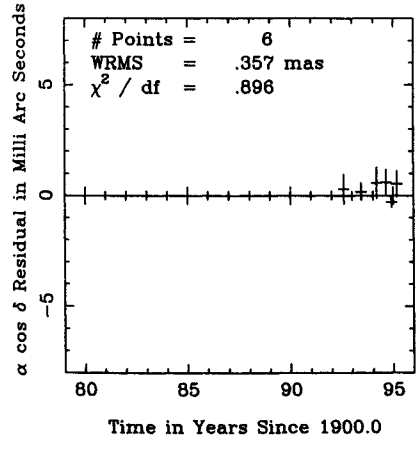
Arc Solution for 2121+053 : α cos δ



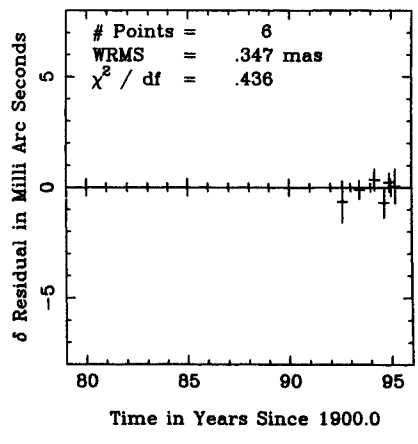
Arc Solution for 2121+053 : δ



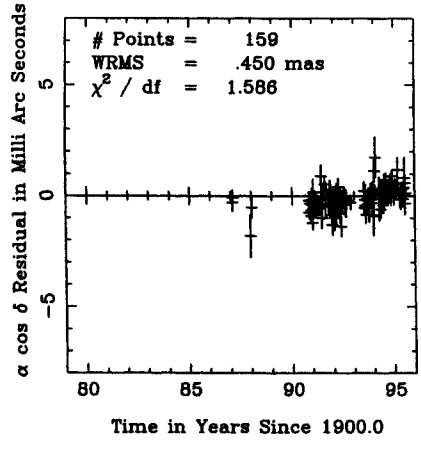
Arc Solution for 2126−158 : α cos δ



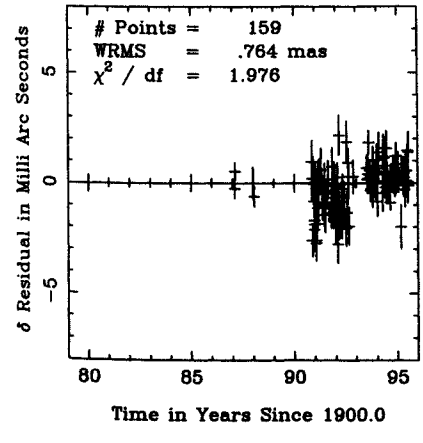
Arc Solution for 2126−158 : δ



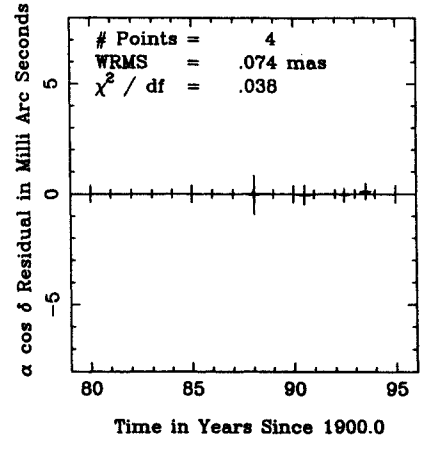
Arc Solution for 2128−123 : α cos δ



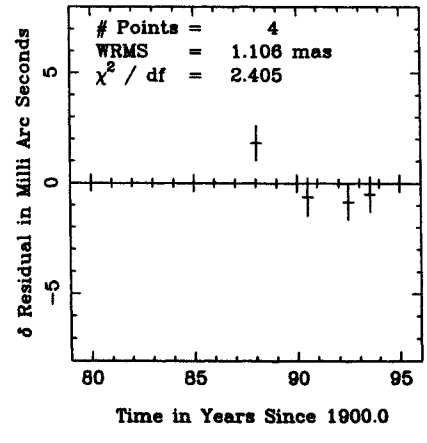
Arc Solution for 2128−123 : δ



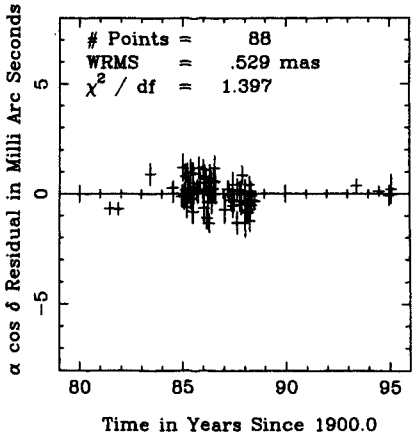
Arc Solution for 2131−021 : α cos δ



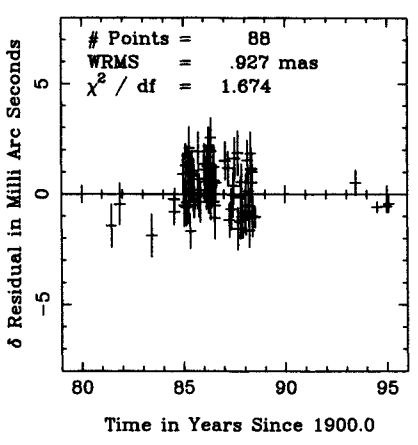
Arc Solution for 2131−021 : δ



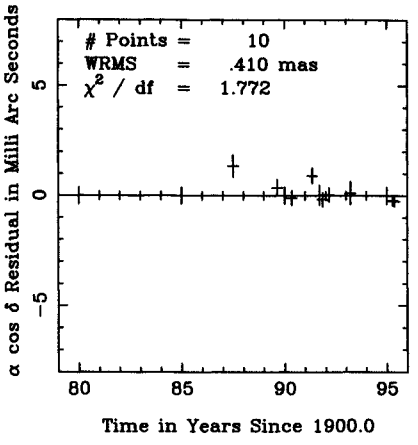
Arc Solution for 2134+004 : α cos δ



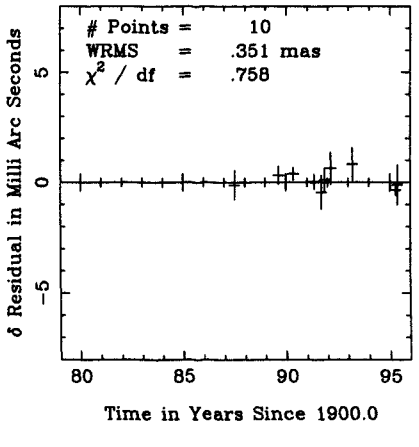
Arc Solution for 2134+004 : δ



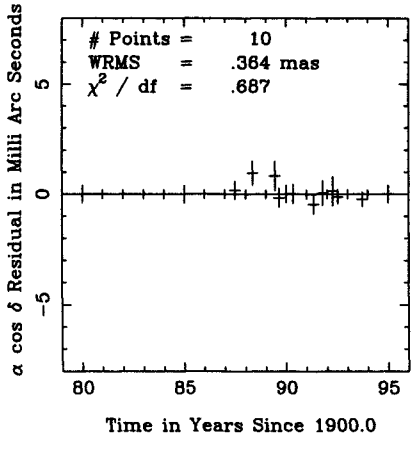
Arc Solution for 2136+141 : α cos δ



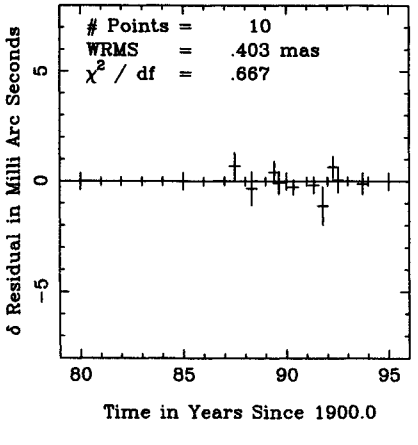
Arc Solution for 2136+141 : δ



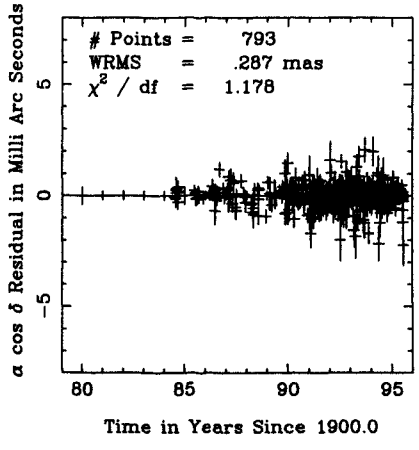
Arc Solution for 2144+092 : α cos δ



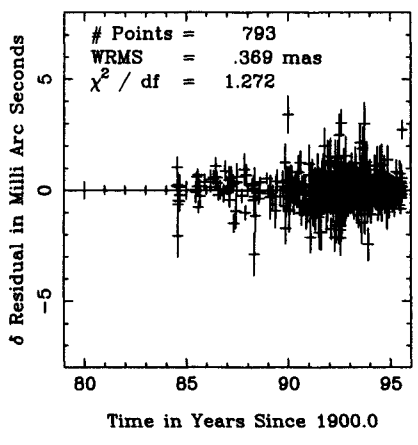
Arc Solution for 2144+092 : δ



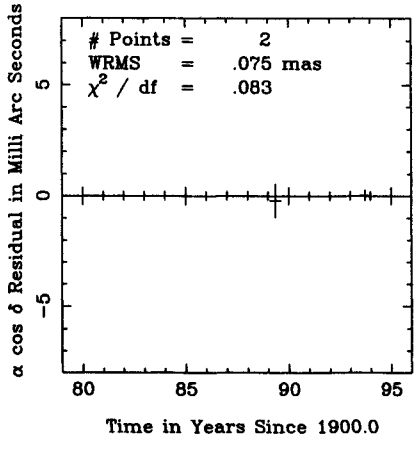
Arc Solution for 2145+067 : α cos δ



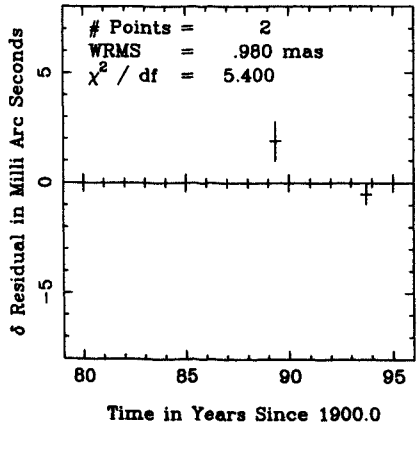
Arc Solution for 2145+067 : δ



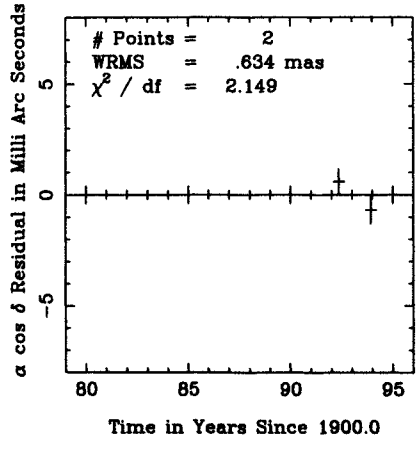
Arc Solution for 2149+056 : α cos δ



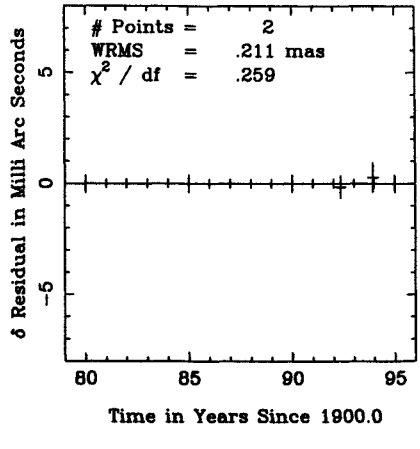
Arc Solution for 2149+056 : δ



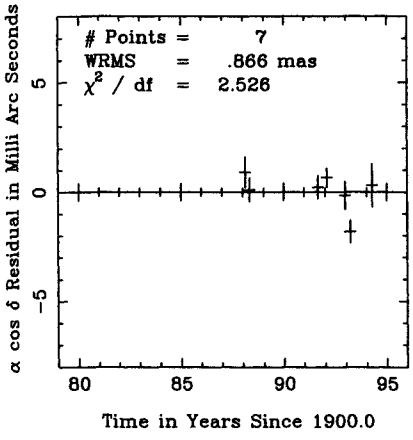
Arc Solution for 2146−783 : α cos δ



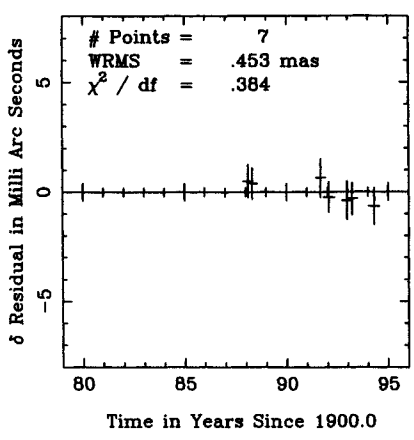
Arc Solution for 2146−783 : δ



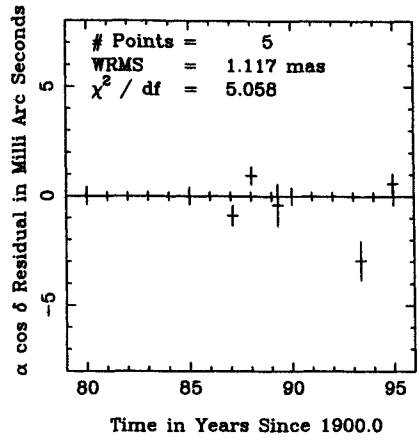
Arc Solution for 2150+173 : α cos δ



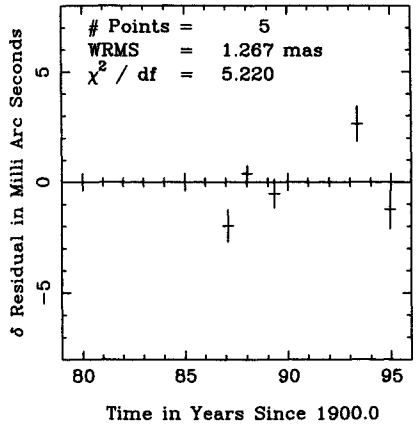
Arc Solution for 2150+173 : δ



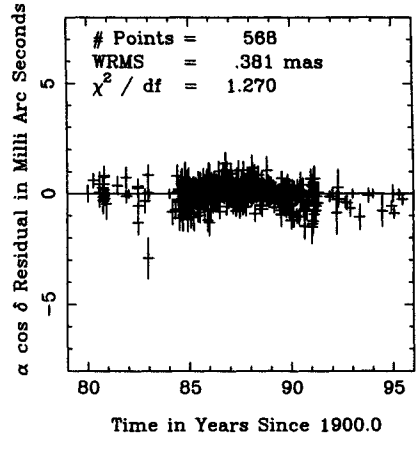
Arc Solution for 2155−152 : α cos δ



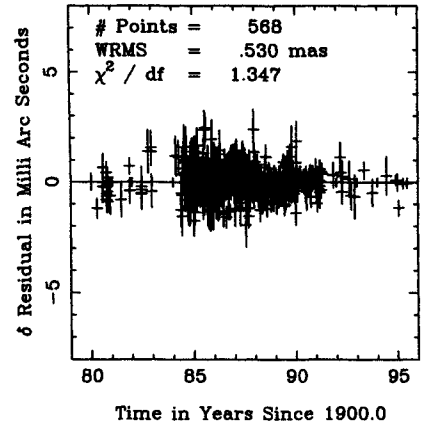
Arc Solution for 2155−152 : δ



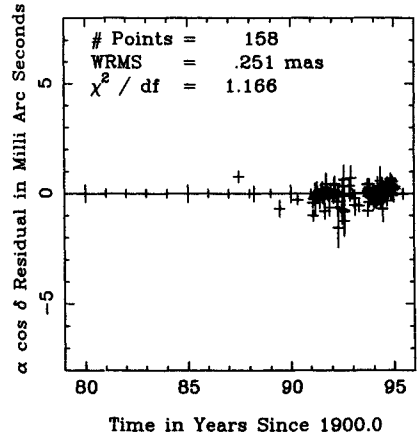
Arc Solution for 2200+420 : α cos δ



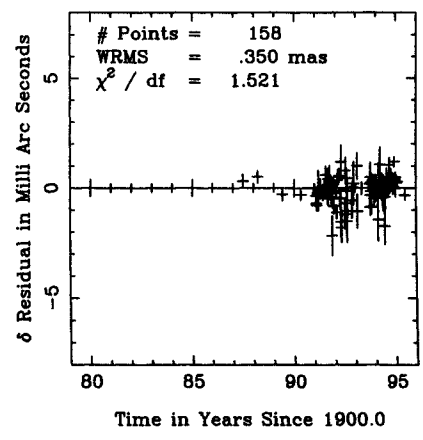
Arc Solution for 2200+420 : δ



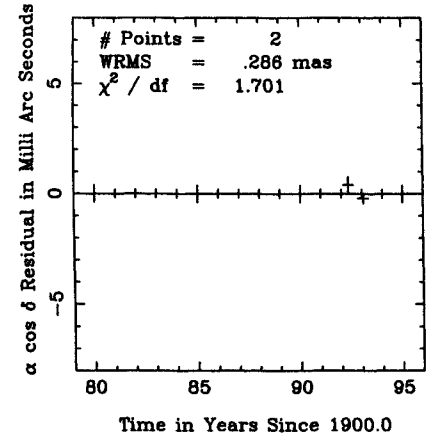
Arc Solution for 2201+315 : α cos δ



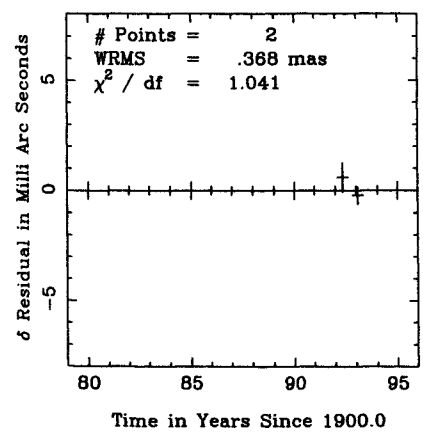
Arc Solution for 2201+315 : δ



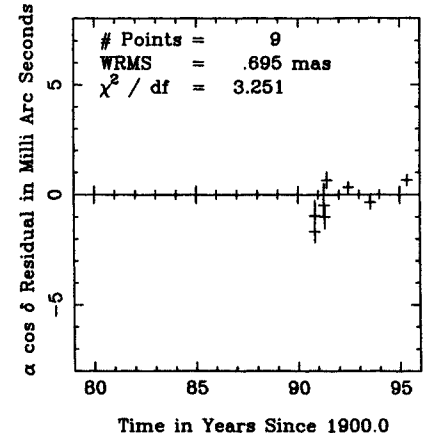
Arc Solution for 2204−540 : α cos δ



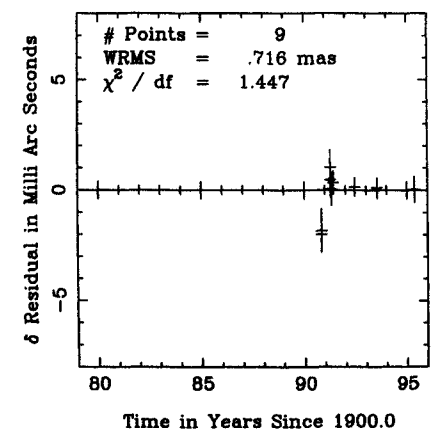
Arc Solution for 2204−540 : δ



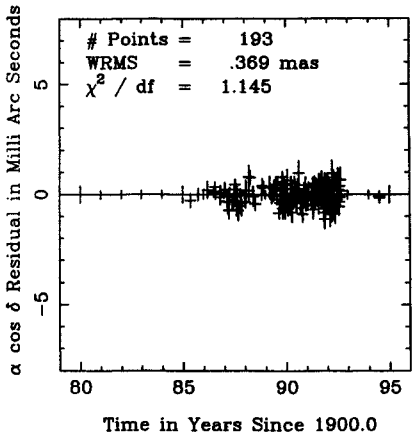
Arc Solution for 2209+236 : α cos δ



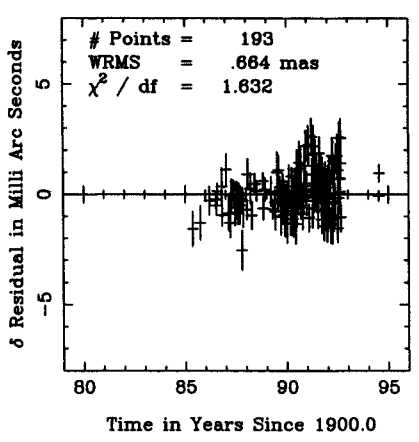
Arc Solution for 2209+236 : δ



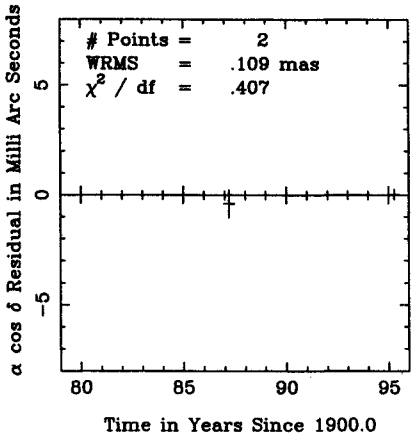
Arc Solution for 2216−038 : α cos δ



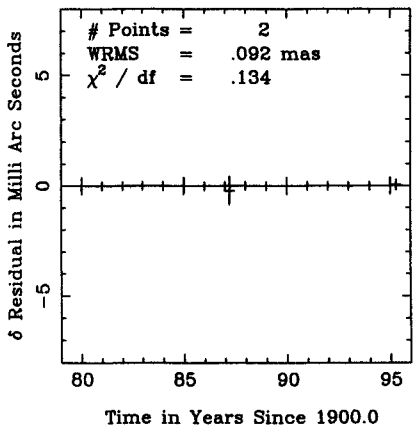
Arc Solution for 2216−038 : δ



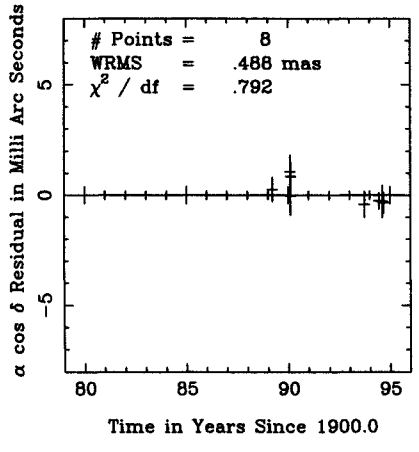
Arc Solution for 2227−088 : α cos δ



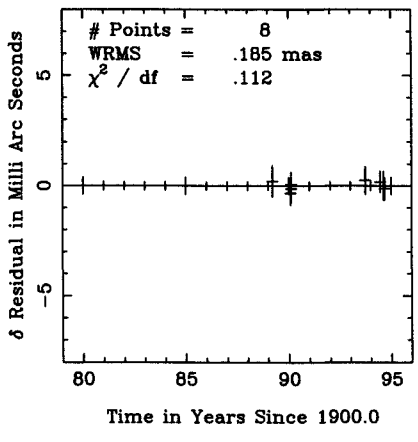
Arc Solution for 2227−088 : δ



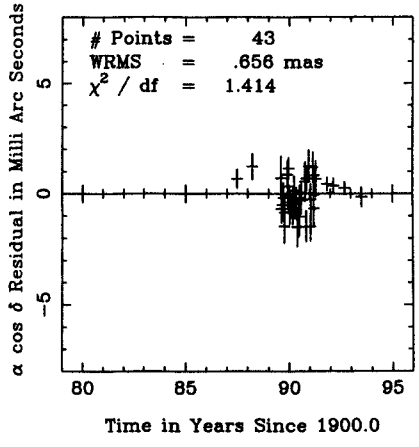
Arc Solution for 2229+695 : α cos δ



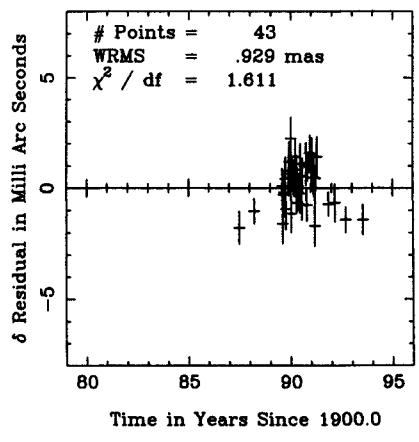
Arc Solution for 2229+695 : δ



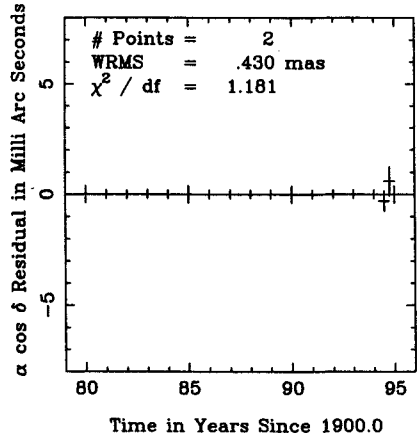
Arc Solution for 2230+114 : α cos δ



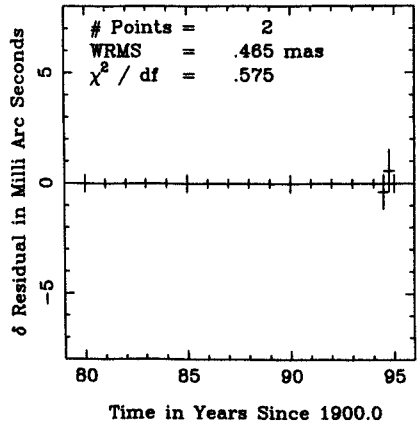
Arc Solution for 2230+114 : δ



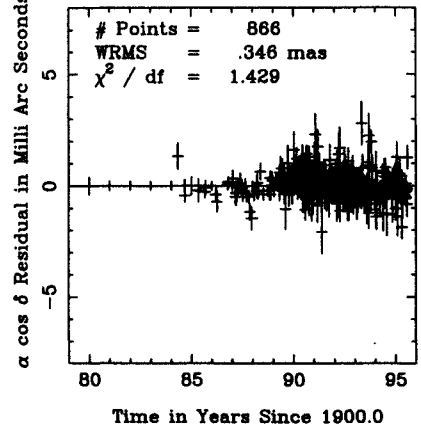
Arc Solution for 2232−488 : α cos δ



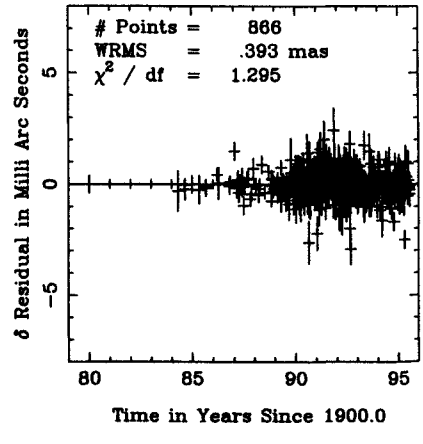
Arc Solution for 2232−488 : δ



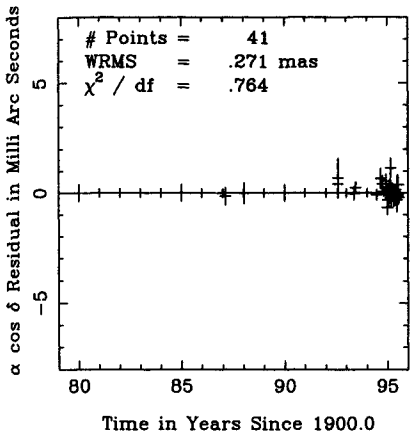
Arc Solution for 2234+282 : α cos δ



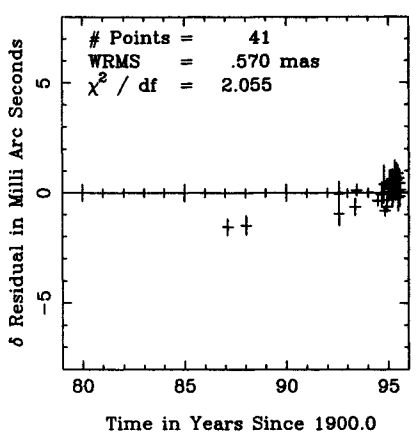
Arc Solution for 2234+282 : δ



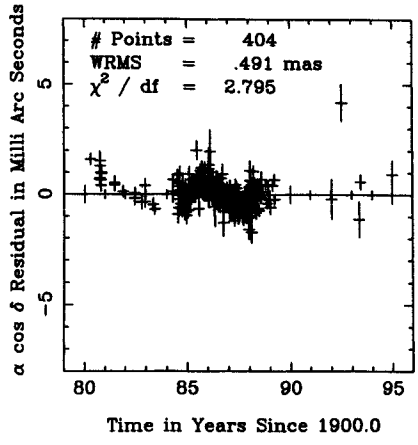
Arc Solution for 2243−123 : α cos δ



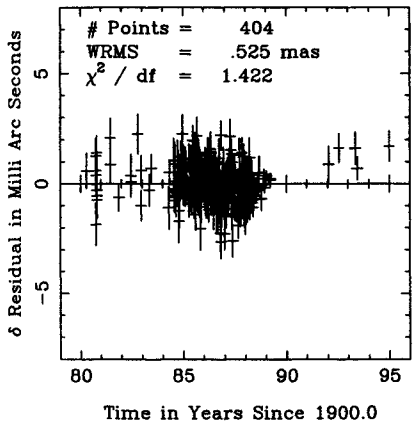
Arc Solution for 2243−123 : δ



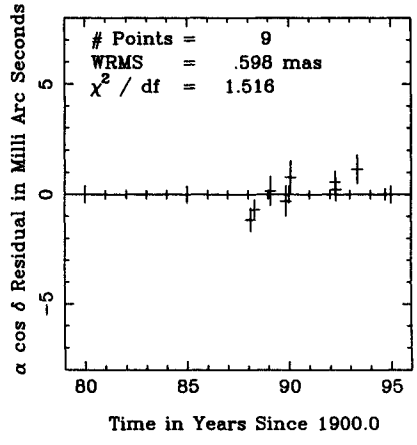
Arc Solution for 2251+158 : α cos δ



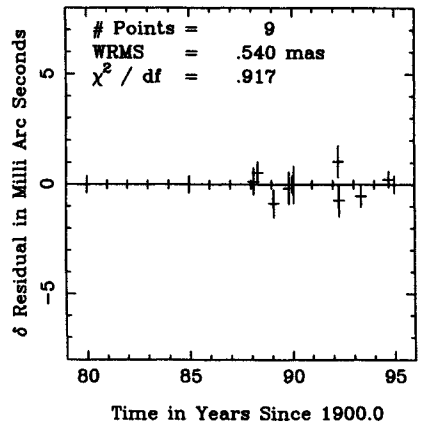
Arc Solution for 2251+158 : δ



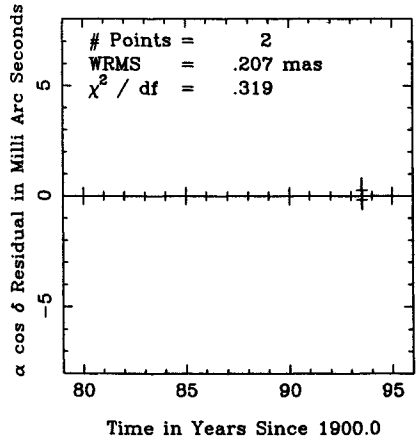
Arc Solution for 2253+417 : α cos δ



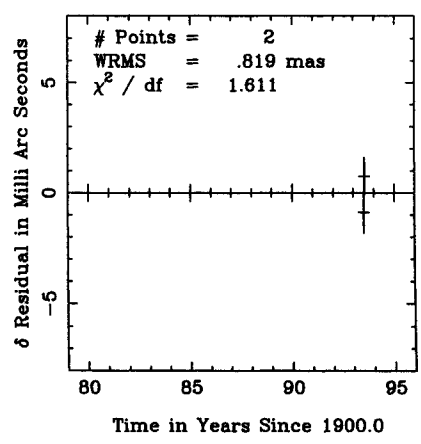
Arc Solution for 2253+417 : δ



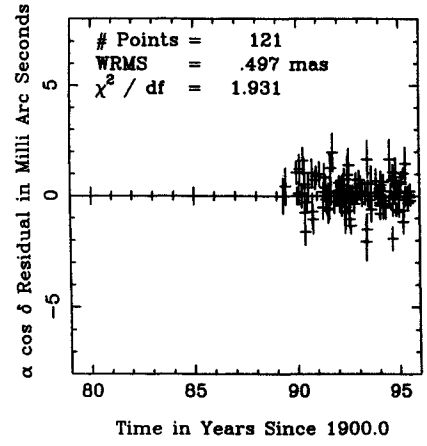
Arc Solution for 2254+024 : α cos δ



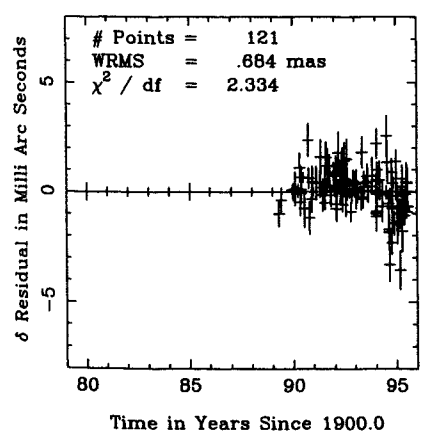
Arc Solution for 2254+024 : δ



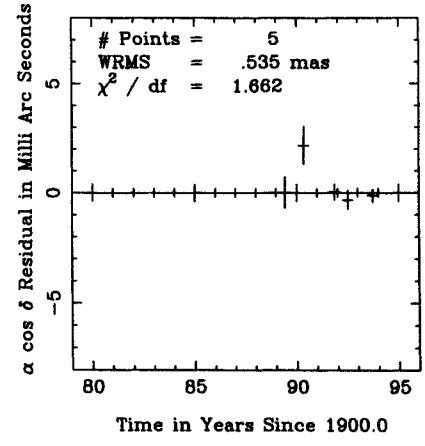
Arc Solution for 2255−282 : α cos δ



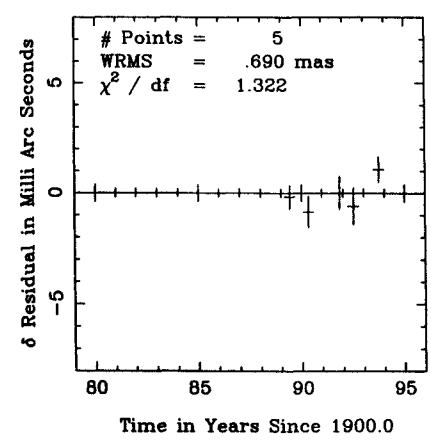
Arc Solution for 2255−282 : δ



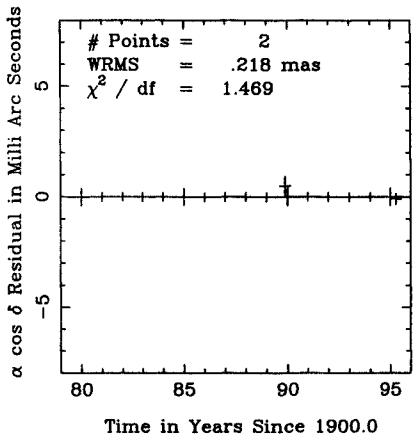
Arc Solution for 2318+049 : α cos δ



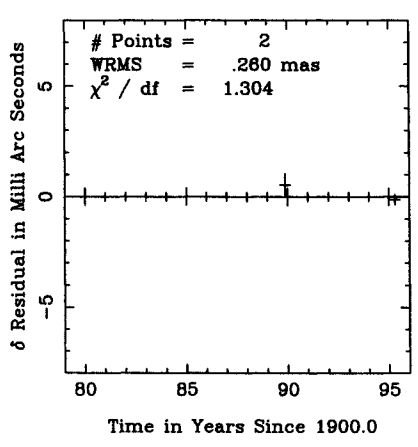
Arc Solution for 2318+049 : δ



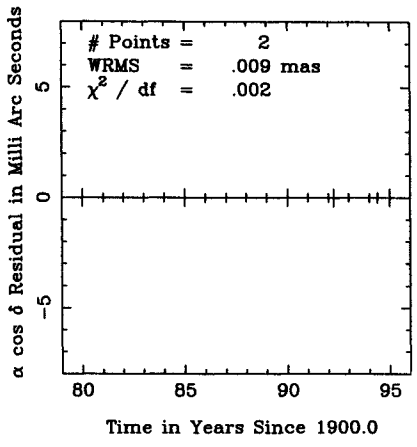
Arc Solution for 2319+272 : α cos δ



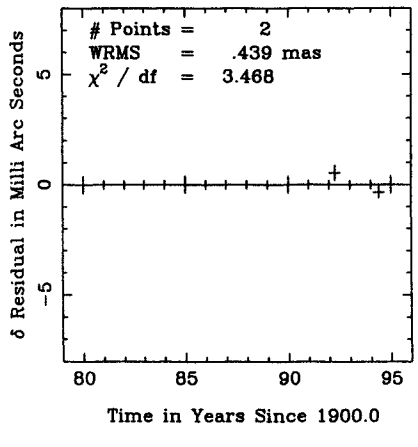
Arc Solution for 2319+272 : δ



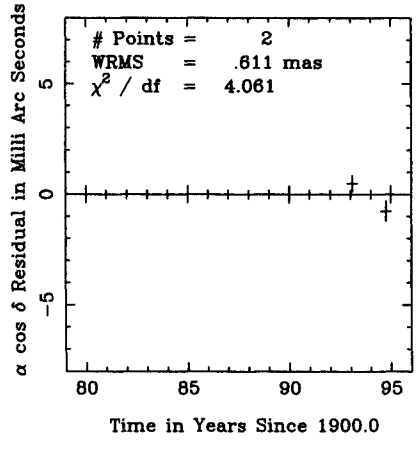
Arc Solution for 2320+506 : α cos δ



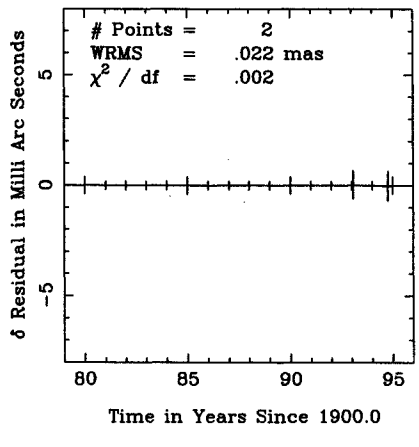
Arc Solution for 2320+506 : δ



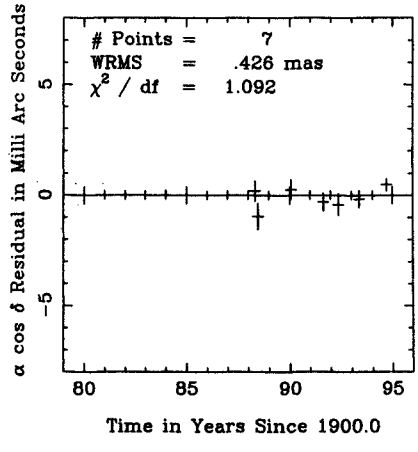
Arc Solution for 2326−477 : α cos δ



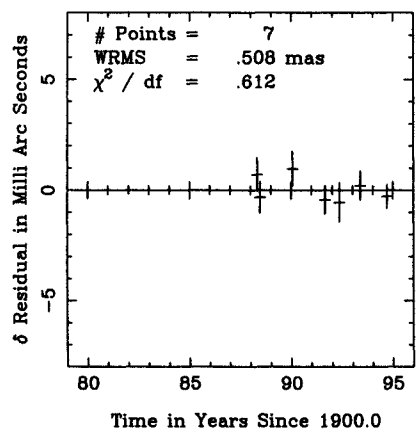
Arc Solution for 2326−477 : δ



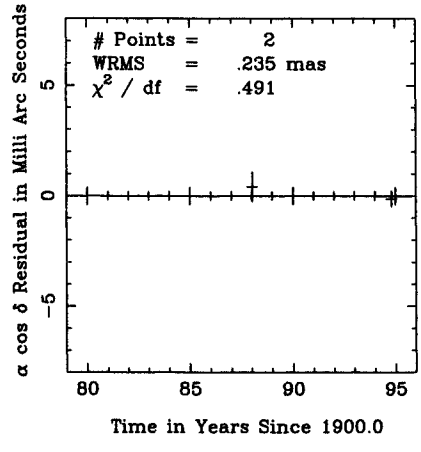
Arc Solution for 2328+107 : α cos δ



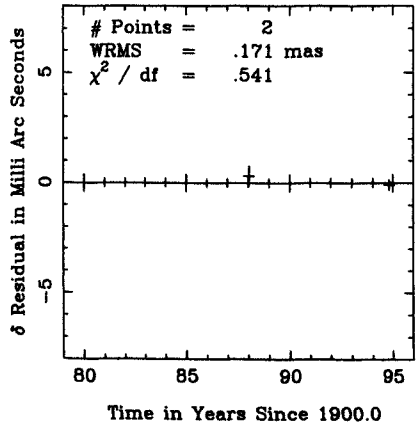
Arc Solution for 2328+107 : δ



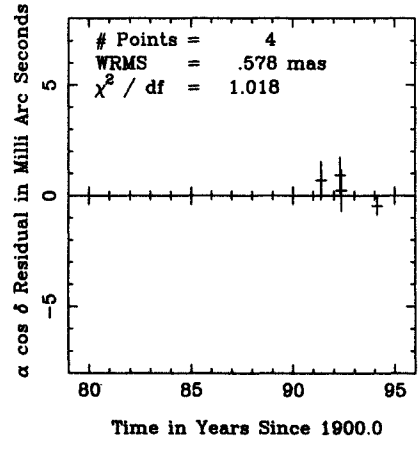
Arc Solution for 2329−162 : α cos δ



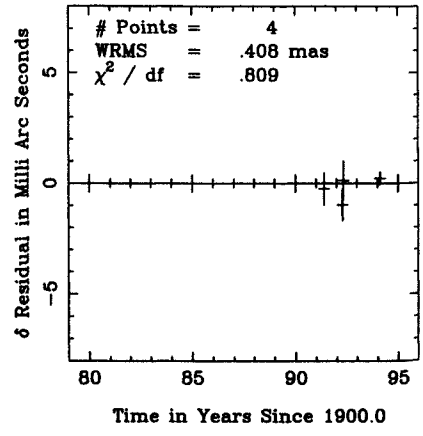
Arc Solution for 2329−162 : δ



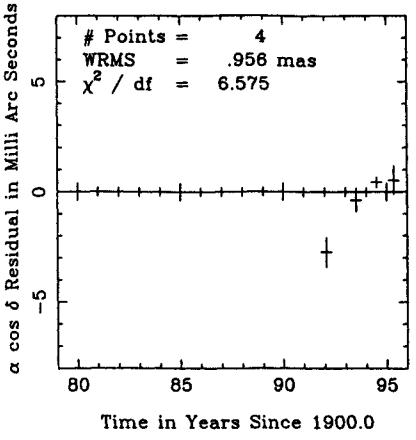
Arc Solution for 2331−240 : α cos δ



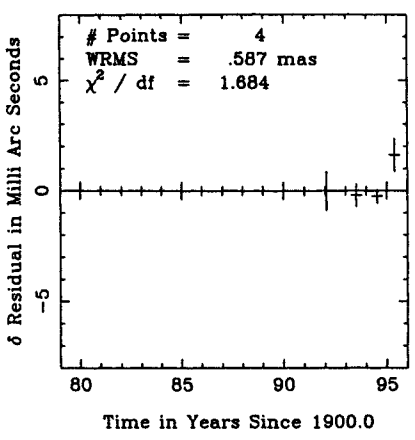
Arc Solution for 2331−240 : δ



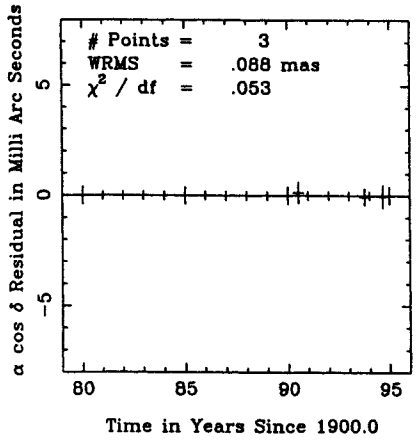
Arc Solution for 2337+264 : α cos δ



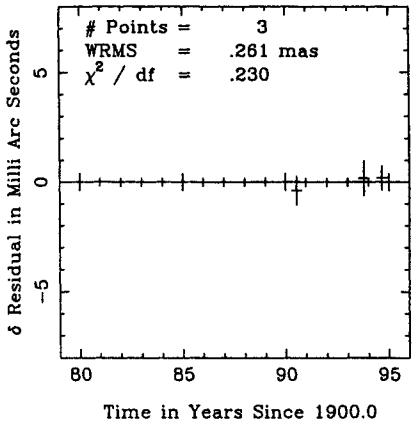
Arc Solution for 2337+264 : δ



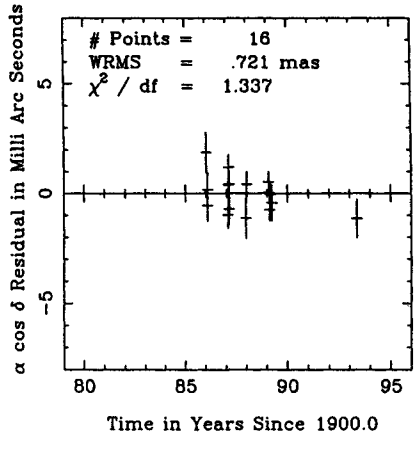
Arc Solution for 2344+092 : α cos δ



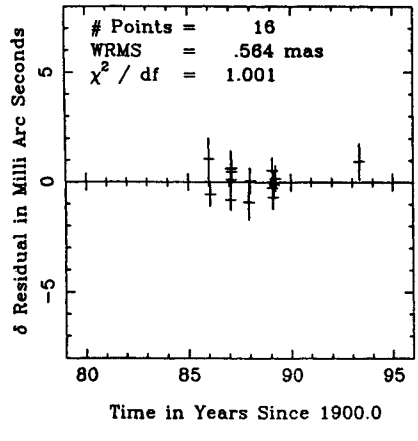
Arc Solution for 2344+092 : δ



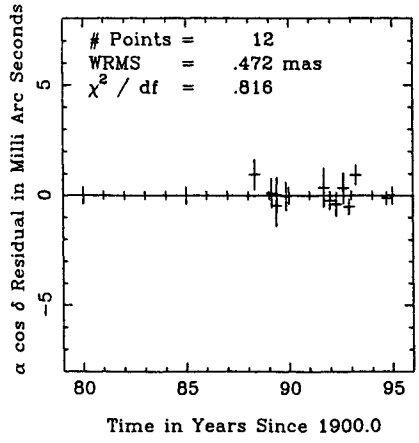
Arc Solution for 2345−167 : α cos δ



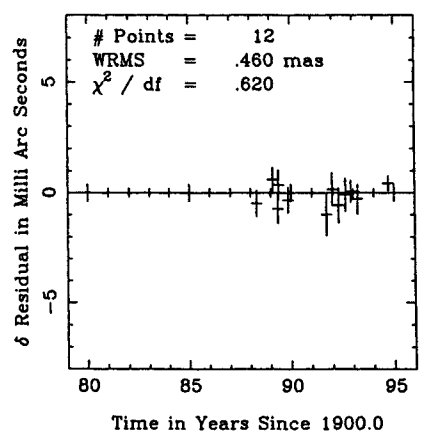
Arc Solution for 2345−167 : δ



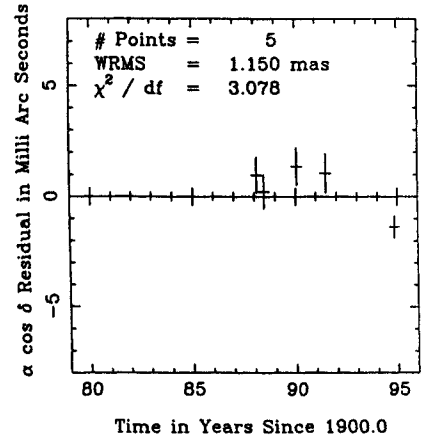
Arc Solution for 2351+456 : α cos δ



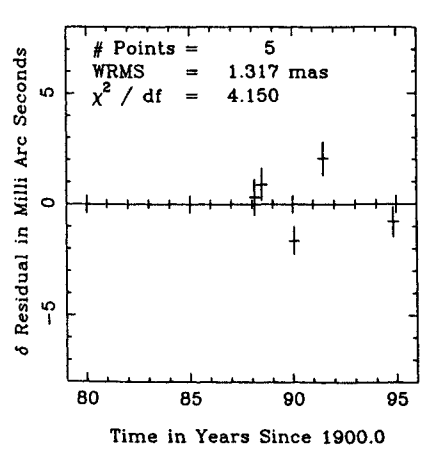
Arc Solution for 2351+456 : δ



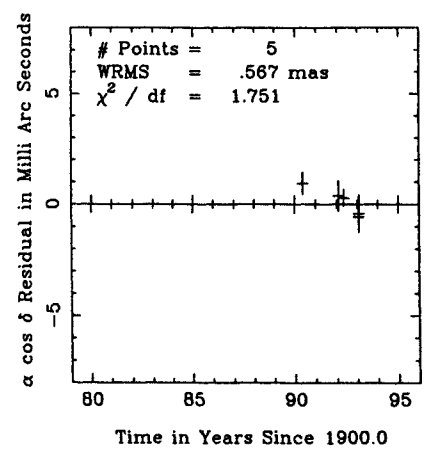
Arc Solution for 2352+495 : α cos δ



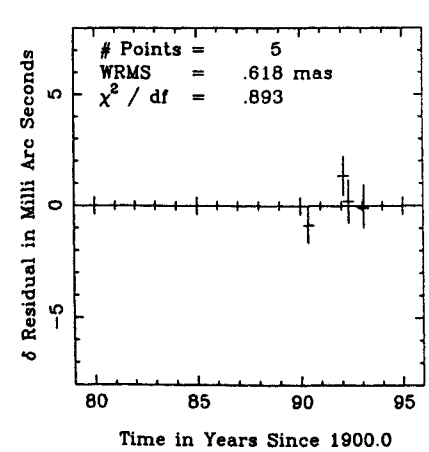
Arc Solution for 2352+495 : δ

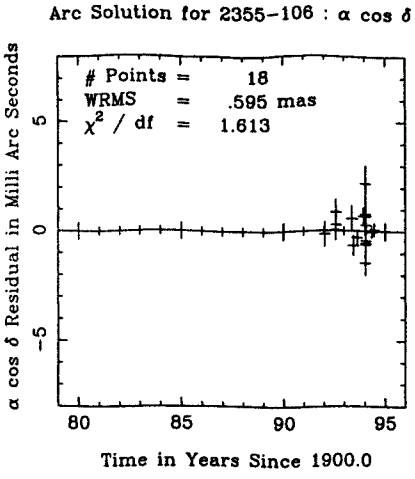


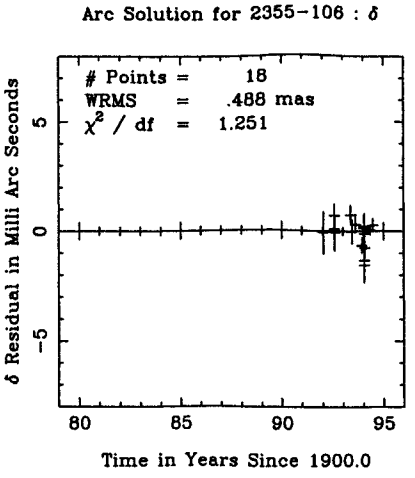
Arc Solution for 2355−534 : α cos δ



Arc Solution for 2355−534 : δ




Arc Solution for 2355-106 : α cos δ
# Points = 18
WRMS = .595 mas
χ² / df = 1.613
α cos δ Residual in Milli Arc Seconds
5
0
-5
80
85
90
95
Time in Years Since 1900.0


Arc Solution for 2355-106 : δ
# Points = 18
WRMS = .488 mas
χ² / df = 1.251
δ Residual in Milli Arc Seconds
5
0
-5
80
85
90
95
Time in Years Since 1900.0

5. Dictionary of aliases

B. Archinal [1], E.F. Arias [2,3], A.-M. Gontier [2], C. Mercuri-Moreau [2], O.J. Sovers [4],

1. U.S. Naval Observatory
2. Central Bureau of IERS, Observatoire de Paris/CNRS URA1125
3. Facultad de Ciencias Astronomicas y Geofisicas de La Plata; Observatorio Naval Buenos Aires; CONICET, Argentina
4. Jet Propulsion Laboratory

While deriving the database of physical characteristics described in Part III-2 above, information was also maintained on alternate (or alias) names for the various radio sources. Additional sources of alias names were then used to add additional names to the database.

The following sources were used overall. See Part III-2 for further information.

• The "VLBI survey", 1985, Preston R.A., Morabito D.D., Williams J.G., Faulkner J., Jauncey D.L., Nicolson G.D., *Astron. J.*, **90**, p. 1559.

• The "Quasars and Active Galactic Nuclei (7th edition, 1996)" list of M. P. Veron-Cetty and P. Veron. This was published as an ESO Scientific Report in 1996.

• "A Revised and Updated Catalog of Quasi-stellar Objects.", 1993, Hewitt, A. and Burbridge, G., *Astrophys. J. Suppl. Ser.*, **87**, p. 451.

• A listing "Master Source List" by T. Marshall Eubanks (private communication, January 14, 1997).

• A listing of radio source names maintained by the IERS Central Bureau, entitled "Dictionary of Radio Source Names". This list concerns 2569 sources and is available via anonymous ftp from 145.238.100.28 (hpiers.obspm.fr), file "iers/icrf/ar96/dico.rsc".

• A listing of radio source names maintained by O.J. Sovers.

This research has made use of

• the NASA/IPAC Extragalactic Database (NED), which is operated by the Jet Propulsion Laboratory, Caltech, under contract with the National Aeronautics and Space Administration.

• the Simbad database, operated by the Centre de Données Astronomiques de Strasbourg (CDS).

For additional information on astronomical nomenclature, and references for most of the acronyms used here, see the "Dictionary of Nomenclature of Celestial Objects", maintained by the IAU on the world wide web at http://vizier.u-strasbg.fr:8008/cgi-bin/Dic-Simbad.

The following table is a list, ordered by J2000.0 right ascension, of the possible aliases found for each source. Each line contains information for one radio source, with a list of aliases continued for one to three more lines as necessary.

It is planned to continue to improve this list of aliases with new information as it becomes available and via searches through the NED, Simbad, and other databases. This list, versions of it sorted in different ways, and future versions of this information will be posted to the ftp and web sites described in this Technical Note page v.

Table III-5. Dictionary of aliases (See notes p. III-197)

ICRF Designation (1)	IERS Des. (2)	GSFC/USNO (3)	JPL (4)	Other names (5)			
ICRF J000435.6-473619	0002-478			P 0002-478	PKS 0002-478		
ICRF J000557.1+382015	0003+380		GC 0003+38	ICRF J000557.18+382015.1	4C 38.02	S4 0003+38	
ICRF J000613.8-062335	0003-066			NRAO 5	PHL 2625	PKS 0003-066	
ICRF J001031.0+105829	0007+106	IIIZW2	III ZW 2	ICRF J001031.01+105829.5	0008+106	III Zw 2	PKS 0007+106
ICRF J001033.9+172418	0007+171		GC 0007+17	ICRF J001033.99+172418.8	4C 17.04	GC 0007+171	MC3 0007+171
				OB 113	PKS 0007+171	PKS 0008+171	
ICRF J001052.5-415310	0008-421		P 0008-42	PKS 0008-42			
ICRF J001101.2-261233	0008-264		P 0008-264	PKS 0008-264			
ICRF J001331.1+405137	0010+405			ICRF J001331.13+405137.1	4C 40.01	B3 0010+406	GC 0010+40
				S4 0010+40			
ICRF J001611.0-001512	0013-005		P 0013-00	PKS 0013-00	PKS 0013-005		
ICRF J001708.4+813508	0014+813			ICRF J001708.47+813508.1	0014+81	S5 0014+81	S5 0014+813
ICRF J001945.7+732730	0016+731			0016+73	S5 0016+73	S5 0016+731	
ICRF J002232.4+060804	0019+058		P 0019+058	GC 0019+05	PKS 0019+058		
ICRF J002442.9-420203	0022-423			P 0022-423	PKS 0022-423		
ICRF J002914.2+345632	0026+346		OB 343	S4 0226+34			
ICRF J003824.8+413706	0035+413			S4 0035+41			
ICRF J004204.5+232001	0039+230			ICRF J004204.55+232001.1	PKS 0039+230		
ICRF J004959.4-573827	0047-579		P 0047-579	ICRF J004959.47-573827.3	PKS 0047-579		
ICRF J005041.3-092905	0048-097		P 0048-09	OB 081	PHL 856	PKS 0048-09	PKS 0048-097
ICRF J005846.5-565911	0056-572			P 0056-572	PKS 0056-572		
ICRF J005905.5+000651	0056-001		P 0056-00	4C 00.06	DA 32	OB 094	PHL 923
				PKS 0056-00	PKS 0056-001		
ICRF J010245.7+582411	0059+581						
ICRF J010645.1-403419	0104-408		P 0104-408	PKS 0104-408			
ICRF J010838.7+013500	0106+013		P 0106+01	4C 01.02	GC 0106+013	OC 012	PB 6280
				PKS 0106+01	PKS 0106+013		
ICRF J011137.3+390628	0108+388		GC 0108+38	S4 0108+38			
ICRF J011205.8+224438	0109+224		GC 0109+22	ICRF J011205.82+224438.8	GC 0109+224	S2 0109+22	
ICRF J011327.0+494824	0110+495			S4 0110+49			
ICRF J011343.1+022217	0111+021		P 0111+021	ICRF J011343.14+022217.3	PKS 0111+021		
ICRF J011517.0-012704	0112-017		P 0112-017	PB 6342	PKS 0112-017	UM 310	
ICRF J011612.5-113615	0113-118		P 0113-118	PKS 0113-11	PKS 0113-118		
ICRF J011935.0+321050	0116+319		OC 328	4C 31.04			

Table III-5 (cont.). Dictionary of aliases

ICRF Designation (1)	IERS Des. (2)	GSFC/USNO (3)	JPL (4)	Other names (5)			
ICRF J012031.6-270124	0118-272		P 0118-272	PKS 0118-272			
ICRF J012141.5+114950	0119+115		P 0119+11	PKS 0119+11	PKS 0119+115		
ICRF J012156.8+042224	0119+041		GC 0119+04	GC 0119+041	OC 033	PKS 0119+041	
ICRF J012642.7+255901	0123+257		P 0123+25	ICRF J012642.79+255901.3	4C 25.05	OC 240	PKS 0123+25
				PKS 0123+257			
ICRF J013305.7-520003	0131-522		P 0131-522	ICRF J013305.76-520003.9	PKS 0131-522		
ICRF J013658.5+475129	0133+476		DA 55	ICRF J013658.59+475129.1	OC 457	S4 0133+47	
ICRF J013738.3-243053	0135-247			ICRF J013738.35-243053.9	0136-247	OC 259	OC-259
				PKS 0135-247			
ICRF J013741.2+330935	0134+329	3C48	3C 48	ICRF J013741.30+330935.1	3C 48.0	3CR 48	4C 32.08
				B2 0134+329	CTA 15	DA 54	NRAO 79
				OC 358			
ICRF J014125.8-092843	0138-097			ICRF J014125.83-092843.7	P 0138-097	PKS 0138-097	PKS 0139-09
ICRF J014922.3+055553	0146+056			GC 0146+056	OC 079	PKS 0146+056	
ICRF J015002.6-072548	0147-076			IRAS 01475-0740			
ICRF J015127.1+274441	0148+274		GC 0148+27	ICRF J015127.15+274441.8			
ICRF J015218.0+220707	0149+218		P 0149+21	ICRF J015218.06+220707.7	GC 0149+218	PKS 0149+21	PKS 0149+218
ICRF J015310.1-331025	0150-334		P 0150-334	PKS 0150-334			
ICRF J015456.2+474326	0151+474			B3 0151+47			
ICRF J015537.0-404842	0153-410		P 0153-410	PKS 0153-410			
ICRF J015734.9+744243	0153+744			ICRF J015734.96+744243.2	0153+74	S5 0153+74	S5 0153+744
ICRF J020213.6-762003	0202-765			MSH 01-71	P 0202-76	PKS 0202-76	PKS 0202-765
ICRF J020333.3+723253	0159+723			ICRF J020333.39+723253.7	0159+72	S5 0159+72	
ICRF J020346.6+113445	0201+113		P 0201+113	PKS 0201+113			
ICRF J020450.4+151411	0202+149		P 0202+14	4C 15.05	PKS 0202+14		
ICRF J020457.6-170119	0202-172		P 0202-17	PKS 0202-17	PKS 0202-172		
ICRF J020504.9+321230	0202+319		DW 0202+31	ICRF J020504.93+321230.1	B2 0202+31	B2 0202+319	DW 0202+319
				GC 0202+319	PKS 0202+319		
ICRF J021046.2-510101	0208-512		P 0208-512	PKS 0208-512			
ICRF J021730.8+734932	0212+735			0212+73	PKS 0212+735	S5 0212+73	S5 0212+735
				S5 0212+73A			

Table III-5 (cont.). Dictionary of aliases

ICRF Designation (1)	IERS Des. (2)	GSFC/USNO (3)	JPL (4)	Other names (5)			
ICRF J021748.9+014449	0215+015			ICRF J021748.95+014449.7	OD 026	PKS 0215+015	
ICRF J022239.6+430207	0219+428			ICRF J022239.61+430207.8	3C 66A		
ICRF J022256.4-344128	0220-349		P 0220-349	ICRF J022256.40-344128.7	PKS 0220-349		
ICRF J022428.4+065923	0221+067		GC 0221+06	PKS 0221+067			
ICRF J022850.0+672103	0224+671	4C67.05	DW 0224+67	ICRF J022850.05+672103.0	4C +67.05	4C 67.05	
ICRF J022934.9-784745	0230-790			ICRF J022934.95-784745.6	P 0230-790	PKS 0230-790	
ICRF J023145.8+132254	0229+131		P 0229+13	4C 13.14	GC 0229+131	OD 148	PKS 0229+13
				PKS 0229+131			
ICRF J023752.4+284808	0234+285		CTD 20	4C 28.07	B2 0234+28	B2 0234+285	GC 0234+285
				OD 258	PKS 0234+285		
ICRF J023838.9+163659	0235+164		GC 0235+16	ICRF J023838.93+163659.3	0236+164	AO 0235+16	AO 0235+164
				GC 0235+164	OD 160		
ICRF J023945.4-023440	0237-027		P 0237-027	PKS 0237-027			
ICRF J023951.2+041621	0237+040		GC 0237+04	GC 0237+040	OD 062	PKS 0237+040	
ICRF J024008.1-230915	0237-233		P 0237-23	OD 263	PHL 8462	PKS 0237-23	PKS 0237-233
ICRF J024104.7-081520	0238-084	NGC1052	P 0238-084	NGC 1052	PKS 0238-084	PKS 238-084	
ICRF J024229.1+110100	0239+108		OD 166	ICRF J024229.17+110100.7	PKS 0239+108		
ICRF J024457.6+622806	0241+622			ICRF J024457.70+622806.5	4U 0241+61	4U 0241+62	
ICRF J025134.5+431515	0248+430			ICRF J025134.54+431515.8	GC 0248+43	GC 0248+430	S4 0248+43
				S4 0248+430			
ICRF J025246.1-710435	0252-712						
ICRF J025329.1-544151	0252-549		P 0252-549	PKS 0252-549	PKS 052-549		
ICRF J025334.8+180542	0250+178		GC 0250+17				
ICRF J025927.0+074739	0256+075		OD 094.7	ICRF J025927.08+074739.6	PKS 0256+075	PKS 0259+07	
ICRF J030230.5+121856	0259+121						
ICRF J030335.2+471616	0300+470		OE 400	4C 47.08			
ICRF J030350.6-621125	0302-623		P 0302-623	ICRF J030350.63-621125.5	PKS 0302-623		
ICRF J030642.6+624302	0302+625						
ICRF J030903.6+102916	0306+102			ICRF J030903.62+102916.3	OE 110	PKS 0306+102	
ICRF J030956.0-605839	0308-611			ICRF J030956.10-605839.1	P 0308-611	PKS 0308-611	
ICRF J031155.2-765150	0312-770			ICRF J031155.25-765150.8	P 0312-77	PKS 0312-77	PKS 0312-770
ICRF J031301.9+412001	0309+411			ICRF J031301.96+412001.2	MW 0309+41	NRAO 128	S4 0309+41
ICRF J031948.1+413042	0316+413	3C84	3C 84	ICRF J031948.16+413042.1	NGC 1275		
ICRF J031951.2+190131	0317+188		P 0317+188	PKS 0317+188			

Table III-5 (cont.). Dictionary of aliases

ICRF Designation (1)	IERS Des. (2)	GSFC/USNO (3)	JPL (4)	Other names (5)			
ICRF J032153.1+122113	0319+121		P 0319+12	OE 131	PKS 0319+12		
ICRF J032957.6+275615	0326+277	0326+278		ICRF J032957.67+275615.5	DW 0326+27	DW 0326+277	
ICRF J033413.6-400825	0332-403		P 0332-403	PKS 0332-403			
ICRF J033553.9-543025	0334-546			P 0334-546	PKS 0334-546		
ICRF J033630.1+321829	0333+321	NRAO140	NRAO 140	4C 32.14	B2 0333+321	DA 107	HEAO 0333+321
				OE 355			
ICRF J033717.1+013722	0334+014						
ICRF J033930.9-014635	0336-019	CTA26	CTA 26	ICRF J033930.94-014635.8	DA 110	GC 0336-019	OE 063
				PKS 0336-01	PKS 0336-019		
ICRF J034035.6-211931	0338-214		P 0338-214	PKS 0338-214			
ICRF J034423.1+155943	0341+158						
ICRF J034506.4+145349	0342+147			ICRF J034506.42+145349.6			
ICRF J035721.9-481215	0355-483			P 0355-483	PKS 0355-483		
ICRF J035929.7+505750	0355+508	NRAO150	NRAO 150	4C 50.11			
ICRF J040221.2-314725	0400-319		P 0400-319	PKS 0400-319			
ICRF J040305.5+260001	0400+258		CTD 26	ICRF J040305.59+260001.5	0400+257	B2 0400+258	DW 0400+25
				DW 0400+258	GC 0400+258	OF 200	PKS 0400+258
ICRF J040353.7-360501	0402-362		P 0402-362	PKS 0402-362			
ICRF J040534.0-130813	0403-132		P 0403-13	PKS 0403-13	PKS 0403-132		
ICRF J040659.0-382628	0405-385		P 0405-385	PKS 0405-385			
ICRF J040748.4-121136	0405-123		P 0405-12	ICRF J040748.43-121136.7	HEAO 0405-123	MSH 04-12	OF 109
				PKS 0405-12	PKS 0405-123		
ICRF J040820.3+303230	0405+304	0405+305		ICRF J040820.38+303230.5			
ICRF J040820.3-654509	0407-658			PKS 0407-658			
ICRF J040905.7-123848	0406-127			OF 111	P 0406-127	PKS 0406-127	
ICRF J040922.0+121739	0406+121		GC 0406+12	ICRF J040922.01+121739.8	PKS 0406+121		
ICRF J041636.5-185108	0414-189		P 0414-189	ICRF J041636.54-185108.3	MC 0414-189	PKS 0414-189	
ICRF J042315.8-012033	0420-014		P 0420-01	ICRF J042315.80-012033.1	OA 129	OF 035	PKS 0420-01
				PKS 0420-014			
ICRF J042356.0+415002	0420+417		VRO 41.04.01				

Table III-5 (cont.). Dictionary of aliases

ICRF Designation (1)	IERS Des. (2)	GSFC/USNO (3)	JPL (4)	Other names (5)			
ICRF J042442.2-375620	0422-380			ICRF J042442.24-375620.8	PKS 0422-380		
ICRF J042446.8+003606	0422+004		P 0422+00	ICRF J042446.84+003606.3	GC 0422+004	OF 038	PKS 0422+00
				PKS 0422+004			
ICRF J042636.6+051819	0423+051		P 0423+051	ICRF J042636.60+051819.9	PKS 0423+051		
ICRF J042747.5+045708	0425+048		P 0425+048	PKS 0425+048			
ICRF J042840.4-375619	0426-380		P 0426-380	ICRF J042840.42-375619.6	PKS 0426-380		
ICRF J043221.1-510925	0431-512		P 0431-512	PKS 0431-512			
ICRF J043311.0+052115	0430+052	3C120	3C 120	ICRF J043311.10+052115.6	BW Tau		
ICRF J043701.4-184448	0434-188		P 0434-188	PKS 0434-188			
ICRF J043900.8-452222	0437-454		P 0437-454	ICRF J043900.85-452222.6	PKS 0437-454		
ICRF J044017.1-433308	0438-436		P 0438-43	PKS 0438-43	PKS 0438-436		
ICRF J044238.6-001743	0440-003	NRAO190	NRAO 190	ICRF J044238.66-001743.4	DA 145	OF 067	PKS 0440-00
				PKS 0440-003			
ICRF J044331.6+344106	0440+345						
ICRF J044907.6+112128	0446+112		P 0446+11	ICRF J044907.67+112128.6	PKS 0446+11		
ICRF J044923.3+633209	0444+634			GC 0444+63	S4 0444+63		
ICRF J045005.4-810102	0454-810		P 0454-81	ICRF J045005.44-810102.2	PKS 0454-81	PKS 0454-810	
ICRF J045314.6-280737	0451-282		P 0451-28	PKS 0451-28	PKS 0451-282	PKS 0454-282	
ICRF J045550.7-461558	0454-463		P 0454-46	PKS 0454-46	PKS 0454-463		
ICRF J045703.1-232452	0454-234			OF 292	OF-292	PKS 0454-234	
ICRF J045952.0+022931	0457+024		P 0457+024	ICRF J045952.05+022931.2	GC 0457+024	OF 097	PKS 0457+024
ICRF J050112.8-015914	0458-020		P 0458-02	4C 02.19	DA 157	GC 0458-020	OA 141
				OF 098	PKS 0458-02	PKS 0458-020	
ICRF J050145.2+135607	0458+138		P 0458+138	ICRF J050145.27+135607.2	PKS 0458+138		
ICRF J050215.4+060907	0459+060		GC 0459+06				
ICRF J050321.1+020304	0500+019			OG 003			
ICRF J050401.7-604952	0503-608		P 0503-608	PKS 0503-608			
ICRF J050523.1+045942	0502+049		P 0502+049	ICRF J050523.18+045942.7	PKS 0502+049		
ICRF J050643.9-610940	0506-612		P 0506-61	ICRF J050643.99-610941.0	PKS 0506-61	PKS 0506-612	
ICRF J050842.3+843204	0454+844			ICRF J050842.36+843204.5	0454+84	S5 0454+84	S5 0454+844
ICRF J050927.4+101144	0506+101		P 0506+101	PKS 0506+101			
ICRF J051002.3+180041	0507+179		P 0507+17	ICRF J051002.37+180041.6	PKS 0507+17	PKS 0507+179	
ICRF J051349.1-215916	0511-220		P 0511-220	OG 220	PKS 0511-220		

Table III-5 (cont.). Dictionary of aliases

ICRF Designation (1)	IERS Des. (2)	GSFC/USNO (3)	JPL (4)	Other names (5)			
ICRF J051637.7-723707	0517-726						
ICRF J051644.9-620705	0516-621			ICRF J051644.93-620705.4			
ICRF J052109.8+163822	0518+165	3C138	3C 138	ICRF J052109.89+163822.1	3C 138.0	3CR 138	4C 16.12
				DA 170	NRAO 205	OG 130.2	PKS 0518+165
ICRF J052234.4-610757	0522-611		P 0522-611	PKS 0522-611			
ICRF J052257.9-362730	0521-365		P 0521-36	ICRF J052257.98-362730.9	MSH 05-36	PKS 0521-36	PKS 0521-365
ICRF J052531.4-455754	0524-460		P 0524-460	PKS 0524-460			
ICRF J052930.0-724528	0530-727		P 0530-728	ICRF J052930.04-724528.5	PKS 0530-728		
ICRF J053007.9-250329	0528-250			PKS 0528-250			
ICRF J053056.4+133155	0528+134		P 0528+134	OG 147	PKS 0528+134		
ICRF J053238.9+073243	0529+075		OG 050				
ICRF J053850.3-440508	0537-441		P 0537-441	ICRF J053850.36-440508.9	PKS 0537-441		
ICRF J053932.0-155030	0537-158		P 0537-158	PKS 0537-158			
ICRF J053942.3+143345	0536+145						
ICRF J053954.2-283955	0537-286			ICRF J053954.28-283955.9	B1 0537-286	OG 263	OG-263
				PKS 0537-286			
ICRF J054138.0-054149	0539-057		P 0539-057	ICRF J054138.08-054149.4	PKS 0539-057		
ICRF J054236.1+495107	0538+498	3C147	3C 147	ICRF J054236.14+495107.2	3C 147.0	3CR 147	4C 49.14
				CTA 39	DA 186	NRAO 221	OG 465
ICRF J054734.1+272156	0544+273			ICRF J054734.15+272156.8			
ICRF J055530.8+394849	0552+398		DA 193	B2 0552+398	B2 0552+39A	B2 0552+39B	OA 198
				PKS 0552+398			
ICRF J055932.0+235353	0556+238			ICRF J055932.03+235353.9			
ICRF J060309.1+174216	0600+177						
ICRF J060752.6+672055	0602+673			GC 0602+67			
ICRF J060759.6-083449	0605-085		P 0605-08	OH 010	PKS 0605-08		
ICRF J060940.9-154240	0607-157		P 0607-15	MC 0607-157	PKS 0607-15	PKS 0607-157	
ICRF J061357.6+130645	0611+131						
ICRF J061423.8+604621	0609+607			ICRF J061423.87+604621.8	OH 617		
ICRF J061635.9-345616	0614-349		P 0614-349	P 0614-34	PKS 0614-34	PKS 0614-349	
ICRF J061732.3-363414	0615-365		P 0615-365	PKS 0615-365			
ICRF J062331.7-441302	0622-441		P 0622-441	PKS 0622-441			
ICRF J062419.0+385648	0620+389			OH 335	S4 0620+389		
ICRF J062603.0+820225	0615+820			ICRF J062603.01+820225.6	0615+82	S5 0615+82	S5 0615+820

Table III-5 (cont.). Dictionary of aliases

ICRF Designation (1)	IERS Des. (2)	GSFC/USNO (3)	JPL (4)	Other names (5)			
ICRF J063111.9-415426	0629-418			ICRF J063112.00-415426.9	P 0629-418	PKS 0629-418	
ICRF J063546.5-751616	0637-752		P 0637-75	ICRF J063546.51-751616.8	HEAO 0637-752	MC 0637-752	PKS 0637-75
				PKS 0637-752			
ICRF J063920.9-334600	0637-337		P 0637-337	PKS 0637-337			
ICRF J064204.2+675835	0636+680			ICRF J064204.26+675835.6	GC 0636+68	GC 0636+680	S4 0636+68
				S4 0636+680			
ICRF J064524.0+212151	0642+214	3C166	3C 166	3C 166.0	4C 21.21		
ICRF J064632.0+445116	0642+449		OH 471	ICRF J064632.03+445116.6	B3 0642+449		
ICRF J064814.0-304419	0646-306		P 0646-306	PKS 0646-306			
ICRF J064848.4-473427	0647-475		P 0647-475	PKS 0647-475			
ICRF J065024.5-163739	0648-165			ICRF J065024.58-163739.7	PKS 0648-165		
ICRF J065358.2+370540	0650+371			B2 0650+37	B2 0650+371	GC 0650+37	GC 0650+371
				S4 0650+37	S4 0650+371	UT 0650+371	
ICRF J070001.5+170921	0657+172						
ICRF J070134.5-463436	0700-465			P 0700-465	PKS 0700-465		
ICRF J071046.1+473211	0707+476			ICRF J071046.10+473211.1	B3 0707+476	GC 0707+47	S4 0707+476
ICRF J071338.1+434917	0710+439		OI 417	S4 0710+43			
ICRF J071424.8+353439	0711+356			OI 318			
ICRF J072153.4+712036	0716+714			ICRF J072153.45+712036.4	0716+71	S5 0716+71	S5 0716+714
ICRF J072516.8+142513	0722+145		P 0722+145	ICRF J072516.81+142513.7	4C 14.23	PKS 0722+145	
ICRF J072550.6-005456	0723-008		DW 0723-00	ICRF J072550.64-005456.5	OI 039	PKS 0723-008	
ICRF J072611.7+791131	0718+792	0718+793		ICRF J072611.74+791131.0	0718+79		
ICRF J072905.4-363945	0727-365						
ICRF J073019.1-114112	0727-115		P 0727-11	PKS 0727-11	PKS 0727-115		
ICRF J073545.8-173548	0733-174		P 0733-17	ICRF J073545.81-173548.5	PKS 0733-17	PKS 0733-174	
ICRF J073807.3+174218	0735+178		P 0735+17	ICRF J073807.39+174219.0	DA 237	GC 0735+178	OI 158
				PKS 0735+17	PKS 0735+178	VRO 17.07.02	
ICRF J073816.9-332212	0736-332		P 0736-332	PKS 0736-332			
ICRF J073856.4-673550	0738-674			ICRF J073856.50-673550.8	PKS 0738-674		

Table III-5 (cont.). Dictionary of aliases

ICRF Designation (1)	IERS Des. (2)	GSFC/USNO (3)	JPL (4)	Other names (5)			
ICRF J073918.0+013704	0736+017		P 0736+01	OI 061	PKS 0736+01	PKS 0736+017	
ICRF J074110.7+311200	0738+313		OI 363	ICRF J074110.70+311200.2	B2 0738+31	B2 0738+313	DW 0738+313
				GC 0738+313			
ICRF J074202.7+490015	0738+491						
ICRF J074331.6-672625	0743-673			P 0743-67	PKS 0743-67	PKS 0743-673	
ICRF J074533.0+101112	0742+103		DW 0742+10				
ICRF J074554.0-004417	0743-006		P 0743-006	4C 00.28	OI 072	PKS 0743-006	
ICRF J074625.8+254902	0743+259		GC 0743+25	ICRF J074625.87+254902.1			
ICRF J074836.1+240024	0745+241		B2 0745+24	ICRF J074836.11+240024.1	B2 0745+241	OI 275	PKS 0745+241
ICRF J075052.0+123104	0748+126		P 0748+126	OI 280	PKS 0748+126		
ICRF J075301.3+535259	0749+540			ICRF J075301.38+535259.6	4C 54.15	OI 582	S4 0749+54
ICRF J075706.6+095634	0754+100		P 0754+100	ICRF J075706.64+095634.9	OI 090.4	PKS 0754+100	
ICRF J080815.5-075109	0805-077		P 0805-07	PKS 0805-07	PKS 0805-077		
ICRF J080839.6+495036	0804+499		OJ 508	ICRF J080839.67+495036.5	GC 0804+49	GC 0804+499	S4 0804+49
				S4 0804+499			
ICRF J080856.6+405244	0805+410			ICRF J080856.65+405244.9	B3 0805+410	GC 0805+41	UT 0805+410
ICRF J081108.8-492943	0809-493		P 0809-492	PKS 0809-492	PKS 0809-493		
ICRF J081126.7+014652	0808+019		P 0808+019	DW 0808+019	OJ 014	PKS 0808+019	
ICRF J081525.9+363515	0812+367			ICRF J081525.94+363515.1	B2 0812+36	B2 0812+367	CSO 182
				OJ 320			
ICRF J081815.9+422245	0814+425		OJ 425	S4 0814+42	S4 0814+425		
ICRF J082057.4-125859	0818-128		P 0818-128	ICRF J082057.45-125859.2	OJ 131	PKS 0818-128	
ICRF J082447.2+555242	0820+560			ICRF J082447.24+555242.7	4C 56.16A	4CP 56.16A	GC 0820+56
				GC 0820+560	OJ 535		
ICRF J082455.4+391641	0821+394			ICRF J082455.48+391641.9	4C 39.23	B2 0821+39	B2 0821+394
				GC 0821+39	GC 0821+394	LHE 226	OJ 336
ICRF J082526.8-501038	0823-500			PKS 0823-500			
ICRF J082538.6+615728	0821+621			4CP 62.12	4CP 62.12B		
ICRF J082550.3+030924	0823+033		P 0823+033	MG 0825+0309	OJ 038	PKS 0823+03	PKS 0823+033
ICRF J082601.5-223027	0823-223		P 0823-223	PKS 0823-223			

Table III-5 (cont.). Dictionary of aliases

ICRF Designation (1)	IERS Des. (2)	GSFC/USNO (3)	JPL (4)	Other names (5)			
ICRF J082804.7-373106	0826-373			ICRF J082804.78-373106.3	PKS 0826-373		
ICRF J083052.0+241059	0827+243		B2 0827+24	AO 0827+243	B2 0827+243	OJ 248	
ICRF J083148.8+042939	0829+046		MA 0829+04	ICRF J083148.88+042939.1	OJ 049	PKS 0829+046	
ICRF J083223.2+491321	0828+493		OJ 448	ICRF J083223.22+491321.0	S4 0828+49		
ICRF J083322.3-444138	0831-445	VELA-G		Vel G			
ICRF J083454.9+553421	0831+557		4C 55.16	ICRF J083454.90+553421.1			
ICRF J083520.6-451035	0833-450	VELA		Vel A			
ICRF J083639.2-201659	0834-201		P 0834-20	ICRF J083639.22-201659.5	PKS 0834-20	PKS 0834-201	
ICRF J083722.4+582501	0833+585			ICRF J083722.41+582501.8	GC 0833+58	GC 0833+585	S4 0833+58
				S4 0833+585			
ICRF J084124.3+705342	0836+710		4C 71.07	S5 0836+71	S5 0836+710		
ICRF J084127.0-754027	0842-754			MC 0842-754	P 0842-75	PKS 0842-75	PKS 0842-754
ICRF J084205.0+183540	0839+187		GC 0839+18	ICRF J084205.09+183541.0	DW 0839+18	GC 0839+187	PKS 0839+187
				UT 0839+187			
ICRF J085441.9+575729	0850+581			ICRF J085442.00+575729.9	4C 58.17	GC 0850+58	GC 0850+581
				S4 0850+581			
ICRF J085448.8+200630	0851+202	OJ287	OJ 287	ICRF J085448.87+200630.6	GC 0851+202	OB 287	PG 0851+202
				PKS 0851+202	VRO 20.08.01		
ICRF J090216.8-141530	0859-140		P 0859-14	MSH 09-11	OJ 199	PKS 0859-14	PKS 0859-140
ICRF J090303.9+465104	0859+470		OJ 499	ICRF J090303.99+465104.1	4C 47.29		
ICRF J090910.0+012135	0906+015		P 0906+01	4C 01.24	DA 263	OK 011	PKS 0906+01
				PKS 0906+015			
ICRF J091437.9+024559	0912+029		P 0912+029	PKS 0912+029			
ICRF J091552.4+293324	0912+297		B2 0912+29	ICRF J091552.40+293324.0	B2 0912+297	OK 222	
ICRF J092058.4+444153	0917+449			ICRF J092058.46+444154.0	GC 0917+44	S4 0917+44	S4 0917+449
ICRF J092129.3-261843	0919-260			OK 232	OK-232	PKS 0919-260	
ICRF J092136.2+621552	0917+624			ICRF J092136.23+621552.2	OK 630	S4 0917+62	S4 0917+624
				S5 0917+62			
ICRF J092246.4-395935	0920-397		P 0920-39	PKS 0920-39	PKS 0920-397		
ICRF J092314.4+384939	0920+390						
ICRF J092703.0+390220	0923+392	4C39.25	4C 39.25	4C +39.25	B2 0923+39	B2 0923+392	DA 267
				OK 340			

Table III-5 (cont.). Dictionary of aliases

ICRF Designation (1)	IERS Des. (2)	GSFC/USNO (3)	JPL (4)	Other names (5)			
ICRF J092751.8-203451	0925-203		P 0925-203	PKS 0925-203			
ICRF J093032.5-853359	0936-853			P 0936-853	PKS 0936-853		
ICRF J094855.3+403944	0945+408			ICRF J094855.34+403944.6	4C 40.24	DA 273	OK 476
				VRO 40.09.02			
ICRF J095456.8+174331	0952+179		AO 0952+17	ICRF J095456.82+174331.2	0952+172	AO 0952+179	OK 186
				PKS 0952+179	VRO 17.09.04		
ICRF J095524.7+690113	0951+692	SN1993J		SN 1993J			
ICRF J095533.1+690355	0951+693	M81	M 81	MESSIER 81	NGC 3031		
ICRF J095649.8+251516	0953+254	OK290	OK 290	GC 0953+254	VRO 25.09.08		
ICRF J095819.6+472507	0955+476			ICRF J095819.67+472507.8	B3 0955+476	OK 492	S4 0955+47
ICRF J095820.9+322402	0955+326		3C 232	ICRF J095820.95+322402.2	4C 32.33	B2 0955+326	DA 279
				NRAO 342	OK 393	TON 469	
ICRF J095847.2+653354	0954+658			ICRF J095847.25+653354.8	GC 0954+65	S4 0954+65	S4 0954+658
				S4 0954+65A			
ICRF J100159.9-443800	0959-443		P 0959-443	PKS 0959-443			
ICRF J100614.0-501813	1004-500						
ICRF J100741.4+135629	1004+141		GC 1004+14	GC 1004+141	OL 108.1	PKS 1004+141	
ICRF J101353.4+244916	1011+250			B2 1011+25	B2 1011+250	GC 1011+250	TON 490
ICRF J101447.0+230116	1012+232			ICRF J101447.07+230116.6	4C 23.24	OL 220	PKS 1011+23
				P 1012+232	PKS 1012+232		
ICRF J101725.8+611627	1014+615						
ICRF J102232.7-103744	1020-103		P 1020-103	ICRF J102232.80-103744.4	MSH 10-17	OL 133	PKS 1020-103
				UT 1020-103			
ICRF J102311.5+394815	1020+400			ICRF J102311.57+394815.4	B2 1020+40	B3 1020+400	GC 1020+40
				GC 1020+400	UT 1020+400		
ICRF J102429.5-005255	1021-006		P 1021-00	PKS 1021-00	PKS 1021-006		
ICRF J102444.8+191220	1022+194		GC 1022+19	4C 19.34	OL 136		
ICRF J103303.7+411606	1030+415			ICRF J103303.71+411606.2	B3 1030+41	GC 1030+41	GC 1030+415
				VRO 10.41.03			
ICRF J103502.1-201134	1032-199		P 1032-199	ICRF J103502.16-201134.4	MC 1032-199	PKS 1032-199	
ICRF J103507.0+562846	1031+567		OL 553	ICRF J103507.04+562846.8	S4 1031+56		
ICRF J103716.0-293402	1034-293		P 1034-293	OL 259	PKS 1034-293		
ICRF J104117.1+061016	1038+064		OL 064.5	ICRF J104117.16+061016.9	4C 06.41	OTL 1038+064	

Table III-5 (cont.). Dictionary of aliases

ICRF Designation (1)	IERS Des. (2)	GSFC/USNO (3)	JPL (4)	Other names (5)			
ICRF J104142.9-474006	1039-474						
ICRF J104146.7+523328	1038+528	1038+52A		ICRF J104146.78+523328.2	OL 564		
ICRF J104148.8+523355	1038+529	1038+52B		ICRF J104148.90+523355.6	1038+528	1038+528B	QSO 1038+528
ICRF J104244.6+120331	1040+123	3C245	3C 245	ICRF J104244.61+120331.3	3C 245.0	3CR 245	4C 12.37
				AO 1040+123	DA 289	NRAO 358	OL 166.6
				PKS 1040+123			
ICRF J104423.0+805439	1039+811			ICRF J104423.06+805439.4	1039+81	S5 1039+81	S5 1039+811
ICRF J104455.9+065538	1042+071		P 1042+071	PKS 1042+071			
ICRF J104806.6-190935	1045-188			MC 1045-188	P 1045-18	PKS 1045-18	
ICRF J104827.6+714335	1044+719			1044+71	S5 1044+71		
ICRF J105104.7-313814	1048-313		P 1048-313	PKS 1048-313			
ICRF J105148.7+211952	1049+215		P 1049+21	ICRF J105148.79+211952.3	4C 21.28	OL 282	PKS 1049+21
				PKS 1049+215			
ICRF J105653.6+701145	1053+704			1053+70	S5 1053+70		
ICRF J105811.5+811432	1053+815			ICRF J105811.54+811432.7	1053+81	S5 1053+81	
ICRF J105829.6+013358	1055+018		P 1055+01	4C 01.28	DA 293	OL 093	PKS 1055+01
				PKS 1055+018			
ICRF J105843.3-800354	1057-797		P 1057-79	ICRF J105843.31-800354.2	PKS 1057-79	PKS 1057-797	
ICRF J110331.5-325116	1101-325		P 1101-325	ICRF J110331.53-325116.7	CTS K15.03	PKS 1101-325	
ICRF J110352.2-535700	1101-536			P 1101-536	PKS 1101-536		
ICRF J110427.3+381231	1101+384		B2 1101+38	ICRF J110427.31+381231.8	B2 1101+384	MARK 421	MKN 421
				OM 303			
ICRF J110708.6-444907	1104-445		P 1104-445	PKS 1104-445			
ICRF J110712.6-682050	1105-680		P 1105-680	PKS 1105-680			
ICRF J111358.6+144226	1111+149		GC 1111+14	ICRF J111358.70+144227.0	GC 1111+149	OM 118	PKS 1111+149
ICRF J111826.9-463415	1116-462			P 1116-46	PKS 1116-46	PKS 1116-462	
ICRF J111857.3+123441	1116+128		P 1116+12	ICRF J111857.30+123441.7	4C 12.39	DA 299	DW 1116+128
				OM 127	PKS 1116+12	PKS 1116+128	
ICRF J112027.8+142054	1117+146			4C 14.41	P 1117+14	PKS 1117+14	
ICRF J112553.7+261019	1123+264		P 1123+26	B2 1123+264	PB 2704	PKS 1123+26	PKS 1123+264
ICRF J112704.3-185717	1124-186		P 1124-186	PKS 1124-186			

Table III-5 (cont.). Dictionary of aliases

ICRF Designation (1)	IERS Des. (2)	GSFC/USNO (3)	JPL (4)	Other names (5)			
ICRF J112813.3+592514	1125+596						
ICRF J113007.0-144927	1127-145		P 1127-14	DW 1127-145	OM 146	PKS 1127-14	PKS 1127-145
ICRF J113053.2+381518	1128+385		GC 1128+38	ICRF J113053.28+381518.5	B3 1128+385	S4 1128+38	
ICRF J113130.5-050019	1128-047		P 1128-047	PKS 1128-047			
ICRF J113143.2-581853	1129-580						
ICRF J113320.0+004052	1130+009		P 1130+009	ICRF J113320.06+004052.8	PKS 1130+009		
ICRF J114608.1-244732	1143-245		P 1143-245	ICRF J114608.10-244732.9	OM 272	PKS 1143-245	
ICRF J114658.2+395834	1144+402			B3 1144+402	GC 1144+40	S4 1144+40	
ICRF J114701.3-381211	1144-379		P 1144-379	PKS 1144-379			
ICRF J114751.5-072441	1145-071			OM 076	OM-076	PKS 1145-071	
ICRF J115019.2+241753	1147+245		B2 1147+24	ICRF J115019.21+241753.8	B2 1147+245	GC 1147+245	OM 280
ICRF J115043.8-002354	1148-001		P 1148-00	4C 00.47	DW 1148-001	OM 080	PKS 1148-00
				PKS 1148-001	UM 458		
ICRF J115113.4-672811	1148-671		P 1148-671	ICRF J115113.43-672811.1	PKS 1148-671		
ICRF J115312.4+805829	1150+812			ICRF J115312.50+805829.2	1150+81	S5 1150+81	S5 1150+812
ICRF J115324.4+493108	1150+497		4C 49.22	ICRF J115324.47+493108.8	BP 141	GB 1150+497	LB 2136
				LHE 310	OM 484		
ICRF J115825.7+245017	1155+251		GC 1155+25	ICRF J115825.79+245018.0			
ICRF J115912.7-094052	1156-094		P 1156-094	PKS 1156-094			
ICRF J115931.8+291443	1156+295		GC 1156+29	4C 29.45	B2 1156+295	CTD 77	OM 295
				TON 599	Ton 599		
ICRF J120935.2-401613	1206-399			PKS 1206-399	P 1207-399	PKS 1207-399	
ICRF J121546.7-173145	1213-172		P 1213-17	PKS 1213-17	PKS 1213-172		
ICRF J121555.6+344815	1213+350		4C 35.28	ICRF J121555.60+344815.2	GC 1213+35	GC 1213+350	
ICRF J121752.0+300700	1215+303		B2 1215+30	ICRF J121752.08+300700.6	B2 1215+303	ON 325	
ICRF J121806.2-460029	1215-457			MC 1215-457	P 1215-45	PKS 1215-45	PKS 1215-457
ICRF J121906.4+482956	1216+487			ICRF J121906.41+482956.2	ON 428	S4 1216+48	S4 1216+487
ICRF J122131.6+281358	1219+285		ON 231	B2 1219+285	GC 1219+285	VRO 28.12.02	W COM
				W Com			
ICRF J122222.5+041315	1219+044		P 1219+04	ICRF J122222.55+041315.8	4C 04.42	PKS 1219+04	PKS 1219+044
ICRF J122340.4+804004	1221+809			ICRF J122340.49+804004.3	1221+80	S5 1221+80	S5 1221+809
ICRF J122452.4+033050	1222+037		P 1222+037	4C 03.23	PKS 1222+037		
ICRF J122454.3-831310	1221-829			P 1221-82	PKS 1221-82	PKS 1221-829	
ICRF J122847.4+370612	1226+373			ICRF J122847.42+370612.1			

Table III-5 (cont.). Dictionary of aliases

ICRF Designation (1)	IERS Des. (2)	GSFC/USNO (3)	JPL (4)	Other names (5))			
ICRF J122906.6+020308	1226+023	3C273B	3C 273	ICRF J122906.70+020308.6	2A 1226+023	3C 273.0	3C 273B
				4C 02.32	4U 1226+023	DA 324	MSH 12+08
				NRAO 400	ON 044	PG 1226+023	PKS 1226+02
				PKS 1226+023			
ICRF J123049.4+122328	1228+126	3C274	3C 274	NGC 4486	Virgo A		
ICRF J123715.2-504623	1234-504						
ICRF J123924.5+073017	1236+077		P 1236+077	ICRF J123924.59+073017.2	PKS 1236+077		
ICRF J123943.0-102328	1237-101		P 1237-10	ON 162	PKS 1237-10	PKS 1237-101	
ICRF J123946.6-684530	1236-684		P 1236-684	ICRF J123946.65-684530.9	PKS 1236-684		
ICRF J123959.4-113722	1237-113	M104	M 104	MESSIER 104	NGC 4594		
ICRF J124251.3+375100	1240+381			B2 1240+38	B2 1240+381	GC 1240+38	S4 1240+381
ICRF J124604.2-073046	1243-072			ON 073	ON-073	PKS 1243-072	
ICRF J124646.8-254749	1244-255		P 1244-255	PKS 1244-255			
ICRF J125359.5-405930	1251-407			PKS 1251-407			
ICRF J125438.2+114105	1252+119		P 1252+11	ICRF J125438.26+114105.9	MC2 1252+119	ON 187	PKS 1252+11
				PKS 1252+119			
ICRF J125459.9-713818	1251-713		P 1251-71	ICRF J125459.92-713818.4	PKS 1251-71	PKS 1251-713	
ICRF J125611.1-054721	1253-055	3C279	3C 279	4C 05.55	CTA 56	MSH 12-020	NRAO 413
				ON 089	PKS 1253-055		
ICRF J125614.2+565225	1254+571			ICRF J125614.23+565225.2	MARK 231		
ICRF J125759.0-315516	1255-316			ON 392	ON-392	PKS 1255-316	
ICRF J130020.9+141718	1257+145		P 1257+145	ICRF J130020.92+141718.5	PKS 1257+145		
ICRF J130252.4+574837	1300+580			GC 1300+58			
ICRF J130533.0-103319	1302-102		P 1302-102	ICRF J130533.02-103319.4	OP 106	PG 1302-102	PKS 1302-102
ICRF J130933.9+115424	1307+121			4C 12.46	MC 1307+121	MC2 1307+12	MC2 1307+121
				OP 112			
ICRF J131028.6+322043	1308+326		B2 1308+32	ICRF J131028.66+322043.8	AU CVn	B2 1308+326	CSO 836
				GC 1308+326	OP 313	US 371	
ICRF J131607.9-333859	1313-333		OP-322	OP 322	PKS 1313-333		
ICRF J131736.4+342515	1315+346	OP326	OP 326	ICRF J131736.49+342515.9	B2 1315+346	B2 1315+34A	GV 172
ICRF J132304.2-445233	1320-446		P 1320-446	P 1320-44	PKS 1320-44	PKS 1320-446	
ICRF J132527.6-430108	1322-427	CEN-A	P 1322-42	CEN A	CENTAURUS A	NGC 5128	PKS 1322-42

Table III-5 (cont.). Dictionary of aliases

ICRF Designation (1)	IERS Des. (2)	GSFC/USNO (3)	JPL (4)	Other names (5))			
ICRF J132616.5+315409	1323+321			4C 32.44	GC 1323+32		
ICRF J132700.8+221050	1324+224			ICRF J132700.86+221050.2			
ICRF J133108.2+303032	1328+307	3C286	3C 286	3C 286.0	3CR 286	4C 30.26	B2 1328+307
				CTA 60	DA 346	NRAO 425	OP 348
ICRF J133237.5-664650	1329-665						
ICRF J133739.7-125724	1334-127		DW 1335-12	1335-127	PKS 1334-127	PKS 1335-127	
ICRF J133752.4-650924	1334-649		P 1334-649	PKS 1334-649			
ICRF J134022.9+375443	1338+381			ICRF J134022.95+375443.8	GB 1338+3809		
ICRF J134345.9+660225	1342+662		GC 1342+662	ICRF J134345.96+660225.7	S4 1342+662		
ICRF J134408.6+660611	1342+663		GC 1342+663	ICRF J134408.68+660611.6	S4 1342+663		
ICRF J134733.3+121724	1345+125		P 1345+12	4C 12.50	PKS 1345+12		
ICRF J134934.6+534117	1347+539			ICRF J134934.66+534117.0	4C 53.28	GC 1347+53	GC 1347+539
ICRF J135256.5-441240	1349-439		P 1349-439	PKS 1349-439			
ICRF J135406.8-020603	1351-018		P 1351-018	PKS 1351-018			
ICRF J135546.6-632642	1352-632						
ICRF J135704.4+191907	1354+195		P 1354+19	4C 19.44	DA 354	OP 191	PKS 1354+19
				PKS 1354+195	VRO 19.13.06		
ICRF J135711.2-152728	1354-152		OP-192	OP 192	PKS 1354-152		
ICRF J135755.3+764321	1357+769			1357+76			
ICRF J135900.1-415252	1355-416		P 1355-41	MSH 13-45	PKS 1355-41	PKS 1355-416	
ICRF J140445.8-013021	1402-012		P 1402-012	PKS 1402-012	UM 632		
ICRF J140501.1+041535	1402+044		P 1402+044	PKS 1402+044			
ICRF J140700.3+282714	1404+286	OQ208	OQ 208	ICRF J140700.39+282714.7			
ICRF J140856.4-075226	1406-076		P 1406-076	OQ 010	PKS 1406-076		
ICRF J141154.8+213423	1409+218						
ICRF J141558.8+132023	1413+135		P 1413+135	PKS 1413+135			
ICRF J141908.1+062834	1416+067			ICRF J141908.18+062834.8	3C 298	3C 298.0	3CR 298
				4C 06.49	DA 364	MSH 14+05	NRAO 441
				OQ 027.7	PKS 1416+067		

Table III-5 (cont.). Dictionary of aliases

ICRF Designation (1)	IERS Des. (2)	GSFC/USNO (3)	JPL (4)	Other names (5)			
ICRF J141946.5+542314	1418+546		GC 1418+54	ICRF J141946.60+542314.8	CSO 633	GC 1418+546	OQ 530
				OQ 530A	S4 1418+54		
ICRF J141946.6+382148	1417+385			B3 1417+385	UT 1417+385		
ICRF J141959.2+270625	1417+273			4C 27.28			
ICRF J142230.3+322310	1420+326			B2 1420+32	B2 1420+326	OQ 334	
ICRF J142700.3+234800	1424+240			ICRF J142700.39+234800.0	PKS 1424+240		
ICRF J142756.2-420619	1424-418		P 1424-41	PKS 1424-41	PKS 1424-418		
ICRF J143257.6-180135	1430-178		OQ-151	MC 1430-178	OQ 151	PKS 1430-178	
ICRF J143439.7+195200	1432+200			PKS 1432+200			
ICRF J143535.4+301224	1433+304						
ICRF J143645.8+633637	1435+638			ICRF J143645.80+633637.9	GC 1435+63	S4 1435+63	
ICRF J143809.4-220454	1435-218		P 1435-218	OQ 259	PKS 1435-218		
ICRF J144516.4+095836	1442+101	OQ172	OQ 172	ICRF J144516.47+095836.1	MC2 1442+101	PKS 1442+101	
ICRF J144553.3-162901	1443-162			P 1443-162	PKS 1443-162		
ICRF J144815.0-162024	1445-161		P 1445-16	ICRF J144815.05-162024.5	PKS 1445-16	PKS 1445-161	
ICRF J144828.7+760111	1448+762			ICRF J144828.78+760111.6	1448+76	S5 1448+76	
ICRF J145427.4-374733	1451-375		P 1451-375	PKS 1451-375			
ICRF J145432.9-401232	1451-400			P 1451-400	PKS 1451-400		
ICRF J145907.5+714019	1458+718	3C309.1	3C 309.1	3CR 309.1	4C 71.15	NRAO 464	PKS 1458+718
				S5 1458+718			
ICRF J150048.6+475115	1459+480			ICRF J150048.65+475115.5	GC 1459+48		
ICRF J150424.9+102939	1502+106		OR 103	4C 10.39	MC2 1502+106	PKS 1502+106	
ICRF J150506.4+032630	1502+036		P 1502+036	PKS 1502+036			
ICRF J150609.5+373051	1504+377			ICRF J150609.53+373051.1	B2 1504+37	B3 1504+377	OR 306
				S4 1504+37			
ICRF J150704.7-165230	1504-166		P 1504-167	MC 1504-166	OR 102	PKS 1504-166	PKS 1504-167
ICRF J151002.9+570243	1508+572			GB 1508+5714			
ICRF J151250.5-090559	1510-089		P 1510-08	PKS 1510-08	PKS 1510-089		
ICRF J151344.8-101200	1511-100		P 1511-100	PKS 1511-10	PKS 1511-100		
ICRF J151656.7+193212	1514+197		GC 1514+19	ICRF J151656.80+193213.0	GC 1514+197	PKS 1514+197	
ICRF J151741.8-242219	1514-241		P 1514-24	ICRF J151741.81-242219.5	AP LIB	AP Lib	OR 225
				PKS 1514-24	PKS 1514-241		
ICRF J152237.6-273010	1519-273		P 1519-273	PKS 1519-273			
ICRF J153452.4+013104	1532+016		P 1532+01	ICRF J153452.45+013104.2	PKS 1532+01	PKS 1532+016	

Table III-5 (cont.). Dictionary of aliases

ICRF Designation (1)	IERS Des. (2)	GSFC/USNO (3)	JPL (4)	Other names (5)			
ICRF J154049.4+144745	1538+149		GC 1538+14	ICRF J154049.49+144745.9	4C 14.60	OR 165	
ICRF J154917.4+503805	1547+507			ICRF J154917.47+503805.8	OR 580	S4 1547+50	
ICRF J154929.4+023701	1546+027		P 1546+027	OR 078	PKS 1546+027		
ICRF J155035.2+052710	1548+056		DW 1548+05	4C 05.64	PKS 1548+056		
ICRF J155059.1-825806	1540-828		P 1540-82	PKS 1540-82	PKS 1540-828		
ICRF J155658.8-791404	1549-790		P 1549-79	ICRF J155658.87-791404.3	PKS 1549-79	PKS 1549-790	
ICRF J155751.4-000150	1555+001		DW 1555+00	DW 1555+001	P 1555+001	PKS 1555+001	
ICRF J155821.9-140959	1555-140		P 1555-140	PKS 1555-140			
ICRF J155930.9+030448	1557+032			MG 1559+0305			
ICRF J160140.4+431647	1600+432	1600+43A		1600+434			
ICRF J160140.5+431646	1600+431	1600+43B					
ICRF J160207.2+332653	1600+335		B2 1600+33	ICRF J160207.26+332653.1			
ICRF J160431.0-444131	1600-445						
ICRF J160734.7-333108	1604-333		P 1604-333	ICRF J160734.76-333108.9	PKS 1604-333		
ICRF J160846.2+102907	1606+106		P 1606+10	ICRF J160846.20+102907.8	4C 10.45	PKS 1606+10	
ICRF J160913.3+264129	1607+268	CTD93	CTD 93	PKS 1607+268			
ICRF J161341.0+341247	1611+343		DA 406	ICRF J161341.06+341247.9 OS 319	GC 1611+343	GV 273	LHE 403
ICRF J161637.5+045932	1614+051		P 1614+051	PKS 1614+051			
ICRF J161749.2-771718	1610-771		P 1610-77	PKS 1610-77	PKS 1610-771		
ICRF J161903.6+061302	1616+063		DW 1616+06	ICRF J161903.69+061302.2	DW 1616+063	PKS 1616+063	
ICRF J162418.4-680912	1619-680		P 1619-680	ICRF J162418.44-680912.5	PKS 1619-680		
ICRF J162546.8-252738	1622-253		P 1622-253	PKS 1622-253			
ICRF J162557.6+413440	1624+416			ICRF J162557.67+413440.6	4C 41.32	DA 411	
ICRF J162606.0-295126	1622-297		P 1622-29	PKS 1622-29	PKS 1622-297		
ICRF J163515.4+380804	1633+382	1633+38	GC 1633+38	4C 38.41 OS 356	B2 1633+38	B2 1633+382	GC 1633+382

Table III-5 (cont.). Dictionary of aliases

ICRF Designation (1)	IERS Des. (2)	GSFC/USNO (3)	JPL (4)	Other names (5)			
ICRF J163813.4+572023	1637+574		P 1637+574	ICRF J163813.46+572024.0	GC 1637+57	GC 1637+574	OS 562
				PKS 1637+574	S4 1637+57	S4 1637+574	
ICRF J164029.6+394646	1638+398	NRAO512	NRAO 512	OS 264.4	S4 1638+398		
ICRF J164207.8+685639	1642+690			ICRF J164207.85+685639.8	4C 69.21	GC 1642+69	GC 1642+690
ICRF J164258.8+394836	1641+399	3C345	3C 345	ICRF J164258.81+394837.0	3C 345.0	3CR 345	4C 39.18
				4C 39.48	DA 420	LHE 413	NRAO 513
				OS 368			
ICRF J165039.5-294346	1647-296		P 1647-296	PKS 1647-296			
ICRF J165352.2+394536	1652+398	DA426	DA 426	ICRF J165352.22+394536.6	4C 39.49	4U 1652+398	B2 1652+398
				MARK 501	MKN 501	OS 387	
ICRF J165801.4+344328	1656+348			ICRF J165801.42+344328.4	B2 1656+34	B2 1656+348	GC 1656+34
				GC 1656+348	OS 392		
ICRF J165802.7+473749	1656+477			1656+47	S4 1656+47	S4 1656+477	
ICRF J165809.0+074127	1655+077		OS 092	PKS 1655+077			
ICRF J165833.4+051516	1656+053		DW 1656+05	DW 1656+053	OS 094	PKS 1656+053	
ICRF J170053.1-261051	1657-261		P 1657-261	PKS 1657-261			
ICRF J170717.7+453610	1705+456			4C 45.34			
ICRF J170734.4+014845	1705+018		P 1705+018	ICRF J170734.42+014845.7	PKS 1705+018		
ICRF J170934.3-172853	1706-174		OT-111	ICRF J170934.35-172853.4	1707-175	OT 111	
ICRF J171913.0+174506	1717+178		GC 1717+17	GC 1717+178	OT 129	PKS 1717+177	PKS 1717+178
ICRF J172341.0-650036	1718-649		P 1718-649	ICRF J172341.03-650036.6	NGC 6328	PKS 1718-649	
ICRF J172727.6+453039	1726+455			ICRF J172727.65+453039.7	B3 1726+455	GC 1726+45	S4 1726+45
ICRF J172818.6+501310	1727+502			ICRF J172818.62+501310.5	I ZW 187	II ZW 77	OT 546
ICRF J172824.9+042704	1725+044		P 1725+044	ICRF J172824.95+042704.9	PKS 1725+044		
ICRF J173302.7-130449	1730-130	NRAO530	NRAO 530				
ICRF J173315.1-372232	1729-373						
ICRF J173420.5+385751	1732+389			B3 1732+389	OT 355	S04 1732+389	S4 1732+389
ICRF J173549.0+504911	1734+508			GC 1734+50			
ICRF J173735.7-563403	1733-565			P 1733-56	PKS 1733-56	PKS 1733-565	
ICRF J173927.3+495503	1738+499			OT 463	S4 1738+499		

Table III-5 (cont.). Dictionary of aliases

ICRF Designation (1)	IERS Des. (2)	GSFC/USNO (3)	JPL (4)	Other names (5)			
ICRF J173957.1+473758	1738+476		OT 465	S4 1738+47			
ICRF J174036.9+521143	1739+522		4C 51.37	GC 1739+52	GC 1739+522	OT 566	
ICRF J174358.8-035004	1741-038		P 1741-038	OT 068	PKS 1741-03	PKS 1741-038	
ICRF J174425.4-514443	1740-517		P 1740-517	PKS 1740-517			
ICRF J174535.2+172001	1743+173		GC 1743+17	ICRF J174535.21+172001.4	PKS 1743+173		
ICRF J174614.0+622654	1745+624			ICRF J174614.03+622654.7	4C 62.29		
ICRF J174726.6+465850	1746+470						
ICRF J174832.8+700550	1749+701			ICRF J174832.84+700550.8	1748+701	S4 1749+70	S4 1749+701
				S5 1749+70	S5 1749+701	W1 1749+701	
ICRF J175132.8+093900	1749+096		OT 081	4C 09.57	PKS 1749+096		
ICRF J175151.2-252400	1748-253						
ICRF J175322.6+440945	1751+441			ICRF J175322.65+440945.7	OT 486	OT 486.4	S4 1751+44
				S4 1751+441			
ICRF J175342.4+284804	1751+288		GC 1751+28				
ICRF J180024.7+384830	1758+388			OT 398	S4 1758+38	S4 1758+388	
ICRF J180045.6+782804	1803+784			ICRF J180045.68+782804.0	1803+78	S5 1803+78	S5 1803+784
ICRF J180132.3+440421	1800+440			ICRF J180132.31+440421.9	B3 1800+44	B3 1800+440	OU 401
				S4 1800+440			
ICRF J180323.4-650736	1758-651		P 1758-651	ICRF J180323.50-650736.8	PKS 1758-651		
ICRF J180650.6+694928	1807+698	3C371	3C 371	3C 371.0	3CR 371	4C 69.24	NRAO 548
ICRF J180821.8+454220	1806+456			GC 1806+45	GC 1806+456	S4 1806+45	S4 1806+456
ICRF J180957.8-455241	1806-458		P 1806-458	PKS 1806-458			
ICRF J181935.0-634548	1814-637		P 1814-63	PKS 1814-63	PKS 1814-637		
ICRF J181945.3-552120	1815-553		P 1815-554	PKS 1815-554			
ICRF J182057.8-252812	1817-254						
ICRF J182314.1+793849	1826+796						
ICRF J182402.8+104423	1821+107		P 1821+10	MC2 1821+107	PKS 1821+10	PKS 1821+107	
ICRF J182407.0+565101	1823+568			ICRF J182407.07+565101.5	4C 56.27	4C 56.27A	GC 1823+56
ICRF J183250.1+283335	1830+285		GC 1830+28	ICRF J183250.19+283336.0	4C 28.45	B2 1830+285	B2 1830+28A
				CTD 108	OU 251	VRO 28.18.01	
ICRF J183537.2-714958	1829-718		P 1829-718	PKS 1829-718			
ICRF J183728.7-710843	1831-711		P 1831-711	PKS 1831-711			
ICRF J184208.9+794617	1845+797	3C390.3	3C 390.3	ICRF J184208.99+794617.1	4C 79.18		
ICRF J184233.6+680925	1842+681			ICRF J184233.64+680925.2	GC 1842+68	GC 1842+681	S4 1842+68

Table III-5 (cont.). Dictionary of aliases

ICRF Designation (1)	IERS Des. (2)	GSFC/USNO (3)	JPL (4)	Other names (5)			
ICRF J184916.0+670541	1849+670			ICRF J184916.07+670541.7	4C 66.20	GC 1849+67	S4 1849+67
ICRF J185457.2+735119	1856+737	1856+736		ICRF J185457.30+735119.9	S5 1856+73		
ICRF J190255.9+315941	1901+319	3C395	3C 395	4C 31.52			
ICRF J191109.6-200655	1908-201		OV-213	OV 213	PKS 1908-201		
ICRF J191240.0-801005	1903-802		P 1904-80	ICRF J191240.02-801005.9	1904-802	P 1903-80	PKS 1903-80
				PKS 1903-802	PKS 1904-80	PKS 1904-802	
ICRF J192332.1-210433	1920-211		OV-235	OV 235			
ICRF J192451.0-291430	1921-293		OV-236	OV 236	PKS 1921-293		
ICRF J192559.6+210626	1923+210		OV 239.7	PKS 1923+210			
ICRF J192748.4+735801	1928+738			1928+73	4C 73.18	S5 1928+738	
ICRF J192840.8+084848	1926+087						
ICRF J193006.1-605609	1925-610			P 1925-610	PKS 1925-6100		
ICRF J193124.9+224331	1929+226						
ICRF J193435.0+104340	1932+106						
ICRF J193510.4+203154	1932+204						
ICRF J193716.2-395801	1933-400		P 1933-400	PKS 1933-400			
ICRF J193925.0-634245	1934-638		P 1934-63	PKS 1934-63	PKS 1934-638		
ICRF J193926.6-152543	1936-155		P 1936-15	PKS 1936-15	PKS 1936-155		
ICRF J193957.2-100241	1937-101		P 1937-101	PKS 1937-101			
ICRF J194025.5-690756	1935-692			P 1935-692	PKS 1935-692		
ICRF J194121.7-621121	1936-623		P 1936-623	PKS 1936-623			
ICRF J194606.2+230004	1943+228						
ICRF J195330.8+353759	1951+355						
ICRF J195510.7-611519	1950-613		P 1950-613	PKS 1950-613			
ICRF J195542.7+513148	1954+513			ICRF J195542.74+513148.5	OV 591	PKS 1954+513	
ICRF J195740.5+333827	1955+335			ICRF J195740.55+333827.9			
ICRF J195759.8-384506	1954-388		P 1954-388	ICRF J195759.82-384506.4	PKS 1954-388		
ICRF J200057.0-174857	1958-179		OV-198	OV 198	PKS 1958-179		
ICRF J200324.1-325145	2000-330		P 2000-330	ICRF J200324.12-325145.1	PKS 2000-330		
ICRF J200530.9+775243	2007+777			2007+77	S5 2007+77	S5 2007+777	
ICRF J200617.6+642445	2005+642						

Table III-5 (cont.). Dictionary of aliases

ICRF Designation (1)	IERS Des. (2)	GSFC/USNO (3)	JPL (4)	Other names (5)			
ICRF J200744.9+402948	2005+403			2005+40	TEX 2005+403		
ICRF J200925.3-484953	2005-489		P 2005-489	ICRF J200925.39-484953.7	PKS 2005-489		
ICRF J201114.2-064403	2008-068	OW-015		ICRF J201114.22-064403.6	2011-067	OW 015	
ICRF J201115.7-154640	2008-159		P 2008-159	PKS 2008-159			
ICRF J201713.0+744047	2017+745	2017+743		ICRF J201713.08+744048.0	4C +74.25	4C 74.25	S5 2017+74
ICRF J202206.6+613658	2021+614		OW 637	S4 2021+61			
ICRF J202319.0+315302	2021+317			ICRF J202319.02+315302.3	4C 31.56		
ICRF J202510.8+334300	2023+335	2023+336					
ICRF J203147.9+545503	2030+547		OW 551	ICRF J203147.96+545503.1	4C 54.42		
ICRF J203154.9+121941	2029+121		P 2029+121	ICRF J203154.99+121941.3	PKS 2029+121		
ICRF J203837.0+511912	2037+511	3C418	3C 418	ICRF J203837.03+511912.7 NRAO 636	3C 418.0	3CR 418	4C 51.42
ICRF J204008.7-250746	2037-253		P 2037-253	PKS 2037-253			
ICRF J205051.1+312727	2048+312	CL4		ICRF J205051.13+312727.4	CL 4	CYGNUS LOOP 4	
ICRF J205133.7+744140	2051+745			ICRF J205133.73+744140.5	S5 2051+74		
ICRF J205616.3-471447	2052-474		P 2052-47	ICRF J205616.36-471447.6	MC 2052-474	PKS 2052-47	PKS 2052-474
ICRF J205741.6-373402	2054-377			PKS 2054-377			
ICRF J210138.8+034131	2059+034		P 2059+034	ICRF J210138.83+034131.3	OW 098	PKS 2059+034	
ICRF J210159.1-421916	2058-425			P 2058-425	PKS 2058-425		
ICRF J210217.0+470216	2100+468			ICRF J210217.06+470216.3			
ICRF J210544.9-782534	2059-786			ICRF J210544.96-782534.5	P 2059-78	PKS 2059-78	PKS 2059-786
ICRF J210933.1-411020	2106-413		P 2106-413	ICRF J210933.19-411020.6	PKS 2106-413		
ICRF J211529.4+293338	2113+293		B2 2113+29B	ICRF J211529.41+293338.4	B2 2113+29		
ICRF J211630.8-805355	2109-811			ICRF J211630.85-805355.2	P 2109-811	PKS 2109-811	
ICRF J211810.5-301911	2115-305			MSH 21-34	OX 325	PKS 2115-30	PKS 2115-305
ICRF J212344.5+053522	2121+053		OX 036	GC 2121+053	PKS 2121+053		
ICRF J212912.1-153841	2126-158		P 2126-15	PKS 2126-15	PKS 2126-158		
ICRF J213032.8+050217	2128+048		P 2127+04	PKS 2127+04			
ICRF J213135.2-120704	2128-123		P 2128-12	ICRF J213135.26-120704.8 PKS 2128-123	OX 148	PHL 1598	PKS 2128-12
ICRF J213410.3-015317	2131-021		P 2131-021	4C 02.81	PKS 2131-021		
ICRF J213638.5+004154	2134+004	2134+00	P 2134+004	DA 553 PKS 2134+004	GC 2134+004	OX 057	PHL 61

Table III-5 (cont.). Dictionary of aliases

ICRF Designation (1)	IERS Des. (2)	GSFC/USNO (3)	JPL (4)	Other names (5)			
ICRF J213901.3+142335	2136+141		OX 161	ICRF J213901.31+142336.0	PKS 2136+141		
ICRF J214622.9-152543	2143-156		OX-173	ICRF J214622.98-152543.9	OX 173	PKS 2143-156	
ICRF J214710.1+092946	2144+092		OX 074	PKS 2144+092			
ICRF J214712.7-753613	2142-758			P 2142-75	PKS 2142-75	PKS 2142-758	
ICRF J214805.4+065738	2145+067		P 2145+06	ICRF J214805.46+065738.6	4C 06.69	DA 562	OX 076.1
				PKS 2145+06	PKS 2145+067		
ICRF J215137.8+055212	2149+056		OX 082	PKS 2149+056			
ICRF J215155.5-302753	2149-307	2149-306	P 2149-306	PKS 2149-306	PKS 2149-307		
ICRF J215203.1-780706	2146-783			ICRF J215203.15-780706.6	P 2146-78	PKS 2146-78	PKS 2146-783
ICRF J215224.8+173437	2150+173			ICRF J215224.82+173437.8	P 2149+17	PKS 2149+17	PKS 2150+173
ICRF J215705.9-694123	2152-699			PKS 2152-69	PKS 2153-69		
ICRF J215806.2-150109	2155-152		OX-192	OX 192	PKS 2155-152		
ICRF J215852.0-301332	2155-304		P 2155-304	H 2155-304	PKS 2155-304		
ICRF J220243.2+421639	2200+420	VR422201	VRO 42.22.01	ICRF J220243.29+421640.0	BL LAC	OY 401	
ICRF J220314.9+314538	2201+315		B2 2201+31A	ICRF J220314.98+314538.3	4C 31.63	B2 2201+315	GC 2201+315
				PKS 2201+315			
ICRF J220743.7-534633	2204-540		P 2204-54	ICRF J220743.73-534633.8	PKS 2204-54	PKS 2204-540	
ICRF J221205.9+235540	2209+236		P 2209+236	ICRF J221205.97+235540.5	PKS 2209+236		
ICRF J221302.4-252930	2210-257		P 2210-25	PKS 2210-25	PKS 2210-257		
ICRF J221438.5-383545	2211-388		P 2211-388	PKS 2211-388			
ICRF J221620.0+351814	2214+350		GC 2214+35	B2 2214+35	B2 2214+350	GC 2214+350	UT 2214+350
ICRF J221852.0-033536	2216-038		P 2216-03	ICRF J221852.04-033536.9	4C 03.79	MSH 22-06	OY 027
				PB 7136	PKS 2216-03	PKS 2216-038	
ICRF J222547.2-045701	2223-052	3C446	3C 446	4C 05.92	LHE 519	MSH 22-010	NRAO 687
				OY 039	PKS 2223-052		
ICRF J222940.0-083254	2227-088		P 2227-08	PHL 5225	PKS 2227-08	PKS 2227-088	
ICRF J223036.4+694628	2229+695			ICRF J223036.47+694628.1	2229+69	S5 2229+69	
ICRF J223040.2-394252	2227-399		P 2227-399	MD3:45	PKS 2227-399		
ICRF J223236.4+114350	2230+114	CTA102	CTA 102	4C 11.69	DA 582	MC2 2230+114	OY 150
				PKS 2230+114			

Table III-5 (cont.). Dictionary of aliases

ICRF Designation (1)	IERS Des. (2)	GSFC/USNO (3)	JPL (4)	Other names (5)			
ICRF J223513.2-483558	2232-488		P 2232-488	ICRF J223513.24-483558.8	PKS 2232-488		
ICRF J223622.4+282857	2234+282		GC 2234+28	B2 2234+282	B2 2234+28A	CTD 135	
ICRF J223634.0-143322	2233-148		P 2233-148	PKS 2233-148			
ICRF J224618.2-120651	2243-123		OY-172.6	OY 172.6	PB 7192	PKS 2243-123	
ICRF J224838.6-323552	2245-328		P 2245-328	PKS 2245-328			
ICRF J225357.7+160853	2251+158	3C454.3	3C 454.3	ICRF J225357.75+160853.6	3CR 454.3	4C 15.76	DA 586
				MC3 2251+158	NRAO 701	OY 185	PKS 2251+158
ICRF J225504.2-084404	2252-090	2252-089	P 2252-089	PKS 2252-089	PKS 2252-090		
ICRF J225536.7+420252	2253+417		GC 2253+41	B3 2253+417	GC 2253+417	OY 489	
ICRF J225717.3+074312	2254+074		GC 2254+07	ICRF J225717.30+074312.3	OY 091	PKS 2254+074	
ICRF J225717.5+024317	2254+024		P 2254+024	GC 2254+024	OY 091.3	PB 5195	PKS 2254+024
ICRF J225805.9-275821	2255-282		P 2255-282	PKS 2255-282			
ICRF J230223.8-371806	2259-375		2259-374	PKS 2259-375			
ICRF J230305.8-303011	2300-307		P 2300-307	PKS 2300-307			
ICRF J230343.5-680737	2300-683			ICRF J230343.57-680737.5	PKS 2300-683		
ICRF J231409.3-445549	2311-452		P 2311-452	PKS 2311-452			
ICRF J231448.5-313839	2312-319		P 2312-319	ICRF J231448.50-313839.5	PKS 2312-319		
ICRF J232044.8+051349	2318+049		GC 2318+04	GC 2318+049	OZ 031	PB 5337	PKS 2318+049
ICRF J232159.8+273246	2319+272		B2 2319+27	ICRF J232159.86+273246.4	4C 27.50		
ICRF J232225.9+505751	2320+506			ICRF J232225.98+505752.0	OZ 533		
ICRF J232331.9-031705	2320-035		P 2320-035	PHL 2278	PKS 2320-035		
ICRF J232747.9-144755	2325-150		P 2325-150	PKS 2325-150			
ICRF J232917.7-473019	2326-477		P 2326-477	ICRF J232917.70-473019.1	PKS 2326-477		
ICRF J233040.8+110018	2328+107		P 2328+10	4C 10.73	GC 2328+107	MC2 2328+107	OZ 146.9
				PKS 2328+10	PKS 2328+107		
ICRF J233138.6-155657	2329-162		P 2329-16	ICRF J233138.65-155657.0	PKS 2329-16	PKS 2329-162	
ICRF J233159.4-381147	2329-384		P 2329-384	ICRF J233159.48-381147.7	PKS 2329-384		
ICRF J233355.2-234340	2331-240			OZ 252	OZ-252	PKS 2331-240	
ICRF J233612.1-523621	2333-528		P 2333-528	PKS 2333-528			
ICRF J233757.3-023057	2335-027		P 2335-027	PKS 2335-027			
ICRF J234029.0+264156	2337+264		GC 2337+26	ICRF J234029.03+264156.8			
ICRF J234636.8+093045	2344+092	2344+09A	P 2344+09	4C 09.74	HIA 2344+092	OZ 073.5	PB 5532
				PG 2344+092	PKS 2344+09	PKS 2344+092	

Table III-5 (cont.). Dictionary of aliases

ICRF Designation (1)	IERS Des. (2)	GSFC/USNO (3)	JPL (4)	Other names (5))			
ICRF J234802.6-163112	2345-167		P 2345-16	MC 2345-167	OZ 176	PKS 2345-16	PKS 2345-167
ICRF J235421.6+455304	2351+456			ICRF J235421.68+455304.2	4C 45.51	OZ 486	
ICRF J235430.1-151311	2351-154			MC 2351-154	OZ 187	OZ-187	PKS 2351-154
ICRF J235509.4+495008	2352+495		DA 611				
ICRF J235600.6-682003	2353-686		P 2353-68	2353-685	PKS 2353-68	PKS 2353-685	PKS 2353-686
ICRF J235753.2-531113	2355-534		P 2355-534	PKS 2355-534			
ICRF J235810.8-102008	2355-106		P 2355-106	PHL 600	PKS 2355-106	UT 2355-106	
ICRF J235933.1+385042	2356+385		GC 2356+38	B2 2357+38			

Notes

(1) ICRF Designations, constructed from J2000.0 coordinates with the format
ICRF JHHMMSS.s+DDMMSS or ICRF JHHMMSS.s-DDMMSS
They follow the recommendations of the IAU Task Group on Designations.

(2) IERS designation, previously constructed from B1950 coordinates.
The complete format, including acronym and epoch in addition to the coordinates, is
IERS BHHMM+DDd or IERS BHHMM-DDd

(3) "blokq.dat" name, as in databases at USNO and GSFC. Blank if same as IERS designation. Note that this is not necessarily a name that follows the IAU nomenclature rules. These names are provided so as to allow easier access to the original data.

(4) JPL name. Blank if same as "blokq.dat" name. Note that this is not necessarily a name that follows the IAU nomenclature rules. These names are provided so as to allow easier access to the original data.

(5) Other ("alias") names, with up to four per line and up to three continuation lines. Names already given are not repeated. If they exist, preliminary ICRF names are given first. These are not the currently recommended ones but were published earlier for the Hipparcos link objects in the 1995 IERS Annual Report, p. II-21 to II-29. Additional names are given in alphabetical order.

PART IV

IAU RESOLUTIONS AND DESCRIPTION OF ICRS

1 - IAU RESOLUTIONS

2 - ARIAS *et al.* (1995) paper

Buenos Aires, 1991

Resolution A4: Recommendations from the Working Group on Reference Systems

Recommendations I to IX

The XXIst General Assembly of the International Astronomical Union,

RECOMMENDATION I

considering,

that it is appropriate to define several systems of space-time coordinates within the framework of the General Theory of Relativity,

recommends,

that the four space-time coordinates ($x^0 = ct$, x^1, x^2, x^3) be selected in such a way that in each coordinate system centered at the barycenter of any ensemble of masses, the squared interval ds^2 be expressed with the minimum degree of approximation in the form:

$$ds^2 = -c^2 d\tau^2$$

$$= -\left(1 - \frac{2U}{c^2}\right)(dx^0)^2 + \left(1 + \frac{2U}{c^2}\right)[(dx^1)^2 + (dx^2)^2 + (dx^3)^2],$$

where c is the velocity of light, τ is proper time, and U is the sum of the gravitational potentials of the above mentioned ensemble of masses, and of a tidal potential generated by bodies external to the ensemble, the latter potential vanishing at the barycenter.

Notes for Recommendation I

1. *This recommendation explicitly introduces The General Theory of Relativity as the theoretical background for the definition of the celestial space-time reference frame.*

2. *This recommendation recognizes that space-time cannot be described by a single coordinate system because a good choice of coordinate system may significantly facilitate the treatment of the problem at hand, and elucidate the meaning of the relevant physical events. Far from the space origin, the potential of the ensemble of masses to which the coordinate system pertains becomes negligible, while the potential of external bodies manifests itself only by tidal terms which vanish at the space origin.*

3. *The ds^2 as proposed gives only those terms required at the present level of observational accuracy. Higher order terms may be added as deemed necessary by users. If the IAU should find it generally necessary, more terms will be added. Such terms may be added without changing the rest of the recommendation.*

4. *The algebraic sign of the potential in the formula giving ds^2 is to be taken as positive.*

5. *At the level of approximation given in this recommendation, the tidal potential consists of all terms at least quadratic in the local space coordinates in the expansion of the Newtonian potential generated by external bodies.*

RECOMMENDATION II

considering,

a) the need to define a barycentric coordinate system with spatial origin at the center of mass of the solar system and a geocentric coordinate system with spatial origin at the center of mass of the Earth, and the desirability of defining analogous coordinate systems for other planets and for the Moon,

b) that the coordinate systems should be related to the best realization of reference systems in space and time, and,

c) that the same physical units should be used in all coordinate systems,

recommends that,

1. the space coordinate grids with origins at the solar system barycenter and at the center of mass of the Earth show no global rotation with respect to a set of distant extragalactic objects,

2. the time coordinates be derived from a time scale realized by atomic clocks operating on the Earth,

3. the basic physical units of space-time in all coordinate systems be the second of the International System of Units (SI) for proper time, and the SI meter for proper length, connected to the SI second by the value of the velocity of light $c = 299792458\ ms^{-1}$.

Notes for Recommendation II

1. *This recommendation gives the actual physical structures and quantities that will be used to establish the reference frames and time scales based upon the ideal definition of the system given by Recommendation I.*

2. *The kinematic constraint for the rate of rotation of both the geocentric and barycentric reference systems cannot be perfectly realized. It is assumed that the average rotation of a large number of extragalactic objects can be considered to represent the rotation of the universe which is assumed to be zero.*

3. *If the barycentric reference system as defined by this recommendation is used for studies of dynamics within the solar system, the kinematic effects of the galactic geodesic precession may have to be taken into account.*

4. *In addition, the kinematic constraint for the state of rotation of the geocentric reference system as defined by this recommendation implies that when the system is used for dynamics (e.g., motions of the Moon and Earth satellites), the time dependent geodesic precession of the geocentric frame relative to the barycentric frame must be taken into account by introducing corresponding inertial terms into the equations of motion.*

5. *Astronomical constants and quantities are expressed in SI units without conversion factors depending upon the coordinate systems in which they are measured.*

RECOMMENDATION III

considering,

the desirability of the standardization of the units and origins of coordinate times used in astronomy,

recommends that,

1. the units of measurement of the coordinate times of all coordinate systems centered at the barycenters of ensembles of masses be chosen so that they are consistent with the proper unit of time, the SI second,

2. the reading of these coordinate times be 1977 January 1, $0^h\ 0^m\ 32.184^s$ exactly, on 1977 January 1, $0^h\ 0^m\ 0^s$ TAI exactly (JD = 2443144.5, TAI), at the geocenter,

3. coordinate times in coordinate systems having their spatial origins respectively at the center of mass of the Earth and at the solar system barycenter, and established in conformity with the above sections (1) and (2), be designated as Geocentric Coordinate Time (TCG) and Barycentric Coordinate Time (TCB).

Notes for Recommendation III

1. *In the domain common to any two coordinate systems, the tensor transformation law applied to the metric tensor is valid without re-scaling the unit of time. Therefore, the various coordinate times under consideration exhibit secular differences. Recommendation 5 (1976) of IAU Commissions 4, 8 and 31, completed by Recommendation 5 (1979) of IAU Commissions 4, 19 and 31, stated that Terrestrial Dynamical Time (TDT) and Barycentric Dynamical Time (TDB) should differ only by periodic variations. Therefore, TDB and TCB differ in rate. The relationship between these time scales in seconds is given by:*

$$TCB - TDB = L_B \times (JD - 2443144.5) \times 86400.$$

The present estimate of the value of L_B *is* 1.550505×10^{-8} $(\pm 1 \times 10^{-14})$ *(Fukushima et al., Celestial Mechanics, 38, 215, 1986).*

2. *The relation TCB - TCG involves a full 4-dimensional transformation*

$$TCB - TCG = c^{-2} \left[\int_{t_o}^{t} (v_e^2/2 + U_{ext}(x_e))dt + v_e.(x - x_e) \right],$$

x_e *and* v_e *denoting the barycentric position and velocity of the Earth's center of mass and* x *the barycentric position of the observer. The external potential* U_{ext} *is the Newtonian potential of all solar system bodies apart from the Earth. The external potential must be evaluated at the geocenter. In the integral,* t = *TCB and to is chosen to agree with the epoch of Note 3. As an approximation to TCB - TCG in seconds one might use:*

$$TCB - TCG = L_C \times (JD - 2443144.5) \times 86400 + c^{-2} v_e.(x - x_e) + P.$$

The present estimate of the value of L_C *is* 1.480813×10^{-8} $(\pm 1 \times 10^{-14})$ *(Fukushima et al., Celestial Mechanics, 38, 215, 1986). It may be written as* $[3GM/2c^2a] + \epsilon$ *where G is the gravitational constant, M is the mass of the Sun, a is the mean heliocentric distance of the Earth, and* ϵ *is a very small term (of order* 2×10^{-12}*) arising from the average potential of the planets at the Earth. The quantity P represents the periodic terms which can be evaluated using the analytical formula by Hirayama et al., ("Analytical Expression of* $TDB\text{-}TDT_o$*", in Proceedings of the IAG Symposia, IUGG XIX General Assembly, Vancouver, August 10-22, 1987). For observers on the surface of the Earth, the terms depending upon their terrestrial coordinates are diurnal, with a maximum amplitude of 2.1 μs.*

3. *The origins of coordinate times have been arbitrarily set so that these times all coincide with the Terrestrial Time (TT) of Recommendation IV at the geocenter on 1977 January 1,* $0^h\ 0^m\ 0^s$ *TAI. (See Note 3 of Recommendation IV.)*

4. *When realizations of TCB and TCG are needed, it is suggested that these realizations be designated by expressions such as TCB(xxx), where xxx indicates the source of the realized time scale (e.g., TAI) and the theory used for the transformation into TCB or TCG.*

RECOMMENDATION IV

considering,

a) that the time scales used for dating events observed from the surface of the Earth and for terrestrial metrology should have as the unit of measurement the SI second, as realized by terrestrial time standards,

b) the definition of the International Atomic Time, TAI, approved by the 14th Conférence Générale des Poids et Mesures (1971) and completed by a declaration of the 9th session of the Comité Consultatif pour la Définition de la Seconde (1980),

recommends that,

1) the time reference for apparent geocentric ephemerides be Terrestrial Time, TT,

2) TT be a time scale differing from TCG of Recommendation III by a constant rate, the unit of measurement of TT being chosen so that it agrees with the SI second on the geoid,

3) at instant 1977 January 1, $0^h\ 0^m\ 0^s$ TAI exactly, TT have the reading 1977 January 1, $0^h\ 0^m\ 32.184^s$ exactly.

Notes for Recommendation IV

1. *The basis of the measurement of time on the Earth is International Atomic Time (TAI) which is made available by the dissemination of corrections to be added to the readings of national time scales and clocks. The time scale TAI was defined by the 59th session of the Comité International des Poids et Mesures (1970) and approved by the 14th Conférence Générale des Poids et Mesures (1971) as a realized time scale. As the errors in the realization of TAI are not always negligible, it has been found necessary to define an ideal form of TAI, apart from the 32.184^s offset, now designated Terrestrial Time, TT.*

2. *The time scale TAI is established and disseminated according to the principle of coordinate synchronization, in the geocentric coordinate sytem, as explained in CCDS, 9th Session (1980) and in Reports of the CCIR, 1990, annex to Volume VII (1990).*

3. *In order to define TT it is necessary to define the coordinate system precisely, by the metric form, to which it belongs. To be consistent with the uncertainties of the frequency of the best standards, it is at present (1991) sufficient to use the relativistic metric given in Recommendation I.*

4. *For ensuring an approximate continuity with the previous time arguments of ephemerides, Ephemeris Time, ET, a time offset is introduced so that TT-TAI = 32.184^s exactly at 1977 January 1, 0^h TAI. This date corresponds to the implementation of a steering process of the TAI frequency, introduced so that the TAI unit of measurement remains in close agreement with the best realizations of the SI second on the geoid. TT can be considered as equivalent to TDT as defined by IAU Recommendation 5 (1976) of Commissions 4, 8 and 31, and Recommendation 5 (1979) of Commissions 4, 19 and 31.*

5. *The divergence between TAI and TT is a consequence of the physical defects of atomic time standards. In the interval 1977-1990, in addition to the constant offset of 32.184^s, the deviation probably remained within the approximate limits of ± 10μs. It is expected to increase more slowly in the future as a consequence of improvements in time standards. In many cases, especially for the publication of ephemerides, this deviation is negligible. In such cases, it can be stated that the argument of the ephemerides is TAI + 32.184^s.*

6. *Terrestrial Time differs from TCG of Recommendation III by a scaling factor, in seconds:*

$$TCG - TT = L_G \times (JD - 2443144.5) \times 86400.$$

The present estimate of the value of L_G is 6.969291×10^{-10} ($\pm 3 \times 10^{-16}$). The numerical value is derived from the latest estimate of gravitational potential on the geoid, W = 62636860 (± 30) m^2/s^2 (Chovitz, Bulletin Géodesique, 62, 359, 1988). The two time scales are distinguished by different names to avoid scaling errors. The relationship between L_B and L_C of Recommendation III, notes 1 and 2, and L_G is, $L_B = L_C + L_G$.

7. *The unit of measurement of TT is the SI second on the geoid. The usual multiples, such as the TT day of 86400 SI seconds on the geoid and the TT Julian century of 36525 TT days, can be used provided that the reference to TT be clearly indicated whenever ambiguity may arise. Corresponding time intervals of TAI are in agreement with the TT intervals within the uncertainties of the primary atomic standards (e.g., within ± 2 x 10^{-14} in relative value during 1990).*

8. *Markers of the TT scale can follow any date system based upon the second, e.g., the usual calendar date or the Julian Date, provided that the reference to TT be clearly indicated whenever ambiguity may arise.*

9. *It is suggested that realizations of TT be designated by TT(xxx) where xxx is an identifier. In most cases a convenient approximation is:*

$$TT(TAI) = TAI + 32.184^s.$$

However, in some applications it may be advantageous to use other realizations. The BIPM, for example, has issued time scales such as TT(BIPM90).

RECOMMENDATION V

considering,

that important work has already been performed using Barycentric Dynamical Time (TDB), defined by IAU Recommendation 5 (1976) of IAU Commissions 4, 8 and 31, and Recommendation 5 (1979) of IAU Commissions 4, 19 and 31,

recognizes,

that where discontinuity with previous work is deemed to be undesirable, TDB may be used.

Note to Recommendation V

Some astronomical constants and quantities have different numerical values depending upon the use of TDB or TCB. When giving these values, the time scale used must be specified.

RECOMMENDATION VI

considering,

the desirability of implementing a conventional celestial barycentric reference system based upon the observed positions of extragalactic objects, and,

noting,

the existence of tentative reference frames constructed by various institutions and combined by the International Earth Rotation Service (IERS) into a frame used for Earth rotation series,

recommends,

1. that intercomparisons of these frames be extensively made in order to assess their systematic differences and accuracy,
2. that an IAU Working Group consisting of members of Commissions 4, 8, 19, 24, 31 and 40, the IERS, and other pertinent experts, in consultation with all the institutions producing catalogs of extragalactic radio sources, establish a list of candidates for primary sources defining the new conventional reference frame, together with a list of secondary sources that may later be added to or replace some of the primary sources, and,

requests,

1. that such a list be presented to the XXIInd General Assembly (1994) as a part of the definition of a new conventional reference system,

2. that the objects in this list be systematically observed by all VLBI and other appropriate astrometric programs.

Note for Recommendation VI

This recommendation essentially describes the first part of the work that must be done to prepare the realization of the reference system defined by Recommendations I and II. The choice of objects must be made in the first place by considering their observability by VLBI, but special care should be taken to include a large proportion of extragalactic radio sources with well identified optical counterparts.

RECOMMENDATION VII

considering,

a) that the new conventional celestial barycentric reference frame should be as close as possible to the existing FK5 equator and equinox and the dynamical equinox which are referred to J2000.0,

b) that it should be accessible to astrometry in visual as well as in radio wavelengths,

recommends,

1. that the principal plane of the new conventional celestial reference system be as near as possible to the mean equator at J2000.0 and that the origin in this principal plane be as near as possible to the dynamical equinox of J2000.0,

2. that the positions of the extragalactic objects selected in accordance with Recommendation VI and representing the reference frame be computed initially for the equator and equinox J2000.0 using the best available values of the celestial pole offset with respect to the IAU expressions for precession and nutation,

3. that a great effort be made to compare reference frames of all types, in particular the FK5, solar system and extragalactic reference frames,

4. that observing programs be undertaken or continued in order to relate planetary positions to radio and optical objects, and to determine the relationship between catalogs of extragalactic source positions and the best catalogs of star positions, in particular the FK5 and Hipparcos catalogs.

Notes for Recommendation VII

1. *This recommendation specifies the choice of the coordinate axes that will be adopted in the final reference frame and describes the work to be done before such a frame can be constructed. Although the considerations call for visual and radio wavelengths for the primary catalog, other observable wavelengths are not excluded. Positions of objects observed in other wavelengths should also be referred to the same system.*

2. *The objective set by this recommendation is that there should be no discontinuity in the positions of stars when the present FK5 frame is replaced by the extragalactic reference frame. This means that the position of the extragalactic objects should be in the FK5 system for J2000.0. It is acknowledged that the best values of precession and nutation must be used in order to avoid introducing spurious proper motions into the positions of extragalactic objects. The final transfer to the preferred equinox and principal plane will be done by applying a rotation at J2000.0.*

3. *The dynamical equinox in this recommendation is defined as the intersection of the mean equator and the ecliptic. The latter is defined as the uniformly rotating plane of the orbit of the Earth-Moon barycenter averaged over the entire period for which the ephemerides are valid. Since it is ephemeris dependent, the choice of the equinoctial point will be made using the most accurate and generally available ephemerides of the solar system at the time.*

4. *The definition given to the reference system by Recommendations I and II implies the stability in time of the system of coordinates realized by the celestial reference frame. The directions of the coordinate axes should not be changed even if at some later date the realization of the dynamical equinox or CEP are improved. Similarly, modifications to the set of extragalactic objects realizing the reference system should be made in such a way that the directions of the axes are not changed. This means that once the coordinate axes have been specified, in the way described in the first part of the recommendation, the connection between the definition of the conventional reference system and the peculiarities of the Earth's kinematics will have been severed.*

5. *As long as the relationship between the optical and the extragalactic radio frames is not sufficiently accurately determined, the FK5 catalog shall be considered as a provisional realization of the celestial reference system in optical wavelengths.*

RECOMMENDATION VIII

recognizing,

a) the importance to astronomy of adopting conventional values of astronomical and physical constants,

b) that values of these constants should be unchanged unless they differ significantly from their latest estimates,

c) that estimates of these constants should be improved frequently to represent the current status of knowledge,

d) the necessity of providing standard procedures using these numerical values, and,

noting,

a) that the MERIT Standards and IERS Standards have contributed significantly to the progress of astronomy and geodesy,

b) that numerical values in these standards have served as a system of constants in analyzing observations of high quality, and

considering,

that procedures in these standards do not cover the whole of fundamental astronomy,

recommends,

that a permanent working group be organized by Commissions 4, 5, 8, 19, 24 and 31, in consultation with the IAG and the IERS, in order to update and improve the system of astronomical units and constants, the list of estimates of fundamental astronomical quantities and standard procedures; this group shall:

1. prepare a draft report on the system of astronomical units and constants at least six months before the XXIInd General Assembly (1994),

2. prepare a draft list of best estimates of astronomical quantities at least six months before each following General Assembly,

3. prepare, at least six months before each following General Assembly, a draft report on standard procedures needed in fundamental astronomy, which,

   a) should have a maximum degree of compatibility with the IERS Standards,

b) should include the implementations of procedures in the form of tested software and/or test cases,

c) should be available not only in written form, but also in machine-readable form,

4. prepare a draft report on possible electronic access to these units, constants, quantities and procedures at least six months before the XXIInd General Assembly (1994).

RECOMMENDATION IX

recognizing,

that a generally accepted non-rigid Earth theory of nutation, including all known effects at the one tenth milliarcsecond level, is not yet available,

recommends,

1. that those satisfied with accuracy of the nutation angles (ϵ or $\psi \sin\epsilon_0$) numerically greater than $\pm$ 0.002" (one sigma rms) may continue to use the 1980 IAU Nutation Theory (P.K. Seidelmann, Celestial Mechanics, 27, 79, 1982),

2. that those requiring values of the nutation angles more accurate than $\pm$ 0.002" (one sigma rms) should make use of the Bulletins of the IERS which publish observations and predictions of the celestial pole offsets accurate to about $\pm$ 0.0006" (one sigma rms) for a period of up to six months in advance,

3. that the IUGG be encouraged to develop and adopt an appropriate Earth model to be used as the basis for a new IAU Theory of Nutation.

CCIR *International Radio Consultative Committee*

IAG *International Association of Geodesy*

IUGG *International Union of Geodesy & Geophysics*

IERS *International Earth Rotation Service*

Den Haag, August 1994

Resolution B5 on the Working Group on Reference Frames

The XXIInd General Assembly of the International Astronomical Union

Considering that the IAU Working Group on Reference Frames consisting of members of Commissions 4, 8, 19, 24 and 31, the International Rotation Service (IERS) and other pertinent experts has been formed to produce a list of candidate extragalactic radio sources for defining the new conventional reference frame and secondary sources that may later be added to the primary sources or replace some of the primary sources,

Noting that a list of sources which define the conventional reference frame together with list of candidate sources which may, at some future date, be added to or replace the defining sources has been made,

Recommends that this list of defining sources be adopted by the XXIInd General Assembly (1994) as the first stage in the definition of the new reference frame, and

Requests that the Working Group on Reference Frames be continued and its membership be reviewed by Commissions 4, 8, 19, 24 and 31 and the IERS to

1. define the positions of the radio sources on the list,

2. determine the relationship of this frame to an optical frame defined by stars, and

3. recommend to the XXIIIrd General Assembly (1997) that a way be found to organize the work for the maintenance and evolution of this frame and its extension to other frames at other wavelengths.

Astron. Astrophys. 303, 604-608 (1995)

ASTRONOMY
AND
ASTROPHYSICS

The extragalactic reference system of the International Earth Rotation Service, ICRS

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Received 1 February 1995 / Accepted 28 March 1995

Abstract. The celestial reference system of the International Earth Rotation Service (IERS), ICRS, was recommended to the International Astronomical Union (IAU) for adoption as the conventional system, under the name of International Celestial Reference System, by the IAU working group on reference frames. This system agrees with the decisions taken by IAU in 1991 and it is consistent with the FK5 system at J2000.0. It is maintained on the basis of high-accuracy observations of extragalactic radio sources by very long baseline interferometry (VLBI). The maintenance algorithm ensures stable directions of its axes within ±20 microarcseconds. The typical accuracy of the source coordinates is ±300 microarcseconds. ICRS is accessible directly by the observation of extragalactic objects and indirectly through the major reference frames attached to the Galaxy, the Solar System and the Earth.

Key words: reference systems – astrometry – quasars:general

1. Introduction

The International Astronomical Union (IAU) decided in 1991 that its celestial reference system would be realized on the basis of precise coordinates of extragalactic radio sources. The corresponding IAU recommendations (Bergeron 1992) specify that its origin has to be at the barycentre of the Solar System and that its axes have to be fixed with respect to the extragalactic objects.

One of the missions of the International Earth Rotation Service (IERS) is to maintain a comprehensive reference system for application in astronomy, in space navigation and in global geodynamics. The IERS celestial reference system (ICRS), materialised by the J2000.0 equatorial coordinates of compact extragalactic radio sources measured by very long baseline interferometry (VLBI), fulfills the IAU recommendations.

The definition, the realization, the maintenance and the accessibility of ICRS are described in this paper.

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2. Definition of ICRS

The 1991 IAU recommendations on reference frames request that the future IAU celestial reference frame be based on a kinematical rather than dynamical definition by using quasars or active nuclei of galaxies for its materialisation. This new concept in the history of IAU celestial reference frames is expected to make coordinate axes fixed with respect to distant matter in the Universe. The earlier definitions adopted privileged axes in the dynamics of the Earth's motion in space, the mean equator and the dynamical equinox at some reference epoch (e.g. B1950, J2000.0). For the sake of continuity, the previous conventional directions at J2000.0 were retained in the new definition. As a result, the new coordinate axes are expected to be consistent with the previous ones, implicitly defined by the FK5 star catalogue (Fricke et al. 1988), within the uncertainty of the latter. We explain below how the definition of ICRS agrees with the IAU recommendations and we show its continuity with the FK5 system.

2.1. Origin of coordinate axes

According to the IAU recommendations, the origin of coordinate axes of the new celestial reference system should be at the barycentre of the Solar System.

This condition is fulfilled for ICRS through modelling of observations in the framework of General Relativity. Agreement has been reached among analysts on the appropriate corrections (see McCarthy 1992). Further intercomparison of the various models actually used is necessary to check the accuracy of the actual barycentric property of the coordinate axes.

2.2. Principal plane

The IAU recommends that the principal plane of the new celestial reference system be close to the mean equator at J2000.0.

The principal plane of the IERS system was defined by the equator plane implied by the IAU (1976) and IAU (1980) con-

ventional precession and nutation (Lieske et al. 1977; Seidelmann 1982). Since these models are now known to be in error by several milliarcseconds (mas), it is necessary to use more accurate precession and nutation models to locate the mean equator of J2000.0, relative to the IERS system. Such models can indeed be built from the same VLBI observations that serve to establish the extragalactic reference frame. For this purpose, Souchay et al. (1995) analysed the 1979–1994 VLBI estimates of the Earth's celestial pole offsets (Ma et al. 1994) and derived corrections to the conventional precession and to the largest nutation terms. Based on their corrections, the predicted shift of the Earth's mean pole at J2000.0, relative to the IERS celestial pole, is 18.0 ± 0.1 mas in the direction 12h and 5.3 ± 0.1 mas in the direction 18h. Another independent study combining 16 years of VLBI observations and 24 years of lunar laser ranging (LLR) observations (Charlot et al. 1995) concludes that these shifts are 17.5 ± 1.0 mas and 4.7 ± 1.0 mas, respectively. The two studies are consistent and show that the ICRS celestial pole is offset from the mean pole at J2000.0 by less than 20 mas.

The IAU recommendations also stipulate that the direction of the new conventional celestial pole be consistent with that of the FK5 system. The uncertainty of the FK5 pole direction can be estimated (i) by considering that the systematic part is dominated by a correction of −2.5 mas/a to the precession constant imbedded in the FK5 system, and (ii) by adopting Fricke's (1982) accuracy of the FK5 equator (±20 mas), and Schwan's (1988) limit to the residual rotation (±0.7 mas/a), taking the epochs of observations from Fricke et al. (1988). Assuming that the error in the precession rate is absorbed by the proper motions of stars, the uncertainty on the FK5 pole position relative to the mean pole at J2000.0 estimated in this way is ±50 mas. Thus the IERS celestial pole is consistent with that of the FK5 system within the uncertainty of the latter.

2.3. Origin of right ascensions

The IAU recommends that the origin of right ascensions of the new celestial reference system be close to the dynamical equinox at J2000.0.

The Ox axis of the IERS celestial system was implicitly defined in the initial realization (Arias et al. 1988) by adopting the right ascensions of 23 radio sources from catalogues obtained by the Goddard Space Flight Center (GSFC), the Jet Propulsion Laboratory (JPL), and the National Geodetic Survey (NGS). These catalogues were compiled by fixing the right ascension of 3C273B to the usual (Hazard et al. 1971) conventional FK5 value (12h 29m 6.6997s at J2000.0).

The uncertainty in the FK5 origin of right ascensions is estimated to be ±80 mas. This value was derived from the equator accuracy given by Fricke (1982) and from the residual rotation rate limit given by Schwan (1988), assuming a mean epoch of 1955 for the star proper motions and random errors in the FK5 positions. Studies by Morrison et al. (1990) and Lindegren et al. (1995) have shown that the FK5 catalogue has systematic position errors of the order of 100 mas. As a consequence the above uncertainty (±80 mas) is likely to be optimistic.

The location of the dynamical equinox in the IERS system was recently determined within ±10 mas by Folkner et al. (1994). By using an indirect method comparing VLBI and LLR terrestrial frames and Earth orientation, they derived the frame tie between the IERS system and the JPL Solar System ephemeris frame. Their results show that the x-axis of the IERS system is offset from the mean equinox of epoch J2000 by 78 ± 10 mas. Thus, the ICRS origin of right ascensions is consistent with the FK5 origin, and complies with the IAU recommendations.

3. Realization and maintenance of ICRS

3.1. Accuracy and precision

The accuracy of the axes of ICRS could in principle be limited, either by inaccurate precession and nutation models, or by large-scale systematic errors in the source coordinates.

It is well known that, as a result of the inaccuracy of the conventional IAU (1976) precession and IAU (1980) theory of nutation, their direct use in the analysis of VLBI observations would give rise to systematic errors in the source positions and to misorientation of the axes of the frames, both at the level of a few milliarcseconds. Therefore the established practice in catalogue work is to estimate additional parameters which describe the motion of the celestial pole relative to its conventional position, either by estimating celestial pole offsets for each session, or by estimating corrections to the precession constant and to some of the largest nutation terms, as allowed by the length and density of the series of observations analysed. Sovers (1991) showed that these procedures have similar performances on the resulting source positions. The estimation of coordinates in ICRS is based on frames obtained at the IERS analysis centres by one of these techniques. Consequently they are free from systematic errors caused by inaccurate precession and nutation models. The small offsets between the poles of the catalogues, that are due to inconsistent fixing of the celestial pole offsets at some reference day, are accounted for by the adjustment of rotation angles; they have no influence on the consistency of source coordinates in the IERS frame.

Another type of possible systematic error is related to low elevation observations in the case of observing networks with a modest north-south extension. This effect may be modelled as a linear dependence of declination errors on declination which can reach 0.01 mas per degree and create a tilt of the frame equator of up to 0.6 mas (Feissel et al. 1995). However, considering recent global analyses based on complex observing networks, these systematic differences seem to be now at the level of 0.001 mas per degree and 0.1 mas respectively (IERS 1994). No other type of systematic differences can be found above this level in the present-day VLBI celestial reference frames (Feissel et al. 1995; Eubanks et al. 1994). This is confirmed by the fact that the residual coordinate differences, after taking into account the small systematic errors mentioned above, decrease as the square root of the number of observations, with a typical value of ±0.25 mas for 100 observations (Arias et al. 1993).

Table 1. Relative orientation of the successive realizations of ICRS (angles A_1, A_2, A_3 rotate the realization of year $n-1$ to that of year n based on the subset of primary sources of year $n-1$)

Year of realization	Number of sources total	primary	A_1 (mas)	A_2 (mas)	A_3 (mas)	References
1988	228	23	—	—	—	Arias et al. (1988)
1989	209	20	-0.15 ± 0.10	-0.24 ± 0.10	0.21 ± 0.07	IERS (1989)
1990	228	51	0.00 ± 0.12	0.07 ± 0.11	0.05 ± 0.10	IERS (1990)
1991	396	57	0.03 ± 0.05	0.06 ± 0.04	0.00 ± 0.04	IERS (1991)
1992	422	65	0.05 ± 0.09	0.03 ± 0.09	-0.09 ± 0.07	IERS (1992)
1993	504	153	0.00 ± 0.03	0.00 ± 0.03	0.00 ± 0.02	IERS (1993)
1994	531	209	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	IERS (1994)

3.2. Maintenance

The new highly precise astrometric techniques and the possibility to re-analyse large numbers of observations whenever necessary raise the question of how one should understand the conventional character of the celestial frame. In practice, there are two possible interpretations:

(i) The source coordinates themselves are considered conventional, i.e., their numerical values are fixed for some time (years). This is the philosophy on which the series of FK catalogues is based.

(ii) The axes of the system are conventionally considered as fixed to their initial directions, but improved source coordinates available at the time of analysis are provided to users; this is required for space navigation, Earth orientation programs, geodetic applications, the link of celestial frames, etc. The maintenance method applied by IERS is along these lines; such a procedure is made possible by the high model standardization among the IERS analysis centres, and because the implementation of an extragalactic celestial frame implies less geophysical and astronomical modelling than does the series of FK catalogues. This approach was also adopted in the 1991 IAU resolutions on reference systems.

The initial definition of the IERS system and its maintenance process are described by Arias & Feissel (1990). As new information on source positions became available, new issues of the IERS celestial reference frame (ICRF) were introduced, applying every time a no rotation constraint with respect to the previous realization. In this process, the axes of the frame were maintained and the frame was progressively densified and made more precise. The maintenance of the axes is based on selected primary (or defining) sources, whose coordinates are stable and consistent. With the increasing quality of results since the start of this work, the number of primary sources increased from 23 in 1988 to 209 in 1994. Table 1 lists the issues of ICRF since 1988, with the successive rotation angles estimated on the basis of the subset of primary sources. The stability of axes is currently kept within ± 0.02 mas. The progressive refinement and densification of the frame was based on VLBI observation programs operated by the Jet Propulsion Laboratory, a consortium of geodetic institutes in the framework of IRIS (International Radio Interferometry Surveying), the Goddard Space Flight Center, the US Naval Observatory, and the Naval Research Laboratory.

The non-rotating character of the frame results from the assumption that the sources have undetectable proper motions; checks are regularly performed to ensure the validity of this constraint (Ma & Shaffer 1991; Eubanks et al. 1994). Apparent motions may be observed for some sources, but they are likely to be caused by variations in their mas-scale brightness distribution. For example, Charlot (1994) showed that the apparent change of position observed for the quasar 3C273 vanishes when its mas-scale structure is modelled in the VLBI analysis with its astrometric position referred to the central core of the source. When changes in the observed position are detected for some sources, a special treatment needs to be applied.

To conclude the preparation phase started by IERS in 1988, defining coordinates for the extragalactic objects selected by the IAU working group on reference frames (De Vegt & Johnston 1994) will be adopted in 1995. The typical accuracy of the source coordinates is ± 0.3 mas (IERS 1994). In the future, the IAU sources will be monitored, and IERS will continue to study the stability of their coordinates and publish the necessary updates (Arias & Gontier 1994).

4. Accessibility of ICRS

The direct access to the extragalactic objects is most precise through VLBI observations, a technique which is not widely available to users. Therefore, while VLBI is used for the maintenance of the frame, the tie of ICRS to the major practical reference frames (the Hipparcos galactic reference frame, the JPL ephemerides of the Solar System, and the IERS terrestrial reference system) is or will be secured.

The tie of the galactic frame to ICRS is a part of the Hipparcos project. It is described in some detail by Lindegren & Kovalevsky (1995). It will be based on a variety of approaches: observation of radio stars by VLBI (Lestrade et al. 1995) and by connected-element radio interferometry, Hubble Space Telescope astrometry, photographic astrometry, and Earth orienta-

tion observations. Its expected accuracy is ±0.5 mas at the Hipparcos mean epoch of observation (1991.25) and ±0.5 mas/a for the time evolution.

The Jet Propulsion Laboratory has announced (Standish 1994) that their future lunar and planetary ephemerides will be oriented onto the extragalactic celestial reference frame. The study by Folkner et al. (1994) shows that the tie between the two reference frames is known within ±3 mas.

The IERS Earth orientation parameters provide the permanent tie of ICRS to the IERS terrestrial reference system (ITRS). This tie is available daily with an accuracy of 0.5 mas (Feissel et al. 1993). The principles on which ITRS is established and maintained are described by Boucher & Altamimi (1990). It is geocentric, the centre of mass being defined for the whole Earth, including oceans and atmosphere. It is available worldwide at the ±1 cm level of accuracy by a reference frame consisting of coordinates for about 200 sites observed by VLBI, lunar and satellite laser ranging, and by the GPS and DORIS satellite-based radio positioning systems.

5. Conclusion

The IERS celestial reference system, ICRS, is defined in agreement with the 1991 IAU recommendations. Its realization is precise at the sub-milliarcsecond level. ICRS provides continuity with the old conventional celestial reference system (FK5) within the errors of the latter. It is accessible directly by VLBI observation of the extragalactic fiducial objets (compact radio sources), and indirectly via the Hipparcos stellar catalogue, the JPL ephemerides, and the IERS terrestrial reference frame through Earth orientation parameters. It is maintained on the basis of permanent VLBI observing programs in geodynamics and additional astrometric campaigns.

Acknowledgements. The extragalactic reference system presented in this paper is primarily due to the continued technical innovation and observational efforts of the National Aeronautics and Space Administration (NASA) and the Jet Propulsion Laboratory (JPL) over the past 25 years. Along the years, NASA and JPL were joined by the National Oceanic and Atmospheric Administration (NOAA), the US Naval Observatory (USNO), the Naval Research Laboratory (NRL) and many institutions from other countries. The VLBI data analyses that ensure the present high accuracy of the reference frame are carried out by a number of people, in particular at NASA/GSFC, JPL, NOAA, and USNO. We are specially indebted to W. E. Carter, T. M. Eubanks, J. L. Fanselow, C. S. Jacobs, K. J. Johnston, C. Ma, D. D. McCarthy, J. L. Russell, O. J. Sovers, and Y. Yatskiv for stimulating discussions and support. The IERS extragalactic reference system is available to the wide scientific community.

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This article was processed by the author using Springer-Verlag TEX A&A macro package 1992.

Imprimé en France par INSTAPRINT S.A.
1-2-3, levée de la Loire – LA RICHE – B.P. 5927 – 37059 TOURS Cedex 1
Tél. 02 47 38 16 04

Dépôt légal 3ème trimestre 1997