

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

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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 512×512 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.



































































































































