

Comparison of “Old” and “New” Concepts: Astrometry

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SUMMARY

The introduction of the International Celestial Reference System (ICRS) and the newly adopted system of the Celestial Intermediate Pole (CIP), Celestial Ephemeris Origin (CEO), Terrestrial Ephemeris Origin (TEO), and new precession-nutation model IAU2000A will require a transitional period of use of the old classical and the new systems. The new system is to be introduced in January 2003. The two systems are described in detail in Seidelmann and Kovalevsky (2002).

The contrast of old and new systems for astrometry can be summarized as below.

The changes for astrometry are the fixed frame is fixed and epoch independent; mean positions are no longer needed; the Celestial Ephemeris Origin (CEO), Celestial Intermediate Pole (CIP), and Stellar Angle, or Earth Rotation Angle, are introduced replacing the equinox and Celestial Ephemeris Pole (CEP); milli & micro arcsecond accuracies are now possible; relativity is the basis; the Time Scales are TT, TCG, and TCB; the precession-nutation are combined in the new model IAU 2000A; there is a pole offset; geodesic precession and nutation are included; new definitions are introduced; the observation reduction procedures are modified; the ephemerides are on a fixed frame; and the equinox and ecliptic are only needed for phenomena.

For astrometry the old and new can be tabulated as:

“OLD”	“NEW”
FK5	ICRS
Dynamical	Kinematic
Bright Stars	Extragalactic Sources
Precessing Equinox	Stable Fiducial Point
Moving Reference Frame	Fixed Reference Frame
Newtonian	Relativistic
Sidereal Time	Stellar Angle
CEP	CIP
Equinox	CEO
Equation Cross Talk	Purer Equations.

The observational reduction process can be summarized in the table, with the steps that are different indicated by an x:

POSITIONS	CORRECTIONS
Raw Observations	refraction instrument parameters
Local Place	diurnal aberration TT-UTC
Topocentric Apparent Place	polar motion (x) diurnal parallax UT1 irregularities (x) TCG-TT (x)
Geocentric Apparent Place	Stellar Parallax Stellar Aberration deflection of light light time precession-nutation (x) geodesic precession (x) TCB-TCG (x)
Barycentric Catalog Place (ICRF)	

The following changes in definitions must be introduced for the new system : the CEP is replaced by CIP; the CEO replaces the equinox; the equinox is defined by and for the ephemerides only; the division between polar motion and nutation is in part by periods of terms; there is no need for mean places; geodesic precession is included; and right ascension origins must be specified; either from the CEO or the equinox. For accuracy purposes the classical system must include the corrections to the CIP, the new precession-nutation model, and geodesic precession.

The outstanding issues remaining for astrometry are the transitional period for the dual system and when the new system can be really introduced; are the values in the precession-nutation model finalized; should geodesic precession be included in the precession-nutation model or should it be treated as a separate correction (it is a very separate phenomena.); is standardized software available to provide for the change; what is the potential for confusion as two systems are in use; and how can the astronomical community be educated about the changes ?

In conclusion the ICRS is a logical progression with greater rigor and a theoretical bases. The ICRS has some simplifications: fixed, epoch independent, reference frame; independent of solar system dynamics; fiducial point not precessing along moving equator; proportionality between stellar angle and UT1; microsecond accuracy predictability of fiducial point; and a lack of interaction in expressions for motions of reference frames.

Seidelmann, P.K. and Kovalevsky, J. 2002, "Applications of the new concepts and definitions(ICRS, CIP, and CEO) in fundamental astronomy", *Astron Astrophys*, in press.