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Present status of the celestial reference system and frame

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Abstract. We discuss the present status of the celestial reference system and frame.
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From 1 January 1998 the IAU adopted the International Celestial Reference System (ICRS) oriented by distant extragalactic objects in the framework of general relativity with the underlying assumption that the ensemble of such objects has no global rotation. The initial fundamental realization of the ICRS is the ICRF (International Celestial Reference Frame) based on positions of 212 defining radio sources measured with VLBI along with 396 other sources with consistent positions (Ma *et al.* 1998). The position uncertainty floor is ~ 0.25 mas with the frame axes determined at the ~ 0.03 mas level. VLBI data acquired from 1995 to 2002 have been used to determine positions of 109 additional sources in ICRF-Ext.2 (Fey *et al.* 2004) as well as to refine the positions of the non-defining sources. Considering also the 23 sessions of the VLBA Calibrator Survey (VCS), in which new sources were observed in only one session (Petrov *et al.* 2006), there are ~ 3500 sources with astrometric positions better than a few mas.

There have been several important developments since 1995 when the initial ICRF analysis was completed. The number of 24-hr sessions has increased by $\sim 65\,\%$ and the number of observations by $\sim 200\,\%$ with more robust observing networks, but data acquisition is still primarily for geodetic monitoring. More systematic methods for identifying astrometrically stable sources have been developed. A permanent IVS (International VLBI Service for Geodesy and Astrometry) program for monitoring at least once every six months ~ 300 stable, potentially stable and defining sources not used in geodetic observing was started in 2004, and astrometric observing in the southern hemisphere has been enhanced. Observations have begun at K- and Q-bands, where source structure is generally more compact. Better geophysical modeling should permit simultaneous adjustment of the VLBI celestial and terrestrial reference frames without distortion.

With the accumulated improvements in data, modeling and analysis a new ICRF is desirable. The challenges are selecting revised defining sources, handling source position variation in the analysis, and preparing for the optical frame of *Gaia*. Because the quasars that are expected to be most accurately measured by *Gaia* are much brighter optically than most radio sources currently used in astrometric VLBI, the identification and observation of the best radio-optical tie objects must be pursued. In any case, even though the precision of the optical frame is anticipated to be an order of magnitude better than the uncertainty of current VLBI frame, the VLBI frame will continue to be essential for measuring variations in Earth orientation parameters.

References

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