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The International Celestial Reference Frame System (ICRS)

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The definition of a precise inertial reference frame is fundamental to the determination of the location and motion of objects in the sky (astrometry) and features on the earth (geodesy). Since most observing instruments are on the earth surface or in earth orbit, the earth rotation, motion and crustal distortions add considerable complexity to the determination of astrometric and geodetic parameters.

After the discovery in the 1960's of quasars—bright radio compact objects in the center of giant galaxies that are less than one-millarcsecond (mas) (5 nanoradian) in angular size and exceedingly distant (>10**21 km)—astronomers realized that these objects could form the backbone of the nearly quasi-reference system that was more accurate than previous systems.

The majority of the radio data comes from Very Long Baseline Interferometry (VLBI) that has mas-resolution, and has been incorporated with Global Positioning Satellite (GPS) and Laser ranging technologies. The ICRS is the name of the overall system dealing with the data collection, its analysis and interpretation, and is described here. Nearly forty years of data collecting and its analysis have produced a quasi-inertial reference frame that is stable in direction to about 0.02 mas, positions of thousands of radio sources that are accurate to 0.05 mas, earth orientation accuracy to 0.1 mas, earth rotation accuracy of 0.01 msec, polar motion accuracy of < 1cm, and position/motion of radio telescopes to an accuracy of a about 3 mm per year. The major limitations to the ICRF accuracy are the tropospheric and ionospheric refraction, and the variable structure of the radio emission from quasars.

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