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DETERMINATION OF AN INFRARED REFERENCE FRAME

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The mission of the European Space Agency's Hipparcos satellite was to provide high precision astrometric and photometric data for over 100,000 stars and somewhat lower precision data on over a million additional stars. These observations were made in the optical band (340 - 850 nm) and resulted in median precisions of better than 1 milli-arcsec (mas) in position and parallax and 1 mas/yr in proper motion. The Hipparcos frame is inertial within an estimated uncertainty of ± 0.25 mas/yr. The other important wavelength band for astrometry has been the radio band. A reference frame has been defined based on absolute Very Long Baseline Interferometry (VLBI) positions of several hundreds of radio sources. There have been a number of projects to refine the link between the optical and radio reference frames.

In recent years there has been increasing interest in the astrometry of infrared sources. For example, stars with circumstellar shells can be observed in both the optical and radio (e.g. SiO maser emission). The infrared emission from such sources is dominated by thermal dust emission. The spatial distribution of radiation in the three bands is expected to be quite different.

In 1982 we proposed a number of infrared-selected sources ($S_{10\mu m} \geq 100$ Jy) for inclusion in the Hipparcos Input Catalog. Most of those sources were observed, and in Sutton (1997) we report the optical astrometric results (position, proper motion, and parallax) for 87 such sources. These sources were selected to have reasonable agreement between infrared and optical positions, and so may be used as primary standards for future infrared astrometry. They are well distributed across the sky, but exhibit some bias towards the galactic plane and the northern hemisphere. We have also obtained a set of 1480 secondary standards (unpublished)

A comparison between optical positions and 86 GHz SiO maser positions for 10 sources indicates coincidence at the 0.15 arcsec level, consistent with current uncertainties in the SiO positions. Improved measurements of the SiO maser positions are needed. VLBI data show that SiO maser spots can be distributed in broken rings of radii 10 – 30 mas, presumably centered on the stellar position. However the SiO flux may be distributed asymetrically, in which case the flux-weighted center of the SiO emission can be different from the stellar position.

We have also published a related paper on phase fluctuations in millimeter interferometry (Sutton and Hueckstaedt 1996). Radiometric monitoring of emission from atmospheric water vapor may be a method for correcting for such fluctuations. This is relevant to positional determinations at centimeter and millimeter wavelengths. The integration of visible, infrared, and radio astrometry is one of our principal goals.

Publications:

Sutton, E. C. and Hueckstaedt, R. M., "Radiometric Monitoring of Atmospheric Water Vapor as it Pertains to Phase Correction in Millimeter Interferometry", 1996, *Astron. Astrophys. Suppl. Ser.*, **119**, 559-567.

Sutton, E. C., "Hipparcos Astrometry of Infrared-Selected Sources and Comparison with SiO Maser Positions", 1997, *Publ. Astron. Soc. Pacific*, **109**, 1085-1088.