A SYSTEMATIC STUDY ON THE RECONCILIATION BETWEEN THE OPTICAL AND RADIO REFERENCE SYSTEMS

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In this communication we discuss the comparison between the radio positions of 48 stars obtained at the VLA (McCarthy 1984), referred to the primary extragalactic radio reference frame, and their optical positions referred to FK5 system through the series of the Carlsberg meridian circle catalogues.

The direct comparison of the positions, in the sense optical minus radio, yielded $\Delta\alpha\cos\delta = -0''.036 \pm 0''.021$ and $\Delta\delta = +0''.021 \pm 0''.015$. The rotation angles between the two frames were found as A1 $= 0''.046 \pm 0''.040$, A2 $= 0''.086 \pm 0''.045$ and A3 $= 0''.074 \pm 0''.042$. The high A2 value is compatible with several former investigations. Finally, we used the arc length method, as described by Arias et al. 1988 (A&A 199, 357), to assert the consistency of the two frames. The distribution of residuals is compatible with a gaussian distribution with $0''.28$ standard deviation. Accounting for the quoted precision of the Carlsberg positions, we conclude that the discussed VLA positions of radio stars form a secondary celestial reference frame, tied to the primary extragalactic radio reference frame, to a precision of about 100 mas.

The error budget possibly includes systematic and observational errors assigned to the radio position determination, as well as effects of non-coincidence of the optical and radio centroids. Within a scenario in which the centroids offset is $\Delta = 20$ mas and the VLA error is $\eta = 80$ mas, using Froeschlé & Kovalevsky expressions (1988; A&A 116, 89), this set of VLA positions for radio stars would be able to orient the HIPPARCOS system to the level of 8 mas, at the HIPPARCOS catalogue mean epoch. The conclusion thus support the continuation of VLA programs to obtain precise astrometric positions for radio stars.

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CYG X-1, A BENCHMARK STAR FOR TYING THE OPTICAL AND RADIO REFERENCE FRAMES

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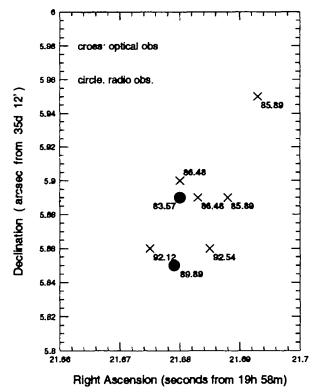
Cyg X-1 is a variable spectroscopic binary (Mv = 8.9) with one component presumably a black hole. It is also a source of X-ray and radio emission. In its radio bursts it reaches flux densities of up to 150 mJy (Estalella et al. 1983, A&A 124, 309), and in its quiescent state its flux density at frequencies between 1.4 and 85 GHz is between 10 and 40 mJy (Wendker 1993, A&AS 86, 357). We made VLBI observations of Cyg X-1 and two nearby extragalactic reference sources, 1951+355 and 1955+335, at 8.4 GHz on 20 Nov. 1989. The following radio observatories were used: VLA, Bonn, Robledo (DSS63), Goldstone (DSS14), Greenbank, Haystack, Medicina, and Onsala. From about 1300 phase delay rate observations we determined the coordinates of Cyg X-1 and their standard errors within the quasi-inertial IERS (1993) extragalactic reference frame at the epoch of observations relative to J2000: $\alpha = 19^h\ 58^m\ 21.6788^s \pm 0.0003^s$ and $\delta = 35°\ 12'\ 5''.849 \pm 0''.003$. In the figure, we compare our position determination with a previous VLBI one (Walter et al. 1988, A&AS 86, 357) and optical positions from meridian circle observations. The radio positions yielded a yearly proper motion of $\mu_\alpha =$ $-0.0002^s \pm 0.0001^s$ and $\mu_\delta = -0''.006 \pm 0''.002$. The values agree, within 1.5 of the combined (rss) errors, with those presented by Morrison et al. (1990, A&A 236, 256). The proper motion error is at the level of those of the 30 months FAST/NDAC preliminar HIPPARCOS data solutions (Lestrade et al. 1995, A&A 304, 182).



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