INTERRELATION OF PRESENT OPTICAL AND RADIO REFERENCE FRAMES [+]

Chr. de Vegt
Hamburger Sternwarte

Abstract: Comparison of optical and radio positions in the northern hemisphere yields local systematic differences up to o$''$2, mainly due to combined systematic errors of current optical reference frame and contributing main catalogues. Interrelations of radio/optical frame and future developments are discussed.

The requirements to obtain an unique interrelation of the independent radio - and optical reference frames by a suitable net of carefully selected extragalactic and galactic objects which display optical counterparts provides some difficulties which are partly due to the different underlying principles by which the traditional optical fundamental reference system is constructed.

As a consequence, the satisfactory alignment of radio/optical maps of extended objects or the correct identification of a radio point source emitter can be achieved only if the systematic differences of both reference frames in that particular sky region are known ; at least with the same accuary as the single position determinations themselves.

RADIO REFERENCE FRAME

An extragalactic radio reference frame based on about 25o extragalactic compact sources with optical counterparts is under investigation by a working group of IAU Com. 24 (1). To a certain extent such a frame is already provided by several radio source position catalogues obtained from VLBI and CEI techniques. Accuracies of about 1o mas have been

+ Discussion on page 466

R. Fanti et al. (eds.), VLBI and Compact Radio Sources, 357–360.

https://doi.org/10.1017/S0074180900078475 Published online by Cambridge University Press

obtained and further improvements to better than 5 mas are expected soon. Due to its extragalactic nature this new reference frame should be free of any systematic motion for a foreseen timescale, provided, all astronomical constants (precession, nutation ...) involved are determined definitely and all instrumental effects are correctly calibrated, these problems however need further investigation and cannot be considered as having been solved at present.

OPTICAL REFERENCE FRAME

The current optical reference frame is based on the FK4 system, realized by the positions and proper motions of 1535 bright stars $m_V < 6.5$ which provide an uniform coverage of the sky with about 1* / 28 sq.deg. The FK4 will be soon replaced by the FK5 which will have an increased stellar density and is extended to fainter magnitudes ~ 8. Furthermore, the FK5 will be based on the new precession constant, a different equinox and an improved system of positions and proper motions. (2)
For an all sky comparison of the radio/optical reference frame, the stellar density of the FK4 and FK5 is too low.
Comparisons of both systems are based at present on the IRS catalogue (3) , which is represented on the northern hemisphere by an improved version of the AGK3R-catalogue: the AGK3RN (4). The southern hemisphere will be soon covered by the SRS catalogue, probably available at the end of 1983. The complete IRS catalogue will contain about 5o ooo stars on system FK4 or probably FK5 and provides then a stellar density of 1* / sq.deg. in the magnitude range $m_V \sim 7-9$.

EXAMPLE OF COMPARISON OF REFERENCE FRAMES

The following comparison is based on about 3o extragalactic and galactic sources ; optical positions were determined in the system of the AGK3RN catalogue at average epoch 198o (see (5)) . Optical positions have been obtained mainly from prime focus plates of large reflectors using a system of fainter reference stars based on the AGK3RN system (6). In

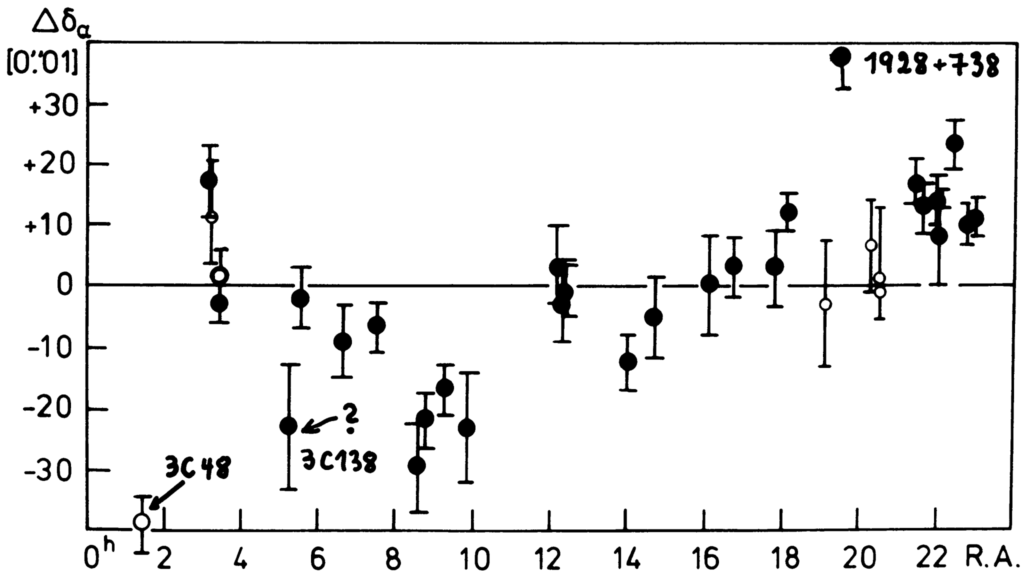
https://doi.org/10.1017/S0074180900078475 Published online by Cambridge University Press

contrast to the radio system, any optical catalogue system differs at epoch $t \neq t_o$ from its initial system (t_o) mainly due to the influence of systematic errors of proper motions. Therefore the differences $\Delta\delta$ "optical - radio", shown in the diagram (only δ will be discussed in this context) represent the combined effect of the FK4 system at $t \sim 198o$ and the AGK3RN at t ; an unique separation of both contributions is not possible at present. Concerning the FK4 part, a sky averaged total error of about o".1 may be assumed (7). From the comparison one therefore can estimate the differences of the radio/optical frames based on the combined AGK3RN/FK4 systems. The diagram shows that local systematic differences may reach about o".2. Results from additional 4o sources will be soon available to improve the sky coverage.

FUTURE OPTICAL REFERENCE FRAME

Mainly due to the influence of proper motions, the optical reference frame has to be improved continuously. Substantial progress will be expected during this decade both, from groundbased and space activities. Groundbased: the IRS will be reobserved by USNO pole-to-pole, new or improved photoelectric transit circles have been set in operation (Bordeaux, Tokyo, Washington 7") extensive work on new photographic catalogues is underway (Hamburg Obs., RGO, ...) As a result new positions of IRS stars with m.e. $\sim$ o".o8 are expected, photographic positions and proper motions with m.e. of $\approx$ o".o5 and $\sim$ o".oo3/y will be added for fainter stars, providing then a dense net for faint radio source position work. Spaceborn: The HIPPARCOS astrometry-satellite-mission (2) will provide positions and proper motions of 1oo ooo stars with m.e. of $\sim$ o".oo2 and $\sim$ o".oo2/y at mean epoch 199o, probably all IRS stars will be included. This high precision stellar net will be adjusted finally to the extragalactic radio reference frame. Thus a close cooperation between radio and optical astrometry will be needed to establish a new global reference frame for the benefit of astronomy and neighbouring disciplines.

https://doi.org/10.1017/S0074180900078475 Published online by Cambridge University Press



Differences Δ δ "optical-radio" for AGK3RN/FK4 based optical system and corresponding radio data. Open circles show radio stars, filled extra-galactic sources. Indicated displacement of particular sources is due to source structure.

REFERENCES

(1) Argue A.N., de Vegt Chr., 1982, Abh.Hamb.Stw. 1o/3

(2) Fricke W., 1982, ESA-SP-177 , 43

(3) Smith C., 198o, Mitt.Astron.Ges. 48, 95

(4) Corbin T., de Vegt Chr., 1981, Astron.Astrophys. 1o4, 88

(5) de Vegt Chr., Gehlich U.K., 1982, Astron.Astrophys. 113, 213

(6) de Vegt Chr., 1979, Proc. IAU Coll. 48, 1o1 Vienna

(7) Lederle T., 1978, CDS Inf.Bull. 14, 62

Acknowledgement

This research has received financial support from BMFT, Project o1ooo13/8.