OPTICAL POSITIONS AND PROPER MOTIONS OF SELECTED RADIO STARS*

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ABSTRACT. From a list of 275 confirmed or potential radio stars proposed to the Hipparcos input catalogue we selected about 80 objects which either lie outside the conventional astrometric catalogues or which are SAO-stars having declinations less than -17°. The positions of these stars were derived from measurements on POSS, SRC, and ESO(B) plates using reference stars from the SAO catalogue for the northern candidates, and from the Perth 70 catalogue for the southern candidates, respectively. The epochs of our positions fall in the middle of the fifties and seventies. For 52 stars other epochs were supplied by observations taken from literature. We determine proper motions from these positions which provide a base-line up to 35 years.

1. INTRODUCTION

With the advent of quasi inertial radio reference frame (RFF) represented by extragalactic objects (Fanselow et al., 1984) the obvious question arises about how to interconnect the RFF and optical reference frames, such as the ground-based reference system of FK5 or the rigid map of the whole sphere which will be provided by the Space Astrometry Satellite Hipparcos. Radio stars constitute one of the means of interconnection of frames. Provided that their positions and proper motions are known in the optical and radio frequency domains any residual rotation of the optical frame is determinable relative to the RFF, and its orientation can be fixed.

Below we present results on optical positions and proper motions of some 80 confirmed or potential radio stars proposed to the Hipparcos Input Catalogue (e.g. Argue, 1985). Apart from a few deliberately included SAO stars in the southern hemisphere the selected objects lack reliable astrometric positions and proper motions. We consider these results a contribution to the data base from which the linkage of optical frames with the RFF will materialize.

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*dedicated to the memory of H.M.Schwerdtfeger

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2. POSITIONS

As some of the radio stars are located in crowded areas and are faint besides, the production of finding charts was thought helpful (Hering et al., 1986). The positions of the objects having declinations > -17°5 were measured relative to reference stars of the SAOC (SAO, 1966) on POSS Atlas Schmidt plates, those having declinations < -17°5 relative to reference stars of the Perth 70 Catalogue (Høg and von der Heide, 1976) on SRC and ESO(B) Atlas Schmidt plates. The objects were centred visually on a cross wire. At least three settings were made on each object. The diffraction spikes were assumed to define the position of the bright stars ($6 < m_B < 10$). The repeatability of the settings was ∿ 4 μm for bright stars, for fainter stars it was even better. The SRC, ESO and POSS plates are similar, ∿ 67"/mm, so the above repeatability corresponds to an uncertainty of about 0"27 in right ascension (RA) and declination (Dec). This is the order of the internal error which is comprised of the setting errors plus possible systematic errors of the measuring machines.

Finally, the positions of the measured radio stars are the arithmetic mean of the individual settings on each programme star. Altogether we have determined RA and Dec of 75 stars; the average standard deviations in RA and Dec amount to

$$\sigma(\mathrm{RA})\cdot\cos(\mathrm{Dec}) = 0''427 \quad \text{and} \quad \sigma(\mathrm{Dec}) = 0''443.$$

The individual positions will be published elsewhere (Schwerdtfeger et al., 1987).

3. PROPER MOTIONS

There are 52 stars among the afore-mentioned set of 75 stars for which observations at different epochs were found enabling us to attempt the determination of proper motions. The epochs available for determining proper motions range from 1950 to 1986. Seldom we could avail of more than three star positions dispersed over this base-line of about 35 years. Some twenty stars were represented by only two positions. Each star treated, however, had its epochs arranged so that the maximum epoch difference approached the base-line length. In these circumstances a weighted least squares fit of a straight line seems to be appropriate in order to arrive at positions and proper motions at some mean epoch of observation. Owing to the volume the presentation of these data falls outside the scope of this paper. To provide some insight, however, Table 1 lists those newly determined proper motions of which we believe that they are not embedded in astrometric catalogues. The adjustment process was fed upon a data base containing the respective star positions in the system of FK4, the standard deviations and the observation epochs.

Table 1. Proper motions of radio stars

Designation	Annual proper motion μ_α(0^{s}0001)	μ_δ(0$''$001)	Observation epochs (years from 1900.0)		
HD 4004; 7	73 ± 34	3 ± 18	54.8(82)	86.5(98)	
IK Tau; 30	-4397 ± 10	-1833 ± 17	54.0(82)	81.0(22)	
GJ 207.1; 55	-158 ± 5	-147 ± 6	51.9(82)	77.1(41)	86.9(98)
HD 39741; 65	-30 ± 37	-28 ± 17	54.1(82)	86.2(98)	
V616 Mon; 70	-36 ± 3	-53 ± 5	55.9(82)	75.7(11)	76.0(41)
VV Mon; 77	13 ± 10	10 ± 16	53.0(82)	87.0(98)	
GJ 473A; 131	-1158 ± 13	230 ± 15	56.2(82)	78.9(41)	
HD 126753; 152	-8 ± 13	-18 ± 17	55.4(82)	85.6(98)	
GJ 569; 158	198 ± 14	-127 ± 26	50.2(82)	84.6(98)	
V818 Sco; 174	-51 ± 6	136 ± 12	54.5(82)	70.5(15)	76.5(41)
VX Sgr; 192	-15 ± 12	33 ± 13	51.6(82)	79.8(22)	
V426 Oph; 193	3 ± 11	-43 ± 21	50.5(82)	86.4(98)	
FR Sct; 197	-19 ± 1	23 ± 1	51.6(82)	70.6(76)	86.5(98)
GJ 729; 200	454 ± 21	-236 ± 11	50.5(82)	74.6(82)	86.6(98)
GJ 735; 203	75 ± 8	-94 ± 12	51.5(82)	86.4(98)	
HM Sge; 213	-38 ± 8	339 ± 15	50.5(82)	85.9(98)	
Cyg OB2-12; 228	10 ± 1	-6 ±0.4	53.5(82)	76.6(21)	86.4(98)
HD 199252; 236	409 ± 14	-1402 ± 13	53.5(82)	86.7(98)	
GJ 896A; 264	372 ± 9	-45 ± 16	54.7(82)	85.8(98)	

Notes:

The second designation refers to Hipparcos, INCA proposal no.210. The code numbers adjacent to the epochs have the following meaning: (11) Ward et al. (1975); (15) Hjellming and Wade (1971); (21) de Vegt (1982); (22) Soulie and Baudry (1983); (41) Clements and Argyle (1984); (76) de Vegt et al. (1985); (82) Schwerdtfeger et al. (1987); (98) Requième (1987).

4. DISCUSSION AND CONCLUSION

There are 30 star positions among the total of 75 having epochs around 1975 while the epochs of the remaining part lie around 1955. Bearing in mind the standard deviations quoted above and the proper motions redetermined for a subset of 52 stars, it can be taken for granted that the stars of this subset meet the positional requirements of the Hipparcos Input Catalogue at epoch 1990. In most cases the accuracy is sufficiently high thus obviating the problem of grid step ambiguity faced in the course of reduction of Hipparcos measurements.

Apart from a few cases (cf. Table 1) the results on proper motions seem to be significant. We assessed the external accuracy by comparing our proper motions (SHW) with those listed in the SAOC (SAO, 1966) and those of Clements and Argyle (1984), here abbreviated by CA. The differences in right ascension and declination, respectively, are given in Table 2.

Table 2. Mean differences of independently determined proper motions

Sets of stars	$\Delta\mu_\alpha$(ms/y)	$\Delta\mu_\delta$(mas/y)	Number of common stars
SHW-SAOC	-0.9 ± 2.1	- 5 ± 8	20
SHW-CA	-1.3 ± 0.8	8 ± 15	12
SHW-SAOC	-1.4 ± 1.7	-27 ± 12	16
SHW-CA	-1.7 ± 0.9	-19 ± 11	9

Position measurements on Schmidt plates may be suspected of impairing the accuracy of proper motions. Therefore we have omitted the observations of code number (82) leading to the figures in the lower half of Table 2 which, however, under similar base-line conditions do not evidence this suspicion. - As a whole the mean differences and their errors are larger than expected, a fact which points to noisy and, perhaps, inconsistent position measurements.

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REFERENCES

Argue, A.N.: 1985, Report by Subgroup 2130 (Link to Extragalactic Reference Objects). In Scientific Aspects of the Input Catalogue Preparation, Proceedings of a Colloquium on the European Astrometry Satellite Hipparcos held at Aussois, 3 to 7 June 1985, Eds. T.D. Guyenne, J. Hunt, ESA SP-234, Paris, 237

Clements, E.D., Argyle, R.W.: 1984, Mon.Not.R.Astron.Soc. **209**, 1

de Vegt, C.: 1982, Astron.Astrophys. **109**, 282 de Vegt, C., Florkowski, D.R., Johnston, K.J., Wade, C.M.: 1985, Astron.J. **90**, 2387

Fanselow, J.L., Sovers, O.J., Thomas, J.B., Purcell, Jr., G.H., Cohen, E.J., Rogstad, D.H., Skjerve, L.J., Spitzmesser, D.J.: 1984, Astron.J. **89**, 987

Hering, R., Schwerdtfeger, H.M., Walter, H.G.: 1986, Bull. Inform. CDS No. 30, 61

Hjellming, R.M., Wade, C.M.: 1971, Astrophys.J. **164**, L1

Høg, E., von der Heide, J.: 1976, Perth 70. A Catalogue of Positions of 24900 Stars, Hamburger Sternwarte, 334 p.

Requième, Y.: 1987, private communication

SAO: 1966, Star Catalog. Publications of the Smithsonian Institution of Washington,D.C., No.4562, Washington

Schwerdtfeger, H.M., Hering, R., Walter, H.G.: 1987, in preparation

Soulie, G., Baudry, A.: 1983, Astron.Astrophys. Suppl.Ser. **52**, 299

Ward, M.J., Penston, M.V., Murray, C.A., Clements, E.D.: 1975, Nature **257**, 659