

WORK ON ASTROMETRY IN 1993–1996 AT SHANGHAI ASTRONOMICAL OBSERVATORY

J.L. Zhao, J.J. Wang

Shanghai Astronomical Observatory, CAS, 80 Nandan Road, Shanghai 200030, China

ABSTRACT

In the last three years, a number of new results on astrometry were obtained at Shanghai Astronomical Observatory. The studies of Praesepe and Pleiades gave high-precision positions and proper motions of numerous stars brighter than $B = 16$ mag in these regions, which should be excellent extensions of the Hipparcos system after they are linked with it. Relative proper motions and membership probabilities of the open clusters M67, M11, NGC2286, and Orion were determined. A program of absolute proper motions and space motions for some globular clusters and Galactic field RR Lyrae stars has started. This program will be based on the Hipparcos system after the Hipparcos Catalogue is available for us. Optical observations of several radio sources were performed with photographic plates and CCD.

Key words: open clusters; globular clusters; reference system.

1. PRAESEPE AND PLEIADES

Proper motions of 296 AC stars in the central part of the Praesepe region are determined by Wang & Jiang (1993). The measurements of six Paris AC plates and seven plates taken with the Zo-Se (Sheshan) 40 cm refractor are used to determine the proper motions. Accuracies are higher than 0.005 arcsec per year and mostly arrive at about 0.001 arcsec per year.

A high-precision study of proper motions and membership of 924 stars in the central region of Praesepe is performed by Wang et al. (1995a). High-precision proper motions for 296 stars in a 90×90 arcmin² region centred on BD+20:2170 are obtained from seven plates taken with the 40 cm refractor ($f = 6895$ mm) at Sheshan station of Shanghai Observatory and six AC plates. In addition, high-precision proper motions for 257 stars in the same region are obtained from the former seven plates and the stellar positions in Russell's catalogue. Being combined with the data given by other authors, these proper motions give a sample of 924 stars in the region mentioned above. With membership probabilities estimated by an improved maximum likelihood method,

a very good sample of 198 members is obtained. The accuracies of these proper motions range from 0.2–5.0 mas per year, of which 60 per cent are better than 1.0 mas per year, and the completeness is nearly down to $B = 15.5$ mag.

High-precision positions and proper motions of 441 stars in the Pleiades astrometric standard region are determined by Wang et al. (1996a). Based on a preliminary reference catalogue, constructed by a combination of the catalogues PPM and ACRS, and the data given by other authors, 33 exposures on 11 plates taken with the Sheshan 40 cm refractor in 86 years are reduced by the central overlapping technique, and high-precision positions and proper motions of 441 stars in the Pleiades astrometric standard region are obtained. The standard errors of positions are less than 0.05 arcsec and the standard errors of proper motions for 90 per cent of stars less than 1 mas per year.

2. OTHER OPEN CLUSTERS

A study of proper motions in the region of the open cluster M67 and membership of stars is performed by Zhao et al. (1993). Relative proper motions and membership probabilities of 1064 stars in the open cluster M67 region are determined from measurements of 9 plate pairs scanned by PDS-1010MS at Purple Mountain Observatory. The plates were taken with the 40 cm refractor at Sheshan station of Shanghai Observatory. The average standard errors of proper motions vary from 0.4 mas per year for bright stars in the inner part of the field to some 1.5 mas per year for faint stars in the outer part of the field.

Proper motions of stars in the region of the open cluster NGC 2286 and its membership study are determined by Tian et al. (1994). Relative proper motions and membership probabilities of 2400 stars in the open cluster NGC 2286 region are determined from measurements of 8 plates scanned by ASTROSCAN at Leiden Observatory. The plates have the maximum epoch difference of some 70 years and were taken with the 40 cm refractor at Sheshan station of Shanghai Observatory. The average standard errors of proper motions vary from 0.7 mas per year for bright stars in the inner part of the field to some 1.6 mas per year for faint stars in the outer part of the field.

Proper motions of stars in the region of the Orion Nebula cluster (C 0532-054) are determined by Tian et al. (1996). Relative proper motions and membership probabilities for 333 stars within an area of 1.6×1.8 degrees centred on the Orion Nebula M42 are determined using plates taken over a period of 83 years taken with the 40 cm refractor of Shanghai Observatory. The plates were measured with the ASTROSCAN automatic plate-measuring machine of Leiden Observatory. The average proper motion accuracy obtained for stars in the photographic magnitude range 7–14 mag is 0.3 mas per year. Errors are somewhat larger towards fainter and brighter magnitude, but the majority lie well below 1 mas per year. 64 per cent of the stars have been measured successfully on 13 out of 18 plates.

A study of the open cluster M11 is performed by Su et al. (1996). 10 plate pairs with epoch differences of 16–70 years of the open cluster M11, which were taken with the 40 cm refractor of Shanghai Observatory, were measured on the PDS-1010 microdensitometers and relative proper motions of 872 stars in the cluster region are determined, of which accuracies of 85 per cent are better than 0.1 arcsec per century.

3. GLOBULAR CLUSTERS AND GALACTIC FIELD RR LYRAE STARS

The results, progress, and open questions in respect of the determination of relative proper motions and estimation of membership probabilities, the detection of internal motions, and the determination of absolute proper motions and investigation of space motions of the globular clusters since the middle of 1970s are reviewed by Wang (1997). A program of astrometric and kinematic studies for some globular clusters has started at Shanghai Observatory.

High precision measurements of absolute proper motion for Galactic field RR Lyrae stars on the reference frame from the Lick NPM catalogue enables the investigation of space motions for these stars based on more reliable data. A program has been started to carry out such measurements from plates taken with the 40 cm refractor at Sheshan station, Shanghai Observatory. The reduction technique used in the program is described by Wang & Mao (1997) and an example, SW Aqr, is given to compare with different techniques.

4. REFERENCE SYSTEM

A discussion of the precession constant is performed by Wang et al. (1995b) on the optical observation of the counterparts of extragalactic radio sources with long time intervals.

A high-precision study of proper motions of 22 Hipparcos stars with photographic plates is performed by Wang et al. (1996b). 50 exposures on 20 plates with the epoch differences up to 86 years, which were taken with the 40 cm refractor at Sheshan station of Shanghai Observatory, were reduced. Taking the PPM catalogue as initial reference catalogue and using the

central overlapping method with the iteration process, we obtain high-precision positions and proper motions of 22 Hipparcos stars around the radio source IAU0316+413 and in the Pleiades astrometric standard region. The mean errors of the proper motions of these stars in right ascension and declination are 0.51 mas per year and 0.47 mas per year, respectively. The external errors of positions and proper motions of the stars are also discussed.

With the CCD of the 60 cm reflector, optical positions of radio sources 0716+714 and 0839+187 have been obtained by Wang & Tang (1996). The reference stars are selected from Carlsberg Automatic Meridian Circle (CAMC) catalogue. The mean value of internal accuracy for the positions of the sources is 0.19 arcsec. A comparison between our results and those in other optical and radio catalogues are also given.

REFERENCES

- Su, C.G., Zhao, J.L., Tian, K.P., 1996, *Annals of Shanghai Observatory Academia Sinica*, 17, 205
- Tian, K.P., Zhao, J.L., van Leeuwen, F., 1994, *A&AS*, 105, 15
- Tian, K.P., van Leeuwen, F., Zhao, J.L., et al., 1996, *A&AS*, 118, 503
- Wang, J.J., 1997, *Progress of Astronomy*, 15, in press
- Wang, J.J., Chen, L., Zhao, J.H., et al., 1995a, *A&AS*, 113, 419
- Wang, J.J., Chen, L., Zhao, J.H., et al., 1996a, *Acta Astronomica Sinica*, 37, 69
- Wang, J.J., Jiang, P.F., 1993, *Annals of Shanghai Observatory Academia Sinica*, 14, 75
- Wang, J.J., Mao, Y.Q., 1997, *Annals of Shanghai Observatory Academia Sinica*, 18, in press
- Wang, S.H., Tang, Z.H., 1996, *Publications of Yunnan Observatory*, submitted
- Wang, S.H., Tang, Z.H., Jin, W.J., et al., 1996b, *A&AS*, submitted
- Wang, S.H., Xu, T.Q., Lu, P.Z., 1995b, *Acta Astronomica Sinica*, 36, 418
- Zhao, J.L., Tian, K.P., He, Y.P., et al., 1993, *A&AS*, 100, 243