THE PARALLAX AND PROPER MOTION PROGRAM OF THE SHANGHAI OBSERVATORY 1.56-M ASTROMETRIC REFLECTOR

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ABSTRACT. The main properties of the 1.56-m astrometric reflector of Shanghai Observatory are described. Some principles of selecting program stars are presented. The experimental program that has been performed with the Zô-sè 40-cm refractor since 1980 is outlined. Accuracies which are expected to be obtained for new program parallaxes are discussed.

1. INTRODUCTION

The Shanghai Observatory 1.56-m astrometric reflector is being mounted at Zô-sè, a hill about 30 km southwest of the city center of Shanghai, and will go into observational operation.

The aperture of the primary mirror of the new telescope is 1.56-m. Its optical system is the Ritchey-Chretien system. It is only with one working focus, that is, the R-C Cassegrain focus. The equivalent focus length is 15.6 m (scale being 13".22/mm). A coma-free field of 30 minutes of arc in diameter is provided. The telescope can be used to photograph stars down to magnitude 17.5 within exposure time of 15 minutes.

One of the main observing programs with this telescope is to determine trigonometric parallaxes of stars. Unfortunately, the weather of Shanghai is not very satisfactory. The number of observable, fine nights is some 120 in a year, of which nights used for determining parallaxes may be only about 50 a year, and therefore 40-50 sky areas are selected for our parallax program during 1988-1991.

2. SELECTION OF STARS

The program stars selected for parallax observation can be divided into two sorts: white dwarfs and members of nearby open clusters (Hyades and Pleiades).

The white dwarfs are extracted from 'White Dwarf Candidates for Trigonometrical Parallax Determination' of Moffett et al. (1985), which

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gives predicted parallaxes deduced for 110 white dwarfs by the visual surface brightness relation based on assumptions for their linear radii. We intend to determine trigonometric parallaxes of about 20 stars in this list during 1988-1991.

The Hyades cluster is the basis of distance scale for Population I stars. 11 Hyades stars with magnitudes 9-13, for which parallaxes have been determined by other observatories, are included in our program. Repeated accurate determinations of parallaxes for these stars will be helpful to obtaining results with higher and higher accuracies. In addition, all the stars down to magnitude 15, appeared on the plates covering these sky areas will be reduced with the central overlap technique in order to obtain their parallaxes and proper motions, and then determine their memberships.

The Pleiades cluster is also interesting because of its age closer to those of clusters containing Cepheid variables. We divide the 1°x1° region round the center of the Pleiades field into five corner-center overlapping areas and intend to photograph every area. The data of these plates will be reduced with the plate overlap technique, and the parallaxes and proper motions of all the stars down to magnitude 16 will be obtained.

The Preasepe cluster (the central region) and several other parallax standard fields, recommended by the working group on parallax standards (Upgren 1982), will be also observed in our program.

3. EXPERIMENTAL PROGRAM

As a preparation, since 1980 an experimental program has been performed with the Zô-sè 40-cm refractor (f = 6.9 m, scale being 29".89/mm). Ten parallax stars, of which parallaxes were determined by some other observatories, are included in the program. The purpose of the program is to gain experience in this field and knowledges of parallax reduction methods. All the plates for the ten series had been taken by the end of 1985. Up to now, the observational data of 5 series have been reduced and those of the others are being processed.

Kodak 103a-O spectroscopic emulsion was used for all the exposures with no filter. Observational hour angles are not restricted within narrow limits and for a few plates hour angles are slightly greater than 2 h (east or west). Parallax factors in R.A. are usually about ±0.9 except for a small part of plates, for which parallax factors in R.A. are about ±0.7 . For some parallax stars with higher declinations a few plates were taken at the dates when parallax factors in Decl. of these stars were roughly maximum.

The plates of BD+2°348 series were manually measured on the Zeiss coordinate measuring machine at Zô-sè and those of other series were automatically measured on the PDS-1010MS microdensitometer at the Purple Mountain Observatory. The digital image centering of PDS measurements is obtained by means of a circular Gaussian distribution fitting (Chiu 1977).

The plate and parallax reductions of BD+2°348 are by means of an iteration algorithm with the central overlapping technique suggested

by Eichhorn and Jefferys (1971). For the others, Murray and Corben (1979) 's normal equation system with the rigorous non-iterative technique is applied, but the system is solved by means of an iterative scheme (Wang 1985).

In parallax solutions for later three series the refraction terms are included in star constants by means of the method developped by Monet and Dahn (1983), which lead to effective reduction of systematic errors arising from the atmospherical dispersion.

TABLE I

Star	No. of Pl.	No. of Exp.	Interval of Epochs	No. of Constr. Stars	$\bar{m}_{pg}$ of Constr. Stars	π_{abs} ±s.e.	$\bar{\pi}_{abs}$ ±s.e.	Ref.*
					m	″	″	
BD+2°348	24	72	80.0-81.0	8	11.1	0.0930 178	0.0851 24	1
BD+63°869	29	80	81.9-84.4	10	11.4	0.0786 126	0.0956 23	2
Barnard's	32	87	82.2-84.7	19	11.3	0.5422 132	0.5482 14	3
BD+70°68	30	86	82.0-84.7	22	12.3	0.1270 94	0.1171 42	3
BD+4°4157	25	74	82.7-85.4	16	11.1	0.0791 65	0.0772 48	3

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Table 1 gives the absolute parallaxes, π_{abs}, determined with the Zô-sè 40-cm refractor for five parallax stars, data of which have been reduced. For comparison, the weighted-average absolute parallaxes, $\bar{\pi}_{abs}$, for these stars, which are obtained from combining our results with those of other observatories, are given as well. The weights are determined in terms of the standard errors of the parallaxes published.

4. EXPECTED ACCURACIES

From table 1 we find that, when plates are measured with PDS microdensitometer, accuracies of parallaxes are about ±0.″010 with 103a-0 emulsion on the 40-cm refractor. For 103a-0 emulsion, accuracies of image positions measured with PDS microdensitometer are about ±1 μm,

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and for IIIa-J emulsion, those are some ±0.4 μm (Chiu 1977). If image positions on plates taken with the 1.56-m reflector are of the same accuracy, for 103a-O emulsion accuracies of parallaxes are improved to about ±0".004, and for IIIa-J emulsion some ±0".002. Taking account of that the new telescope is free from effects of the coma, spherical aberration and chromatic aberration, systematic errors caused by the optical system should be significantly less than those of the 40-cm refractor, and then accuracies of parallaxes determined for stars in the new program should be better than ±0".004 or ±0".002, for 103a-O or IIIa-J emulsion, respectively.

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