

PRECISION OF PARALLAXES FROM AUTOMATIC AND MANUAL MEASURES
FROM NEW PARALLAXES OF THE HYADES CLUSTER REGION

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ABSTRACT. Measures of 25 members of the Hyades and about 260 field stars have been made for parallax and proper motion in two ways, automatically using a PDS microdensitometer and manually using a conventional measuring machine. Reductions show the parallax errors from the former are about half those of the latter method.

Since 1970, the 0.5m refractor of the Van Vleck Observatory has been used to take plates of 13 fields in the central region of the Hyades cluster. Recently, all of the plates were measured on the Mann two-screw measuring machine of the Van Vleck Observatory and later they were remeasured on the PDS microdensitometer of the Yale Observatory. The series contain between 38 and 53 plates each and cover the period from 1970 to 1982. Altogether 33 members of the Hyades and about 270 reference stars were measured. Of the members, 25 are in the magnitude range 8.2 to 12.3, as well as eight very bright members in the range 3.4 to 6.6. As expected, the measuring precision of these very bright stars is very poor.

In addition to new parallaxes and proper motions for members of the Hyades of very high precision, the two sets of measures allow a comparison to be made between two very different measuring techniques incorporating personal and automatic impersonal measures. The 13 fields cover areas of about 50 by 70 arc minutes and the plate scale is 24"/5mm. Both sets of data were reduced using one or another variant of the linear plate-constant method of reduction. The resulting absolute parallaxes from the Mann and PDS machines for the 25 members fainter than 8.0 are presented in Table I. Some of the stars were measured on more than one plate series since some of the fields overlap each other. Thus there are 38 individual parallax determinations of cluster members.

Table II lists the weighted and unweighted mean parallax and its standard error and the individual standard error for the stars shown individually in Table I. The results are given for all parallaxes grouped together as well as for the 15 original target stars among the

TABLE I

Individual Absolute Parallaxes of Hyades Stars.

No.	m_v	PDS		MANN	
		Wtd	Mean	Wtd	Mean
276*	10.5	0"0168	+0"0041	0"0246	+0"0107
294*	10.9	0.0182	0.0053	0.0197	0.0109
310*	10.0	0.0229	0.0034	0.0287	0.0093
334	11.6	0.0113	0.0049	0.0156	0.0106
354	11.2	0.0227	0.0025	0.0238	0.0078
363*	9.0	0.0241	0.0048	0.0293	0.0133
400	8.1	0.0290	0.0182	0.0282	0.0282
435	10.4	0.0274	0.0044	0.0218	0.0117
444	11.1	0.0233	0.0061	0.0071	0.0178
459*	9.5	0.0236	0.0061	0.0165	0.0142
472*	9.0	0.0300	0.0055	0.0286	0.0165
475*	11.1	0.0269	0.0025	0.0301	0.0065
500*	10.7	0.0156	0.0029	0.0144	0.0075
502*	12.0	0.0213	0.0034	0.0107	0.0091
529*	12.3	0.0143	0.0045	0.0041	0.0099
548*	10.3	0.0182	0.0034	0.0308	0.0090
559	12.8	0.0387	0.0143	0.0047	0.0200
560*	9.1	0.0281	0.0068	0.0202	0.0141
587	8.9	0.0230	0.0070	0.0237	0.0172
638*	12.2	0.0229	0.0063	0.0095	0.0115
645*	11.0	0.0195	0.0054	0.0382	0.0131
684	8.9	0.0333	0.0048	0.0205	0.0153
692	8.7	0.0352	0.0046	0.0192	0.0124
747*	9.7	0.0161	0.0041	0.0360	0.0115
778	9.4	0.0158	0.0076	0.0218	0.0177

Hyades (indicated by asterisks in the first column of Table I). These results compare closely with cumulative probability (probit) plots for the same data where the central 80% of the data is used and the outliers are excluded.

The mean parallax of the group varies little from one weighting method to another and the moduli center closely around the generally accepted value of 3.3. The individual standard errors in parallax for the Mann measures average near 0"011 whereas for the PDS data they increase when all stars are considered. The precision of the Mann results can be compared to three earlier estimations for Van Vleck parallaxes of field stars of about the same range in apparent magnitude chosen mostly from the lists of dwarf stars of Vyssotsky. These estimates include one by Uppgren (1973) who found +0"0080+0"0017 from 70 target stars from Vyssotsky's lists, and another by Hanson and Lutz (1983) who found +0"0094+0"0018 from earlier parallax solutions for 14 members of the Hyades made from part of the plate material used here. The third is the determination made by van Altena (1987) who gets

TABLE II

Summary of Mean Parallaxes for Hyades Stars.

Wt	Stars	Method	π_{abs}	σ	σ_1
1/ σ	38	PDS	0 ^h .0220	+0 ^h .0011	+0 ^h .0071
	38	MANN	0.0217	0.0018	0.0109
	15	PDS	0.0190	0.0010	0.0041
	15	MANN	0.0215	0.0030	0.0115
Unit	38	PDS	0.0230	0.0015	0.0093
	38	MANN	0.0238	0.0022	0.0133
	15	PDS	0.0194	0.0014	0.0055
	15	MANN	0.0217	0.0029	0.0111

+0^h.010 from intercomparisons between parallaxes of Van Vleck and other observatories. The investigations conclude that the Van Vleck parallaxes (unlike those of some of the other observatories) can be characterized by a single value for the error.

The distributions of the relative parallaxes for the reference stars are shown in the histograms appearing in Figure 1. Here, as for

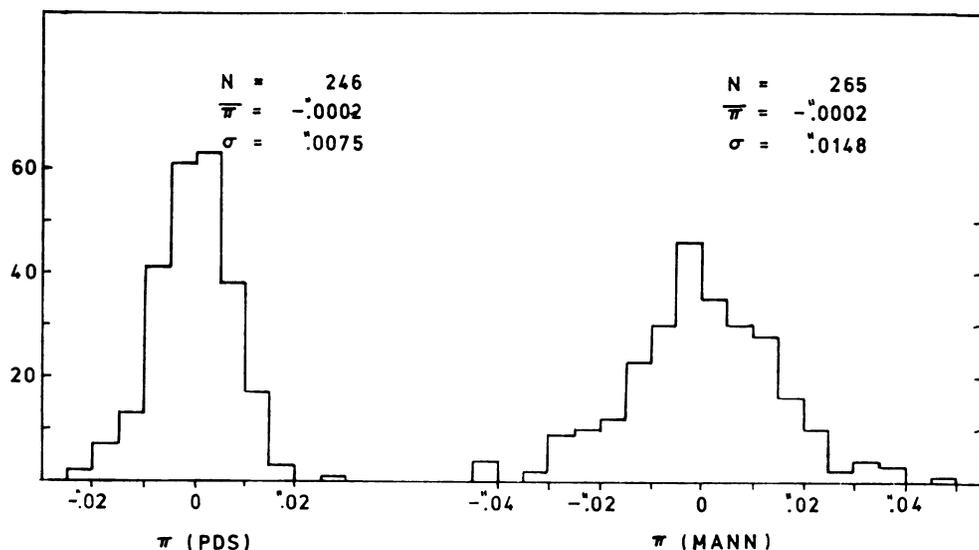


Figure 1 - Histograms showing the distributions of the relative parallaxes of the reference stars and their means and dispersions for the PDS measures (left) and the Mann measures (right). The data are not corrected to absolute parallax or for cosmic dispersion (both of which are small compared to the observational dispersion).

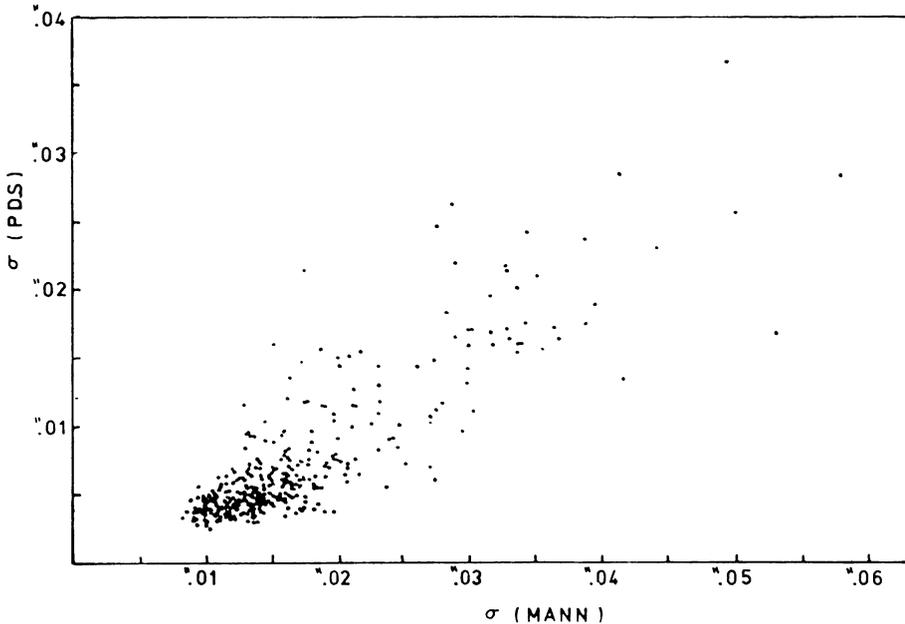


Figure 2 - Plot of the individual standard parallax errors for all stars measured. The abscissa and ordinate represent the Mann and PDS data, respectively.

the parallaxes of the member stars, the errors of the PDS measures are about half those from the hand measures using the Mann machine. Figure 2 shows a plot of the results of the two methods for the individual stars. It confirms that the automatic measures possess about half the error of the hand measures and that there is only a moderate correlation for any one star. The larger errors for the field stars as compared to the target stars, may be due to the fact that they cover much more of the field as well as a wider range in apparent magnitude, and the modeling techniques may not fully account for their variations. A few of them may also lie in the vignettted portion of the field.

In conclusion, new measures for parallax of members of the Hyades are presented which confirm the accepted distance to the cluster. Two sets of measures of the same plate material were made, using automatic and hand measure techniques. For both the members and for the field stars, they indicate that the automatic measures produce errors about half as large as the hand measures. This implies that about 3/4 of the total variance is in the measures, and other factors which are believed to introduce error into the parallax process (such as atmospheric, optical and emulsion variations) account for about one-fourth of the total error. The analysis of these data will continue, and will include proper motions as well as other modeling methods for parallaxes in order to examine the differences between the errors of the members

and the field stars. The results reported briefly here will be given in detail in a later publication.

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REFERENCES

- Hanson, R. B. and Lutz, T. E. 1983, *M.N.R.A.S.* 202, 201.
Uppgren, A. R. 1973, *A. J.* 78, 79.
van Altena, W. F. 1987, General Catalogue of Trigonometric Stellar Parallaxes, Fourth Edition, in preparation.