

An astrometric study of Lalande 21185

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The parallax, proper motion, and acceleration in position of the Sun's fourth nearest stellar neighbor, Lalande 21185, have been determined from 143 exposures obtained with the Allegheny Observatory 30-in. Thaw photographic refractor. Several tests fail to confirm the existence of the unseen companion proposed by Lippincott (1960).

INTRODUCTION

LALANDE 21185 is a star with an apparent visual magnitude of 7.5 and a M2V spectrum. As the Sun's fourth nearest stellar neighbor it has been the subject of many astrometric investigations. The most comprehensive of these (Lippincott 1960) suggest the existence of an unseen low mass companion with an orbital period of 8.0 years. The Lippincott study supersedes an earlier study (van de Kamp and Lippincott 1951) which, based on 71% of the plates used in the later paper, had suggested a more massive companion with an orbital period of 1.14 years.

The *Catalogue of Stars within twenty-five parsecs of the Sun* (Woolley 1970) lists the radial velocity of Lalande 21185 as -86.5 km/sec and the absolute parallax as $0''.396 \pm 0.006$ standard error.

I. MATERIALS AND REDUCTIONS

143 exposures on 56 plates were measured for this study. The epochs of these plates had an even distribution in the months December through May, and over their range of 1934–1972.

The measuring and reduction procedures are the same as those outlined in previous papers by the author (Gatewood 1972; Gatewood and Eichhorn 1973).

Table I lists the star number (a continuing sequence starting with the above cited papers), estimated photographic magnitude, absolute parallax, standard error of the parallax, 1950.0 right ascension, internal standard error of the right ascension, proper motion in right ascension, the internal standard error of this component of the motion, the 1950.0 declination, the internal standard error of the declination, declination component of the proper motion, and the internal standard error of this component of the proper motion. The least significant unit of each standard error coincides with the least significant unit of the corresponding quantity. The absolute parallaxes listed here are equal to the relative parallaxes plus a correction of $+0''.002$. The system of the positions and motions given for the stars in this region is that of the SAOC, ostensibly that of the FK4, and was reduced from those stars common to Table I and that Catalog. Thus, the systematic errors of these quantities should be similar to those of the SAOC and FK4.

The parallax derived here supersedes the recent Allegheny value of $0''.406 \pm 0''.009$ standard error (Beardsley *et al.* 1973). Only two plates have been added to the series since the previous study; thus, the over four times increase in the weight of the parallax (similar to that observed in other studies in this series)

TABLE I. Relative positions, proper motions, and absolute parallaxes of 18 stars in the region of Lalande 21185 on the system of the FK4.

No.	m_{pg}	π_{abs}	Stand. error	R.A. 1950	Stand. error R.A.	μ/yr	Stand. error (μ)	Dec. 1950	Stand. error Dec.	μ'/yr	Stand. error (μ')
52	9.8			10 ^h 58 ^m 29 ^s .2844	17	+0.00053	11	36°20'05".554	12	-0.0099	7
53	11.8	+0.004	4	10 59 07.6088	2	-0.00045	2	36 05 49.415	6	-0.0367	2
54	12.7	+0.005	5	10 59 23.9098	3	+0.00041	3	36 20 27.050	8	-0.0185	3
55	12.6	-0.001	7	10 59 27.9678	4	-0.01146	4	36 34 19.476	10	-0.0050	5
56	9.3	...	...	10 59 52.0973	9	-0.00069	5	36 36 21.238	8	-0.0049	5
57	12.7	0.000	2	10 59 55.9246	1	-0.00366	1	36 31 47.060	3	-0.0498	2
58	12.6	-0.001	4	10 59 56.7853	3	+0.00096	3	36 09 21.908	6	-0.0322	3
59	12.2	+0.001	4	11 00 01.3622	2	-0.00036	2	36 19 43.811	5	-0.0076	3
60	8.6	...	...	11 00 10.4917	11	-0.00131	7	35 56 46.822	9	-0.0069	6
61	12.7	+0.005	7	11 00 30.6682	5	+0.00071	4	36 02 06.579	9	-0.0239	4
62 ^a	8.9	+0.398	4	11 00 36.5936	3	-0.04647	3	36 18 19.723	6	-4.7693	3
63	12.7	+0.001	4	11 00 41.6444	2	-0.00181	2	36 08 09.023	4	-0.0027	2
64	12.8	-0.004	7	11 00 48.5735	4	-0.00412	4	36 06 02.446	8	-0.0203	4
65	12.2	-0.001	4	11 01 29.4036	2	-0.00435	2	36 10 45.028	5	-0.0407	3
66	13.0	+0.010	8	11 01 32.7618	5	+0.00122	5	36 20 17.767	9	-0.0128	4
67	12.4	0.000	4	11 01 38.1643	2	+0.00123	2	36 22 10.819	5	-0.0121	2
68	12.8	+0.008	4	11 01 54.5762	3	-0.00016	3	36 22 05.451	5	-0.0205	3
69	10.6	...	...	11 02 07.7706	24	+0.00004	14	36 05 04.603	14	-0.0225	8

^a Lalande 21185, light reduced via rotating sector to that of a star with a photographic magnitude of 12.3.

must be attributed to the measuring and reduction procedures outlined by Gatewood (1972) and Gatewood and Eichhorn (1973).

The acceleration in position in x and y followed by their standard errors for Lalande 21185 as reduced from our observations are $+0.00008 \pm 0.00006$ and -0.00048 ± 0.00006 seconds of arc per year per year. From these and the values listed in Table I we find a dynamical radial velocity of -119 ± 16 km/sec.

II. CONCLUSIONS

The parallax given in Table I is in good agreement with the one cited earlier, averaging these we find $\pi = 0''.397 \pm 0''.004$. Thus, Lalande 21185 along with Barnard's star and Proxima Centauri is one of three stars for which the parallax is known with a standard error of one percent or less.

Like Barnard's star (Gatewood and Eichhorn 1973) the y component of the proper motion of Lalande 21185 is much greater than the x component and again the observed perturbation is almost entirely in the x positions. Thus we will concern ourselves only with the x residuals. Figure 1 is a plot of the normal points formed by averaging all of these residuals for each one eighth phase of the most recently proposed orbit. The points are of similar weight and should, assuming the standard error of a single exposure is $0''.030$ (Gatewood 1972), have a standard error of $0''.007$. The curved line represents the positions computed from the published orbit while the straight line denotes the path of an unperturbed star.

Using the individual observations, as is always our practice, and which are available on punched cards supplied by the author, we next computed the semi-major axis of the photocenter. Assuming the published orbital elements we find $\alpha = 0''.003 \pm 0''.004$ standard error. The value found in the latest Sproul study was $0''.034 \pm 0''.004$ standard error.

The coefficient of correlation of the variation of our positions from a nonperturbed motion to those variations predicted by Lippincott was 0.07. Thus, we

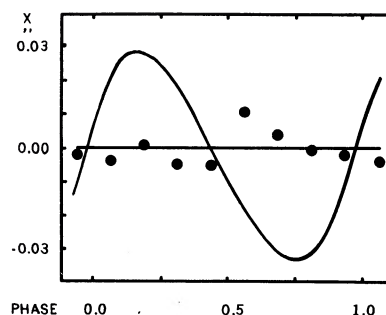


FIG. 1. A plot of the observed deviation from rectilinear motion. Curved line indicates deviation predicted by published orbit.

conclude that our observations do not confirm the existence of the object proposed by Lippincott.

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