

24. COMMISSION DES PARALLAXES STELLAIRES ET DES MOUVEMENTS PROPRES

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TRIGONOMETRIC PARALLAXES

An essential increase of the parallax determination programme may be stated since the last report, particularly with respect to fainter stars.

Professor K. Aa. Strand reports that since the completion in April 1964 of the 61-inch (155 cm) astrometric reflector of the U.S. Naval Observatory, located at Flagstaff, Arizona, 9000 plates have been obtained for astrometric studies.

In this programme 335 stars are being observed for parallaxes. Most of these stars are in the visual magnitude range 12.0 to 16.5 and were selected from the Luyten and the Giclas proper motion programmes.

A programme of photometry and spectral classification of the parallax stars and their comparison stars have been initiated. On the average, four comparison stars are selected for each parallax star.

Since the installation in April 1966 of a two-coordinate automatic measuring machine, a total of 1500 plates have been measured. An average plate with 3 to 5 comparison stars now takes 5 minutes to measure, including orientation, which is a gain by a factor of 6 in measuring speed as compared to manual measuring techniques.

The measurements also show a gain in accuracy in that the mean error of unit weight in the parallax solutions is reduced by 24% to $\pm 0''.035$ ($\pm 2.7 \mu$).

Electronic computer reduction programmes are used for the computation of parallax factors, plate constants, and the least squares solution for parallax and proper motion. As of 1 October 1966 twenty or more plates have been obtained for 115 parallax series. Twenty-five series have 30 or more plates of the required 50-plate series for a definite parallax determination and these are estimated to be completed within the next year or year and a half.

At the Lick Observatory, the observing programme to measure the parallaxes of 120 faint red dwarfs, white dwarf and U Geminorum stars from plates taken with the automatic camera on the 36-inch (91 cm) refractor, began in 1961 by S. Vasilevskis, is nearing completion. Parallax fields have been photographed in the blue and the yellow with 20-inch Carnegie double astrograph. These will be used not only for the evaluation of magnitude and colour effects but also for investigating the reference frame of the comparison stars in deriving absolute parallaxes (I, p. 611).

Professor W. J. Luyten has determined a few preliminary parallaxes with the 48-inch (122 cm) Schmidt telescope, thus indicating that it is at least possible to use Schmidt telescopes for parallax work. Professor Luyten notes that for extremely faint stars—18th magnitude or fainter—there may be no other way at present.

Dr J. V. B. Lourens reports that at the Cape Observatory the present parallax programme consists of two parts:

(a) The measurement of plates obtained mainly during the years 1943 to 1951 for the re-determination of parallaxes of nearby stars already observed at the Cape. Since the last report 1567 of these plates have been measured and 83 rejected; about 900 remain to be measured.

(b) An observing programme which started at the end of January, 1965. On this programme at present are 102 stars: 57 stars, south of -20° declination, from Gliese's list, 12 stars which have relatively large photometric parallaxes, 18 stars from Parenago's lists and the remainder consisting of stars which are known astrometric binaries, stars included in the programme at the request of other astronomers, e.g. suspected white dwarfs, subdwarfs, etc. and some other stars.

Dr C. A. Murray reports from the Royal Greenwich Observatory that the current programme on the 26-inch (66 cm) refractor has been reduced to about 100 stars, by the exclusion of a large number of stars on the original pre-war Greenwich list for which modern spectroscopic and other evidence suggests that the parallaxes are likely to be small. Two thirds of the present programme consists of stars in Gliese's catalogue for which only spectroscopic parallaxes are available. For about half the stars on the programme, twenty or more plates have been obtained since 1959; measurement and reduction has been started.

First-epoch plates have been obtained with the 26-inch refractor on faint stars with annual proper motions in excess of $1''$, which appear from time to time in the lists of Luyten and Giclas; it is hoped to measure parallaxes of these stars from plates to be obtained at the prime focus of the 98-inch (249 cm) Isaac Newton telescope.

At the Leander McCormick Observatory the parallax and proper motion programme is being continued. Emphasis is being placed on the 300 red dwarfs on Vyssotsky's list not previously observed for parallaxes. Trigonometric parallaxes of 36 stars determined with the 26-inch refractor have been printed in *Astr. J.* (3). This is the 39th list of parallaxes by the Leander McCormick Observatory, and follows that in *Astr. J.*, 64, 265, 1959.

At the Allegheny Observatory six definitive and five preliminary parallaxes were determined (from the new parallax plates measured for the determination of white and red dwarf stars) (1, p. 581).

At the Sproul Observatory the work in progress includes a comprehensive study of systematic errors in parallaxes with particular attention to the parallax determinations from declination measurements. A high accumulation of photographic plates was maintained; a relation with the continued drought seems to be indicated (2 p. 780). As before the observation programme includes mainly astrometry of nearby stars.

Professor Van de Kamp reports that the Sproul refractor has been in continuous operation since 1912 and a total of over 66 000 plates have been taken. Between January 1912 and 1 July 1962 a total of about 51 000 plates have been taken; 41 155 were taken over the 25-year period ending 1 July 1962, an average of 1646 annually. Over the four-year period ending 1 July 1962, 15 222 plates were taken, or about 3800 yearly. The number would have been slightly higher except for the dismantling of the telescope on May 9-11 of this year. The telescope has been completely overhauled and modernized. The telescope is now being installed and we should be in full operation again by the first of January 1967.

The astrometric programme is being continued without any substantial changes. We continue to measure parallaxes and mass ratios and search for perturbations. The perturbations of μ Cassiopeiae (4) and α Ophiuchi (5) both discovered at the Allegheny Observatory have been analysed and published. Studies of several other perturbations are under way.

Recent results for parallax and mass ratio include: ξ Scorpii (6); Σ 2173 (7); BD + 77° 361 (8); White Dwarf CC 398 (9); Hu 1176 (10); Six nearby stars (11); Astrometric Binary CC 1299

(12). The parallaxes of two nearby stars, L 1159-16 (parallax $0''.210 \pm 0.009$) and G 175-34 (parallax $0''.19$) have been measured and published (13). Additional information may be found in the report of Commission 26. A study has been made of the effective wavelengths of the Sproul photovisual technique using different emulsions and different filters.

At the Van Vleck Observatory the programme of measuring parallaxes and proper motions is being continued (15). The investigations of the method of reduction and of the systematic errors in parallax research are in progress. In an abstract of J. Gibson paper (14) a procedure of taking parallax plates of a galactic cluster is proposed. By such observation it may be possible to establish the existence of systematic errors among measures of small parallaxes by different observatories.

At the Pulkovo Observatory parallax work is being started with the 26-inch visual refractor. The first preliminary results of the parallax determination of five stars are printed in *Astr. Zu.* (16). The observing programme is now in progress concerning red dwarfs on Vyssotsky's list and some occasional stars of special interest, as for instance the white dwarf LP9-231. In a note on this star W. F. Van Altena (17) points out the large discrepancy between the trigonometric parallax determined by Luyten and the photometric parallax. Parallax observations are now under way at the Lick, Yerkes and Pulkovo Observatories.

SPECTROSCOPIC PARALLAXES

As in previous reports we can mention only a few papers concerning the determination of stellar distances by the spectroscopic method.

At the David Dunlap Observatory Dr J. D. Fernie developed a method for determining the distances of R. R. Lyrae variables from just a single observation of V and $B-V$, provided that the period is already known. A feature of the result is that true distance moduli may be obtained without knowledge of the interstellar reddening (1, p. 584). H. H. Guetter published a paper on distances of 97 OB stars (18). A. Beer determined the photoelectric distances of 461 northern OB stars and the galactic structure from $H\gamma$ -luminosities (19). R. M. Petrie published 'Spectroscopic absolute magnitudes of early-type stars from hydrogen absorption—a revision' (20).

Quite possibly, I have missed some other papers concerning spectroscopic (and also photometric) parallaxes, but I should like to note that it would be more suitable to report on such investigations connected with spectrophotometric and colourimetric methods in the reports of Commissions 29 or 45. It is desirable that this question be discussed at our meeting in Prague.

PROPER MOTIONS

The following report should be supplemented by reference to the reports of Commissions 8, 23, 26, 27, 34, 37 and perhaps some other commissions since proper motion determinations concern also double stars, variable stars, planetary nebulae, star clusters, etc.

The programme for obtaining absolute proper motions of stars referred to galaxies is being continued.

The Pulkovo programme for photographing the first-epoch plates of selected areas of galaxies and fundamental stars in the declination zone $+90^\circ$ to -25° is being completed at the following observatories: Pulkovo, Moscow, Kiev (Golosseyevo), Tashkent, Bucharest, Shanghai (Zô-Sè) and Bordeaux. In all 3500 plates for galaxies and 2500 plates for fundamental stars were obtained. We note with satisfaction the Bordeaux catalogue of the galaxies in the declination zone -5° to -25° with equatorial coordinated of 521 galaxies calculated from measured positions on 165 plates taken with the Carte-du-Ciel astrograph (21).

At the Taschkent Observatory the determination of proper motions of stars referred to galaxies in 23 selected areas of the Pulkovo programme has been completed and the constants

of solar motion and galactic rotation derived. The second-epoch plates have been taken after an interval of 20 years (22).

Similar but more extensive work is in progress at the Pulkovo Observatory concerning the reduction of relative to absolute proper motions of stars by means of the galaxies in 89 areas. A communication on this work will be made at the Prague conference.

At the Toulouse Observatory, the photographic observations of galaxies were continued.

In the southern hemisphere the observations of galaxies at the Cerro Calan Observatory (Santiago, Chile) have been renewed after remounting the astrographic refractor at the end of 1964.

Dr B. J. Harris reports that at Bickley – the new site of the Perth Observatory – the observations of the galaxy areas in the declination zone -25° to -90° will be commenced during 1967. Dr Harris hopes that by the time of the General Assembly in Prague the astrographic telescope will be working fully again.

Dr J. Landi Dessy reports that at the Cordoba Observatory the photographic observations of the galaxy areas are in progress and more than 100 plates have been obtained. Seven areas south of -69° declination could not be photographed, as also at Santiago, owing to the mounting of the astrograph.

These seven areas were fully observed at the Cape Observatory.

At Pulkovo, I am preparing a list of fundamental stars in the southern zone -25° to -90° to be proposed for photographic observations in addition to the galaxies.

As to the installation in Chile of the new 700 mm meniscus astrometric telescope (see the previous report of Commission 24 (23)), it was decided to mount the instrument at Mount El Roble 100 km north of Santiago at an altitude 2200 m. There are certainly great difficulties in building a new observatory on a rocky top where it is necessary to build a new road. Nevertheless the work has advanced well and it appears that the instrument may be installed in 1967.

At the Yale-Columbia Southern Observatory, El Leoncito, Argentina a new 50-cm twin astrograph was mounted in March 1965 (24). The chief purpose is to extend to the South Pole the Lick Observatory proper motion programme referring to the faint galaxies.

The determination of absolute proper motions of brighter stars by comparing the two catalogue AGK2 and AGK3 is nearly completed at the Hamburg-Bergedorf Observatory. Being in the FK4 system, they will present the data for comparison with the proper motions derived by galaxies in the northern hemisphere.

The determinations of proper motions of the Carte du Ciel catalogue stars are in progress at the Toulouse Observatory: positions and proper motions of reference stars are determined, see IV Catalogue, revised (25).

The large proper motions of about 1000 stars in the astrographic zones $+32^{\circ}$ and $+33^{\circ}$ have been determined (26). Stars of the Catania astrographic catalogue with large proper motions have been also published (27).

The determination of large proper motions of stars fainter than the 8th magnitude (to about the 17th magnitude) with motions $\geq 0''.27$ per year have been continued at the Lowell Observatory (28). The number of stars listed in 200 regions is 11 514. The number of different stars is 8151 and newly discovered 4610. Approximately 62 additional regions remain to be studied in order to complete all of the sky from the equator to the north pole.

Professor Luyten reports that the Proper Motion Survey with the 48-inch (122 cm) Schmidt telescope has been vigorously pushed (29) and to date more than 100 pairs of plates have been blinked, more than 40 000 proper motion stars found, and motions have been published for more than 15 000 of these, down to the 21st magnitude, photographic. In particular, more than 3000 proper motions have been determined in the region of the Hyades cluster while the

North Polar Cap—north of declination $+75^\circ$ —has been completely examined. It is hoped that the general catalogue of all proper motions found in this region of 700 square degrees, and containing, probably, some 8000 different stars, will be published before the next General Assembly.

Among the objects found is one star of the fifteenth magnitude with a proper motion of 3.63 annually, the largest motion found in more than 30 years. In addition a large number of new white dwarfs has been found (30), bringing the total published at Minnesota to more than 1500. More than 700 faint wide pairs with common proper motion have been found, and data for these are being prepared for publication.

The more than 15 000 motions referred to before have been used to determine the solar motion for extremely faint stars (31). Finally, about a dozen stars with $H = m + 5 + 5 \log \mu$ exceeding $+25$, indicating absolute magnitudes beyond $M = +19$ pg, have been found.

J. H. Anderson has discussed the motions of a number of F stars and has shown that, contrary to the spectroscopic claims, these stars do not form a cluster.

At Minnesota, Luyten, Hughes and Smith have determined proper motions for another 800 faint blue stars (32), including 300 within the area of the Praesepe cluster, and have shown that quasi-stellars may well become the ideal objects against which to measure absolute proper motions of very faint stars (33).

Proper motions have been published for more than 30 U Geminorum stars and ancient novae, from which Kraft and Luyten have made a new determination of the luminosities of the U Geminorum stars (34).

Professor Strand reports that as an adjunct to the parallax programme of the U.S. Naval Observatory with the 61-inch (123 cm) astrometric reflector, a proper motion programme is carried out of stars selected from the Luyten and the Giclas proper motion programmes.

A total of 867 stars are in the programme for which first epoch plates have been completed for 225 stars. A completed first epoch consists of two plates of fair quality or better, with at least two exposures on each plate.

In the Special Reprint of the Smithsonian Institute a catalogue of positions and proper motions of 258 997 stars is given. These have been compiled from several catalogues in the FK4 system and reduced to the epoch and equinox of 1950.0 (35).

Dr C. A. Murray reports from the Royal Greenwich Observatory that a large programme for determining proper motions of RR Lyrae stars from astrographic material has been carried out. Details have been reported to Commission 23.

In connection with the RR Lyrae programme, Dr Clube has made a study of the relative merits of various methods of determining mean parallaxes of reference stars; the most readily available method is from the observed dispersion of proper motions, and this leads to reliable results provided that care is taken over the rejection of stars with large relative proper motions. Dr Clube has prepared a scheme for the reduction of relative to absolute proper motion, which will appear in *Quart. J. R. astr. Soc.*

Details of work in fields of various star clusters have been reported to Commission 37. Measurement of the Mount Wilson 60-inch (152 cm) plates is continuing.

Details have also been reported to Commission 23 of an investigation of proper motions in the Oxford astrographic zone in the region of the North Galactic Pole.

A repetition of plates on most of the northern Kapteyn Areas, originally obtained at Greenwich before about 1915 is being carried out at Herstmonceux; it is also planned to repeat the Radcliffe proper-motion plates on the 26-inch (66 cm) refractor at Herstmonceux. Details of this work have been reported to Commission 33.

Mr Murray has investigated the proper motions of field stars in the region of M 67. He has constructed a kinematic frame of reference in this field from the observed relative proper

motions and two-colour photometry, which agrees well with the fundamental system obtained by correcting GC for known errors.

Determinations of proper motions of variable stars and novae, of planetary nebulae, star clusters and field stars in the surrounding regions have been continued at many observatories.

At the Pulkovo Observatory, members of the galactic clusters NGC 1960, 2099 and 6705 were found on the basis of *UBV* photometry and proper motions (36). A study of eight galactic clusters from proper motions and photometric characteristics of separate stars have been carried out by V. V. Lavdovsky (37). The proper motions of two planetary nebulae NGC 6853 (Dumbbell Nebula) and NGC 7662 and of 2112 field stars have been determined by O. N. Chudovicheva (38). By the same author an investigation of expansion of the Crab Nebula and proper motions of two central stars and 699 field stars have been published (39). The proper motion of Nova Lac 1910 and of 1814 field stars have been determined by V. A. Sokolova (40).

The revised tables for the reduction of relative to the absolute proper motions have been published using new values of the Oort's constants and Binnendijk's mean parallaxes (41).

At the Sternberg Astronomical Institute, N. M. Artjukhina has obtained proper motions of 4350 field stars in the region of the Praesepe cluster (42). She has also obtained proper motion of 54 variable stars W UMa type (43). The proper motions of three planetary nebulae NGC 6210, 6543 and 6826 and of 298 field stars have been determined by D. K. Karimova (44). The proper motions of 65 stars of the globular cluster M 13 and of 48 field stars have been determined by L. P. Panteleeva (45). The same author together with Ja. P. Gorelov obtained the absolute proper motion of 90 stars relative to the galaxy NGC 4736 (46). E. D. Pavlovskaya determined proper motion of 28 RR Lyrae variable stars (in press).

At the Tashkent Observatory the proper motion of two variable stars SU UMa and AY Lyr and field stars have been obtained by Sh. Primkulov (47).

A. Upgren determined proper motions of stars in the galactic cluster M 37 (48).

G. Van Herk obtained proper motions, mean parallaxes and space velocity of RR Lyr variables (49).

We must cite also:

Murray, C. A., Corbek, P. M., Allchorn, Mary B.: Investigation of proper motions in field of the cluster M 67.I: The central region (50).

Murray, C. A., Jones, D. H. P., Candy, M. P.: Studies of the globular cluster ω Centauri. III: Proper motions (51).

Murray, C. A., Lowne, C. M., Clements, E. D.: Proper motions in the region of the Hyades (52).

Wayman, P. A., Symms, Z. S. T., Blukwell, K. C.: Proper motions and radial velocities of Hyades stars (53).

Dr T. Shimizu reports about some by-product results from the latitude and the time observations announced by Professor T. Okuda, director of Mizusawa Observatory. Corrections to Boss' catalogue values of proper motions of the observed stars have been derived by analysing the secular change in the yearly mean values of *Z* term. They coincide well with those given in the catalogue of all ILS stars prepared by P. Melchior. Corrections of proper motions in declination to Boss' Catalogue were preliminary determined from the results of seven years latitude observations. Preliminary corrections of proper motions of the Mizusawa PZT stars to the values given in the star list referred to the FK3 system were determined from the results of seven years observations during the period from 1958 to 1964. Details will be published in the coming issue of the *Publ. int. Latit. Obs. Mizusawa* which will appear early in 1967.

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BIBLIOGRAPHY

1. Reports of Observatories, 1964-65. 1965, *Astr. J.*, **70**, 581-665.
2. Further Reports of Observatories. 1965, *Astr. J.*, **70**, 765-783.
3. Osvalds, V. 1966, *Astr. J.*, **71**, 513.
4. Lippincott, S. L., Wyckoff, S. 1964, *Astr. J.*, **69**, 471.
5. Lippincott, S. L., Wagman, N. 1966, *Astr. J.*, **71**, 122.
6. Van de Kamp, P., Harrington, B. S. 1964, *Astr. J.*, **69**, 402.
7. Gray, D. F. 1964, *Astr. J.*, **69**, 406.
8. Gray, D. F. 1965, *Astr. J.*, **70**, 304.
9. Gray, D. F. 1965, *Astr. J.*, **70**, 414.
10. Van de Kamp, P., Moore, S. 1966, *Astr. J.*, **71**, 524.
11. Bieger, G. S. 1964, *Astr. J.*, **69**, 804.
12. Bieger, G. S. 1964, *Astr. J.*, **69**, 812.
13. Van de Kamp, P., Yang, C. -Y., Worth, M. D. 1966, *Publ. astr. Soc. Pacif.*, **78**, 167.
14. Gibson, J. 1964, *Astr. J.*, **69**, 138.
15. Osborn, W., Ching-Yew-Yang 1966, *Astr. J.*, **71**, 647.
16. Kanaev, I. I. 1965, *Astr. Zu.*, **42**, 669.
17. Van Altena, W. F. 1966, *Publ. astr. Soc. Pacif.*, **78**, 345.
18. Guetter, H. H. 1964, *Publ. David Dunlap Obs.*, **2**, 405.
19. Beer, A. 1964, *Mon. Not. R. astr. Soc.*, **128**, 261.
20. Petrie, R. M. 1965, *Publ. Dom. astrophys. Obs. Vittoria*, **12**, 317.
21. Milet, B., Pourtau, L., et al. 1966, *Publ. Obs. Univ. Bordeaux*, **1**, **2**, **3**.
22. Rahimov, A. G. 1964, *Trudy Tashkent. Astr. Obs.*, ser. II, **10**, 31.
23. Deutsch, A. N. *Trans. IAU*.
24. Brouwer, D. 1965, *Inf. Bull. Southern Hemisph.*, no. 6, 2.
25. Bouigue, R., Dedier, H. 1964, *Ann. Obs. astr. mét. Toulouse*, **30**, 7.
26. Goyal, A. N., Aravamudan, S. 1965, *J. Observateurs*, Marseille, **48**, no. 7-8, 158 and 167.
27. Tempesti, P., et al. 1966, *Mem. Soc. astr. ital.*, **37**, 65.
28. Giclas, H. L., Burnham, R., Thomas, N. G. 1964-66, *Lowell Obs. Bull.*, nos. 129, 132 and 136.
29. Luyten, W. 1965, *Proper motion survey*, **6**, **7**, **8**, Minnesota.
30. Luyten, W. 1965, *Publ. astr. Obs. Univ. Minnesota*, **3**, no. 16.
31. Luyten, W. 1966, *Proper motion survey*, **10**, Minnesota.
32. Luyten, W., Smith, J., Hughes, 1966, *A search for faint blue stars*, **37**, **38**.
33. Luyten, W., Smith, J. 1966, *Astrophys. J.*, **145**, 366.
34. Luyten, W., Kraft, R. 1966, *A search for faint blue stars*, **36**.
35. *Spec. Repr. Smithsonian Inst. astrophys. Obs.* 1964, no. 151, 39.
36. Bronnikova, N. M. 1964, *Izv. glav. astr. Obs. Pulkove*, no. 174, 144.
37. Lavdovsky, V. V. 1965, *Ibid.*, no. 176, 138.
38. Chudovicheva, O. N. 1965, *Ibid.*, no. 176, 219.
39. Chudovicheva, O. N. 1966, *Ibid.*, no. 179, 115.
40. Sokolova, V. A. 1966, *Ibid.*, no. 179, 133.
41. Zhukov, L. V. 1966, *Astr. Zu.*, **43**, 1107.
42. Artjukhina, N. M. 1966, *Trudy gos. astr. Inst. Sternberga*, **34**, **35**.
43. Artjukhina, N. M. 1964, *Perem. Zvezdy*, **15**, no. 2.
44. Karimova, D. K. 1965, *Soobshch. gos. astr. Inst. Sternberga*, nos. 139, 142 and 143; 1967, *Ibid.*, no. 149 (in press).
45. Panteleeva, L. P. 1965, *Ibid.*, nos. 140-141.
46. Panteleeva, L. P., Gorelov, Ja. P. 1965, *Ibid.*, nos. 140-141.
47. Primkulov, Sh. 1965, *Cirk. Tashkent. astr. Obs.*, no. 334.
48. Uppgren, A. 1965, *Astr. J.*, **70**, 149.
49. Herk van, G. 1965, *Bull. astr. Inst. Netherl.*, **18**, 71.
50. Murray, C. A., et al. 1965, *R. Obs. Bull.*, no. 91, E325.
51. Murray, C. A., et al. 1965, *Ibid.*, no. 100, E81.
52. Murray, C. A., et al. 1966, *Ibid.*, no. 108, E153.
53. Wayman, P. A., et al. 1965, *Ibid.*, no. 98, E33.