ASTRONOMY & ASTROPHYSICS
SUPPLEMENT SERIES

Astron. Astrophys. Suppl. Ser. **139**, 25–28 (1999)

New high proper motion stars with declinations between −5° and −30°, and right ascensions between 13h 30m and 24h⋆

H. Wroblewski and E. Costa

Departamento de Astronomía, Universidad de Chile, Casilla 36-D, Santiago, Chile
e-mail: hwroblew@das.uchile.cl, ecosta@das.uchile.cl

Received September 4; accepted April 1, 1999

Abstract. Proper motions, positions, finding charts and magnitudes are given for 293 newly discovered stars with proper motions larger than 0.15 arcsec/year. They are located between −5° and −30° in declination, and 13h 30m and 24h in right ascension. Their blue photographic magnitudes range from approximately 13.0 to 18.5. Six stars of the above sample have proper motions larger than 0.4 (0.401 to 0.534) arcsec/year. An estimated precision level between 7 and 13 mas/year was achieved for the proper motions.

Key words: astrometry — stars: kinematics

1. Introduction

In this paper we give new results of a program to identify high proper motion stars in the southern hemisphere, being carried out with the Maksutov Astrograph at the Estación Astronómica de Cerro El Roble (EACR), operated by the University of Chile.

The present survey uses as first epoch plates those taken with the Maksutov telescope between 1969 and 1970 by H. Potter and A. Lokalov. They are centered on 164 fields selected by N. Deutsch on the basis of their high density of galaxies, which were to be used as fiducial objects for the determination of absolute proper motions. Given the characteristics of the telescope, and of the available plate scanning and measuring devices, this original program was conceived with a minimum time base of 20 years.

Subsequent testing showed however that with the available manual measuring machine it was not possible to carry out precise astrometry of the galaxies that had been chosen as reference points, so the absolute proper motion program was momentarily abandoned. On the other hand, as a result of these tests it became clear that a shorter time base, of roughly 15 years, was adequate to determine the relative motions of fast moving objects with respect to background stars, provided that their blue photographic magnitude were fainter than ∼ 10 and brighter than ∼ 19.

The acquisition of second epoch plates with the latter purpose was therefore started in 1985. As a result of our survey 2055 new high proper motion stars have been discovered in the 99 areas, 25 square degrees each, explored so far (see e.g. Wroblewski & Torres 1997 and references therein). Among these, 89 objects have annual proper motions in the range $0.4 - 0.5$ arcsec/year, 27 in the range $0.6 - 07$ arcsec/year, 3 in the range $0.8 - 0.9$ arcsec/year, and two very rapid moving objects, namely WT248 and WT1827, have motions of 1.197 and 1.971 arcsec/year, respectively. We have also re-discovered 947 stars from the Luyten Catalogue (LTT) within the same areas; for them we have provided improved data and finding charts (see e.g. Wroblewski & Torres 1998 and references therein).

In this work, the sixth part of our program, we present the results of the search for high proper motion stars in other 19, $5° \times 5°$ areas located between −5° and −30° in declination, and 13h 30m and 24h in right ascension. Only newly discovered objects have been included here; new data and finding charts for re-discovered LTT stars will be published elsewhere (Wroblewski & Costa, in preparation).

It should be noted that although up to this point the only specific purpose of our program has been the identification of fast moving stars, once our observational survey is completed a limited statistical analysis of the high proper motion data will be presented, together with an evaluation of the completeness of the Luyten survey. This latter objective is perhaps the most important given some far-reaching conclusions that can be obtained from

Send offprint requests to: H. Wroblewski

⋆ Table 2 is only available in electronic form at the CDS via anonymous ftp 130.79.128.5 or http://cdsweb.u-strasbg.fr/Abstract.html and figures 2 are available in the on-line edition of the journal at http://www.edpsciences.com

Table 1. The areas. See text for details

Nr.	R.A. (1950.0)		DEC		T	
	h	m	o	′	y_1	y_2
107	13	33.6	−08	04	24.0	25.2
109	13	42.9	−07	30	25.0	24.2
112	14	21.7	−16	33	24.0	24.0
116	14	39.6	−17	03	26.0	25.8
117	14	45.0	−18	53	21.8	25.9
118	14	58.2	−07	16	25.0	26.0
119	15	14.9	−17	25	24.2	24.0
120	15	15.4	−23	55	24.1	24.8
121	15	18.8	−12	55	24.1	24.1
133	19	39.9	−10	25	24.0	24.0
134	19	51.8	−12	42	24.2	24.1
142	20	45.8	−08	33	23.9	23.9
144	21	17.2	−09	00	24.0	24.0
147	21	59.6	−20	48	24.0	23.9
152	22	29.7	−14	23	25.3	25.2
153	22	36.1	−25	57	25.0	25.0
156	22	57.8	−13	08	25.2	24.9
157	23	09.5	−28	48	23.2	24.0
161	23	37.0	−12	55	25.2	26.0

Luyten's extensive work. In spite of the so far limited sky coverage of our survey, it has proven of importance to studies of the solar neighborhood (see e.g. Patterson et al. 1998; Henry et al. 1997).

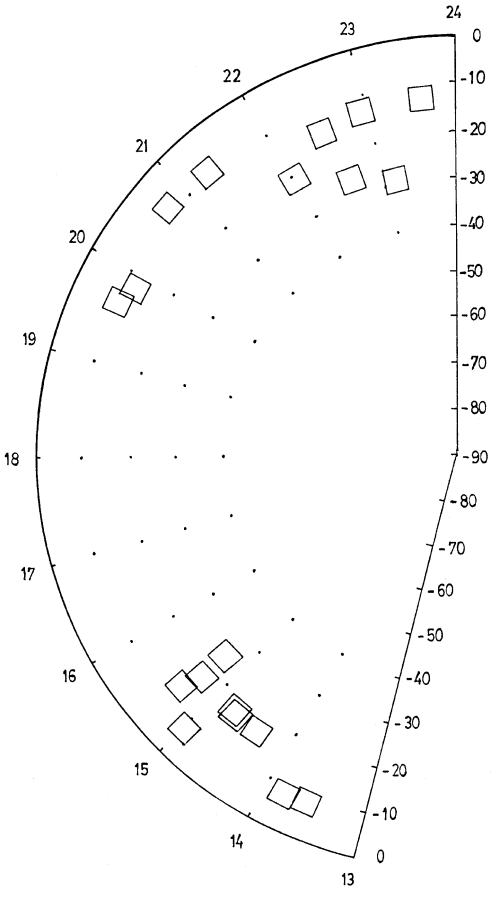

Fig. 1. The searched areas

2. Observations

The observations were carried out with the flat−field 70/100/210 cm Maksutov Astrograph (field: $5^\circ \times 5^\circ$, scale: $99.4''$/mm) at the EACR.

All first epoch plates are 30 min exposure Kodak 103a0 plates. Although most of the second epoch plates are also 30 min exposure Kodak 103aO plates, definitive non-availability of this emulsion forced us to use hypersensitized Kodak IIIaJ plates to secure some of the second epoch fields. Extensive testing showed that with a 40 min exposure, the treated (forming gas baked) IIIaJ emulsions reached roughly the same magnitude limit as the 103aO's. All plates were taken near culmination and in good seeing conditions. Their limiting magnitude is approximately $B = 20$.

Table 1 gives the 1950.0 coordinates of the 19 area centers, and the time base (T) in years between the first and second epoch observations. Two first epoch and two second epoch plates are available for each area; y_1 and y_2 are their corresponding time bases in Table 1. Figure 1 shows the distribution of the searched areas in the sky. It should be noted that a few of them have a fraction of their fields overlapped.

3. Reductions

High proper motion stars were identified blinking the first epoch plates against the second epoch plates with a Zeiss-Jena plate comparator.

Being M_x the motion detected in x between the first and second epoch observations, and T the time base between both epochs, the annual proper motion in x, m_x will be:

$$M_x + ax + by + cx^2 + dxy + ey^2 + f = m_x \times T.$$

An analogous relation gives the annual proper motion in y, m_y.

To determine the constants in the above relations, 35 to 45 uniformly distributed $\sim$ 16th magnitude background stars with no evident proper motion were adopted as reference stars in each area. Reference stars whose calculated proper motions turned out to exceed $0.5''$ during T were rejected in the final reductions.

The positions of the newly discovered high proper motion stars were determined from the second epoch plates, relative to a subset of the Hipparcos Catalogue stars present in each field. Although on the average roughly 60 measurable catalogue stars could be identified in the fields, considering that ultimate positional precision was

not in the scope of the present work, only the best distributed ones were used for the reductions. This number varied between 30 and 40.

The plates were measured to 1μ ($0.1''$ at the plate scale) with a digital Zeiss-Jena Ascorecord measuring machine. Only one setting was made on all stars (catalogue, background and target). Six term (const., X, Y, XY, X^2, Y^2) quadratic relations were used in the reductions. Third order terms were not included because the flat field of the Maksutov Astrograph is almost free of distortions. Also, since all plates were taken near culmination, refraction third order terms were not important.

4. Errors

The total internal errors of the proper motions presented in Table 2 were obtained by means of the relations given in Wroblewski & Torres (1989). The errors in the measurement of the target and of the background reference stars used in the above relations were average values previously determined (this because only one setting was made on each reference or target star, which prevented a more direct calculation of the measurement error). The values adopted varied- depending on the magnitude of the star- between $\pm 0.10''$ and $\pm 0.21''$ for the X coordinate, and between $\pm 0.10''$ and $\pm 0.23''$ for the Y coordinate. Precision levels between 7 and 13 mas/year were achieved for the proper motions.

To check the reality of the errors estimated as described above, many pairs of plates with similar epochs have been reduced throughout our survey. For timebases of roughly one year, background reference stars used in the final calculations, known to have virtually null proper motions in a timebase of about 20 years, show however calculated proper motions of the order of 0.2 arcsec/year in the mean. These "motions" are simply a reflection of the overall error of the procedure for $T \sim 1$. In a timespan of 24 years- which is the mean timebase of the results given in this paper- this error is reduced to about 0.008 arcsec/year, figure which is in good agreement with those given in Table 2 and in Sect. 5.

Although we did not determine individual total internal errors for the positions of the fast moving stars, based on extensive experience with a similar observational and reduction set-up (see e.g. Costa & Loyola 1989; Costa & Loyola 1998), we estimate that these errors are in in the range $0.15''$ to $0.25''$.

5. Results

As a result of this sixth survey we have discovered 293 stars with proper motions larger than 0.15 arcsec/year, not included in existing proper motion catalogues. Six of them have proper motions larger than 0.4 (0.401 to 0.534) arcsec/year. Blue photographic magnitudes for the complete sample range from approximately 13.0 to 18.5.

The data is presented in Table 2, only available in electronic form at the Centre de Données Astronomiques de Strasbourg (CDS). The content of the columns is:

Column 1: Our list number.
Column 2: Location number. The first two digits give the area number, and the remaining digits the star number.
Column 3: Estimated blue photographic magnitude.
Columns 4 and 5: RA and Dec for J2000.0.
Column 6: Total annual proper motion for J2000.0.
Column 7: Total annual proper motion error.
Column 8: Position angle for J2000.0.
Column 9: Remarks.

Both the total annual proper motions and the position angles presented in Table 2 are the average of two independent determinations, based on different first/second epoch plate pairs. Twelve stars that are common to two overlapping areas have been identified with an (*) in the Remarks column. The results given for them are therefore average values based on four first/second epoch pairs. The standard deviations of these average values provide the means to independently ascertain the errors of the positions and proper motions. The computed Sigmas varied between: $0.11''$ and $0.28''$ (positions); 0.004 and 0.018 arcsec/year (proper motions). Keeping in mind that the Sigmas obtained are based on only four independent settings made on each object, it is interesting to note that these values are consistent with the error estimates given in Sect. 4 for the positions and proper motions.

The magnitudes listed in Table 2 were determined by visual comparison with a photoelectric sequence given by Ardeberg & Lindgren (1987). We estimate them to be accurate to ~ 0.5 magnitudes.

Finding charts for the 293 newly discovered stars are presented in Fig. 2. They will appear only in the on-line edition of the journal. The charts were reproduced from digitized images extracted from the Digitized Sky Survey (DSS), produced by the Space Telescope Science Institute. Charts are 4.5 arcmin on a side. North is at the top, East to the left.

6. Notes on individual objects

WT 2132, 2133 and **WT 2269, 2270**: These pairs are partially resolved in our plates. They could be binary systems.

WT 2057, 2151, 2161, 2275, 2279, 2294 and **2326**: These objects look slightly elongated or show structure in the DSS images. In our plates they are not resolved.

WT 2159: This star conforms a pair with the much brighter high proper motion star **LTT 6166** (re-discovered by our survey). It could be a binary system.

Acknowledgements. We are indebted to Prof. C. Anguita for his interesting comments. We are also grateful to R. Antezana and M. Wischnjewsky for cooperating to explore the plates and prepare the finding charts. This work was partially financed by the Fondo Nacional de Investigación Científica y Tecnológica (Proy. 1930953, Fondecyt).

References

Ardeberg A., Lindgren H., 1987, A&AS 67, 103
Costa E., Loyola P., 1989, A&AS 78, 141
Costa E., Loyola P., 1998, A&AS 131, 259
Henry T.J., Ianna P.A., et al., 1997, AJ 114, 388
Luyten W.J., 1957, A Catalogue of 9867 Stars in the Southern Hemisphere with Proper Motions Exceeding 0.2 arcsec Annually. Lund Press, Minneapolis, Minnesota
Patterson R.J., Ianna P.A., Begam M.C., 1998, AJ 115, 1648
Wroblewski H., Torres C., 1989, A&AS 78, 231
Wroblewski H., Torres C., 1997, A&AS 122, 447
Wroblewski H., Torres C., 1998, A&AS 128, 457
Wroblewski H., Costa E. (in preparation)