

# High proper motion stars with declinations between $-30^\circ$ and $-40^\circ$ , and right ascensions between 00 h and 10 h 40 m<sup>\*,\*\*</sup>

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**Abstract.** Proper motions, positions, finding charts and magnitudes are given for 147 newly discovered stars with proper motions larger than 0.15 arcsec/year. They were found in a search for high proper motion stars carried out in thirteen  $5^\circ \times 5^\circ$  areas, located between  $-30^\circ$  and  $-40^\circ$  in declination, and 00 h and 10 h 40 m in right ascension. Their blue photographic magnitudes range from approximately 9.0 to 18.5. Nine objects from the above sample have proper motions larger than 0.4 (0.404 to 0.550) arcsec/year. The same type of data is also presented for 149 Luyten Catalogue (LTT, Luyten 1957) stars re-discovered during the above search. An estimated precision level between 6 and 22 mas/year was achieved for the proper motions.

**Key words.** astrometry – stars: kinematics

## 1. Introduction

In this paper we give new results of a decade-old program to identify high proper motion stars in the southern hemisphere, being carried out with the flat-field 70/100/210 cm Maksutov Astrograph at the Estación Astronómica de Cerro El Roble (EACR), operated by the University of Chile. Our survey uses as first epoch a collection of plates taken with the Maksutov telescope between 1969 and 1970 by H. Potter and A. Lokalov. They are centered on 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. A brief description of why and how this original project evolved into the present relative proper motion program can be found in Wroblewski & Costa (1999); hereafter W&C.

In the course of our survey we have explored 118 areas, 25 square degrees each. Within them we have discovered 2348 new high proper motion stars, and we have re-discovered 1113 LTT stars. In this work, the seventh

part of our program, we present the findings of a search for high proper motion stars carried out in other thirteen  $5^\circ \times 5^\circ$  areas located between  $-30^\circ$  and  $-40^\circ$  in declination, and 00 h and 10 h 40 m in right ascension. In the past, the data for re-discovered LTT stars has been published separately from that for the newly discovered objects (see e.g. Wroblewski & Costa 2000); from this paper on the data for new and re-discovered fast moving stars will be published together.

In spite of the limited sky coverage of our survey, it has already proven of importance to studies of the solar neighborhood (see e.g. Henry et al. 1997; Patterson et al. 1998). Furthermore, our most recent and conspicuous discoveries are being used in advance from publication as targets in various parallax programs aimed at finding the missing members of the nearby star sample (Henry et al. 1999; Ianna et al. 1998), and also in spectroscopic studies of nearby stars (Inese 1999).

## 2. Observations

The plates were obtained with the Maksutov telescope at the EACR. Their limiting magnitude is approximately  $B = 20$ . Additional information about the telescope and the plate material can be found in W&C.

Table 1 gives the 1950.0 coordinates of the 13 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.

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I note with regret that the first author, H. Wroblewski, passed away on September 14, 2000.

\* Tables 2 and 3 are only available in electronic form at the CDS, via anonymous ftp to [cdsarc.u-strasbg.fr](ftp://cdsarc.u-strasbg.fr) (130.79.128.5), or via

<http://cdsweb.u-strasbg.fr/cgi-bin/qcat?J/A+A/367/725>

\*\* Figures 4 and 5 are only available in electronic form at <http://www.edpsciences.org>

**Table 1.** The areas. See text for details

| Nr. | RA       |      | DEC |    | T     |       |
|-----|----------|------|-----|----|-------|-------|
|     | (1950.0) |      |     |    | $y_1$ | $y_2$ |
|     | h        | m    | o   | '  |       |       |
| 3   | 00       | 27.9 | -33 | 04 | 29.3  | 29.2  |
| 8   | 00       | 52.6 | -37 | 38 | 29.2  | 29.0  |
| 9   | 00       | 53.5 | -31 | 27 | 21.1  | 20.0  |
| 12  | 01       | 19.1 | -34 | 19 | 21.2  | 21.0  |
| 29  | 03       | 22.8 | -37 | 12 | 29.0  | 28.9  |
| 30  | 03       | 28.0 | -33 | 10 | 29.0  | 28.8  |
| 32  | 03       | 36.6 | -35 | 37 | 21.0  | 21.1  |
| 43  | 05       | 01.6 | -32 | 02 | 22.0  | 23.0  |
| 44  | 05       | 03.5 | -38 | 04 | 28.9  | 29.0  |
| 47  | 05       | 47.2 | -34 | 35 | 29.0  | 28.9  |
| 68  | 09       | 49.2 | -32 | 42 | 29.2  | 28.9  |
| 75  | 10       | 17.5 | -33 | 59 | 22.1  | 22.0  |
| 78  | 10       | 28.5 | -34 | 59 | 21.3  | 21.7  |

It should be noted that a few of them have a fraction of their fields overlapped.

### 3. Reductions and errors

High proper motion stars were identified blinking the first epoch plates against the second epoch plates with a Zeiss-Jena plate comparator. The plates were measured to  $1\mu$  ( $0.1''$  at the plate scale) with a digital Zeiss-Jena Ascorecord measuring machine. Six term quadratic relations were used in all reductions. Details on the reduction procedure are given in Sect. 3 of W&C.

The total internal errors of the proper motions presented in Tables 2 and 3 were obtained as explained in Sect. 4 of W&C. Precision levels between 6 and 22 mas/year were achieved for the proper motions.

Positions were determined from the second epoch plates, relative to the Hipparcos Catalogue stars present in each field. Although individual position errors were not determined, based on extensive experience with a similar observational and reduction set-up (see e.g. Costa & Loyola 1989, 1998), we estimate that these errors lie in the range  $0.15''$  to  $0.25''$ .

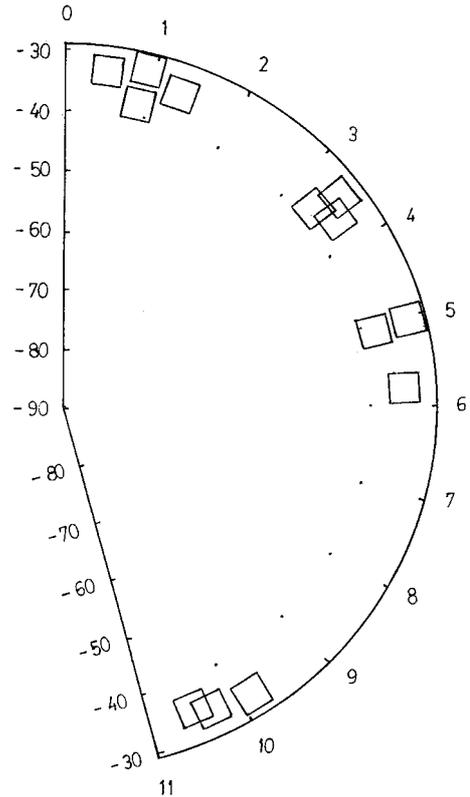
### 4. Results

As a result of this seventh survey we have discovered 147 stars with proper motions larger than  $0.15$  arcsec/year, and re-discovered 149 LTT stars. The blue photographic magnitudes of the newly discovered stars range from approximately 9.0 to 18.5. Nine of them have proper motions larger than  $0.4$  ( $0.404$  to  $0.550$ ) arcsec/year.

The data for the new high proper motion stars is presented in Table 2; that for the re-discovered LTT stars is given in Table 3. Both tables are available only in electronic form at the Centre de Données Astronomiques de Strasbourg (CDS).

The contents of Table 2 are:

*Column 1:* Our list number;  
*Column 2:* Location number. The first two digits give the

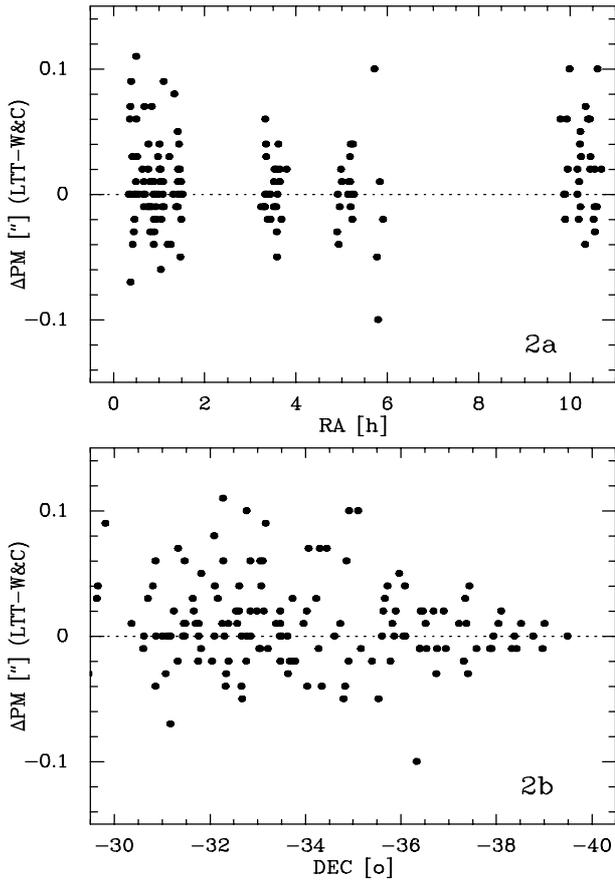
**Fig. 1.** The searched areas

*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 (Rem).

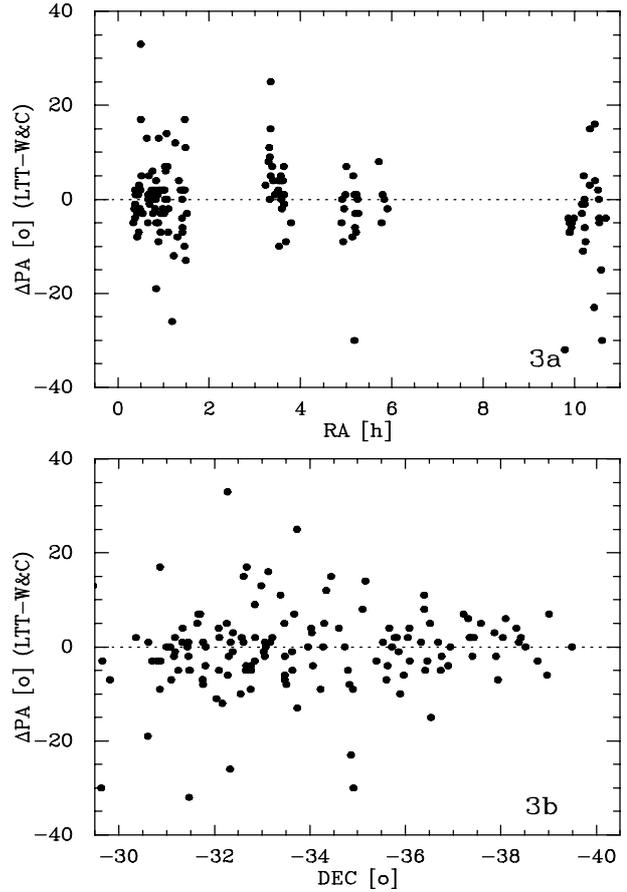
The contents of Table 3 are:

*Column 1:* LTT number;  
*Column 2:* Location number. The first two digits give our area number, and the remaining digits the star number;  
*Column 3:* LTT 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:* Difference (Dpm) between our proper motion and that given by Luyten, in the sense LTT-W&C;  
*Column 10:* Difference (Dpa) between our position angle and that given by Luyten, in the sense LTT-W&C;  
*Column 11:* Remarks (Re).

The total annual proper motions and position angles presented in Cols. 6 and 8 of Tables 2 and 3 are averages of two independent determinations based on different first/second epoch plate pairs. Stars that are common to two overlapping areas have been identified with an (\*) in the Remarks column (we did not find any fast moving stars in the small overlap zone between areas 29, 30 and



**Fig. 2. a, b)** Differences in the sense LTT-W&C between our proper motions and those of Luyten, plotted as a function of the coordinates



**Fig. 3. a, b)** Differences in the sense LTT-W&C between our position angles and those of Luyten, plotted as a function of the coordinates

32 shown in Fig. 1). The results given for them are therefore mean values based on four first/second epoch plate pairs. The standard deviations of these latter mean values provide the means to independently ascertain the errors of the positions and proper motions. The computed sigmas varied between  $0.14''$  and  $0.31''$  (positions); and between  $0.005$  and  $0.023$  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 quoted in Sect. 3.

As shown by Figs. 2 and 3, which are plots of the residuals  $D_{pm}$  and  $D_{pa}$  as a function of the coordinates, there is no evidence of systematic differences between our values of the proper motions and position angles of the LTT stars and those given by Luyten. Highly discordant cases (see next section) were not included in the plots.

The magnitudes listed in Table 2 were determined by visual comparison with a photoelectric sequence by Ardeberg & Lindgren (1987). We estimate them to be accurate to  $\sim 0.5$  mag. The magnitudes listed in Table 3 are those given by the LTT.

Finding charts for the newly discovered stars fainter than magnitude  $\sim 10$  (140 objects) are presented in Fig. 4;

those for the re-discovered LTT stars fainter than magnitude (LTT)  $\sim 10$  (122 objects) are given in Fig. 5. Both figures 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 (STScI). Charts are 4.5 arcmin on a side. North is at the top, East to the left.

## 5. Notes on individual objects

**LTT 590, LTT 3717:** These stars show very small motions, not measurable with our plate material. For them Luyten gives proper motions of  $0.21$  and  $0.33$  arcsec/year, respectively.

**LTT 1619:** Not visible in our plates. Luyten assigns a photographic magnitude of  $12.6$  to this star.

**LTT 1630 and LTT 3816:** For these stars we obtain position angles which differ greatly from those given by Luyten.  $D_{pa}$  for these objects was left blank in Table 3. Also, the LTT assigns a much brighter magnitude ( $13.3$ ) than we do ( $16.0$ ) to LTT 1630.

**LTT 2372:** In the corresponding finding chart given in Fig. 5, this star appears partially superposed, and to the NW, of a brighter star. Due to its motion, in recent epoch plates it appears almost completely superposed, and to the SE, of that star.

**LTT 3757:** We did not detect any motion for this star. Luyten assigns a proper motion of 0.25 arcsec/year to it.

**WT 2394, WT 2395:** These stars may form a binary system.

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