

THE POSITIONS AND PROPER MOTIONS OF 58483 STARS IN THE PULKOVO FIELDS WITH GALAXIES ON THE TYCHO-2 SYSTEM (PUL-3)

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ABSTRACT. A catalogue of positions and proper motions which contains 58483 stars mainly $12^m \div 16.5^m$ (Pul-3) in 146 fields, has been constructed at the Pulkovo observatory. The Pul-3 is based on the results of measurements of the photographic plates with galaxies (Deutsch's plan). All plates were taken using the Pulkovo Normal Astrograph. The Tycho-2 has been used as a reference catalogue. The mean epoch of the Pul-3 is 1963.25. The internal errors of astrometric data of the Pul-3 are $\pm 80 \text{ mas}$ for positions and $\pm 5 \text{ mas/yr}$ for proper motions.

1. OBSERVATIONS AND ASTROMETRIC REDUCTIONS

The observations were made with Pulkovo Normal Astrograph ($F = 3467 \text{ mm}$, $D = 330 \text{ mm}$) during the periods from 1935 till 1960 (the first epoch) and from 1969 till 1986 (the second epoch). The exposure times were 1 hour. The majority of stars are in magnitudes range $12^m \div 16.5^m$. The maximal density of stars in the Pulkovo plates is 500 stars per square degree.

The Tycho-2 (Hog E. et. al. 2000) catalogue has been used as a reference catalogue. Only approximate equatorial coordinates of the optical centers of all plates had been known in initial stage of construction of the Pul-3 catalogue and thus recalculation of ones has been done. A six-parameters plate model has been used for astrometric reductions of the plates.

2. THE PUL-3 CATALOGUE CONSTRUCTION

The systematic errors in stars positions depending on coma of the lens and ones as functions of the magnitudes and color indexes (using values B and R from the USNO-A2.0 catalogue) of stars have been revealed in residuals of tangential coordinates of reference stars.

The coma parameters have been determined ($c = 1.6 \pm 0.2 \text{ mas} \cdot \text{mm}^{-1} \cdot \text{mag}^{-1}$ and $\text{mag}_0 = 11.3^m \pm 1.2^m$). Magnitude equation and color equation do not depend on plates emulsion but ones strongly depend on declination zone. The considerable magnitude equation corrections have been obtained for stars with $\text{mag} < 9^m$ and $\text{mag} > 14^m$. The color equation corrections in RA significantly less than ones in DECL. The coefficients of color equations in DECL linearly increase from pole to equator. The more than 50 mas improvement has been made by taking into account of all revealed systematic errors.

Table 1: The estimations of precision of the Pul-3 for different declination zones (internal errors are denoted by ϵ symbol and external errors relative to Tycho-2 are denoted by σ symbol).

declination zone	$\epsilon_{\alpha \cos \delta}$ mas	ϵ_{δ} mas	$\epsilon_{\mu_{\alpha \cos \delta}}$ mas/yr	$\epsilon_{\mu_{\delta}}$ mas/yr	$\sigma_{\alpha \cos \delta}$ mas	σ_{δ} mas	$\sigma_{\mu_{\alpha \cos \delta}}$ mas/yr	$\sigma_{\mu_{\delta}}$ mas/yr
$-5^{\circ} \div 5^{\circ}$	90	98	5.5	6.0	141	160	9.2	10.2
$5^{\circ} \div 15^{\circ}$	86	86	5.3	5.3	136	159	8.7	10.0
$15^{\circ} \div 25^{\circ}$	79	88	4.5	5.1	130	148	9.2	9.1
$25^{\circ} \div 35^{\circ}$	85	85	5.1	5.2	154	159	10.2	11.2
$35^{\circ} \div 45^{\circ}$	79	78	4.8	4.8	151	157	9.7	10.1
$45^{\circ} \div 55^{\circ}$	79	82	4.8	4.9	157	159	11.4	12.5
$55^{\circ} \div 65^{\circ}$	77	80	4.9	5.1	162	175	9.9	12.1
$65^{\circ} \div 75^{\circ}$	74	78	4.6	4.8	126	142	8.0	9.8
$75^{\circ} \div 85^{\circ}$	73	78	4.8	5.1	127	142	8.8	9.9
for full catalogue	80	84	4.9	5.1	142	155	9.2	10.1

The completely corrected equatorial coordinates and new proper motions have been calculated for all stars on each field. The mean epoch of the Pul-3 catalogue is 1963.25. The mean errors of positions and proper motions of the Pul-3 catalogue are presented in Table 1.

The comparisons of the Pul-3 catalogue with Tycho-2 (7588 common stars) and ARIHIP (Wielen R. et. al. 2001)(795 common stars) have been done at the mean epoch of the Pul-3 catalogue. The most systematic differences (Tycho-2 – Pul-3) are within $\pm 10 \text{ mas}$ for coordinates and $\pm 0.5 \text{ mas/yr}$ for proper motions. The mean differences (ARIHIP – Pul-3) are slight also: $\overline{\Delta \alpha \cos \delta} = +6 \text{ mas}$, $\overline{\Delta \delta} = -4 \text{ mas}$, $\overline{\Delta \mu_{\alpha \cos \delta}} = +0.28 \text{ mas/yr}$, $\overline{\Delta \mu_{\delta}} = +0.76 \text{ mas/yr}$.

The components of angular velocity vector of rotation of the system of the Pul-3 (Tycho-2 system) relative to the system of the Pul-2 (Bobylev V.V. et. al. 2000) (Pul-2 is a catalogue of absolute proper motions with respect to background galaxies) were obtained from differences of the proper motions (Pul-3 – Pul-2) for more than 50000 mostly faint stars. $\omega_x = -0.76 \pm 0.91 \text{ mas/yr}$, $\omega_y = -0.75 \pm 0.74 \text{ mas/yr}$, $\omega_z = -2.05 \pm 0.71 \text{ mas/yr}$. These results are in good agreement with the similar estimations (Kovalevsky J. et. al. 1997) from (Hipparcos – Lick NPM1) proper motions differences.

The stars from Pul-3 catalogue may be used as reference stars in processing of positional CCD-observations in small fields. The Pul-3 catalogue in combination with modern observations will allow to improve the precision of the proper motions of the faint stars. The Pul-3 is put to CDS, Strasburg, France (I/290).

3. REFERENCES

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