# CONTRIBUTION OF THE MAIN ASTRONOMICAL OBSERVATORY OF UKRAINIAN ACADEMY OF SCIENCES TO THE LINK OF THE HIPPARCOS AND EXTRAGALACTIC REFERENCE FRAMES

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## ABSTRACT

Absolute proper motions of stars with respect to galaxies obtained within the KSZ programme were used in the determination of spin parameters of the Hipparcos catalogue system relative to the inertial reference frame. Solutions using bright, faint, blue, and red stars as well as the whole magnitude range of stars were found. 'The faint KSZ stars' solution ($\omega_x = -0.27 \pm 0.80$mas/yr, $\omega_y = +0..15 \pm 0.60$mas/yr, $\omega_z = -1.07 \pm 0.80$mas/yr) is considered as the most reliable and is recommended for the correction of the Hipparcos catalogue system.

Key words: Hipparcos; KSZ; absolute proper motions.

## 1. INTRODUCTION

As it is generally known the Hipparcos Catalogue has a high degree of internal consistency. However, as the satellite was not able to observe extragalactic objects directly the Hipparcos Catalogue system may contain a spurious rotation. Therefore, it needs calibration which includes determination of the orientation of the system in a certain epoch and its spin correction with respect to the extragalactic frame. There are several methods for linkage of the Hipparcos system to the extragalactic one based on the use of both new techniques and traditional methods of ground-based astrometry. In this paper we present the results of the application of absolute proper motions of stars in selected fields of the sky, obtained within the KSZ programme, to determine a spin correction of the final Hipparcos Catalogue system.

## 2. CHARACTERISTICS OF GROUND–BASED OBSERVATIONAL DATA

The programme, called the Catalogue of Faint Stars (KSZ—abbreviated from Russian Katalog Slabykh Zvezd), was proposed by Pulkovo astronomers in the third decade of this century. Two epochs of KSZ observations were obtained at the Golosiiv (Kyiv), Pulkovo, Moscow, Tashkent, and Shanghai observatories and some individual catalogues were constructed. These catalogues were used in Golosiiv for compiling the general catalogue of absolute proper motions of stars with respect to galaxies (Rybka & Yatsenko 1997). The general catalogue consists of absolute proper motions of 977 Hipparcos stars in 180 sky areas north of $-25$ degrees in declination. These data were applied for the determination of the components $(\omega_x, \omega_y, \omega_z)$ of the mutual rotation of the Hipparcos and extragalactic reference frame.

## 3. DETERMINATION OF THE ROTATION OF THE HIPPARCOS CATALOGUE SYSTEM

Some results of the determination of these rotational angles were given in (Kislyuk et al. 1997). In particular the effect of magnitude equation on the determination of $\omega$ were studied (see first three lines in Table 1). We came to a conclusion that since the proper motions of stars in the KSZ programme were obtained relative to faint galaxies the proper motions of only faint stars did practically not depend on a magnitude equation. 'The faint KSZ stars' solution (the second line in Table 1) were used for linkage of the Hipparcos system (Kovalevsky et al. 1997).

*Table 1. KSZ solution.*

| Stars | N/n | $\omega_x$ $(mas/yr)$ | $\omega_y$ $(mas/yr)$ | $\omega_z$ $(mas/yr)$ |
|---|---|---|---|---|
| All | 179/839 | $1.4 \pm 0.5$ | $0.4 \pm 0.4$ | $-2.1 \pm 0.4$ |
| Faint | 154/415 | $-0.3 \pm 0.8$ | $0.2 \pm 0.6$ | $-1.1 \pm 0.8$ |
| Bright | 156/390 | $2.7 \pm 1.1$ | $2.0 \pm 0.8$ | $-2.2 \pm 0.8$ |
| Blue | 172/499 | $1.3 \pm 0.8$ | $1.0 \pm 0.6$ | $-2.4 \pm 0.9$ |
| Red | 153/340 | $1.2 \pm 1.0$ | $-0.1 \pm 0.8$ | $-2.5 \pm 1.1$ |

Note: N is number of KSZ sky fields, n is number of stars.

As a next step towards a study of systematic errors of $\omega$ determination we analyse a dependence of our solution on colour of stars. Figure 1 gives the distribution of the used stars on their so-called 'reduced' proper motions (H) and colour indexes (B–V). All stars are approximately divided into two groups: more blue

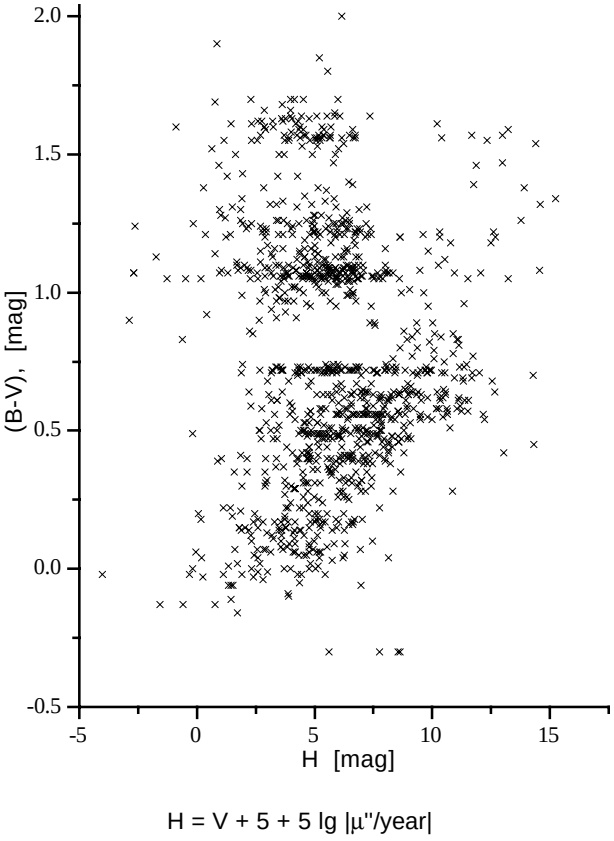


*Figure 1. Distribution of stars on colour indexes (B–V) and reduced proper motions (H).*

stars: B–V< 0.9 and more red stars: B–V> 0.9. The last two lines in Table 1 give the solutions for these different subsets of data.

Figure 2 shows the change of values $(\omega_x, \omega_y, \omega_z)$ with the exclusion of stars in gradually decreasing B–V (solid triangles) and gradually increasing B–V (open triangles).

One can see some dependence of the angle $\omega_y$ on B–V but it may be marginal in order to take it into consideration.

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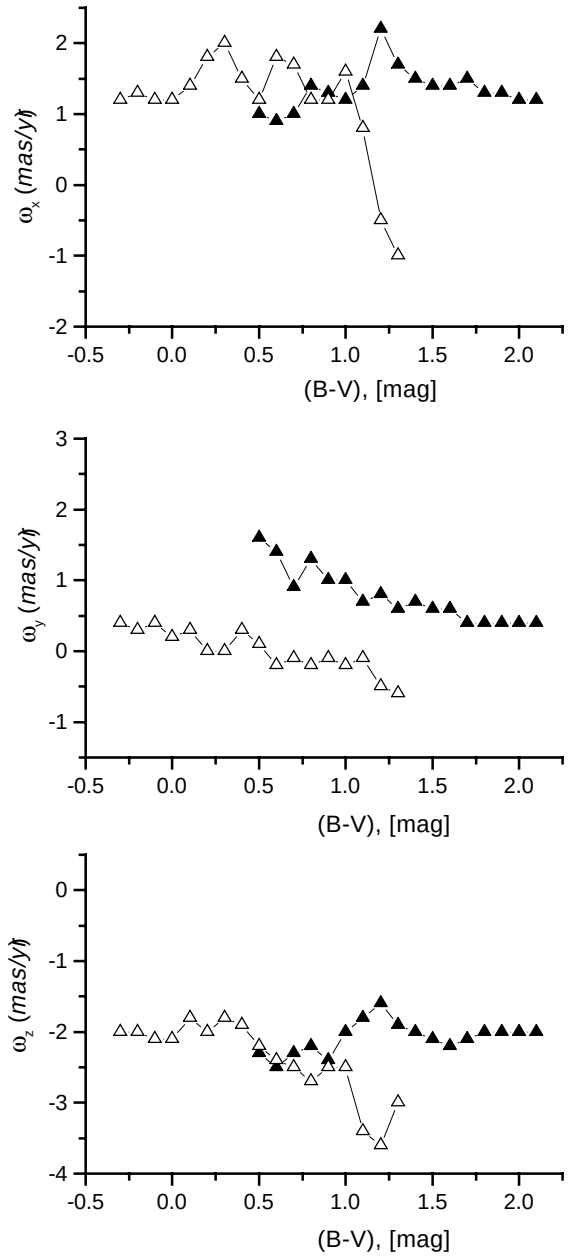


*Figure 2. Change of the angles $\omega_i$ with exclusion of stars gradually decreasing B–V (solid triangles) and increasing B–V (open triangles).*