

## THE HIPPARCOS MISSION AND THE BELGRADE ZENITH-TELESCOPE OBSERVATIONS

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**Abstract.** At the beginning of 1990 we started collecting our past observations made with Belgrade ZT and making a new reduction in the FK5 reference frame. After the XXI IAU General Assembly, Buenos Aires 1991, our investigation was made in accordance with the task of Commission 19 of the International Astronomical Union, "Rotation of the Earth", which formed the Working Group on Earth Rotation in the HIPPARCOS reference frame - WG ERHRF to collect the data and create a central data bank of past optical astrometric observations. We cooperate and some results are presented here.

### 1. INTRODUCTION

The first value of the precise Belgrade latitude, determined in 1947 from visual zenith-telescope - ZT (Askania-Bamberg No 77241, 110/1287 mm) observations by applying Talcott method, was  $\varphi = 44^{\circ}48'13.''167 \pm 0.''008$  (Djurković, Ševarlić, Brkić, 1951). At the beginning of 1949 started regular ZT observations and are still carried out.

From 1990 we started the preparation of the Belgrade ZT observations in a computer readable form and their re-reduction in the FK5 reference frame (in accordance with Msc Thesis "The analysis of the variation of Belgrade latitude in the period 1949-1985" of Goran Damljanović). The HIPPARCOS catalogue had not been finished yet, and we used the PPM catalogue for our re-reduction.

At the XXI IAU General Assembly, Commission 19 formed the WG ERHRF to collect the data and analyse them in the HIPPARCOS reference frame. The Hipparcos Program (ESA 1989) will give the star coordinates, proper motions and parallaxes at the  $0.''002$  level of accuracy (at the epoch of observation) for the reference stars used by most of the astronomical stations. The Belgrade ZT observations are at the WG ERHRF list of the best observations performed in the past (Vondrák, Feissel and Essaifi, 1992).

## 2. PROCEDURE AND RESULTS

The PPM Star Catalogue (Röser and Bastian, 1991), Vol. I and Vol. II, contains 181731 stars north of  $-2^{\circ}.5$  of declination, equinox and epoch J2000.0. It is a representation of the FK5 system at higher star densities and fainter magnitudes. It replaces two older catalogues : AGK3 and the SAO Catalogues. For the stars contained in FK5 Part I (the Basic Fundamental Stars) and in FK5 Part II (the Bright Extension Stars), PPM gives the original FK5 data.

The Old Belgrade Latitude Programme - OP (Djurković, Ševarlić, Brkić, 1951) was observed in the period 1949-1960. The New Belgrade Latitude Programme - NP (Ševarlić and Teleki, 1960) was started in 1960 and the observations are still carried out.

The procedure for the re-reduction of NP has been described and the basic results published (Damljanović, 1994). The re-reduction of OP is finished (it will be published) the basic results being :

- the angular value of the micrometer screw revolution (R) is  $40.''1073$  for the period 1949-1960 (it is in good accordance with its NP's value,  $40.''1080$  for the period 1960-1963),

- the angular division values of the Talcott's levels (L) were :  $1.''2581$  for the upper level and  $1.''1547$  for the lower one in the period 1949-1960 (they are also in good accordance with their NP's values,  $1.''2684$  for the upper level and  $1.''1798$  for the lower one in the period 1960-1968),

- the temperature coefficients :  $0.''00606$  for the upper level and  $0.''00400$  for the lower one in the period 1949-1960.

The re-reduction is in accordance with MERIT standards (Melbourne et al., 1983). The new IAU(1976) coordinate system of astronomical constants, the IAU(1980) nutation model, and the new dynamical reference system (JPL DE200/LE200 Ephemeris, 1984) are used. The FORTRAN programme for refraction is like that used in forming the "Refraction Tables of Pulkovo Observatory" (Abalakin, 1985). The General Catalogue of Trigonometric Stellar Parallaxes (Jenkins, 1952) and The General Catalogue of Stellar Radial Velocities (Wilson, 1953) are used for the calculation of the apparent places of OP and NP stars.

The numerous systematic errors are taken into account. Under both Belgrade latitude programmes : the effect of the statistical parallaxes for the stars without trigonometric ones, the deviation of the vertical, the wind effect, the E-W effect-the error due to the clamp position of the telescope, the effect of the level bubble length variation, the correction for the curvature of the parallel, the temperature terms of the levels, the systematic errors in declinations and proper motions of Talcott's pairs and (sub)groups of OP and NP. The personal equation was taken into account for the NP only. The temperature term, the progressive and the periodic errors of the micrometer screw revolution are not applied (Milovanović et al., 1981).

We used the Student-Fisher criterion for eliminating the excessive instantaneous latitudes resulting from some Talcott's pairs.

The polar motion was eliminated from the material and the observations were brought in accordance with the mean pole BIH1979. After that we made determina-

tions of the systematic errors in declinations and proper motions of Talcott's pairs and (sub)groups of OP and NP.

### 3. CONCLUSIONS

We investigated numerous systematic errors and the whole material (OP and NP) is corrected for them. Our basic results are a contribution to Hipparcos program - the mean error (of the instantaneous latitude from one Talcott's pair) being less than before.

From the preliminary ZT observations made in 1947 the mean error was  $\pm 0.''255$  (Djurković, Ševarlić, Brkić, 1951). The mean error of the OP (1949-1960) was  $\pm 0.''220$  (Ševarlić and Teleki, 1960). After our re-reduction the mean error is  $\pm 0.''199$  (1949-1960);  $\pm 0.''211$  (1949-1951.5),  $\pm 0.''195$  (1951.5-1953.5),  $\pm 0.''192$  (1953.5-1957),  $\pm 0.''205$  (1958-1960).

The mean error of the NP (from 1960 till now) was  $\pm 0.''272$  (1960-1965.5) and  $\pm 0.''146$  (1969-1974) (Grujić et al. 1989); after our re-reduction the mean error is  $\pm 0.''148$  (1960-1985);  $\pm 0.''164$  (1960-1963),  $\pm 0.''171$  (1964-1967),  $\pm 0.''151$  (1968-1970),  $\pm 0.''137$  (1971-1972),  $\pm 0.''115$  (1973-1976) (Damljanović, 1994).

With a better catalogue in the future (the Hipparcos Catalogue) we can expect to find systematic errors and obtain results with a better accuracy. The observations made with the classical instruments may attain better accordance with those made with new techniques. They may contribute to more thorough precession and nutation investigations. We take part in that work with our original ZT observations.

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