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ACCURACY OF THE BELGRADE CATALOGUE OF HLS AND RADIO STARS

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Abstract. The accuracy of the Belgrade HLS-and-Radio-Star Catalogue is estimated on the basis of a comparison between its positions and those in the Kazan, SAO and PPM catalogues for the same stars. No systematic trend in both right ascension and declination is discovered. The outer accuracy of star positions in the Belgrade catalogue is significantly lower than the inner one.

1. INTRODUCTION

In the period 1991-1993 the high-luminosity stars (HLS) from the Pulkovo Programme and the radio stars from the Bordeaux Programme were observed with the Large Meridian Circle of the Belgrade Observatory. The descriptions of the programmes and of the observed catalogue compiled at Belgrade were given elsewhere (Sadžakov *et al.*, 1996).

The observed catalogue contains positions (right ascensions and declinations) for 146 HLS and 78 radio stars in the declination zone -30^o - $+80^o$. The coordinates are calculated in the FK5 system and given for the equator and equinox J2000.0 and for the corresponding observational epochs. The rms error of a single observation is $\varepsilon_\alpha \cos\delta = \pm 0^s.025$, i. e. $\varepsilon_\delta = \pm 0''.32$, for right ascension and declination, respectively. It should be noted that this observing program contains only a few stars within the right-ascension interval 8-15 hours.

For the purpose of obtaining an insight concerning the accuracy of the star positions in the Belgrade catalogue (BC) we examine the random and systematic errors by comparing them to the positions given in one observed and two derived catalogues.

The observed catalogue (Yatsenko *et al.* 1991) was formed at Kazan in the period 1981-1987 with a visually-photographic meridian circle. It contains declinations of 158 HLS calculated in the FK4 system given for the equator and equinox B1950.0 and for the corresponding observational epochs. The declinations of the Kazan-catalogue (KC) stars are within the zone $+30^o$ - $+70^o$, whereas the rms error of a single observation is $\varepsilon_\delta = \pm 0''.45$.

The derived catalogues with which the comparison is done are SAO (ed. Whipple 1966) and PPM (Röser 1991).

2. THE METHOD OF COMPARISON

The star positions in two catalogues - KC and SAO - are given in the FK4 system for the equator and equinox B1950.0, whereas in the other two - BC and PPM - the FK5 system and the equator and equinox J2000.0 are used. For the purpose of comparing the star positions in BC with the corresponding ones in KC and SAO an additional reduction of the Belgrade observational data to the FK4 system is undertaken. However, the obtained positions are for the equator and equinox J2000.0 and for the corresponding observational epochs. The declinations of the KC stars are reduced to the epoch B1950.0 by using the proper motions taken from the list of the HLS-Programme stars, to be then reduced to J2000.0 according to the IAU recommendation (Aoki *et al.* 1983). Following the same recommendation the positions of the SAO stars are also reduced from B1950.0 to J2000.0.

The positions of the BC stars are reduced from the observational epochs to J2000.0:

- with the proper motions given in the HLS list in the comparison with the star positions in KC;
- with the SAO proper motions in the comparison with the star positions in SAO and
- with the PPM proper motions in the comparison with the star positions in PPM.

The differences in the positions are calculated by the following formulae

$$\Delta\alpha = \alpha_{BC} - \alpha_{CAT} \qquad \Delta\delta = \delta_{BC} - \delta_{CAT}$$

where BC denotes a coordinate of a star in BC, whereas CAT for right ascension indicates that the star is either from SAO or from PPM, and in the case of declination that it is from either KC, SAO and PPM.

The obtained differences are groupped within declination zones and the mean values are calculated for each zone ($\Delta\alpha_\delta$ and $\Delta\delta_\delta$). After subtracting these values from the corresponding individual differences the new ones are groupped in right ascension and the mean values are calculated within time intervals ($\Delta\alpha_\alpha$ and $\Delta\delta_\alpha$). Considering that within the zone 8-15 hours there are no programme stars, we assume that the right-ascension scale is within 15-32 hours because of the curve continuity.

3. RESULTS OF THE COMPARISON

BC has 86 HLS in common with KC, 210 stars with SAO (138 HLS and 72 radio ones) and 165 stars with PPM (120 HLS and 45 radio).

The results of the comparison with the given three catalogues are presented in Figs.1-4. From Fig. 1 it is seen immediately that the BC $\Delta\alpha_\delta$ deviations are smaller compared to PPM, than compared to SAO. This is to be expected for two reasons. Firstly, PPM is given in the FK5 system which is, as well known, more accurate than the FK4 one in which SAO is given. Secondly, the observational epoch of our catalogue is much closer to the one of PPM than to the SAO one and hence the effect of inaccuracy of the proper motions is less.

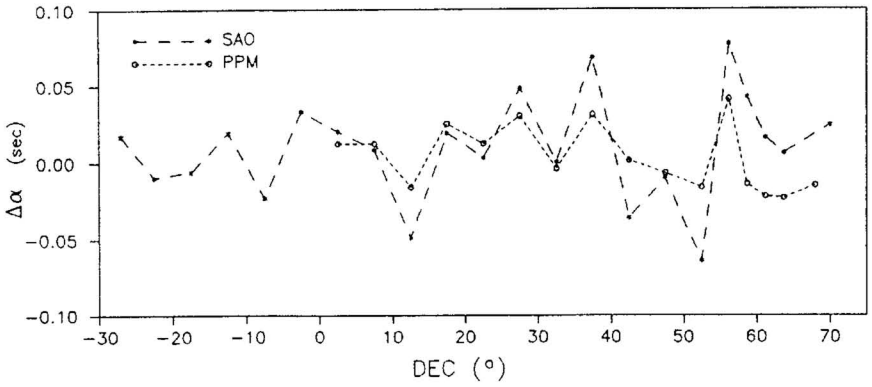

Fig. 1. Mean values of deviations $\Delta\alpha_\delta$ in BC from SAO and PPM.

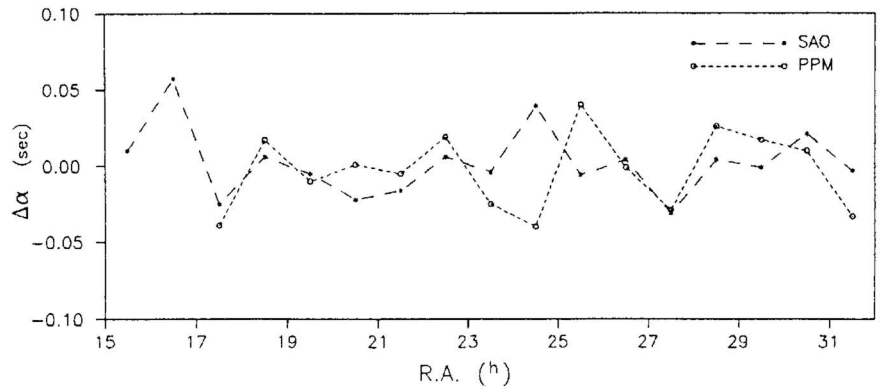

Fig. 2. Mean values of deviations $\Delta\alpha_\alpha$ in BC from SAO and PPM.

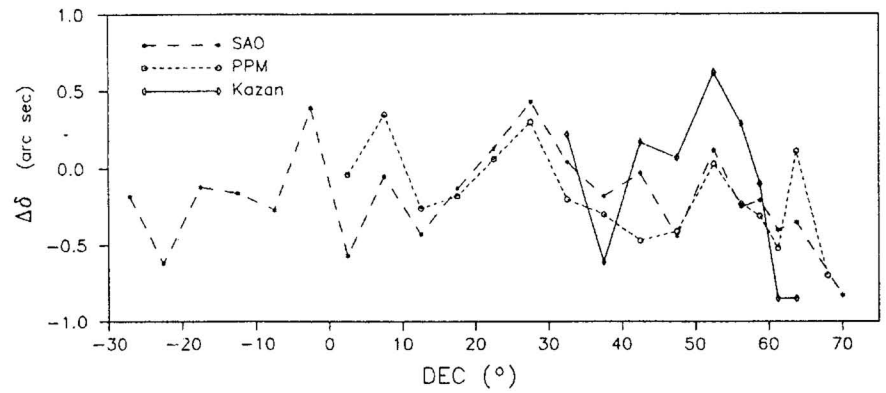

Fig. 3. Mean values of deviations $\Delta\delta_\delta$ in BC from KC, SAO and PPM.

After removing the corrections $\Delta\alpha_\delta$ we obtain the deviations $\Delta\alpha_\alpha$ presented in Fig.2. It is seen from the plot that these mean deviations are somewhat lower than in Fig.1. However, it is impossible from Figs. 1 and 2 to find a systematic dependence on declination or right ascension.

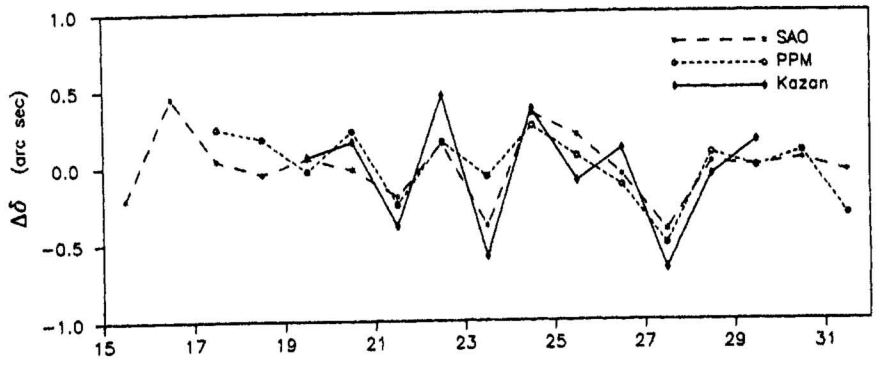

Fig. 4. Mean values of deviations $\Delta\delta_\alpha$ in BC from KC, SAO and PPM.

It is possible to see from Figs. 3 and 4 that the declination differences between BC and KC are somewhat more prominent. After removing $\Delta\delta_\delta$ we obtain the differences $\Delta\delta_\alpha$ presented in Fig.4 where all the three curves are easily seen. This can be attributed to the declination errors of our catalogue.

The rms errors of a single difference are: for the comparison with PPM $\sigma_\alpha \cos\delta = \pm 0^s.066$, $\sigma_\delta = \pm 0''.79$; in the case of SAO $\sigma_\alpha \cos\delta = \pm 0^s.097$, $\sigma_\delta = \pm 0''.93$; i. e. $\sigma_\delta = \pm 1''.12$ for the case of KC. These errors indicate that the outer accuracy of our measurements are by far lower than the inner one.

4. CONCLUSION

The analysis of the obtained results shows that there is no prominent systematic trend in BC, either in declination or in right ascension. Therefore, it may be said that the FK5 system is well reproduced by BC. As for the random errors, the inner accuracy of our catalogue is on the level of the accuracy of classical instruments, but the individual deviations in star positions show that its outer accuracy is significantly lower. This could be expected in view of the analyses of the previous catalogues obtained with the Belgrade Meridian Circle having shown similar results.

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