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THE ACCURACY ESTIMATE FOR STAR POSITIONS IN THE VICINITY OF RADIO SOURCES IN ZONE −30° TO +60° OBTAINED WITH LMC IN BELGRADE

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SUMMARY: With the Large Meridian Circle of the Belgrade Observatory we carried out in the period 1982–1987 visual measurements, by using the relative method, of the coordinates of 290 stars from 78 areas of the sky situated in the vicinity of radio sources. The results of the comparison of the Belgrade Catalogue with four others as well as the systematic errors of the types $\Delta\alpha$, $\Delta\delta$ are presented.

1. INTRODUCTION

"A Catalog of Positions of 290 Stars situated in the Vicinity of Radio Sources" (Sadžakov et al., 1991) – below the Belgrade Catalogue – was compiled by using the Large Meridian Circle of Belgrade Observatory. It contains the star positions for the equinox B1950.0 and for the observational epochs in the FK4 system. These positions were converted into the FK5 system, to the equinox J2000.0 and corresponding observational epochs by using the formulae given in the Astronomical Almanac (1985).

In addition to it, there are two more observational catalogues of interest to us where comparisons are possible. The first of them is "A Catalogue of Declinations of 254 stars situated in the Vicinity of Extragalactic Radio Sources" (Lazorenko, 1984) – below the Kiev Catalogue – obtained with the Vertical Circle of Kiev Observatory and yielding the positions for the equinox B1950.0 and corresponding observational epochs. The second one is "A Catalogue of Right Ascensions and Declinations of 170 Reference Stars in 63 Areas with Extragalactic Radio Sources (Ri(GMK)89)" (Pinigin, 1992) – below the Pulkovo Catalogue – obtained with the Automatic Horizontal Meridian Circle of Pulkovo Observatory and containing the positions for the equinox J2000.0 and corresponding observational epochs.

In order to obtain a preliminary insight into the quality of the Belgrade Catalogue we carry out comparisons with AGK3 (1975), PPM Star Catalogue (1991), Kiev Catalogue and Pulkovo Catalogue.

Our aim is to establish the external accuracy and to examine the presence of systematic errors in the Belgrade Catalogue.

2. RESULTS OF THE COMPARISON OF STAR POSITIONS

Using the proper motions from AGK3 we compare the Belgrade Catalogue with AGK3 and the Kiev one, whereas using the proper motions from the PPM Star Catalogue we compare it with the PPM Star Catalogue and with the Pulkovo one. In this way we reduce the star positions to the observational epoch of the Belgrade Catalogue. The next step is the formation of the differences

$$\Delta\alpha = \alpha_{BC} - \alpha_{CAT}$$

$$\Delta\delta = \delta_{BC} - \delta_{CAT}$$

where the subscripts mean: BC – Belgrade Catalogue; CAT – the comparison catalogues (AGK3, PPM, Kiev and Pulkovo).

In the differences, as well known, many systematic influences are contained. They can be expressed as:

$$\Delta\alpha = \Delta\alpha_o + \Delta\alpha_\delta + \Delta\alpha_\alpha + \Delta\alpha_m + \Delta\alpha_{sp}$$

$$\Delta\delta = \Delta\delta_o + \Delta\delta_\delta + \Delta\delta_\alpha + \Delta\delta_m + \Delta\delta_{sp}$$

where the indices indicate the influence origin.

The present systematic influences are examined within declination zones, with regard to the observational series duration in right ascension, as well as to magnitude and spectral type. The results are presented in Figs. 1 to 9 and Tables 1 and 2.

Table 1. The systematic differences of $\Delta\alpha_{sp}$ type

catalogue	spec.type	$\Delta\alpha_{sp}$	$\varepsilon_{\Delta\alpha}$	N_α
Belgrade-PPM	O,B,A	$-0^s.005$	$\pm0^s.005$	46
Belgrade-Pulkovo	O,B,A	$-0^s.003$	$\pm0^s.011$	34
Belgrade-PPM	F	$+0^s.004$	$\pm0^s.005$	64
Belgrade-Pulkovo	F	$+0^s.005$	$\pm0^s.011$	40
Belgrade-PPM	G	$+0^s.002$	$\pm0^s.006$	42
Belgrade-Pulkovo	G	$+0^s.010$	$\pm0^s.012$	27
Belgrade-PPM	K,M,N	$-0^s.001$	$\pm0^s.004$	82
Belgrade-Pulkovo	K,M,N	$-0^s.007$	$\pm0^s.010$	56

Table 2. The systematic differences of $\Delta\delta_{sp}$ type

catalogue	spec.type	$\Delta\delta_{sp}$	$\varepsilon_{\Delta\delta}$	N_δ
Belgrade-AGK3	O,B,A	$-0''.05$	$\pm0''.06$	53
Belgrade-Kiev	O,B,A	$-0''.02$	$\pm0''.06$	46
Belgrade-PPM	O,B,A	$-0''.07$	$\pm0''.07$	46
Belgrade-Pulkovo	O,B,A	$-0''.11$	$\pm0''.07$	35
Belgrade-AGK3	F	$-0''.06$	$\pm0''.04$	72
Belgrade-Kiev	F	$-0''.09$	$\pm0''.06$	56
Belgrade-PPM	F	$-0''.04$	$\pm0''.06$	64
Belgrade-Pulkovo	F	$-0''.04$	$\pm0''.06$	40
Belgrade-AGK3	G	$+0''.09$	$\pm0''.05$	55
Belgrade-Kiev	G	$+0''.09$	$\pm0''.07$	43
Belgrade-PPM	G	$+0''.05$	$\pm0''.06$	42
Belgrade-Pulkovo	G	$+0''.11$	$\pm0''.09$	29
Belgrade-AGK3	K,M,N	$+0''.02$	$\pm0''.04$	106
Belgrade-Kiev	K,M,N	$+0''.03$	$\pm0''.05$	79
Belgrade-PPM	K,M,N	$+0''.04$	$\pm0''.06$	83
Belgrade-Pulkovo	K,M,N	$+0''.04$	$\pm0''.07$	60

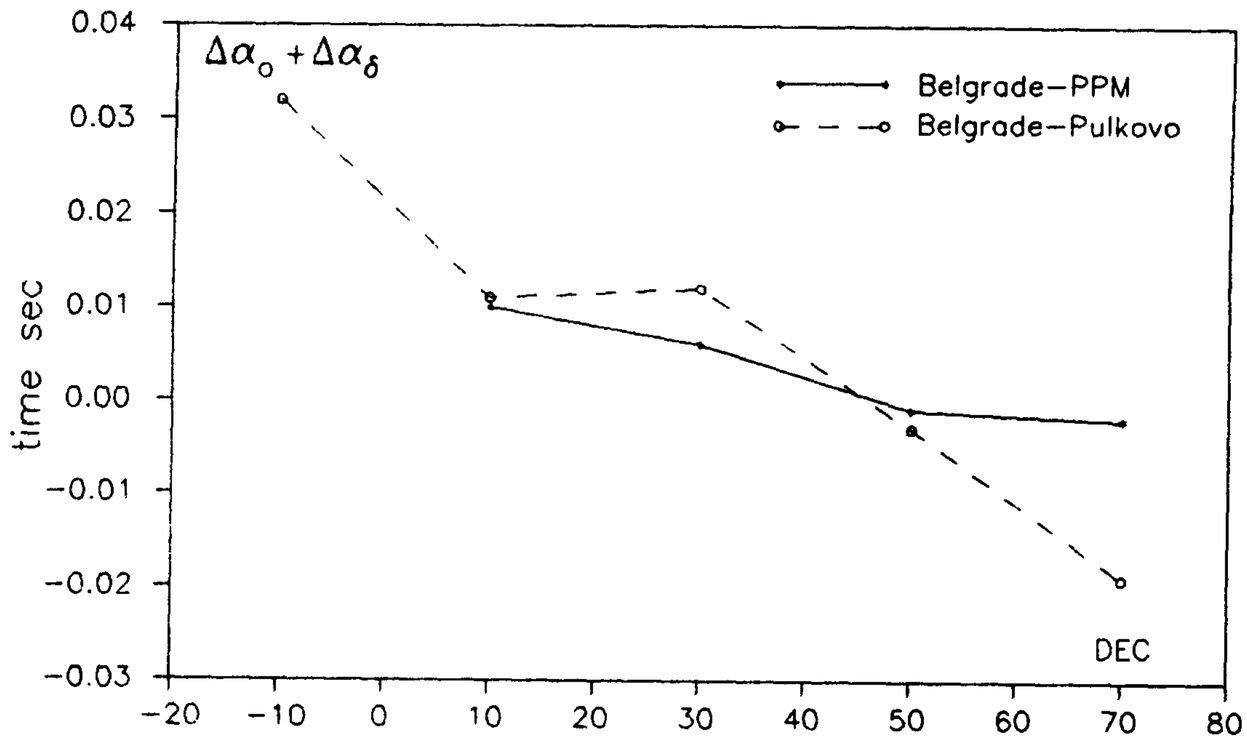

Fig. 1. Systematic differences $(\Delta\alpha_o + \Delta\alpha_\delta)$ type.

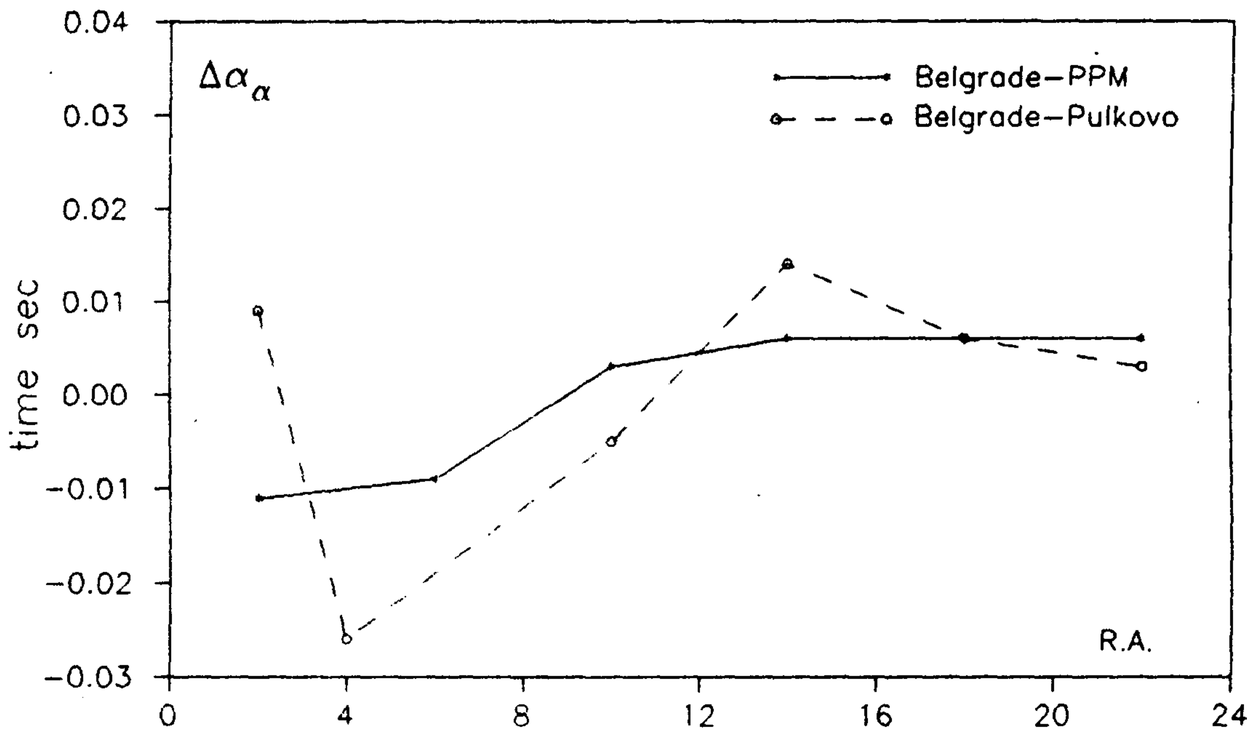

Fig. 2. Systematic differences $\Delta\alpha_\alpha$ type.

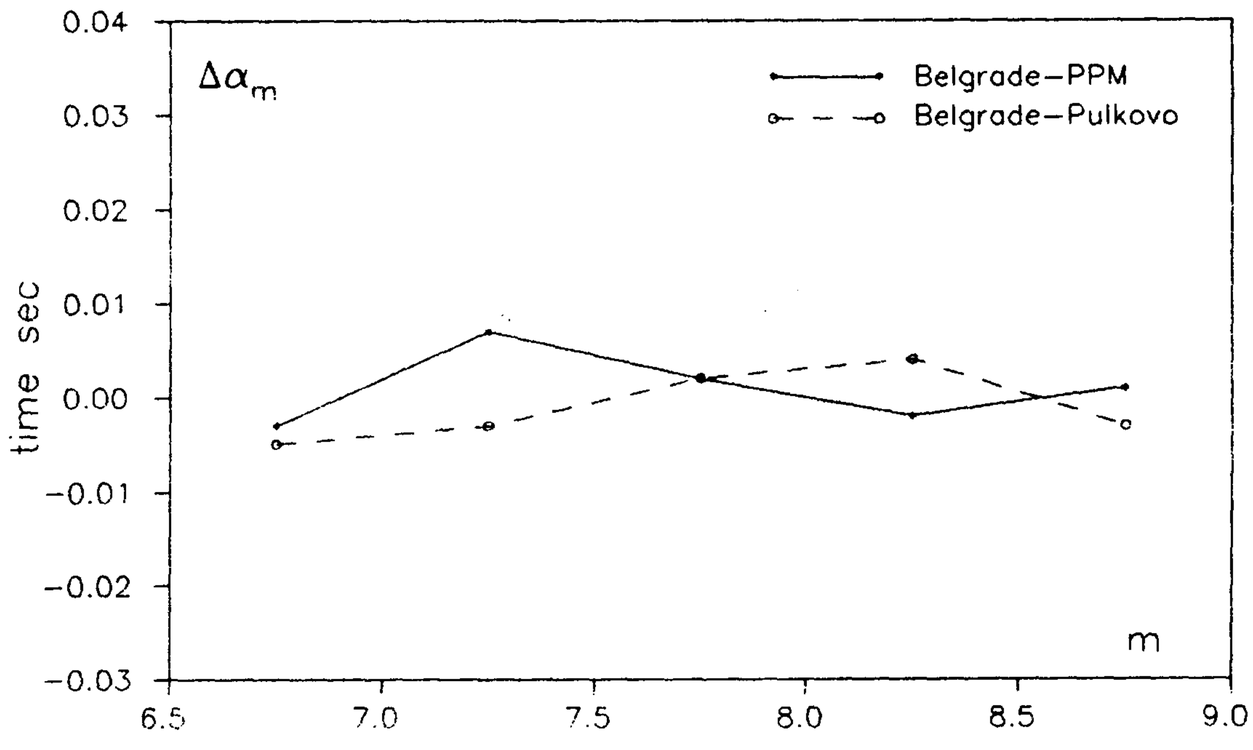

Fig. 3. Systematic differences $\Delta\alpha_m$ type.

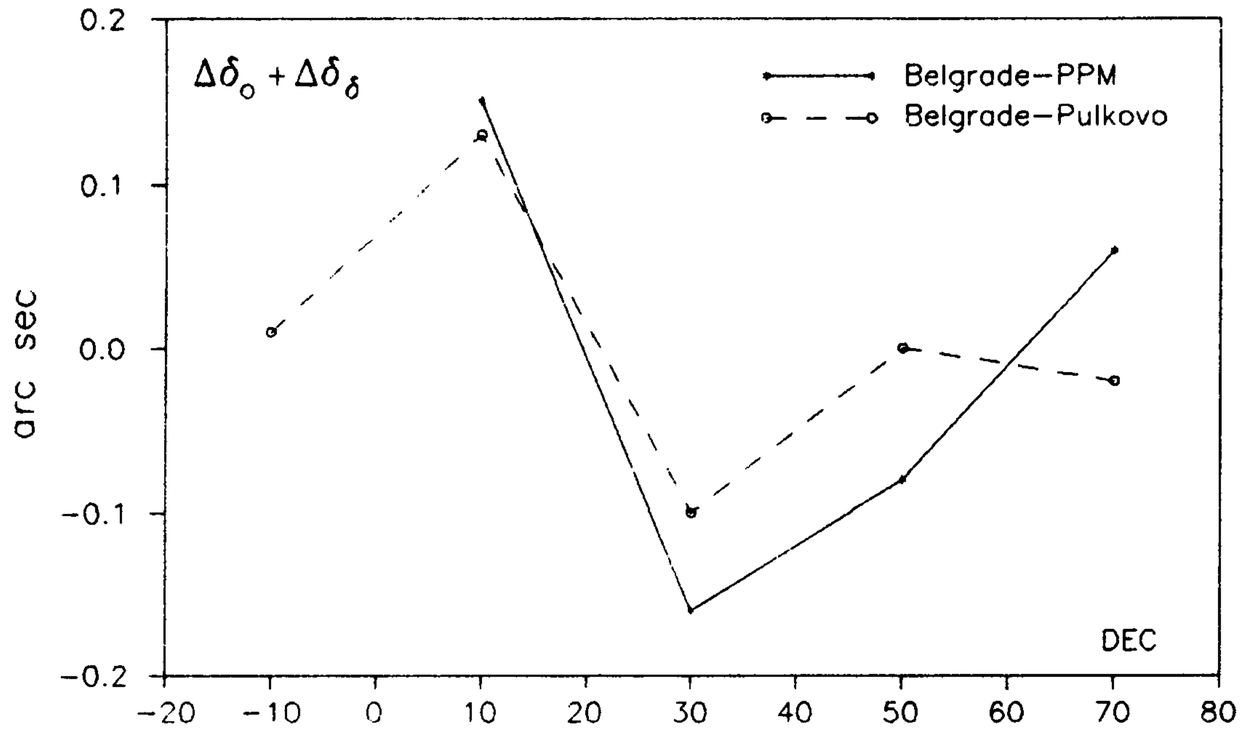

Fig. 4. Systematic differences ($\Delta\delta_o + \Delta\delta_\delta$) type.

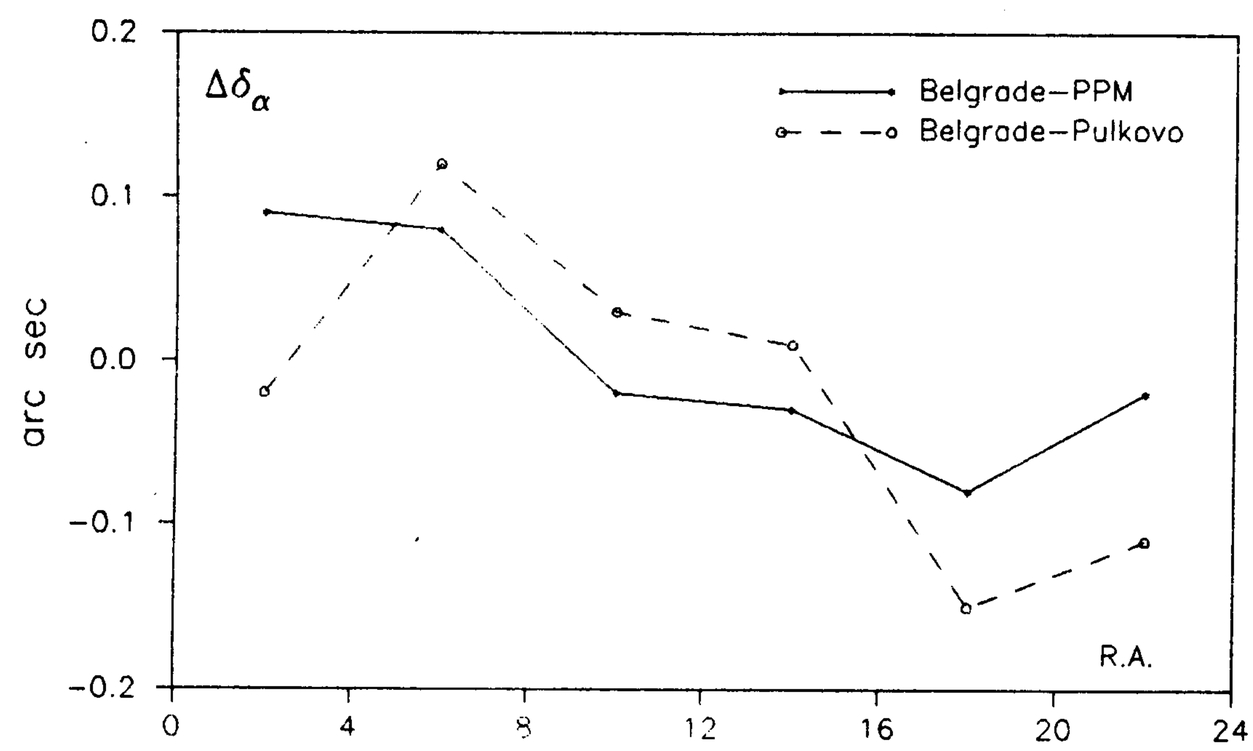

Fig. 5. Systematic differences $\Delta\delta_\alpha$ type.

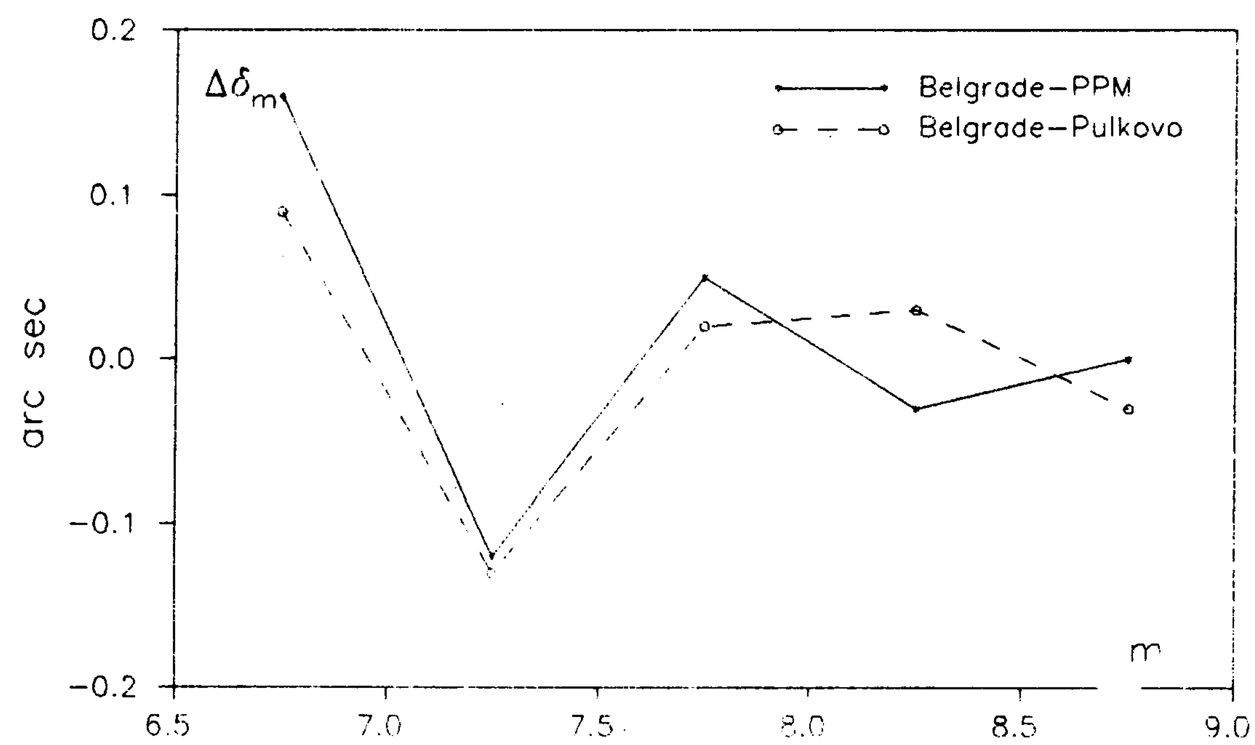

Fig. 6. Systematic differences $\Delta\delta_m$ type.

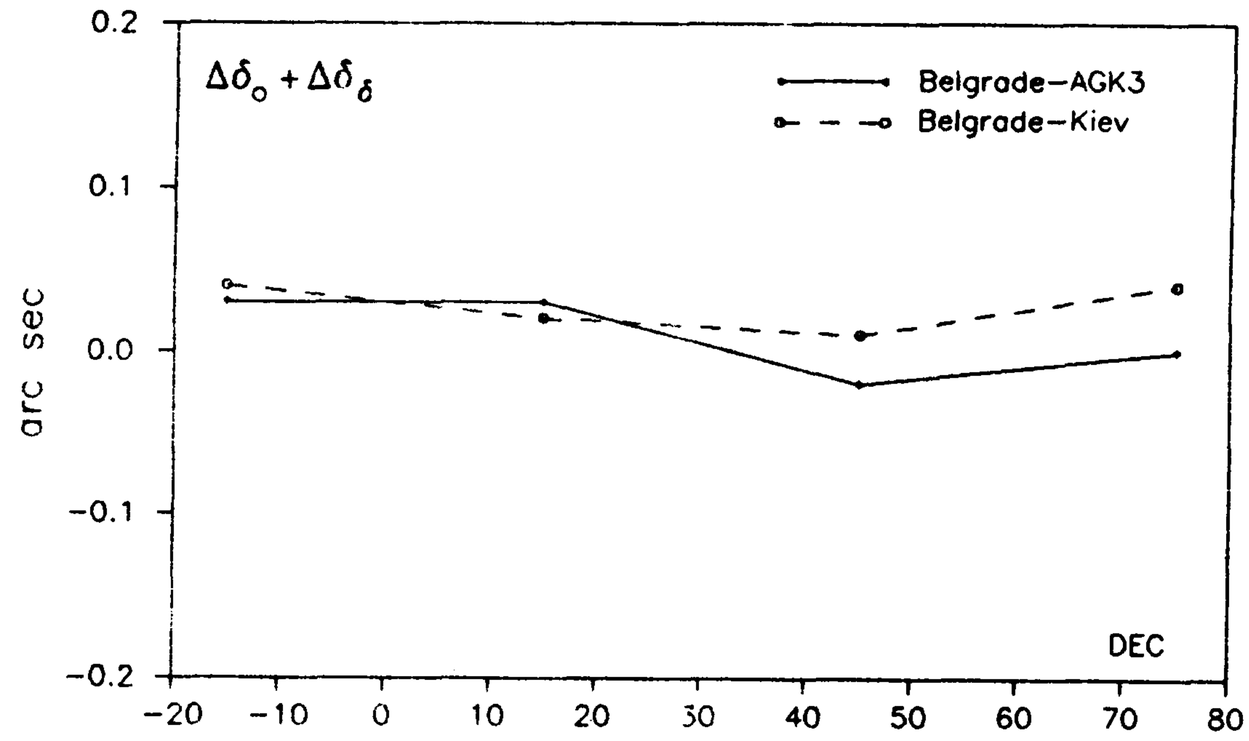

Fig. 7. Systematic differences ($\Delta\delta_o + \Delta\delta_\delta$) type.

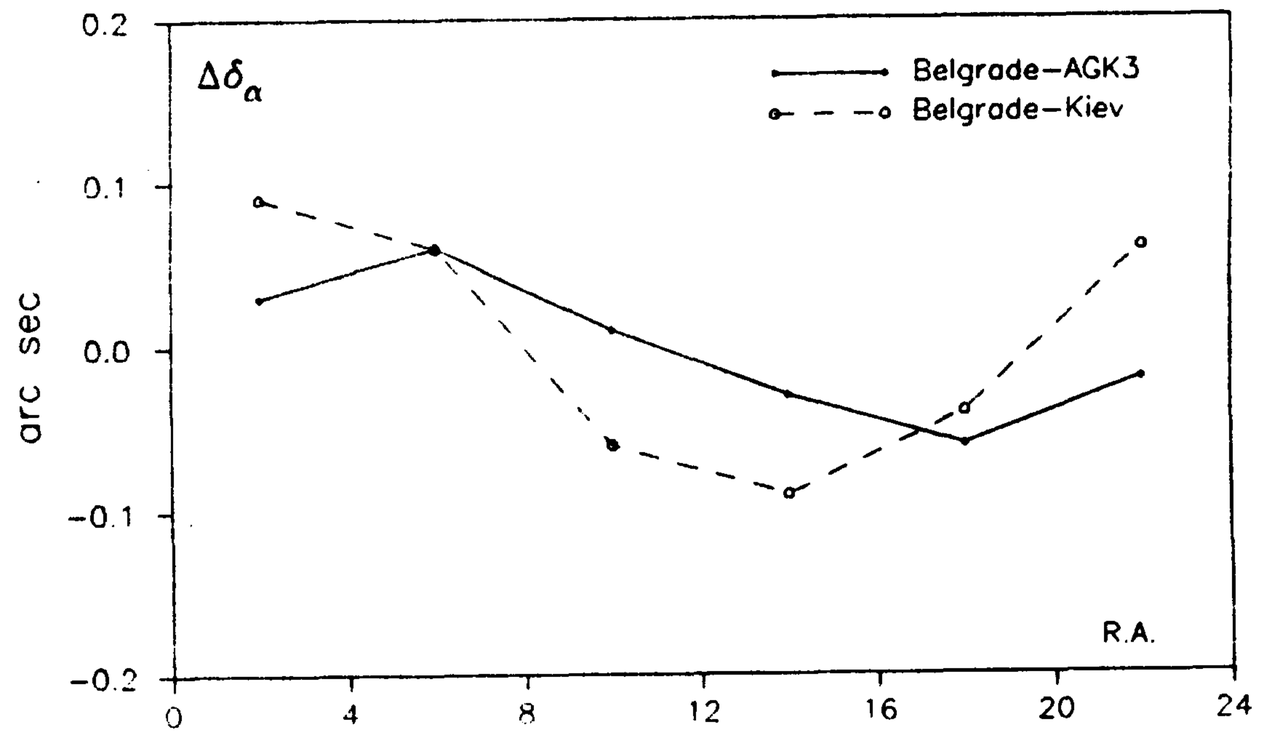

Fig. 8. Systematic differences $\Delta\delta_\alpha$ type.

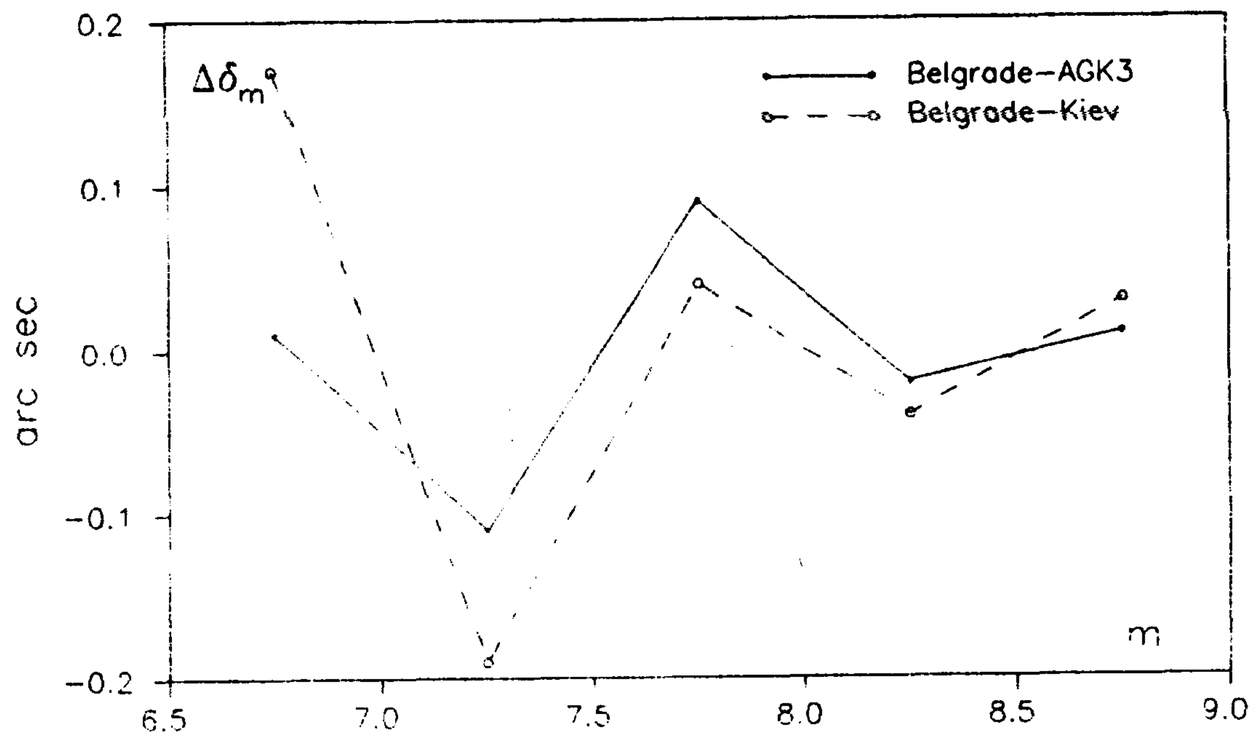

Fig. 9. Systematic differences $\Delta\delta_m$ type.

The systematic effects of the type $(\Delta\alpha_o+\Delta\alpha_\delta)$ and $(\Delta\delta_o+\Delta\delta_\delta)$ are first singled out and numerical values are formed for individual segments of the sky. The values $(\Delta\alpha_o+\Delta\alpha_\delta)$ vary from $-0^s.019$ to $+0^s.032$, $(\Delta\delta_o+\Delta\delta_\delta)$ vary from $-0''.16$ to $+0''.15$. These values are calculated with weights on the basis of the number of stars in each interval.

The values $\Delta\alpha_\alpha$ vary from $-0^s.026$ to $+0^s.014$ and $\Delta\delta_\alpha$ vary from $-0''.15$ to $+0''.12$ in individual segments of the sky. The curve representing the mean values of $\Delta\alpha_\alpha$ and $\Delta\delta_\alpha$ in the four hours zones takes a sinusoidal form (see Figs. 2, 5 and 8). In the zone 0^h to 12^h in right ascension, the values $\Delta\alpha_\alpha$ are $-0^s.026$ to $+0^s.009$ and from 12^h to 24^h they are $+0^s.003$ to $+0^s.014$; from 0^h to 12^h in right ascension, the values $\Delta\delta_\alpha$ are $-0''.02$ to $+0''.12$ and from 12^h to 24^h they are $-0''.15$ to $+0''.01$.

The values $\Delta\alpha_m$ vary from $-0^s.005$ to $+0^s.007$ and $\Delta\delta_m$ vary from $-0''.13$ to $+0''.16$ (see Figs. 3, 6 and 9).

3. CHARACTERISTIC RESULTS OF STAR POSITIONS

Fig. 1, as well as, Figs. 4 and 7, indicates the systematic influence of $(\Delta\alpha_o+\Delta\alpha_\delta)$ and $(\Delta\delta_o+\Delta\delta_\delta)$ type in the case of the Belgrade Catalogue where the positions for the equinox J2000.0 are obtained by conversion from the B1950.0.

It is seen in Figs. 2, 5 and 8 that the Belgrade catalogue contains the systematic errors of $\Delta\alpha_\alpha$ and $\Delta\delta_\alpha$ type and that their nature is seasonal; in Figs. 6 and 9 that the systematic errors of $\Delta\delta_m$ type are also evident in the magnitude range 7^m-8^m.

Tables 1 and 2 show the systematic differences of $\Delta\alpha_{sp}$ and $\Delta\delta_{sp}$ type where the spectral-type influence is more prominent in declination.

4. CONCLUSION

On the basis of the laid out above, we can say that the systematic effects of $(\Delta\alpha_o+\Delta\alpha_\delta)$, $(\Delta\delta_o+\Delta\delta_\delta)$, $\Delta\alpha_\alpha$, $\Delta\delta_\alpha$ types are evident and, most probably, they result from:

1. seasonal systematic errors;
2. possible systematic errors in proper motions (AGK3 or PPM Star Catalogue);
3. systematic errors resulting from observations of right ascensions and declinations, made by zones.

The systematic errors of $\Delta\delta_m$ type are evident especially for stars whose apparent magnitude is about $7^m.2$ to $7^m.8$.

The systematic errors of $\Delta\delta_{sp}$ type are the largest for stars of spectral types G,K,M,N.

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ОЦЕНА ТАЧНОСТИ ПОЛОЖАЈА ЗВЕЗДА У ОКОЛИНИ РАДИО ИЗВОРА У ЗОНИ ОД −30° ДО +60° ДОБИЈЕНИХ НА ВМК У БЕОГРАДУ

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Оригинални научни рад

На Великом Меридијанском Кругу Београдске опсерваторије у периоду од 1982-1987. године извршили смо визуелна мерења координата 290 звезда у 78 области неба смештених у околини радио извора коришћењем релативне методе. Представљени су резултати поређења Београдског каталога са друга четири као и систематске грешке типа $\Delta\alpha$ и $\Delta\delta$.