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Preliminary report

CHARACTERISTICS OF THE BELGRADE STAR CATALOGUE PROGRAMME OF PZT ONDREJEV (BCPZT)

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SUMMARY: The Belgrade star catalogue obtained using the Belgrade Large Meridian Circle (2r=190mm, f=2578mm) observations has been terminated recently according to the PZT Ondrejev programme. In this article the obtained results have been compared with the PZT Ondrejev star catalogue (2r=250mm, f=3780mm) as well as with the AGK3. Systematic errors arrived at in these comparisons indicate the star positions (α, δ) in the Belgrade and Ondrejev catalogues determined with high accuracy whereas proper motions given in the AGK3 are burdened with systematic errors, which increase with time.

1. INTRODUCTION

The Belgrade star catalogue of the PZT Ondrejev (BCPZT) (Sadźakov et al., in press) programme, was made with the Large Meridian Circle using a relative method, between 1985-1990 in Belgrade. The star positions were derived with accuracy $\varepsilon_\alpha \cos\delta = \pm 0^s.010$, $\varepsilon_\delta = \pm 0''.15$ for the mean epoch Ep=1987.34 within the FK5 system, for the equator and equinox J2000.0 . Most stars are tiny ($8^m.5$ - $11^m.0$) and bright nights are required for observation.

The following catalogues have been used for the computation of the accuracy estimates of the BCPZT star positions:

1. "Mean positions and proper motions of 224 stars based on PZT observations at Ondrejev in 1973-1986" (OPZT).

The mean epoch of the resulting catalogue PZT 86 is 1981.56 , the average standard errors in right ascension and declination, referred to this epoch, are equal to $\pm 0^s.0015$ and $\pm 0''.017$, respectively. The proper motions in right ascension and declination were obtained with an accuracy characterized by the average standard errors of $\pm 0^s.051\ cy^{-1}$ and $\pm 0''.57\ cy^{-1}$ which will cause the standard errors in position to increase to $\pm 0^s.0096$ and $\pm 0''.106$ by the end of the century. Positions and proper motions of the stars catalogue is given in the reference system defined by the equator and equinox of FK5 for the new standard epoch J2000.0 , without the E-terms of aberration.

2. "AGK3 - Star Catalogue of Positions and Proper Motions"

The positions (α, δ) and proper motions (μ_α, μ_δ) are given in the FK4 system for the equator and equinox B1950.0 . The star position mean square error has been defined on the basis of mean weight values and amounts to $\pm 0''.21$ whereas the standard error of the proper motions is of the order of $\pm 0''.010$/year.

Table 1. Systematic differences of coordinates (BCPZT–OPZT) in right ascension

α	$\Delta\alpha_\alpha$	ε_α	N_α	$\Delta\delta_\alpha$	ε_δ	N_δ
0 – 4	$+0^s.0015$	$\pm0^s.0090$	37	$+0''.008$	$\pm0''.172$	37
4 – 8	$-0^s.0017$	$\pm0^s.0103$	36	$-0''.059$	$\pm0''.209$	36
8 – 12	$-0^s.0063$	$\pm0^s.0090$	38	$-0''.013$	$\pm0''.209$	38
12 – 16	$+0^s.0016$	$\pm0^s.0124$	38	$+0''.006$	$\pm0''.222$	38
16 – 20	$+0^s.0049$	$\pm0^s.0131$	36	$+0''.023$	$\pm0''.173$	36
20 – 24	$+0^s.0003$	$\pm0^s.0130$	38	$+0''.033$	$\pm0''.175$	38

Table 2. Systematic differences of coordinates (BCPZT—AGK3) in right ascension

α	$\Delta\alpha_\alpha$	ε_α	N_α	$\Delta\delta_\alpha$	ε_δ	N_δ
0 – 4	$-0^s.0017$	$\pm0^s.0333$	37	$-0''.317$	$\pm0''.573$	36
4 – 8	$+0^s.0000$	$\pm0^s.0268$	35	$+0''.278$	$\pm0''.513$	34
8 – 12	$-0^s.0012$	$\pm0^s.0291$	38	$+0''.136$	$\pm0''.567$	37
12 – 16	$-0^s.0060$	$\pm0^s.0280$	36	$-0''.017$	$\pm0''.545$	38
16 – 20	$+0^s.0078$	$\pm0^s.0292$	35	$+0''.097$	$\pm0''.477$	32
20 – 24	$+0^s.0014$	$\pm0^s.0306$	37	$-0''.153$	$\pm0''.550$	36

The common star positions and proper motions within the zone (49° -50°) BCPZT and AGK3 have been converted into the FK5 system to the equator and J2000.0 equinox by means of forms printed in the Astronomical Almanac for the years 1986, pp.B58 under Conversion of stellar positions and proper motions from the standard epoch B1950.0 to J2000.0

2. CATALOGUE COMPARISON

The stellar positions and proper motions being given within the FK5 system for the equinox J2000.0 . The reduction of the BCPZT position to the epoch 2000.0 took place, in one case by application of proper motion from the PZT Ondrejev catalogue, and in the second case by the AGK3. The differences have been formed:

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

$\Delta\delta = \delta_{BCPZT} - \delta_{CAT}$ CAT= OPZT or AGK3

The differences obtained in this manner have been broken up to a number of factors for which it is assumed that they have causing the differences.

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

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

The differences $\Delta\alpha_\delta$ and $\Delta\delta_\delta$ had been disregarded owing to a narrow observation zone (49°-50°). For the results obtained see Tables 1–6.

Tables comprise seven columns where: α - right ascension, δ - declination, m - magnitude, Sp - spectral type; and with $\Delta\alpha_\alpha$, $\Delta\delta_\alpha$, $\Delta\alpha_m$, $\Delta\delta_m$, $\Delta\alpha_{sp}$, $\Delta\delta_{sp}$ - systematic differences in the α, m, Sp function; ε - the errors of defining such systematic differences; N_α and N_δ - the number of stars in right ascension and declination.

To obtain the picture of these differences of systematic character we have made use of the sixth degree polynomial and obtained the Figs.1 and 2.

In processing the material the PC/AT 286 computer was used.

Table 3.Systematic differences of coordinates (BCPZT–OPZT) in magnitude

m	$\Delta\alpha_m$	ε_α	N_α	$\Delta\delta_m$	ε_δ	N_δ
m < 7.5	$-0^s.0015$	$\pm0^s.0124$	24	$-0''.017$	$\pm0''.233$	24
7.5 – 8.0	$+0^s.0039$	$\pm0^s.0064$	20	$+0''.001$	$\pm0''.181$	20
8.0 – 8.5	$-0^s.0001$	$\pm0^s.0101$	25	$-0''.045$	$\pm0''.186$	25
8.5 – 9.0	$+0^s.0015$	$\pm0^s.0105$	40	$+0''.002$	$\pm0''.154$	40
9.0 – 9.5	$+0^s.0010$	$\pm0^s.0124$	53	$+0''.029$	$\pm0''.192$	53
9.5 –10.0	$-0^s.0012$	$\pm0^s.0119$	28	$+0''.040$	$\pm0''.211$	28
m >10.0	$-0^s.0035$	$\pm0^s.0108$	33	$-0''.036$	$\pm0''.199$	33

Table 4. Systematic differences of coordinates (BCPZT–AGK3) in magnitude

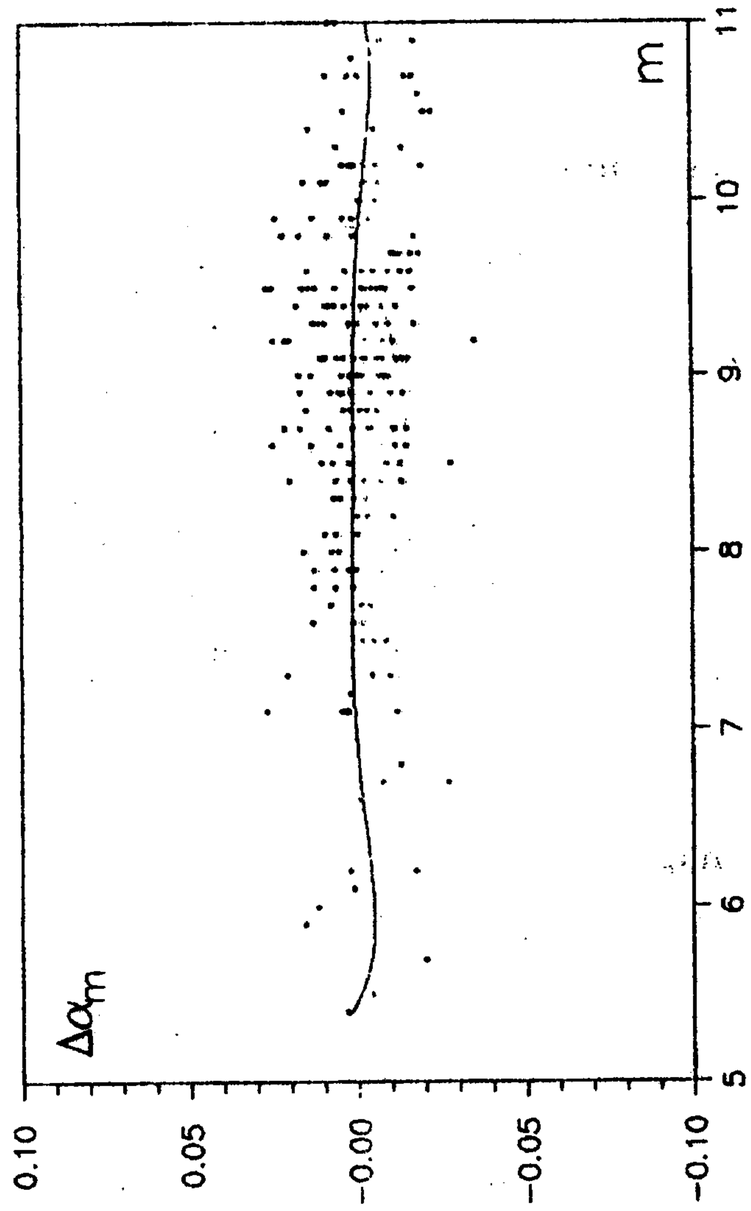
m	$\Delta\alpha_m$	ε_α	N_α	$\Delta\delta_m$	ε_δ	N_δ
m < 7.5	$+0^s.0133$	$\pm0^s.0298$	22	$-0''.074$	$\pm0''.233$	21
7.5 – 8.0	$+0^s.0098$	$\pm0^s.0285$	19	$+0''.173$	$\pm0''.181$	19
8.0 – 8.5	$+0^s.0006$	$\pm0^s.0310$	25	$+0''.037$	$\pm0''.186$	24
8.5 – 9.0	$-0^s.0052$	$\pm0^s.0303$	39	$-0''.104$	$\pm0''.154$	39
9.0 – 9.5	$-0^s.0018$	$\pm0^s.0273$	52	$+0''.077$	$\pm0''.192$	52
9.5 –10.0	$-0^s.0093$	$\pm0^s.0241$	28	$+0''.073$	$\pm0''.211$	26
m>10.0	$+0^s.0018$	$\pm0^s.0314$	33	$-0''.141$	$\pm0''.199$	32

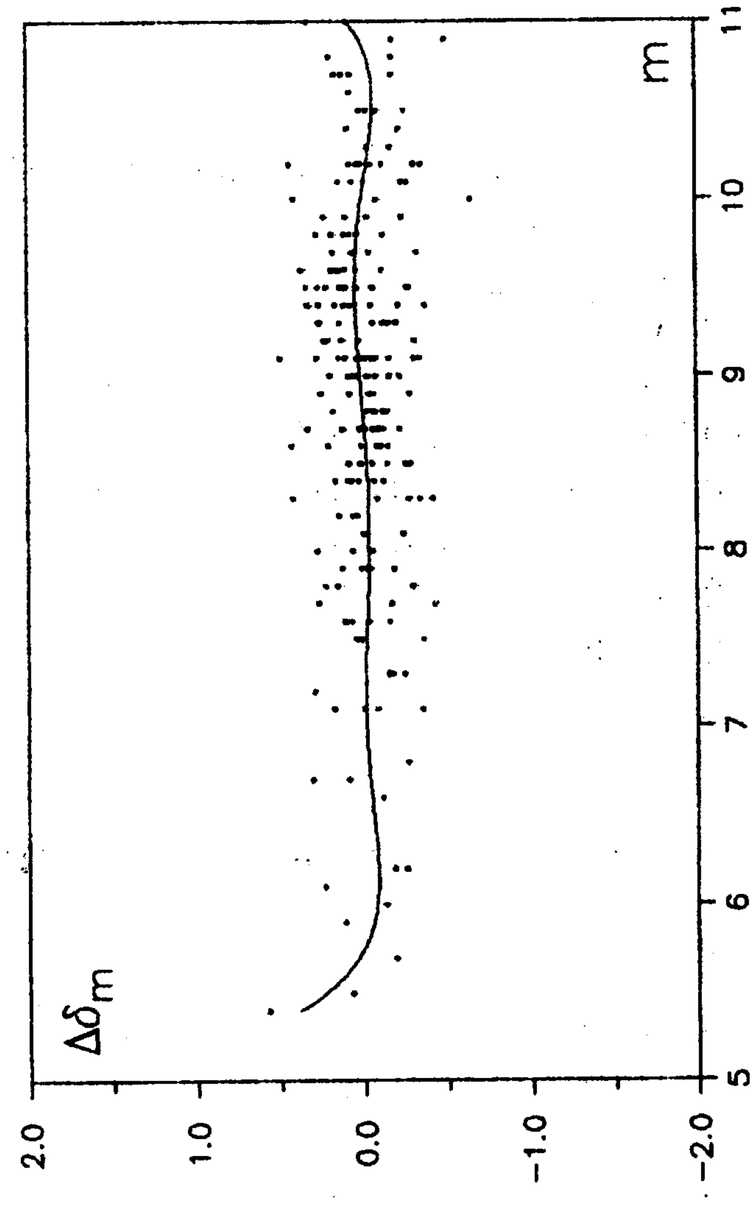
Table 5. Systematic differences of coordinates (BCPZT–OPZT) against spectral types

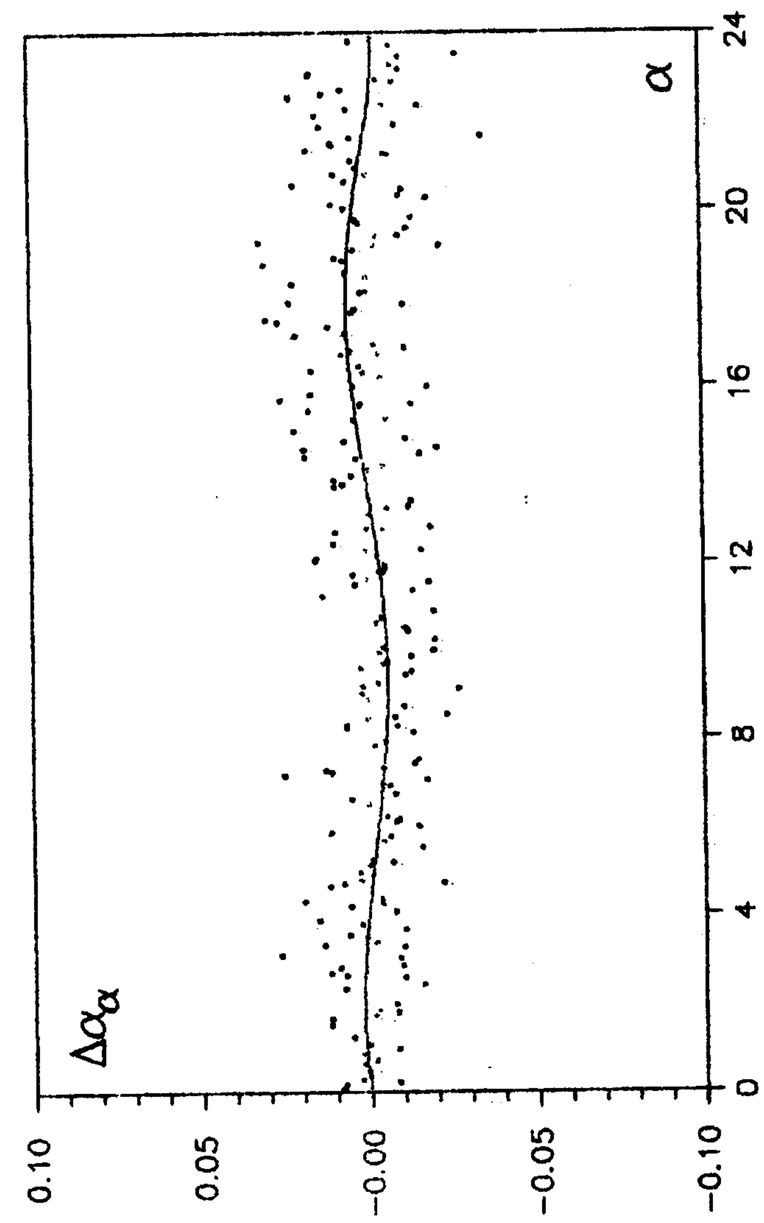
Sp	$\Delta\alpha_{sp}$	ε_α	N_α	$\Delta\delta_{sp}$	ε_δ	N_δ
O, B, A	$-0^s.0004$	$\pm0^s.0020$	79	$-0''.004$	$\pm0''.216$	79
F	$+0^s.0006$	$\pm0^s.0030$	55	$+0''.005$	$\pm0''.211$	55
G	$+0^s.0000$	$\pm0^s.0025$	28	$+0''.002$	$\pm0''.194$	28
K, M, N	$+0^s.0000$	$\pm0^s.0024$	61	$+0''.001$	$\pm0''.126$	61

Table 6. Systematic differences of coordinates (BCPZT–AGK3) against spectral types

Sp	$\Delta\alpha_{sp}$	ε_α	N_α	$\Delta\delta_{sp}$	ε_δ	N_δ
O, B, A	$-0^s.0050$	$\pm0^s.0562$	78	$-0''.059$	$\pm0''.497$	76
F	$+0^s.0070$	$\pm0^s.0443$	55	$+0''.129$	$\pm0''.536$	55
G	$-0^s.0034$	$\pm0^s.0553$	25	$-0''.003$	$\pm0''.559$	26
K, M, N	$+0^s.0015$	$\pm0^s.0497$	60	$-0''.046$	$\pm0''.522$	56







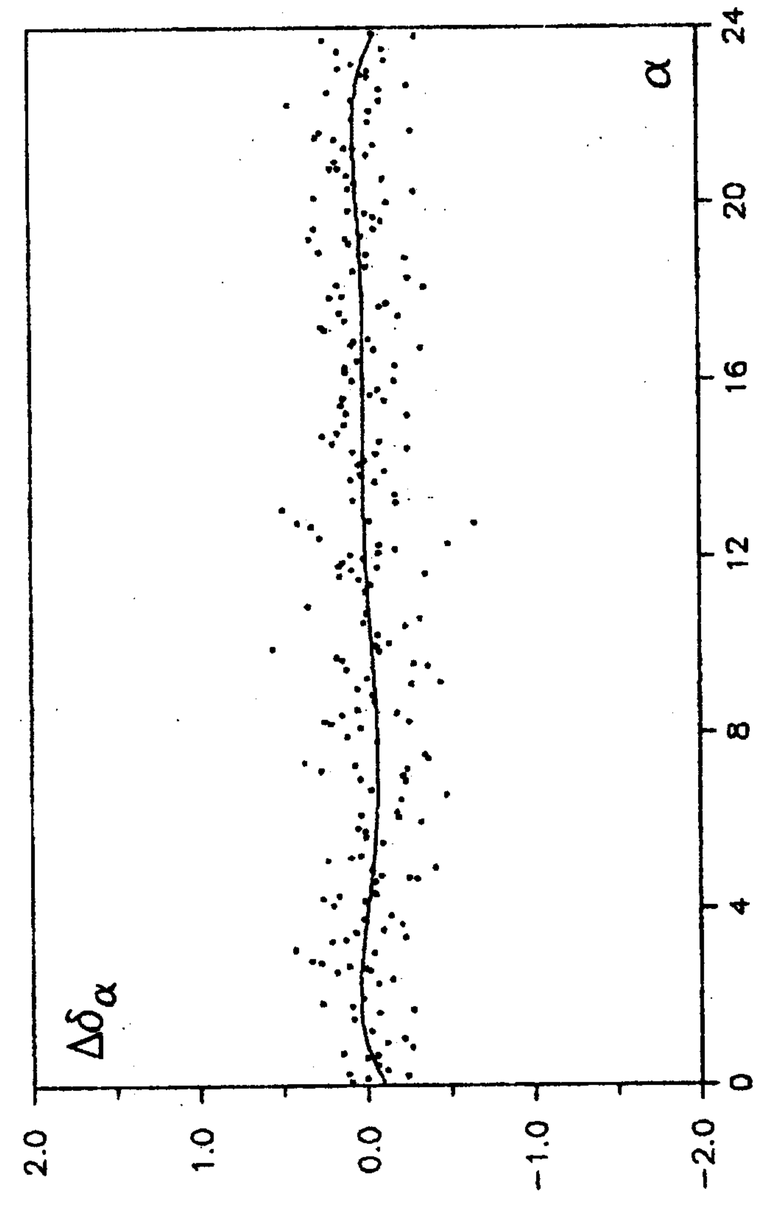


Fig. 1. Systematic differences for stars common to BCPZT and OPZT : a) $\Delta\alpha_\alpha$, b) $\Delta\alpha_m$, c) $\Delta\delta_\alpha$ and d) $\Delta\delta_m$.

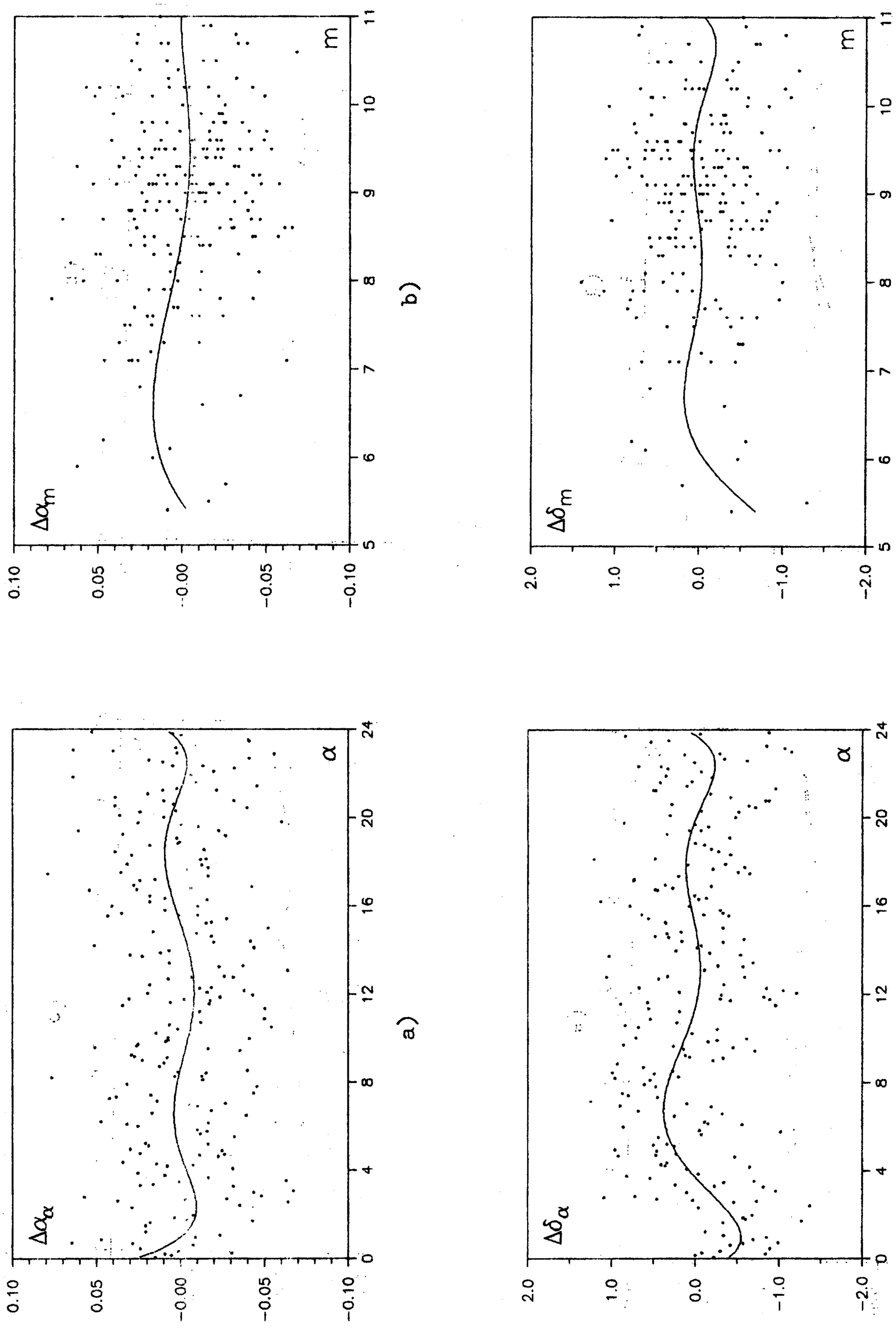
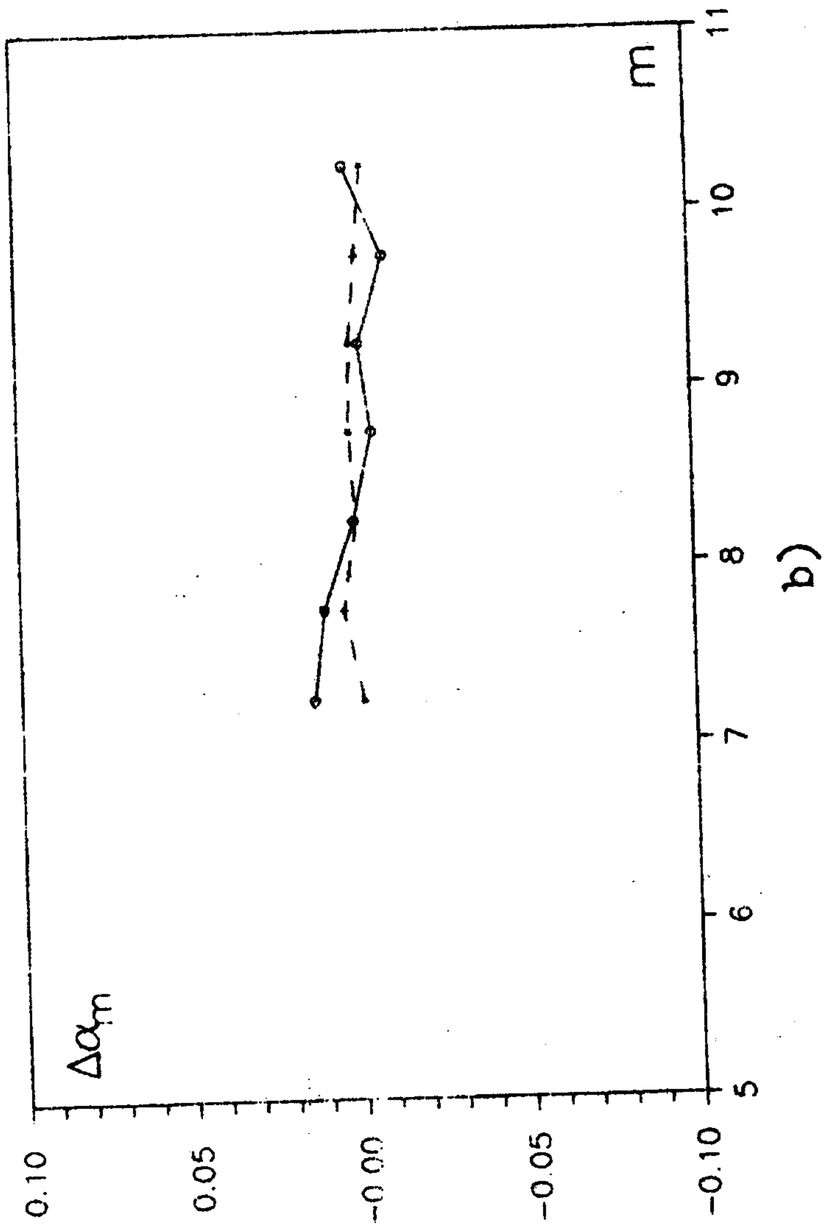
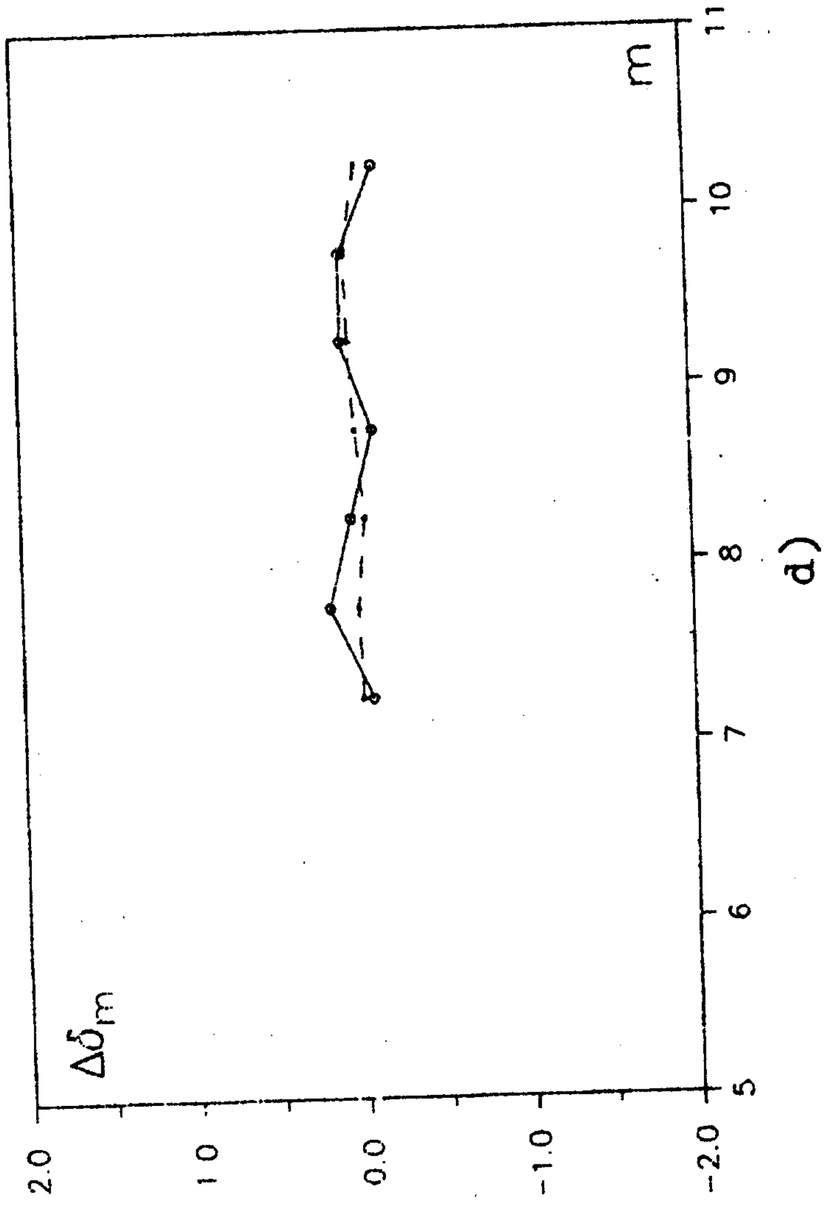
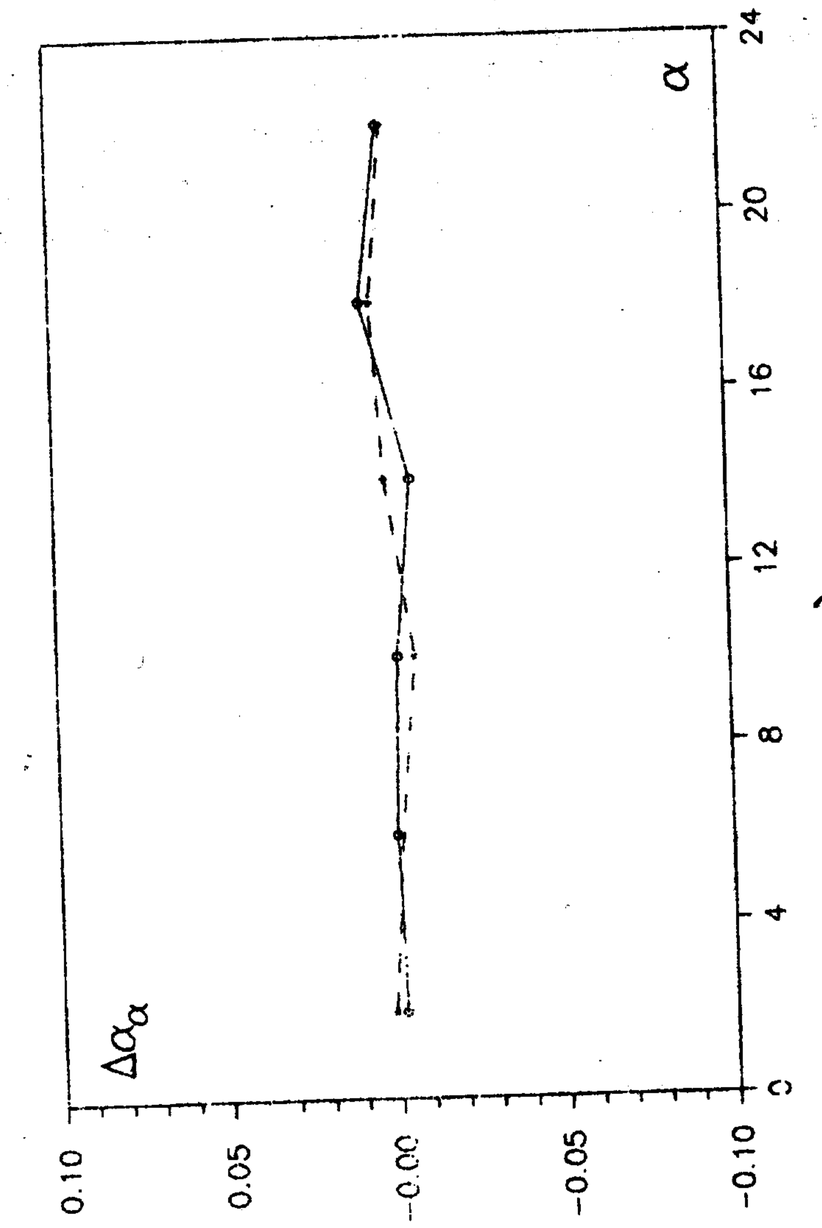


Fig. 2. Systematic differences for stars common to BCPZT and AGK3 : a) $\Delta\alpha_\alpha$, b) $\Delta\alpha_m$, c) $\Delta\delta_\alpha$ and d) $\Delta\delta_m$.







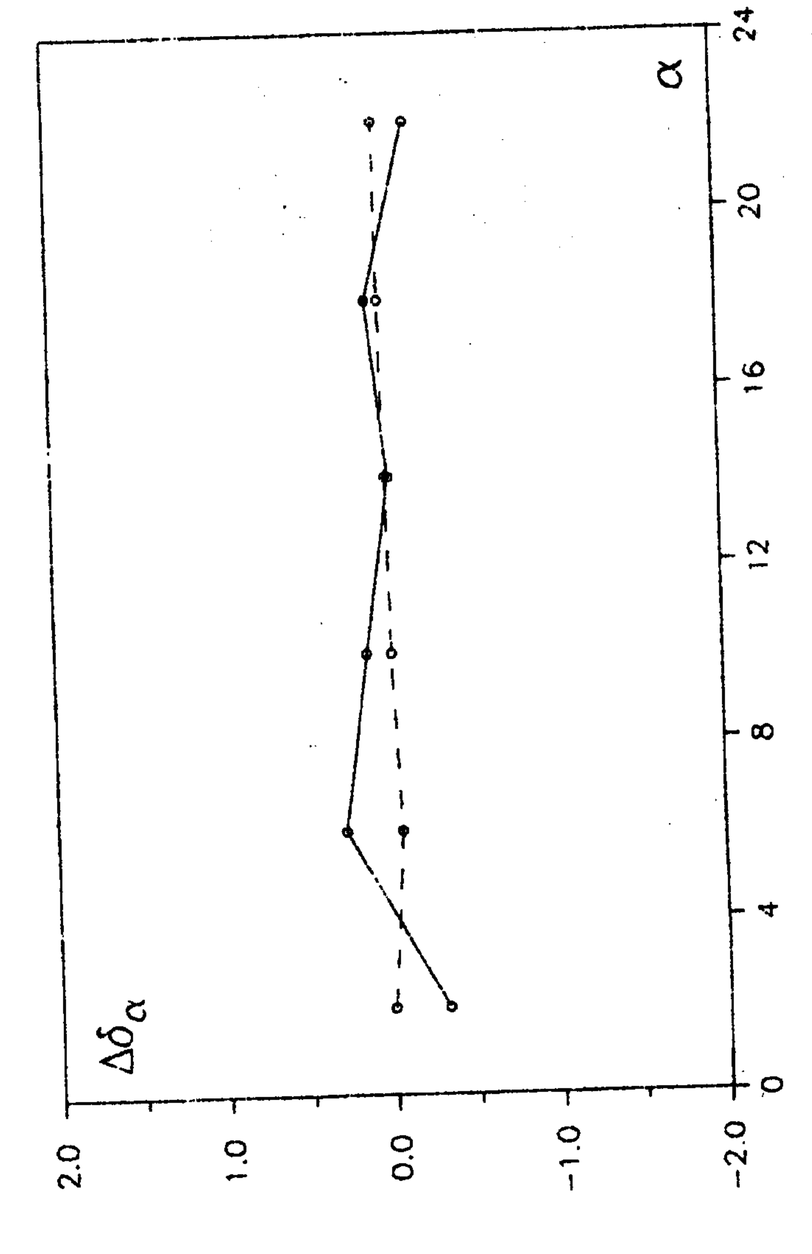


Fig. 3. Systematic differences BCPZT-OPZT (dashed line) and BCPZT-AGK3 (solid line) : a) $\Delta\alpha_\alpha$, b) $\Delta\alpha_m$, c) $\Delta\delta_\alpha$ and d) $\Delta\delta_m$.

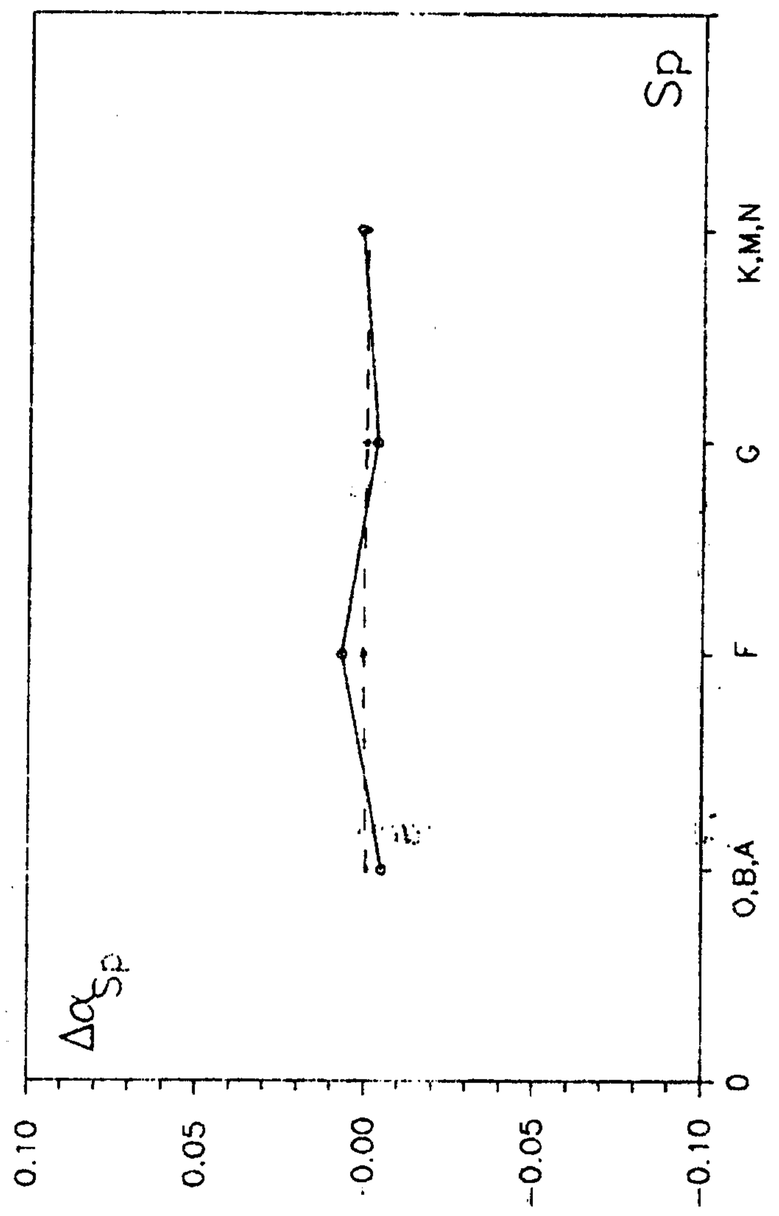


Fig. 4. Systematic differences BCPZT-OPZT (dashed line) and BCPZT-AGK3 (solid line) : a) $\Delta\alpha_{sp}$ and b) $\Delta\delta_{sp}$.

3. OBTAINED RESULTS ANALYSIS

The values of differences in the function α, m, Sp given in Tables 1–6 are evident but not disturbing for the catalogues BCPZT and OPZT, whereas the AGK3 is different, see Figs.3 and 4.

The catalogue AGK3, i.e. the position of stars and proper motions has been examined by many authors, the authors of this articles included, and it had been determined, and is being confirmed again that the errors are big enough and they increase in time.

4. CONCLUSION

A very good star position compatibility given in the BCPZT and OPZT indicates that the (α, δ) positions have been well defined in both catalogues, and particularly the proper motions in the OPZT are of a high quality, which is not the case with the AGK3. The comparison of these three catalogues (BCPZT, OPZT, AGK3) point to a very obvious (serious errors of the AGK3, which increases in time).

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КАРАКТЕРИСТИКЕ БЕОГРАДСКОГ КАТАЛОГА ЗВЕЗДА ПРОГРАМА PZT У ОНДРЕЈЕВУ (BCPZT)

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Претходно саопштење

Београдски каталог звезда добијен из посматрања на Великом меридијанском кругу у Београду (2r=190mm, f=2578mm) непосредно је завршен по програму PZT у Ондрејеву. У овом раду добијени резултати су поређени са Каталогом звезда PZT у Ондрејеву (2r=250mm, f=3780mm) као и са AGK3. Систематске грешке добијене из ових поређења указују да су положаји звезда (α, δ) у каталозима Београда и Ондрејева одређени са високом тачношћу, док су сопствена кретања дата у AGK3 оптерећена систематским грешкама, које се повећавају са временом.