Bull. Astron. Belgrade № 152 (1995), 71 – 77

UDC 521.95/97:520.255
Original scientific paper

ON THE SYSTEMATIC ERRORS OF DECLINATIONS AND PROPER MOTIONS FROM THE BELGRADE ZENITH-TELESCOPE OBSERVATIONS IN THE PERIOD 1949-1960

G. Damljanović

Astronomical Observatory, Volgina 7, 11050 Belgrade, Yugoslavia

(Received: September 27, 1995)

SUMMARY: New reduction was carried out (in the FK5 reference frame) of the Belgrade ZT observations made in the period 1949-1960. The PPM Star Catalogue was used for the positions and the proper motions of our stars. The systematic errors of the declinations and the proper motions of groups and Talcott's pairs in that period are presented.

1. INTRODUCTION

At the beginning of 1990 we started the preparation of the Belgrade ZT (visual zenith-telescope Askania-Bamberg No 77241, 110/1287 mm) observations in a computer-readable form in order to make their new reduction in the FK5 reference frame.That was a part of my msc. thesis "The analysis of the variation of Belgrade latitude in the period 1949-1985". The HIPPARCOS catalogue had not been finished yet and we used the PPM Star Catalogue (Röser & Bastian, 1991).

After a year, 1991, at the XXI IAU General Assembly, Buenos Aires, Commission 19 of the International Astronomical Union, "Rotation of the Earth", formed WG ERHRF (the Working Group on Earth Rotation in the HIPPARCOS reference frame) to collect the past observations and to analyse them in that reference system. Our investigations are in line with it. The Hipparcos program is expected to provide star coordinates, proper motions and parallaxes at the 0 ".002 level of accuracy or better at the epoch of observation. It opens new possibilities for the analysis of the existing astronomical observations. The Hipparcos (ESA,1989) had observed the sets of reference stars used by most of the astronomical stations. It was necessary to collect the data and create a central data bank of optical astrometric observations. The WG ERHRF has set up a list of the best observations performed in the past (or are still in progress, as with Belgrade ZT). The Belgrade Observatory is in that list (Vondrák,Feissel and Essaifi, 1992) with the observations in the period 1949-1990 made with ZT.

We have presented the procedure for the new reduction of the New Belgrade Latitude Programme – NP (Ševarlić&Teleki,1960) for the period 1960–1985. The calculation was described and the basic results reported in Damljanović (1994). The procedure for the re-reduction of the Old Belgrade Latitude Programme-OP (Djurković, Ševarlić, Brkić, 1951) and the basic results are exposed here.

2. CATALOGUE AND CONSTANTS

We used the PPM Star Catalogue,Vol. I and Vol. II . It is a catalogue of 181 731 stars north of -2.5 degrees of declination for the equinox and epoch J2000.0 . The PPM is a rerpesentation of the FK5 system with higher star densities and fainter magnitudes and gives the original FK5 data for the stars contained in FK5 Part I and in FK5 Part II (the Basic Fundamental Stars and the Bright Extension Stars). This catalogue replaces two older catalogues which served for the same purpose in the past: AGK3 and the SAO Catalogues.

Flag "F" indicates stars that are contained in FK5 (Part I and Part II), flag "H" denotes the stars contained in AGK3R and/or one of the CMC (The Carlsberg Meridian Circle, nos. 1 to 4) catalogues, flag "D" denotes the double star.

Numerous stars of OP have obtained very precise coordinates and proper motions because 81% of its stars are with flag "F" or "H", 10% with flag "D". But "D" stars did make some problems in the observations and the reduction. Their coordinates and proper motions are of lower accuracy than those of single stars and their observations with ZT are difficult.

All the changes (in re-reduction) are in accordance with MERIT standards. The new astronomical constants IAU(1976), the coordinate system (as defined by FK5), the nutation model IAU(1980), and the dynamical reference system (defined by JPL DE200/LE200 ephemeris) are used. The FORTRAN programme for refraction is like that used in forming the "Refraction Tables of Pulkovo Observatory" (Abalakin, 1985).

The instrument's constants, applied in the re-reduction, are:

- the angular value of the micrometer screw revolution (R) was $40''.1073$ in the period 1949-1960 (it is in good accordance with its NP's value, $40''.1080$ in 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 temperature term, the progressive and the periodic errors of the micrometer screw revolution are not applied (Milovanović et al. 1981).

We took the radial velocities from The General Catalogue of Stellar Radial Velocities (Wilson,1953) and the trigonometric parallaxes from The General Catalogue of Trigonometric Stellar Parallaxes (Jenkins,1952) for the calculation of the apparent places of OP stars.

Seven systematic errors are taken into account (the correction for the curvature of the parallel, the wind effect, the deviation of the vertical, the E-W effect-the error due to the clamp position of ZT, the effect of the statistical parallaxes for the stars without trigonometric parallaxes, the effect of the level bubble lenght variation, the temperature terms of the levels). In the period 1949-1960 there were not any observers with numerous observed Talcott's pairs and the personal equation was not applied. The excessive instantaneous latitudes resulting from some Talcott's pairs were eliminated using of the Student-Fisher criterion. Thereupon the polar motion was eliminated from the material and the observations were brought in accordance with the mean pole BIH1979, being thus prepared for determinations of the systematic errors of declinations and proper motions of Talcott's pairs and groups of OP.

3. CALCULATIONS AND RESULTS

3.1 The systematic errors of the declinations and the proper motions of Talcott's pairs

For every year and every i–th pair (for the period 1949-1960) the values φ_{it_0} are determined:

$$\varphi_{it_0} = \frac{1}{n}\sum_{l=1}^{n}\varphi_{lit},$$

where: φ_{it_0} is the annual mean value, φ_{lit} is the instantaneous latitude at the epoch t, t – the epoch of observation, t_0 – the mean epoch of n observations, n – the annual number of observations.

We then derived, also for every year and every group k,

$$\varphi_{kt'_0} = \frac{1}{N}\sum_{j=1}^{N}\left(\frac{1}{p}\sum_{i=1}^{p}\varphi_{it}\right),$$

where $\varphi_{kt'_0}$ denotes the mean latitude from N annual values of the mean latitude of the group, N – the number of annual values of the mean latitude of the group, p – the number of pairs of the group. The group I contains 7 pairs, the group II 6 pairs, the group III 6 pairs, the group IV 7 pairs, the group V 7 pairs, the group VI 7 pairs, the group VII 7 pairs, the group VIII 7 pairs, the group IX 7 pairs, the group X 7 pairs, the group XI 6 pairs, the group XII 8 pairs. We used only the mean latitudes of groups resulting from five observed pairs at least. t'_0 is the mean epoch of observations. There are some cases of

$N = 0$. In that case $\varphi_{kt'_0}$ was the mean value from the remaining values $\varphi_{kt'_0}$ (for the years when $N \geq 1$). The evening data and the morning data were separated. There is always $N \leq n$.

Hence $t_0 \approx t'_0$, for each year (for each group k and every pair i in the group) we derive,

$$r = \varphi_{kt'_0} - \varphi_{it_0},$$

where: $k = 1, 2, ..., 12$, and $i = 1, 2, ..., 8$.

The equation of condition is (for each pair there are 24 equations, 12 equations from the evening data and as many equations from the morning data)

$$\sqrt{n}\Delta_{i_1}\delta + \sqrt{n}\Delta_{i_1}\mu'(t' - 1955.0) = \sqrt{n}r$$

for $(i_1 = 1, 2, ..., 82)$,

$$t' = \frac{1}{2}(t_0 + t'_0)$$

$$1955.0 = 1949.0 + \frac{1}{2}(1961.0 - 1949.0).$$

where: $\sqrt{n}$ is the weight, $\Delta_{i_1}\delta$ and $\Delta_{i_1}\mu'$ are the unknowns derived by the least square method (the results are displayed in Table 2.), t' is the epoch of value r. $\varepsilon_{\Delta_{i_1}\delta}$ and $\varepsilon_{\Delta_{i_1}\mu'}$ are the mean errors for $\Delta_{i_1}\delta$ and $\Delta_{i_1}\mu'$.

3.2 The systematic errors of the declinations and the proper motions of the groups

For two groups k and k+1 observed on the same night we have (for every year):

$$\varphi_{kt_0} = \varphi_{t_0} + \Delta\delta_k + \Delta\mu'_k(t_0 - 1955.0) + z_{t_0}$$

$$\varphi_{k+1t'_0} = \varphi_{t'_0} + \Delta\delta_{k+1} + \Delta\mu'_{k+1}(t'_0 - 1955.0) + z_{t'_0}$$

where: φ_{kt_0} is the mean latitude of group k observed at the epoch t_0 (with the polar changes only), φ_{t_0} is the observed mean latitude of the group (z_{t_0} and the systematic errors $\Delta\delta_k$, $\Delta\mu'_k$ are not eliminated), z_{t_0} is the local non-polar change at t_0, $\Delta\delta_k$ and $\Delta\mu'_k$ are the unknowns of the group.

$$\varphi_{kt_0} - \varphi_{k+1t'_0} = (\varphi_{t_0} - \varphi_{t'_0}) + (\Delta\delta_k - \Delta\delta_{k+1}) +$$

$$+(\Delta\mu'_k - \Delta\mu'_{k+1})(t - 1955.0) + (z_{t_0} - z_{t'_0})$$

$$t = \frac{1}{2}(t_0 + t'_0)$$

$$t_0 \approx t'_0.$$

Since (for four hours of observations)

$$\varphi_{kt_0} - \varphi_{k+1t'_0} \approx 0''.001$$

$$z_{t_0} - z_{t'_0} \approx 0''.01$$

we obtain the equation of condition (for each combination of the groups k and k+1 there are 12 equations,one equation for a year) with unknowns ε_k and ν_k :

$$\Delta\varphi_{kt} = \varepsilon_k + \nu_k(t - 1955.0)$$

where

$$\Delta\varphi_{kt} = -(\varphi_{t_0} - \varphi_{t'_0})$$

$$\varepsilon_k = \Delta\delta_k - \Delta\delta_{k+1}$$

$$\nu_k = \Delta\mu'_k - \Delta\mu'_{k+1}$$

for $k = 1, 2, ..., 12$. $\Delta\varphi_{kt}$ is the annual mean value from m values $-(\varphi_{t_0} - \varphi_{t'_0})$, and t is the mean epoch for $\Delta\varphi_{kt}$. We used only the observations of the group resulting from five observed pairs at least.

There are some years when groups k and k+1 were not observed in the same night ($m = 0$). For those cases we took for $\Delta\varphi_{kt}$ and t the mean values from the remaining values for years when groups k and k+1 were observed in at least one night conjointly. We used the condition $\sum_{k=1}^{12}\Delta\delta_k = 0$.

The least square metod gives the solution for ε_k and ν_k with their mean errors $\varepsilon_{\varepsilon_k}$ and ε_{ν_k}, k = 1, 2,..., 12. After using the conditions $\sum_{k=1}^{12}\varepsilon_k = 0$, and $\sum_{k=1}^{12}\nu_k = 0$ we get results set forth in Table 1. The systematic errors of declinations and proper motions of groups are calculated according to:

$$\Delta\delta_k = \frac{1}{12}(\varepsilon_{k+1} + 2\varepsilon_{k+2} + 3\varepsilon_{k+3} + ... + 11\varepsilon_{k+11})$$

$$\Delta\mu'_k = \frac{1}{12}(\nu_{k+1} + 2\nu_{k+2} + 3\nu_{k+3} + ... + 11\nu_{k+11})$$

$(k = 1, 2, ..., 12)$, the results being presented in Table 1 . $-0''.0525 \leq \Delta\delta_k \leq 0''.0783$, and $-0''.01219 \leq \Delta\mu'_k \leq 0''.01119$. The mean errors of $\Delta\delta_k$ and $\Delta\mu'_k$ are: less than $\pm 0''.0658$ for $\Delta\delta_k$, and less than $\pm 0''.0192$ for $\Delta\mu'_k$.

Table 1. The values ε_k and ν_k with their mean errors, and the systematic errors of declinations $\Delta\delta_k$ and propre motions $\Delta\mu'_k$ of groups

Groups	ε_k	$\varepsilon_{\varepsilon_k}$	ν_k	ε_{ν_k}	Group	$\Delta\delta_k$	$\Delta\mu'_k$
1- 2	0".0019	±0".0251	-0".0019	±0".0072	1	-0".0525	-0".00664
2- 3	.0985	.0371	.0008	.0107	2	-.0506	-.00856
3- 4	.0304	.0489	-.0004	.0145	3	.0479	-.00774
4- 5	-.0642	.0205	-.0040	.0059	4	.0783	-.00817
5- 6	.0070	.0291	.0130	.0084	5	.0141	-.01219
6- 7	-.0160	.0255	.0053	.0074	6	.0211	.00084
7- 8	.0120	.0158	.0037	.0046	7	.0051	.00615
8- 9	-.0522	.0245	.0005	.0071	8	.0171	.00981
9-10	.0436	.0233	-.0057	.0067	9	-.0351	.01035
10-11	-.0410	.0260	.0065	.0075	10	.0085	.00469
11-12	.0114	.0154	-.0109	.0045	11	-.0326	.01119
12- 1	-0".0314	±0".0229	-0".0069	±0".0066	12	-0".0211	0".00027

$\Delta\delta_k$ and $\Delta\mu'_k$ have been calculated previously (Ševarlić,1961).Our values$\Delta\delta_k$ are remarkably lesser than the old ones. This is because the FK3 and the AGK2A catalogues in the FK3 reference frame (whose accuracy is lower than PPM's one) were used in the past.

3.3 The final systematic errors of the declinations and the proper motions of Talcott's pairs

From:

$$\Delta\delta_{i_1} = \Delta\delta_k + \Delta_{i_1}\delta$$

$$\Delta\mu'_{i_1} = \Delta\mu'_k + \Delta_{i_1}\mu'$$

($i_1 = 1, 2, ..., 82$), we obtain the final systematic errors of declinations $\Delta\delta_{i_1}$ and proper motions $\Delta\mu'_{i_1}$ of Talcott's pairs for OP listed in Table 2. We have $-0".3159 \leq \Delta\delta_{i_1} \leq 0".3864$ and $-0".03385 \leq \Delta\mu'_{i_1} \leq 0".03083$. Some large values of $\Delta\delta_{i_1}$ come probably from Talcott ' s pairs whose stars entail problems (for example, wrong star observed for some time–"ws"), or star marked with flag "D", or without any flag (meaning that the coordinates of this star are of lower accuracy). They are: III group, 15th pair – "ws" and the second star is without any flag, VIII (48) – "ws" and both stars are with flag "DH", IV (24) – "ws" and the second star is without any flag, IV (23) – "ws" , VII (45) – the first star is without any flag, VIII (50) – the second star is without any flag, IX (61) – the first star is without any flag and the second star is with flag "D", I (5) – the first star is with flag "DH", II (13) – the first star is with flag "DH", III (16) – both stars are with flag "DH", V (30) – the first star is without any flag, VIII (51) – the second star is without any flag, VIII (53) – the second star is with flag "D", XI (71) – the second star is with flag "D". We can use both, $\Delta\delta_{i_1}$ and $\Delta\mu'_{i_1}$, because they are well evaluated from 12 years observations of OP (the evaluation for $\Delta\delta_{i_1}$ is better than the one for $\Delta\mu'_{i_1}$). The values $\Delta\delta_{i_1}$ and $\Delta\mu'_{i_1}$ are close to the mean errors of all PPM's stars, because the mean err.pos.1990 is 0".27, the mean err.prop.mt. for the mean epoche 1930.7 is 0".0042 (Röser & Bastian,1991), and $rms \leq 0".1$ (of the positions at the epoch 1950) of common stars after the catalogues ACRS and PPM are compared (Mitsuru Sôma,1993). The mean errors for $\Delta\delta_{i_1}$ and $\Delta\mu'_{i_1}$ are: less than ±0".0828 for $\Delta\delta_{i_1}$, and less than ±0".0257 for $\Delta\mu'_{i_1}$.

Table 2. The components $\Delta_{i_1}\delta$ and $\Delta_{i_1}\mu'$ with their the mean errors, and the final systematic errors of declinations and proper motions

Gr.	Pair	$\Delta_{i_1}\delta$	$\varepsilon_{\Delta_{i_1}\delta}$	$\Delta_{i_1}\mu'$	$\varepsilon_{\Delta_{i_1}\mu'}$	$\Delta\delta_{i_1}$	$\Delta\mu'_{i_1}$
I	1	−0".0415	±0".0225	0".00171	±0".00666	-0".0940	-0".00493
I	2	.1187	.0165	-.00119	.00492	.0662	-.00783
I	3	.1270	.0226	-.00308	.00683	.0745	-.00972
I	4	-.0382	.0164	-.00050	.00492	-.0907	-.00714
I	5	-.0676	.0151	-.00336	.00451	-.1201	-.01000
I	6	.0070	.0139	-.00420	.00415	-.0455	-.01084
I	7	-.1164	.0183	-.00241	.00553	-.1689	-.00905
II	8	.0976	.0235	-.00759	.00754	.0470	-.01615
II	9	.0012	.0232	-.00085	.00735	-.0494	-.00941

Table 2 (continued)

Gr.	Pair	$\Delta_{i_1}\delta$	$\varepsilon_{\Delta_{i_1}\delta}$	$\Delta_{i_1}\mu'$	$\varepsilon_{\Delta_{i_1}\mu'}$	$\Delta\delta_{i_1}$	$\Delta\mu'_{i_1}$
II	10	-.1048	.0164	-.01245	.00529	-.1554	-.02101
II	11	.0699	.0141	.00217	.00453	.0193	-.00639
II	12	.0014	.0223	.02281	.00717	-.0492	.01425
II	13	-.0916	.0235	-.01424	.00764	-.1422	-.02280
III	14	-.1540	.0331	.01082	.01084	-.1061	.00308
III	15	.3385	.0503	-.00201	.01705	.3864	-.00975
III	16	.0751	.0275	-.02611	.00924	.1230	-.03385
III	17	-.1345	.0243	.00076	.00825	-.0866	-.00698
III	18	-.0625	.0278	.00778	.00946	-.0146	.00004
III	19	-.0614	.0243	.00635	.00787	-.0135	-.00139
IV	20	-.0823	.0240	-.00044	.00673	-.0040	-.00861
IV	21	-.0725	.0370	.01181	.01076	.0058	.00364
IV	22	-.0158	.0328	-.00265	.00938	.0625	-.01082
IV	23	.0555	.0425	-.01409	.01220	.1338	-.02226
IV	24	.1194	.0177	-.00869	.00501	.1977	-.01686
IV	25	-.0835	.0247	.01397	.00694	-.0052	.00580
IV	26	.0653	.0376	.01519	.01076	.1436	.00702
V	27	.0449	.0344	.00135	.00920	.0590	-.01084
V	28	.0750	.0223	.01051	.00595	.0891	-.00168
V	29	-.0245	.0312	.02292	.00845	-.0104	.01073
V	30	.1086	.0236	-.00090	.00626	.1227	-.01309
V	31	-.0549	.0285	-.01039	.00760	-.0408	-.02258
V	32	-.1497	.0244	.00065	.00655	-.1356	-.01154
V	33	.0437	.0243	.00437	.00651	.0578	-.00782
VI	34	-.0095	.0179	-.01214	.00538	.0116	-.01130
VI	35	-.0955	.0192	.01110	.00599	-.0744	.01194
VI	36	-.0254	.0290	.01535	.00886	-.0043	.01619
VI	37	.0567	.0189	-.00232	.00588	.0778	-.00148
VI	38	.0157	.0145	.00574	.00452	.0368	.00658
VI	39	.0318	.0307	-.00009	.00928	.0529	.00075
VI	40	.0241	.0274	-.02788	.00820	.0452	-.02704
VII	41	.2084	.0190	.00652	.00553	.2135	.01267
VII	42	-.0627	.0205	-.00841	.00596	-.0576	-.00226
VII	43	.0136	.0146	.00293	.00427	.0187	.00908
VII	44	.1164	.0280	-.00774	.00817	.1215	-.00159
VII	45	-.3210	.0223	.00304	.00641	-.3159	.00919
VII	46	-.0281	.0168	-.01833	.00486	-.0230	-.01218
VII	47	.1225	.0178	.00479	.00507	.1276	.01094
VIII	48	.0954	.0171	-.00216	.00483	.1125	.00765
VIII	49	-.0072	.0157	.00515	.00446	.0099	.01496
VIII	50	.2914	.0189	.01700	.00533	.3085	.02681
VIII	51	-.1742	.0160	-.00902	.00452	-.1571	.00079
VIII	52	.0243	.0193	-.00364	.00550	.0414	.00617
VIII	53	-.1946	.0162	-.00198	.00463	-.1775	.00783
VIII	54	-.0291	.0183	-.00462	.00522	-.0120	.00519
IX	55	.0613	.0253	.00715	.00743	.0262	.01750
IX	56	.0417	.0165	.00356	.00483	.0066	.01391
IX	57	.0523	.0161	.00030	.00480	.0172	.01065
IX	58	.0179	.0146	-.00301	.00437	-.0172	.00734
IX	59	.0261	.0137	.00721	.00410	-.0090	.01756
IX	60	.0120	.0152	.00148	.00452	-.0231	.01183
IX	61	-.1968	.0163	-.00755	.00480	-.2319	.00280
X	62	.0665	.0163	-.00287	.00489	.0750	.00182
X	63	.0631	.0183	-.00020	.00552	.0716	.00449
X	64	-.0008	.0215	-.00418	.00650	.0077	.00051
X	65	-.0081	.0164	.00638	.00497	.0004	.01107
X	66	-.0260	.0113	-.00455	.00343	-.0175	.00014
X	67	-.0177	.0238	-.00186	.00732	-.0092	.00283
X	68	-.0932	.0239	.00733	.00718	-.0847	.01202
XI	69	.0749	.0223	.01964	.00677	.0423	.03083
XI	70	-.0488	.0230	-.00647	.00703	-.0814	.00472
XI	71	-.1159	.0160	-.00345	.00488	-.1485	.00774
XI	72	.0885	.0183	-.00450	.00563	.0559	.00669
XI	73	.0145	.0177	.00103	.00541	-.0181	.01222
XI	74	.0230	.0179	-.00428	.00537	-.0096	.00691

Table 2 (continued)

Gr.	Pair	$\Delta_{i_1}\delta$	$\varepsilon_{\Delta_{i_1}\delta}$	$\Delta_{i_1}\mu'$	$\varepsilon_{\Delta_{i_1}\mu'}$	$\Delta\delta_{i_1}$	$\Delta\mu'_{i_1}$
XII	75	-.0004	.0165	.00679	.00462	-.0215	.00706
XII	76	.0035	.0195	.00026	.00552	-.0176	.00053
XII	77	-.0108	.0169	.00248	.00484	-.0319	.00275
XII	78	.0271	.0157	-.01481	.00448	.0060	-.01454
XII	79	-.0254	.0117	-.00012	.00335	-.0465	.00015
XII	80	.0570	.0158	-.00917	.00458	.0359	-.00890
XII	81	-.0456	.0199	.00913	.00566	-.0667	.00940
XII	82	-0".0155	±0".0174	0".00375	±0".00501	-0".0366	0".00402

$\Delta\mu'_k$, $\Delta_{i_1}\mu'$,and $\Delta\mu'_{i_1}$ are in seconds of arc per year.

4. CONCLUSION

The 12 years period (1949-1960) is used to derive the final systematic errors of declinations and proper motions of the groups and the Talcott's pairs comprised in OP. The whole material is corrected by them and the mean error (of the instantaneous latitude from one Talcott's pair) comes out less than before. From the preliminary ZT observations made in 1947 the mean error was ±0".255 (Djurković, Ševarlić, Brkić, 1951). The mean error of the OP in the period 1949-1960 was ±0".220 (Ševarlić and Teleki, 1960). After our re-reduction the mean error is: ±0".211 (1949-1951.5), ±0".195 (1951.5-1953.5), ±0".192 (1953.5-1957), ±0".205 (1958-1960), and ±0".199 (1949-1960). This may also be a contribution to Hipparcos program. With the Hipparcos Catalogue we shall get better possibility to find out the systematic errors and obtain result with better accuracy. Then the old observations (made with classical instruments) will be in better accordance with the new ones (made with new techniques). It will afford a new insight into precession and nutation. The Belgrade Observatory with its ZT observations can take part in that work and this was the reason for the present re-reduction of the old ZT observations.

Acknowledgment – This work has been supported by Ministry for Science and Tehnology of Serbia through the project "Physics and Motions of Celestial Bodies".

REFERENCES

***: 1977, *IAU Transaction*, Reidel Publ., **XVIB**, Dordrecht.
***: 1984, *JPL DE200/LE200 Ephemeris*, USNO Tapes NA0109 & NA0110.
***: 1989, *Hipparcos mission*, ESA, SP-1111, Vol. II, 252.
Abalakin, V. K., ed.: 1985, *Refraction Tables of Pulkovo Observatory* (V edition), NAUKA, Leningrad, GAO AN SSSR.
Aoki, S., Guinot, B., Kaplan, G. H., Kinoshita, H., McCarthy, D. D., Seidelmann, P. K.: 1982, *Astron. Astrophys.*, **105**, 359.
Damljanović, G.: 1994, *Bull. Obs. Astron. Belgrade,* **150**, 29-35.
Djurković, P., Ševarlić, B., Brkić, Z.: 1951, *Publ. Obs. Astron. Belgrade,* **4**.
Fricke, W., Schwan, H., Lederle, T. :1988, *Fifth Fundamental Catalogue (FK5). Part I. The Basic Fundamental Stars.,* Veröff. Astron. Rechen-Institut, Heidelberg, Nr. 32.
Fricke, W., Schwan, H., Corbin, T., et al.: 1991, *Fifth Fundamental Catalogue (FK5). Part II. The FK5 Extension - New Fundamental Stars.,* Veröff. Astron. Rechen-Institut, Heidelberg, Nr. 33.
Grujić, R., Teleki, G.: 1982, *Hvar Obs. Bull. Suppl.,* **6**, No. 1, 71.
Jenkins, L. F.: 1952, *Gen. Cat. of Trigonometric Stel. Parallaxes,* Yale University Obs.
Kapteyn, J. C.: 1920, *Astron. J.*, **52**, 23.
Lieske, J. H., Lederle, T., Fricke, W., Morando, B.: 1977, *Astron. Astrophys.*, **58**, 1.
Lieske, J. H.: 1979, *Astron. Astrophys.*, **73**, 282.
Mueller, I. I.: 1969, *Spherical and Practical Astronomy as Applied to Geodesy,* F. Ungar Publishing Co., Inc.
Milovanović, V., Teleki, G., Grujić, R.: 1981, *Publ. Astron. Obs. Sarajevo,* **1**, 131.
Melbourne, W., *et al.*: 1983, *Project Merit Standards*, USNO Circular, No. 167.
Mitsuru Sôma : 1993, IAU, *Developments in Astrometry and Their Impact on Astrophysics and Geodynamics*, I.I.Mueller and B.Kolaczek (eds.), Printed in the Netherlands, 404.
Roeser, S., Bastian, U.: 1991, *Positions and Proper Motions (PPM) Star Catalogue,* Astron. Rechen-Institut, Heidelberg.
Smart, W. M.: 1958, *Combination of Observations*, Cambridge, University Press.
Ševarlić, B.: 1961, *Publ. Obs. Astron. Belgrade,* **9**, 63.

Ševarlić, B., Teleki, G.: 1960, *Bull. Obs. Astron. Belgrade,* **24**, No. 3/4, 19.

Vondrák, J., Feissel, M., Essaifi, N.: 1992, *Astron. Astrophys.*, **262**, 329.

Wilson, R. E.: 1953, *Gen. Cat. of Stel. Radial Velocities,* Mount Wilson Obs., Carnegie Institution of Washington Publ. 601.

Yumi, S., Yokoyama, K.: 1980, *Results of the International Latitude Service in a homogeneous system 1899.9-1979.0,* Central bureau IPMS, Mizusawa.

СИСТЕМАТСКЕ ГРЕШКЕ ДЕКЛИНАЦИЈА И СОПСТВЕНИХ КРЕТАЊА ГРУПА И ТАЛКОТОВИХ ПАРОВА СТАРОГ ПРОГРАМА ИЗ ПОСМАТРАЊА НА БЕОГРАДСКОМ ЗЕНИТ-ТЕЛЕСКОПУ ЗА ПЕРИОД 1949-1960

Г. Дамљановић

Астрономска опсерваторија, Волгина 7, 11050 Београд, Југославија

УДК 521.95/97:520.255
Оригинални научни рад

Дате су вредности систематских грешака деклинација и сопствених кретања група и Талкотових парова Старог Програма - СП из посматрања на Београдском зенит-телескопу. За њихово добијање коришћен је посматрачки материјал добијен у периоду 1949-1960.