Publications of the Department of Astronomy — Beograd, № 12, 1983.

UDC 521.27; 521.113 OSP

CORRECTIONS OF THE RIGHT ASCENSIONS OF 297 KSV STARS

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Received June 29, 1982

Abstract: Corrections of right ascensions of 297 stars are determined from the observations with the small transit instrument of Belgrade Observatory in the period 1969—1979. The systematic errors of the type $\Delta\alpha_\delta$ is verying by 0.ˢ025; systematic errors $\Delta\alpha_\alpha$ are of the order 0.ˢ01. This agrees well with the results obtained elsewhere.

S. Šegan: Popravke rektascenzija 297 zvezda određene su iz posmatranja na malom pasažnom instrumentu Opservatorije u Beogradu u periodu 1969—1979. godine. Popravke tipa $\Delta\alpha_\delta$ variraju u granicama od 0.ˢ025, a popravke tipa $\Delta\alpha_\alpha$ su reda 0.ˢ01 što se dobro slaže sa ranijim rezultatima.

1. INTRODUCTION

After pioneer works of M. S. Zver'ev (1950) and N. N. Pavlov (1951) it was shown that the determination of the right ascension corrections Δ_α from Time Service observations was possible.

The catalogue improuvements based on observations collected during The International Geophysical year (Afanas'eva, 1957; Guinot, 1959; Pavlov, 1961) have confirmed that the use of Time Service observations for Δ_α computation and, inverse, the use of Δ_α corrections make Universal Time determination more precise and accurate.

The first Δ_α corrections from Belgrade Time Service observations (transit instrument BAMBERG №. 63131, D=10 cm, F=100 cm) have been obtained by Đurović (1976).

We will represent in this paper some results concerning Δ_α computation from later observations (1969—1979).

2. INSTRUMENT AND METHOD OF OBSERVATION

From April 1969 up to December 1979 one programme of 297 stars of the soviet time services catalogue (KSV), divided into 27 groups, has been observed. Each group contained one star $\delta \subset (60°, 70°)$ observed in the lower culmination. We will use this observation for absolute azimut computation.

The star distribution as a function of δ is given in the Table 1.

TEBLE 1

group / zone			3		5		7		9		11		13		15		17		19		21		23		25		27
1	4	3	4	4	2	4	3	4	3	4	3	3	4	3	3	3	3	3	4	4	4	4	3	3	2	3	4
2	0	0	0	1	1	0	0	0	1	0	1	0	0	1	0	1	0	1	0	1	0	0	0	0	2	1	0
3	3	5	4	4	4	3	4	3	3	3	4	3	3	3	4	3	5	4	3	3	3	4	4	5	3	3	2
4	3	2	2	1	3	3	3	3	3	3	2	4	3	3	3	3	2	2	3	2	3	2	3	2	3	3	4
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

The names of the zones: 1 — equatorial, 2 — intermediairre, 3 — zenithal, 4 — northern, 5 — lower culmination

The registration of observed moments has been made by electromagnetic chronograph.

The standard deviation (s. d.) of the high pass observation, of Universal Time is

$$E = \pm 0^s.031 \quad .$$

The clock correction $C(k)$ has been computed by well known Mayer's formula.

Major part of observations has been made in early evening hours. Before the begining of observations (1 hour at last) the dome had been opened.

3. OBSERVATION SMOOTHING AND CORECTIONS OF THE RIGHT ASCENSIONS

Apparent star positions were computed in Pulkovo (USSR) in the catalogue system of soviet Time Services (from 1971 it is KSV).

For each observation of the group i we have one system of equations:

$$U(k) = C(k) + M(k)\ A(k) \quad , \tag{1}$$

where $U(k) = \alpha(k) - T(k)$ represent the »observed« values. If A and C are the solutions of the system (1), the residues

$$v(k) = U(k) - C + M(k)\ A) \tag{2}$$

serves for internal smoothing of $C(k)$.

Reapeted observation of the group i gives for each star k an assemble of residues $v(k)$. *Let* $\lambda(k)$ represents ist mean value. The smoothed (corrected) values of observed function $U_c(k)$ are computed by the formula:

$$U_c(k) = C + M(k)\ A + \lambda(k) \tag{3}$$

The annual values of s. d. E before and after smoothing and the number of rejected observations are given in the Table 3.

TABLE 3

year	before smoothing E ($0^s.001$)	Nr	after smoothing E ($0^s.001$)	Nr
1969	±31	59	±28	1
1970	36	15	30	3
1971	35	32	29	7
1972	35	21	29	7
1973	34	69	30	4
1974	34	35	28	1
1975	38	36	31	11
1976	40	39	35	6
1977	41	32	36	12
1978	37	19	34	4
1979	±40	20	±37	7

Besides corrections of $\lambda(k)$ some other systematical errors were established and eliminated.

By analizing the measured inclination of the horizontal axis we get the existence of systematical difference of clock correction wich depends on the observational order. The mean annual values of these differences are shown in the Table 4.

TABLE 4 ($0^s.0001$)

year	$\Delta\beta = \beta(EW) - \beta(WE)$	$\Delta C = C(EW) - C(WE)$	Number of obs. nights
1969	—22	—110	213
1970	—29	— 39	147
1971	—25	— 20	151
1972	—21	— 13	113
1973	—34	— 36	75
1974	—34	— 9	105
1975	—24	— 41	122
1976	—37	— 19	101
1977	—29	— 70	111
1978	—44	— 66	65
1979	——	— 21	86

Mean values are:

$$\Delta\beta = -0^s.0030 \pm 0^s.0004 \quad , \quad \Delta C = -0^s.0031 \pm 0^s.0006$$

It is probable that a part of ΔC could be explained by the $\Delta\beta$.

The azimuts $A(k)$ have been computed by using of observations of each non-zenithal star and »mean« zenithal star. Let $DA(j)$ represents the difference between mean $A(k)$ of the southern ($\delta < +30°$) and northern ($\delta > +55°$) stars for the observation night j

$DA(j) = (A(S) - A(N))j.$

The weights of azimuts A have been computed by the formula:

$$W(k) = (M(k) - M(z))^2 \cos^2\delta(k) \quad ,$$

where $M(z)$ is the mean azimuthal coefficient for the zenithal zone.

Let:

$$A'(k) = \begin{cases} A(k) \text{ , for southern stars} \\ A(k) + DA(j) \text{, for northern stars.} \end{cases}$$

The system of equations:

$$A'(k) = A_o + \Delta A\,(\alpha(k) - \alpha_o) + \text{error} \quad , k = 1,n$$

has been solved by the least square method (α_o represents a mean α). In the next step of computation the smoothed azimuts:

$$\bar{A}(k) = A_o + \Delta A\ (\alpha(k) - \alpha_o)$$

were used.

The corrected $C(k)$ is:

$$C'(k) = U(k) - M(k)\bar{A}(k) \ .$$

For the observation night j the mean difference

$$DC(j) = C'(EW) - C'(WE)$$

was applied to reduce the all results to the order EW:

$$C''(k) = \begin{cases} C'(k) + DC(j) \text{ , for WE} \\ C'(k) \qquad\qquad \text{ , for EW.} \end{cases}$$

With $C''(k)$ and $\bar{A}(k)$ the residues $v(k)$ (equation 2) and new, corrections $\lambda(k)$ computed for two observation cycles:

1969—1974 (cycle I) and

1975—1979 (cycle II).

The external coherence between groups is not improved because of very great the closing error of the system:

$$C_g(^i) - C_g(^{i+1}) = L(i),$$
$$C_g(^{i+27}) = C_g(^i) \ , \qquad (i) = 1,2,\ldots,27).$$

$L(i)$ represents the mean difference of the mean corrections $C''(k)$ for groups i and $i+1$. Thus, the absolute error $\Delta\alpha_a$ of KSV could not be obtained.

The absolute azimut Aa is computed in two steps. From the observations of upper and lower culminations of northern stars from the same zone of δ for each group was computed

$$A'a = \frac{U_c(N) - U'_c(N)}{M(N) - M'(N)} \tag{5}$$

$U_c(N)$, $M(N)$ represents the means of corrected $U(k)$ and $M(k)$ of northern stars, $U'_c(N)$, $M'(N)$ are relative to the star in lower culmination. $A'a$ is not free of $\Delta\alpha_a$ of KSV. Let DA (see the Table I) represents the annual mean of differences:

$$DA(k) = A'a - \mathring{A}_c(k) \ .$$

As the frequency of observations different groups varie in the wide range, the component $\Delta\alpha_a$ in DA is very important.

With:

$$\mathring{A}(k) = \mathring{A}_c(k) + DA \tag{6}$$

the new corrections $C(k)$ were computed:

$$C(k) = C_c(k) - M(k)\mathring{A}(k) \ . \tag{7}$$

For each observation night j and each observed star k we calculated the difference:

$$D\alpha(k, j) = C(k) - Cz \ ,$$

were Cz represents the mean $C(k)$ for zenithal stars. Let $D\alpha(k)$ represents the mean of $D\alpha(k, j)$ over a cycle of observation.

The same star k observed in two culminations has two corrections of α:$D\alpha_u(k)$ *and* $D\alpha_l(k)$, were indices u and l are relatives to upper and lover culmination.

In the second step the last correction of azimut CA is computed according to:

$$CA = \frac{D\alpha_u(k) - D\alpha_l(k)}{M_u(k) - M_l(k)}$$

For two cycles (I and II) the correction CA has the values:
$CA(I) = 0^s.003 \pm 0^s.001$, $CA(II) = 0^s.004 \pm 0^s.001$
Definitive corrections of α have been computed by correcting $D\alpha(k)$:

$$\Delta\alpha(k) = D\alpha(k) - M(k) \cdot CA \tag{8}$$

4. THE COMPARISON OF BELGRADE CATALOGUE B2 WITH OTHERS

The system $\Delta\alpha(k)$ $(k = 1,297)$, named system B2, is given in Annexe I. It represents the system of mean corrections for two mentioned cycles.

The s.d. of $\Delta\alpha(k)$ for two cycles is:

$$E(I) = E(II) = \begin{cases} \pm 0^s.018 \sec\delta, \text{ without of lower culm.,} \\ \pm 0^s.020 \sec\delta, \text{ with them.} \end{cases}$$

According to Đurović (1976) s.d. —s are: for meridian circle of Moscou $E = \pm 0^s.019 \sec\delta$, for Tepfer's meridian circle of Pulkovo $E = \pm 0^s.017 \sec\delta$ and for photographic circle of Copenhagen $E = \pm 0^s.015 \sec\delta$. The mean $\Delta\alpha(k)$ for different declination zones ($\Delta\alpha_\delta$) are given in the Table II. As we will see later, total variation $\Delta\alpha_\delta$ of FK4 is approximatelly $0^s.030$. This result is agreement with result of other autors (Afanas'eva-Staritzin, 1971; Đurović, 1976; Mancuso, 1973).

$\Delta\alpha'(k)$ for three zones of δ: (—10°, +30°), (+30°, +55°) and (+55°, +70°) were computed according to:

$$\Delta'\alpha(k) = \Delta\alpha(k) - \Delta\alpha_\delta.$$

This difference according to used method of determination $\Delta\alpha(k)$ represents the differential zonal correction $\Delta\alpha_\alpha$ of zenithal zone.

$\Delta'\alpha_\alpha$ are given in the Table III.

The magnitude error $\Delta\alpha(m)$ (Table IV) is computed from equation:

$$\Delta\alpha(m) = \Delta\alpha(k) - \Delta\alpha_\delta - \Delta'\alpha_\alpha.$$

The corrections $\Delta\alpha(k)$ for the cycle I (system I) and the cycle II have been reduced to the system FK4 by using $\Delta\alpha(k)$ of 204 common stars of FK4 and KSV. The differences α (KSV) — α(FK4) are published in Astr. zhurnal Academ. nauk SSSR, 1973. The error $\Delta\alpha_\delta$ of FK4 with respect to systems I, II, KSV and precedent Belgrade system B1, is given in the Table V and show in the Figure 1. On the basis of these results we assume that the corrections $\Delta\alpha(k)$ in Annexe I could be used for improuvement of the accuracy and more precise of determination Universal Time.

TABLE I (in $0^s.001$)

year	DA	s.d. (DA)	CA	s.d. (CA)	frequency
1969	11	±27	+3	±1	184
1970	12	2	3	1	125
1971	8	2	3	1	101
1972	—	—	—	—	—
1973	—	—	—	—	—
1974	15	5	3	2	29
1975	— 2	2	4	1	85

year	DA	s.d. (DA)	CA	s.d. (CA)	freguency
1976	—19	3	4	1	84
1977	—15	2	4	1	102
1978	—17	3	4	2	53
1979	—16	± 3	4	±1	66

TABLE II

zone δ	mean δ	$\Delta\alpha_s$	s. d. ($\Delta_{\alpha s}$)	mean az. coef.
—10°, 10°	2°.17	0s.007	±0s.001	0.6677
10, 10	15.44	0.001	0.002	0.5082
20, 30	24.39	—0.005	0.002	0.3821
30, 40	36.39	0.000	0.002	0.1794
40, 50	45.49	—0.002	0.001	—0.0212
50, 60	55.41	0.002	0.002	—0.3328
60, 70	63.80	0.006	0.002	—0.7514

TABLE III

zone decl. r. asc.	—10°, +30°	+30°, 55°	+55°, +70°
1h.4	0s.002±0s.001	0s.000±0s.003	—0s.005±0s.004
4.0	—0.001 0.002	0.000 0.002	—0.009 0.006
6.7	—0.002 0.003	0.002 0.002	—0.008 —
9.3	0.000 0.002	0.001 0.002	—0.004 0.004
12.0	0.002 0.002	0.000 0.004	0.000 0.006
14.7	0.000 0.001	0.002 0.003	—0.007 0.007
17.3	0.001 0.002	—0.002 0.004	0.011 0.007
20.0	—0.001 0.002	0.000 0.002	0.001 0.004
22.7	—0.001 0.002	0.000 0.002	0.012 —

TABLE IV

APP. MAGNITUDE	WEIGHT	CORRECTIONS
1m.5	21	—0s.002±0s.001
2.5	106	—0.004 —
3.5	155	0.001 0.002
4.5	600	—0.002 0.002
5.5	986	0.000 0.001
6.5	904	0.002 —

TABEL V

KSV — FK4 mean δ		B2 — KSV mean δ		B2 — FK4	B1 — FK4
— 2°.5	0s.007	— 1°.7	0s.010	0s.016	0s.030
7.5	— 5	6.8	4	— 2	25
17.5	— 8	17.6	1	— 8	25
27.5	— 5	26.7	— 5	— 10	12

KSV — FK4 mean δ		B2 — KSV mean δ			B2 — FK4	B1 — FK4
37 .5	1	39 .0		0	— 1	3
47 .5	2	47 .2	—	2	0	1
57 .5	3	57 .7		2	6	6
67 .5	0 .007	65 .1		006	0 .014	0 .007

The work is a part of the research project of the Basic Organization of Associated Labour for Matematics, Mechanics and Astronomy of the Belgrade Faculty of Sciences, funded by the Republic Community of Sciences of Serbia.

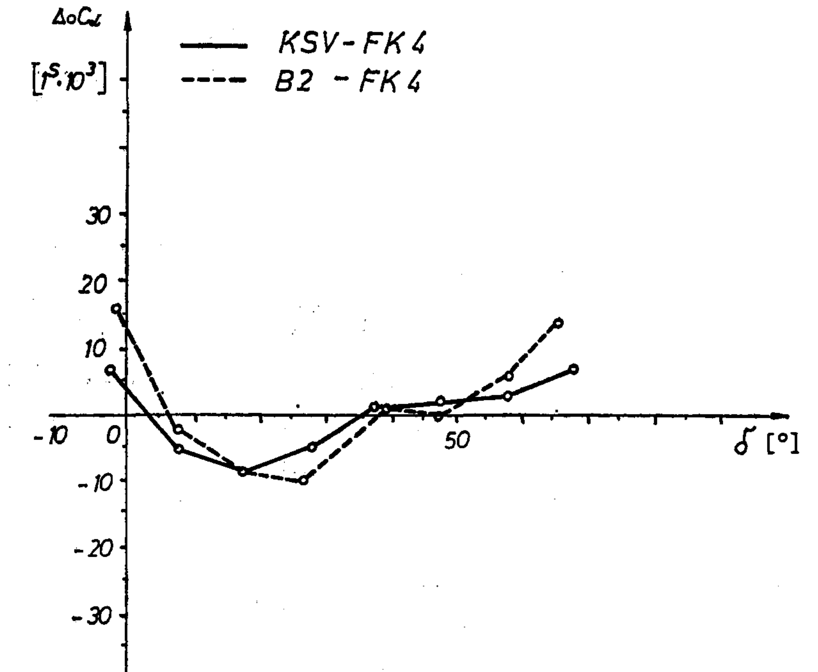

Fig. 1

APPENDIX

1	2	3	4	5	5'	6	7
1.	2	480	58.98	0.0003	-0.0068	0.009	2.4
2.	7	720	15.02	0.0126	-0.0012	0.006	2.9
3.	26KGZ	900	61.37	-0.0153	-0.0271	0.007	5.8
4.	1009	1200	37.80	-0.0070	-0.0059	0.003	5.2
5.	1010	1440	1.77	0.0094	0.0283	0.006	6.0
6.	43KGZ	1620	44.23	0.0164	0.0207	0.004	5.2
7.	16	1860	62.77	0.0158	0.0152	0.006	4.2
8.	17	2100	53.73	0.0051	-0.0109	0.003	3.7
9.*	478	2400	62.80	-0.0252	0.0147	0.004	5.9
0.	27	2760	24.10	-0.0027	-0.0053	0.004	4.3
1.	1022	3060	- 1.30	0.0050	0.0065	0.004	4.9
1	1373	3233		37	20		
12.	33	3300	38.33	-0.0070	0.0034	0.003	3.9
13.	36	3660	7.73	0.0094	0.0016	0.006	4.4
14.	1030	3960	54.77	0.0126	0.0212	0.005	5.3
15.	1033	4320	7.42	0.0023	-0.0044	0.005	5.6
16.	1034	4560	3.45	0.0108	0.0173	0.004	5.3
17.	1035	4860	45.37	-0.0001	0.0033	0.002	5.0
18.	48	5040	60.08	0.0145	-0.0096	0.006	2.8
19.	178KGZ	5280	46.85	-0.0292	-0.0285	0.003	5.3
20.	184KGZ	5520	59.08	0.0059	-0.0193	0.007	4.9
21.	52	5760	48.48	-0.0007	-0.0007	0.004	3.8
22.*	185270C	6060	64.97	-0.0891	-0.0488	0.011	5.7
♦ 2	1278	2841		32	24		
23.	1050	6420	16.80	0.0138	-0.0026	0.002	5.7
24.	63	6720	63.52	0.0266	0.0133	0.003	3.4
25.	230KGZ	6960	17.67	-0.0008	-0.0002	0.002	5.2
26.*	521	7440	64.52	-0.1530	-0.0064	0.002	3.6
27.	75	7680	34.85	-0.0006	0.0093	0.002	3.1
28.	77	7920	50.93	-0.0046	0.0031	0.002	5.4
29.	1063	8220	47.25	0.0105	-0.0041	0.002	5.1
30.	285KGZ	8400	55.72	-0.0093	-0.0134	0.002	5.2
31.	290KGZ	8640	50.15	0.0094	-0.0023	0.002	4.9
32.	1069	8940	17.57	0.0080	-0.0045	0.003	6.4
33.	1072	9240	5.47	-0.0036	0.0037	0.004	5.0
♦ 3	1359	2683		27	21		
34.	91	9480	0.20	-0.0010	-0.0042	0.003	4.0
35.	93	9720	49.10	-0.0109	-0.0080	0.002	4.2
36.	333KGZ	9960	29.12	0.0034	-0.0121	0.004	4.6
37.	103	10320	52.63	-0.0019	0.0110	0.001	4.1
38.*	554	10620	66.05	-0.0382	-0.0025	0.005	4.9
39.	108	10980	53.38	0.0022	-0.0005	0.001	3.1
40.	112	11220	49.50	-0.0028	-0.0165	0.002	4.2
41.	114	11400	19.62	-0.0166	-0.0014	0.003	4.5
42.	1089	11580	20.93	0.0051	0.0013	0.004	5.0
43.	1093	11880	3.27	0.0085	0.0268	0.004	5.0
44.	1096	12120	64.48	-0.0068	0.0273	0.004	5.6
♦ 4	1563	2767		29	15		

APPENDIX (CONT.)

1	2	3	4	5	5'	6	7
45.	122	12420	59.83	-0.0205	-0.0127	0.002	4.4
46.	1098	12660	35.37	0.0035	0.0104	0.002	5.8
47.	1101	12900	0.30	0.0023	0.0073	0.003	4.4
48.	129	13200	63.12	0.0008	-0.0039	0.005	5.3
49.*	587	13560	62.70	-0.0376	0.0286	0.008	5.1
50.	1105	13860	57.88	-0.0027	0.0015	0.005	5.8
51.	147	14160	39.92	0.0052	0.0044	0.002	3.0
52.	150	14340	12.40	-0.0074	-0.0022	0.007	3.8
53.	1113	14640	50.27	-0.0127	0.0038	0.002	4.3
54.	1116	14940	26.40	-0.0002	-0.0221	0.006	5.6
55.	1117	15180	48.33	-0.0013	-0.0113	0.001	4.3
♦ 5	1621	2957		22	12		
56.	548KGZ	15480	65.07	0.0101	0.0295	0.007	5.4
57.	1120	15720	- 3.82	0.0152	0.0040	0.003	5.2
58.	164	16020	19.12	0.0033	-0.0038	0.002	3.6
59.	1124	16260	43.00	0.0018	0.0006	0.002	6.1
60.	169	16500	- 3.42	0.0014	0.0106	0.003	4.1
61.	1128	16860	49.92	0.0047	-0.0049	0.002	5.8
62.	175	17100	56.70	-0.0176	-0.0131	0.004	5.4
63.	179	17400	5.55	-0.0038	-0.0103	0.003	3.8
64.*	2027KGZ	17760	65.18	-0.0302	0.0720	0.025	4.8
65.	182	18060	60.40	-0.0219	-0.0115	0.008	4.2
66.	185	18240	41.20	0.0046	-0.0007	0.003	3.3
♦ 6	1538	2990		22	21		
67.	672KGZ	18480	46.93	0.0071	0.0107	0.003	5.6
68.*	2051KGZ	18720	62.90	0.0291	0.0103	0.009	5.5
69.	710KGZ	19080	62.62	-0.0116	0.0012	0.010	5.9
70.	201	19440	6.32	0.0054	0.0049	0.006	1.7
71.	203	19620	63.05	-0.0205	-0.0006	0.009	5.8
72.	208	19980	9.47	0.0032	0.0079	0.004	4.5
73.	789KGZ	20340	65.68	0.0060	0.0322	0.007	5.8
74.	216	20640	49.02	-0.0113	-0.0106	0.003	5.5
75.	221	20940	39.13	-0.0069	-0.0033	0.002	4.2
76.	224	21240	7.40	0.0000	0.0023	0.006	0.1
77.	227	21420	44.95	0.0008	-0.0071	0.002	2.1
♦ 7	1487	3065		15	30		
78.	1163	21720	23.27	-0.0006	0.0006	0.007	4.3
79.	232	21960	14.77	0.0011	0.0037	0.004	4.4
80.*	685	22440	64.38	-0.0403	0.0153	0.010	5.0
81.	885KGZ	22740	53.47	0.0074	0.0226	0.005	5.4
82.	242	22980	49.30	0.0010	-0.0034	0.004	5.1
83.	906KGZ	23280	58.18	-0.0158	0.0037	0.008	6.0
84.	1174	23460	7.35	-0.0013	0.0019	0.009	4.5
85.	247	23700	61.52	-0.0063	-0.0110	0.012	6.0
86.	931KGZ	24060	44.55	-0.0135	-0.0089	0.004	5.2
87.	948KGZ	24480	67.60	-0.0179	-0.0099	0.013	5.0
88.	963KGZ	24780	- 1.08	0.0012	-0.0006	0.005	5.3
♦ 8	1351	3178		18	29		

APPENDIX (CONT.)

1	2	3	4	5	5′	6	7
89.	971KGZ	25020	3.65	0.0165	0.0202	0.006	6.0
90.	980KGZ	25380	59.85	-0.0064	-0.0064	0.013	6.5
91.	986KGZ	25620	15.98	-0.0066	-0.0255	0.006	5.6
92.*	723	25980	67.62	-0.0169	-0.0023	0.022	3.2
93.	1005KGZ	26160	49.52	-0.0129	0.0133	0.006	4.8
94.	1191	26520	40.73	0.0006	0.0038	0.004	5.3
95.	286	26820	31.85	0.0072	0.0103	0.006	4.2
96.	1040KGZ	27060	1.98	-0.0070	0.0038	0.005	5.3
97.	1195	27240	46.25	0.0014	-0.0087	0.008	5.8
98.	292	27600	58.78	0.0052	0.0138	0.009	5.0
99.	10420GC	27840	65.53	-0.0250	0.0170	0.015	6.0
# 9	1357	3176		22	20		
100.	299	28380	47.65	0.0034	-0.0152	0.005	5.7
101.	1208	28500	15.87	0.0034	-0.0002	0.004	6.0
102.	302	28740	60.40	0.0071	0.0433	0.009	6.0
103.	1100KGZ	28980	13.20	0.0074	0.0005	0.006	5.1
104.	307	29160	51.60	-0.0020	0.0016	0.005	4.9
105.	1215	29400	68.57	-0.0020	0.0133	0.012	5.5
106.	1118KGZ	29700	59.67	-0.0076	0.0101	0.008	5.5
107.	314	30060	43.28	-0.0243	-0.0239	0.002	4.4
108.	316	30240	- 3.80	0.0191	0.0034	0.004	4.0
109.*	767	30540	62.90	0.1016	0.0002	0.006	4.3
110.	1152KGZ	30840	- 7.88	0.0147	0.0144	0.005	5.6
# 10	1334	3116		33	17		
111.	1225	31140	45.93	0.0035	0.0106	0.007	5.5
112.	326	31380	18.27	0.0116	-0.0005	0.007	4.2
113.	1230	31680	- 3.33	0.0106	0.0119	0.007	5.2
114.	1189KGZ	32040	64.72	-0.0230	-0.0090	0.009	5.6
115.	339	32340	41.90	0.0051	-0.0053	0.004	4.1
116.	341	32520	47.28	0.0030	-0.0121	0.004	3.7
117.	1239	32880	22.17	-0.0130	-0.0062	0.003	5.2
118.	346	33120	43.35	0.0045	0.0009	0.004	5.3
119.*	803	33480	62.45	-0.0121	0.0014	0.014	2.6
120.	1244	33780	26.32	-0.0178	-0.0028	0.007	4.6
121.	355	34140	63.20	-0.0148	0.0107	0.010	3.8
# 11	1141	3002		33	19		
122.	1249	34620	4.78	-0.0137	-0.0121	0.008	4.8
123.	1283KGZ	34800	39.90	0.0088	0.0160	0.003	5.5
124.	1287KGZ	35040	57.27	-0.0177	-0.0120	0.007	5.4
125.	368	35340	59.18	-0.0170	0.0153	0.008	3.9
126.	1301KGZ	35640	49.97	0.0067	0.0105	0.004	5.3
127.	378	35940	8.18	-0.0026	-0.0049	0.004	4.9
128.	1259	36180	54.03	-0.0042	0.0097	0.004	5.7
129.	1320KGZ	36360	- 0.22	0.0134	0.0190	0.007	4.5
130.	14054GC	36780	60.13	-0.0014	0.0093	0.007	6.1
131.*	2752KGZ	37020	62.65	-0.0704	0.0462	0.012	6.0
132.	387	37320	65.72	-0.0091	0.0140	0.007	4.9
# 12	1085	3125		32	25		

APPENDIX (CONT.)

1	2	3	4	5	5′	6	7
133.	14377GC	37620	45.37	-0.0183	-0.0285	0.004	6.5
134.	396	37860	9.47	0.0132	0.0120	0.006	3.8
135.*	853	38280	63.43	-0.0419	0.0400	0.013	5.2
136.	1276	38520	46.37	0.0006	-0.0051	0.004	5.3
137.	1279	38700	19.05	0.0113	0.0146	0.003	5.6
138.	1387KGZ	39000	59.48	0.0456	0.0570	0.006	5.7
139.	15035GC	39300	22.52	-0.0196	-0.0383	0.006	6.2
140.	1282	39480	40.58	-0.0017	-0.0111	0.003	5.1
141.	417	39720	61.92	-0.0153	0.0076	0.008	2.0
142.	1423KGZ	40200	68.43	0.0105	0.0356	0.011	6.4
143.	1292	40500	- 3.48	0.0203	0.0140	0.006	4.6
# 13	1012	3124		35	20		
144.	427	40800	6.20	0.0067	0.0091	0.006	4.1
145.*	882	40980	62.12	0.0286	0.0650	0.018	5.2
146.	432	41340	43.33	0.0092	0.0105	0.004	5.9
147.	1458KGZ	41580	54.95	-0.0015	0.0008	0.009	5.8
148.	440	42060	66.92	-0.0220	0.0079	0.015	5.5
149.	441	42240	47.95	-0.0051	-0.0106	0.006	3.8
150.	445	42540	1.93	0.0060	0.0009	0.005	3.8
151.	16315GC	42840	56.77	0.0008	0.0168	0.008	5.9
152.	1311	43140	6.78	0.0043	0.0140	0.006	4.6
153.	1503KGZ	43500	49.33	-0.0201	0.0245	0.003	7.8
154.	1508KGZ	43800	26.03	0.0051	-0.0127	0.004	5.8
# 14	1270	3143		43	17		
155.	458	44100	40.83	-0.0111	-0.0126	0.004	5.9
156.	460	44280	- 0.50	0.0083	0.0034	0.001	4.0
157.	461	44640	39.18	0.0060	0.0088	0.003	5.2
158.	467	44940	58.57	-0.0021	0.0052	0.006	5.4
159.	1324	45300	- 5.67	0.0150	0.0207	0.005	5.9
160.	478	45600	62.88	-0.0310	-0.0032	0.012	5.9
161.	1328	45840	7.03	-0.0024	-0.0020	0.005	5.2
162.	1579KGZ	46140	37.68	0.0286	0.0227	0.003	5.9
163.*	32	46500	60.55	0.0227	0.0115	0.015	2.8
164.	1601KGZ	46740	66.77	-0.0219	-0.0198	0.014	5.5
165.	1338	47100	45.43	-0.0044	0.0069	0.003	5.7
# 15	1232	3252		51	16		
166.	492	47400	28.03	-0.0062	-0.0135	0.005	4.3
167.	1623KGZ	47640	41.02	0.0067	0.0165	0.002	5.7
168.	1346	47940	40.30	-0.0117	-0.0059	0.003	5.7
169.	497	48180	55.08	-0.0079	-0.0110	0.005	2.4
170.	500	48420	60.10	-0.0036	0.0053	0.007	5.4
171.	1351	48780	3.82	0.0136	0.0074	0.004	4.9
172.*	55	49200	67.90	-0.0568	-0.0345	0.007	5.5
173.	509	49560	49.47	-0.0101	-0.0151	0.004	1.9
174.	511	49860	64.87	-0.0040	0.0080	0.010	4.8
175.	1693KGZ	50100	1.20	0.0126	-0.0045	0.004	5.9
176.	516	50400	1.68	0.0017	0.0134	0.006	4.3
# 16	1108	3170		50	22		

APPENDIX (CONT.)

1	2	3	4	5	5′	6	7
177.	1706KGZ	50820	49.60	-0.0141	-0.0080	0.002	5.4
178.	1712KGZ	51120	69.57	-0.0289	0.0118	0.009	5.4
179.	1370	51420	35.65	0.0097	0.0038	0.003	4.8
180.	1375	51780	5.95	0.0078	0.0093	0.004	5.1
181.*	292KGZ	52020	67.27	-0.0525	0.0305	0.011	4.6
182.	1750KGZ	52440	49.50	-0.0065	-0.0011	0.002	5.9
183.	1754KGZ	52620	54.15	-0.0029	-0.0013	0.003	5.5
184.	545	52860	- 5.53	0.0027	0.0094	0.004	4.0
185.	547	53100	2.02	-0.0023	-0.0008	0.006	3.8
186.	549	53460	59.42	-0.0018	-0.0004	0.004	5.7
187.	1786KGZ	53700	49.75	0.0240	0.0214	0.005	5.7
# 17	1090	3158		54	25		
188.	555	54060	40.50	0.0136	-0.0016	0.004	3.6
189.	1397	54300	54.67	0.0043	-0.0123	0.006	5.2
190.	1814KGZ	54660	19.08	0.0014	-0.0074	0.004	6.0
191.	1400	55020	20.68	0.0044	-0.0066	0.005	5.7
192.*	1096	55320	64.48	0.0685	0.0340	0.018	5.6
193.	572	55620	29.20	0.0012	0.0069	0.005	3.7
194.	1852KGZ	55860	64.32	0.0068	0.0175	0.012	5.9
195.	1863KGZ	56100	10.12	0.0014	0.0053	0.007	5.4
196.	1876KGZ	56520	52.45	-0.0166	-0.0028	0.006	5.5
197.	587	56760	62.70	-0.0074	0.0218	0.014	5.1
198.	1416	57120	42.53	0.0153	0.0172	0.005	4.6
# 18	1020	3339		52	26		
199.	595	57420	54.83	0.0129	0.0125	0.013	5.0
200.	598	57660	58.65	0.0170	0.0293	0.016	4.1
201.	601	58080	45.02	-0.0051	-0.0020	0.005	4.3
202.	603	58380	- 3.62	0.0047	0.0155	0.009	3.0
203.*	548KGZ	58680	65.07	-0.0524	-0.0092	0.021	5.4
204.	1965KGZ	59040	61.58	0.0093	0.0284	0.010	2.9
205.	618	59340	21.55	0.0003	-0.0042	0.005	2.8
206.	621	59580	42.50	0.0008	0.0034	0.003	4.2
207.	1997KGZ	59940	4.28	0.0198	0.0148	0.010	5.7
208.	22611GC	60360	42.28	-0.0347	-0.0270	0.004	6.2
209.	1440	60660	24.70	-0.0040	-0.0083	0.006	5.2
# 19	955	3348		64	44		
210.	2027KGZ	60960	65.18	0.0170	0.0390	0.015	4.8
211.	1446	61200	33.62	0.0125	0.0039	0.004	5.8
212.	635	61440	12.78	-0.0019	-0.0045	0.005	4.9
213.	639	61740	65.75	0.0014	0.0105	0.009	3.2
214.	2058KGZ	62100	- 0.42	0.0032	0.0061	0.006	4.8
215.	2069KGZ	62400	46.27	0.0127	0.0076	0.004	5.8
216.	650	62760	48.28	0.0059	0.0020	0.005	5.8
217.	653	63000	52.32	0.0059	0.0026	0.005	3.0
218.	656	63240	12.58	-0.0002	0.0024	0.008	2.1
219.*	789KGZ	63540	65.68	0.0284	0.0493	0.021	5.8
220.	668	63960	2.72	0.0106	0.0061	0.007	3.7
# 20	862	3379		79	55		
221.	2134KGZ	64320	6.10	-0.0024	-0.0054	0.008	5.8
222.	676	64560	51.50	-0.0057	0.0034	0.003	2.4
223.	2158KGZ	64800	1.30	0.0035	0.0052	0.006	4.4
224.	2178KGZ	65220	43.45	-0.0218	-0.0224	0.003	5.1
225.	2482OGC	65400	54.28	0.0071	0.0108	0.003	5.9
226.	685	65640	64.38	0.0053	0.0322	0.007	5.0
227.	1476	65940	3.37	0.0082	-0.0014	0.006	4.7
228.	2211KGZ	66180	58.78	-0.0029	0.0106	0.005	4.8
229.	1480	66480	- 2.67	0.0163	0.0174	0.009	5.4
230.*	247	66900	61.52	-0.0278	0.0052	0.015	6.0
231.	2243KGZ	67320	55.52	0.0074	0.0091	0.008	5.1
# 21	803	3417		88	66		
232.	1492	67560	52.95	-0.0014	-0.0008	0.005	5.8
233.	707	67860	59.35	0.0091	0.0075	0.008	4.8
234.	711	68040	43.90	-0.0184	-0.0276	0.005	4.0
235.	712	68280	15.03	0.0021	-0.0009	0.006	4.2
236.	717	68700	- 4.93	0.0130	0.0092	0.006	3.6
237.	2312KGZ	68880	6.02	0.0050	0.0006	0.006	5.4
238.	723	69180	67.62	-0.0087	0.0204	0.009	3.2
239.	726	69360	53.32	0.0025	0.0048	0.004	4.0
240.	1503	69840	11.88	0.0047	0.0076	0.009	5.2
241.*	284	70080	68.56	-0.0352	-0.0447	0.022	5.8
242.	738	70560	50.15	0.0175	0.0214	0.005	4.6
# 22	896	3408		99	76		
243.	2383KGZ	70800	45.45	0.0068	0.0096	0.003	5.0
244.*	1042OGC	71040	65.53	0.0218	0.0139	0.024	6.0
245.	745	71340	8.78	0.0039	0.0031	0.007	0.9
246.	2416KGZ	71580	57.45	-0.0085	-0.0156	0.007	5.0
247.	752	71820	19.42	-0.0032	-0.0086	0.005	3.7
248.	2439KGZ	72060	64.73	0.0104	0.0380	0.010	5.4
249.	2453KGZ	72300	53.08	0.0159	0.0207	0.005	5.7
250.	2464KGZ	72660	61.98	0.0123	0.0370	0.009	5.7
251.	2478KGZ	72900	47.62	-0.0016	-0.0008	0.007	4.2
252.	765	73260	40.17	-0.0027	-0.0084	0.005	2.3
253.	2497KGZ	73440	21.32	0.0160	0.0157	0.009	5.8
# 23	961	3465		112	68		
254.	767	73740	62.90	0.0094	0.0244	0.010	4.3
255.	1537	73980	4.80	0.0040	-0.0065	0.006	6.7
256.	2522KGZ	74220	- 1.22	0.0020	0.0139	0.008	4.5
257.	777	74400	45.17	-0.0068	-0.0091	0.003	1.8
258.	783	74700	61.72	0.0026	0.0086	0.007	3.6
259.	2555KGZ	74940	43.95	0.0110	0.0028	0.003	5.1
260.*	1189KGZ	75240	64.72	-0.0450	-0.0166	0.016	5.6
261.	1551	75540	47.40	-0.0086	-0.0031	0.004	4.9
262.	792	75840	43.80	-0.0048	-0.0047	0.003	3.9
263.	2599KGZ	76140	53.43	-0.0059	-0.0123	0.006	5.7
264.	800	76440	5.12	-0.0026	-0.0071	0.009	4.1
# 24	1016	3416		108	49		

APPENDIX (CONT.)

1	2	3	4	5	5'	6	7
265.	803	76680	62.45	0.0012	0.0339	0.012	2.6
266.	2629KGZ	77040	46.58	-0.0114	-0.0143	0.003	5.5
267.*	355	77340	63.20	0.1256	-0.0435	0.015	3.8
268.	1568	77580	45.47	0.0052	0.0072	0.003	4.2
269.	2657KGZ	77820	61.95	0.0175	0.0236	0.012	4.9
270.	1572	78300	60.98	0.0032	0.0217	0.009	4.5
271.	1575	78540	30.03	0.0060	0.0071	0.004	5.0
272.	823	78720	25.78	-0.0126	0.0005	0.003	5.0
273.	1580	79020	- 4.52	0.0101	0.0180	0.008	6.4
274.	2707KGZ	79260	52.73	0.0045	0.0201	0.004	5.7
275.	827	79440	- 0.47	0.0176	0.0011	0.005	3.2
# 25	1098	3169		83	32		
276.	833	79680	33.03	-0.0044	-0.0056	0.002	5.6
277.	1583	79980	39.57	-0.0020	-0.0033	0.003	4.6
278.	2752KGZ	80220	62.65	0.0314	0.0607	0.009	6.0
279.*	387	80520	65.72	-0.0040	0.0343	0.026	4.9
280.	1588	80880	8.98	-0.0015	-0.0059	0.004	5.8
281.	850	81240	- 0.27	0.0111	0.0186	0.003	4.1
282.	853	81480	63.43	0.0074	0.0309	0.007	5.2
283.	858	81780	41.67	0.0044	-0.0059	0.004	5.2
284.	863	82140	66.05	0.0038	0.0104	0.009	3.7
285.	2827KGZ	82440	8.65	-0.0033	-0.0066	0.007	5.0
286.	2838KGZ	82680	52.50	-0.0019	-0.0003	0.007	6.4
# 26	1319	3265		53	31		
287.	1604	83160	49.13	-0.0063	0.0063	0.011	5.8
288.	875	83520	57.00	0.0203	0.0129	0.006	5.6
289.	2881KGZ	83880	- 5.28	0.0144	0.0152	0.003	5.7
290.	882	84180	62.12	0.0039	0.0075	0.008	5.2
291.	885	84480	12.60	0.0117	-0.0016	0.005	4.7
292.	1616	84780	40.07	0.0029	-0.0097	0.013	5.5
293.*	440	85260	66.92	0.0232	-0.2828	0.965	5.5
294.	895	85560	67.63	0.0089	0.0090	0.010	5.0
295.	1625	85860	10.78	-0.0041	-0.0034	0.006	5.4
296.	1628	86100	22.48	-0.0092	-0.0066	0.007	6.3
297.	2953KGZ	0	61.05	0.0333	0.0440	0.019	5.7
# 27	1392	3389		33	25		

EXPLANATION OF THE APPENDIX

THE COLUMNS ARE:

1 - ORDINARY NUMBER OF STAR OF THE OBSERVATIONAL PROGRAMME
2 - THE SIGNATURE IN THE FUNDAMENTAL CATALOGUE
3 - RIGHT ASCENSION (IN SECONDS) ; 4 - DECLINATION (IN DEGREES)
5 - $\Delta\alpha$ AT THE CYCLE I (IN SECONDS); 6 - $\Delta\alpha$ AT THE CYCLE II
6 - MEAN S.D. OF $\Delta\alpha$ (IN SECONDS); 7 - APPARENT MAGNITUDE .

AFTER EACH GROUP OF 11 STARS (AN OBSERVATIONAL GROUP) THERE ARE DATA:

- ORDINARY NUMBER OF THE GROUP , - MEAN OBSERVATIONAL EPOCH AT THE CYCLE I , AND AT THE CYCLE II (IN JULIAN DAYS BEGINING WITH JD0 = 2440000 , - MEAN FREQUENCY OF OBSERVATION OF THE GROUP AT THE CYCLE I, - AND AT THE CYCLE II.

THE STARS SIGNED WITH (*) IN EACH GROUP ARE THE STARS OBSERVED IN THE LOWER CULMINATION.

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