

**OBSERVATIONS OF THE SUN AND PLANETS  
WITH THE BELGRADE LARGE MERIDIAN CIRCLE**

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(Received: January 19, 1995)

**SUMMARY:** The results of the observations of the Sun, Mercury, Venus and Mars made with the Large Meridian Circle of the Belgrade Observatory in 1994 are presented.

It is now 20 years since the systematic observations of the Sun, Mercury and Venus (14 years for those of Mars) with the Large Meridian Circle ( $2r=190$  mm,  $f=2578$  mm) of the Belgrade Observatory were initiated. These observations are the continuation of our observations published in Sadžakov *et al.* (1976, 1981, 1982a, 1982b, 1983, 1985, 1988, 1991) and Dačić *et al.* (1989, 1992, 1993, 1994).

The observations are relative, the reference stars being taken from the FK5. The data treatment involved the circle division corrections as well as those for flexure, collimation and refraction (calculated according to the Pulkovo Tables). No account is taken of the "day-night" corrections and the personal errors. One limb of the planets was observed when these were phased, otherwise both limbs have been observed. For observations of the Sun we use a filter from a high-quality glass.

The Sun's right ascension was deduced, as usual, from the trailing front and back limbs and the declination from settings on the upper and lower

edges.

Mercury was mostly observed by central bisection of its image. In those cases when the seeing was satisfactory, the illuminated part of the planet was observed. Venus and Mars were observed in the same way as the Sun, or only one limb. In both cases of observing one limb only, the diameter correction was applied.

The temperature inside the pavilion was read before and after the observation at two places, north and south of the instrument. The mean temperature was used in the reductions.

The ephemeris of the Sun, Mercury, Venus and Mars were calculated at the Institute of Theoretical Astronomy in Sankt-Petersburg.

The number of observations of the Sun and planets in 1994 is presented in Table 1, where:

$N$  – the number of reference stars transits;

$n$  – the number of observing tours;

$k=N/n$  – the average number of reference stars transits per observing tours.

**Table 1.** Data on Observations

Object observ.	N	n	k
Sun	125	32	4
Mercury	62	11	6
Venus	112	27	4
Mars	44	6	7

where

$\nu_i$  - the deviation (O-C) of the mean value for a particular period:

n - the number of observations.

The error of a single observation was determined according to the formula

$$\epsilon_{(O-C)} = \pm \left[ \frac{\sum \nu_i^2}{(n-1)} \right]^{1/2}$$

Mean annual differences  $(O-C)_\alpha$  and  $(O-C)_\delta$  for the Sun and planets;  $\epsilon_\alpha$  and  $\epsilon_\delta$  - mean errors of single observations; n - the number of observations are summarized in Table 2.

**Table 2.** (O-C) Differences and their Errors for the Observed Objects in 1994.

Objects	$(O-C)_\alpha$	$\epsilon_\alpha$	n	$(O-C)_\delta$	$\epsilon_\delta$	n
Sun	+0 <sup>o</sup> 004	±0 <sup>o</sup> 027	32	+0 <sup>''</sup> 06	±0 <sup>''</sup> 30	31
Mercury	+0.010	±0.031	11	-0.07	±0.35	11
Venus	+0.002	±0.030	27	-0.11	±0.34	26
Mars	+0.001	±0.023	6	+0.05	±0.42	6

**Table 3.** Data on the Sun observations

Date	Observ.	t <sup>o</sup> C	Ba	n	R.A.	$(O-C)_\alpha$	DEC	$(O-C)_\delta$	$E_p$	Clamp
					h m s	o ' "				
1994.										
01.03.	2	14.2	743.8	1	22 48 27.867	.010	-7 35 08.20	.37	4.16	W
09.03.	2,3	11.0	749.2	2	23 18 12.310	.047	-4 29 50.54	-.15	4.19	W
15.03.	3	12.9	743.7	4	23 40 15.582	.026	-2 08 15.65	-.23	4.20	W
28.03.	1,2	9.2	748.3	1	0 27 38.439	.005	2 59 02.84	.29	4.24	W
29.03.	1,2,3	9.9	750.4	4	0 31 16.702	.009	3 22 26.35	-.36	4.24	W
31.03.	1,2,3	16.4	744.4	2	0 38 33.442	-.002	4 09 01.74	.42	4.25	W
01.06.	2,3	20.1	746.9	5	4 36 28.647	-.019	22 03 00.60	-.04	4.42	W
14.07.	1,2,3	23.0	746.9	1	7 34 06.114	-.021	21 40 35.97	.17	4.53	W
25.07.	1,2,3	26.0	745.4	9	8 18 08.750	.041	19 39 08.14	.27	4.56	W
26.07.	1,2,3	27.4	746.4	8	8 22 05.544	.015	19 26 03.14	.35	4.57	W
27.07.	1,2,3	27.1	745.8	11	8 26 01.752	.025	19 12 38.76	-.04	4.57	W
29.07.	2,3	25.7	745.0	4	8 33 52.409	.025	18 44 52.93	.29	4.57	W
01.08.	2,3	28.2	744.8	6	8 45 33.982	-.013	18 00 55.65	-.28	4.58	E
02.08.	2	29.2	744.1	4	8 49 26.661	-.056	17 45 40.78	.24	4.59	E
03.08.	1,2	28.0	745.7	5	8 53 18.748	.002	17 30 08.51	-.29	4.59	E
04.08.	1,2	27.7	745.8	4	8 57 10.242	.023	17 14 19.16	.17	4.59	E
05.08.	1,2	27.8	746.2	5	9 01 01.143	.032	16 58 13.03	-.22	4.59	E
06.08.	1,2	27.5	747.2	5	9 04 51.450	.019	16 41 50.45	-.10	4.60	E
08.08.	1,2	30.0	745.9	9	9 12 30.276	-.005	16 08 17.17	-.09	4.60	E
22.08.	2,3	29.6	745.0	3	10 04 58.340	.013	11 46 48.70	.33	4.64	E
29.08.	2,3	24.6	744.0	3	10 30 37.060	-.036	9 21 29.69	.09	4.66	E
30.08.	2,3	23.1	744.8	3	10 34 15.426	-.006	9 00 05.44	-.19	4.66	E
07.09.	3	25.0	743.3	2	11 03 12.251	-.047	6 04 06.67	-	4.68	E
12.09.	3	25.0	745.6	5	11 21 10.871	.016	4 10 42.02	-.55	4.70	E
13.09.	3	25.0	744.0	1	11 24 46.178	-.006	3 47 46.88	.34	4.70	E
11.10.	2	12.2	750.2	3	13 05 57.089	.005	-7 00 58.54	.77	4.78	E
12.10.	3	11.9	753.1	4	13 09 38.368	.012	-7 23 33.32	-.14	4.78	E
13.10.	3	12.2	752.6	4	13 13 20.130	-.049	-7 46 01.97	.55	4.78	E
18.10.	2	10.4	748.1	3	13 31 56.901	.024	-9 36 40.22	-.14	4.80	E
19.10.	2	10.6	747.8	3	13 35 41.996	.021	-9 58 24.34	.01	4.80	W
01.11.	2	16.0	747.8	2	14 25 31.790	-.024	-14 25 25.54	.24	4.84	W
02.12.	2,3	1.1	758.1	2	16 33 29.904	.049	-21 57 07.52	-.10	4.92	W

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**Table 4. Data on the Mercury observations**

Date	Observ.	t°C	Ba	n	R.A. h m s	(O - C) <sub>α</sub>	DEC ° ' "	(O - C) <sub>δ</sub>	E <sub>p</sub>	Clamp
1994.									1990+	
25.07.	2,-,-	25.9	745.4	9	7 00 46.510	-.041	21 57 01.84	-.31	4.56	W
26.07.	1,2,-	26.2	746.4	8	7 07 37.628	.035	22 00 10.21	-.12	4.57	W
27.07.	1,3	25.9	745.8	11	7 14 46.266	.014	22 01 21.79	-.60	4.57	W
29.07.	2	24.9	745.0	4	7 29 51.230	-.009	21 57 13.72	.28	4.57	W
03.08.	1,2	27.0	745.7	5	8 10 58.878	.041	21 03 09.87	.11	4.59	E
06.08.	1,2	27.0	747.2	5	8 36 47.367	.050	19 59 05.34	-.33	4.60	E
08.08.	1,2	30.0	745.9	9	8 53 57.974	.003	19 04 04.32	.37	4.60	E
29.08.	3	25.0	744.0	3	11 27 09.093	.022	4 24 26.26	.32	4.66	E
12.09.	3	26.2	745.6	5	12 43 31.460	-.009	-5 44 53.92	.28	4.70	E
01.11.	2	14.8	747.8	2	13 21 23.084	.037	-6 34 27.74	-.50	4.84	W
02.12.	2	1.1	758.1	2	16 05 52.017	-.033	-20 53 25.08	-.26	4.92	W

**Table 5. Data on the Venus observations**

Date	Observ.	t°C	Ba	n	R.A. h m s	(O - C) <sub>α</sub>	DEC ° ' "	(O - C) <sub>δ</sub>	E <sub>p</sub>	Clamp
1994.									1990+	
01.03.	2	15.1	743.8	1	23 29 34.710	-.013	-4 47 52.86	-.47	4.16	W
09.03.	2	10.5	749.2	2	0 06 01.874	-.050	-0 43 18.40	-.44	4.19	W
15.03.	3	14.9	743.7	4	0 33 13.518	-.037	2 21 43.67	-.28	4.20	W
31.03.	2	17.1	744.4	2	1 46 20.253	.020	10 20 08.46	-.34	4.25	W
14.07.	3	23.9	746.9	1	10 24 28.735	.048	11 23 12.73	-.43	4.53	W
25.07.	2,3	27.2	745.4	9	11 09 25.523	.021	6 12 07.82	.47	4.56	W
26.07.	3	27.4	746.4	8	11 13 22.983	-.015	5 42 54.69	-.07	4.57	W
27.07.	1,3	27.3	745.8	11	11 17 19.253	.049	5 13 34.94	.54	4.57	W
29.07.	3	27.0	745.0	4	11 25 08.309	-.045	4 14 38.05	-.15	4.57	W
01.08.	2	29.8	744.8	6	11 36 43.485	.012	2 45 38.58	.32	4.58	E
02.08.	2	30.0	744.1	4	11 40 33.038	.009	2 15 52.15	-.63	4.59	E
03.08.	1	28.0	745.7	5	11 44 21.532	-.001	1 46 03.46	.17	4.59	E
04.08.	1,2	29.3	745.8	4	11 48 08.977	.000	1 16 13.13	-.66	4.59	E
05.08.	1,2	29.0	746.2	5	11 51 55.386	-.013	0 46 21.79	-.32	4.59	E
06.08.	1,2	28.2	747.2	5	11 55 40.767	-.003	0 16 30.08	-.21	4.60	E
08.08.	1,2	30.0	745.9	9	12 03 08.471	.036	-0 43 11.94	-.28	4.60	E
22.08.	3	30.5	745.0	3	12 53 26.906	-.056	-7 33 34.83	-	4.64	E
29.08.	3	25.1	744.0	3	13 17 13.365	.034	-10 48 06.81	.40	4.66	E
30.08.	3	24.8	744.8	3	13 20 31.947	.009	-11 15 02.12	.03	4.66	E
07.09.	3	26.0	743.3	2	13 46 04.030	.035	-14 40 38.51	.40	4.68	E
12.09.	3	26.2	745.6	5	14 00 58.145	.007	-16 38 40.79	-.08	4.70	E
11.10.	2	14.0	750.2	3	14 53 34.370	.031	-23 47 55.58	-.43	4.78	E
12.10.	3	13.0	753.1	4	14 53 42.917	-.046	-23 51 18.12	-.33	4.78	E
13.10.	3	13.8	752.6	4	14 53 42.356	.006	-23 53 35.55	-.21	4.78	E
18.10.	2	11.1	748.1	3	14 51 20.344	-.019	-23 47 23.33	.22	4.80	E
19.10.	2	11.1	747.8	3	14 50 24.299	-.005	-23 42 21.69	.06	4.80	W
02.12.	2	-0.7	758.1	2	14 08 24.894	.029	-11 39 16.28	-.23	4.92	W

**Table 6. Data on the Mars observations**

Date	Observ.	t°C	Ba	n	R.A. h m s	(O - C) <sub>α</sub>	DEC ° ' "	(O - C) <sub>δ</sub>	E <sub>p</sub>	Clamp
1994.									1990+	
01.06.	2,-,-	17.6	746.9	5	2 16 50.654	-.035	12 54 44.07	.43	4.42	W
26.07.	3	23.9	746.4	8	4 57 31.338	.009	22 32 43.38	-.06	4.57	W
27.07.	2	24.0	745.8	11	5 00 27.488	.031	22 37 48.65	-.51	4.57	W
01.08.	2	24.9	744.8	6	5 15 06.445	-.006	23 00 10.69	.47	4.58	E
05.08.	2	24.9	746.2	5	5 26 46.745	-.010	23 14 24.45	.32	4.59	E
08.08.	2	26.0	745.9	9	5 35 29.728	.014	23 22 57.81	-.35	4.60	E

The results of the observations in 1994 are given in Tables 3 - 6.

Each of the four tables contains eleven columns. Their description is given below.

Date - the date of observation;

Observ. - observers: 1-S.Sadžakov, 2-M.Dačić, 3-Z.Cvetković;

$t^{\circ}\text{C}$  - mean temperature inside the pavilion;

Ba - atmospheric pressure in mm Hg;

n - the number of the reference FK5 stars;

R.A. - observed right ascensions (hours, minutes and seconds of time);

$(O-C)_{\alpha}$  -  $(O-C)$  of the right ascensions (seconds of time);

DEC - observed declinations (degrees, minutes and seconds of arc);

$(O-C)_{\delta}$  -  $(O-C)$  of the declinations (seconds of arc);

$E_p$  - epoch of observation;

Clamp - clamp position.

*Acknowledgments* - This work has been supported by Ministry for Science and Technology of Serbia through the project "Physics and Motions of Celestial Bodies".

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## ПОСМАТРАЊА СУНЦА И ПЛАНЕТА УРАЂЕНА НА БЕОГРАДСКОМ ВЕЛИКОМ МЕРИДИЈАНСКОМ КРУГУ

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УДК 523.41/43-523.9  
Претходно саопштење

Представљени су резултати посматрања Сунца, Меркура, Венере и Марса урађених на Ве-

ликом меридијанском кругу Београдске опсерваторије у 1994. години.