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RESULTS OF PLANET OBSERVATIONS WITH THE BELGRADE VERTICAL CIRCLE | (Supplement I)

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SUMMARY: Results of observations of five major planets with the Belgrade Vertical Circle, carried out in the period April 1985 to December 1986, are presented. The O–C differences for the observed planets, as well as the mean errors of observations are given. Differences of the observed apparent and the ephemeris apparent semi–diameters of the planets Mars, Jupiter and Saturn are given, too.

1. INTRODUCTION

This paper is second in the series, where results are presented of the observations of solar system bodies with the Belgrade Vertical Circle (Askania, 190/2578 mm). First results, containing planet observations obtained during the period 1983–1984 were published by Trajkovska (1986). In the present paper results are given of the observations of Mars, Jupiter, Saturn, Uranus and Neptune, carried out in 1985 and 1986.

2. RESULTS OF OBSERVATIONS

The method and organization of observations have been explained in the preceding paper (Trajkovska, 1986). Here, therefore, only the results of planet observations are given. Apparent places have been computed according to the IAU recommendations from 1976.

The list of the observed stars, being selected from FK4, is displayed in Table I, where n is the number of observations and m – apparent magnitude. On the average 7 to 8 stars were observed per each planet's transit.

During this period, in total, Mars has been observed 4 times. Jupiter – 12, Saturn – 18, Uranus – 17 and Neptune 15 times.

The O–C differences, shown in Table II, were computed by using the ephemeris declinations of the planets supplied by the Leningrad Institute of Theoretical Astronomy. The Table II gives besides:

- ephemeris date at the moment of culmination with a precision of 10^{-5} day;
- Julian ephemeris date up to 10^{-5} day;
- initial instrument position (E or W);
- δ – observed apparent geocentric declination;
- order of the observed edges (N, S, C – centre of the disc, combination of four settings: I – NSSN, II – SNNS);
- $\Delta\pi$ – correction for the parallax;
- n – the number of the reference stars for the given observation;
- note on the circumstances of observation (1 – through the clouds, 2 – image unsteady, 3 – image indistinct, 4 – settings dubious).

Table I. Reference stars observed with the planets

№	N_{FK4}	m	n	№	N_{FK4}	m	n
1	1357	5.7	3	31	1487	3.3	2
2	515	5.2	1	32	1493	6.2	15
3	1365	6.4	1	33	706	2.1	1
4	1366	6.4	1	34	710	3.6	20
5	1369	5.7	2	35	720	3.0	20
6	1381	6.2	2	36	722	5.0	8
7	1387	5.3	3	37	727	4.6	3
8	1391	6.0	3	38	731	5.7	2
9	559	4.7	11	39	736	4.7	4
10	1407	5.9	13	40	1512	5.5	3
11	1413	5.0	15	41	1517	5.1	8
12	1415	5.1	19	42	1522	5.0	9
13	1419	5.5	9	43	753	4.6	1
14	597	2.9	5	44	1529	6.0	8
15	607	3.1var.	3	45	762	3.2	1
16	1430	5.8	4	46	773	5.3	3
17	624	5.0	19	47	1547	4.8	1
18	1437	7.6	6	48	1548	6.0	8
19	1447	6.2	1	49	789	6.3	3
20	1449	6.1	11	50	1552	4.2	4
21	644	3.4	11	51	1561	4.3	9
22	1457	4.3	6	52	1569	4.8	3
23	1461	5.7	4	53	812	3.8	9
24	1463	4.9	19	54	818	5.4	3
25	1464	4.4–5.0	1	55	819	3.0	9
26	1470	6.3	13	56	1580	6.4	1
27	682	4.0	1	57	840	4.3	3
28	687	2.8	1	58	1595	5.3	3
29	692	2.9	17	59	864	3.8	3
30	1485	5.8	11	60	1608	4.5	3

Table II.

Date	JED	Initial instr. position	δ	O–C	Edge	Δπ	n	Note
	2446		MARS					
1968 9 5.78438	679.28438	E	−27°09' 43".76	−0".22	II/I	15".11	3	
1986 9 8.77908	682.27908	W	26 54 35.49	−0.20	II/I	14.69	5	
1986 10 2.74436	706.24436	W	24 10 36.63	−0.46	II/I	11.70	6	
1986 10 3.74313	707.24313	E	−24 01 58.71	0.50	II/I	11.59	7	2)
	2446		JUPITER					
1985 7 16.00859	263.50859	W	−17°16' 7".99	0".12	II/I	1".88	9	
1985 7 22.98720	269.48720	W	17 31 39.80	0.36	I/II	1.90	8	
1985 7 25.97798	272.47798	E	17 38 32.45	0.49	I/II	1.90	7	
1985 9 5.84952	314.34952	W	19 2 44.07	0.35	I/II	1.87	11	
1985 9 13.82601	322.32601	E	19 11 49.46	−0.17	I/II	1.84	9	
1985 9 19.80872	328.30872	E	19 16 35.07	−0.53	II/I	1.81	11	2)
1985 9 20.80587	329.30587	E	19 17 11.96	−0.09	I/II	1.81	9	
1985 10 3.76964	342.26964	E	19 20 32.38	−1.01	II/I	1.74	10	
1985 10 4.76692	343.26692	W	19 20 26.25	−0.05	II/I	1.73	10	
1986 10 4.86987	709.36987	E	7 19 51.93	−0.02	II/I	1.70	8	
1986 10 17.83138	721.33138	E	7 44 50.49	0.77	I/II	1.67	7	2), 3)
1986 11 13.75566	748.25566	E	− 7 56 38.39	−0.17	II/I	1.54	8	
	2446		SATURN					
1985 7 4.79718	251.29718	E	−16° 3' 31".33	0".94	II/I	0".83	8	2)
1985 7 5.79436	252.29436	E	16 3 15.19	1.95	I/II	0.82	8	2)
1985 7 8.78591	255.28591	E	16 2 35.26	0.59	II/I	0.82	6	
1985 7 9.78311	256.28311	W	16 2 24.84	0.17	II/I	0.82	5	
1985 7 11.77751	258.27751	W	16 2 8.41	−0.48	I/II	0.82	5	1)
1985 7 16.76358	263.26358	W	16 1 53.82	−0.78	II/I	0.81	7	3)
1986 5 14.98118	565.48118	W	19 32 8.36	0.54	I/II	0.88	7	2)
1986 5 21.96060	572.46060	W	19 27 17.42	0.11	II/I	0.88	8	2)
1986 6 19.87540	601.37540	W	19 8 22.47	0.52	I/II	0.87	7	
1986 6 20.87248	602.37248	W	19 7 49.75	0.41	II/I	0.87	5	2)
1986 7 23.77802	635.27802	W	18 57 34.62	−0.73	I/II	0.84	3	2)
1986 7 24.77523	636.27523	E	18 57 31.28	0.84	I/II	0.83	1	2), 3)
1986 7 25.77244	637.27244	E	−18 57 31.55	−0.13	II/I	0.83	3	
	2446		URANUS					
1985 6 30.87390	247.37390	E	−22°38' 7".19	−0".28	C	0".45	11	
1985 7 4.86256	251.36256	E	22 37 12.64	1.15	C	0.45	6	2)
1985 7 5.85972	252.35972	E	22 36 59.37	0.13	C	0.45	9	
1985 7 6.85891	253.35891	E	22 36 46.24	−0.15	C	0.44	8	
1985 7 8.85123	255.35123	E	22 36 20.40	1.24	C	0.44	6	4)
1985 7 15.83148	262.33148	W	22 34 55.50	−0.39	C	0.44	9	
1985 7 16.82866	263.32866	W	22 34 44.25	−0.43	C	0.44	7	
1985 7 22.81181	269.31181	W	22 33 41.91	1.18	C	0.44	9	
1985 7 29.79224	276.29224	W	22 32 40.79	−0.31	C	0.44	9	
1985 7 30.78945	277.28945	W	22 32 33.27	−0.18	C	0.44	8	
1986 6 19.91956	601.41956	E	23 9 40.71	−0.30	C	0.45	7	
1986 7 23.82316	635.32316	E	23 4 17.84	−0.04	C	0.44	6	
1986 7 25.81754	637.31754	W	23 4 3.22	−0.40	C	0.44	7	
1986 7 28.80913	640.30913	W	23 3 41.86	−0.36	C	0.44	8	
1986 7 29.80633	641.30633	W	23 3 35.05	−0.32	C	0.44	9	
1986 7 30.80353	642.30353	W	23 3 28.08	0.09	C	0.44	8	
1986 8 1.79794	644.29794	W	−23 3 15.27	0.40	C	0.44	8	
	2446		NEPTUNE					
1985 6 30.92503	247.42503	E	−22°15' 54".73	−0".54	C	0".28	11	4)
1985 7 3.91660	250.41660	W	22 16 1.73	−0.75	C	0.28	7	3), 4)
1985 7 4.91379	251.41379	E	22 16 4.14	0.34	C	0.28	6	4)
1985 7 5.91098	252.41098	E	22 16 6.56	0.01	C	0.28	9	
1985 7 6.90817	253.49817	E	22 16 8.99	0.24	C	0.28	8	
1985 7 8.90256	255.40256	W	22 16 13.85	−0.33	C	0.28	6	
1985 7 15.88292	262.38292	E	22 16 30.95	1.39	C	0.28	9	4)
1985 7 22.86331	269.36331	W	22 16 49,16	−0.83	C	0.27	9	3)
1985 7 29.84374	276.34374	W	22 17 7.42	−1.23	C	0.27	9	3)
1986 6 19.96338	601.46338	W	22 15 16.70	−0.52	C	0.28	7	3)
1986 7 23.86791	635.36791	E	22 17 26.06	1.48	C	0.28	6	3)
1986 7 28.85392	640.35392	W	22 17 47.24	−0.19	C	0.27	8	3), 4)
1986 7 29.85112	641.35112	W	22 17 50.60	0.28	C	0.27	9	
1986 7 30.84833	642.34833	W	22 17 53.87	0.83	C	0.27	8	
1986 8 1.84274	644.34274	W	−22 18 2.74	−0.40	C	0.27	8	

Table III Differences of the observed and ephemeris apparent semi-diameters of the planets

MARS

Date	R_o-R_e	Date	R_o-R_e
5.9.1986	2".574	2.10.1986	2".585
8.9.1986	1.810	3.10.1986	2.975

JUPITER

Date	R_o-R_e	Date	R_o-R_e
16.7 1985	2".373	20. 9.1985	1".614
22.7.1985	2.852	3.10.1985.	2.064
25.7.1985	2.053	4.10.1985	1.854
5.9.1985	2.006	4.10.1986	1.948
13.9.1985	1.503	17.10.1986	1.748
19.9.1985	2.958	13.11.1986	1.894

SATURN

Date	R_o-R_e	Date	R_o-R_e
22.4.1985	1".802	16.7.1985	1".730
16.6.1985	1.738	24.4 1986	3.029
30.6.1985	1.900	14.5.1986	3.119
4.7.1985	1.867	21.5.1986	3.239
5.7.1985	2.837	19.6.1986	2.395
6.7.1985	1.680	20.6.1986	2.300
8.7.1985	1.217	23.7.1986	2.255
9.7.1985	1.675	24.7.1986	2.445
11.7.1985	1.290	25.7.1986	2.405

The differences of the observed apparent semi-diameters are listed in Table III. The mean square errors σ of the O–C values for each planet, as well as mean square errors σ_1 of the differences R_o-R_e, are shown in Table IV. The O–C and R_o-R_e values, along with number of observation n are also given in the same Table.

Observation of the solar system bodies with Vertical Circle are continually going on the results of observations will be regularly published.

Table IV Mean square errors σ and σ_1

Planet	Year	$\overline{O-C}$	σ	$\overline{R_o-R_e}$	σ_1	n
Mars	1985	–	–	–	–	–
	1986	–0.10	±0".41	2".49	±0".49	4
	1985–86	–0.10	0.41	2.49	0.49	4
Jupiter	1985	–0.06	0.48	2.14	0.50	9
	1986	0.19	0.51	1.86	0.10	3
	1985–86	0.00	0.47	2.07	0.47	12
Saturn	1985	0.40	0.99	1.77	0.44	10
	1986	0.22	0.52	2.65	0.41	8
	1985–86	0.30	0.83	2".16	±0".61	18
Uranus	1985	0.20	0.70	–	–	10
	1986	–0.13	0.30	–	–	7
	1985–86	0.06	0.58	–	–	17
Neptune	1985	–0.19	0.79	–	–	9
	1986	0.25	0.78	–	–	6
	1985–86	0".07	± 0".74	–		15

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