

MERIDIAN OBSERVATIONS OF THE OUTER PLANETS WITH THE BELGRADE VERTICAL CIRCLE

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Abstract. In this paper a survey of observations of the outer planets with the Belgrade Vertical Circle over the period 1982-1995 is given.

1. INTRODUCTION

The planet observations with meridian instruments are performed for the purpose of determining ($O - C$) from which subsequently one obtains the corrections to the equinox and equator positions $\Delta\alpha_0$ and $\Delta\delta_0$, as well as the corrections to the orbital elements for the observed planets.

The meridian observations of the outer planets (Mars, Jupiter, Saturn, Uranus and Neptune) with the Belgrade Vertical Circle (BVC) were begun in 1982 by Dj. Božičković, to be regularly continued in 1983 by Dj. Božičković and V. Trajkovska. The inner planets have not been observed because their meridian observations are performed during the day light and our instrument has not been protected against the solar radiation.

This paper contains a survey of planet observations performed with BVC between 1982 and 1995.

2. OBSERVATIONS

Table 1 contains the number of planet observations for each year between 1982 and 1995.

Mars was not observed every year due to the observing conditions, either because its meridian transit was in the day light, or because the atmospheric conditions did not allow this. Neptune was not observed in 1983 due to unfavourable atmospheric conditions.

During an observational night in addition to the planets some reference stars were also observed for the purpose of obtaining the latitude of the observing site.

Table 1. Number of observations of the planets with BVC between 1982 and 1995.

Year	PLANETS				
	Mars	Jupiter	Saturn	Uranus	Neptune
1982	11	14	8	9	5
1983	–	17	12	7	–
1984	38	31	17	19	15
1985	–	32	17	20	12
1986	35	16	10	14	12
1987	–	8	17	18	14
1988	7	6	9	5	8
1989	6	5	17	16	6
1990	–	14	13	13	12
1991	11	9	13	9	9
1992	–	13	8	8	9
1993	4	6	12	8	6
1994	–	12	8	8	6
1995	8	7	5	8	7
Total	120	190	166	164	121

3. REDUCTION OF OBSERVATIONS

Since the latitude of the observing site is $\varphi \approx +44^{\circ}48'$, all observations were performed south of zenith and therefore for the purpose of determining the declinations is used the formula $\delta = \varphi - z$. Consequently, in order to obtain the declination of a planet one should find φ at the moment of the observation since the zenith distance z is obtained by observing its meridian transit.

In the case of the planet observations with vertical circles φ is obtained in a classical way from the star observations during the observational night. However, these instruments offer another possibility for determining φ . If they are used for compiling absolute catalogues of star declinations, which is their basic purpose, then for each of these catalogues there is a determined mean latitude φ_0 for the observation period. These latitudes can be used in obtaining $(O - C)_\delta$ for the planets. The latitude which is looked for can be obtained for an observing night from the mean latitude and the corresponding correction for the polar motion. The determination of $(O - C)_\delta$ with latitudes obtained in this way requires a reliable determination of all corrections necessary in calculating the zenith distances z .

4. RESULTS

Trajkovska's $(O - C)_\delta$ determinations relating to the two-years periods - 1983-1984 and 1985-1986 - were published in Trajkovska (1986; 1988).

In Table 2 are presented the $\overline{(O - C)}_\delta$ values, the rms error of their individual values σ and n - number of measurements for the two two-years periods mentioned above.

Table 2. Values $\overline{(O - C)}_\delta$, σ and n .

Planet	$\overline{(O - C)}_\delta$	σ	n
Mars	+0 " 40	$\pm 0 " 54$	13
	-0.10	0.41	4
Jupiter	+0.23	0.61	18
	0.00	0.47	12
Saturn	0.00	0.65	11
	+0.30	0.87	18
Uranus	+0.20	0.73	16
	+0.06	0.58	17
Neptune	+0.75	0.65	9
	+0 " 07	$\pm 0 " 74$	15

The analysis of the systematic effects affecting the $(O - C)_\delta$ determinations with BVC made by Trajkovska and Mijatov (1993) shows that the application of the classical reduction method gives rise to significant inaccuracies in the $(O - C)_\delta$ determinations. Therefore, the authors have proposed a method usable in finding the corrections of these values.

5. CONCLUSION

With BVC a large observational material has been gathered over 14 years of observing the outer planets. It may serve for the $\Delta\delta_0$ determination and contribute to the determination of the corrections to the observed-planets orbital elements. Considering that during a part of the observing period the absolute measurements were also performed, it will be possible to verify the idea concerning the mean-latitude application in the $(O - C)_\delta$ determination.

References

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