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Occultation Observations in Moscow During 1992 -1994.

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At the end of 1991 the small group of teenagers had been formed on the base of astronomical circle of Moscow House of Youth Sceince and Technology. We all decided to start the observations of star's occultation by the Moon. This task was choosed due to the clarity of results, the possibility of various equipments from watch to photoelectric measuring devices and the absence of nessecerity in long homogenous observational sets.

We have the precomputation program written by O. I. Mitin in 1986 - 1988. This program allows to calculate: disappearance and appearance moments, position angles of contact points, stellar coordinates, the position of Moon's sickle, Moon's phase and components of contact point velocity at the the lunar limb. The last is calculated in according with next article (O. I. Mitin, The precomputation program for occultation observations., Preprint of the Stenberg Institute #5).

All the calculations are carried out according with the Bessel method, except of the grazing and near grazing events for which this method does not work. In a such case the moment of minimum distance between lunar limb and star are calculated. We assume that Moon is the sphere of 1737.3 km diameter. All the others parameters of events named before calculated too. We use SAO catalogue as containing big quantity of the stars up to 9 m evenly distributed over the sky. The lunar motion is calculated on the base of the numerical DE200/LE200 theory. All calculations are performed in topocentric coordinate system, as it looks for the observer at the moment of the event. We do not take into account the influence of the lunar limb zone profile and the distortion of the lunar shadow cylinder by refraction. The precomputation accuracy is about few seconds in the most cases, except of grazings, near grazing events and the catalogue errors. The precomputation program had been written in FORTRAN. The cumputing time for one night predictions is aboute 1/2 min for 486DX2-66. In Table 1 we give the comparison between predictions and observations for April 1 1993 as example.

Table 1

SAO	mag.	R.A.	Decl.	UT comp.	UTC obs.	P	h
97703	9.0	08 16 42.99	15 20 10.17	19 25 36.72	19 25 24.48	34.3	42
97726	8.7	08 18 50.86	15 02 20.16	20 19 54.80	20 19 52.28	68.0	35
97746	8.7	08 20 48.88	14 43 36.75	21 16 26.92	21 16 20.52	94.7	28
97754	9.1	08 21 20.78	14 37 18.13	21 32 49.76	21 32 42.99	105.4	26
97759	9.1	08 21 31.82	14 37 50.61	21 37 24.90	21 37 19.17	100.1	25
97762	7.4	08 21 36.08	14 47 15.17	21 42 38.13	21 42 32.97	62.0	24
97765	9.1	08 21 45.74	14 45 44.03	21 46 27.83	21 46 24.52	64.9	24
97756	8.0	08 21 27.61	14 20 18.02	21 59 34.18	21 59 18.08	167.5	22
97779	9.0	08 22 51.40	14 21 55.86	22 20 17.98	22 20 16.85	127.8	19

We have worked out several registrations methods. In each of them we use quartz generator for keeping the time with the $10E^{-5}$ s accuracy. In the case of observations at the Sternberg Institute observatory (20-cm refractor at 15-m high dome) we can use our ordinary equipment with the 220 V AC power supply (professional radio receiver, oscilloscope, frequency measurer, thermostabilized quartz clock). We ordinary use RWM & RID broadcasting stations to equal quartz clock scale with UTC through oscilloscope measurements. Due to considerable variations of observers' delays we do not take into account the delays which arise due to radio signals propagation. The equalization accuracy of scales is about or less then 2 ms, as it had been tested in special experiments. Our equipment is described in details in other our article, and now we want to describe our methodics.

1. Field conditions.

We use tape recorder, quartz second generator and additional watches. Difference between generator scale and UTC one ordinary is measured and recorded long before observations and is controlled after ones; the additional watches control at the same time. Next, the precision time scale is kept by the quartz generator. The signals of generator and pressed button are recorded on the magnetic tape. Minutes are marked manually by the button press according the whatches just before and after observations. In this method we have to measure different kinds of observer's delays. But due to difficulties for observers with minute marking the accuracy of this method was hardly better than 0.1 s. However this way of registration can be performed in every situation because small size, little weight of used equipment and using the battery supply only. The observer's delays are measured in laboratory conditions. By this way we obtained our first results in 1992. But only one of them was confident: March10, SAO76388 (6.9 m_{vis}), UTC = = $17^h40^m50^s.98 \pm 0.10$.

2. Observatory conditions.

We use all the availible technics without any limitations of weight, size or power supply. Hence, we use oscilloscope for time scale adjusting, frequency meter for the press button moment definition and industrial quartz clock standard for time keeping. Moreover, we can carry out the measurements of observers' delays during the observations throw the artifical star occultation (appearance or disappearance). For each observer we get the samples of 20-30 delays and the statistical processing of these sets permits to estimate the true error for each observation. Also, we can provide the observers' training all over the observational set in original conditions and trace the delay variations through the observer's feeling and attention level. In additional, our technique allows to registrate events for bright stars by two observers at the same time and independent. The second observer uses the 15-cm telescope big enough for this purpose.

Next results were obtained by this method:

Date	UTC obs.	SAO,BD	m vis.	Ob-r	Ev-t	Obs'del	std.dev	sicle	Sun's angl
Mar27	18 21 29.34	76010	9.1	DS	occ 54300	0.342	0.048	0.172	-104.6
	18 44 55.26	+19 560	9.5	DS	occ 54300	0.342	0.048		
	19 05 45.71	93507	7.5	DS	occ 54300	0.342	0.048	0.174	-104.4
Apr 1	19 25 24.48	97703	9.0	OU	occ 54300	0.290	0.031	0.662	-79.2
	20 19 52.28	97726	8.7	OU	occ 54300	0.290	0.031	0.681	-78.7
	21 16 20.52	97746	8.7	OU	occ 54300	0.290	0.031	0.684	-78.6
	21 32 42.99	97754	9.1	DS	occ 54300	0.290	0.017	0.686	-78.6
	21 37 19.17	97759	9.1	DS	occ 54300	0.291	0.018	0.686	-78.6
	21 42 32.97	97762	7.4	DS	occ 54300	0.291	0.018	0.686	-78.6
	21 46 24.52	97765	9.1	DS	occ 54300	0.292	0.019	0.686	-78.6
	21 59 18.08	97756	8.1	DS	occ 54300	0.293	0.019	0.686	-78.6
	22 20 16.65	97779	9.0	DS	occ 54300	0.297	0.022	0.687	-78.6
Apr 3	21 20 38.19	118164	5.9	DD	occ 54300	0.330	0.051	0.876	-75.8
Apr28	18 34 56.29	97455	8.9	IE	occ 42200	0.307	0.035	0.415	-77.8
	18 36 43.02	97456	9.3	IE	occ 42200	0.307	0.035	0.415	-77.8
	19 00 22.34	97457	8.7	AS	occ 44300	0.380	0.048	0.417	-77.7

Remarks.

Observers:

IE - Igor Egorov, AS - Alexei Solov'ev, DS - Dmitrij Sokolov, PN - Pavel Naumov, OM - Oleg Mitin, OU - Oleg Ugolnikov, SK - Serg Korobkin, DD - Dmitrij Dorofeev, JP - Juriy Pakhomov, ChV - Chernetskiy Vladimir, SCh - Sergey Chernov.

Telescope:

AVR -1. (Astronomical Visual Refractor; Mirror diameter is 20 cm; 240x magnification). It belongs to Sternberg Astronomical Observatory and is used by students.

Longitude: $2^h30^m10^s.910$,

Latitude: $55^o41'57."10$ (both are in the old pole system, that is equal geodetic coordinats on Krasovsky ellipsoid).

Altitude: 210 m (the high of the dome included).

During all observations the dark limb was not visible.

The set of digits means conditions of observations:

The first (from left to right) digit means the weather: 5 - clear, 4 - haze, 3 - dense clouds, 2 - very bad weather, 1 - too cold.

The second one means the character of atmosferic turbulence: 4 - sharp and quiet image, 3 - sharp, but trembling image, 2 - unqiet and glimmer one, 1 - the star looks as stormy spot.

The third digit means character of star's disappearance: 3 - momentary, 2 - gradually weaken, 1 - sharp change of star's ligh in moment of disappearance.

Last two digits mean the number of special remark.

Special remarks: 1 - two stars disappeared wiht time interval about 0.2 - 0.4 sec., 2 - by by-sight, 3 - star disappeared in Moon's crater, 4- slight brightness fluctuation before disappearence, 5 - on light fone. 6 - the beginning of dissapearence. 7- the end of it.

*) ashy light has been observed, #) dark limb has been visible.

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