SOME RESULTS OF THE PHOTOMETRY OF GEO OBJECTS

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ABSTRACT. Odessa Astronomical Observatory participated in the photometric observations of the GEO objects from June to September 2004. The photometric observations of the GEO objects were carried out at Observatory Station in Mayaky. For the observations 50 cm telescope Cassegrain was used. During the observations 7 light curves was obtained.

Key words: geostationary orbit (GEO), GEO objects, light curve.

The large number of artificial GEO objects and risk of its collision are needed the regular monitoring of Near Earth Space (Konovalenko at al., 2003). At June-September 2004 in Odessa Astronomical Observatory, simultaneously with positional observations, the photometric observations of the some GEO objects were organized. The ephemerides were given by MAO Academy of Science of Russia (Pulkovo). The photometric observations were obtained at the 50 cm Cassegrain telescope, in its focus is located electrophotometer with receiver of the radiation FEU-79. The optic-mechanical block and broadband amplifier are designed by A.I.Movchan. During the observations 7 light curves of such GEO objects: 98029, 95035, 95099, Cosmos-X was received. The observed data are given in the table 1.

The photometric light curves are presented on fig. 1-8. Besides integral light the observations were obtained in filters B and V. The analysis of given results and searching of the period were made by means of software package, including Fourier-analysis. The obtained periods of change of the brightness are given in the table. Figure 1 shows the changes of the brightness of GEO object 98029. They were got 21.06.04 during nearly hour. The brightness of GEO object, after the calculation of the absorption in atmosphere and adductions to one distance, is 8.2 magnitude and shows the small variations with typical time around 22.0 minutes, that is possible caused by precession of axis rotation. The fragment of the light curve GEO object 95035 is given on fig. 2, it shows the change of the brightness with period of 1.06 sec. In different dates GEO object 95099 reveals such periods: P_0 = 32.87 sec (28.07.04), P_0 = 32.61 sec (16.08.04), P_0 = 32.22 sec (14.09.04). The value P_0 = 97.5 sec (28.07.04) and P_0 = 98.0 sec (16.08.04) is, possibly, the value of the precession rotation period of the satellite. This is seen from presented fragment of the light curve on fig. 5. As to object "Cosmos-X", the observed change of the brightness, in our view, is not caused by proper rotation of the object, but periodic moving of the solar battery panels for Sun. The calculation of orientation of panels, which reflect light as a mirror, for to mirror flashes from curves of change of the brightness GEO object "Cosmos - X" for 12.09.04 shows that its movement occurred, practically, in plane of the ecliptic. So, direction of normal in the event of the first flash – α = 176.96°, δ = 4.94°, the second – α = 179.22°, δ = 4.96°. The absence of the mirror flash 14.09.04 is explained simply. An observation of the satellite began well later, than 12.09.04. And orientation for forming the mirror flash became unfavourable. The first maximum on this light curve under the conditions of luminosity corresponds for the third maximum on the light curve for 12.09.04. The change of the brightness superposing on mirror flashes with the period 44-47 sec is caused probably by hit mirror "bunny", which moves on panels of the solar battery, on gaps between separate sections of battery. More exactly estimation is possible in the case of colourimetric observations of this GEO object. The orientation of the panels of the last GEO object is fairly well saved relatively to Sun, though it slowly (~ 1.2 degree overnight) moves on orbit. During the first flash the angle of inclination of the panels to Sun was 6.5°, during the second one 8.7°. The minimum inclination of the panels to Sun was ~ 5.0°. This is a classical inclination of the panels to Sun in active GEO object. It is known that positional observations allow to separate the objects on groups depending on character of the motion relative to the observer on surface of the Earth (Hernandez & Jehn, 2004). On the other hand the photometry of GEO objects allows to classify

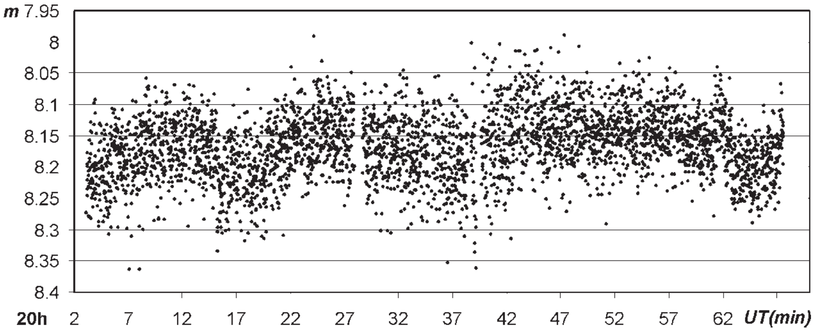

Fig. 1: CO 98029 21.06.04 UT$_o$=20^{h}03^{m}05^s (integral light)

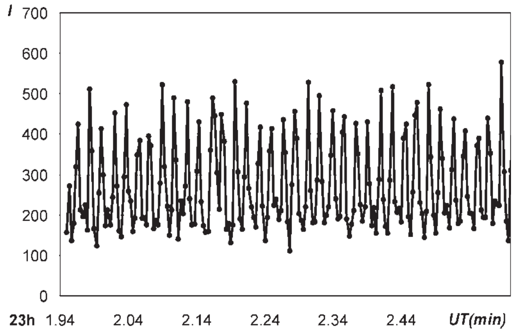

Fig. 2: CO 95035 20.07.04 UT$_o$=23^{h}01^{m}56^s (V-filtr, fragment)

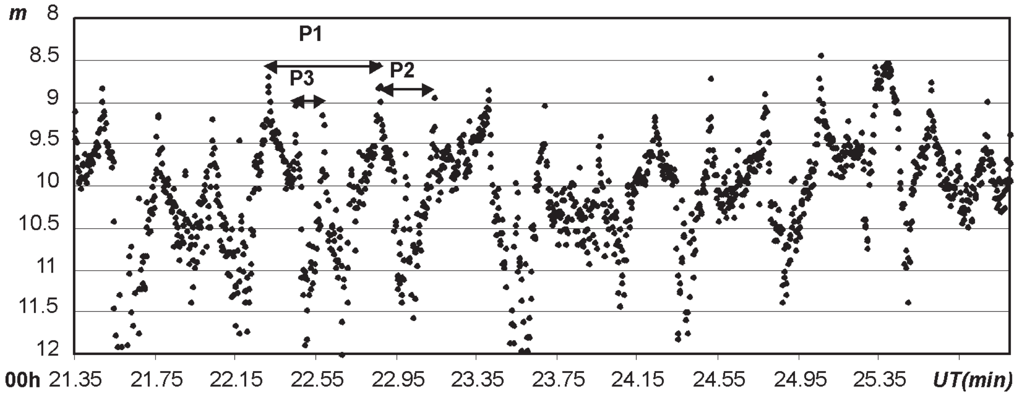

Fig. 3: CO 95099 28.07.04 UT$_o$=00^{h}18^{m}02^s (integral light, fragment)

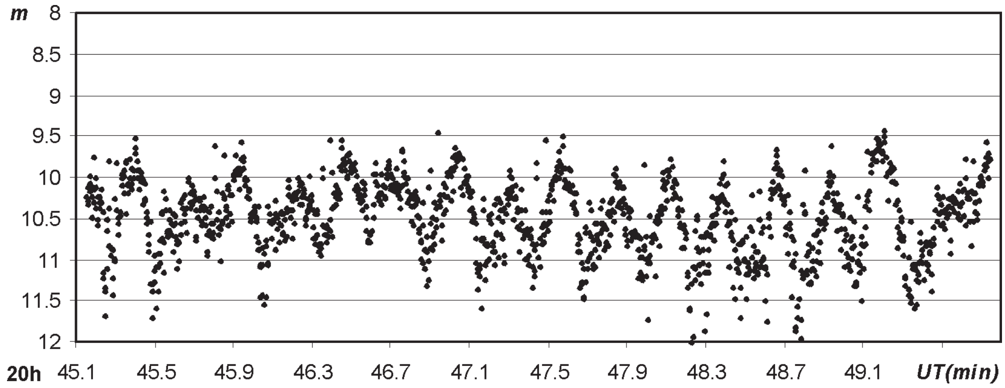

Fig. 4: CO 95099 16.08.04 UT$_o$=20^{h}45^{m}09^s (integral light, fragment)

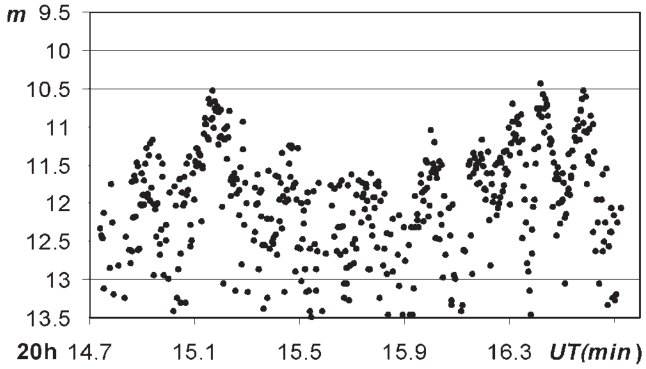

Fig. 5: CO 95099 16.08.04 UT$_o$=20^{h}14^{m}07^s (B-filtr, fragment)

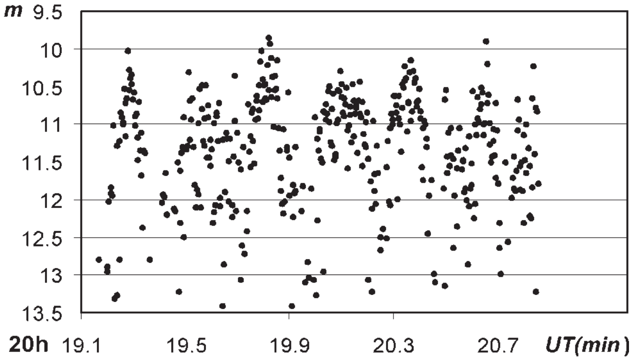

Fig. 6: CO 95099 16.08.04 UT$_o$=20^{h}19^{m}17^s (V-filtr, fragment)

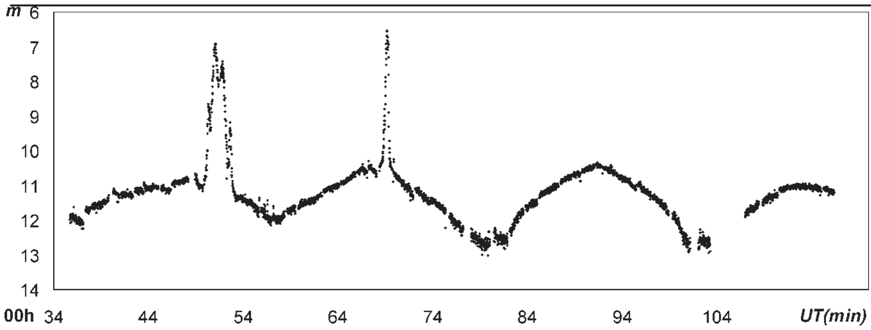

Fig. 7: CO Cosmos-X 12.09.04 $UT_o = 00^h35^m42^s$

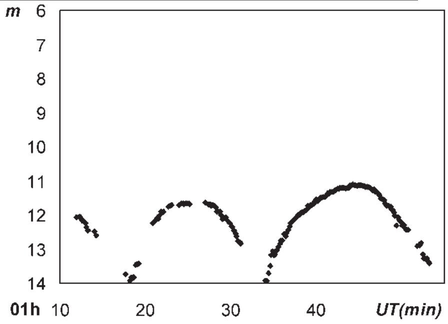

Fig. 8: CO Cosmos-X 14.09.04 $UT_o = 01^h11^m56^s$

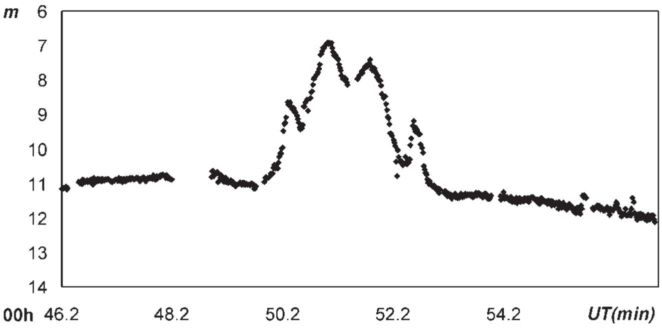

Fig. 7a: CO Cosmos-X 12.09.04 $UT_o = 00^h35^m42^s$ (fragment1)

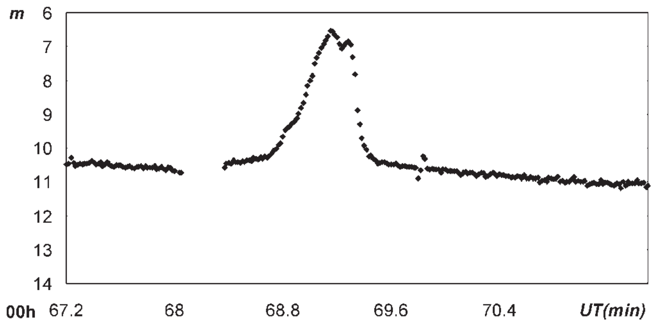

Fig. 7b: CO Cosmos-X 12.09.04 $UT_o = 00^h35^m42^s$ (fragment2)

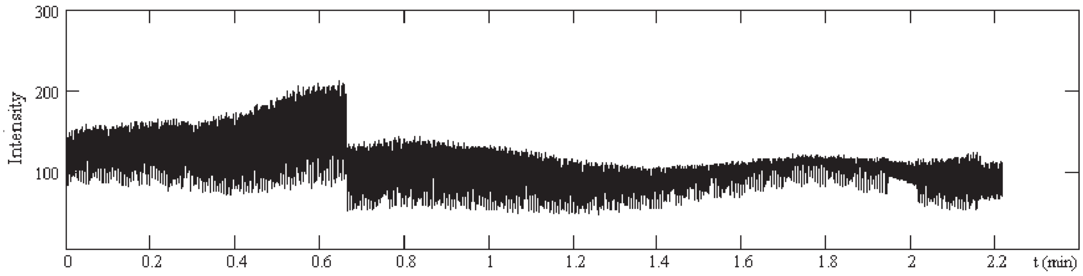

Fig. 9: The radar curves obtained for GEO object 98029 using Evpatoria RT-70=>Bear Lakes RT-64 bi-static system got by I.E.Molotov et al. 25.06.2004 on temporary interval of 2.2 minutes. Processing of the reflected radio signal was carried out in Radio-Physical Research Institute (N.Novgorod) by M.Nechaeva et al. Time to sampling radio signal – 0.016 sec. On short temporary interval period change to powers is not discovered.

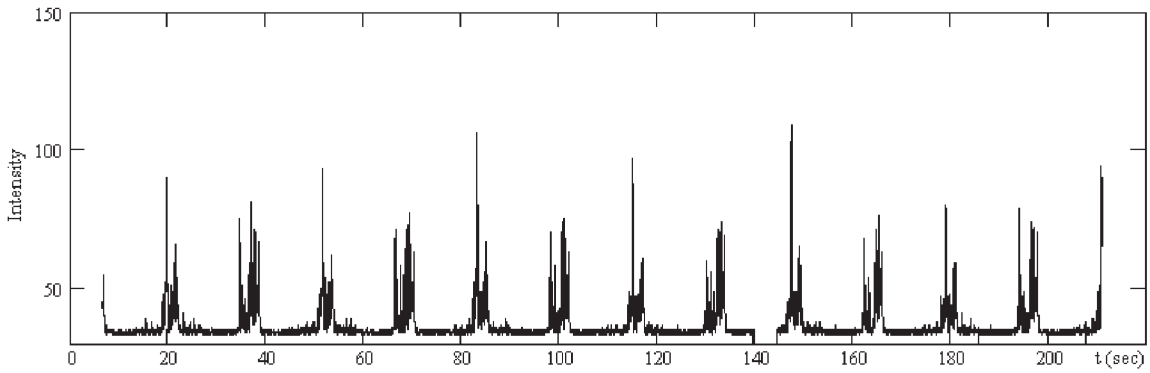

Fig. 10: The radar curves obtained for GEO object 95099 using Evpatoria RT-70=>Bear Lakes RT-64 bi-static system got by I.E.Molotov et al. 03.10.2004 on temporary interval of 3.5 minutes. Processing of the reflected radio signal was carried out in Radio-Physical Research Institute (N.Novgorod) by M.Nechaeva et al. Time to sampling radio signal – 0.016 sec. Period change of the power: P = 31.85 sec.

Table 1:

GEO objects	Date of observation	Time of observation	Longitude of the under-satellite point (deg)	Time of accumulation of signal (sec)	Spectral range of observations	Duration of observations (minutes)	Magnitude	Period of change of the brightness
98029	21.06.04	$20^h03^m05^s$	44.4E	1	Integral light	64.45	8.3^m-8.05^m	~ 22 min
95035	20.07.04	23 01 56	39E	0.2	Integral light, B, V	30.92	–	1.06sec, 0.53sec, 0.27sec
95099	28.07.04	00 18 02	42E	0.2	Integral light	10.40	12^m-8.5^m	97.50sec, 32.87sec, 16.48sec, 8.23sec
95099	16.08.04	20 14 07	14E	0.2	Integral light, B, V	30	13^m-10.5^m	98.00sec, 32.61sec, 16.36sec
95099	14.09.04	00 32 44	3.5E	0.2	Integral light	14	12.5^m-10.5^m	32.22sec, 16.11sec
Cosmos-X	12.09.04	00 35 42	2.3W	1	Integral light	80	12.8^m-6.5^m	21.5min
Cosmos-X	14.09.04	01 11 56	3.6W	10	Integral light	40	11.7^m-11.15^m	21.5min

the objects on character of the motion of the center of the masses by the methods of astrophysics, that gives important information, relating to status GEO objects, and, accordingly, the danger of approach with actively functioning objects.

On fig. 9, 10 curve changes of intensity a radio-echo GEO objects 98029 and 95099, received by I.E.Molotov et al. 25.06.2004 and 03.10.2004 on Bear Lakes RT-64, are presented. Small difference is at period object 95099 in optical and radio range possible to explain so, light curves there is integrated signal from the whole surface, but radar curves from separate details of the object. It also explicable different time of the accumulation.

References

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