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THE UNUSUAL LIGHTCURVE OF 1990 TR

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ABSTRACT

Amor asteroid 1990 TR was monitored during three nights shortly after discovery. Obtained lightcurves did not reveal a repeatable curve with two maxima and two minima. However, some features suggest periodicity, and a synodic rotational period P = 6.25 hours was determined. Individual and composite lightcurves are presented. The colors are best represented by the class S.

INTRODUCTION

When monitoring lightcurves of asteroids we usually expect to observe two maxima and two minima, reflecting an elongated shape for the observed object. There are just a few known objects, e.g. 29 Amphitrite, 51 Namausa, 75 Euridike, 287 Nepthys, and 471 Papagena which show 3 maxima and 3 minima in their lightcurves. 471 Papagena had been extensively studied by several researches with unambiguous results. (Lustig 1977, Scaltriti and Zappala 1978, Surdej and Surdej 1977, Di Martino and Cacciatori 1984). Such lightcurves with multiple extrema are interpreted as caused by irregular shapes and/or by albedo spots on the objects surface. To this list we may add Earth Approching asteroid 1990 TR.

Asteroid 1990 TR was discovered by S. Ueda and H. Kaneda (IAU Circ. #5121) and independently by A. V. Tarasova and L. I. Chernykh (IAU Circ. #5137). The ephemeris based on the discovery predicted the object to be as bright as 12.9 magnitude in Oct 1990 and still as bright as 14.4 at the end of November.

OBSERVATIONS AND RESULTS

Amor asteroid 1990 TR was monitored during the nights of Nov 13 and 18,1990. Color measurements were obtained during the night of Nov 19. The data presented here were obtained with a photoelectric photometer equipped with a Hamamatsu photomultipier R943-02 on the 1.5 meter telescope at the University of Arizona Observatory on Mt. Lemmon in the Catalina Mountain range of Tucson. When monitoring visual lightcurves, two comparison stars in the vicinity of the asteroid were measured regularly. The ubvwx "subset" filters of the eight-color asteroid filters (Tedesco et al. 1982) were used. Comparison stars' standartization and color transformation was done during the night of Nov 19. The aspect data and physical parameters are presented in Table I and Table II respectively.

Unexpectedly, the observations turned out to be quite challenging, as 1990 TR appeared to be about 1.5 mag fainter (V = 15.2 at maximum) than predicted by the initial ephemeris. The 5.5 hours of monitoring during the first night revealed a complex lightcurve with two maxima and two minima followed by a semi-plateau (Fig. 1). To be certain that the lightcurve is not modulated by faint stars, the asteroid path was checked against a Hubble Telescope Guide Star plate. The path seems to be clear to the best of my knowledge. On Nov 18 a plateau was observed again (Fig. 2). Assuming that this is the same as the one from Nov 13, the composite lightcurve was plotted as seen in Fig. 3, from which a synodic period of rotation P = 6hr 15m was determined. However a period of 7hr 54min will match both lightcurves and single measurements from the night of Nov 19 as well.

At present there is not enough data to differentiate between the interpretations of irregular shape or albedo spots. Perhaps a local topography like craters and flat areas should be taken into consideration. There are small asteroids with lightcurves having "bump" visible only on occasion. Fig. 4 shows such lightcurve for 1917 Cuyo observed in Oct 1989. Similarly, Fig. 5 shows two pronounced bumps for 3908 1980 PA. A well known asteroid with three maxima, 1580 Betulia, has at times a "normal" two maxima lightcurve as observed in May 1989 (Fig. 6). There is just a hint of maximum splitting. If this were the only observation of Betulia we would treat it as a typical asteroid.

As 1990 TR appears to be an interesting candidate for future studies, I calculated its ephemeris for the next 10 years. In Table III the favorable oppositions are listed. The +1.5 mag correction to the V magnitude was applied. At its best, the object may be observed from the southern hemisphere, being 17.1 magnitude at its brightest. This calls for a CCD camera and a telescope larger than 1 meter.
With so much successful activity in discoveries of Earth Approaching asteroids, reaching to fainter and fainter ones - read shorter and shorter observability windows - the follow up is falling behind. A much better organized, concentrated, effort is needed. This doesn't mean necessarily an increase in current total observing time. One or two nights of observations from telescopes well spaced in longitude will produce by far more complete data than hundreds of hours of observing at one site (weather permitting such a long run). This is particularly true if an object turns out to be a slow rotator, with a period of several days.

ACKNOWLEDGMENTS

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TABLE I

Aspect data for 1990 TR

Date UT yr/mo/day	RA h m	Dec (1950)	Long (1950)	Lat (1950)	r (AU)	Δ (AU)	Phase
90/11/13	01 56	26 47	36.55	13.91	1.405	0.432	13.4
90/11/18	01 55	27 03	36.45	14.25	1.429	0.467	15.9
90/11/19	01 55	27 06	36 45	14.26	1.434	0.474	16.1

TABLE II

Physical Parameters for 1990 TR

Date	u-v	b-v	V	v-w	v-x	Period	amp.	H	CLASS
	m	m	m	m	m	h	m	m	
90/11/19	0.81	0.12	15.22	0.13	0.07	6.15	0.19	16.05	S

TABLE III

Favorable oppositions for 1990 TR

Date	Dec	V mag.
1993 May-Aug	-40	17.1 - 18
1996 Apr-Jun	-25	18.3 - 19

REFERENCES

Di Martino M., and Caciatori S. (1984) Photoelectric Photometry of 14 Asteroids. Icarus, 60, 75-82.

Lustig G. (1977) Die Rotations Periode und die Photoelektrische Lichtkurve des Planetoiden 471 Papagena. Astron. & Astrophys. Suppl., 30, 117-119

Scaltriti F. and Zapalla V. (1978) Photoelectric Photometry of Asteroids 37, 80, 97, 216, 270, 313 and 471. Icarus, 34, 428-435.

Surdej A. and Surdej J. (1977) Rotation Period and Photoelectric Lightcurves of Asteroid 471 Papagena. Astron. & Astrophys. Suppl., 30, 121-124.

Tarasova A. V. and Chernykh L. I. (1990) 1990 TR. IAU Circ. #5137.

Tedesco E. F., Tholen D. J., and Zellner B. (1982) The Eight Color Survey: Standard Stars. Astron. J., 87, 1585-1592.

Ueda S., and Kaneda H. (1990) 1990 TR. IAU Circ. #5121.

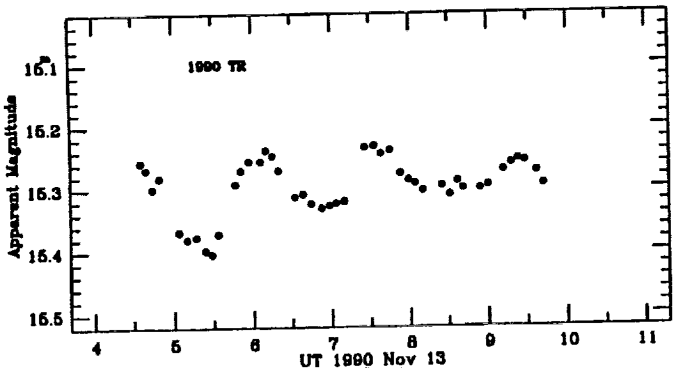

Fig. 1. Lightcurve of 1990 TR obtained on Nov 13, 1990.

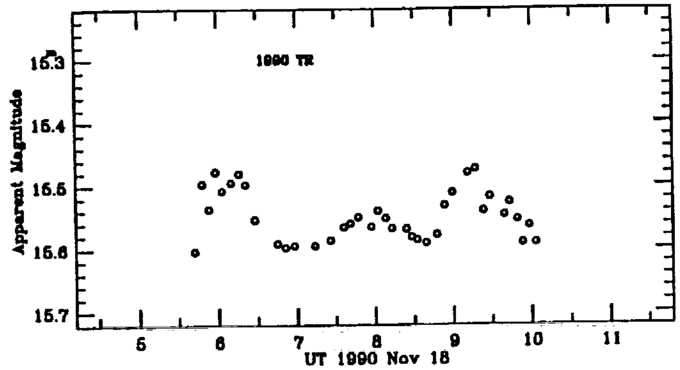

Fig. 2. Lightcurve of 1990 TR obtained on Nov 18, 1990.

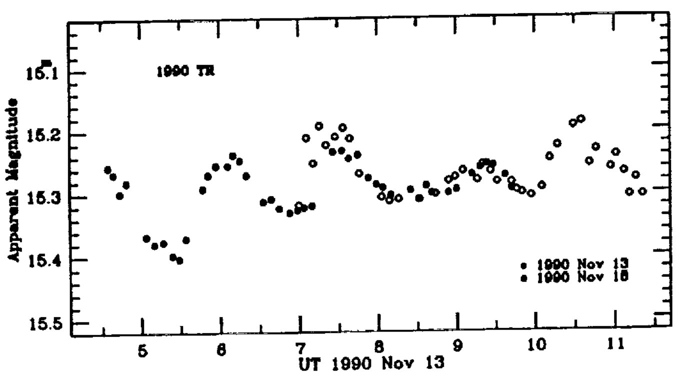

Fig. 3. Composite lightcurve of 1990 TR.

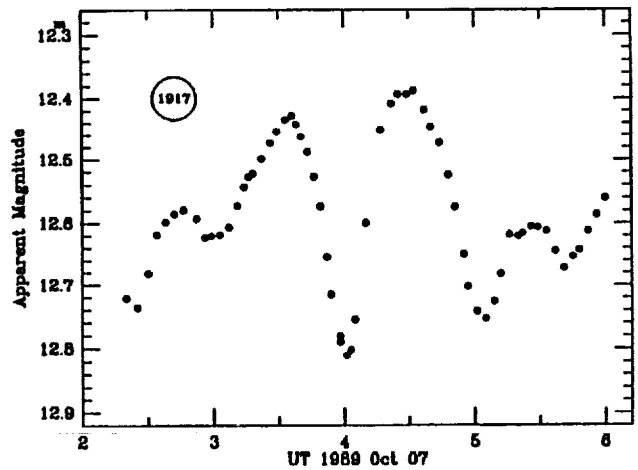

Fig. 4. Lightcurve of 1917 Cuyo obtained on Oct 7, 1989.

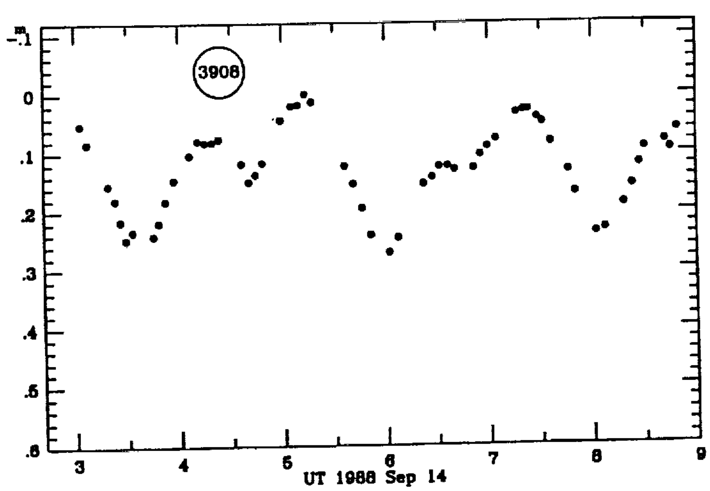

Fig. 5. Lightcurve of 3908 (1980 PA) obtained on Sep 14, 1988.

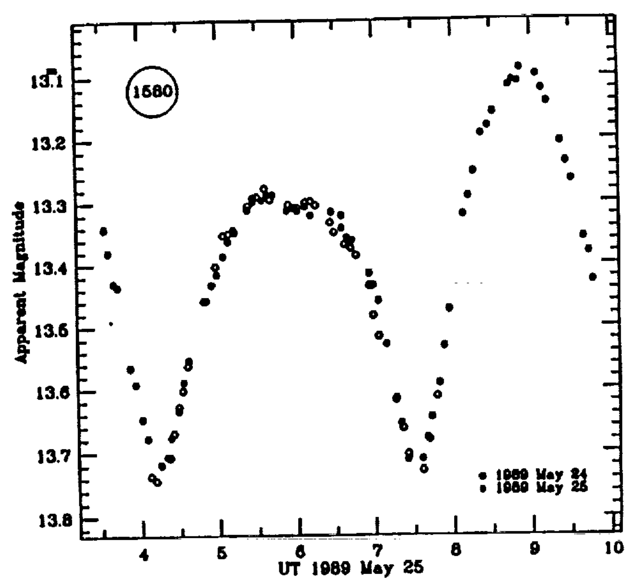

Fig. 6. Lightcurve of 1580 Betulia obtained on May 24-25, 1989.