

PHOTOELECTRIC LIGHTCURVES OF MINOR PLANETS 599 LUISA AND 128 NEMESIS DURING THE 1976 OPPOSITION*

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Asteroids 599 Luisa and 128 Nemesis were observed photometrically at the European Southern Observatory during the 1976 opposition. The lightcurve of 599 Luisa shows two well shaped minima and maxima together with a short time scale feature. The synodic period of rotation found for 599 Luisa is $9^h33^m58^s \pm 46^s$ and the maximum amplitude of the lightcurve 0.18 mag. Minor planet 128 Nemesis could only be observed during one night and appears to be a probable low-spin rotation asteroid.

Key words: asteroid – rotation period – lightcurve – 599 Luisa – 128 Nemesis

1. INTRODUCTION

Ephemeris of Minor Planets for 1976 predicted the opposition (ITA 1976) for 599 Luisa on September 15 with $B=11.6$ mag and for 128 Nemesis on July 28 with $B=11.9$ mag. Wind, snow and clouds made this end of winter very hard in Chile; we were able to deal only three nights for observing 599 Luisa and just one for 128 Nemesis. No previous observations for these asteroids seem to be reported in the literature up to now (Gehrels 1970).

The observations were carried out with a single channel pulse counting *UBV* photometer attached to the 50 cm photoelectric telescope of the European Southern Observatory at La Silla. Each single measurement lasted around 30 sec.

When observing the photoelectric lightcurves of these asteroids we measured regularly one or two comparison stars (DM–35°15887 (K1) and DM–34°16136 (F2) for 599 Luisa and DM–29°16775 (G) for 128 Nemesis) chosen close to the path of the asteroids and of similar colours and magnitude. This allowed to remove easily the small extinction effects from the lightcurves of the minor planets as well as judging the quality of the nights. The general observing routine included frequent observations of the asteroids, sky and comparison stars. Because of the poor meteorological conditions during the run of our observations no transformations from the instrumental system (*UBV*)' to the standard one (*UBV*) were attempted. Only differences in V' , i.e. $\Delta V'$ in the sense of asteroid minus comparison star, are plotted against U.T. in figures 1 to 5.

The lightcurves for 599 Luisa refer to the comparison star DM–35°15887 and the one for 128 Nemesis to the comparison star DM–29°16775.

Table 1 contains the date of observations, the right ascension and declination, the ecliptic longitude and latitude, the geocentric distance Δ , the heliocentric distance r , the phase angle α , the light times for the asteroids and the number of the figure relative to the corresponding date. In order to obtain accurate coordinates (R.A., decl., etc.) for the minor planets a few plates were made with the 40 cm double refractor of the European Southern Observatory at La Silla. Finally, the ephemeris for 599 Luisa and 128 Nemesis were determined by one of us (H.D.) at the Royal Observatory of Belgium (Debehogne *et al.* 1976).

2. LIGHTCURVES AND PERIOD

The $\Delta V'$ lightcurves for 599 Luisa and 128 Nemesis respectively shown in figures 1, 2, 3 and 5 are not corrected for the phase and distance effects, the abscissae are U.T. without correction for light time.

* Observations made at the European Southern Observatory, La Silla, Chile

Figure 4 illustrates the mean composite lightcurve of 599 Luisa, constructed from the three single night curves. The horizontal line in figure 4 indicates a mean magnitude, the areas enclosed by the mean curve above and below that line being equal. Except a short time scale feature (~ 0.03 mag) located around the phase 0.6 in figure 4, the lightcurve of 599 Luisa appears fairly continuous with two well shaped minima and maxima and with a maximum amplitude of 0.18 mag. The magnitude differences between the maxima M_1 and M_2 (see figure 4) and between the minima m_1 and m_2 are respectively -0.04 and -0.03 mag. The phase differences between the positions of the extrema M_1 and M_2 and between those of m_1 and m_2 are respectively about 0.5 and 0.6. Different superpositions of the lightcurves obtained during the three observing nights allow to derive straight away the lapse of time separating two similar features in the 599 Luisa's lightcurve. Location on time scale of such a feature is determined within a precision of 20 sec. Table 2 encloses the lapses of time derived when comparing the lightcurves (maxima, minima) from September 5 and 6, 5 and 8, 6 and 8, 1976. Assigning weights proportional to the number of cycles we deduce the following mean rotational synodic period

$$P = 9^{\text{h}}33^{\text{m}}58^{\text{s}} \pm 46^{\text{s}} = 0^{\text{d}}38859 \pm 0.00053.$$

The only lightcurve recorded for 128 Nemesis on September 10, 1976 shows a linear trend with an increase in magnitude of about 0.025 mag during 6 hours of observation.

3. DISCUSSION

Because of the continuous character of the lightcurve and the phase differences of its extrema it is very likely that the light variations of 599 Luisa are due mostly to the changing shape of the asteroid spinning around one axis. Local variations of the albedo over the asteroid surface are not excluded either. The mean rotational synodic period of $9^{\text{h}}34^{\text{m}}$ found for 599 Luisa ranges among the most typical ones (2 h–12 h, Schober 1976). The short time scale feature Δm appearing in the lightcurve of 599 Luisa (figure 4) is not unusual (Scaltriti *et al.* 1976). This could be an evidence for a local change of the albedo or a local topographic accident (small mountain, etc.). In the case of the second alternative and under the assumption that the so-called "topographic accident" appears to the observer as a complete black area we can estimate roughly a minimum value for its relative surface $\Delta S/S$, S representing the projected area of the asteroid perpendicularly to the line of sight. Indeed, we have $\Delta m \simeq 0.03 \simeq -2.5 \log [(S - \Delta S)/S]$ and thus $\Delta S/S \simeq 0.027$.

During the observations of 128 Nemesis its geocentric and heliocentric distances and its phase angle were all increasing. The enhancement of brightness during 6 hours on September 10, 1976 can therefore just be explained in terms of a low-spin rotation asteroid. A short series of measurements during 40 unexpected minutes gave us a cloud of points with $\Delta V' = 0.660 \pm 0.010$ mag for 128 Nemesis on September 13, 1976 at 4 h (U.T.). Because of both distance and phase effects, 128 Nemesis should have presented a drop in brightness of 0.053 mag between September 10 and 13, 1976 assuming a mean phase coefficient $\bar{\beta} = 0.023$ mag/degree. The magnitude differences for 128 Nemesis between September 10 and 13 at 4 h U.T. is found to be 0.080 mag. All these results support the preceding conclusion *i.e.* that the lightcurve of 128 Nemesis changes very slowly with time.

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Table 1 Aspect data, light times and figure numbers for 599 Luisa and 128 Nemesis

Date of Observation (0h U.T.)	R.A. (1950.0)	Dec. (1950.0)	λ (1950.0)	β (1950.0)	Δ (A. U.)	r (A. U.)	α	Light time	Figure
Sep 5, 1976	23 ^h 39 ^m 31	-34°52'6	199°88	-29°68	1.03205	1.97185	14°69	0 ^d .00596	1, Luisa
Sep 6, 1976	23 38.27	-34 51.1	200.08	-29.56	1.03207	1.97173	14.68	0.00596	2, Luisa
Sep 8, 1976	23 36.17	-34 46.8	200.48	-29.30	1.03268	1.97155	14.70	0.00596	3, Luisa
Sep10, 1976	20 02.24	-28 12.5	243.13	-07.57	1.81475	2.57440	17.59	0.01048	5, Nemesis

Table 2 Epochs and lapse of time between two similar extrema appearing in a pair of lightcurves (see text).

Epoch (U.T., 1976)	Extremum	Lapse of time	Deduced N° of Cycles
Sep 5, 4.380h±0.005h Sep 6, 9.100	m ₂	28.720h	3
Sep 5, 8.170h Sep 6, 3.210	m ₁	19.040	2
Sep 5, 4.380h Sep 8, 8.964	m ₂	76.584	8
sep 5, 6.176h Sep 8, 1.080	M ₁	66.904	7
Sep 5, 8.170h Sep 8, 3.080	m ₁	66.910	7
Sep 6, 3.210h Sep 8, 3.080	m ₁	47.870	5
Sep 6, 5.300h Sep 8, 5.180	M ₂	47.880	5
Sep 6, 9.100h Sep 8, 8.964	m ₂	47.864	5

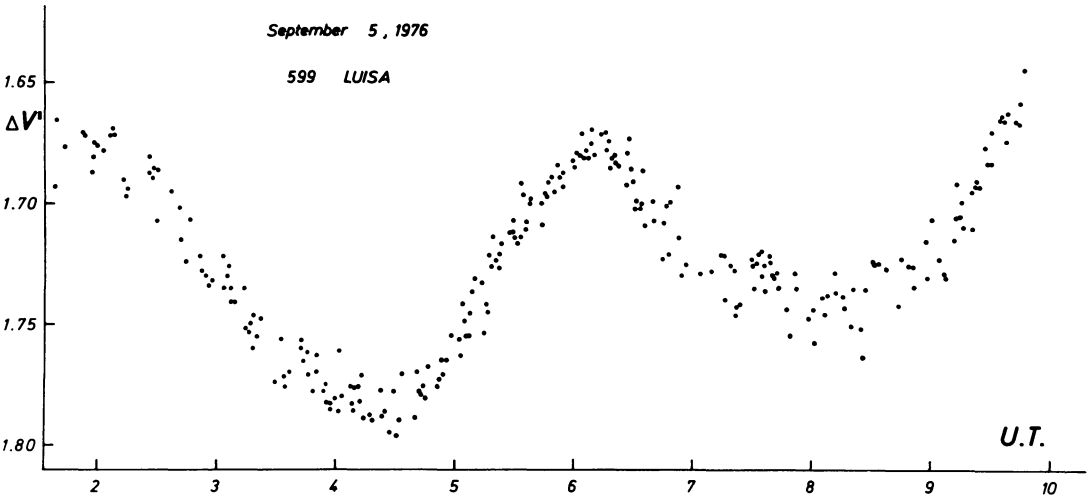


Figure 1 Lightcurve of 599 Luisa on September 5, 1976.

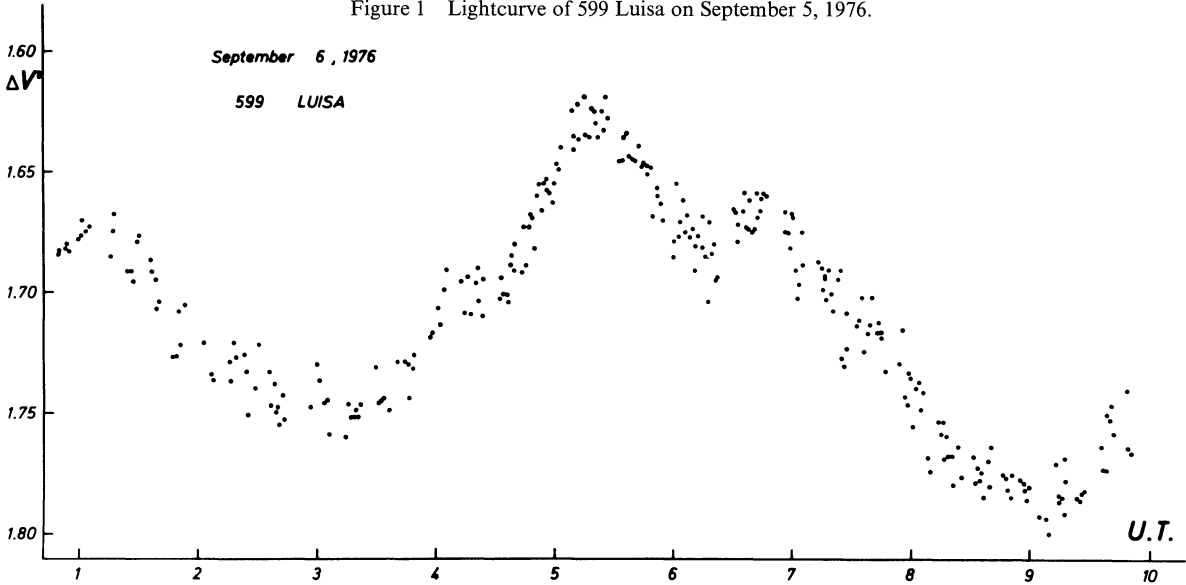


Figure 2 Lightcurve of 599 Luisa on September 6, 1976.

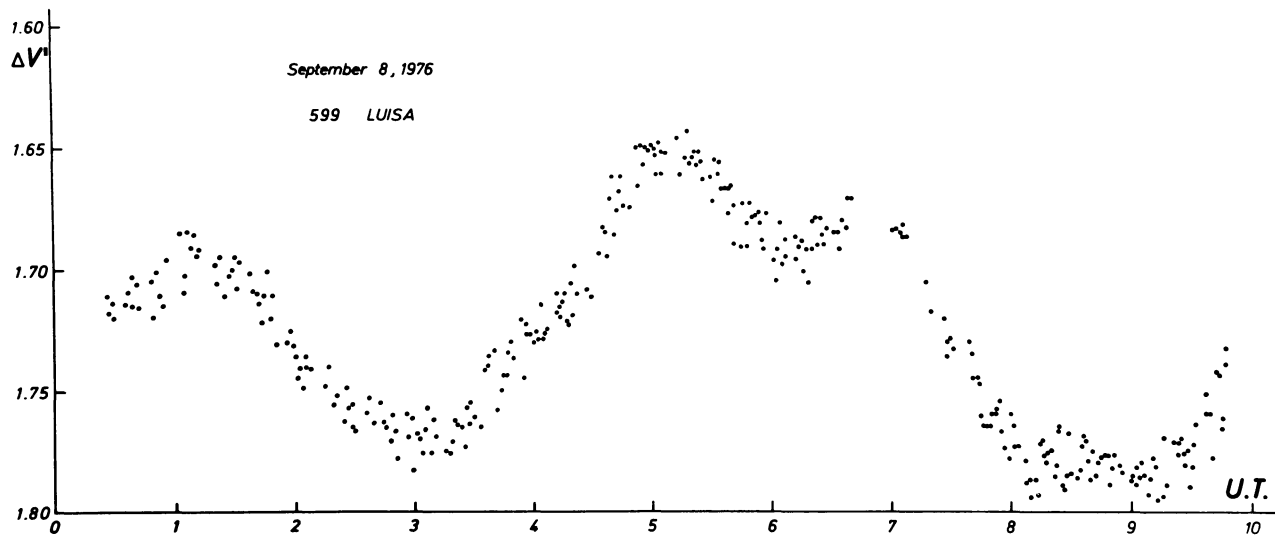


Figure 3 Lightcurve of 599 Luisa on September 8, 1976.

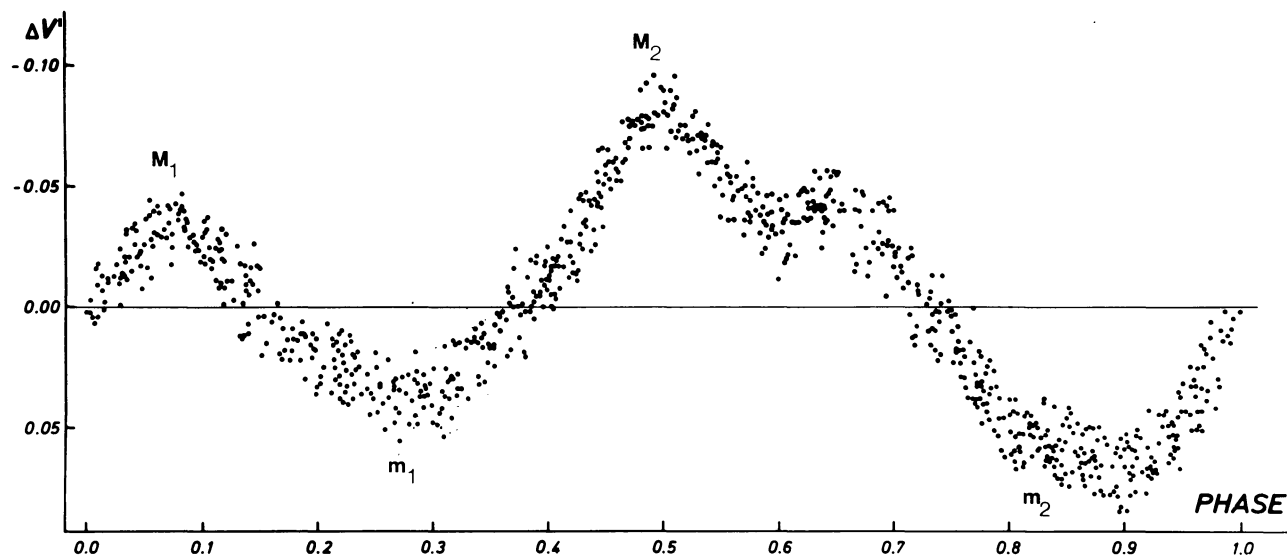


Figure 4 Mean lightcurve of 599 Luisa. The ordinates are referred to the mean magnitude line (see text).

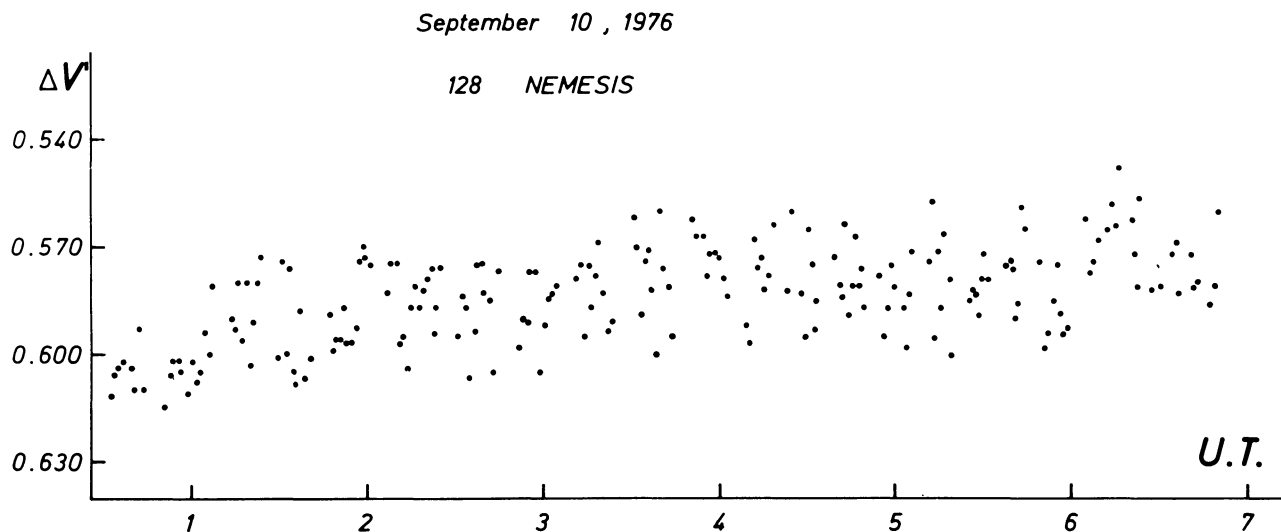


Figure 5 Lightcurve of 128 Nemesis on September 10, 1976.