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PHOTOELECTRIC LIGHTCURVES AND ROTATION PERIOD OF THE MINOR PLANET 148 GALLIA

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The minor planet 148 Gallia was observed during the 1977 opposition with a photoelectric photometer attached to the ESO 50 cm telescope at the European Southern Observatory. The lightcurve shows two maxima and minima with a total amplitude $\Delta V=0.32$ mag. The synodic period of rotation found is $20^h39^m49^s \pm 26^s$ and ranges 148 Gallia among the long period asteroids.

Key words: asteroid – Minor Planet – lightcurve – 148 Gallia

1. INTRODUCTION

Ephemeris of Minor Planets for 1977 (ITA, 1977) predicted the opposition of 148 Gallia on November 24, 1977 with $B=11.3$ mag. Photometric observations of the minor planet 148 Gallia in the standard UBV system were carried out during three different runs, respectively December 6-10, 1977, December 15 and 16, and December 31-January 3, 1978 with the ESO 50 cm telescope at the observatory of La Silla (ESO, Chile).

No previous observations of this asteroid are reported in the literature up to now. Table 1 presents 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 small planet and the number of the figure corresponding to the given date. These ephemerides were computed by using the elliptical elements from ITA (1977) and the POS program complex kindly put at our disposal by R.M. West.

2. OBSERVATIONS

A single-channel photometer equipped with an EMI 6256 photomultiplier, Schott standard filters for the UBV magnitudes and a Pelletier cooling system was used for the photoelectric measurements. Basic integration time of 30 sec. was chosen when collecting the photons in a 22 arcsec. diaphragm. The general observing routine included frequent observations of the asteroid, sky, one comparison star and some E region stars (Cousins and Stoy, 1962). The data were reduced to the standard UBV system in the usual way, taking into account the first and second order extinction as well as a linear colour transformation. The star CP1 (see table 2) was taken as a comparison until December 16 and the star CP2 later on. With the exception of the night December 15 (not photometric), all our observing runs were of very good weather quality.

3. LIGHTCURVES AND ROTATION PERIOD

Figures 1-10 display the photometric measurements of 148 Gallia in the V filter for each single night of observations. These lightcurves are not corrected for the phase and distance effects, and the abscissae are U.T. without correction for light time.

A complete lightcurve for the minor planet 148 Gallia, constructed from the ten individual night curves when taking into account the distance (see table 1) and phase ($\alpha=0.035$ mag./deg.) effects, is presented in figure 11. In that figure the lightcurve shows two well shaped maxima (M_1, M_2) and minima (m_1, m_2) with a maximum amplitude $\Delta V=0.32$ mag.

The colour indexes were found to be $B-V=0.87\pm0.01$ and $U-B=0.45\pm0.02$ without evident variations during the light changes and the range of phase ($\alpha=18.2°$–$22°$) covered by our observations.

Table 3 encloses the epochs and lapses of time between two similar extrema appearing in a pair of lightcurves. Location on time scale of the epochs was determined with a precision of 30 sec. Assigning weights proportional to the number of cycles elapsed between two similar extrema we deduced the following mean rotational synodic period

$$P=20^{h}39^{m}49^{s}\pm26^{s}=0.86098^{d}\pm0.00030^{d}.$$

4. DISCUSSION

Though the general shape of the lightcurve for 148 Gallia can be easily interpreted as due to the changing shape of the minor planet, it is very probable that local variations of the albedo over the asteroid surface and/or shadowing effects due to large-scale roughness bring also some contributions in the lightcurve. Indeed, around the phase $\phi=0.2$ in figure 11 the lightcurve is divided into two distinct parts corresponding respectively to the observations of December 6-7, 1977 and December 31-January 1, 1978 rather than the remaining part of the observations are well superposed. This effect results in an enhancement of the phase coefficient α which can be explained by local variations of the albedo and/or the presence of large-scale roughness (cf. Surdej and Surdej, 1978) over that part of the area reflecting the light minimum m_1. The rather long rotation period $P=20^{h}39^{m}49^{s}$ ranges 148 Gallia at the high end in the histogram of the distribution of minor planet rotation periods (Schober 1978).

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Table 1 Aspect data, light times and figure numbers for 148 Gallia

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
Dec. 06, 1977	$03^h51^m07^s$	-21°46'39"	49°.177	-40°.765	1.4919	2.2865	18°.2	$0^d.00862$	1
07,	03 50 22	-21 40 16	48.996	-40.614	1.4963	2.2873	18.3	0.00864	2
08,	03 49 38	-21 33 27	48.822	-40.457	1.5008	2.2881	18.4	0.00867	3
09,	03 48 56	-21 26 13	48.662	-40.295	1.5056	2.2889	18.5	0.00870	4
10,	03 48 14	-21 18 35	48.504	-40.127	1.5105	2.2897	18.6	0.00872	5
16,	03 44 31	-20 24 51	47.755	-39.022	1.5435	2.2948	19.4	0.00891	6
31,	03 39 11	-17 21 38	47.324	-35.736	1.6502	2.3089	21.6	0.00953	7
Jan. 01, 1978	03 39 03	-17 07 28	47.368	-35.500	1.6585	2.3099	21.7	0.00958	8
02,	03 38 57	-16 53 08	47.422	-35.264	1.6669	2.3109	21.8	0.00963	9
03,	03 38 52	-16 38 39	47.482	-35.027	1.6754	2.3120	22.0	0.00968	10

Table 2 Coordinates, V magnitudes, $B-V$ and $U-B$ colours of comparison stars

comp.star	α (1950)	δ (1950)	V	B-V	U-B
CP1	$03^h44^m44^s$	-22°01'59"	10.95	0.62	0.08
CP2	03 34 24	-17 24 13	10.75	0.60	0.09

Table 3 Epochs and lapse of time between two similar extrema appearing in a pair of lightcurves (see text)

Epoch (U. T.)		Extremum	Lapse of time	Deduced N° of cycles
Dec. 06, 1977	$4^h.000$	m_1	$599^h.588$	29
Dec. 31, 1977	3.588			
Dec. 08, 1977	4.471	M_1	20.665	1
Dec. 09, 1977	1.136			
Dec. 08, 1977	4.471	M_1	599.083	29
Jan. 02, 1978	3.554			
Dec. 09, 1977	4.285	m_2	165.334	8
Dec. 16, 1977	1.619			
Dec. 09, 1977	1.136	M_1	578.418	28
Jan. 02, 1978	3.554			
Dec. 09, 1977	4.285	m_2	599.182	29
Jan. 03, 1978	3.467			
Dec. 10, 1977	5.380	M_2	144.731	7
Dec. 16, 1977	6.111			
Dec. 16, 1977	1.619	m_2	433.848	21
Jan. 03, 1978	3.467			

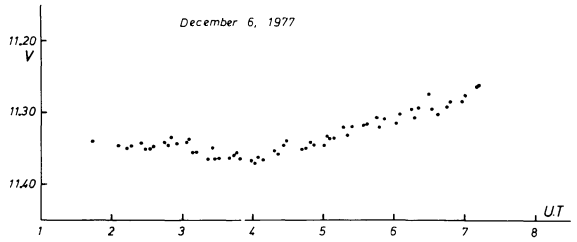

Figure 1 V lightcurve of 148 Gallia on December 6, 1977.

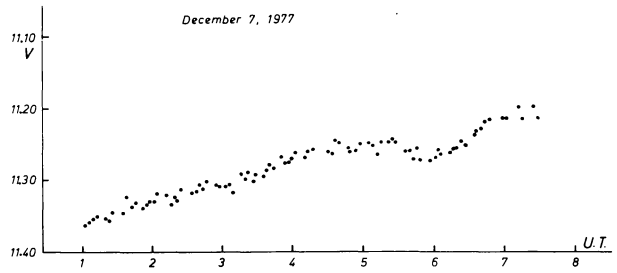

Figure 2 V lightcurve of 148 Gallia on December 7, 1977.

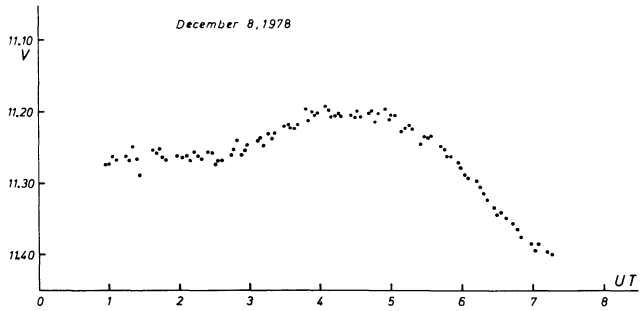

Figure 3 V lightcurve of 148 Gallia on December 8, 1977.

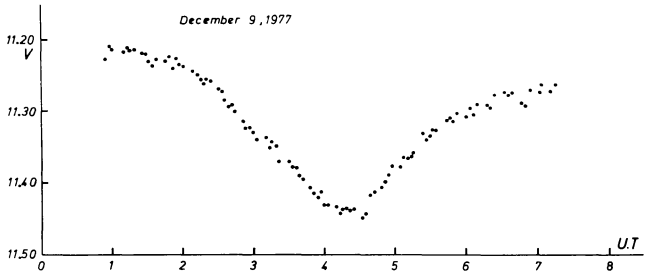

Figure 4 V lightcurve of 148 Gallia on December 9, 1977.

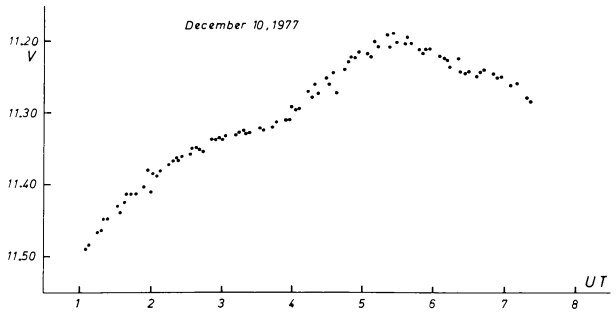

Figure 5 *V* lightcurve of 148 Gallia on December 10, 1977.

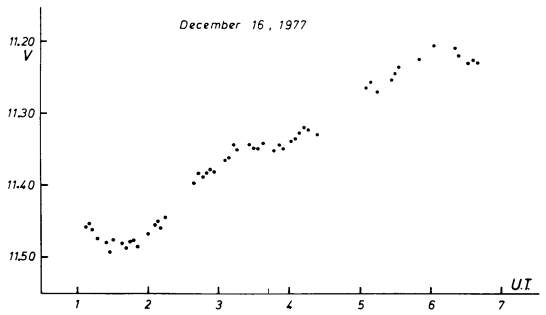

Figure 6 *V* lightcurve of 148 Gallia on December 16, 1977.

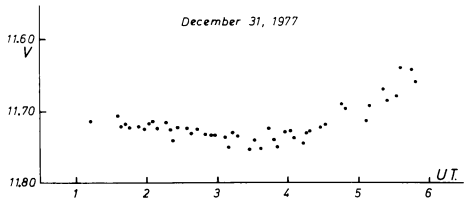

Figure 7 *V* lightcurve of 148 Gallia on December 31, 1977.

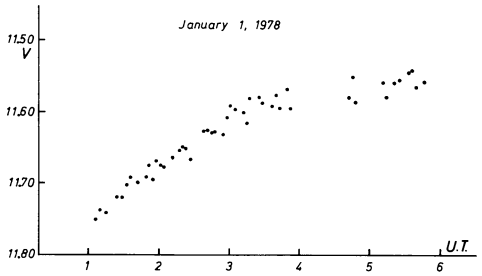

Figure 8 *V* lightcurve of 148 Gallia on January 1, 1978.

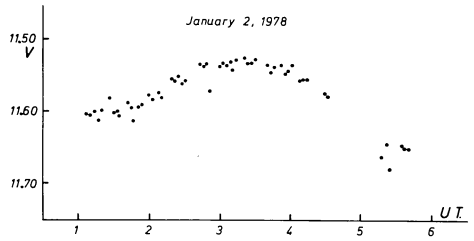

Figure 9 *V* lightcurve of 148 Gallia on January 2, 1978.

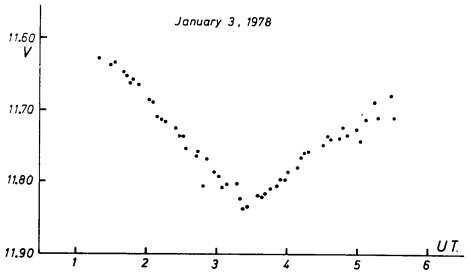

Figure 10 *V* lightcurve of 148 Gallia on January 3, 1978.

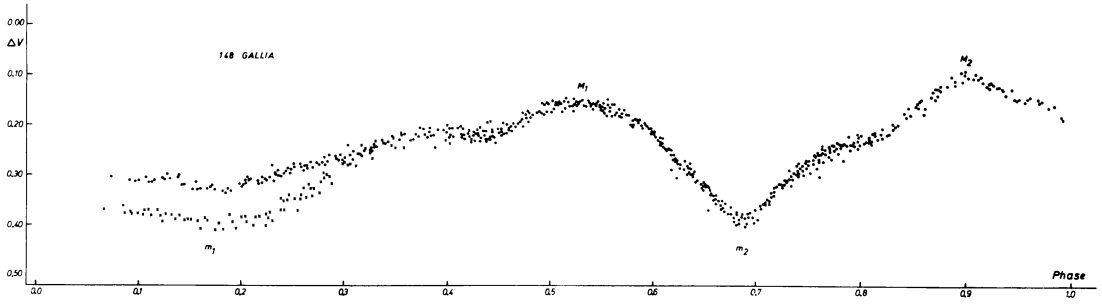

Figure 11 Composite *V* lightcurve of 148 Gallia (see text).