

both the primary and secondary maxima are of nearly equal brightness, all of the extrema were polled without distinction between primary or secondary. The primary and secondary minima differ by about 0.05 mag, but they were treated equally as well; this contributes to the somewhat higher scatter in the “lightcurve minima” phase curve, compared to the phase curve for the “lightcurve maxima.” Two methods were used to poll the asteroid’s brightness at the extrema. First, the Fourier fit to the lightcurve was adjusted up and down to minimize the mean-square error to the measured lightcurve data in the neighborhood of the extremum of interest, and then the magnitude of the Fourier fit was determined. Second, the actual photometric measured data point at the time of maximum/minimum light was recorded. The difference between these two estimates of maximum or minimum brightness rarely differed by more than a few hundredths of a magnitude. Both the “Fourier fit” and the “actual measured” data points are included in the final phase curve in order to give a visual feel for the quality of the data.

The JPL Horizons ephemeris system was used to determine the solar phase angle (α), Sun and Earth distances (R and D , respectively) for the time of each lightcurve extremum, and the reduced magnitude $V_R = V - 5\log(RD)$ was calculated using this information. The phase curves (V_R vs. α) for the lightcurve maxima and minima are shown in Figure 2. The best fits to the data are:

Lightcurve brightness maxima

$$H_{max} = 12.053 \pm 0.006, G = 0.259 \pm 0.008$$

Lightcurve brightness minima

$$H_{min} = 12.289 \pm 0.009, G = 0.246 \pm 0.014$$

Combining these, the best estimate of the mean V-magnitude is

$$H_0 = 12.17 \pm 0.02, G = 0.25 \pm 0.01$$

This value of absolute magnitude is consistent with the previously-reported data recorded in the asteroid lightcurve database.

This appears to be the first report of a phase curve for this object. In the small bodies node (<http://pdssbn.astro.umd.edu/>), 1130 Skuld is identified as a “class S” asteroid, and the slope parameter determined here is consistent with that designation. It is a member of the Flora dynamical family; I note that the slope parameter for 4 Flora is reported as $G = 0.28$, so my reported slope parameter of 1130 Skuld is quite similar to that of the main body of this family.

References

Behrend (2009) reported at:

http://obswww.unige.ch/~behrend/page_cou.html

Robinson (2009) reported at: <http://btboar.tripod.com/lightcurves/>

Acknowledgements

This research made use of the JPL Horizons system (<http://ssd.jpl.nasa.gov/?horizons>), and the NASA Astrophysics Data System (<http://adswww.harvard.edu/index.html>).

CCD PHOTOMETRY AND LIGHTCURVE ANALYSIS OF 985 ROSINA AND 990 YERKES FROM GRUP D’ASTRONOMIA DE TIANA (G.A.T.) OBSERVATORY

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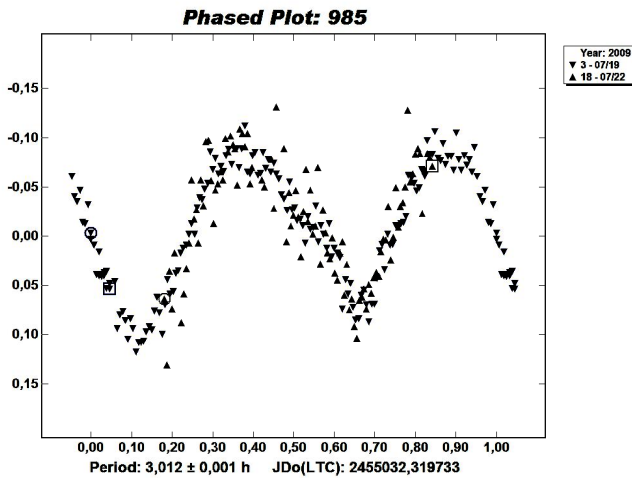
Two first lightcurve determination attempts were carried out from the Grup d’Astronomia de Tiana Observatory on several nights spanning from 2009 July 19 to November 10. The asteroids covered by this work are 985 Rosina, a body of known lightcurve parameters, and 990 Yerkes, a main-belt asteroid whose period had not been determined to date. We obtained a synodic period of 3.012 ± 0.001 h for 985 Rosina that matches very accurately previous lightcurve measurements. For 990 Yerkes a 24.56 ± 0.01 h period and 0.25 mag amplitude has been tentatively established by our observations.

The *Grup d’Astronomia de Tiana* (G.A.T.) Observatory is situated in Tiana, in the southernmost part of the *Serra de Marina*, a moderately-polluted suburban park 15 km north of Barcelona. In spite of the limitations imposed by the local light conditions, useful observations can still be carried out thanks to the forest surrounding the building. The G.A.T. Observatory was recently equipped with a Paramount GEM (German Equatorial Mount), a 43-cm modified Dall-Kirkham Planewave reflector, and a dual-chip SBIG STL-1001 CCD camera with filter wheel and AO-L adaptive optics unit, yielding a 28.9' x 28.9' field of view and an effective resolution of 1.70 arc sec/pix.

This work has been carried out by four members of the G.A.T.: Jaume Martínez, who has been carrying out a high-school research project, was in charge of target selection, telescope operation, and data processing; Joan Martín operated the telescope and acquired images on several nights; Ramón Bosque worked in data reduction and revised this paper, and Josep M. Aymamí acquired, processed and reduced data, and wrote this paper.

985 Rosina is a Mars-crossing (MC) asteroid ($e = 0.27669$, $a = 2.2997$) with a well known rotational period of 3.0126 h (quality code 3; see documentation in Warner et al, 2009) and an amplitude of 0.22 mag (Behrend, 2009). We collected 260 60s images on the nights of 2009 July 19 and July 22 through a C filter with *Maxim DL* acquisition software. The imaging chip of the STL-1001 CCD camera operated at -20° C and all images were calibrated with master bias, dark, and flat frames. Differential photometry of the asteroid was performed “live” at the observatory by using *Fotodif*, a free software program that allows us to follow the asteroid’s lightcurve easily on-site as the images are being downloaded. Measurements carried out with different software packages (*Astrometrica* and *Focas II*) showed that the asteroid’s brightness compared to a number of stars in the R band of the USNO A2 catalogue was approximately mag 13.8. With the weather cooperating, we managed to capture a full rotation period on the very first night and, after obtaining images on a second night, we could derive our own lightcurve with *Canopus*, which shows a period of 3.012 ± 0.001 h and 0.22 mag amplitude,

which are in good agreement with the published data (see references in Warner et al, 2009).



990 Yerkes. This main-belt asteroid ($e = 0.21556$, $a = 2.66838$) was the next target of a short list that we set at the end of northern summer. The choice was based on its favourable location in the sky in the 2009 September-November timeframe with a maximum forecast brightness of about mag 14 as well as the fact that no known period had been reported to date according to the Lightcurve Database (Warner et al. 2009). Free software, *Orbitas*, helped us prepare an ephemeris showing that 990 Yerkes would remain rather weak until mid-August 2013, when it would briefly reach mag 14 again. We subsequently discovered that 990 Yerkes had been included in the Lightcurve Photometry Opportunities section of the third quarter *Minor Planet Bulletin*.

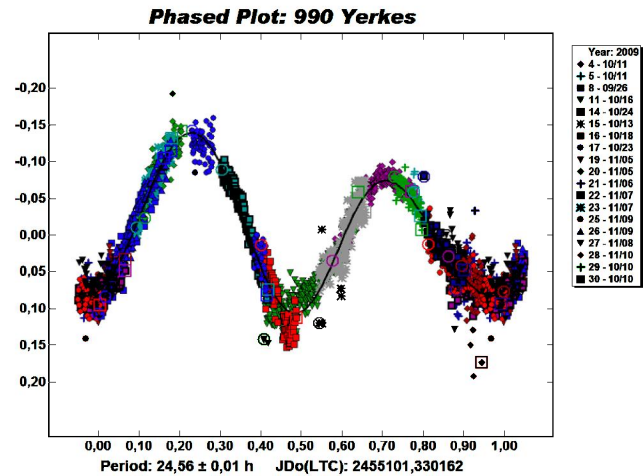
Our observations cover a range of phase angles (5.3° to 16.7°). Only on three nights did the asteroid rise above mag 14. The images were fully calibrated with master bias, dark, and flat frames, with the CCD chip working at -15°C .

Date	Phase Angle	Forecast Mag.	Observations
2009 09 26	16.7	14.47	39
2009 09 27	16.2	14.45	96
2009 10 11	9.9	14.43	147
2009 10 13	9.0	14.09	156
2009 10 14	8.6	14.07	97
2009 10 16	7.7	14.03	236
2009 10 17	7.3	14.01	82
2009 10 18	6.9	13.99	114
2009 10 23	5.3	13.91	234
2009 10 24	5.1	13.91	12
2009 11 05	6.9	14.06	106
2009 11 06	7.3	14.09	258
2009 11 07	7.7	14.12	188
2009 11 08	8.1	14.14	169
2009 11 09	8.6	14.17	16

Table I. Observing circumstances for 990 Yerkes.

Initial data from the first observing sessions (2009 Sep 26 to Oct 11) spanning 3 h each night showed clear ascending and descending branches of notable amplitude (over 0.15 mag). It soon became clear that 990 Yerkes rotational period was going to be longer than we might have anticipated. On the night of Oct 11, an ascending branch and a turning point were clearly established and several additional fragments were observed between Oct 11 and Oct 24. A series of cloudy days prevented us from continuing to

monitor the asteroid, and we could only speculate on several solutions ranging from 25 to 32 h. We restarted the observations after the October full moon, and 60s-90s exposures were acquired the nights of Nov 5 to Nov 10 through C filter. These provided more comprehensive coverage and allowed us to refine the lightcurve that we present here. Our best estimate period for 990 Yerkes 24.56 ± 0.01 h with 0.25 mag. amplitude.



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