ROTATIONAL PERIOD DETERMINATION AND TAXONOMIC CLASSIFICATION FOR ASTEROID 536 MERAPI

Massimiliano Mannucci, Nico Montigiani
Osservatorio Astronomico Margherita Hack (A57)
Florence, ITALY
info@astrofilifiorentini.it

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CCD photometric observations of outer main-belt asteroid 536 Merapi were obtained in order to measure the rotation period and to find the color indexes B-V and V-R. These measures were performed using the instrumentation available at the Osservatorio Astronomico Margherita Hack located on the hills near Florence (Italy).

CCD photometric observations of one main-belt asteroid was carried out in 2021 March and May at the Osservatorio Astronomico Margherita Hack (A57). We used a 0.35-m f/8,25 Smith-Cassegrain telescope, a SBIG ST10 XME CCD camera, clear filter and B, V, Rc photometric filters. The pixel scale was 1 arcsec when binned at 2×2 pixels. Data processing and analysis were done with *MPO Canopus* (Warner, 2017). All the images were calibrated with dark and flat field frames using *Astroart* 6.0. Table I shows the observing circumstances and results.

536 Merapi was discovered by the American astronomer George Henry Peters on May 11, 1904, from Washington, D.C. It is named after Mount Merapi, one of the most active volcanos in Indonesia. We chose it from the list of lightcurve photometry opportunities on the Minor Planet Bulletin (Warner et al., 2021). 536 Merapi is an outer main-belt asteroid with a semi-major axis of 3.498 AU, eccentricity of 0.087, inclination of 19.423 deg and an orbital period of 6.54 years. Its absolute magnitude is H = 8.16 (JPL, 2021; MPC, 2021). Our observations were conducted in two different steps.

The first step consisted in collecting 439 data points with clear filter in three different nights (23/3/2021, 30/3/2021 and 31/3/2021). The derived synodic period was P = 8.7905 ± 0.0005 h with an amplitude of A = 0.16 ± 0.03 mag.

Moreover, we consulted the asteroid lightcurve database (LCDB; Warner et al., 2009) and we found four previous calculated periods: P = 8.78 +/- 0.01h (Koff, 2000), P = 8.809 +/- 0.008h (Ditteon and Hawkins, 2007) and P = 8.79052 +/- 0.00004h (Ďurech et al., 2020). The period we found seems to be in good agreement with the previous mentioned periods.

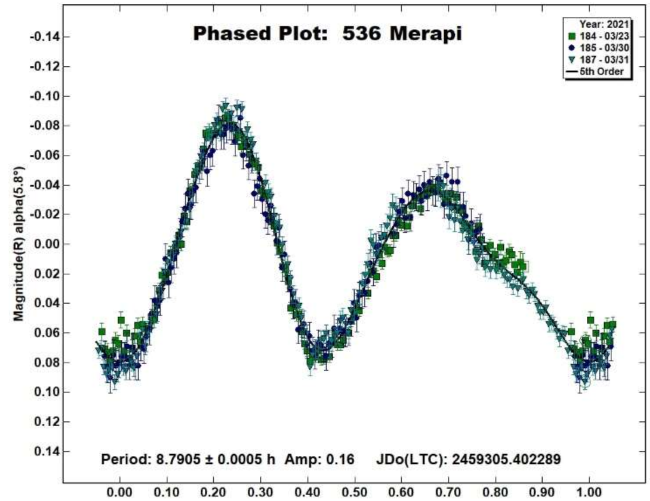

Figure 1. Phased lightcurve of 536 Merapi.

In the second step we collected further 83 data points in two different nights (08/05/2021 and 27/05/2021) using filter V, Rc and B. This allowed us to determine the color indexes (V-R) = 0.404 ± 0.004 and (B-V) = 0.70 ± 0.03. These values are consistent with a low albedo C-type taxonomic class (Shevchenko and Lupishko, 1998) and in good accordance with the previously published results in the LCDB.

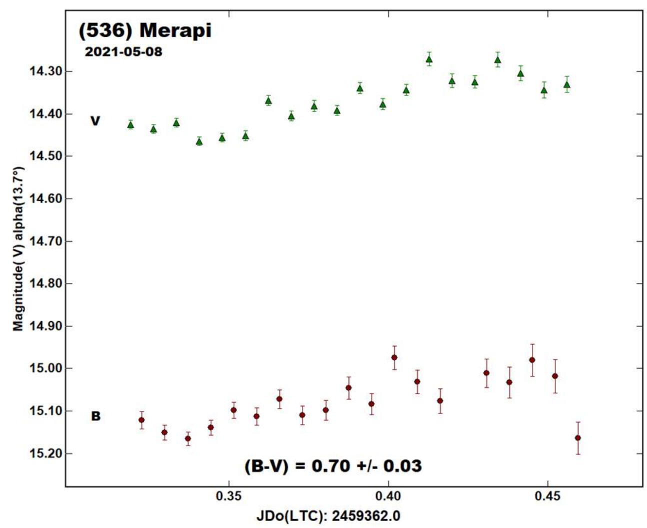

Figure 2. (B-V) raw plot of 536 Merapi.

Number	Name	2021 mm/dd	Pts	Phase	L_{PAB}	B_{PAB}	Period(h)	P.E.	Amp	A.E.	Grp
536	Merapi	23/03-31/03	436	5.81-5.04	193.1	16.9	8.7905	±0.0005	0.16	0.03	OMB

Table I. Observing circumstances and results. Pts is the number of data points. The phase angle is given for the first and last date. L_{PAB} and B_{PAB} are the approximate phase angle bisector longitude and latitude at mid-date range (see Harris *et al.*, 1984). Grp is the asteroid family/group (Warner *et al.*, 2009).

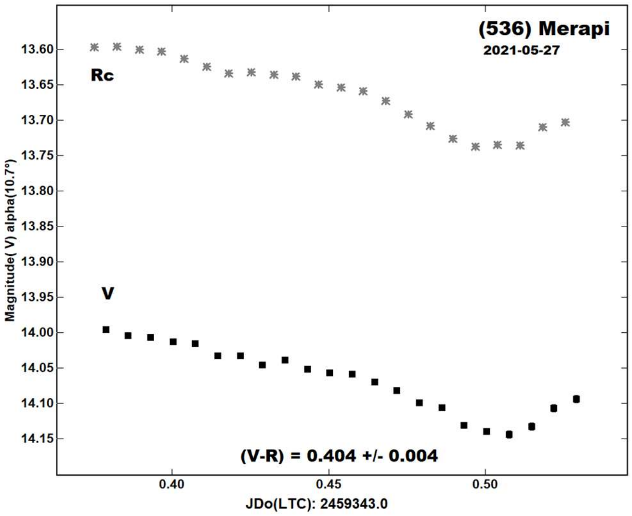

Figure 3. (V-R) raw plot of 536 Merapi.

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LIGHTCURVE AND SYNODIC ROTATION PERIOD FOR 2728 YATSKIV

Vladimir Benishek
Belgrade Astronomical Observatory
Volgina 7, 11060 Belgrade 38, SERBIA
vlaben@yahoo.com

Frederick Pilcher
Organ Mesa Observatory
4438 Organ Mesa Loop
Las Cruces, NM 88011 USA

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A rotational lightcurve and a synodic rotation period were obtained for the first time on the main-belt asteroid 2728 Yatskiv from CCD photometric observations conducted over the time span 2021 June - September at two observatories widely separated in geographic longitude. As a result, a bimodal lightcurve phased to a period of 25.069 ± 0.006 h was established.

Prior to our work, there were no reports on synodic rotation period and lightcurve determinations for the inner main-belt asteroid 2728 Yatskiv. As a program target within the Photometric Survey for Asynchronous Binary Asteroids (*BinAstPhot Survey*) under the leadership of Dr. Petr Pravec from the Astronomical Institute of the Czech Academy of Sciences, 2728 Yatskiv was proposed for active photometric follow-up in 2021 June.

Benishek at Sopot Astronomical Observatory (SAO) in Serbia began photometric observations on 2021 June 13, employing a 0.35-m (f/6.3) Schmidt-Cassegrain telescope (SCT) equipped with a SBIG ST-8XME CCD camera operating in 2×2 binning mode. The first dense photometric datasets obtained by the end of June indicated not only a somewhat longer rotation period, and also its pronounced near commensurability with the Earth's rotation. Due to the parallel work on many other priority targets, and as the rather long rotation period for 2728 Yatskiv became apparent, a sparse data acquisition was implemented in some Benishek's datasets by taking one data point per half an hour.

These early datasets have yielded several harmonically related solutions (various multiples of the basic monomodal solution of somewhat over 12.5 hours). None of them could have been adopted as unequivocal one due to the rather limited amount of data and the shortness of of the observing runs, as well as the fact that progress in observational covering of a broader range of rotational phases from a single geographic longitude was very slow, since possible period solutions are near commensurate with the Earth's rotation.

After a certain delay in the 2728 Yatskiv follow-up observations caused by a large number of other priority targets in the SAO observing schedule, Frederick Pilcher of the Organ Mesa Observatory in Las Cruces, USA was invited to contribute 2728 Yatskiv photometry from a significantly different geographic longitude to effectively resolve the existing period ambiguity. Pilcher kindly accepted the invitation and obtained his first dataset on 2021 September 08. Pilcher used a 0.35-m (f/10) SCT and a SBIG STL-1001E CCD camera. Two 2021 September long datasets by Pilcher were crucial to definitively determine a total amplitude of the combined lightcurve, which turned out to be greater than 0.4 magnitudes, and they also significantly covered a large gap in the lightcurve corresponding to a bimodal period solution of just over 25 hours.