

## LIGHTCURVE AND ROTATION PERIOD OF 1367 NONGOMA

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During the 2024 opposition of 1367 Nongoma, an international team of observers worked to improve the asteroid's lightcurve quality. They determined that 1367 Nongoma has a synodic rotation period of  $133.485 \pm 0.026$  h, with an amplitude of  $0.65 \pm 0.05$  mag.

The Asteroid Lightcurve Database (LCDB; Warner et al., 2009; updated 2023 Oct.) gave an adopted period of 94.8 hours for 1367 Nangoma, listing the reliability as  $U = 1+$ . Given that Nongoma was at a favorable apparition in 2024 August at a brightness of  $V \sim 14.9$ , an international observational campaign was organized to improve the quality of its lightcurve.

Photometric observations were carried out from seven observatories, four of which were located in Malta. The remaining observatories were located in Slovakia, Canada, and the United States. A total of 57 sessions were obtained from 2024 June 8 to August 11, yielding 1770 observations. Table 1 provides the complete equipment list and the observer's total runs.

All images were taken through a clear filter or were unfiltered with an Pan-STARRS  $r'$  bandpass zero point and calibrated using dark and flat-field subtraction. All brightness measurements were based on the Asteroid Terrestrial-impact Last Alert System (ATLAS) catalogue (Tonry et al., 2018).

The equipment used in this study was operated either remotely via the Internet or locally at each telescope. Image acquisition at all Maltese observatories was carried out using *Sequence Generator Pro* (Binary Star Software). In contrast, the Slovakian and Canadian observatories employed *NINA* telescope control software (Berg, 2023) for both image acquisition and telescope automation. RIT Observatory used *Maxim DL* (Version 6.16) for observatory operations and image capture. For image analysis, we employed *MPO Canopus* v10 (Warner, 2017) to perform differential aperture photometry and lightcurve creation. The software's Comparison Star Selector (CSS) feature was used to select comparison stars with near-solar colour.

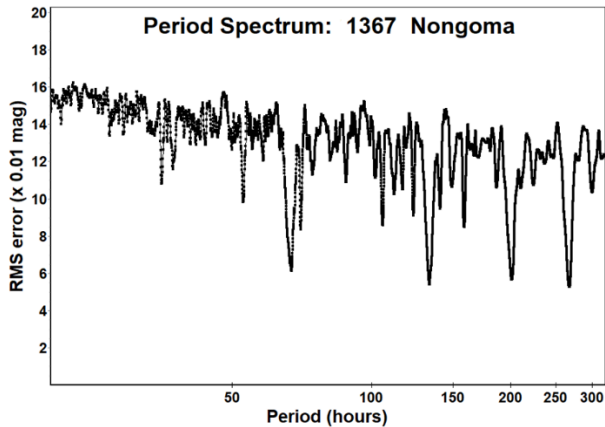
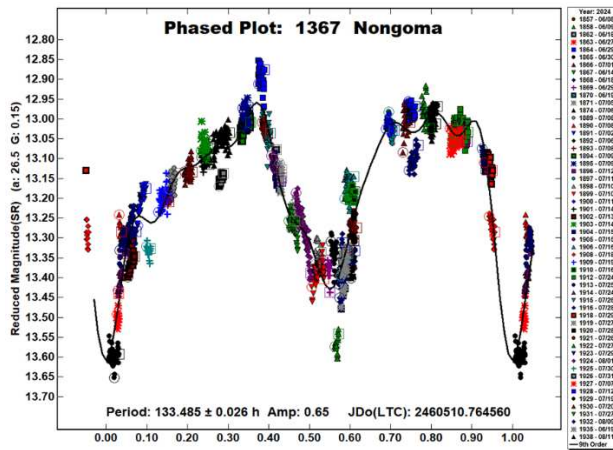
Observatory	Tel	Camera	Obs Runs
A la belle étoile	0.2-m MK	Moravian G2-1600	3
Antares	0.28-m SCT	SBIG ST-11	1
Flarestar (MPC: 171)	0.25-m SCT	Moravian G2-1600	26
Luckystar (MPC: M55)	0.25-m SCT	Atik 460EX	21
Manikata	0.2-m SCT	ZWO ASI2600MM	1
RIT (MPC: 920)	0.30-m SCT	ASI 6200MM	5
Znith	0.2-m SCT	Moravian G2-1600	2

Table 1 – Instrumentation and Observation Runs. SCT: Schmidt-Cassegrain; MK: Maksutov-Cassegrain.

For this asteroid of the Phocaea family, we estimate the synodic rotation period of 1367 Nongoma to be  $133.485 \pm 0.0026$  h with a lightcurve amplitude of  $0.65 \pm 0.05$  magnitudes. This period differs from the one from Oey (2014), which was constrained by limited coverage of the lightcurve. For our analysis, the Fourier algorithm suggested other candidate periods, but these had higher RMS errors, and none resulted in a valid lightcurve. Although the 267.8-hour solution had a slightly lower RMS, it still failed to produce a viable outcome. This was particularly notable since asteroids with lightcurve amplitudes greater than 0.2 magnitudes typically exhibit a bimodal solution, which was not observed in any of the alternatives.

Number	Name	Family	H	Dkm	a (au)	e	i (deg)	P(yrs)	Discovered by	yyyy/mm
1367	Nongoma	701	12.3	9.37	2.34	0.131	22.48	3.59	C. Jackson	1934/07

Table II. Orbital and discovery information. Fam is the group or family using the LCDB values. An asterisk indicates a generic group, otherwise, the numbers are from Nesvorný et al. (2015). Web Sources: JPL: [https://ssd.jpl.nasa.gov/tools/sbdb\\_lookup.html/](https://ssd.jpl.nasa.gov/tools/sbdb_lookup.html#/) MPOInfo: <https://minorplanet.info/php/oneasteroidinfo.php>



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## References

Berg, S., (2023). Nighttime Imaging 'N' Astronomy (NINA) web site <https://nighttime-imaging.eu/>. Last accessed: 2023 June 29.

JPL (2021). Small-Body Database Browser - JPL Solar System Dynamics web site. Last accessed: 2023 11 July.  
<http://ssd.jpl.nasa.gov/sbdb.cgi>

Nesvorný, D.; Brož, M.; Carruba, V. (2015). "Identification and Dynamical Properties of Asteroid Families." In *Asteroids IV* (P. Michel, F. DeMeo, W.F. Bottke, R. Binzel, Eds.). Univ. of Arizona Press, Tucson, also available on astro-ph.

Oey, J. (2014). "Lightcurve analysis of asteroids from Blue Mountains Observatory in 2013." *Minor Planet Bull.* **41**, 276-281.

Tonry, J.L.; Denneau, L.; Flewelling, H.; Heinze, A.N.; Onken, C.A.; Smartt, S.J.; Stalder, B.; Weiland, H.J.; Wolf, C. (2018). "The ATLAS All-Sky Stellar Reference Catalog." *Astrophys. J.* **867**, A105.

Warner, B.D.; Harris, A.W.; Pravec, P. (2009). "The Asteroid Lightcurve Database. *Icarus* **202**, 134-146. Updated 2023 Oct.  
<http://www.MinorPlanet.info/php/lcdb.php>

Warner, B.D. (2016). Collaborative Asteroid Lightcurve Link website. Last accessed: 2018 September 26.  
<http://www.minorplanet.info/call.html>

Warner, B.D. (2017). MPO Software, *MPO Canopus* version 10.7.10.0. Bdww Publishing. <https://bdwpublishing.com/>

Warner, B.D. (2021). Asteroid Lightcurve Data Exchange Format (ALCDEF) web site. <https://alcdef.org>