References

Harris, A.W.; Young, J.W.; Scaltriti, F.; Zappala, V. (1984). "Lightcurves and phase relations of the asteroids 82 Alkmene and 444 Gyptis." *Icarus* **57**, 251-258.

Harris, A.W.; Young, J.W.; Bowell, E.; Martin, L.J.; Millis, R.L.; Poutanen, M.; Scaltriti, F.; Zappala, V.; Schober, H.J.; Debehogne, H.; Zeigler, K.W. (1989). "Photoelectric Observations of Asteroids 3, 24, 60, 261, and 863." Icarus **77**, 171-186.

JPL (2021). Small-Body Database Browser. *https://ssd.jpl.nasa.gov/sbdb.cgi*

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, 1-16.

Warner, B.D.; Harris, A.W.; Pravec, P. (2009). "The Asteroid Lightcurve Database." Icarus **202**, 134-146. Updated 2020 Ocotber. *http://www.minorplanet.info/lightcurvedatabase.html*

Warner, B.D. (2019). MPO Software. MPO Canopus version 10.8.1.1. Bdw Publishing. *http://minorplanetobserver.com*

ROTATION PERIOD DETERMINATION FOR ASTEROIDS 2243 LONNROT, (10859) 1995 GJ7, (18640) 1998 EF9 AND (49483) 1999 BP13

Alessandro Marchini, Leonardo Cavaglioni,
Chiara Angelica Privitera
Astronomical Observatory, DSFTA - University of Siena (K54)
Via Roma 56, 53100 - Siena, ITALY
marchini@unisi.it

Riccardo Papini, Fabio Salvaggio
Wild Boar Remote Observatory (K49)
San Casciano in Val di Pesa (FI), ITALY

(Received: 2021 April 6)

Photometric observations of four main-belt asteroids were conducted in order to determine their synodic rotation periods. For 2243 Lonnrot we found P = 3.813 ± 0.004 h, A = 0.14 ± 0.05 mag; for (10859) 1995 GJ7 we found P = 2.956 ± 0.001 h, A = 0.17 ± 0.05 mag; for (18640) 1998 EF9 we found P = 3.630 ± 0.001 h, A = 0.63 ± 0.02 mag; for (49483) 1999 BP13 we found P = 6.365 ± 0.005 h, A = 0.24 ± 0.03 mag.

CCD photometric observations of four main-belt asteroids were carried out in 2021 January - March at two Italian observatories. At the Astronomical Observatory of the University of Siena (K54), a facility inside the Department of Physical Sciences, Earth and Environment (DSFTA, 2021), we used a 0.30-m *f*/5.6 Maksutov-Cassegrain telescope, SBIG STL-6303E NABG CCD camera, and clear filter; the pixel scale was 2.30 arcsec when binned at 2×2 pixels and all exposures were 300 seconds. At the Wild Boar Remote Observatory (K49) data were obtained with a 0.235-m f/10 (SCT) telescope, a SBIG ST8-XME NABG CCD camera unfiltered; the pixel scale was 1.60 arcsec in binning 2×2 and all exposures were 300 seconds.

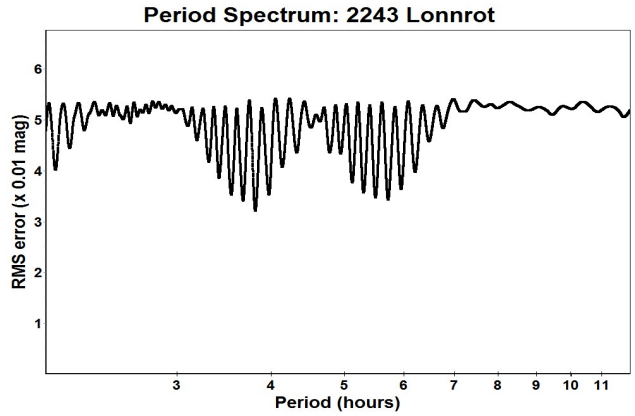
Data processing and analysis were done with *MPO Canopus* (Warner, 2018). All images were calibrated with dark and flat-field frames and the instrumental magnitudes converted to R magnitudes using solar-colored field stars from a version of the CMC-15 catalogue distributed with *MPO Canopus*. Table I shows the observing circumstances and results.

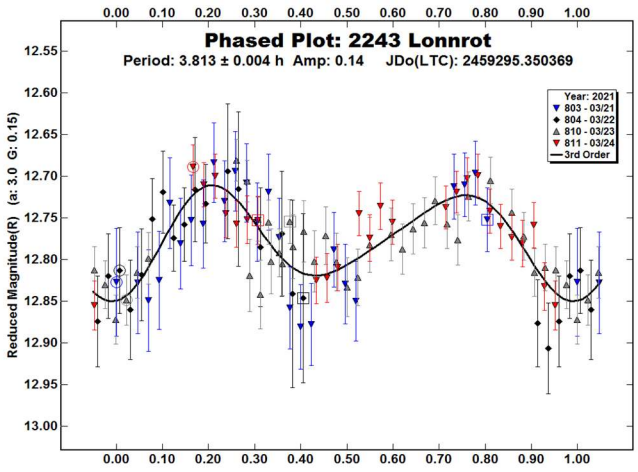
A search through the asteroid lightcurve database (LCDB; Warner et al., 2009) indicates that our results may be the first reported lightcurve observations and results for these asteroids.

2243 Lonnrot (1941 SA1) was discovered on 1941 September 25 by Y. Vaisala at Turku and named after Elias Lonnrot (1802-1884), a physician in Kajaani and later professor of the Finnish language in Helsinki. [Ref: Minor Planet Circ. 7944] It is a main-belt asteroid with a semi-major axis of 2.248 AU, eccentricity 0.197, inclination 6.843°, and an orbital period of 3.37 years. Its absolute magnitude is H = 12.5 (JPL, 2021). The WISE/NEOWISE satellite infrared radiometry survey (Masiero et al., 2014) found a diameter D = 8.628 ± 0.113 km using an absolute magnitude H = 12.8.

Observations were conducted over two nights and collected 106 data points. The period analysis shows a possible solution for the rotational period of P = 3.813 ± 0.004 h with an amplitude A = 0.14 ± 0.05 mag as the most likely bimodal solution for this asteroid. The asteroid crossed by serendipity the same field of

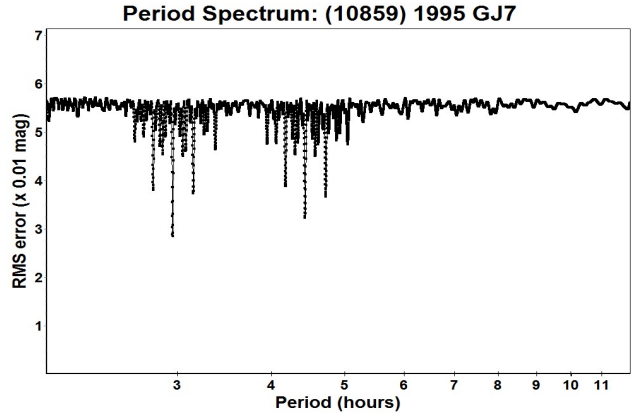
(10859) 1995 GJ7 on March 21 and 23, therefore exposure was not optimized for its magnitude. Despite this and the few data points collected, the model fit is quite good. Further observations are strongly encouraged to nail down the actual period.

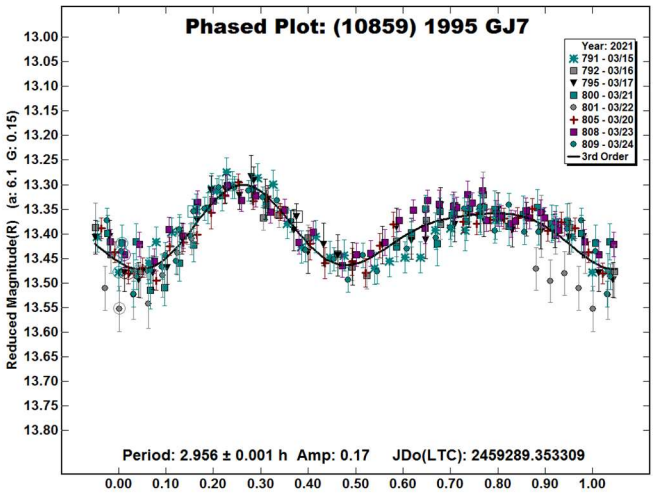




(10859) 1995 GJ7 was discovered on 1995 April 1 by S. Otomo at Kiyosato. It is a main-belt asteroid with a semi-major axis of 2.658 AU, eccentricity 0.158, inclination 9.221°, and an orbital period of 4.33 years. Its absolute magnitude is H = 12.87 (JPL, 2021). The WISE/NEOWISE satellite infrared radiometry survey (Masiero et al., 2012) found a diameter D = 7.758 ± 1.109 km using an absolute magnitude H = 12.80.

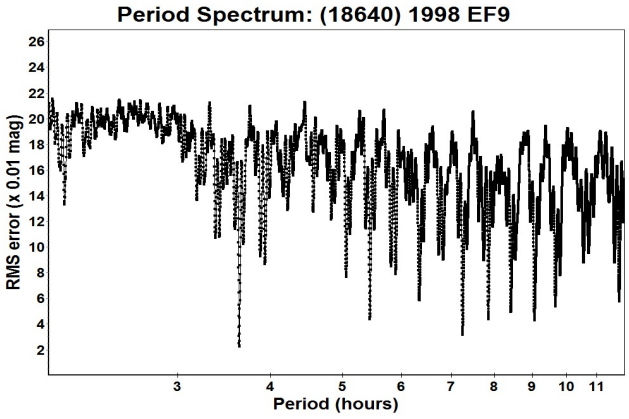
Observations over five nights collected 224 data points. The period analysis shows a bimodal solution for the rotational period of P = 2.956 ± 0.001 h with an amplitude A = 0.17 ± 0.05 mag.

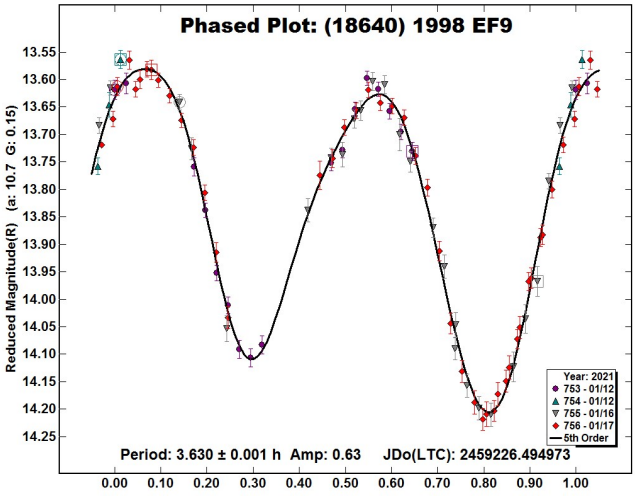




(18640) 1998 EF9 was discovered on 1998 March 7 by Beijing Schmidt CCD Asteroid Program at Xinglong. It is a main-belt asteroid with a semi-major axis of 2.429 AU, eccentricity 0.296, inclination 20.375°, and an orbital period of 3.79 years. Its absolute magnitude is H = 13.23 (JPL, 2021). The WISE/NEOWISE satellite infrared radiometry survey (Masiero et al., 2011) found a diameter D = 6.727 ± 0.060 km using an absolute magnitude H = 12.9.

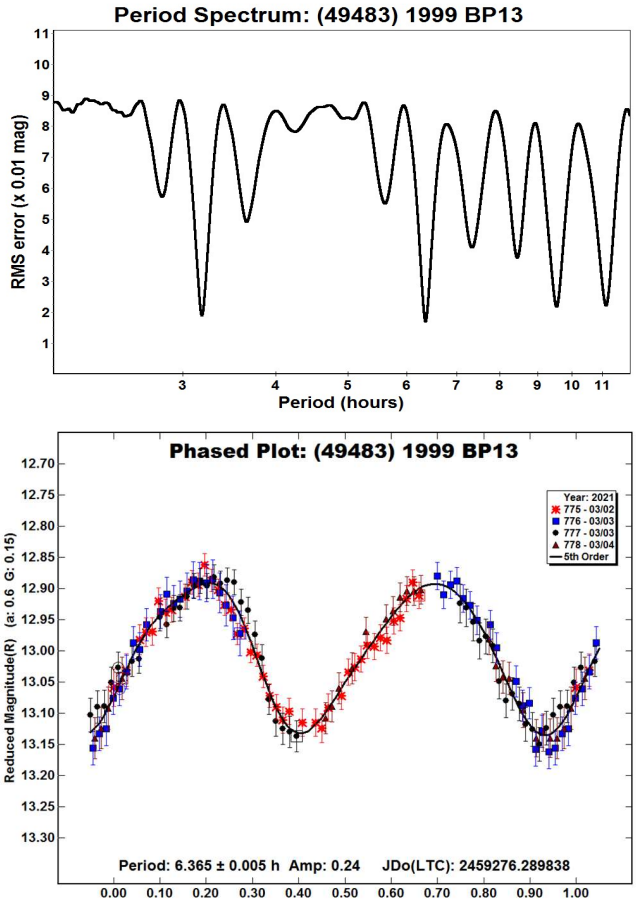
Observations were conducted over four nights and collected 87 data points. The period analysis shows a result for the rotational period of P = 3.630 ± 0.001 h with an amplitude A = 0.63 ± 0.02 mag.





(49483) 1999 BP13 was discovered on 1999 January 25 by K. Korlevic at Visnjan. It is a main-belt asteroid with a semi-major axis of 2.691 AU, eccentricity 0.233, inclination 6.634°, and an orbital period of 4.42 years. Its absolute magnitude is H = 13.15 (JPL, 2021). The WISE/NEOWISE satellite infrared radiometry survey (Masiero et al., 2011) found a diameter D = 13.046 ± 0.841 km using an absolute magnitude H = 13.1.

Observations over two nights collected 144 data points. The period analysis shows a solution for the rotational period of P = 6.365 ± 0.005 h with an amplitude A = 0.24 ± 0.03 mag.



Acknowledgements

Leonardo Cavaglioni and Chiara Angelica Privitera, students of the course in Physics and Advanced Technologies at the Department of Physical Sciences, Earth and Environment, actively participated to the observations and data analysis of some asteroids presented in this article during their internship activities at the Astronomical Observatory of the University of Siena, and appear deservedly as authors. Minor Planet Circulars (MPCs) are published by the International Astronomical Union's Minor Planet Center. *https://www.minorplanetcenter.net/iau/ECS/MPCArchive/MPCArchive_TBL.html*

References

DSFTA (2021). Dipartimento di Scienze Fisiche, della Terra e dell'Ambiente - Astronomical Observatory. *https://www.dsfta.unisi.it/en/research/labs/astronomical-observatory*

Harris, A.W.; Young, J.W.; Scaltriti, F.; Zappala, V. (1984). "Lightcurves and phase relations of the asteroids 82 Alkmene and 444 Gyptis." *Icarus* **57**, 251-258.

JPL (2021). Small-Body Database Browser. *http://ssd.jpl.nasa.gov/sbdb.cgi#top*

Masiero, J.R.; Mainzer, A.K.; Grav, T.; Bauer, J.M.; Cutri, R.M.; Dailey, J.; Eisenhardt, P.R.M.; McMillan, R.S.; Spahr, T.B.; Skrutskie, M.F.; Tholen, D.; Walker, R.G.; Wright, E.L.; DeBaun, E.; Elsbury, D.; Gautier IV, T; Gomillion, S.; Wilkins, A. (2011). "Main Belt Asteroids with WISE/NEOWISE. I. Preliminary Albedos and Diameters." *Astrophys. J.* **741**, A68.

Masiero, J.R.; Mainzer, A.K.; Grav, T.; Bauer, J.M.; Cutri, R.M.; Nugent, C.; Cabrera, M.S. (2012). "Preliminary Analysis of WISE/NEOWISE 3-Band Cryogenic and Post-cryogenic Observations of Main Belt Asteroids." *Astrophys. J. Letters* **759**.

Masiero, J.R.; Grav, T.; Mainzer, A.K.; Nugent, C.R.; Bauer, J.M.; Stevenson, R.; Sonnett, S. (2014). "Main-belt Asteroids with WISE/NEOWISE: Near-infrared Albedos." *Astrophys. J.* **791**, 121.

Warner, B.D.; Harris, A.W.; Pravec, P. (2009). "The Asteroid Lightcurve Database." *Icarus* **202**, 134-146. Updated 2020 Oct. *http://www.minorplanet.info/lightcurvedatabase.html*

Warner, B.D. (2018). MPO Software, *MPO Canopus* v10.7.7.0. Bdw Publishing. *http://minorplanetobserver.com*

Number	Name	2021/mm/dd	Phase	L_{PAB}	B_{PAB}	Period(h)	P.E.	Amp	A.E.	Grp
2243	Lonnrot	03/21-03/24	3.0,2.1	187	3	3.813	0.004	0.14	0.05	MB
10859	1995 GJ7	03/15-03/24	6.2,2.1	186	3	2.956	0.001	0.17	0.05	MB
18640	1998 EF9	01/11-01/18	10.7,13.5	105	-14	3.630	0.001	0.63	0.02	MB
49483	1999 BP13	03/02-03/04	0.5,1.2	161	-1	6.365	0.005	0.24	0.03	MB

Table I. Observing circumstances and results. The first line gives the results for the primary of a binary system. The second line gives the orbital period of the satellite and the maximum attenuation. The phase angle is given for the first and last date. If preceded by an asterisk, the phase angle reached an extrema during the period. L_{PAB} and B_{PAB} are the approximate phase angle bisector longitude/latitude at mid-date range (see Harris *et al.*, 1984). Grp is the asteroid family/group (Warner *et al.*, 2009).