

PHOTOMETRIC OBSERVATIONS AND ANALYSIS OF SEVEN ASTEROIDS

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We report the results of our photometric observations of seven main-belt asteroids from three observatories in Malta, and Slovakia. We obtained the lightcurves for the following asteroids, which can facilitate future analysis at different oppositions: (4798) Mercator; (4958) Wellnitz; (13042) 1990 QE; (15127) 2000 EN45; (16591) 1999 SY17; (28746) 2000 GB148; and (108522) 2001 LQ.

We report on photometric observations of seven main-belt asteroids from two observatories located in Malta, and one at Vážec, Slovakia. Through these observatories listed in Table I, we have observed the following asteroids: (4798) Mercator; (4958) Wellnitz; (13042) 1990 QE; (15127) 2000 EN45; (16591) 1999 SY17; (28746) 2000 GB148; and (108522) 2001 LQ. We employed a clear filter (unfiltered) with SR (Sloan R) zero point for all other images and calibrated all of our images using dark and flat-field subtraction frames.

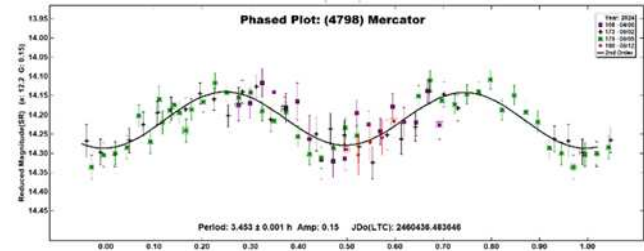
We remotely controlled all our equipment over the internet or from a nearby location for each telescope. We used *Sequence Generator Pro* (Binary Star Software) for image acquisition by all Maltese Observatories. Luckystar Observatory used the *MNA* image acquisition software (Berg, 2023). We used *MPO Canopus* software (Warner, 2017) for our image analysis, to obtain differential aperture photometry and to construct light curves. Table I displays the details of the instrumentation and Observation Runs for each target. We selected near-solar color comparison stars using the Comparison Star Selector (CSS) feature of *MPO Canopus*. We based all brightness measurements on the Asteroid Terrestrial-impact Last Alert System (ATLAS) catalogue (Tonry et al., 2018).

Observatory/ Country	Scope and Type	Camera	Observed Asteroids (#Nights)
Flarestar Obs. (MPC: 171)/ MALTA	0.25-m SCT	Moravian G2-1600	#16591 (4) #28746 (4) #108522 (4)
Luckystar Obs. (MPC: M55)/ SLOVAKIA	0.25-m SCT	Atik 460EX	#4958 (8) #13042 (2) #15127 (7)
Znith Astronomy Obs./ MALTA	0.2-m SCT	Moravian G2-1600	#4798 (4)

Table I – Instrumentation and Observation Runs. SCT: Schmidt-Cassegrain Telescope.

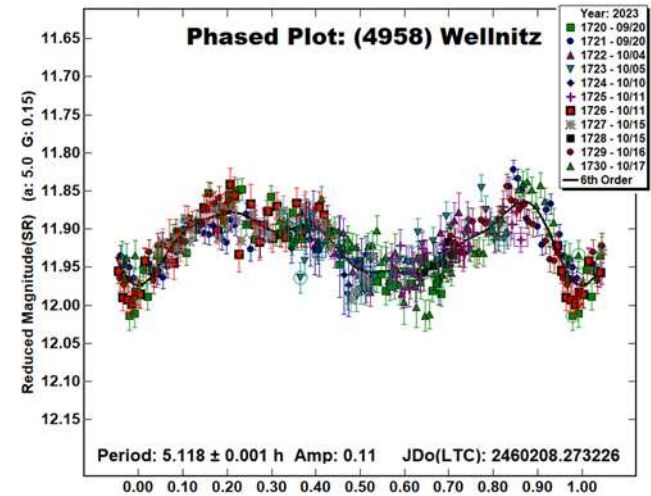
(4798) *Mercator* is a main-belt asteroid discovered on 1989 September 26 by E.W. Elst at La Silla Observatory (Chile). The estimated diameter of Mercator is 5.02 ± 0.138 km (Masiero et al., 2011) and has an absolute magnitude H of 13.64 and orbits with a semi-major axis of 2.197 AU with an eccentricity of 0.110. Mercator takes 3.26 years to complete an orbit around the sun (JPL, 2024).

This asteroid was observed from Znith Observatory on 4 nights, namely on 2024 April 05 and May 02, 05 and 12. Our results yielded a synodic period of 3.453 ± 0.001 h with an amplitude of 0.15 ± 0.05 mag. The LCDB database does not show any published period for (4798) Mercator.



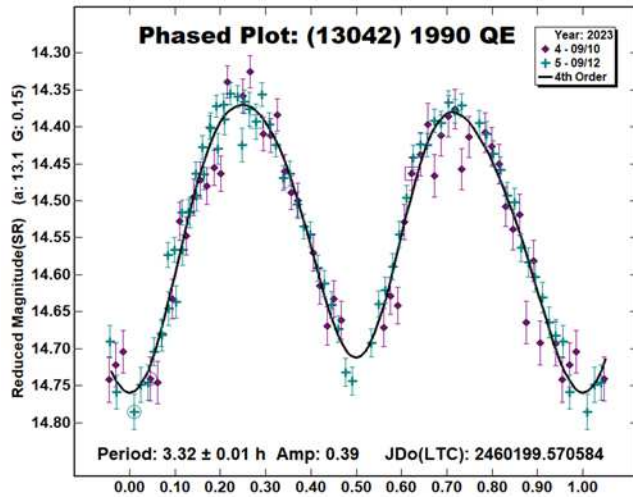
(4958) *Wellnitz* is a main-belt asteroid that was discovered on July 13, 1991 by H.E. Holt at Palomar (USA) (JPL, 2024). Its estimated diameter is 16.358 ± 0.244 km (Masiero et al., 2014). It orbits the sun with a semi-major axis of 3.0145 AU and has an eccentricity of 0.077 and an absolute magnitude H of 11.76. The asteroid completes one orbit around the sun every 5.23 years (JPL, 2024).

We have observed asteroid Wellnitz from Luckystar Observatory over eight nights, namely on 2023 Sep 20 and Oct 4, 5, 10, 11, 15, 16 and 17. Based on these observations, we determined the synodic period to be 5.118 ± 0.001 hours, with an amplitude of 0.11 ± 0.04 mag. The LCDB database does not show any published period for (4958) Wellnitz.



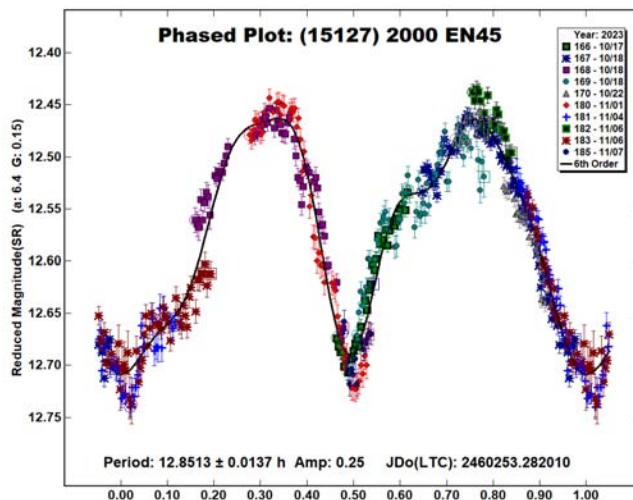
(13042) 1990 QE is also a main-belt asteroid. This asteroid was first discovered on 1990 Aug 18 by E.F. Helin at Palomar (USA). The asteroid has an estimated diameter of 7.367 ± 0.276 km (Masiero et al., 2012), an absolute magnitude H of 13.95 and orbits the sun at a semi-major axis of 2.567 AU. Its orbit has an eccentricity of 0.240, and orbits the sun every 4.11 years (JPL, 2024).

(13042) 1990 QE was observed from Luckystar Observatory over 2 nights on 2023 September 10 and 12 from which we derived the synodic period to be 3.32 ± 0.01 h with an amplitude of 0.39 ± 0.04 mag. The LCDB database does not show any published period for (13042) 1990 QE.



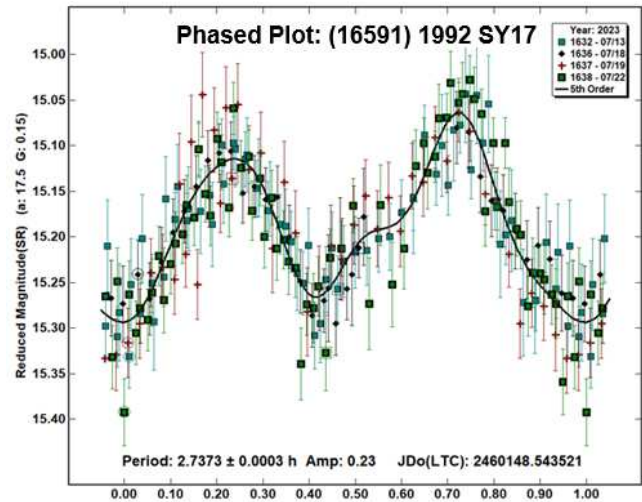
(15127) 2000 EN45 is main-belt asteroid that was discovered on March 09, 2000 by LINEAR. It has an estimated diameter of 19.323 ± 0.204 km diameter, based on H of 12.29. It orbits the sun with a semi-major axis of 2.999 AU with an eccentricity of 0.28 and orbital period of 5.19 years (JPL, 2024).

Luckystar Observatory observed this target for a period of 6 nights starting from 2023 October 17, 18, 22 and November 1, 4, and 6. Our results of (15127) 2000 EN45 show a derived synodic period of 12.8512 ± 0.0137 h with an amplitude of 0.26 ± 0.04 mag. The LCDB database does not show any published period for (15127) 2000 EN45.

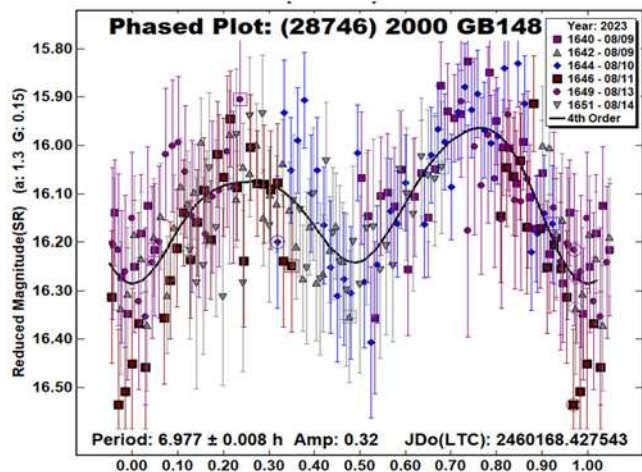


(16591) 1992 SY17 is a main-belt asteroid and was discovered on 1992 September 30 by H.E. Holt at Palomar Observatory, USA (JPL, 2024). The absolute magnitude H is 14.43. The semi-major axis of this asteroid is 2.29 AU and its orbit has an eccentricity of 0.281. It orbits the sun every 3.47 years (JPL, 2024).

(16591) 1992 SY17 was observed on 4 nights from Flarestar Observatory on 2023 July 13, 18, 19 and 22. Our data shows the rotation period to be 2.737 ± 0.0003 h, with an amplitude of 0.23 ± 0.10 mag. Warner et al. (2009) reports a value of 2.737 h based on an incomplete phase plot produced in 2013 by Pál et al. (2020).

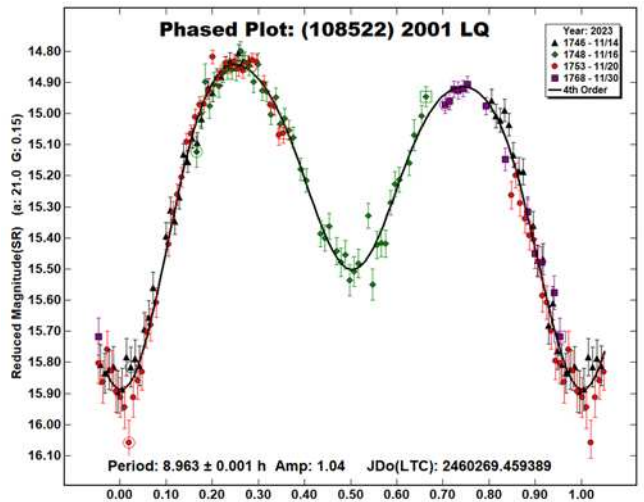


(28746) 2000 GB148 is another main-belt asteroid that was discovered by LINEAR on 2000 Apr 05 at Socorro. Its absolute magnitude H of 15.82. This minor planet orbits the sun with a semi-major axis of 2.373 AU and its orbit has an eccentricity of 0.217, and a period of 3.66 years (JPL, 2024). Observations from Flarestar Observatory were acquired over 4 nights on 2023 August 09, 10, 11 and 13. We derived a synodic period of 6.977 ± 0.008 h with an amplitude of 0.32 ± 0.1 mag. The LCDB database does not show any published period for (28746) 2000 GB148.



(108522) 2001 LQ is a Mars-crossing asteroid that was discovered on 2001 June 14, by LEONOS at Anderson Mesa (JPL, 2024). The estimated diameter of 6.963 ± 1.95 km (Nugent et al., 2016). The asteroid orbits the sun with a semi-major axis of 2.597 AU and has an eccentricity of 0.389. It has an absolute magnitude H of 13.96 and completes one orbit around the sun every 4.18 years (JPL, 2024).

The asteroid (108522) was observed by Flarestar Observatory on the nights of 2023 November 14, 16, 20 and 30. Based on these observations, the synodic period was determined to be 8.963 ± 0.001 hours, with an amplitude of 1.04 ± 0.10 mag. Warner et al., (2009) revised its orbital period as 8.359 h based on an incomplete phase plot (P; U quality 2) produced in 2015 (Waszczak et al., 2015).



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Number	Name	yyyy mm/dd	Phase	L _{PAB}	B _{PAB}	Period(h)	P.E.	Amp	A.E.	Grp
4798	Mercator	2024 04/05-05/12	12.3,10.3	216.3	4.6	3.453	0.001	0.15	0.05	9104*
4958	Wellnitz	2023 09/20-10/17	5.0, 8.3	4.3	10.4	5.118	0.001	0.11	0.04	606
13042	1990 QE	2023 09/10-09/12	13.1,12.9	355.4	18.1	3.32	0.01	0.39	0.04	2007
15127	2000 EN45	2023 10/17-11/06	6.4,13.7	21.5	12.0	12.858	0.002	0.26	0.04	9106*
16591	1992 SY17	2023 07/13-07/22	17.4,14.3	308.1	13.1	2.737	0.0003	0.23	0.1	9103
28746	2000 GB148	2023 08/09-08/13	1.6, 3.9	315.1	1.5	6.967	0.0099	0.34	0.3	2004
108522	2001 LQ	2023 11/14-11/30	21.4,16.3	62.9	-24.6	8.963	0.001	1.04	0.1	9103

Table II. Observing circumstances and results. 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).