Polakis, T. (2020). "Photometric observations of twenty-seven minor planets." *Minor Planet Bull.* **47**, 314-321.

Sada, P.V.; Canizales, E.D.; Armada, E.M. (2005). "CCD photometry of asteroids 651 Antikleia, 738 Alagasta, and 2151 Hadwiger using a remote commercial telescope." *Minor Planet Bull.* **32**, 73-75.

Warner, B.D.; Harris, A.W.; Pravec, P. (2009). "The Asteroid Lightcurve Database." *Icarus* **202**, 134-146. Updated 2023 Oct. *https://minplanobs.org/MPInfo/php/lcdb.php*

LIGHTCURVE ANALYSIS FOR EIGHT MAIN-BELT ASTEROIDS AND ONE MARS CROSSER

Fernando Huet
Observatorio Polop (Z93)
Apdo. 61 03520 Polop (SPAIN)
fhuet@me.com

Gonzalo Fornas
Centro Astronómico del Alto Turia (J57)
Asociación Valenciana de Astronomía (AVA) SPAIN

Alvaro Fornas
Centro Astronómico del Alto Turia (J57)
Asociación Valenciana de Astronomía (AVA) SPAIN

(Received: 2024 January 9)

Photometric observations of eight main-belt asteroids and one Mars-crosser were obtained from 2023 April 15 to December 30. We derived the following synodic rotational periods: 222 Lucia, 7.8370 ± 0.006 h; 862 Franzia, 7.5235 ± 0.0004 h; 1259 Ogyalla, 17.3000 ± 0.0013 h; 1305 Pongola, 8.0648 ± 0.0015 h; 1308 Halleria, 6.0313 ± 0.0005 h; 1412 Lagrula, 5.9165 ±.0.0008 h; 6025 Naotosato, 27.017 ± 0.004 h; 14835 Holdridge, 16.6717 ± 0.0013 h; and (16591) 1992 SY17, 2.73715 ± 0.00009 h. We also obtained the sidereal rotation period for: 222 Lucia, 7.836690 ± 0.000014 h; 862 Franzia, 7.521938 ± 0.000013 h; 1305 Pongola, 8.063733 ± 0.000015 h; and 6025 Naotosato, 27.02452 ± 0.00019 h.

We report on the photometric analysis result for eight main-belt and one Mars-crossing asteroids. This work was done from Observatorio Polop MPC Z93 (Alicante) operated by members of the Valencian Astronomy Association (AVA) (*http://www.astroava.org*). This database shows graphic results of the data (lightcurves), with the plot phased to a given period.

Observatory	Telescope	CCD
Polop Z93	SC 8"	ASI 2600 MM

Table I. List of instruments used for the observations.

We concentrated on asteroids with no reported period and those where the reported period was poorly established and needed confirmation. We also prioritized those asteroids for which we had dense data collected by our team in previous years in order to attempt finding sidereal periods using *MPO LCInvert* (Bdw Publishing, 2023). All the targets were selected from the Collaborative Asteroid Lightcurve (CALL, 2023) and Minor Planet Center (MPC, 2023) websites. The Asteroid Lightcurve Database (LCDB; Warner et al., 2009) was consulted to locate previously published results.

Images were calibrated in *MaximDL* (Diffraction, 2023) and measured using *MPO Canopus* (Bdw Publishing, 2023) with a differential photometry technique. The comparison stars were restricted to near-solar color to reduce the effects of color dependencies, especially at larger air masses. The lightcurves give the synodic rotation period. The amplitude (peak-to-peak) that is shown is that for the Fourier model curve and not necessarily the true amplitude.

If we found enough data in ALCDEF to add to our ours, we tried finding the sidereal period using *MPO LCInvert* (Bdw Publishing, 2023), which uses the inversion method described by Kaasalainen and Torppa (2001a). This software uses the C code for a routine called "Period Scan" that was written by Ďurech based on the original FORTRAN code written by Kaasalainen (2001). The advantage of this method is that it allows combining *dense* data, such as ours and those in the ALCDEF database (ALCDEF, 2023), with *sparse* data such as those produced by all-sky surveys, e.g., Catalina, USNO, ATLAS, Palomar, etc.

This is an iterative method that starts with an initial estimate based on a known synodic period and scans a range of possible sideral periods to find a *global* minimum of χ^2. The procedure starts with six initial poles for each trial period and selects the period that gives the lowest χ^2. If there is a clear minimum in χ^2 when plotted as a function of the period, the associated period is very likely the correct solution. Getting a clear solution is not always certain. Here, we reference only those asteroids with an apparently valid result.

When using *MPO LCInvert*, we assign weighting coefficients to consider the different densities and quality of the data. A value of 1.0 is assigned to *dense* data and 0.3 to sparse data, which is generally appropriate for higher-quality *sparse* data.

Error estimates for inversion method are not obvious. The smallest separation, ΔP, of the *global* minimum (Kaasalainen et al., 2001b), in the period parameter space is roughly given by

$$\Delta P \approx 0.5 * P^2 / \Delta t$$

where Δt is the full epoch range of the data set expressed in the same units as the period. This derives from the fact that the maxima and minima of a double sinusoidal lightcurve for periods P and $P \pm \Delta P$ are at the same epochs after Δt time.

Quoting from Kaasalainen et al. (2001b), "The period error is mostly governed by the epochs of the lightcurves. If the best local χ^2 minimum of the period spectrum is clearly lower than the others, one can obtain an error estimate of, say, a hundredth part of the smallest minimum width ΔP since the edge of a local minimum ravine always lies much higher than its bottom."

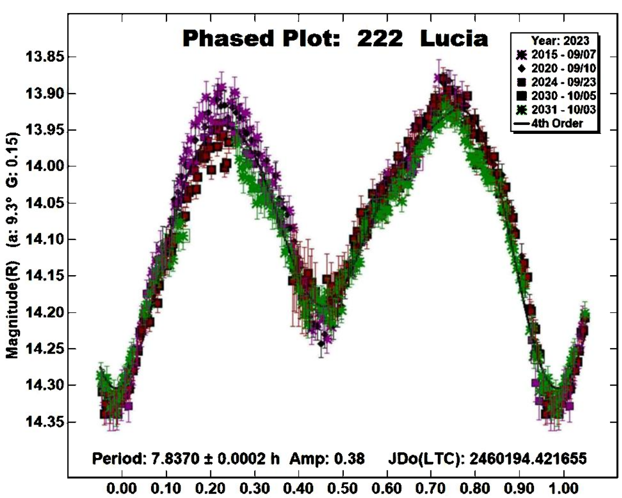
Ďurech proposes an estimate of error of

$$\Delta P \approx (1/10 * 0.5) * P^2/\Delta t$$

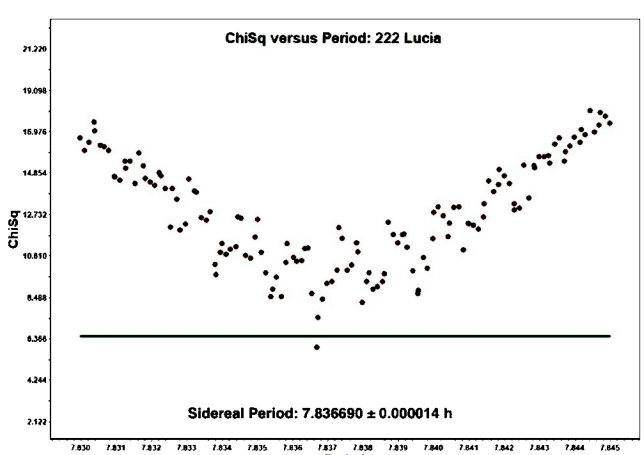
The factor 1/10 means that the period accuracy is 1/10 of the difference between local minima in the periodogram. When using *MPO LCInvert,* we use Ďurech's formula as error estimate.

It's important to note that the period scan must cover a sufficient range of periods so that a true *global* minimum is found, i.e., the minimum across the entire probable period range. In many cases, there are *local*, less deep minimums. Scanning on too small a range can find one of those *local* minimums and not the true *global* minimum.

222 Lucia. This outer main-belt asteroid belongs to the Themis family. It was discovered by Johann Palisa on 1882 Feb 9 in Vienna and is named after the daughter of Austro-Hungarian explorer Graf Wilczek. Based upon analysis of infrared spectra, it has a diameter of 59.8 ± 0.8 km. From our data we derive a synodic rotation period of 7.8370 ± 0.0002 h and an amplitude of 0.38 mag. This is consistent with Oszkiewicz et al. (2017), who found 7.8371 h.



For this asteroid, we had additional *dense* data from our AVA Team obtained in 2016. On ALCDEF we found data from Warner (1999), Stephens (2008), and Oszkiewicz (2016). We also used *sparse* data from Catalina (361 points 2003-2021), Palomar (86 points 2014-2021), USNO (192 points 1998-2010), ATLAS (734 points 2017-2022), and LONEOS (40 points 1999-2008).

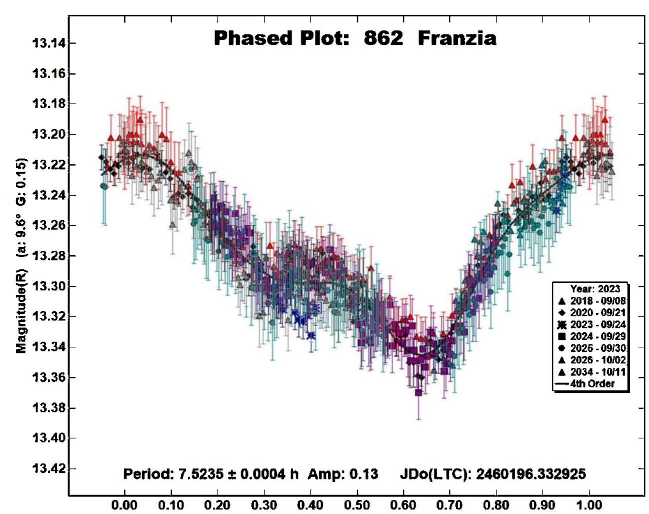


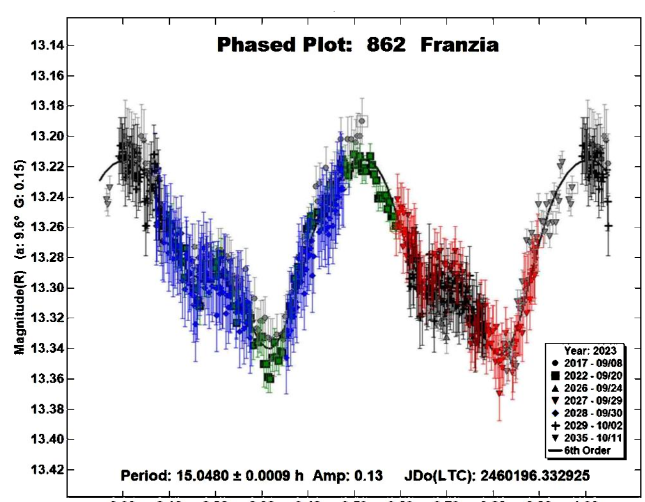
MPO LCInvert found what appears to be a unique sidereal rotation period of 7.836690 ± 0.000014 h. That is consistent with Hanus et al. (2013; 7.83671 h) and Wang et al. (2018; 7.83668 h). The green line represents a level 10% greater than the lowest χ^2.

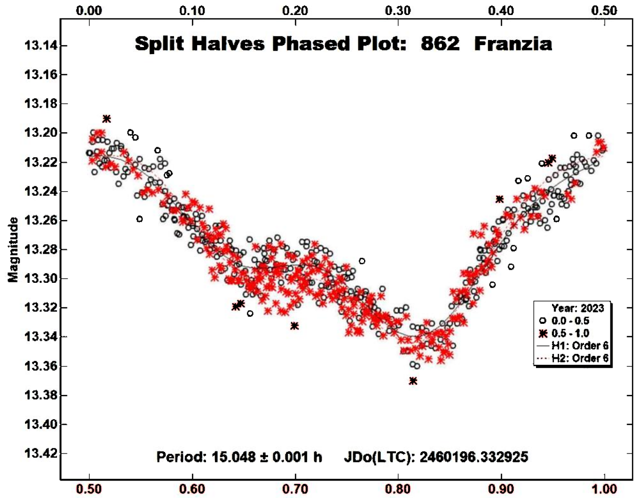
862 Franzia. This middle main-belt asteroid was discovered on 1917 Jan 28 by M.F. Wolf at Heidelberg. We made observations on 2023 Sep 9 to Oct 11. From our data, the period is ambiguous, it depending on adopting a mono- or bimodal lightcurve. We assume it as bimodal, with a period of 15.0480 ± 0.0009 h and an amplitude of 0.13 mag, but it could be monomodal with a period of 7.5235 ± 0.0004 h.

Both halves of the 15.0480-hour lightcurve of are very similar, which makes the monomodal solution possible, but not certain. In fact, at low amplitudes and phase angles, the true solution may have three or more minimum/maximum pairs (Harris et al., 2014).

Previous results include Behrend (2011web; 2014web, 7.52 h), Behrend (2018web, 7.5236 h). Warner (2005; 15.05 h), Warner (2010, 7.65 h). Aznar Macias et al. (2016, 16.299 h), Ferrero (2020, 7.523 h, and Polakis (2020, 7.52 h).





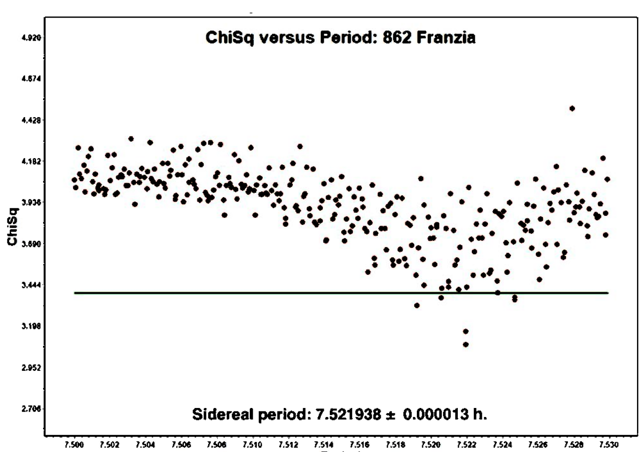


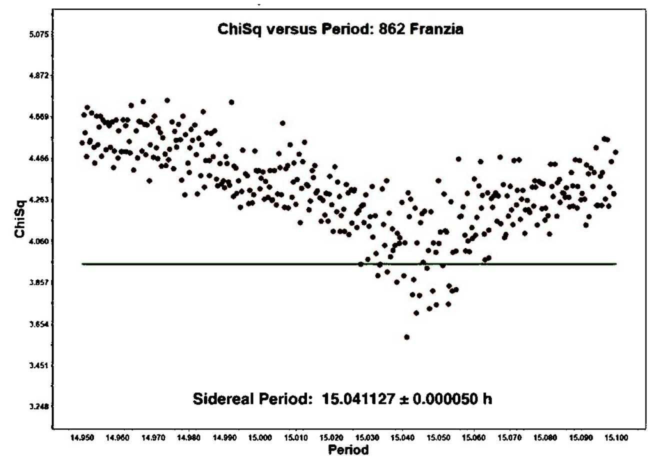
ALCDEF (2023) had *dense* data from Warner (2000; 2004), Brinsfield (2011), Fornas (2016), and Polakis (2020). We added *sparse* data from: USNO (177 points, 1998-2008), Catalina (299 points 2006-2023), ATLAS (841 points, 2017-2023), and Palomar (91 points, 2018-2021). After including our 2023 *dense* data, we tried to get a clear sideral period solution in *MPO LCInvert*.

Unfortunately, the solution was ambiguous with two likely and four not as likely solutions when confining the search to around 7.5 h. The "best" sidereal period there was 7.521938 ± 0.000013 h. When searching around 15.05 h, the best solution was 15.041127 ± 0.000050 h. Both had very similar χ^2 minimums. A search covering 7-16 hours would have taken *much* longer, but it would have shown the possibility of more than one local minimum.

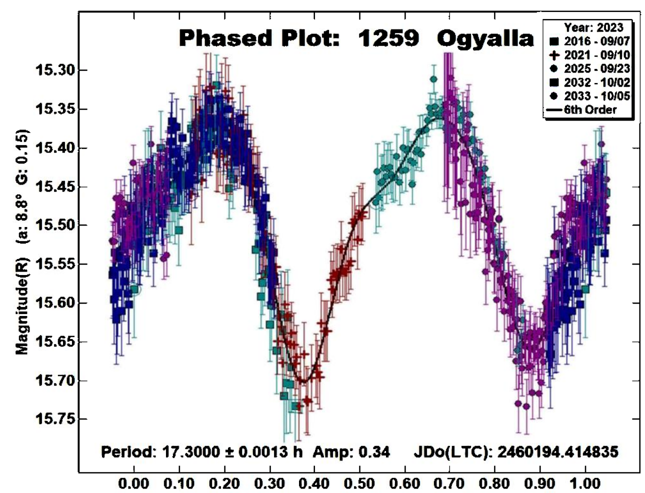
Since they were nearly equal, the *global* minimum was ambiguous. What might favor 7.52 h is that the number of solutions below the 10% χ^2 green line is considerably less than for the longer solution.

In this case, a different, more critical analysis would be warranted, such as that proposed and expanded on by Slivan (2012; 2013; 2014) and Slivan et al. (2023).

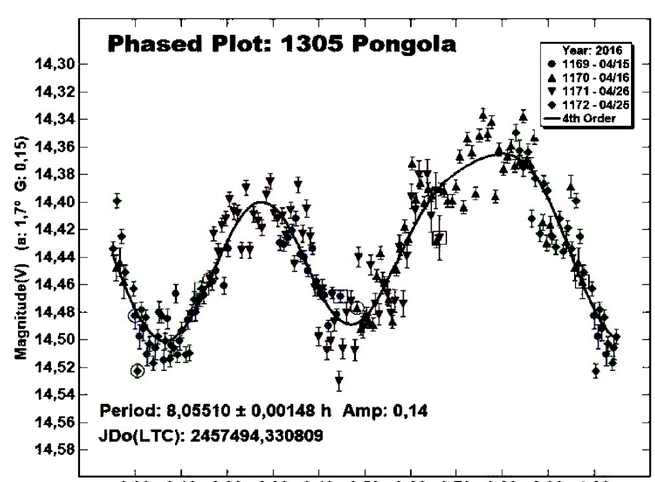


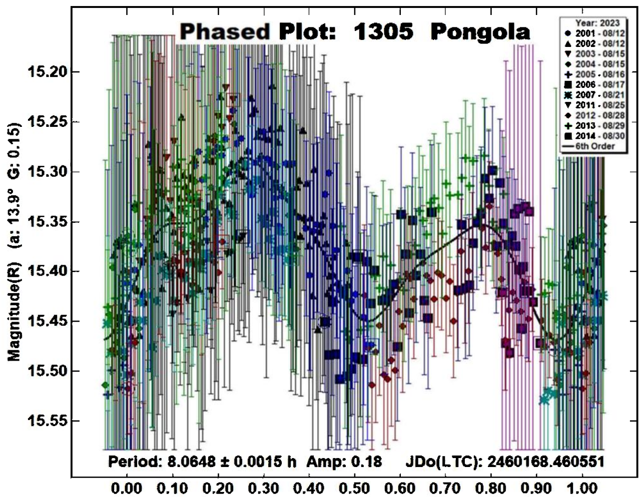


1259 Ogyalla. This outer main-belt asteroid was discovered on 1933 Jan 29 by K. Reinmuth at Heidelberg. We made observations on 2023 Sep 7 to Oct 5. We derived a rotation period of 17.3000 ± 0.0013 h and an amplitude of 0.34 mag. Previous results include Waszczak et al. (2015, 17.304 h), Mansego et al. (2016, 17.334 h) and Erasmus et al. (2020, 17.296 h).



1305 Pongola. This outer main-belt asteroid was discovered on 1928 Jul 16 by H.E. Wood at Johannesburg. We made observations on 2023 Aug 12-30. From our data, we derived a rotation period of 8.0648 ± 0.0015 h and an amplitude of 0.18 mag.

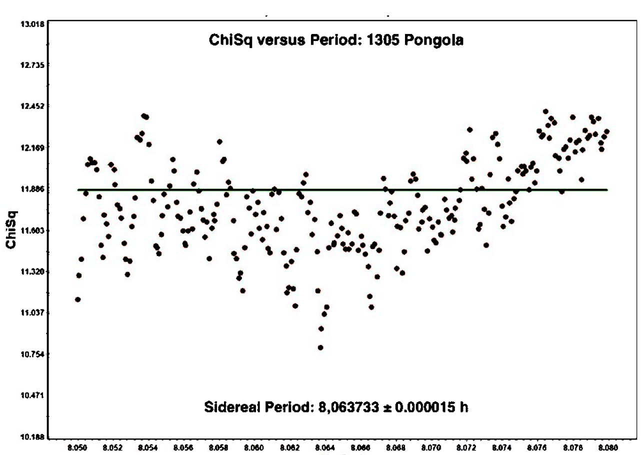




There are several consistent results in the LCDB, among them are Binzel (1987, 8.03 h), Ditteon et al. (2012, 8.06 h), and Sada et al. (2017, 8.0585 h). We re-processed our 2016 data to see they could fit a period similar to ours from the 2023. We were successful, finding 8.055 ± 0.0015 h and amplitude of 0.14 mag.

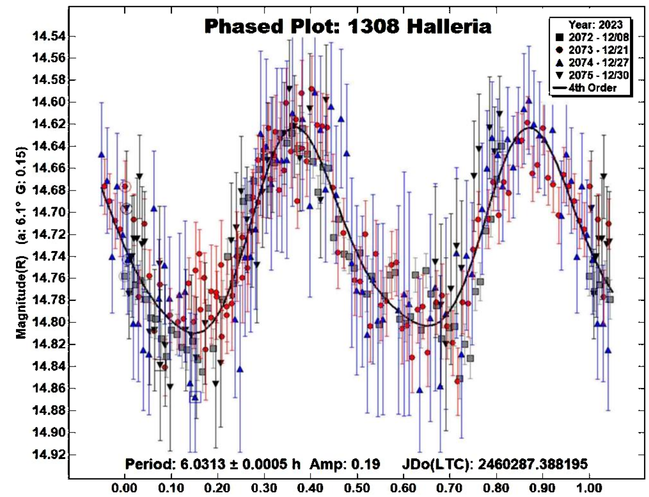
We downloaded data from the ALCDEF site from Waszczak et al. (2015, *sparse*) and Fornas (2016, *dense*). We also used *sparse* data from Catalina (335 points 2003-2023), Palomar (95 points 2013-2022), USNO (125 points 1998-2008), ATLAS (652 points 2017-2021), and LONEOS (29 points 1999-2007). We used those along with our 2023 *dense* data for a sideral period search using *MPO LCInvert*, which led to P = 8.063733 ± 0.000015 h. The error is based on the data from 1999 to 2023.

Given the number of solutions below the 10% green line, the reported period cannot be considered reliable to any degree.

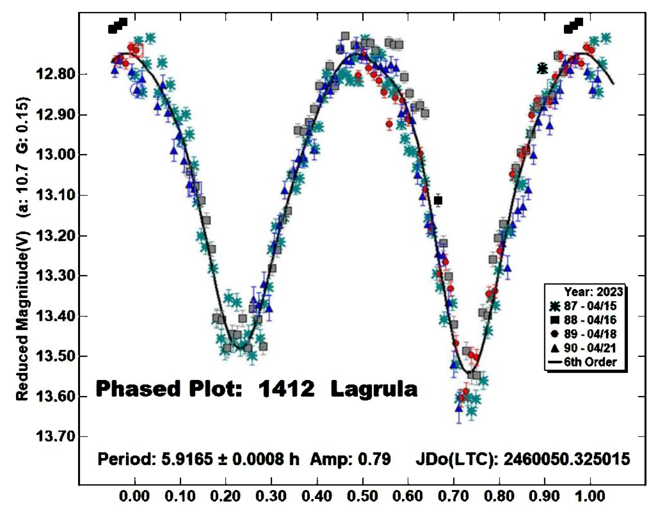


1308 Halleria is a carbonaceous Charis-family asteroid in the outer main-belt and has a diamater of about 43 km. It was discovered on 1931 March 12 by German astronomer Karl Reinmuth at the Heidelberg-Königstuhl State Observatory. We made observations from 2023 December 8-30 and obtained a rotation period of 6.0313 ± 0.0005 h and an amplitude of 0.19 mag.

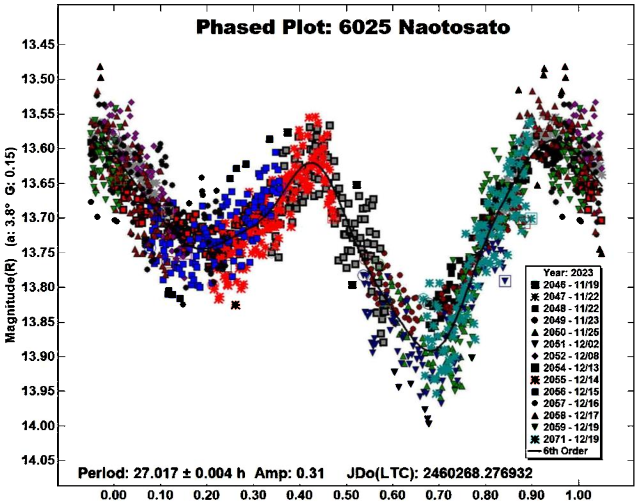
Previous results include Behrend (2008web, 6.026 h) and Pray (2011web, 6.013 h), which are consistent with our result.

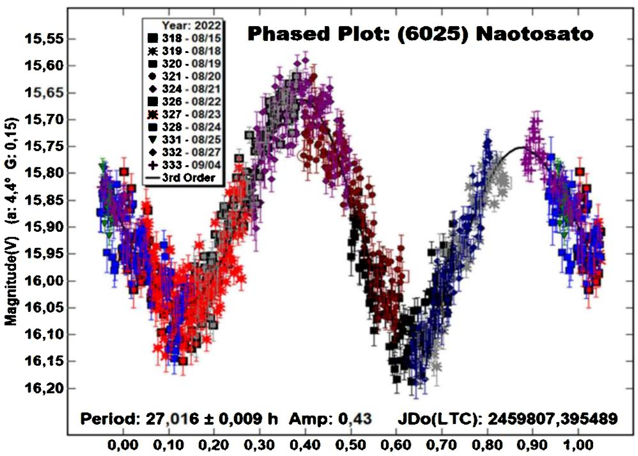


1412 Lagrula. This inner main-belt asteroid was discovered on 1937 January 19 by French astronomer Louis Boyer at the North African Algiers Observatory in Algeria. We made observations from 2023 April 15-21. Our data produced a rotation period of 5.9165 ± 0.0008 h and an amplitude of 0.79 mag. Casalnuovo et al. (2013) found 5.9176 h; team member Aznar et al. (2016) reported 5.882 h; Ďurech et al. (2020) found a sidereal period of 5.917404 h.



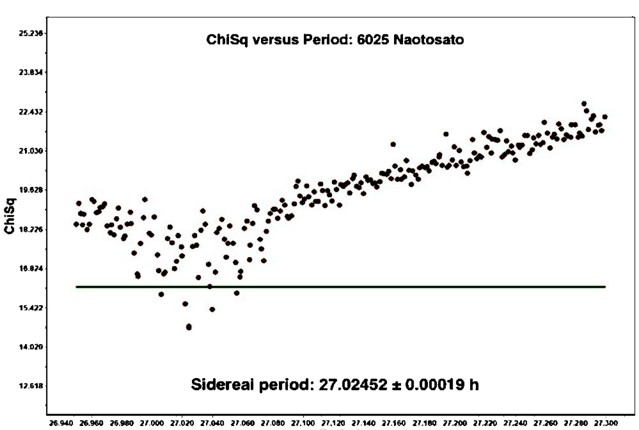
6025 Naotosato. This outer main-belt asteroid was discovered on 1992 Dec 30 by T. Urata at Oohira Observatory, Japan. We made observations from 2022 Aug 15 to Sep 4 (Huet et al., 2023) and found a rotation period of 27.016 h. We had another apparition opportunity in 2023 and repeated the study. Those data led to a rotation period of 27.017 ± 0.004 h and an amplitude of 0.31 mag, The lightcurve has a slightly different shape from our earlier result, as by seen comparing the two.





The only dense data in ALCDEF was our own from 2022. We added sparse data from Catalina (282 points, 2003-2023), Palomar (52 points, 2017-2022), USNO (28 points, 2004-2011), ATLAS (839 points, 2021-2023), and LONEOS (28 points 2001-2007). We used those and our two dense data sets from 2022 and 2023 in *MPO LCInvert*. The result was 27.02452 ± 0.00019 h. We used the interval from 2001-2023 to estimate the error.

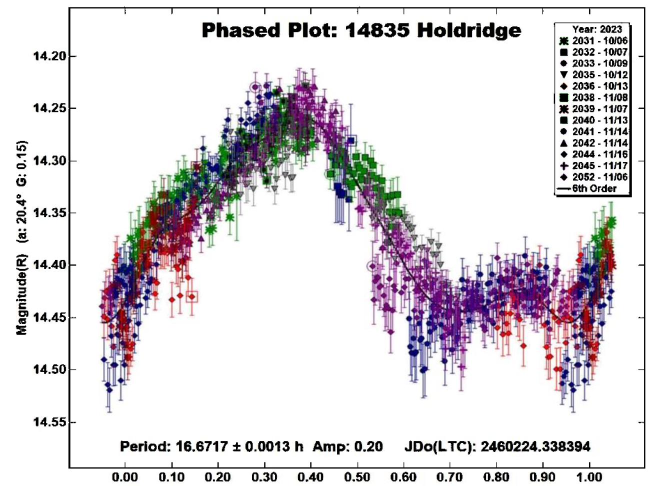
In the lower graph, we show the χ^2 value as a function of the period; it clearly shows a convergence of the solutions but, with at least five of them below the 10% green line, our result is not certain.

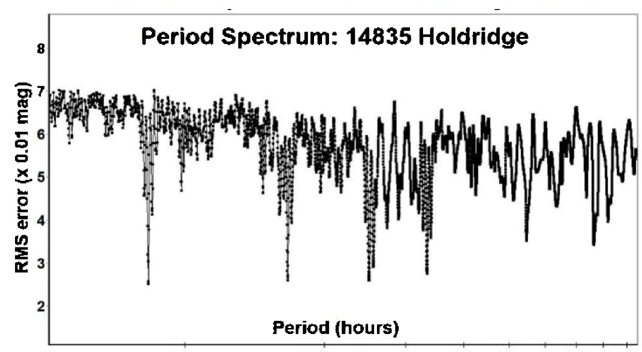


Number	Name	Sidereal Period (h)	P. Error (h)
222	Lucia	7.836690	0.000014
862	Franzia*	7.521938	0.000013
1305	Pongola	8.063733	0.000015
6025	Naotosato	27.02452	0.00019

Table II. Sidereal rotation period obtained from LCINVERT, when available. *Sidereal period corresponding to minimum χ^2.

14835 Holdridge. This main-belt asteroid was discovered on 1987 Nov 26 by C.S. Shoemaker and E.M. Shoemaker at Palomar. We observed this asteroid from 2023 Oct 6 to Nov 17. We found a synodic period of 16.6717 ± 0.0013 h and amplitude of 0.20 mag. This differs considerably from the one by Dose (2023, 164.401 h).

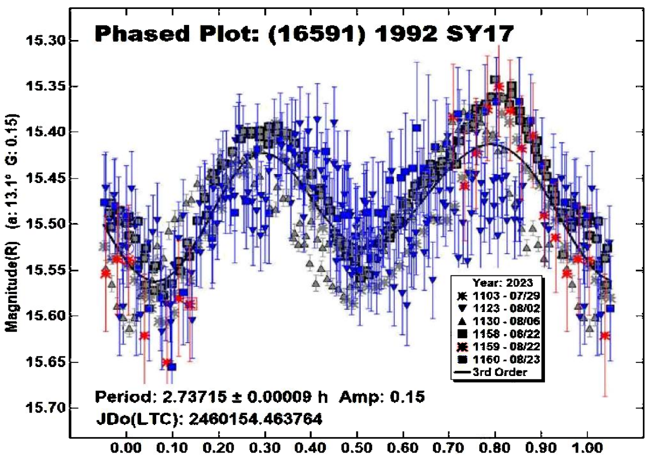




(16591) 1992 SY17. This Marscrosser was discovered on 1992 September 30 by H.E. Holt at Palomar. We made observations from 2023 Jul 29 to Aug 23 to derive a rotation period of 2.73715 ± 0.00009 h and amplitude of 0.15 mag. Pravec et al. (2013web) 2.73728 h.

Number	Name	2023 mm/dd	Phase	L_{PAB}	B_{PAB}	Period(h)	P.E.	Amp	A.E.	Grp
222	Lucia	09/07-10/03	9.0,0.9	9	-2	7.8370	0.0002	0.38	0.02	MB-O
862	Franzia	09/08-10/11	*9.6,10.0	`	16	7.5235	0.0004	0.13	0.01	MB-M
1259	Ogyalla	09/07-10/05	8.5,1.2	9	-2	17.3000	0.0013	0.34	0.02	MB-O
1305	Pongola	04/15-04/26	11.9,13.6	340	-2	8.0648	0.0015	0.18	0.02	MB-O
1308	Halleria	12/08-12/30	6.1,13.2	62	7	6.0313	0.0005	0.19	0.02	MB-O
1412	Lagrula	04/15-04/21	11.1,13.3	185	5	5.9165	0.0008	0.79	0.03	MB-I
6025	Naotosato	11/19-12/19	3.7,10.2	61	7	27.017	0.004	0.31	0.02	MB-I
14835	Holdridge	10/06-11/17	*20.4,15.2	33	15	16.6717	0.0013	0.20	0.01	MB-I
16591	1992 SY17	07/29-08/23	*12.8,16.8	313	14	2.73715	0.00009	0.15	0.01	MC

Table III. Observing circumstances and results. The Phase angle values are 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 and latitude at mid-date range (see Harris et al., 1984). Grp is the asteroid family/group (Warner et al., 2009). ERI: Erigone; EUN: Eunomia; MB-I/O: Main-belt inner/outer; MC: Mars-crosser; NEA: near-Earth; THM: Themis; TRJ: Jupiter Trojan.



Acknowledgements

We would like to express our gratitude to Brian Warner for supporting the CALL web site and his kind suggestions and interest in asteroid 862 Franzia, and to Gonzalo Fornas, for discovering and helping me use *MPO LCInvert*.

References

ALCDEF (2023). Asteroid Lightcurve Data Exchange Format web site. *https:// alcdef.org*

Aznar Macias, A.; Carreno Garcerain, A.; Arce Masego, E.; Brines Rodriques, P.; Lozano de Haro, J.; Fonas Silva, A.; Fornas Silva, G.; Mas Martinez, V.; Rodrigo Chiner, O.; Herrero Porta, D. (2016). "Twenty-one Asteroid Lightcurves at Group Observadores de Asteroides (OBAS): Late 2015 to Early 2016." *Minor Planet Bull.* **43**, 257-263.

Behrend, R. (2008web; 2011web, 2014web; 2018web). Observatoire de Geneve web site.
http://obswww.unige.ch/~behrend/page_cou.html

Bdw Publishing (2023). *MPO Canopus* and *MPO LCInvert* software. *https://bdwpublishing.com*

Binzel, R.P. (1987). "A photoelectric survey of 130 asteroids." *Icarus* **72**, 135-208.

CALL (2023). Collaborative Asteroid Lightcurve Link web site. *https://www.minorplanet.info/php/call.php*

Casalnuovo, G.B. (2013). "Lightcurve Photometry, H-G Parameters and Estimated Diameter for 1412 Lagrula." *Minor Planet Bull.* **40**, 188.

Diffraction (2023). *MaximDL* software.
https://www.cyanogen.com/product/maxim-dl/

Ditteon, R.; Horn, L.; Kamperman, A.; Vorjohan, B.; Kirkpatrick, E. (2012). "Asteroid Lightcurve Analysis at the Oakley Southern Sky Observatory: 2011 April-May." *Minor Planet Bull.* **39**, 26-28.

Ďurech, J.; Tonry, J.; Erasmus, N.; Denneau, L.; Heinze, A.N.; Flewelling, H. Vančo, R. (2020). "Asteroid models reconstructed from ATLAS photometry." *Astron. Astrophys.* **643**, A59.

Dose, E.V. (2023). "Lightcurves of eighteen asteroids." *Minor Planet Bull.* **51**, 42-49.

Erasmus, N.; Navarro-Meza, S.; McNeill, A.; Trilling, D.E.; Sickafoose, A.A.; Denneau, L.; Flewelling, H.; Heinze, A.; Tonry, J.L (2020) "Investigating Taxonomic Diversity within Asteroid Families through ATLAS Dual-band Photometry." *Ap. J. Suppl. Ser.* **247**, A13.

Ferrero, A. (2020). "Photometric Lightcurves of Eight Main-belt Asteroids." *Minor Planet Bull.* **47**, 172-174.

Hanus, J.; Ďurech, J.; Broz, M.; Marciniak, A.; Warner, B.D. and 115 colleagues (2013). "Asteroids' physical models from combined dense and sparse photometry and scaling of the YORP effect by the observed obliquity distribution." *Astron. Astrophys.* **551**, A67.

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(2)**, 251-258.

Harris, A.W.; Pravec, P.; Galad, A.; Skiff, B.A.; Warner, B.D.; Vilagi, J.; Gajdos, S.; Carbognani, A.; Hornoch, K.; Kusnirak, P.; Cooney, W.R.; Gross, J.; Terrell, D.; Higgins, D.; Bowell, E.; Koehn, B.W. (2014). "On the maximum amplitude of harmonics on an asteroid lightcurve." *Icarus* **235**, 55-59.

Huet, F.; Fornas, G.; Fornas, A. (2023). "Lightcurve analysis for Six main-belt asteroids." *Minor Planet Bull.* **50**, 170-172.

Kaasalainen, M. (2001). "Interpretation of lightcurves of precessing Asteroids." *Astron. and Astrophysics* **376**, 302-309.

Kaasalainen, M; Torppa, J. (2001a). "Optimization Methods for Asteroid Lightcurve Inversion. I Shape determination." *Icarus* **143**, 24-36.

Kaasalainen, M; Torppa, J: Muinonen, K. (2001b). "Optimization Methods for Asteroid Lightcurve Inversion. II The complete Inversion Problem." *Icarus* **153**, 37-51.

Mansego, E.A.; Rodriguez, P.B.; de Haro, J.L.; Chiner, O.R.; Silva, A.F.; Porta, D.H.; Martinez, V.M.; Silva, G.F.; Garceran, A.C. (2016). "Eighteen Asteroids Lightcurves at Asteroides Observers (OBAS) - MPPD: 2016 March-May." *Minor Planet Bull.* **43**, 332-336.

MPC (2023). Minor Planet Center web site. *https://www.minorplanetcenter.net/*

Oszkiewicz, D.A.; Skiff, B.A.; Moskovitz, N.; Kankiewicz, P.; Marciniak, A.; Licandro, J.; Galiazzo, M.A.; Zeilinger, W. (2017). "Non-Vestoid candidate asteroids in the inner main belt." *Astron. Astrophys.* **599**, A107.

Polakis, T. (2020). "Photometric Observations of Thirty Minor Planets." *Minor Planet Bull.* **47**, 177-186.

Pravec, P.; Wolf, M.; Sarounova, L. (2013web). *http://www.asu.cas.cz/~ppravec/neo.htm*

Pray, D.P. (2011). *http://www.geocities.com/dppray_2000/*

Sada, P.V.; Olguín, L.; Saucedo, J.C.; Loera-González, P.; Cantú-Sánchez, L.; Garza, J.R.; Ayala-Gómez, S.A.; Avilés, A.; Pérez-Tijerina, E.; Navarro-Meza. S.; Silva, J.S.; Reyes-Ruíz, M.; Segura-Sosas, J.; López-Valdivia, R.; Álvarez-Santana, F.(2017). "Results of the 2016 Mexican Asteroid Photometry Campaign." *Minor Planet Bull.* **44**, 239-242.

Slivan, S.M. (2012). "Epoch Data in Sidereal Period Determination. I. Initial Constraint from Closest Epochs." *Minor Planet Bull.* **39**, 204-206.

Slivan, S.M. (2013). "Epoch Data in Sidereal Period Determination. II. Combining Epochs from Different Apparitions." *Minor Planet Bull.* **40**, 45-48.

Slivan, S.M. (2014). "Sidereal Photometric Astrometry as Efficient Initial Search for Spin Vector." *Minor Planet Bull.* **41**, 282-284.

Slivan, S.M.; McLellan-Cassivi, C.J.; Serra-Ricart, M.; Alarcón, M.R. (2023). "Lightcurve and Constraints on the Spin Vector of Koronis Family Member (1840) Hus: Illustrating Analysis of a Combined Data Set." *Minor Planet Bull.* **50**, 190-193.

Wang, Y.-B.; Xu, Y.; Fan, C.-B.; Liu, C.-Z. (2018). "Study on the spin states of asteroids using a simplistic shape model." *Astron. Nach.* **339**, 457-464.

Warner, B.D. (2005). "Asteroid lightcurve analysis at the Palmer Divide Observatory - Fall 2004" *Minor Planet Bull.* **32**, 29-32.

Warner, B.D. (2010). "Upon Further Review: I. An Examination of Previous Lightcurve Analysis from the Palmer Divide Observatory." *Minor Planet Bull.* **37**, 127-130.

Warner, B.D.; Harris, A.W.; Pravec, P. (2009). "The Asteroid Lightcurve Database." *Icarus* **202**, 134-146. Updated 2021 April. *https://www.minorplanet.info/php/lcdb.php*

Waszczak, A.; Chang, C.-K.; Ofeck, E.O.; Laher, R.; Masci, F.; Levitan, D.; Surace, J.; Cheng, Y.-Ch.; Ip, W.-H.; Kinoshita, D.; Helou, G.; Prince, T.A.; Kulkarini, S. (2015). "Asteroid Light Curves from the Palomar Transient Factory Survey: Rotation Periods and Phase Functions from Sparse Photometry." *Astron. J.* **150**, 75-109.

LIGHTCURVES AND ROTATION PERIODS OF ASTEROIDS 1861 KOMENSKY, 2096 VAINO, 3127 BAGRATION, 3289 MITANI, 3582 CYRANO, 3589 LOYOLA, 3811 KARMA, 4226 DAMIAAN, 4458 OIZUMI, 6086 VRCHLICKY, 6875 GOLGI, (18118) 2000 NB24 AND 29185 REICH

Geoffrey Stone
First Light Observatory Systems
17908 NE 391st St
Amboy, WA 98601 USA
geoff@first-light-systems.com

(Received: 2024 January 14)

We present lightcurves and synodic rotation periods for 1861 Komensky, 2096 Vaino, 3127 Bagration, 3289 Mitani, 3582 Cyrano, 3589 Loyola, 3811 Karma, 4226 Damiaan, 4458 Oizumi, 6086 Vrchlicky, 6875 Golgi, (18118) 2000 NB24 and 29185 Reich observed from 2023 September through 2024 January.

Photometric observation of thirteen asteroids was conducted from 2023 September through 2024 January at Dimension Point Observatory (MPC V42) located near Mayhill, NM.

Images were acquired using a 0.43-m *f*/6.8 Corrected Dall-Kirkham telescope and FLI Kepler KL400 back-illuminated CMOS camera on a PlaneWave Instruments L-500 direct-drive mount. The equipment was operated remotely using *ACP Expert* (Denny, 2023) and *MaximDL* (George et al., 2021). Orbital elements, ephemeris and other information were obtained from the Minor Planet Center (*http://www.minorplanet.net*) the JPL Solar System Dynamics (*http://ssd.jpl.nasa.gov*) and the Lowell Observatory Minor Planet Services (*http://asteroid.lowell.edu*) websites.

Images were made unfiltered in HDR mode, utilizing camera internal stacking every 30 seconds. Exposure duration varied based on the target brightness and apparent motion but were typically 120 seconds.

Image calibration, plate solving, measurement and period analysis were performed using *Tycho-Tracker* V11.0 (Parrott, 2023). Comparison stars of near solar color were chosen from the ATLAS refcat2 star catalog (Tonry et al., 2018) using the comparison star selection feature of *Tycho-Tracker*.

1861 Komensky is an outer main-belt asteroid discovered in 1970 by L. Kohoutek at Bergedorf. We observed in on ten nights in 2023 November through 2024 January resulting in a total of 561 observations. A search of the LCDB found no reported rotation periods. Analysis of the data resulted in a best fit period of 61.8341±0.009925 hours with an amplitude of 0.639±0.06 mag. Coverage is incomplete so this result could be wrong.