Period Analysis

To avoid observation bias, asteroids were followed even if they were long period. Three had to be abandoned for the current observing season due to their low amplitude light curves.

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References

Duffard, R.D., Melita, M., Ortiz, J.L., Licandro, J., Williams, I.P., and Jones, D. (2008). "Light-Curve Survey of the Trojan Asteroids." *Asteroids, Comets, Meteors 2008 held July 14-18, 2008, paper id. 8187.*

Grav, T., Mainzer, A., Bauer, J., Masiero, J., and Nugent, C. (2012). "WISE/NEOWISE Observations of the Jovian Trojan Population: Taxonomy." *Astrophysical Journal* 759, 49-58.

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., and Zeigler, K.W. (1989). "Photoelectric Observations of Asteroids 3, 24, 60, 261, and 863." *Icarus* **77**, 171-186.

Pravec, P., Harris, A. W., Scheirich, P., Kušnirák, P., Šarounová, L., Hergenrother, C. W., Mottola, S., Hicks, M. D., Masi, G., Krugly, Yu. N., Shevchenko, V. G., Nolan, M. C., Howell, E. S., Kaasalainen, M., Galád, A., Brown, P., Degraff, D. R., Lambert, J. V., Cooney, W. R., and Foglia, S. (2005) "Tumbling asteroids." *Icarus* **173**, 108-131.

Stephens, R.D. (2008). "Long Period Asteroids Observed from GMARS and Santana Observatories." *Minor Planet Bul*. **35**, 31-32.

Warner, B.D. (2007). "Initial Results from a Dedicated H-G Project." *Minor Planet Bul.* **34**, 113-119.

A PLETHORA OF PHOCAEA ASTEROIDS

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CCD photometric observations of three Phocaea family asteroids were obtained from the Center for Solar System Studies in 2013 June. 5040 Rabinowitz has a period of 4.691 ± 0.001 h and an amplitude of 0.35 ± 0.02 mag. while 6487 Tonyspear has a period of 74.91 ± 0.02 h and an amplitude of 1.24 ± 0.02 mag., and (70126) 1999 NT2 has a period of 5.41 ± 0.01 h and an amplitude of 0.83 ± 0.03 mag.

The Center for Solar System Studies (CS3) recently started operations. Its participants have a history of studying asteroid families such as Jovian Trojans or Hungarias. When program members of targeted families are not observable, alternative targets such as Near-Earth Objects or the Phocaea family will be selected. No previous periods for these asteroids are reported in the Lightcurve Database (Warner 2013).

Stephens used either a 0.4-m or 0.35-m SCT with a FLI-1001e, SBIG STL-1001E CCD camera while Coley used a 0.35-m SCT with a SBIG ST-9e CCD camera. All images were unbinned with no filter and had Master flats and darks applied to the science frames prior to measurement. Measurements were made using *MPO Canopus*, which employs differential aperture photometry to produce the raw data. Period analysis was done using *MPO Canopus*, which incorporates the Fourier analysis algorithm (FALC) developed by Harris (1989). Night-to-night calibration of the data (generally < ±0.05 mag) was done using field stars converted to approximate Cousins R magnitudes based on 2MASS J-K colors (Warner 2007). The Comp Star Selector feature in *MPO Canopus* was used to limit the comparison stars to near solar color.

5040 Rabinowitz. This asteroid was observed by Coley and Stephens in a crowded star field, which increased the scatter in the plot from dim field stars in the background. Because of this, slight deviations from the Fourier curve were not considered compelling evidence of attenuation events. The average phase angle over the observing run was 21 degrees and the average phase angle bisector Longitude (L_{PAB}) was 271 degrees.

6487 Tonyspear. This asteroid observed by Stephens was also in a crowded star field. The lightcurve profiles with U-shaped maxima and V-shaped minima, the long rotational period and the 'shoulders' on the deepest minimum are suggestive that the asteroid might be a contact binary. The average phase angle over the observing run was 29 degrees contributing to the large amplitude of 1.24 mag. The average phase angle bisector Longitude (L_{PAB}) was 281 degrees.

(70126) 1999 NT2. Also embedded deep in the Milky Way, this asteroid was observed by Stephens. The first night had the densest coverage of observations as it passed in front of a dark nebula near Bernard 133. Subsequent nights were hampered by the dense star fields with over half the images lost to background stars. The Phase Angle was 13 degrees and the phase angle bisector Longitude (L_{PAB}) was 282 degrees.

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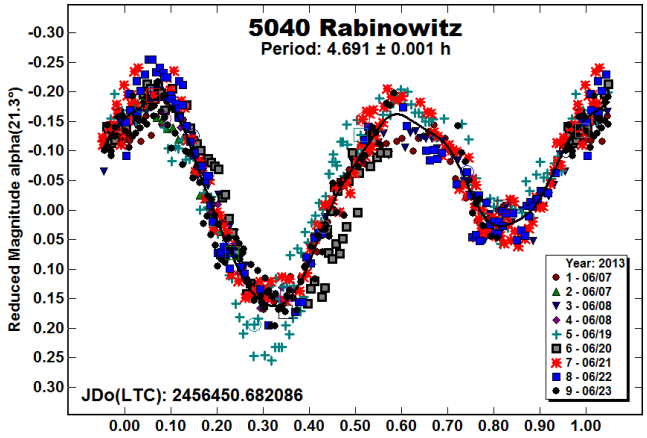
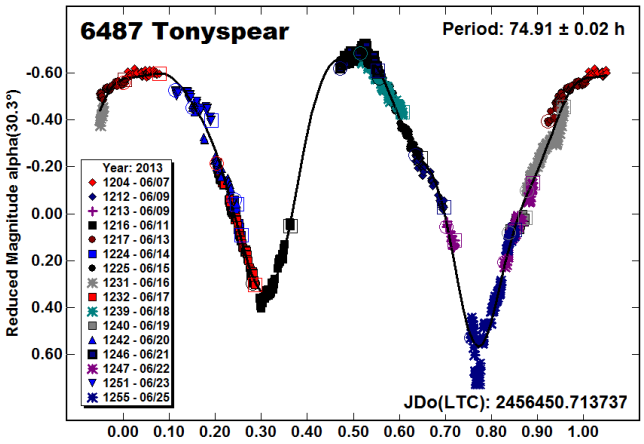
References

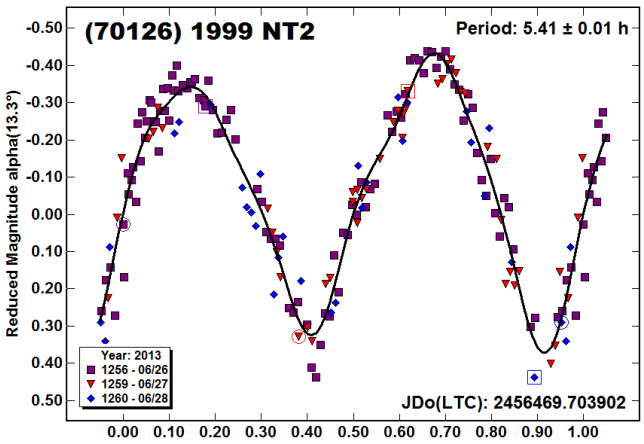
Harris, A.W., Young, J.W., Bowell, E., Martin, L.J., Millis, R.L., Poutanen, M., Scaltriti, F., Zappala, V., Schober, H.J., Debehogne, H., and Zeigler, K.W., (1989). "Photoelectric Observations of Asteroids 3, 24, 60, 261, and 863." *Icarus* **77**, 171-186.

Warner, B.D. (2007). "Initial Results from a Dedicated H-G Project." *Minor Planet Bul.* **34**, 113-119.

Warner, B.D. (2013). The Asteroid Lightcurve Database (LCDB) website. *http://www.minorplanet.info/lightcurvedatabase.html*







LIGHTCURVE PHOTOMETRY, H-G PARAMETERS, AND ESTIMATED DIAMETER FOR 15621 ERIKHOVLAND

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Photometric observations of main-belt asteroid 15621 Erikhovland were made over seven nights during May and June 2013 with a filtered system. The resulting synodic period is 5.3426 ± 0.0001 h with a high amplitude of 0.81 ± 0.02 mag. The color index V-R = 0.33 ± 0.03 mag. The measured absolute visual magnitude, Hv = 12.14 ± 0.09 mag. and the slope parameter, G = 0.08 ± 0.09, are consistent with a low albedo object, e.g., type C. The diameter is estimated to be D = 20 ± 3 km.

The main-belt asteroid 15621 Erikhovland was reported as a lightcurve photometry opportunity, for May 2013, in MPC Call (*http://www.minorplanet.info/PHP/call_OppLCDBQuery.php)*. All the observations were carried out from C62 Eurac Observatory in Bolzano (Italy), during eight observing nights, using a 0.30m reflector telescope, reduced to f/4.0 and a QHY9 CCD camera. Before each session, the observers synchronized the computer's clock with atomic clock time, via Internet NTP servers. Differential photometry and period analysis was done using *MPO Canopus* (Warner, 2012). The derived synodic period was P = 5.3426 ± 0.0001 h (Fig.1) with an amplitude of A = 0.81 ± 0.02 mag.

All filtered images (V Johnson, R Cousins) were calibrated with dark and flat-field frames. The V and R band frames were acquired in sequence changing alternatively the filters (VR VR VR). This allowed us to find the color index of V-R = 0.33 ± 0.05 mag (mean of 30 values). This value is typical of a C-type asteroid (Shevchenko and Lupishko, 1998). Assuming C-type, the geometric albedo is *pv* = 0.06 ± 0.02 (Shevchenko and Lupishko, 1998). The absolute magnitude (Hv) and slope parameter (G) ware found using the H-G Calculator function of MPO Canopus. Seven values obtained pre- and post-opposition of the asteroid, using the maximum values of the lightcurve. Unfortunately, there are no V values at small phase angles, near 0°, which are necessary for an optimal fit. We obtained Hv = 12.14 ± 0.09 mag. and the slope parameter G = 0.08 ± 0.09 (Fig. 2).

From this, we can estimate a diameter of D = 20 ± 3 km using the expression (Pravec and Harris, 2007):

$$D_{(km)} = (1329/\sqrt{Pv})10^{-0.2Hv}$$

References

Warner, B.D. (2012). MPO Software, Canopus version 10.4.1.9. Bdw Publishing. *http://minorplanetobserver.com/*

Minor Planet Call. *http://www.minorplanet.info/PHP*

Shevchenko V.G. and Lupishko D.F. (1998). "Optical properties of Asteroids from Photometric Data". *Solar System Research* **32**, 220-232.