

Acknowledgements

Funding for observations at the Palmer Divide Observatory is provided by NASA grant NNX 09AB48G, by National Science Foundation grant AST-0907650, and by a 2007 Gene Shoemaker NEO Grant from the Planetary Society. The work at Ondřejov was supported by the Grant Agency of the Czech Republic, Grant 205/09/1107. Support for PROMPT has been provided by the National Science Foundation under awards CAREER-0449001, AAG-0707634, and MRI-0836187. Work at Carbone Hill Observatory is supported by a Gene Shoemaker NEO Grant from the Planetary Society. This publication makes use of data products from the Two Micron All Sky Survey, which is a joint project of the University of Massachusetts and the Infrared Processing and Analysis Center/California Institute of Technology, funded by NASA and NSF.

References

Warner, B.D. (2010). "Asteroid Lightcurve Analysis at the Palmer Divide Observatory: 2009 September-December." *Minor Planet Bul.* **37**, 57-64.

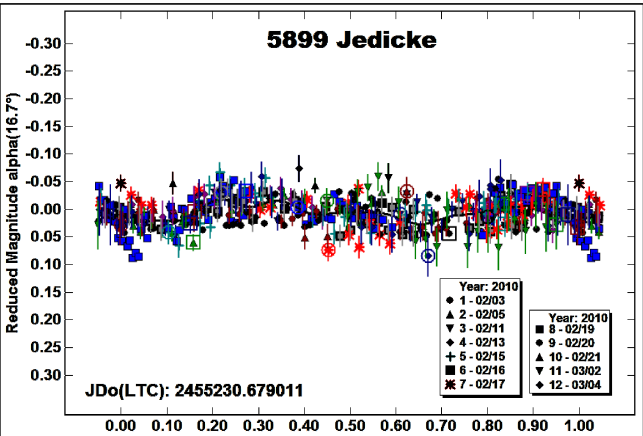


Figure 1. The short-period lightcurve for 5899. This curve is fit to ~3.5 h but several periods between 3 and 4 hours are possible.

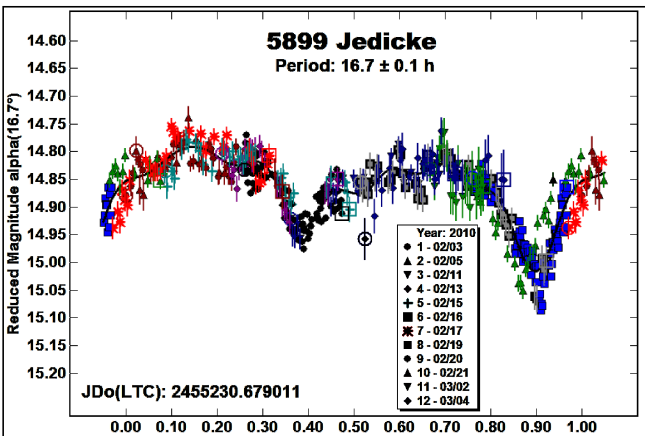


Figure 2. The long-period lightcurve for 5899 shows the mutual events, which allowed finding the orbital period.

Known, Possible, and Suspicious Hungaria Binaries				
Number	Name	P1	Porb	Status
1453	Fennia	4.412	22.99	B
1509	Esclanogona	3.25	~900	B
2074	Shoemaker	2.533	55.5	?
2083	Smither	2.672	30.09	??
2131	Mayall	2.568	23.48	B
2577	Litva	2.813	35.8	B
3309	Brorefeld	2.504	18.46	B
3873	Roddy	2.479	47.3	??
4674	Pauling	2.531	~3500	B
5477	1989 UH2	2.994	24.42	B
5899	Jedicke	3-4	16.7	B
5905	Johnson	3.782	21.78	B
6901	Roybishop	4.682	17.16	?
9069	Hovland	4.218	30.33	B
26471	2000 AS152	2.687	39.25	B
76818	2000 RG79	3.166	14.12	B

Table I. A list of known and likely Hungaria binary asteroids. P1 is the approximate rotation period of the primary (in hours) and Porb is the orbital period of the satellite.

THE LIGHTCURVE FOR THE LONG-PERIOD ASTEROID 4024 RONAN

Robert D. Stephens

Goat Mountain Astronomical Research Station (GMARS)
11355 Mount Johnson Court, Rancho Cucamonga, CA 91737
RStephens@foxandstephens.com

Brian D. Warner

Palmer Divide Observatory / Space Science Institute

(Received: 2 April)

The main-belt asteroid 4024 Ronan was observed 2010 January to March. The derived lightcurve has a synodic period of 365 ± 5 h and an amplitude of 1.0 ± 0.05 mag.

Observations of the main-belt asteroid 4024 Ronan were made by the authors from 2010 January 9 through March 13. The combined data set consists of 2868 data points. Most images were unbinned with no filter. Stephens' observations used a 0.30-m or a 0.35-m SCT with a SBIG STL-1001E CCD camera. Observations at

Palmer Divide were made with a 0.35-m SCT using a SBIG STL-1001E CCD Camera. Measurements were made using *MPO Canopus*, which employs differential aperture photometry to produce the raw data. Period analysis was done using *Canopus*, which incorporates the Fourier analysis algorithm (FALC) developed by Harris et al. (1989).

Night-to-night calibration of the zero points was done using 2MASS magnitudes of up to five comparison stars of similar color to an asteroid. See Warner (2007) and Stephens (2008) for further discussion of this process that provides calibration of the nightly zero points typically good to within 0.05 magnitudes. When working long-period asteroids where a single observing session typically produces a flat curve, it is necessary to calibrate the night-to-night zero points.

4024 Ronan was previously observed by Stephens (2003), who initially found a period of 18.9 h. This analysis was done before the new calibration techniques were developed and resulted in an asymmetric and noisy lightcurve with a 0.4 mag amplitude. Since 2010 provided a favorable opposition, Stephens decided to re-observe Ronan to check the previous results. The observations produced flat lightcurve segments, often characteristic of a long-

period. Even though the observing circumstances were similar to the 2003 observations, the amplitude using calibrated data was far greater. This prompted Stephens to recover and re-measure the 2003 observations using the new calibration methods. The revised results were a partial lightcurve consistent with the 2010 observations. Without calibrating the nightly zero points, a period from the 2003 data could not have been obtained.

The combination of the estimated size of 10 km and ~360 h period make the asteroid a good candidate for tumbling, or non-principal axis rotation (NPAR; see Pravec et al. 2005). However, since the conversion of the 2MASS magnitudes has errors up to ± 0.05 mag, the night-to-night calibrations have minor adjustments. For this reason we cannot say for certain whether or not Ronan is tumbling.

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.

Pravec, P., Harris, A.W., Scheirich, P., Kušnirák, P., Šarounová, L., and 15 colleagues (2005). "Tumbling Asteroids." *Icarus* **173**, 108-131.

Stephens, R. D. (2003). "Long Period Asteroids Observed from GMARS and Santana Observatories." *Minor Planet Bul.* **30**, 46-48.

Stephens, R. D. (2008). "Long Period Asteroids Observed from GMARS and Santana Observatories." *Minor Planet Bul.* **35**, 21-22.

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

ASTEROIDS OBSERVED FROM THE SHED OF SCIENCE OBSERVATORY: 2009 OCTOBER – 2010 MARCH

Russell I. Durkee
Shed of Science Observatory
5213 Washburn Ave. S., Minneapolis, MN, 55410 USA
shedofscience@earthlink.net

(Received: 2010 April 14)

Lightcurve measurements from the Shed of Science Observatory for 2009 October to 2010 March are reported: 616 Elly, $P = 5.30 \pm 0.02$ h; 1372 Haremar, $P = 15.25 \pm 0.03$ h; 1416 Renauxa, $P = 8.700 \pm 0.004$ h; 2181 Fogelin, $P = 14.07 \pm 0.01$ h; 3458 Bodougnat, $P = 3.8565 \pm 0.0005$ h; and 8062 Okhotsysmskij, $P = 5.282 \pm 0.002$ h.

Observations of six asteroids were made at the Shed of Science Observatory between 2009 September and 2010 March. A 0.35-m Schmidt-Cassegrain (SCT) was used with an SBIG ST10XE CCD camera working at a scale of 0.94 arcsec/pixel. Exposures were made through a Celestron UHC LPR filter. *MPO Canopus* was used to perform differential photometry on the reduced images.

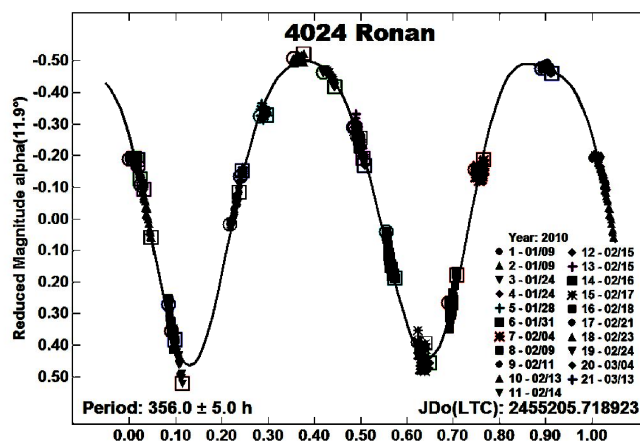


Figure 1: 2010 observations. Avg. $L_{PAB} = 128^\circ$, Avg. $B_{PAB} = 10^\circ$.

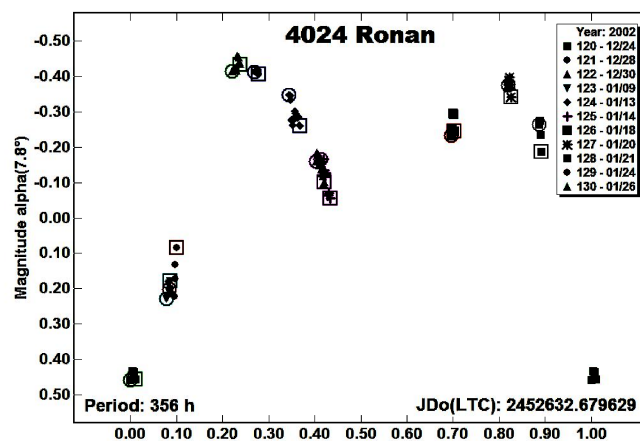


Figure 2: 2003 observations set to $P = 356$ h. Avg. $L_{PAB} = 90^\circ$, Avg. $B_{PAB} = 4^\circ$.

616 Elly. This object was observed on two consecutive nights, 2010 February 24 and 25. Analysis indicates a period of $P = 5.30 \pm 0.02$ h, $A = 0.38$ mag. This is in agreement with recent results by Warner (2010) and earlier results from Alvarez (2004) and Tedesco (2004). Due to the object's short period and the long winter nights, we were able to complete the curve with partial double coverage on both evenings, giving it a reliability code of $U = 3$. (see Warner et al., 2009, for the definition of the U rating).

1372 Haremar. A period of $P = 15.25 \pm 0.03$ h and $A = 0.1$ mag. were derived from seven nights' observations. The curve is not complete and other solutions are possible. We give these results a reliability code of $U = 2$. The ambiguity could be resolved with more observations over a longer time period or, more quickly, by involving another observer at a well-removed longitude.

1416 Renauxa. The lightcurve of this object has been measured on other occasions by Tedesco et al. (2004) and Lagerkvist (1978), both of whom reported a monomodal curve with a period of ~4.3 h. Our observations indicate that the lightcurve has an asymmetric shape that slightly favors a bimodal solution with a period of $P = 8.700 \pm 0.004$ h and $A = 0.1$ mag.

2181 Fogelin. A period of $P = 14.07 \pm 0.01$ h and $A = 0.57$ mag were derived from four nights' observations. This is the first known lightcurve of this object. We give it a reliability code of $U = 3$.