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133.

NEW LIGHTCURVES OF 8 FLORA, 13 EGERIA, 14 IRENE, 25 PHOCAEA, 40 HARMONIA, 74 GALATEA, AND 122 GERDA

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New lightcurves yield synodic rotation periods and amplitudes for: 8 Flora, 12.861 ± 0.001 h, 0.08 ± 0.01 mag; 13 Egeria, 7.0473 ± 0.0001 h, 0.15 ± 0.02 mag in 2007, 0.37 ± 0.02 mag in 2009; 14 Irene, 15.089 ± 0.009 h, 0.03 ± 0.01 mag in 2007, 15.028 ± 0.001 h, 0.16 ± 0.03 mag in 2009; 25 Phocaea, 9.935 ± 0.001 h, 0.11 ± 0.02 mag in 2008, 9.927 ± 0.003 h, 0.06 ± 0.01 mag with one maximum and minimum per cycle in 2009; 40 Harmonia, 8.909 ± 0.001 h, 0.28 ± 0.02 mag; 74 Galatea, 17.268 ± 0.004 h, 0.16 ± 0.03 mag with 4 unequal maxima and minima per cycle; 122 Gerda 10.712 ± 0.010 h, 0.11 ± 0.01 mag.

Observations were made of seven asteroids at the Organ Mesa Observatory where the equipment consists of a Meade 0.35-m LX-200 GPS Schmidt-Cassegrain (SCT) and SBIG STL 1001-E CCD. A red filter was used for the bright asteroids 8, 13, 14, 25, 40, and a clear filter for the fainter asteroids 74 and 122. Exposures were unguided. Image measurement using differential photometry and lightcurve analysis were done with *MPO Canopus*. Due to the large number of data points acquired for each target in this study, the lightcurves have been binned in sets of three data points with a maximum of five minutes between points.

8 Flora. Several different periods have been reported over the years for this asteroid, leaving its true period in doubt. Van Houten-Groeneveld and van Houten (1956) found a period of 13.6 h, but the two minimum that they recorded also supported a period of 12.87 h. Veverka (1971) also recorded two minima that are

consistent with a period near 12.9 h. Hollis et. al. (1987) derived a period of 12.790 h. Di Martino (1989) and Harris and Young (1989) also found periods of approximately 12.87 h, as did Piiornen et al. (1998). Torppa et al. (2003) found a sidereal period of 12.79900 h using lightcurve inversion techniques. Several attempts have also been made to determine the spin axis orientation for Flora. Hollis et al. (1987) reported a pole longitude near 148° while Di Martino et al. (1989) found two possible solutions at longitude 140° or 320° . Torppa et al. (2003) found a pole solution of $(160^\circ, +16^\circ)$ and sidereal period of 12.79900 h, similar to $(155^\circ, +5^\circ)$ found by Durech (2009a), both using lightcurve inversion methods. Durech's sidereal period, however, was 12.86667 h.

New observations of the asteroid obtained by the author on 8 nights from 2009 Feb. 21 to Apr. 26 show a synodic period 12.861 ± 0.001 h and amplitude 0.08 ± 0.01 mag. Miles (private communications), one of the authors of the 12.790 h period by Hollis et. al. (1987), states that he considered this period tentative, and that a reinvestigation of the original data shows a much better fit to 12.87 hours. Durech (private communications) has performed lightcurve inversion combining these new observations with the previous ones and states that the expanded data set confirms his period of 12.86667 h, ruling out the shorter period. Since the sidereal-synodic period difference is generally on the order of 0.005 h for this asteroid, all investigations are now consistent with a period of 12.865 ± 0.005 h and this period for Flora can be considered secure.

13 Egeria. Observations of this asteroid were made by the author during two consecutive apparitions. Data obtained on 3 nights from 2007 Sept. 13-Oct 27 yield a period of 7.047 ± 0.001 h, amplitude 0.15 ± 0.02 mag while those obtained on 5 nights from 2009 Jan. 12-Mar. 8 result in a period of 7.0473 ± 0.0001 h and amplitude 0.37 ± 0.02 mag. These are in agreement with the period adopted in the Asteroid Lightcurve Database (LCDB, Warner et al., 2008).

14 Irene. Periods ranging from 9.47 to 18.71 h have been previously reported (in the LCDB; see Warner et al., 2008). Two new lightcurves were obtained at Organ Mesa in on 2007 Nov. 23 and Dec. 6. This data set is much too sparse to allow an independent period determination; however, they are consistent with a period 15.089 ± 0.009 h, one of the periods in the LCDB. The amplitude at the time was only 0.03 ± 0.01 mag. Observations on 8 nights from 2009 Feb. 28-May 11 show a period of 15.028 ± 0.001 h and amplitude 0.16 ± 0.03 mag. The phases of the individual extrema in the lightcurve remain nearly constant, but their heights vary greatly with changing phase and aspect angle.

IMPORTANT ANNOUNCEMENT

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Minor Planet Bulletin 36 (2009)

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The determination from the 2007 observations that the pole is near the ecliptic shows that the obliquity in 2009 was near 90 degrees, which in turn indicates the synodic period of 15.028 h is fairly close to the sidereal period. The variations in the shape of the lightcurve will be useful in a future determination of the shape by lightcurve inversion.

25 Phocaea. Groeneveld and Kuiper (1954) obtained lightcurves on 4 nights 1950 Aug. 5-10 and found a period 9.945 h, amplitude 0.18 mag. Buchheim (2007), on the basis of observations on 3 nights from 2006 Oct. 21-23, found the same period with amplitude only 0.03 mag. New observations made on 4 nights from 2008 Jan. 13-Feb. 2 show an irregular lightcurve with period 9.935 ± 0.001 h, amplitude 0.11 ± 0.02 mag. This lightcurve is noisy because the target was traveling through a very dense Milky Way star field. Additional observations obtained from 2009 Apr. 13-21 showed a monomodal lightcurve with period 9.927 ± 0.003 h, amplitude 0.06 ± 0.01 mag. All of these period determinations are compatible with the consideration that the synodic period varies with aspect angle and mean motion.

40 Harmonia. The Asteroid Lightcurve Database (Warner et al., 2008) lists several periods with the most secure being ~ 8.9 h. New lightcurves obtained on five nights from 2008 Dec. 19-2009 Jan. 14 show a period of 8.909 ± 0.001 h, amplitude 0.28 ± 0.02 mag. This is fully compatible with previous determinations and was obtained to provide data leading to a spin/shape model.

74 Galatea. Harris and Young (1980) obtained lightcurves on two nights that showed an amplitude of ~ 0.13 mag that were compatible with a 9.0 hour period (and other aliases). Behrend (2009) presents a lightcurve based on data from M. Conjat with a period of 8.628 ± 0.004 h, amplitude 0.09 mag that assumes the usual two maxima and minima per cycle. Pilcher (2008) obtained lightcurves on 11 nights from 2008 Feb. 1-Mar. 23. These showed four unequal maxima and minima per cycle with period 17.270 ± 0.002 h, maximum amplitude 0.08 ± 0.01 mag. New lightcurves on 5 nights from 2009 Mar. 28-Apr. 3 also show four unequal maxima and minima per cycle, a period of 17.268 ± 0.004 h, and amplitude of 0.16 ± 0.03 mag.

122 Gerda. The Asteroid Lightcurve Database (Warner et al., 2008) lists a number of periods of ~ 10.68 h, with the most secure result being that from Robinson (2009) with $P = 10.685$ h, $A = 0.26$ mag. New observations on 3 nights from 2009 Apr. 1-3 show a period 10.712 ± 0.010 h, amplitude 0.11 ± 0.01 mag, with full phase coverage. This is compatible with previous determinations.

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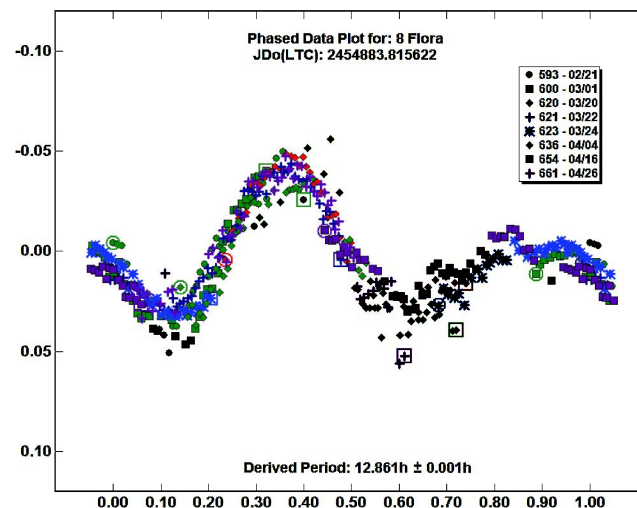
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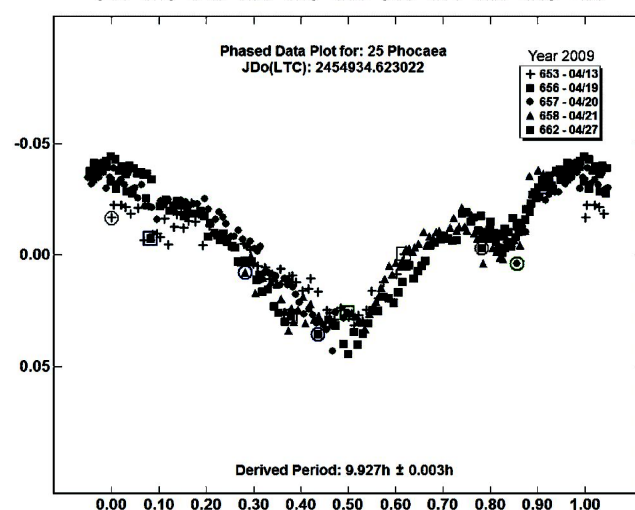
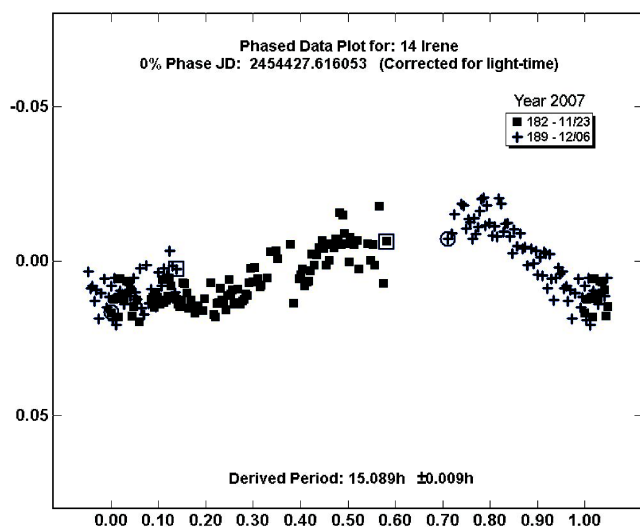
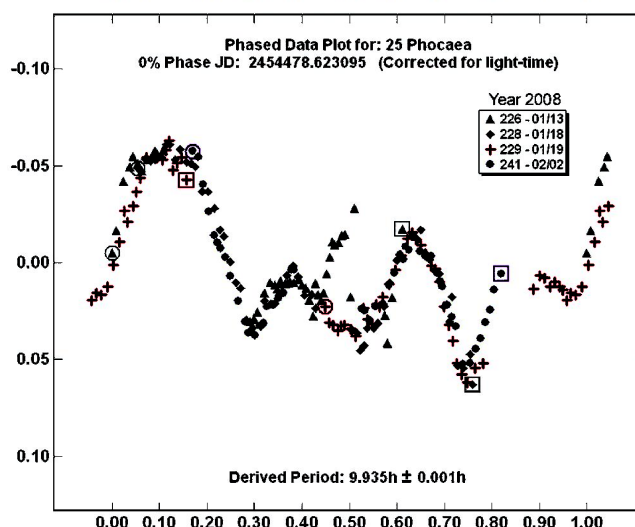
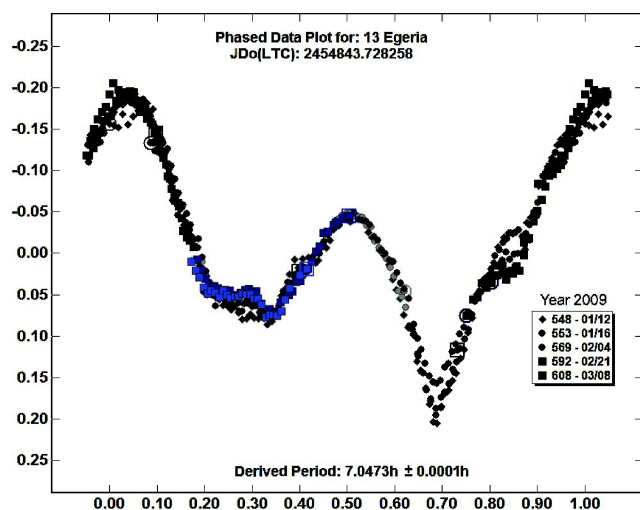
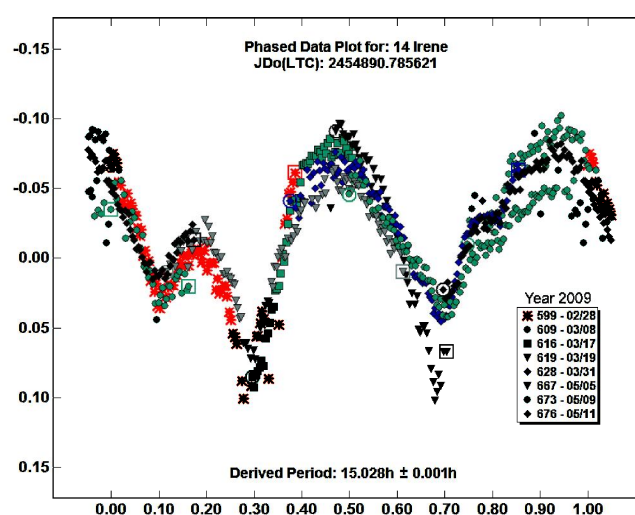
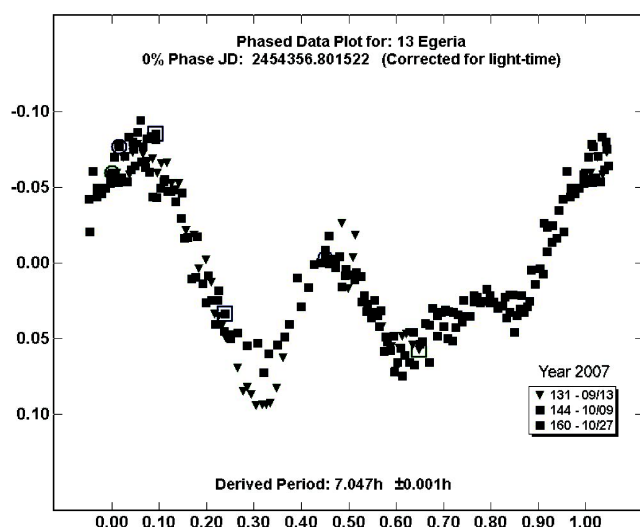
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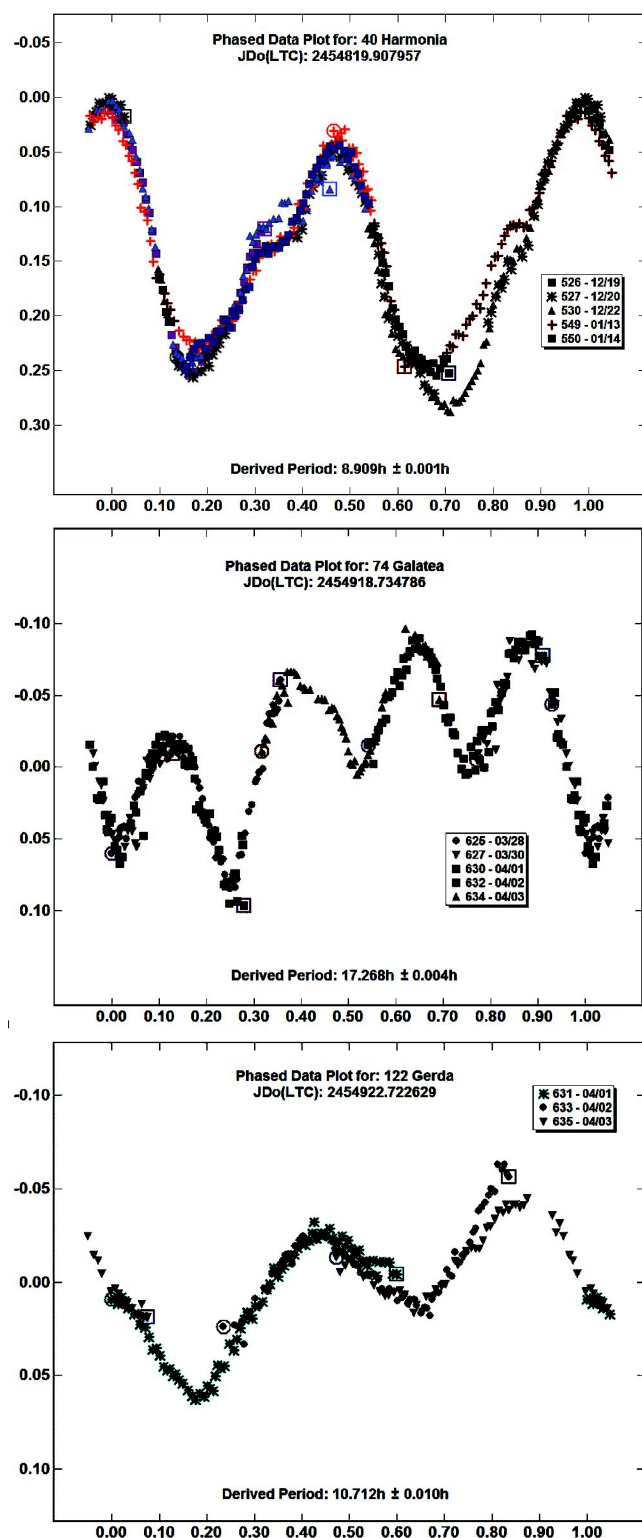
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LIGHTCURVES AND H-G PARAMETERS FOR 901 BRUNSLIA AND 946 POESIA

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Lightcurves and absolute photometry near opposition revealed photometric results for 901 Brunslia and 946 Poesia. For 901 Brunslia, $P=3.1363 \pm 0.0002$ h, $A=0.28 \pm 0.02$, $H=11.93 \pm 0.038$, $G=0.258 \pm 0.045$. For 946 Poesia, $P=73.5 \pm 0.02$ h, $A=0.24 \pm 0.05$, $H=10.54 \pm 0.06$, $G=0.028 \pm 0.06$.

Target selection for a study to determine the absolute magnitude (H) and phase slope parameter (G) of asteroids was made from the quarterly lightcurve photometry opportunities article published in *The Minor Planet Bulletin* (Warner et al., 2009a). This is an extremely useful summary of asteroid research opportunities for lightcurves, low phase angle, spin/shape modeling, radar, and other studies. Chosen were upcoming low phase angle asteroids 901 Brunslia and 946 Poesia. They were both at good sky positions for Stonegate Observatory, had V magnitudes in the 13 to 16 range, and oppositions occurring within six weeks of each other.

Observations were made with a 0.36 meter C-14 f/6.6 Schmidt-Cassegrain telescope and SBIG ST-10XME camera. The camera was run at -15°C and binned 2×2 . The resultant 1.4 arcsecond/pixel scale was slightly over sampled for the nominal 3-5 arcsecond FWHM seeing. No guiding was necessary. The Michigan winter sky was very poor for photometric work with only one night in ten being useful during some periods. On each night a Landolt reference field was imaged with V, R, and Clear filters at an air mass as close as possible to 2 followed by a Henden field as close as possible to air mass of 1 and, in close proximity to the study asteroid. Exposures ranged from 10 to 120 seconds. The nightly three-color data were reduced using *MPO Canopus/PhotoRed* routines (Bdw Publishing, 2008), computing transforms, extinction, and V-R color indices for the reference stars and object, thus reducing the values to standard magnitudes. For a more complete description of the program to determine H-G parameters, as well of as a discussion of the H-G magnitude system, see Vander Haagen (2009) or contact the author by email for an electronic version of that paper.

901 Brunslia. This asteroid reached zero phase angle on 2008 December 13. The initial direction was to obtain as good as possible photometric data over the phase range of 0° to 20° or greater. During this interval, longer instrumental data were collected to determine the period. The lightcurve for 901 Brunslia is shown in Figure 1. The data were phased using *MPO Canopus* and the synodic period of the lightcurve found to be 3.1363 ± 0.0002 h with an amplitude of 0.28 ± 0.02 mag., which is close to an alternate period given by Wisniewski et al. (1997) and recently adopted in the LCDB (Warner et al., 2009b).

The data from 901 Brunslia were corrected to a mean value such that all data points were effectively at the same part of the lightcurve. The data were then corrected for the (R) Sun-asteroid distance and (r) the Earth-asteroid distance. The H/G Calculator in *MPO Canopus* was used to make these calculations and plot the