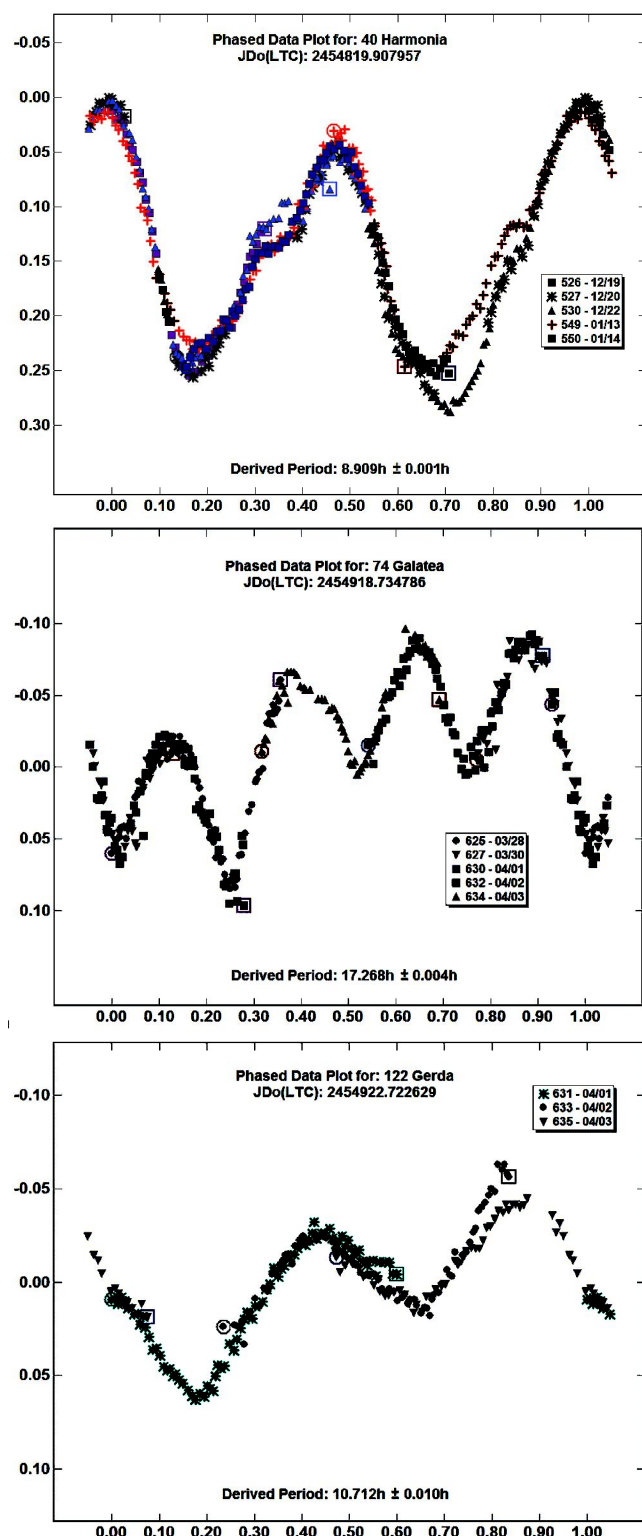




LIGHTCURVES AND H-G PARAMETERS FOR 901 BRUNSLIA AND 946 POESIA

Gary A. Vander Haagen
 Stonegate Observatory, 825 Stonegate Road
 Ann Arbor, MI 48103
 garyvh2@att.net

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

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 $3.1363 \pm 0.0002\text{ h}$ with an amplitude of $0.28 \pm 0.02\text{ mag.}$, 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

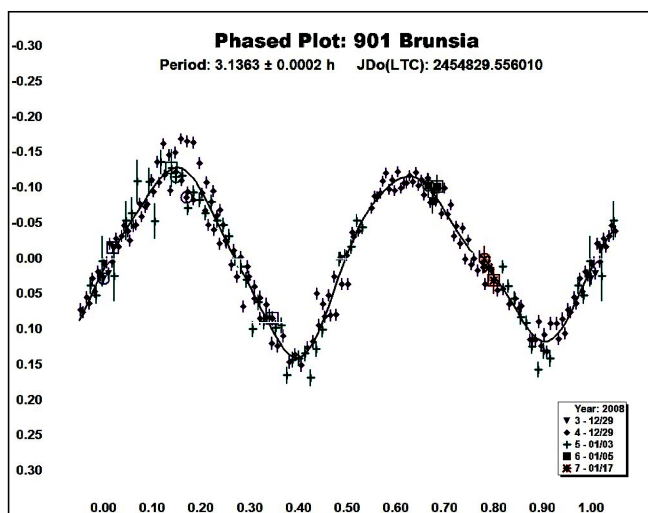


Figure 1. Lightcurve of 901 Brunzia Phased to 3.1363 h.

data (see Figure 2). Based on the derived value of $G = 0.258 \pm 0.045$ and Table 4 in Warner et al. (2009b), 901 Brunzia falls into the range typical for Sq class asteroids (as assigned by SMASS II; summarized in LCDB) with an estimated albedo of $p_v = 0.20$. Looking up the orbital elements in the MPCORB file and comparing with LCDB class-family grouping supports an S taxonomic classification. Knowing the estimated albedos, $p_v = 0.20$, and absolute magnitude, $H = 11.93$, allows calculation of the diameter using the expression (Pravec and Harris, 2007):

$$\log D_{(\text{km})} = 3.1235 - 0.2H - 0.5\log(p_v)$$

This expression yields $D = 12.2$ km for 901 Brunzia.

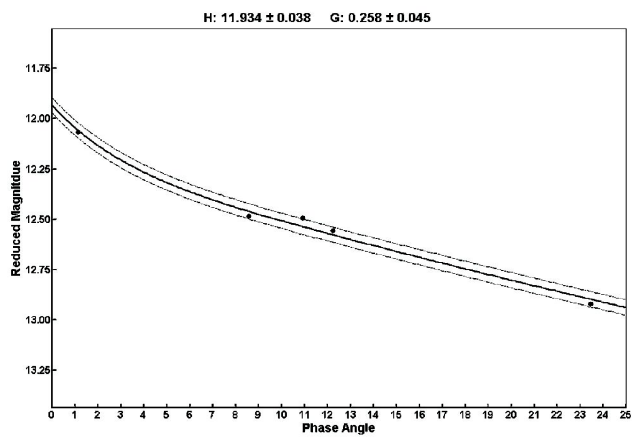


Figure 2. 901 Brunzia H-G parameter phase angle plot

946 Poesia. The same process as described above was used for 946 Poesia. The zero phase angle occurred on 2009 January 16. Photometric data were collected and reduced on 10 nights for use in the $H-G$ parameter determination. Many of these nights were not close to photometric. Long differential photometry runs were also interspersed wherever there was a possible “reasonable” night to determine the asteroids period. The effort was difficult due to the short visibility periods for both seeing and sky position. Even with more than 1100 data points, the period was not determined with certainty. The best solutions are shown in Figures 3 and 4 with periods of 73.5 h and 102.9 h, respectively. The amplitudes for both are 0.24 ± 0.05 mag. Longer nightly runs and successive days would have been useful to resolve the uncertainty.

The adjustments to mean magnitude values and Sun-asteroid and Earth-asteroid corrections were made as described with 901 Brunzia. Both the 73.5 h and 102.9 h periods were used to plot the $H-G$ parameters. The plots are shown in Figures 5 and 6. Figure 5, with means established using the 73.5 h period, yielded the lowest error $H-G$ parameters, which were $H = 10.54 \pm 0.06$ and $G = 0.028 \pm 0.06$. Referring to the SMASS II classifications in the LCDB, the best fit is subclass Ch with a $G = 0.094 \pm 0.08$ and $p_v = 0.056$. Using an albedo of $p_v = 0.056$ and absolute magnitude, $H = 10.54$, the diameter of 946 Poesia is $D = 43.7$ km.

By collecting photometric data over a range of phase angles on either side of zero we have determined the asteroids period, amplitude, the absolute magnitude (H), the slope parameter (G), the general taxonomic class, the estimated geometric albedo, and estimated diameter. This significantly increases the knowledge for each of these asteroids. The taxonomic class could be verified using spectroscopy as outlined in Bus and Binzel (2002).

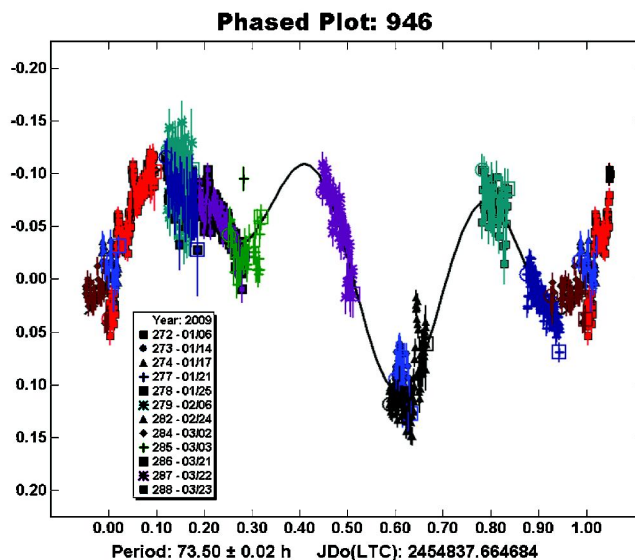


Figure 3. Lightcurve of 946 Poesia Phased to 73.5 h.

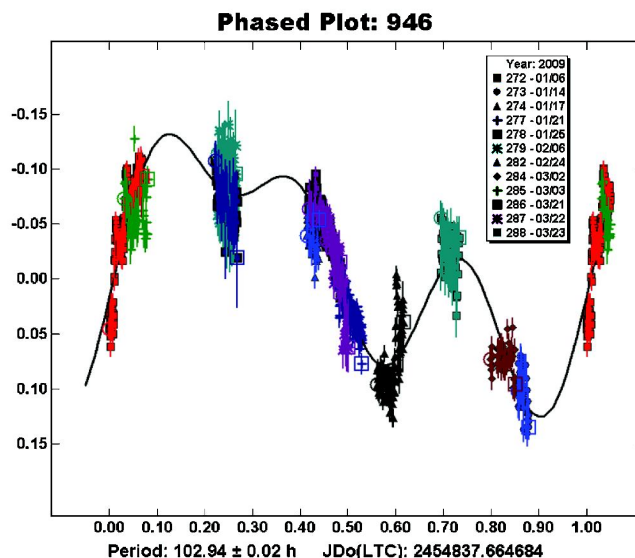


Figure 4. Lightcurve of 946 Poesia Phased to 102.9

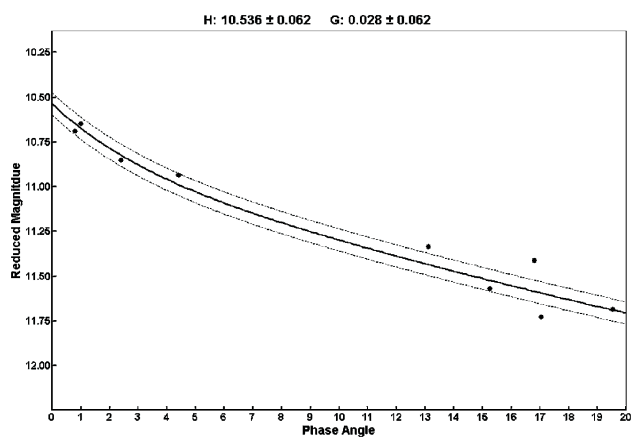


Figure 5. 946 Poesia H-G Parameters using 73.5 h period for finding the mean magnitude.

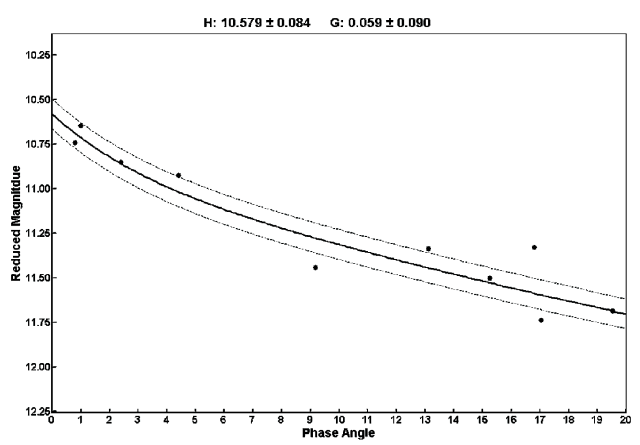


Figure 6. 946 Poesia H-G parameters using 102.9 h period for finding the mean magnitude.

Acknowledgements

The author extends thanks to Brian Warner for the highly useful software tools *Canopus* and *PhotoRed*. Thanks also to Brian for the “gentle push” towards the study of *H-G* Parameters and assistance in sorting out the ambiguous long period of 946 Poesia. Appreciation is also extended to the Society for Astronomical Sciences (SAS) for allowing use of this material as presented at the 2009 Symposium.

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ON THE PERIOD OF 1506 XOSA

George Stecher, Lyle Ford, and Natalie Bianchi
Department of Physics and Astronomy
University of Wisconsin-Eau Claire
Eau Claire, WI 54702-4004 USA
gstecher@uwec.edu

Brian D. Warner
Palmer Divide Observatory/Space Science Institute
Colorado Springs, CO USA

Larry Robinson
Sunflower Observatory, Olathe, KS USA

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Observations from the 2005 opposition of 1506 Xosa combined with re-analyzed data from the 2001 apparition were used to examine the period of 1506 Xosa. The combined data indicate possible periods of 5.9 h and 6.6 h.

The Eau Claire group made R band and I band photometric measurements of 1506 Xosa on 2005 June 16 and 17 using the 0.6-m “Air Force” Telescope located at Hobbs Observatory near Fall Creek, Wisconsin. 60-second exposures were taken with a Photometrics Star I Camera. Images were dark-subtracted and flat-fielded. Instrumental magnitudes were found using *MPO Canopus* version 9.3.1.0 (Warner, 2007a). The asteroid passed near three stars on the night of 16 June, so *Canopus*’ StarBGone star removal algorithm was used to eliminate their signals. Images of standard stars from the LONEOS catalog were used to find transforms and first order extinction coefficients, although not all the stars used were Landolt standards. Transforms and first order extinction coefficients were determined using the modified Hardie method as described in Warner (2006). The transforms and extinction coefficient calculations were made by spreadsheet because the unusual color index, R-I, is not supported by the MPO software. The Eau Claire data show possible periods of approximately 4.0 h, 5.9 h (Figure 1), and 6.6 h (Figure 2), with 4.0 h and 5.9 h giving the best fits.