

LIGHTCURVE AND H-G PARAMETERS FOR 2004 LEXELL

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Lightcurves and absolute photometry near opposition revealed photometric results for 2004 Lexell: $P = 5.4429 \pm 0.0003$ h, $A = 0.42 \pm 0.03$ mag, $H = 12.908 \pm 0.064$ mag, and $G = 0.071 \pm 0.056$.

Selection of 2004 Lexell was made from the quarterly lightcurve photometry opportunities article published in *The Minor Planet Bulletin*, Warner et al. (2010). Asteroid 2004 was a low intensity target, V magnitudes ranging from 14.7 to 16.7, with nightly visibility of 5 to 6 hours over the period 2010 March 6 to May 5, with opposition on March 5.

Observations were made with a 0.43-meter PlaneWave f/6.8 corrected Dall-Kirkham Astrograph and SBIG ST-10XME camera. The camera was run at -15C and binned 3x3 resulting in a 1.4 arcseconds/pixel scale. No guiding was necessary. A total of 878 images were taken with the 591 higher S/N data plotted and phased. An averaging process was used on higher phase angle images for S/N improvement and plotting of the H-G data. The target and reference stars were imaged with V filter. Exposures were 120 seconds with the exception of May 5, when 180-second exposures were used. The nightly data were reduced using *MPO Canopus/PhotoRed* routines (Bdw Publishing, 2010), using the "selector" feature whereby V magnitude reference stars are selected and the target magnitude computed. With the poor nightly sky conditions this method proved more consistent than nightly reductions using Landolt and Henden fields and reducing the values to standard magnitudes.

Photometric data of 2004 indicated a probable period of 5.4429 h. Referencing the Asteroid Lightcurve Database (Warner et al., 2009), there were no previously reported data for 2004 Lexell. Examination of the period spectrum gives near equal probability for a single-extrema solution of 2.721 ± 0.001 h and double-extrema solution of 5.4429 ± 0.0003 h. Examination of the phased data indicates a high degree of symmetry but with an amplitude of 0.42 mag, the longer, bimodal solution is virtually assured (Warner, personal correspondence).

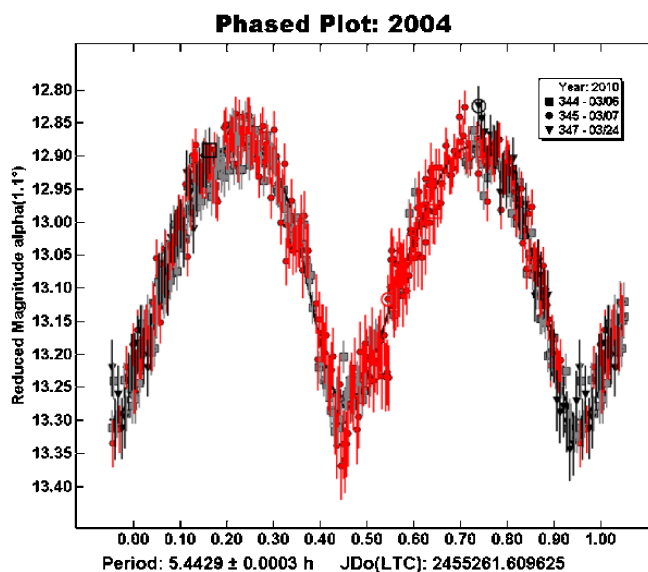
For development of the H-G parameters, the data from 2004 Lexell were corrected to a mean value such that all data points were effectively at the same part of the lightcurve. The data were then corrected for (R) Sun-asteroid distance and (r) the Earth-asteroid distance. The H/G calculator in *MPO Canopus* was used to make these calculations and plot the data. For a more complete discussion of the H-G magnitude system and reduction process refer to Vander Haagen (2009) or contact the author by email for an electronic version of that paper. With a derived value of $G = 0.071 \pm 0.056$, the results were correlated with data published on the relationship among albedos, phase slope parameter (G), and taxonomic class shown in Table 4, Warner et al. (2009). 2004 Lexell's slope parameter (G) is typical of asteroids having low albedos, such as those in the C, G, B, F, P, T, and D. However, the albedo is unknown and can only be guessed. Checking the Bus and

Binzel (2002) SMASS II spectral classification shows no data for the asteroid. Guessing, for example one of these, such as the Ch class, from the previously noted Table 4, $p_v = 0.056 \pm 0.012$, and derived absolute magnitude, $H = 12.908$, allows calculation of the asteroid diameter using the expression (Pravec and Harris, 2007):

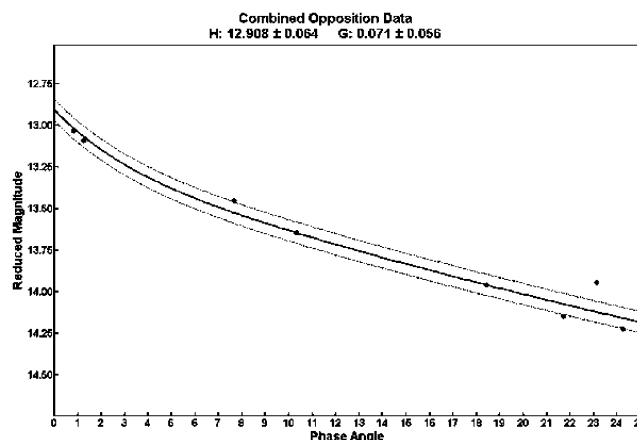
$$\log D_{(\text{km})} = 3.1235 - 0.2H - 0.5\log(p_v)$$

This expression yields $D = 14.7$ km.

Spectral measurements are necessary to establish the subclass and confirm correlation with the slope parameter.



Lightcurve of 2004 Lexell Phased to 5.4429 h



2004 Lexell H-G Parameter Phase Angle Plot Corrected for $P = 5.4429$ h

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LIGHTCURVES FOR 890 WALTRAUT, 3162 NOSTALGIA, AND 6867 KUWANO

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Lightcurve observations have yielded period determinations for the followings asteroids:
890 Waltraut, 12.581 ± 0.001 h; 3162 Nostalgia, 6.413 ± 0.002 h; and 6867 Kuwano, 7.37 ± 0.01 h.

Photometric data on three asteroids were collected at Barnes Ridge Observatory, located in northern California at an altitude of 762 meters, during early to mid-2009. A 0.36-m Meade Schmidt-Cassegrain (SCT) operating with a focal reducer at f/6.06 and Apogee U9 camera were used to acquire the images. The camera was binned 1x1 with a resulting image scale of 0.86 arc-seconds per pixel. The images were taken through a clear filter. All exposures were 120 seconds at -25°C . Nightly data runs were split into two sets with camera orientation being 0 and 180 degrees to allow adjustment of the zero offset between the two sets. All photometric data were obtained with *MaxIm DL V5* driven by *ACP V5* and then analyzed using *MPO Canopus v9.5* (Warner, 2008). All comparison stars and asteroid targets had $\text{SNR} \geq 100$.

890 Waltraut. Data were collected from 2009 July 21 through September 9 resulting in 17 data sets and 792 data points. A period of 12.581 ± 0.001 h was determined. A previous lightcurve with a period of 12.58 ± 0.01 hr and amplitude of 0.35 mag was reported by Brinsfield (2009).

3162 Nostalgia. Data were collected from 2008 February 1-3 resulting in 6 data sets and 421 data points. A period of 6.413 ± 0.002 h was determined. This agrees well with the period found by Carbo et al. (2009).

6867 Kuwano. Data were collected from 2009 June 23-27 resulting in 8 data sets and 365 data points. A period of 7.37 ± 0.01 h was determined. A previous lightcurve with a period of 7.367 ± 0.001 h and amplitude of 0.52 mag was reported by Brinsfield (2009). Vander Haagen (2009) reported the same period but with an amplitude of 0.55 mag.

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