LIGHTCURVE ANALYSIS OF TEN ASTEROIDS

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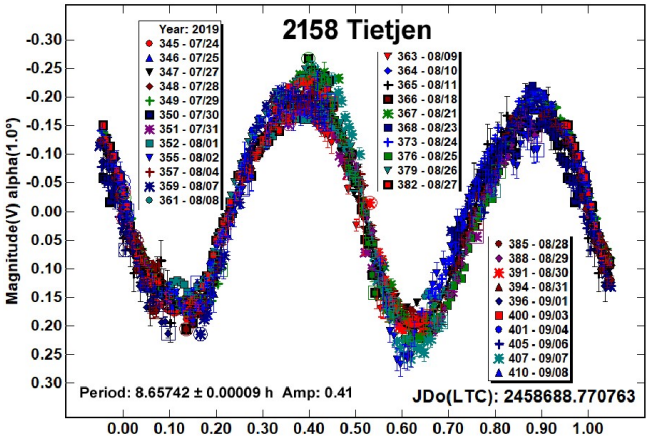
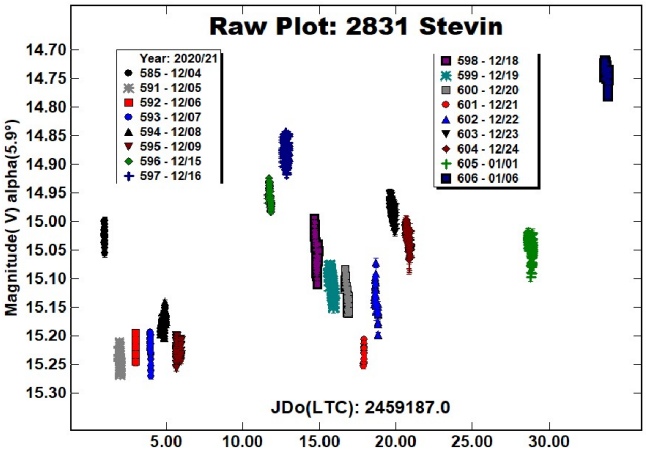
Lightcurves for ten main-belt asteroids were obtained at the Barnes Ridge Observatory from 2019 July 24 through 2020 November 05. Synodic rotation periods and amplitudes are found for nine of the ten main-belt asteroids. Their synodic rotation periods and lightcurve amplitudes are: 2158 Tietjen, 8.65742 h, 0.41 mag; 3313 Mende, 13.3354 h, 0.26 mag; 3989 Odin, 5.3220 h, 0.16 mag; 4021 Dancey, 4.1085 h, 0.15 mag; 4103 Chahine, 104.9519 h, 0.80 mag; 5996 Julioangel, 9.7435 h, 0.26 mag; 7527 Marples, 9.0899 h, 0.49 mag; 9545 Petrovedmosti, 5.6649 h, 0.28 mag; 21242 1995 WZ41, 5.45303 h, 0.43 mag.

Photometric data for nine asteroids were obtained at Barnes Ridge Observatory located in northern California, USA, using a 0.43-m PlaneWave f/6.8 corrected Dall-Kirkham astrograph and Apogee U9 camera. The camera was binned 2×2 with a resulting image scale of 1.26 arcsec per pixel. All image exposures were 210-s taken through a photometric C filter. All images were obtained with *MaxIm DL* V6 driven by *ACP* V8 and analyzed using *MPO Canopus* v10.8.1.1 (Warner, 2019). The *MPO Canopus* Comp Star Selector feature was used to select comparison stars. All comparison stars and asteroid targets had an SNR of at least 100.

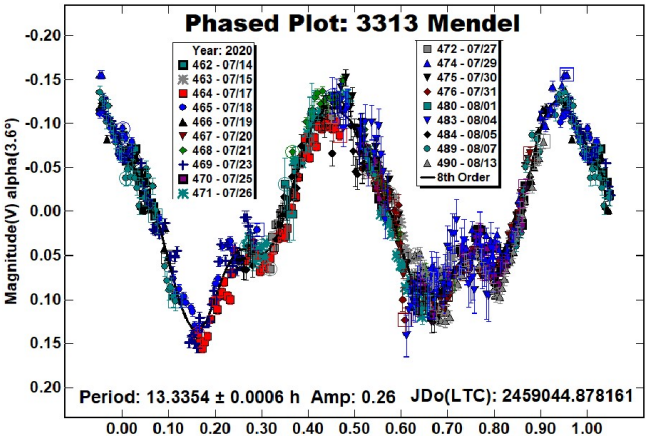
2158 Tietjen. Data were collected from July 24 through September 21 resulting in 36 nights and 1333 data points. 2158 Tietjen was tracked through 163.442 revolutions from phase angles of 0.99 through 20.11 deg. A period of 8.65742 ± 0.00009 h was calculated with a peak-to-peak amplitude of 0.41 ± 0.05 mag. Observations at small phase angles allowed calculation of H-G values of 11.811 ± 0.012 mag and 0.077 ± 0.019 respectively. A search of the Asteroid Lightcurve Database (or other resources) did not find any previously reported results for asteroid 2158.



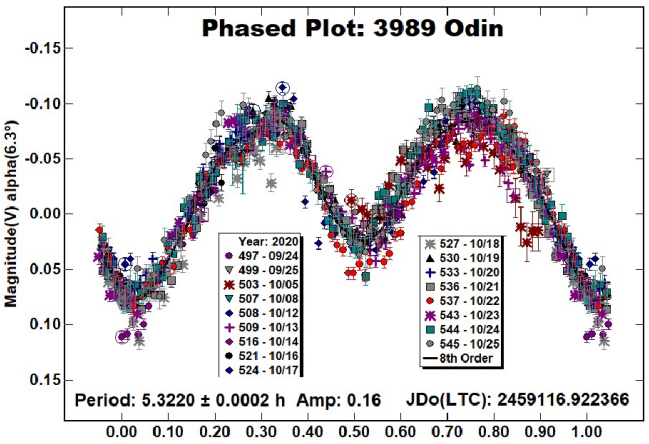
2831 Stevin. Data were collected from December 4 through January 6 2021 resulting in 17 nights and 1006 data points. A period could not be determined since data for all nights lie within ± 0.3 mag of each other. It was felt that adjusting delta comps to try and determine a period was not feasible.



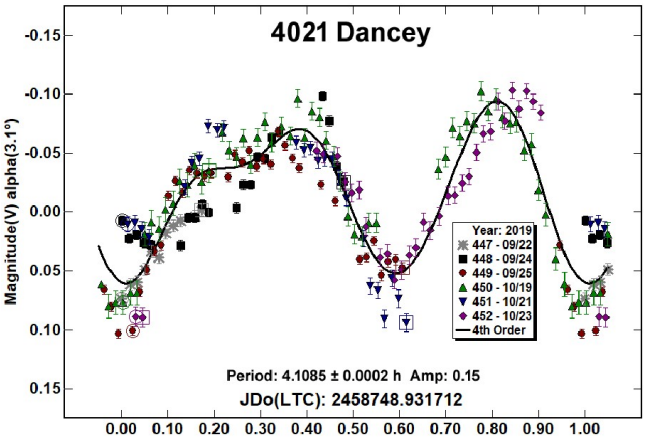
3313 Mendel. Data were collected from July 21 through August 15 2020, resulting in 20 nights and 737 data points. 3313 Mendel was tracked through 57.384 revolutions from phase angles of -3.63 through 13.71 deg. A period of 13.3354 ± 0.0006 h was calculated with a peak-to-peak amplitude of 0.26 ± 0.02 mag. Observations at small phase angles allowed calculation of H-G values of 10.122 ± 0.031 mag and 0.620 ± 0.73 respectively. Data were previously reported by Pal et. al. (2020) with a period of 13.2848 ± 0.0005 h and amplitude of 0.22 ± 0.04 mag.



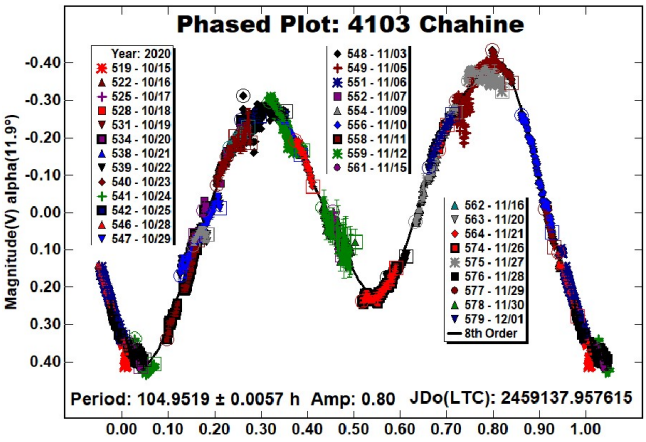
3989 Odin. Data were collected from September 24 through October 25, 2020 resulting in 17 nights and 743 data points. 3989 Odin was tracked through 139.346 revolutions from phase angles of -6.30 through 14.05 deg. A period of 5.3220 ± 0.0003 h was calculated with a peak-to-peak amplitude of 0.16 ± 0.02 mag. Observations at small phase angles allowed calculation of H-G values of 13.219 ± 0.100 mag and 0.545 ± 0.167 respectively. Data were previously reported in the LCDB with a period of 5.3229 ± 0.0002 h and amplitude of 0.16 ± 0.01 mag.



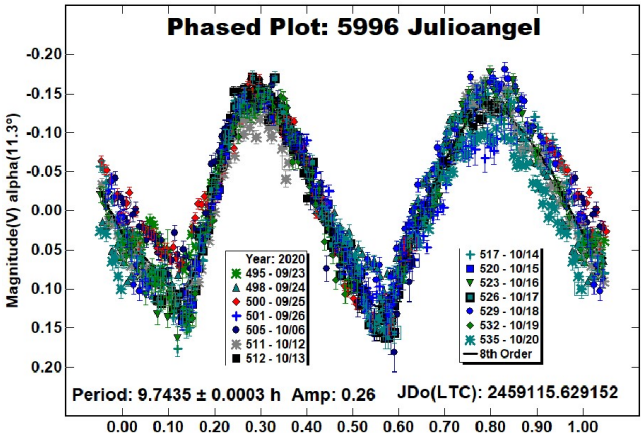
4021 Dancey. Data were collected from September 22 through October 23 2019, resulting in 6 nights and 205 data points. 4021 Dancey was tracked through 180.049 revolutions from phase angles of -3.14 through 17.23 deg. A period of 4.1085 ± 0.0002 h was calculated with a peak-to-peak amplitude of 0.15 ± 0.35 mag. Observations at small phase angles allowed calculation of H-G values of 12.802 ± 0.017 mag and 0.499 ± 0.035 respectively. A search of the Asteroid Lightcurve Database (or other resources) did not find any previously reported results for asteroid 4021.



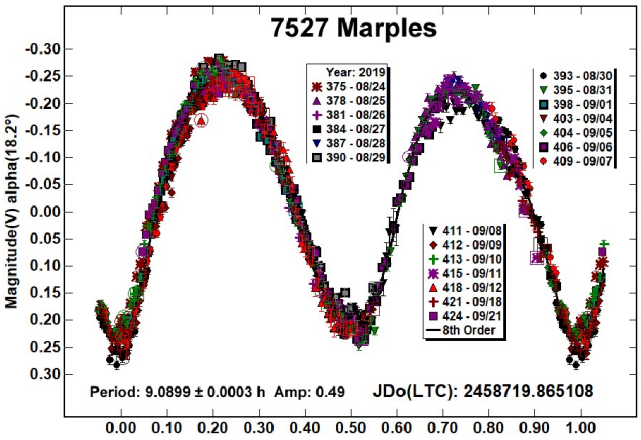
4103 Chahine. Data were collected from October 15 through December 1st 2020 resulting in 30 nights and 2143 data points. 4103 Chahine was tracked through 10.713 revolutions from phase angles of 11.9 through 18.4 deg. A period of 104.9519 ± 0.0057 h was calculated with a peak-to-peak amplitude of 0.80 ± 0.03 mag. Because of the long period only short segments of data were collected each night and it was not possible to derive H-G values. Data were previously reported by Pal et. al. (2020) with a period of 105.161 ± 0.005 h and amplitude of 0.52 ± 0.10 mag.



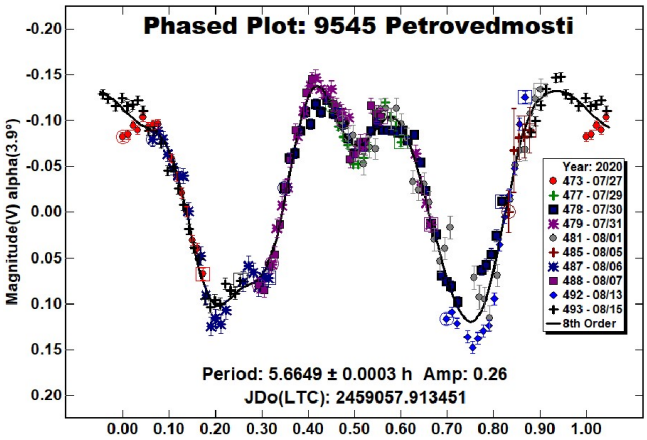
5996 Julioangel. Data were collected from September 23 through October 20 2020, resulting in 14 nights and 1067 data points. 5996 Julioangel was tracked through 67.001 revolutions from phase angles of 11.35 through 20.03 deg. A period of 9.7435 ± 0.0003 h was calculated with a peak-to-peak amplitude of 0.26 ± 0.02 mag. Since observations were started at a phase angle of greater than seven deg. a value of 0.150 was used for H-G calculation resulting in a value for H of 10.329 ± 0.157 mag. Data were previously reported by Durkee (2018) with a period of 9.74 ± 0.01 h and an amplitude of 0.34 ± 0.07 mag.



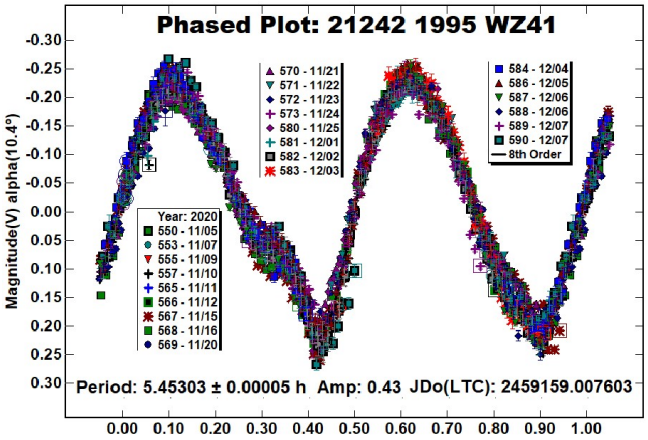
7527 Marples. Data were collected from August 24 through September 21 2019 resulting in 20 nights and 843 data points. 7527 Marples was tracked through 74.225 revolutions from phase angles of -18.9 through -3.95 deg. A period of 9.0899 ± 0.0003 h was calculated with a peak-to-peak amplitude of 0.49 ± 0.03 mag. Observations at small phase angles allowed calculation of H-G values of 14.615 ± 0.077 mag and 0.259 ± 0.088 respectively. Data were previously reported by Benishek (2020) with a period of 9.098 ± 0.004 h and amplitude of 0.54 ± 0.02 mag.



9545 Petrovedomosti. Data were collected from July 27 through August 15 2020, resulting in 10 nights and 215 data points. 9545 Petrovedomosti was tracked through 80.254 revolutions from phase angles of 3.91 through 10.91 deg. A period of 5.6649 ± 0.0003 h was calculated with a peak-to-peak amplitude of 0.28 ± 0.03 mag. Observations at small phase angles allowed calculation of H-G values of 12.185± 0.067 mag and 0.406 ± 0.138 respectively. A search of the Asteroid Lightcurve Database (and other resources) did not find any previously reported results for asteroid 9545.



21242 1995 WZ41. Data were collected from November 5 through December 7 2020, resulting in 15 nights and 1014 data points. 21242 1995 WZ41 was tracked through 140.572 revolutions from phase angles of -10.45 through 6.00 deg. A period of 5.45303 ± 0.00005 h was calculated with a peak-to-peak amplitude of 0.43 ± 0.03 mag. Observations at small phase angles allowed calculation of H-G values of 13.469 ± 0.066 mag and 0.870 ± 0.203 respectively. A search of the Asteroid Lightcurve Database (and other resources) did not find any previously reported results for asteroid 21242.



Acknowledgements

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LCDB: *http://www.minorplanet.info/lightcurvedatabase.html*

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Number	Name	yyyy mm/dd	Phase	L_{PAB}	B_{PAB}	Period(h)	P.E.	Amp	A.E.
2158	Tietjen	2019 07/24-09/22	0.99,20.11	303.35	1.65	8.65742	0.00009	0.40	0.05
2831	Stevin	2020 12/04-2021 01/06		82.65	0.25				
3313	Mendel	2020 07/14-08/15	-3.63,13.71	295.75	6.80	13.3354	0.0006	0.26	0.02
3989	Odin	2020 09/24-10/25	-6.30,14.05	11.05	3.80	5.3220	0.0003	0.16	0.02
4021	Dancey	2019 09/22-10/23	-3.14,17.23	1.85	-3.65	4.1085	0.0002	0.15	0.02
4103	Chahine	2020 10/15-12/01		39.95	12.40	104.9519	0.0057	0.80	0.02
5996	Julioangel	2020 09/23-10/20	11.35,20.03	344.60	12.85	9.7435	0.0003	0.26	0.02
7527	Marples	2019 08/24-09/21	-18.19,-3.95	358.15	3.85	9.0899	0.0003	0.49	0.03
9545	Petrovedomosti	2020 07/27-08/15	3.91,10.91	305.85	4.65	5.6649	0.0003	0.28	0.02
21242	1995 WZ41	2020 11/05-12/07	-10.45,6.00	56.75	-0.40	5.4530	0.00005	0.43	0.02

Table I. Observing circumstances and results. The phase angle is given for the first and last date. If preceded by an asterisk, the phase angle reached an extrema during the period. L_{PAB} and B_{PAB} are the approximate phase angle bisector longitude/latitude at mid-date range (see Harris et al., 1984).