

**LIGHTCURVES OF 153 HILDA
AT LARGE PHASE ANGLES**

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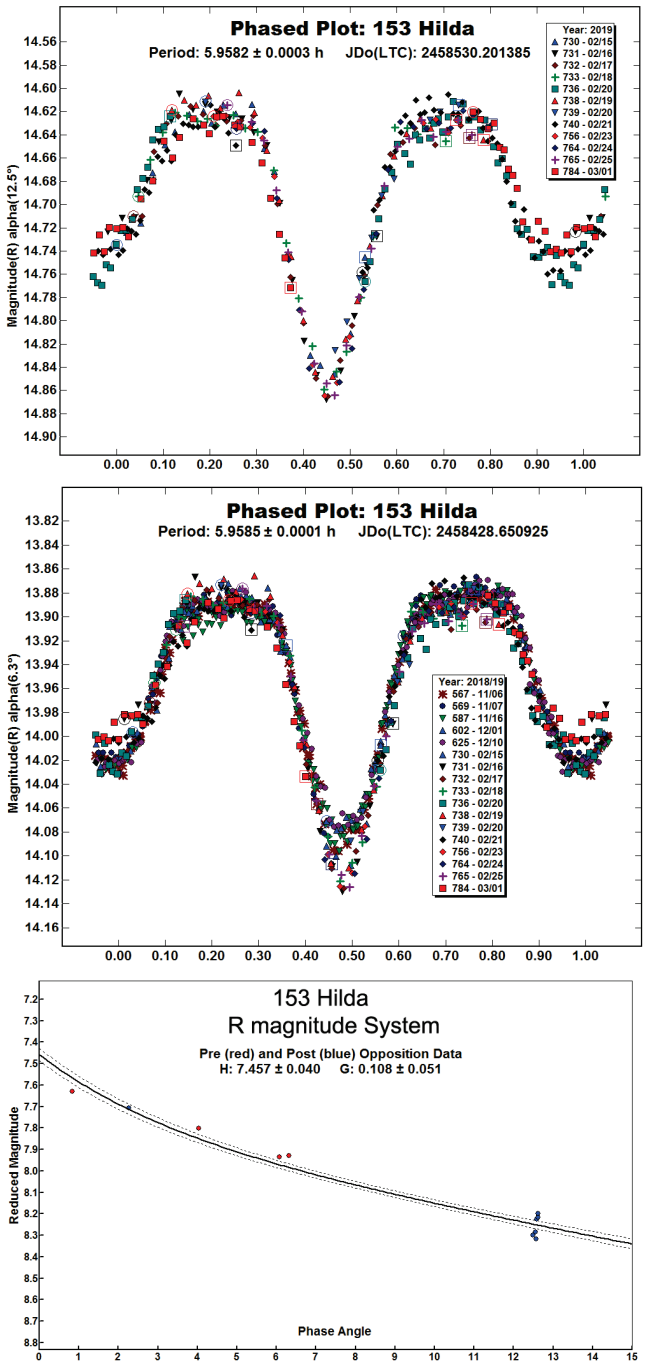
At phase angle 12.5 degrees the synodic rotation period and amplitude of 153 Hilda are 5.9582 ± 0.0003 hours, 0.23 ± 0.02 magnitudes, respectively. An H-G plot in the R magnitude system is also presented with $H_R = 7.457 \pm 0.040$ and $G_R = 0.108 \pm 0.051$. Using an assumed V-R = 0.376 gives $H = 7.833$ with $G = 0.108$.

More than two months after opposition the Hilda-type asteroid 153 Hilda, $a = 3.9$ AU, is at nearly its largest possible phase angle near 12.6 degrees. It could be observed at any one location less than four hours between the end of nautical twilight and declining to low altitude. The two observers, separated by about 8 hours in longitude, collaborated to obtain full phase coverage of the 5.958-hour rotational cycle. Pilcher at the Organ Mesa Observatory used a 0.35-meter $f/10$ Meade LX200 GPS Schmidt-Cassegrain (SCT), SBIG STL-1001E CCD, 60 second exposures, unguided, with a clear filter. Benishek at Sopot Observatory used a 0.35-meter $f/6.3$ Meade LX200 GPS SCT, SBIG ST-10XME CCD, 180 to 240 second exposures, unguided and unfiltered, Photometric measurement and lightcurve construction was done with *MPO Canopus* software. This software identifies stars with near solar colors from the Carlsberg Meridian Catalog 15 (CMC15) and converts the Sloan r' magnitudes to Johnson R magnitudes by $R = r' - 0.22$ (Dymock and Miles 2009). All lightcurves by both observers were plotted in the R magnitude system. Data points were binned in sets of 3 with a maximum time difference of 5 minutes to reduce the number of points in the lightcurve and make the lightcurves easier to read.

Pilcher (2019 and references therein, most with periods near 5.957 hours) observed 153 Hilda near opposition in late 2018, at much smaller phase angle. The year 2018 lightcurve was previously published Pilcher (2019) and is republished here. New observations on 12 nights between 2019 Feb 15 and Mar 1 provide a good fit to an almost identical rotation period of 5.9582 ± 0.0003 h but the amplitude increased to 0.23 ± 0.02 mag. A lightcurve based on all observations between 2018 Nov 6 and 2019 Mar 1 fit a period of 5.9585 ± 0.0001 h.

The range of phase angles covered by observations between 2018 Nov 6 and 2019 Mar 1, 0.8 to 12.6 degrees, is nearly the largest possible for a Hilda-type asteroid. For each session, the magnitude at mid-light, half way between maximum and minimum, was used

to construct an H-G plot. The mid-light H-G plot is in the R rather than the standard V magnitude system. We find $H_R = 7.457 \pm 0.040$ and $G_R = 0.108 \pm 0.051$. Dandy et al. (2003) suggest V-R = 0.376 as an acceptable value of V-R for D/P taxonomic class asteroids. Applying this value to our H_R yields $H = 7.833$. The values in MPCORB (2019) are $H = 7.48$, $G = 0.15$.



Number	Name	yyyy/mm/dd	Pts	Phase	L _{PAB}	B _{PAB}	Period(h)	P.E	Amp	A.E
153	Hilda	2018/11/06-12/10	1840	6.3, 0.8, 2.3	70	-3	5.9586	0.00010	0.20	0.02
153	Hilda	2019/02/15-03/01	874	12.5, 12.6	71	-4	5.9582	0.0003	0.23	0.02

Table I. Observing circumstances and results. Pts is the number of data points. The phase angle is given for the first date, minimum value reached, and last date. LPAB and BPAB are the approximate phase angle bisector longitude and latitude at mid-date range (see Harris et al., 1984).

Acknowledgements

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LOW PHASE ANGLE OBSERVATIONS OF
ASTEROID 291 ALICE

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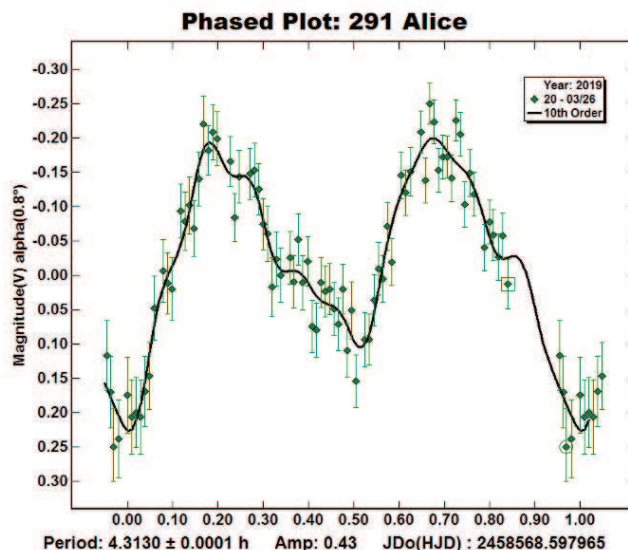
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A low phase angle lightcurve of Flora family asteroid 291 Alice was obtained at Shadowbox Observatory (H60) on 2019-03-26 UT. Period results are consistent with previous observations, $P = 4.313$ h. Phase angle was 0.8 degrees.

Flora family asteroid 291 Alice has been the subject of many investigations including Behrend (1983, 2009, 2015), Binzel and Mullholland (1983), Hanus et al. (2001), Kryszczyńska et al. (1996 and 2012), Lagerkvist (1976), Masiero et al. (2012), Oey (2006), Piironen et al. (1998), Ruthroff (2009), Tedesco et al. (2004), Usui et al. (2011), Veres et al. (2015). This paper concerns observations by the author on 2019-03-06 UT. Observations were made with a 0.3-m Schmidt-Cassegrain (SCT) operating at f/5 on a fork mount. Images were taken through a Johnson V-band filter. The camera was a SBIG STT-1603, binned 2x2 and working at an image scale of 2.18 arcseconds/pixel. Integration time for each image was 120 seconds and camera temperature -25 C.

The low altitude of the target and light interference from ground sources resulted in rather noisy data. SNR never rose above 45.

Images were reduced with dark and flat frames. MPO Canopus 10.7.11.1 was used for differential photometry and period analysis (See Ruthroff, 2010, for technique details). All companion star V-R magnitudes were in the range of 0.4 to 0.7 (Warner 2006).



Number	Name	2019 mm/dd	Pts	Phase	L_{PAB}	B_{PAB}	Period(h)	P.E.	Amp	A.E.	Grp
291	Alice	03/26	79	0.8	184.2	1.0	4.313	0.0001	0.50	0.05	FLOR

Table I. Observing circumstances and results. Pts is the number of data points. The phase angle is given for the first and last date. L_{PAB} and B_{PAB} are the approximate phase angle bisector longitude and latitude at mid-date range (see Harris *et al.*, 1984). Grp is the asteroid family/group (Warner *et al.*, 2009).