

Number	Name	yyyy/mm/dd	Phase	L _{PAB}	B _{PAB}	Period(h)	P.E	Amp	A.E.
470	Kilia	2019/10/27-2020/04/02	* 22.6, 18.3	152	-5	296.2	2.0	0.30	0.05

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

The authors thank Lorenzo Franco for constructing an H-G plot for maximum, mean, and minimum light. The R magnitudes in the data were converted to the V magnitude system by the aforementioned V-R=0.51. The H-G plotting subroutine of MPO Canopus was used to find separate plots at maximum light, mean light, and minimum light. These plots were combined on a spreadsheet showing, at mean light $H=10.25\pm0.05$, $G=0.23\pm0.05$; at maximum light $H=10.19\pm0.03$, $G=0.26\pm0.03$; at minimum light $H=10.32\pm0.03$, $G=0.20\pm0.03$.

MPO Canopus V.10.7 (Warner, 2016) contains a subroutine by which the default $G=0.150$ can be changed for all sessions. The value of G is changed to 0.23 to produce the phased lightcurve for all 94 sessions that is included in this paper. This lightcurve has best fit to a period 296.0 ± 0.1 hours and amplitude 0.30 ± 0.05 magnitudes. Most of the scatter in the lightcurve is due to tumbling, as explained in the next paragraph.

Petr Pravec (personal communication) used simultaneous dual-period software to search for evidence of tumbling. The main period is well established: 296.2 h (realistic error 2 h). The MPO Canopus result, shown in the lightcurve, is 296.0 ± 0.1 hours. The 0.1-hour formal error is unrealistically small. For this paper we adopt the value of 296.2 ± 2 hours. Tumbling was confirmed, but as for the second period, unfortunately it appears commensurate with the main period, so its solution is not unique. One candidate period is 119.3 h (which is near 2/5 commensurate with the main period). But the fit is not robust, as no higher than the 2nd order Fourier series can be meaningfully fitted to the data because of the period commensurability.

We conclude that the synodic rotation period of 470 Kilia is 296.2 ± 2 hours, an amplitude of 0.30 ± 0.05 magnitudes, with confirmed evidence of tumbling. We also find the photometric color index V-R=0.51, and in the V photometric system $H=10.32 \pm 0.05$ and $G=0.23 \pm 0.05$ at mid-light.

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