ROTATION PERIOD DETERMINATION FOR 449 HAMBURGA

Frederick Pilcher
Organ Mesa Observatory (G50)
4438 Organ Mesa Loop
Las Cruces, NM 88011 USA
fpilcher35@gmail.com

Lorenzo Franco
Balzaretto Observatory (A81)
Rome, ITALY

Alessandro Marchini
Astronomical Observatory (K54)
DSFTA, University of Siena
Via Roma, 56
53100 – Siena, ITALY

(Received: 2019 Feb 21)

Twenty-three sessions on 449 Hamburga 2018 Dec. 3 – 2019 Feb. 12 provide a good fit to a synodic rotation period of 36.516 ± 0.001 hours with amplitude 0.06 ± 0.01 magnitudes and three unequal maxima and minima per rotational cycle.

Author Pilcher at the Organ Mesa Observatory used a 0.35-meter Meade LX200 GPS Schmidt-Cassegrain (SCT), SBIG STL-1001E CCD, and clear filter. Author Marchini at the Astronomical Observatory of the University of Siena used a 0.30 meter MCT telescope, SBIG STL-6303e CCD, binned 2x2, and R filter. Both observers measured their images and constructed lightcurves with *MPO Canopus* software and calibration star magnitudes from the Carlsberg Meridian Circle 15 (CMC 15) catalog. To reduce the large number of data points on the lightcurve and make them easier to read, they have been binned in sets of 3 with a maximum time difference of 5 minutes.

Two previously published periods found for 449 Hamburga are by Brinsfield (2010), 18.263 hours; and by Behrend (2011), 18.145 hours, both with bimodal lightcurves containing some gaps. A more comprehensive observation campaign was initiated by first author Pilcher and later joined by Marchini. They were able to fit their data to a lightcurve with period 36.516 ± 0.001 hours, amplitude 0.06 ± 0.01 magnitudes, with three unequal maxima and minima per rotational cycle. This period is twice as great as the periods found by Brinsfield (2009) and by Behrend (2011). A period spectrum between 16 hours and 56 hours is also provided and shows that a period near 18.2 hours can be definitively rejected.

After first author Pilcher had made the first 14 sessions, he sent the data to Petr Pravec for independent analysis. Pravec found a suggestion of very low amplitude tumbling behavior and recommended that additional observations be made from Europe. Lorenzo Franco requested Alessandro Marchini to obtain additional sessions and thereafter led the collaboration. Marchini kindly provided data for sessions 709, 710, 715, 719, and 723 as plotted on the lightcurve. All other sessions are by Pilcher.

After all 23 sessions had been completed, Pravec again examined the data and found no strong evidence for tumbling exceeding 0.02 magnitudes. The authors believe that tumbling is very unlikely. For an object as large as 449 Hamburga, whose diameter is about 80 kilometers, and rotation period as short as 36.5 hours, the time for expected for tumbling to decay to principal axis rotation is short compared with the age of the solar system.

Acknowledgment

The authors thank Petr Pravec for independent analyses of the data.

References

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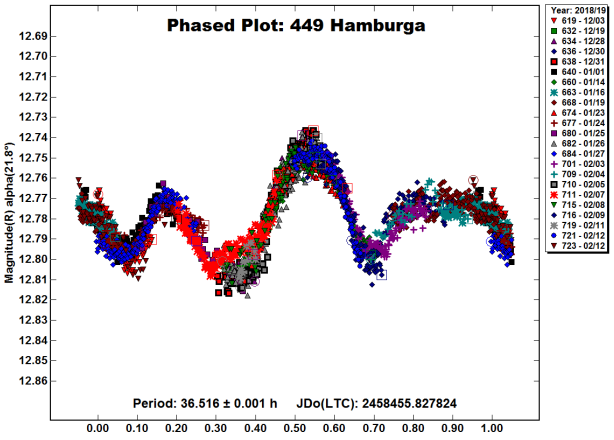

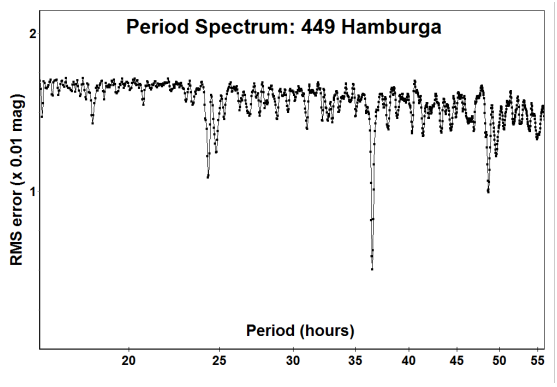

Number	Name	yyyy/mm/dd	Pts	Phase	LPAB	BPAB	Period(h)	P.E	Amp	A.E.
449	Hamburga	2018/12/03-2019/02/12	6728	21.8, 1.6, 13.2	119	2	36.516	0.001	0.06	0.01

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).