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357 NININA AND 748 SIMEISA – TWO ASTEROIDS WITH EARTH COMMENSURATE ROTATION PERIODS

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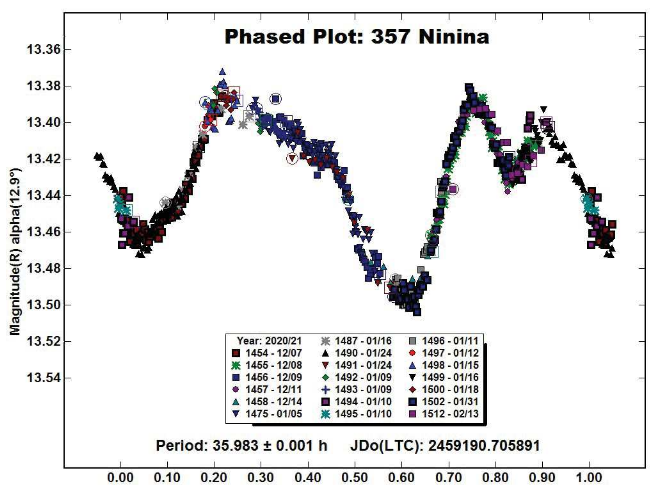
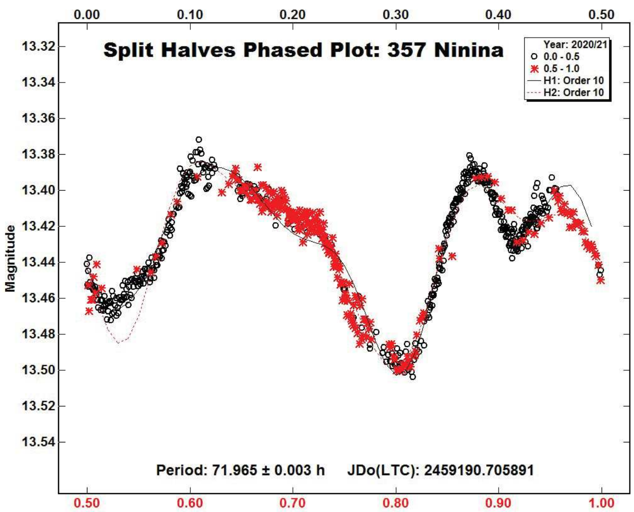
A global collaboration of observers from Australia, Europe, and North America found synodic rotation periods and amplitudes for 357 Ninina 35.983 ± 0.001 h, 0.11 ± 0.01 magnitudes; 748 Simeisa 11.903 ± 0.001 h, 0.08 ± 0.01 magnitudes.

Observations to produce the results reported in this paper have been contributed by Frederick Pilcher in the USA, Lorenzo Franco and Alessandro Marchini in Italy, and Julian Oey in Australia. Equipment details are on Table II. Image photometric measurement and lightcurve construction were done by *MPO Canopus* software. To reduce the number of data points on the lightcurves and make them easier to read, data points have been binned in sets of 5 with maximum time difference 10 minutes.

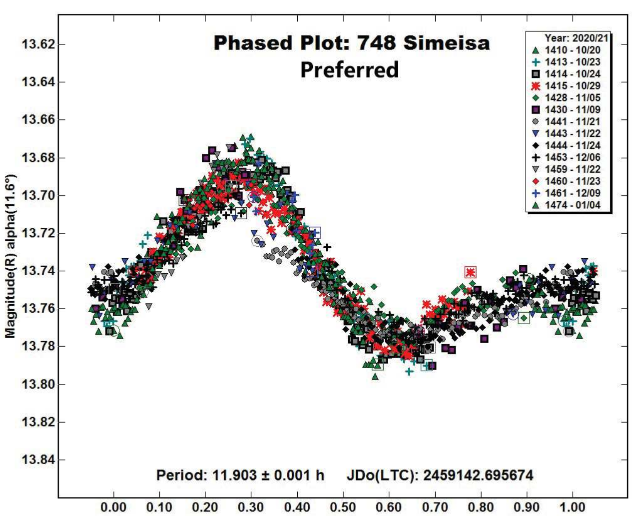
357 Ninina. Previously published rotation periods for 357 Ninina are by Tedesco (1979), > 20 h; Behrend (2005), 35.98h; Oey (2014), 35.9 h in year 2007 observations and 36.0105 h in year 2013 observations. Twenty sessions of new observations 2020 Dec. 7 - 2021 Feb. 13 provide a good fit to a period of 35.983 ± 0.001 h, amplitude 0.11 ± 0.01 magnitudes.

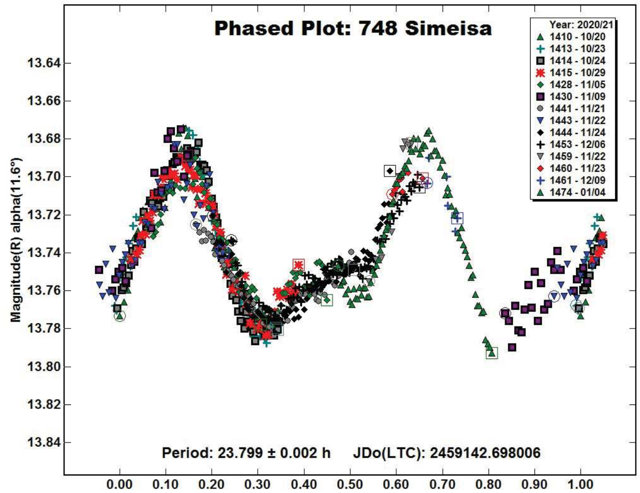


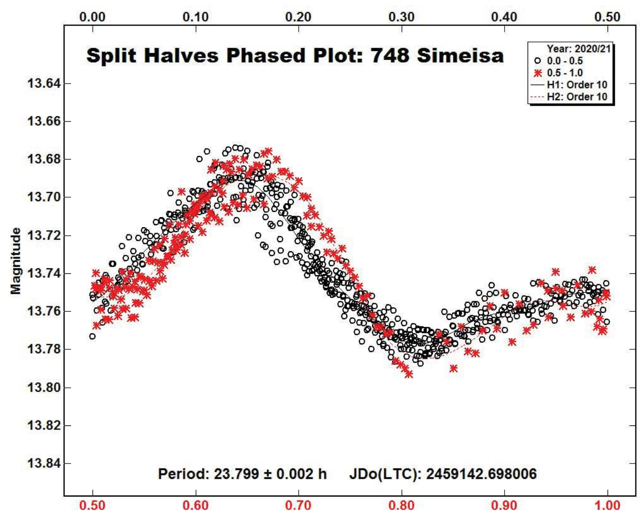
A split-halves plot of the double period is shown. About 90% of both halves of the double period are covered by the data. The segments covered by both halves of the split halves plot are nearly identical. The new result is compatible with previous determinations.



748 Simeisa. This object is a Hilda-type asteroid with orbit in the 3:2 resonance with Jupiter. Previously published rotation periods and amplitudes for 748 Simeisa are by Behrend (2011), 2011 Oct. 4-14, 11.919 h, 0.36 magnitudes, celestial longitude 345º; and Dahlgren et al. (1998), 1995 Aug 31-Sept. 2, 11.88 h, >0.22 magnitudes, celestial longitude 327º. Both observations sets were from a single observatory and show only about 8 hours, or 2/3 phase coverage. Being obtained at similar celestial longitudes, both published lightcurves show a single double-humped maximum rising about 0.2 magnitudes above nearly equal minima about 6 hours apart and a rise toward a second and perhaps higher maximum in the missing segment of the lightcurve. Warner and Stephens (2021) with data obtained at the same opposition as the data used in this paper, 2020 Oct. 30-Nov. 12, 23.633h, 0.10 magnitudes, with nearly 12 hours of their 23.633-hour lightcurve covered.







The authors of this paper obtained fourteen sessions of new observations 2020 Oct. 20 - 2021 Jan. 4 from their respective widely separated longitudes. Our data provide equally good fits to periods of 11.903 ± 0.001 hours with one maximum and minima per rotational cycle and 23.799 ± 0.002 hours with two symmetric maxima and minima, both with full phase coverage and amplitude 0.08 ± 0.01 magnitudes.

A split-halves plot of the double period shows that the two halves of the double period are nearly identical. Careful inspection of the split halves lightcurve shows that the segment between phases 0.7 and 0.8, obtained 2021 Jan. 4 at phase angle 12.6º, is slightly higher than the segments between phases 0.2 and 0.3 obtained more than one month earlier at smaller phase angles. We believe that the small discrepancy is caused by a change of lightcurve shape with changing phase angle, observed in many asteroids, and is not an indication that the double period is correct. It commonly occurs that asteroids with bimodal lightcurves at near equatorial aspect show only one maximum and minimum at a near polar aspect. Comparison of the large amplitudes found in apparently bimodal lightcurves at celestial longitudes 327º and 345º, respectively, with the much smaller amplitude of the current observations near celestial longitude 63º, suggests that our observations are within 20º to 25º of polar aspect.

Number	Name	yyyy/mm/dd	Phase	L_{PAB}	B_{PAB}	Period(h)	P.E	Amp	A.E.
357	Ninina	2020/12/07-2021/02/13	*12.9,11.6	112	-8	35.983	0.001	0.11	0.01
748	Simeisa	2020/10/20-2021/01/04	*11.6,12.6	63	1	11.903	0.001	0.08	0.01

Table I. Observing circumstances and results. The phase angle is given for the first and last date, where the * indicates that minimum phase angle occurred between these dates. L_{PAB} and B_{PAB} are the approximate phase angle bisector longitude and latitude at mid-date range (see Harris *et al.*, 1984).

Observer Observatory (MPC code)	Telescope	CCD	Filter	Observed Asteroids
Frederick Pilcher Organ Mesa Observatory (G50)	0.35-m SCT f/10.0	SBIG STL-1001E	C	357,748
Lorenzo Franco Balzaretto Observatory (A81)	0.20-m SCT f/5.0	SBIG ST7-XME	R	357,748
Alessandro Marchini Astronomical Observatory of the University of Siena(K54)	0.30-m MCT f/5.6	SBIG STL-6303e (bin 2x2)	R	357
Julian Oey Blue Mountains Observatory (Q68)	0.35-m SCT Edge f/7.0 0.35-m SCT f/5.9	SBIG STF-1603W SBIG ST-8XME	C	357,748

Table II. Observing equipment. MCT: Maksutov-Cassegrain, SCT: Schmidt-Cassegrain.

Like the authors of this paper, Warner and Stephens (2021) have published lightcurves for periods near both 12 hours and 24 hours. Their 12-hour lightcurve has a considerably different shape from ours despite having been obtained in the same time frame and leads them to favor the longer period. We are unable to explain the difference in the lightcurves. We invite interested readers to peruse the Warner and Stephens paper and evaluate the different conclusions of this paper and theirs according to their own good judgments. Following the conclusion of the 2020-2021 observing window for 748 Simeisa, we must conclude that the period remains ambiguous. The next opposition of 748 Simeisa occurs in 2022 February near declination +12º. Based on the lightcurves of Behrend (2011) and Dahlgren et al. (1995), a much larger amplitude is expected and globally distributed observations should resolve the ambiguity definitively.

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