

ROTATIONAL PERIODS AND LIGHTCURVE PHOTOMETRY OF 322 PHAEO AND 472 ROMA

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Lightcurves for two asteroids were automatically measured at the Crescent Butte Observatory from July through September 2002. The rotation period and lightcurve amplitude results are as follows: 322 Phaео: 17.5845 ± 0.0001 h and 0.15 ± 0.03 m. (Red filter) 472 Roma: 9.8007 ± 0.0009 h and 0.4 ± 0.05 m. (Unfiltered)

Observations reported here were obtained at Crescent Butte Observatory, (MPC Code 682) as described by Sheridan (2002). The observatory utilizes a 14-inch f/11 SCT and operates automatically using Brian Warner's MPO Connections software. Targets were selected from the "Minor planet Lightcurve Parameters" (Harris 2001). Asteroids were chosen that were listed as having reliability less than three, and were located far enough north for the maximum coverage time during the nightly run. In an effort to avoid duplicating the work of other observatories, selected targets were crosschecked in the "CALL" "Submitted Light Curve Page" (Warner 2001). The raw images were calibrated with dark frames and flat fields using software Bisque "CCDSOft" program. Differential photometry was applied using Brian Warner's MPO Canopus software in conjunction with the USNO-A2.0 star catalogue.

322 Phaео

This main-belt asteroid was discovered on Nov. 27, 1891 by A. Borrelly. Previous lightcurve information was found for this object. The information in "Known Light Curve Parameters" (Harris 2001) indicates that C. Lagerkvist did photometry work on this asteroid, but was unable to obtain a complete lightcurve. Crescent Butte Observatory took 597 red filtered images of this object from Sept. 16, 2002 through Sept. 24, 2002. The results shown in Figure 1 reveal the complete lightcurve with a period of 17.5845 ± 0.0001 h with an amplitude of 0.15 ± 0.02 m. Colin Bembrick of Bathurst, New South Wales, Australia did send me data from unfiltered images of this asteroid taken on September,

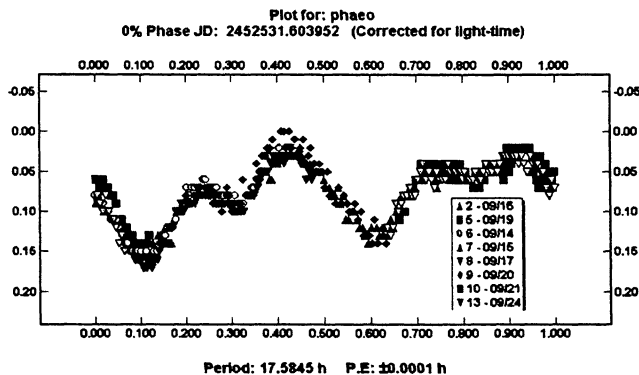


Figure 1: Lightcurve of 322 Phaео based upon a derived period of 17.5845 ± 0.0001 hours.

22, 25, and 29, 2002. Since I had a complete lightcurve I did not include his data.

472 Roma

This main-belt asteroid was discovered on July 11, 1901 by L. Carnera. Previous lightcurve information was found for this object. The information in "Known Lightcurve Parameters" (Harris 2001) indicates that C. A. Angeli did photometry work on this asteroid, but was not able to obtain a complete lightcurve. Crescent Butte Observatory took 491 unfiltered images of this object over five sessions from July 07, 2002 through July 13, 2002. The results shown in Figure 2 reveal the lightcurve with a period of 9.8007 ± 0.0009 h and an amplitude of 0.4 ± 0.04 m.

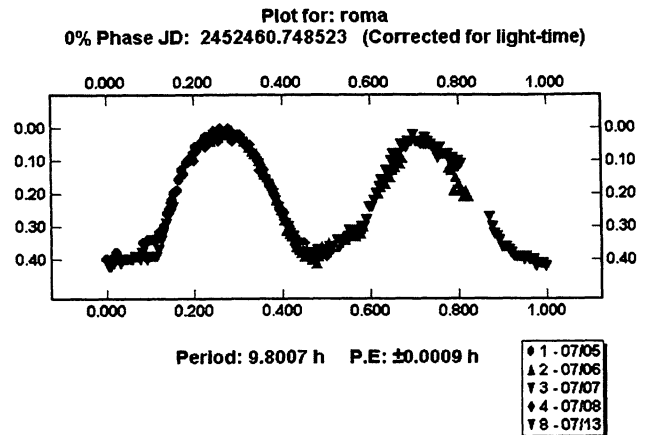


Figure 2: Lightcurve of 472 Roma based upon a derived period of 9.8007 ± 0.0009 hours.

Acknowledgments

I wish to thank Brian Warner, not only for the time and effort he has invested in the development of the MPO Canopus and Connections software, but also for the guidance and advice he has so graciously given me. I would also thank Jerry Foote, of Scopecraft, Inc. for his development of the Winscope software and for building the high quality fork mount for my 14 inch SCT.

References

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ROTATION PERIOD AND SPIN DIRECTION OF NEAR-EARTH ASTEROID (35396) 1997 XF11

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We measured rotation lightcurves of (35396) 1997 XF11 on five nights over a four-week interval during its exceptionally bright 2002 apparition. From our data we derive a synodic rotation period of 3.2566 ± 0.0002 hours near epoch UT 2002 Nov. 22. The synodic period systematically decreased as the asteroid's apparent west-to-east motion slowed, which suggests a prograde sense of rotation.

Introduction

Near-Earth asteroid (35396) 1997 XF11 was discovered in 1997 December (Sugie et al. 1997) and had remained fainter than V mag. 18 since then until its predicted brightening to V mag. 13.4 in 2002 autumn. It won't reach this brightness again until 2028.

In 1998 March, then-unnumbered 1997 XF11 made headlines in the popular media after some interpretations of preliminary calculations of its orbit suggested that it could collide with Earth in 2028. Disagreement among researchers about how close it was likely to pass to Earth and how to characterize the uncertainties involved (Marsden 1999, Chodas and Yeomans 1999, Milani and Valsecchi 1999, Yeomans et al. 1998, Helin et al. 1998, Scotti and Shelus 1998), and how best to communicate such information to the media, led to confusion and sensationalism. The incident raised important issues about impact risk assessment, including how best to balance the interests of scientific research with those of journalism.

Observations

Our observations of (35396) were made on five nights during 2002 November and December at the Whitin Observatory at Wellesley College in Wellesley, MA. We imaged the asteroid and nearby comparison stars through a V filter using a 1024-pixel square CCD detector mounted at the Cassegrain focus of the 0.61-m Sawyer telescope. Focal reduction optics were used to give a field size 16 arcminutes square and an unbinned image scale of 0.9 arcsecond per pixel. Most of the observations were made during clear to mostly clear observing conditions, except for those from Nov. 15 which were limited by gradually thickening clouds. Additional information about the observations is given in Table I.

The IRAF software application packages were used for image processing and synthetic aperture photometry (Massey 1997, Massey and Davis 1992). Error bars representing the one-sigma uncertainty of lightcurve data with respect to its comparison star were estimated using on-chip field stars of similar brightness to the asteroid. Differential brightnesses of the asteroid measured from three of the images recorded on Nov. 15 were very sensitive to small changes in the synthetic aperture size chosen; these

Table I: Observing circumstances. Given for each individual lightcurve are the UT date, predicted mean V magnitude of (35396), exposure time used for individual images, binning used for CCD readout, telescope tracking rate, and observers.

UT Date	Mean V	Exp. (s)	CCD binning	Track rate	Observer(s)
Nov 08	+13.7	15	1×1	sidereal	Bowsher, Chang
Nov 15	+14.5	15–45	"	"	"
Nov 24	+15.5	60	"	"	"
Dec 04	+16.4	120	2×2	"	Slivan, Bowsher
Dec 07	+16.7	120	"	asteroid	Slivan

measurements are unreliable and have been excluded from further analysis.

Determination of Rotation Period and Spin Direction

Prior to determination of the rotation period, the effect of the changing distance to the asteroid during the span of the observations was removed from the individual lightcurves by antedating the data times of mid-exposure for the light-travel time to Earth. The adjusted mid-times represent the times when the light left the asteroid.

The lightcurve data recorded on Nov. 24 span two complete rotations, which constrain the period to be between 3.23 and 3.33 hours. To further refine the period we fit a 4th-order Fourier series simultaneously to all five nights of data, "scanning" the range of possible periods, and we found that only periods near 3.257 hours yield self-consistent composite lightcurves. The uncertainty in the best-fit period 3.2566 ± 0.0002 hours was estimated by adjusting the period upward and downward until the overlapping data from Nov. 8 and Dec. 7 were no longer self-consistent within the uncertainties of the individual observations. The composite lightcurve is presented as Figure 1.

As (35396) moved rapidly away from Earth over the span of our observations the speed of its apparent west-to-east motion changed considerably, causing a measurable change in the observed

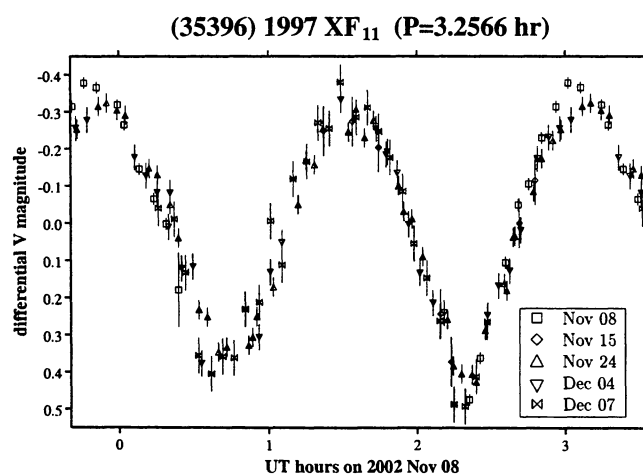


Figure 1: Composite lightcurve of (35396) 1997 XF11 for a rotation period of 3.2566 hours, where the light time-corrected data from each of the five nights have been translated into the plotted time span modulo the period. One rotation period is shown with the earliest and latest 10% of the period span repeated. The error bars shown represent the estimated one-sigma uncertainty with respect to the local comparison star used.