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LIGHTCURVE PHOTOMETRY OF ASTEROID 1059 MUSSORGSKIA

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The minor planet 1059 Mussorgskia has been observed for six nights during its opposition of 2002. Through differential photometric observations, the rotational period was determined to be 5.519 ± 0.002 hours with an amplitude of 0.25 ± 0.05 magnitude.

The observations of 1059 Mussorgskia were made at Flarestar Observatory in San Gwann, Malta from an elevation of 300 feet. Since 1999, Flarestar started operation as Minor Planet Center observatory code 171 and has been performing asteroid astrometry. The observatory operates a 0.25-m. Schmidt-Cassegrain telescope on a computer driven German equatorial mount. For photometry, the telescope is set to operate at an f-ratio of f/2.6 yielding a pixel scale of 2.33 arc seconds per pixel. The imaging CCD camera is a 16-bit Starlight Xpress HX516.

1059 Mussorgskia was selected for observation from a list of lightcurves maintained by Dr. Alan Harris (Harris 2001) and from the Collaborative Asteroid Lightcurve Link (CALL) web site

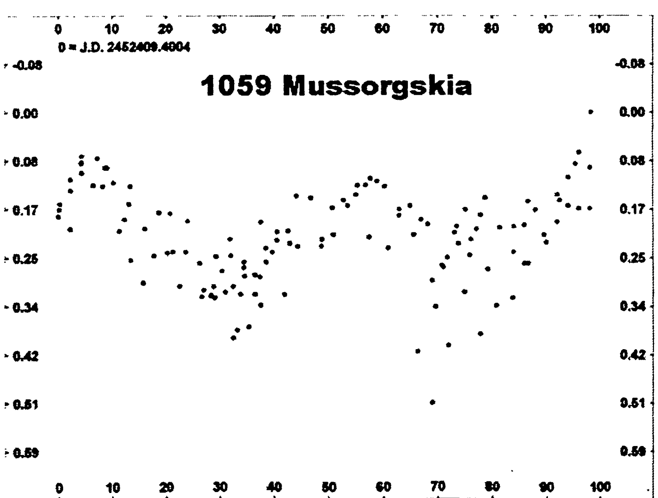

Figure 1. Lightcurve of 1059 Mussorgskia based upon a derived period of 5.519 ± 0.002 h.

"List of Potential Lightcurve Targets" (Warner 2002). Differential photometry was applied using Brian Warner's MPO Canopus software in conjunction with the USNO-SA2.0 star catalog. Lightcurves were also prepared using "Canopus", which is based on the method developed by Dr. Alan Harris (Harris et al., 1989). This program allows compensation for night-to-night comparison star variation by offsetting individual night's magnitude scales to obtain a best fit.

1059 Mussorgskia was discovered July 19, 1925 by V. Albitskij at Simeis. It is estimated that this asteroid is around 47 km. in diameter. Mussorgskia was observed for six nights from 14th. May to 13th. June 2002. During this period, the asteroid's phase angle changed from 8.6 to 10.8 degrees. One hundred forty six images were taken of which nine were not used for the solution. All images were 180 second exposures with an average interval of 240 seconds. Raw images were then calibrated with dark frames and flat fields. Images were unfiltered and times were corrected for light travel from the asteroid to the Earth.

Using Canopus to analyze the data of 1059 Mussorgskia resulted in a synodic rotational period of 5.519 hours with a formal error of ± 0.002 hours, with an amplitude of 0.25 ± 0.05 magnitude.

Acknowledgments

Thanks go to Robert A. Koff for his continuous support and guidance and to Brian Warner for developing the program "Canopus", which made it possible for amateurs to analyze and share lightcurve data.

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PHOTOMETRY OF ASTEROIDS 2962 OTTO AND 3165 MIKAWA

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Two asteroids were observed during October and November of 2001 at the Oakley Observatory (MPC code 916). 2962 Otto was determined to have a period of 2.68 ± 0.01 hours and amplitude of 0.30 ± 0.03 magnitude. The period of 3165 Mikawa was found to be 5.08 ± 0.02 hours and the amplitude was 0.2 ± 0.1 magnitude.

Oakley Observatory is located in Terre Haute, Indiana and has been operational since late 2000. These data sets were taken with 11-inch Celestron Schmidt-Cassegrain telescope with a 110-inch focal length on a Paramount GT-1100 mount. An Apogee AP7 CCD camera set for 120-second exposures accomplished the image acquisition. CCD Soft, developed by Software Bisque, was utilized to dark subtract the images and then flat fields were produced with Diffraction Limited's MaxIm DL. Data analysis and lightcurves were prepared with BDW Publishing's Canopus program.

These asteroids were selected from a database of potential lightcurve targets located on the "CALL" web site (Warner 2001). 3165 Mikawa was named in 1984 after the district in which the discovering installation was located. 2962 Otto was discovered in 1940 and named after the discoverer's great-grandson Otto Oskari Väisälä (Schmadel 1999).

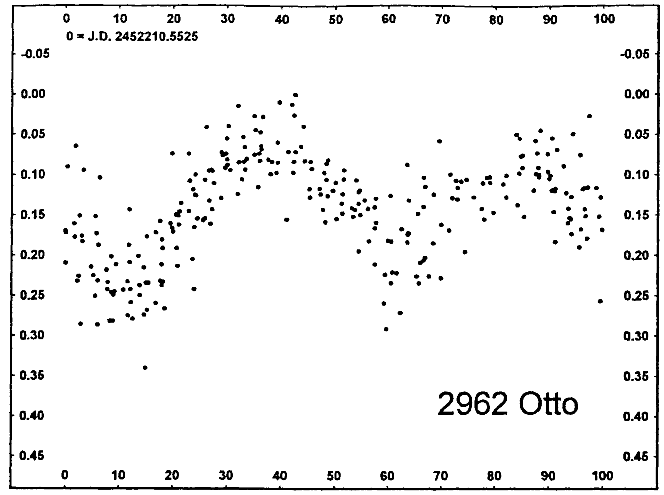

Figure 1. Lightcurve of 2962 Otto based on a period of 2.68 ± 0.01 hours

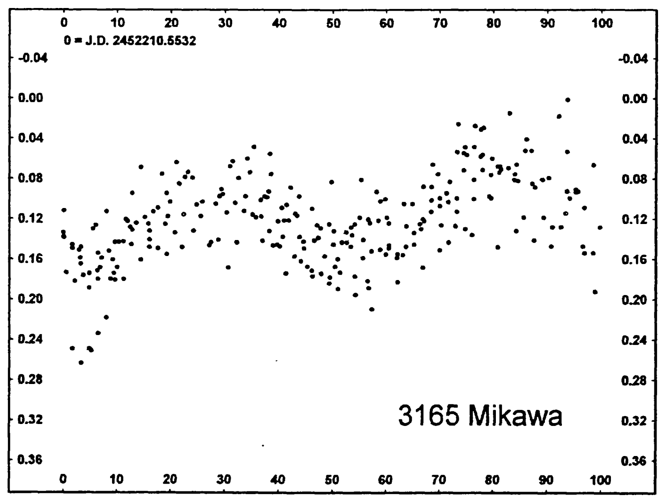

Figure 2. Lightcurve of 3165 Mikawa based on a period of 5.08 ± 0.02 hours.

2962 Otto

Asteroid 2962 Otto was observed in late October early November the nights of the 27th, 2nd, 3rd, and 4th. A total of 356 images were taken, and of this 305 were used. Images were discarded because some images were blurred causing light to fall outside of measurement bounds. It is believed this was caused by perturbations in the telescope mount. The derived period is 2.680 hours and the error determined through Canopus is ± 0.002 hours. This error was not consistent with the noise seen in Figure 1, thus a period search, where the period was changed manually, was performed. From this the derived period is 2.68 hours ± 0.01 hours and amplitude is 0.30 ± 0.03 magnitude.

3164 Mikawa

3164 Mikawa was observed concurrently with 2962 Otto. After data analysis 272 images were used to produce a lightcurve. As in the analysis of Otto some of the images were blurred. From the data the derived period is 5.08 hours ± 0.02 hours with an amplitude of 0.2 ± 0.1 magnitude. The result is shown in Figure 2.

Looking at Figures 1 and 2 it is evident that the data are somewhat noisy, particularly 3164 Mikawa. This is not unexpected as their apparent magnitudes were both close to 14.5. Such a magnitude is at the faint limit for the 11-inch telescope we were using. Trying to clear up some variation we changed to a 15x15-pixel measurement box, but it was not a solution. Future observations will be performed on a 14-inch telescope that will be able to image the asteroids with a favorable S/N ratio. This should also solve the random blurred images as well since a different mount is used. The 14-inch telescope was not used for the observations of Mikawa and Otto as it was already being used for asteroid astrometry on those evenings. As this is the Observatory's first attempt at asteroid photometry we have learned valuable lessons that will improve quality later.

Acknowledgments

Thanks to the designers of "Canopus" which allows lightcurve generation to be an ease, even for beginners.

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ROTATIONAL PERIODS AND LIGHTCURVES OF 1858 LOBACHEVSKIJ, 2384 SCHULHOF, AND (5515) 1989 EL1

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CCD images of asteroid 1858 Lobachevskij recorded in May 2002 revealed a period of 7.00 ± 0.01 h with a lightcurve amplitude of 0.6 mag. Images of asteroids 2384 Schulhof and (5515) 1989 EL1 in March-April 2002 revealed periods of 3.294 ± 0.006 h and 5.230 ± 0.008 h, respectively. Their lightcurve amplitudes were 0.55 mag. and 0.7 mag.

As part of a continuing program of asteroid photometry asteroids 1858 Lobachevskij, 2384 Schulhof and (5515) 1989 EL1 were selected from the "CALL" web site (Warner 2002) for observation at the Oakley Observatory. Our equipment and observational and analysis methods have been described previously (Ditteon, 2002). The only difference between these observations and those previously reported is that we used a 14-inch f/7 Schmidt-Cassegrain telescope in place of the 11-inch telescope.

For asteroid 1859 Lobachevskij, 71 images taken on May 2 and 54 images taken on May 4, 2002 were used in the lightcurve shown in Figure 1. The apparent period is 7.00 ± 0.01 h with an amplitude of 0.6 mag.

For asteroid 2384 Schulhof, 40 images from March 23, 36 images from April 4, 17 images from April 9, and 74 images from April 10, 2002 were used in the lightcurve shown in Figure 2. The apparent period is 3.294 ± 0.006 h and the amplitude is 0.55 mag.

For asteroid (5515) 1989 EL1, 43 images from March 23, 35 images from April 4, 60 images from April 9, and 82 images from April 10, 2002 were used in the lightcurve shown in Figure 3. The apparent period is 5.230 ± 0.008 h with an amplitude of 0.7 mag.

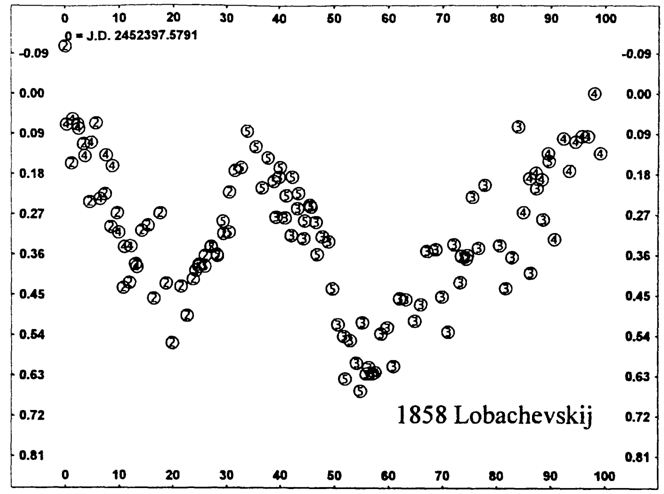

Figure 1. Lightcurve for 1858 Lobachevskij based on a rotational period of 7.00 hours.

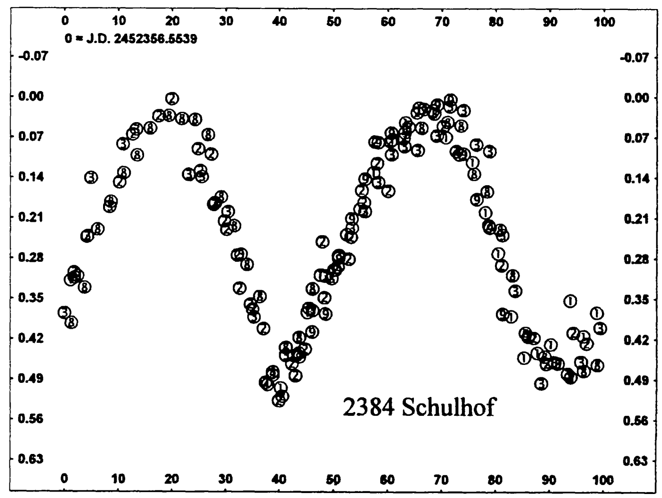

Figure 2. Lightcurve for 2384 Schulhof based on a rotational period of 3.294 hours.

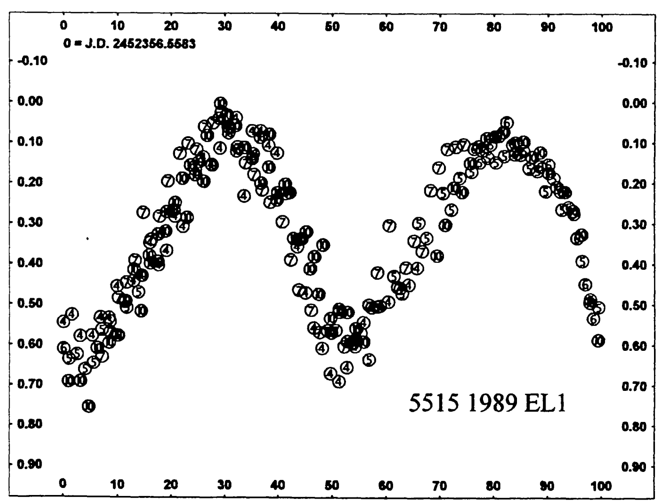

Figure 3. Lightcurve for (5515) 1989 EL1 based on a rotational period of 5.230 hours.

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ROTATION PERIOD AND SOLAR PHASE COEFFICIENTS OF (202) CHRYSEÏS

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CCD photometry of (202) Chryseïs during its 2000 apparition reveals a lightcurve with low amplitude of about 0.08 mag. Careful attention to photometric calibrations was needed to derive a rotation period of 15.74 ± 0.03 hours. The corresponding best-fit values of the Lumme-Bowell solar phase coefficients over the 6- to 19-degree range of phase angles observed are H = 7.57 ± 0.04 and G = 0.29 ± 0.02. Additional observations are desirable because the available data don't completely rule out an alternate possible period of 16.82 hours.

Introduction

We observed asteroid (202) Chryseïs during its 2000 apparition to improve its poorly-known rotation period and determine its previously unknown solar phase coefficients, as a student observing project at Colgate University. Chryseïs was previously studied in 1985 by A. Harris (unpublished), who observed a possible maximum/minimum pair in the lightcurve separated by a decrease of about 0.1 mag. in brightness and about 4 hours in time, and suspected a rotation period near 16 hours.

Observations

Our observations of Chryseïs were made during six nights between 2000 Feb. 8 and Mar. 25 at the Foggy Bottom Observatory at Colgate University in Hamilton, NY. The asteroid and nearby comparison stars were imaged through a V filter using a CCD detector mounted at the Newtonian focus of the 41-cm telescope. Hazy conditions affected the data from Feb. 13 after the first hour, and also the last hour of observations on Mar. 1.

The on-chip comparison stars were later observed with standard stars from Landolt (1983) through both V and R filters so that the lightcurve observations could be transformed to standard V magnitudes. These observations were made on 2002 May 4 to 6 at the Whitin Observatory at Wellesley College in Wellesley, MA, using a CCD detector mounted at the Cassegrain focus of the 61-cm telescope. Observations in two colors were needed so that already-known color transformation coefficients could be used to properly combine the photometry from the two different detector/filter systems (see, for example, Henden and Kaitchuck (1990)).

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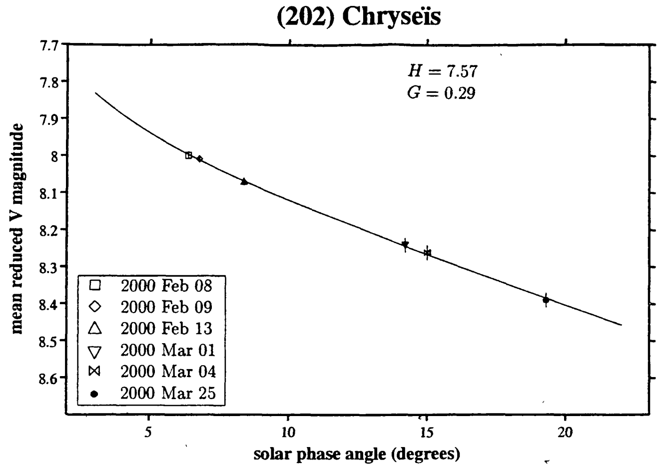

Figure 1. Solar phase function of (202) Chryseïs during the 2000 apparition.

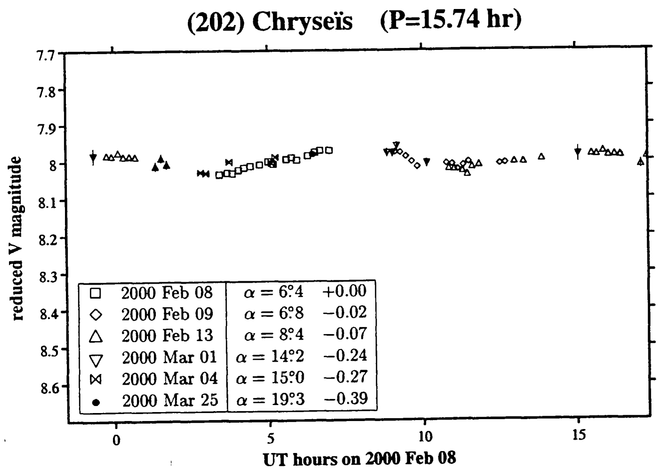

Figure 2. Composite lightcurve of (202) Chryseïs during the 2000 apparition for a rotation period of 15.74 hours. One rotation period is shown with the earliest and latest 10% of the period span repeated. For clarity, error bars representing the estimated one-sigma uncertainty with respect to the local comparison star used are plotted only where they exceed 0.01 mag. The legend gives for each night of data the plot symbol, the UT date of the observations, the solar phase angle alpha, and the offset in magnitudes applied to adjust the data to the solar phase angle on Feb. 8.

The IRAF software application packages were used for both image processing and synthetic aperture photometry (Massey 1997, Massey and Davis 1992). We determined the standard V-R colors and V magnitudes of the comparison stars from the observations made at Wellesley, where the resulting one-sigma uncertainties for the derived V magnitudes were all near 0.01 mag. To transform the instrumental V lightcurves observed at Colgate to standard V in absence of an observed V-R color for Chryseïs itself, we used the solar value of +0.54 (Livingston 2000) with an adopted uncertainty of 0.1 mag. 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. The effects of the changing distance to the asteroid during the span of the observations were removed from the individual lightcurves by reducing the observed V magnitudes to the brightness the asteroid would appear if it were 1 AU from both the Sun and Earth, and by antedating the data time tags for the light-travel time to Earth.

Reduction for Rotation Period and Solar Phase Coefficients

The brightness changes of Chryseïs didn't exceed 0.1 mag. on any single night, while the overall mean brightness decreased slowly by a much greater amount—about 0.4 mag.—as the solar phase angle increased during the 46 days spanned by the observations. To approximately remove the solar phase effect and permit rotation period analysis, we determined an initial Lumme-Bowell solar phase function (Bowell et al. 1989) for Chryseïs by fitting the lightcurves' mean brightnesses, and then used the best-fit slope parameter G to adjust all of the reduced magnitudes to the solar phase angle on Feb. 8.

The data from Feb. 13 exhibit a possible lightcurve minimum/maximum pair separated by an increase of about 0.05 mag. in brightness and about 4 hours in time. This upward slope together with the downward slope observed in 1985 by Harris indicates that either the pair of two lightcurve maxima, or the pair of two minima, are separated by about 8 hours, which supports the previously suspected period of about 16 hours if the lightcurve is doubly periodic and symmetric. The low amplitude of the lightcurves makes it difficult to precisely locate the extrema by inspection, so the Fourier fitting approach described by Harris and Lupishko (1989) was used to identify possible rotation periods. There are many local minima in the root-mean-square residuals of the fits for periods in the range of 12 hours to 24 hours, but we found only two preliminary possible rotation periods which seem consistent with all six nights of lightcurve data. To further check and refine these two candidate periods of 15.75 hours and 16.74 hours, we needed a more careful solar phase solution.

Before solving for the overall solar phase dependence we removed the rotational brightness variation from the data, using a best-fit Fourier series with terms through the second harmonic to model the difference between the observed lightcurve and its mean brightness. The Lumme-Bowell solar phase function was fit to the resulting mean brightnesses, yielding improved H and G coefficients. We applied the new solar phase corrections to the observed data to make a new composite lightcurve and then repeated the process, iterating until the derived mean lightcurve brightnesses changed by less than 0.01 mag. Reduction using the shorter period yields a refined value of 15.74 hours and best-fit solar phase coefficients of $H = 7.57 \pm 0.04$ and $G = 0.29 \pm 0.02$. A plot of mean reduced magnitude vs. phase angle is presented as Figure 1, in which the best-fit phase function is shown as a solid line. Reduction using the longer period yields essentially the same solar phase results, and a refined period of 16.82 hours.

The composite lightcurves for both periods are formally self-consistent within the estimated uncertainties of the data, but for the longer period the overlapping data from Feb. 8 and Feb. 13 seem to have different upward slopes. Therefore we favor the shorter period of 15.74 ± 0.03 hours, but assign our derived period a reliability code of 2 since we can't definitely rule out the longer period. The uncertainty in the result was estimated by adjusting the period upward and downward until the overlapping data from Feb. 8 and Mar. 4 were no longer self-consistent within the uncertainties of the individual observations, while also allowing up to 0.01 mag. of systematic error in their relative overall brightness. The composite lightcurve is presented as Figure 2, in which the data have been adjusted to the solar phase angle on Feb. 8, light-time corrected, and translated into the plotted time span modulo the rotation period.

Acknowledgments

We thank Tom Balonek, Stacey Davis, and Wendy Bauer for generous and flexible telescope scheduling. Andy Hock and Chris Barrett assisted with observing, and Roger Williams provided technical support. Priscilla Benson provided color transformation coefficients for the Wellesley detector/filter combination, and Tom Balonek provided coefficients for the Colgate system.

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COLLABORATIVE PHOTOMETRY OF 3779 KIEFFER

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CCD images of asteroid 3779 Kieffer were recorded at the Oakley Observatory and Sonoran Skies Observatory in May 2002. The combined data reveal a lightcurve period of 2.848 ± 0.002 h with an amplitude of 0.24 mag.

Asteroid 3779 Kieffer was selected from the "CALL" web site (Warner 2002) for observation by both the Oakley Observatory (Observatory Code 916) and the Sonoran Skies Observatory (Observatory Code G94). One of the authors (Ditteon) selected this asteroid because Hugh Kieffer was his PhD thesis adviser at the University of California, Los Angeles in the late 1970's. At that time Kieffer was the principle investigator for the Infrared Thermal Mapper on the Viking Spacecraft. After the Oakley Observatory observations were made, Ditteon checked the "CALL" web site and found a notification that another author (Gross) had also observed the asteroid. Ditteon contacted Gross and Gross sent his data to Ditteon. Both observatories use "Canopus" for analysis, so combining the data was relatively easy.

Thirty four images taken on May 2, 2002 and 73 images taken on May 4 at the Oakley Observatory were used in the lightcurve shown in Figure 1. The Oakley Observatory images were made with a Celestron C-14 telescope operating at f/7 on a Paramount GT-1100 mount using an AP7 CCD camera. Exposures were 120 seconds. Sonoran Skies Observatory recorded 21 images on May 2, 49 images on May 6, 54 images on May 7 and 32 images on May 8 that were used in the lightcurve. These images were made with a Celestron C-14 telescope operating at f/6 on a Paramount GT-1100s mount using an ST9E camera. Exposures were 150 seconds. The period solution was found to be 2.848 ± 0.002 h with a lightcurve amplitude of 0.24 mag.

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Warner, B. D. (2002), "Potential Lightcurve Targets 2002 April 1 – June 30". http://www.MinorPlanetObserver.com/astlc/targets_2Q_2002.htm.

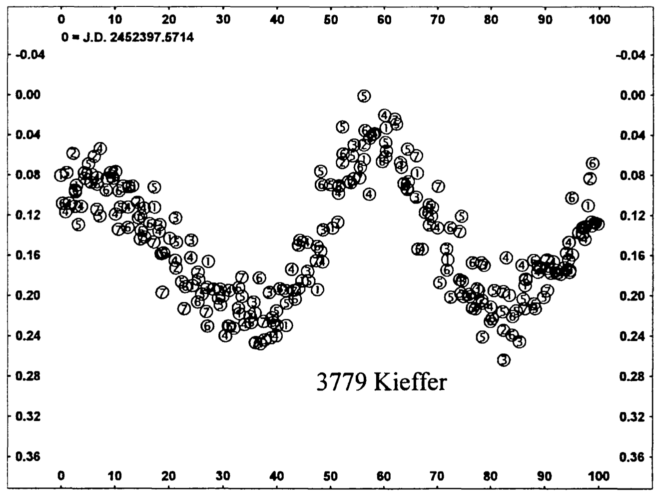

Figure 1. Combined lightcurve of 3779 Kieffer based on a period of 2.848 hours.

PHOTOMETRY OF 769 TATJANA, 818 KAPTEYNA, 1922 ZULU, AND 3687 DZUS

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Results for the following asteroids (lightcurve period and amplitude) observed from Santana Observatory during the period April – June 2002 are reported: 769 Tatjana (35.08 ± 0.01 hours and 0.46 ± 0.03 mag.), 818 Kapteyna (16.35 ± 0.01 hours and 0.20 ± 0.03 mag.), 1922 Zulu (18.65 ± 0.01 hours and 0.19 ± 0.03 mag.), and 3687 Dzus (7.44 ± 0.01 hours and 0.25 ± 0.04 mag.).

Santana Observatory is located in Rancho Cucamonga, California at an elevation of 400 meters and is operated by Robert D. Stephens. Details of the equipment used can be found in Stephens (2002).

All of the asteroids reported here were selected for observation from the "CALL" web site "List of Potential Lightcurve Targets" (Warner 2002). Aperture photometry was performed using the software program "Canopus" developed by Brian Warner and including the Fourier analysis routine developed by Alan Harris (Harris et al, 1989). This program allows combining data from different observers and adjusting the zero points to compensate for different equipment and comparison stars. All observations were unfiltered. Dark frames and flat fields were used to calibrate the images.

769 Tatjana

769 Tatjana is a main-belt asteroid discovered October 6, 1913 by G. N. Neujmin at Simeis. It is possibly named for a former scientific collaborator at the Pulkovo Observatory. 1,103 observations over 12 sessions between March 4 and April 12, 2002 were used to derive the rotational period of 35.08 ± 0.01 hours with an amplitude of 0.46 ± 0.03 magnitude. This span of time covers 27 rotational periods. Approximately 90% of the lightcurve of the long period minor planet was obtained.

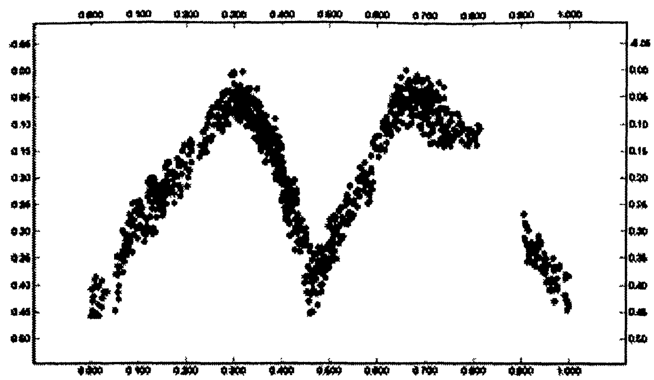

Figure 1: Lightcurve of 769 Tatjana based upon a derived period of 35.08 ± 0.01 hours. Zero phase corresponds to JD 2452364.794661 (corrected for light-time).

818 Kapteyna

818 Kapteyna is a main-belt asteroid discovered February 21, 1916 by M. Wolf at Heidelberg. It is named in honor of Jacobus Cornelius Kapteyn (1851-1922), the director of the Groningen Astronomical Laboratory. 548 observations were obtained in 7 sessions between April 30 and May 14, 2002, which covered 20 rotational periods. The derived rotational period is 16.35 ± 0.01 hours with an amplitude of 0.20 ± 0.03 magnitude.

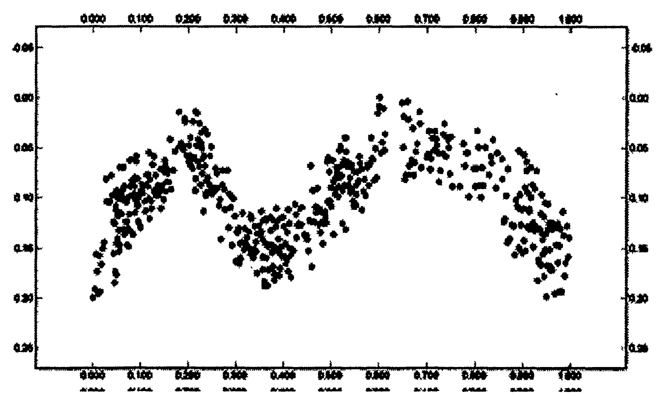

Figure 2: Lightcurve of 818 Kapteyna based upon a derived period of 16.35 ± 0.01 hours. Zero phase corresponds to JD 2452399.755020 (corrected for light-time).

1922 Zulu

1922 Zulu was discovered April 25, 1949 by E. L. Johnson at Johannesburg. It is a member of the Griqua family which librate in the 2:1 ratio of Jupiter's mean motion. Zulu is named for the well-known South African tribe. 765 observations over 14 sessions between May 12 and June 4, 2002 were used to derive the rotational period of 18.65 ± 0.01 hours with an amplitude of 0.19 ± 0.03 magnitude. This span covers 30 rotational periods. The phased lightcurve displays notches in both maxima.

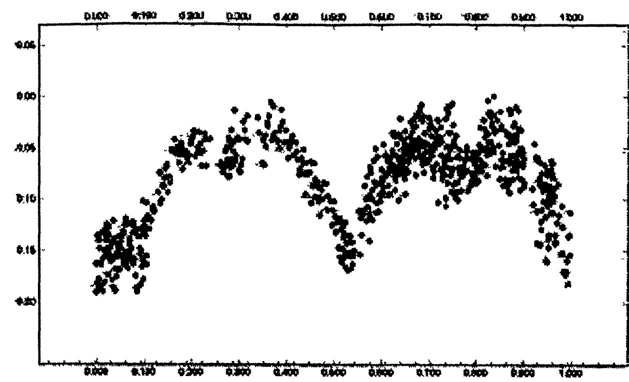

Figure 3: Lightcurve of 1922 Zulu based upon a derived period of 18.65 ± 0.01 hours. Zero phase corresponds to JD 2452428.671996 (corrected for light-time).

3687 Dzus

3687 Dzus is a main-belt asteroid discovered by A. Kopff at Heidelberg on October 7, 1908. It is named in honor of Paul Dzus in appreciation of his helpful assistance at the Minor Planet Center, much of the time as a volunteer. 294 observations over 7 sessions between June 15 and 29, 2002 were used to derive the rotational period of 7.44 ± 0.01 hours with an amplitude of 0.25 ± 0.04 magnitude. This span covers 45 rotational periods. The phased lightcurve displays a notch in one of the maxima which repeated over three sessions.

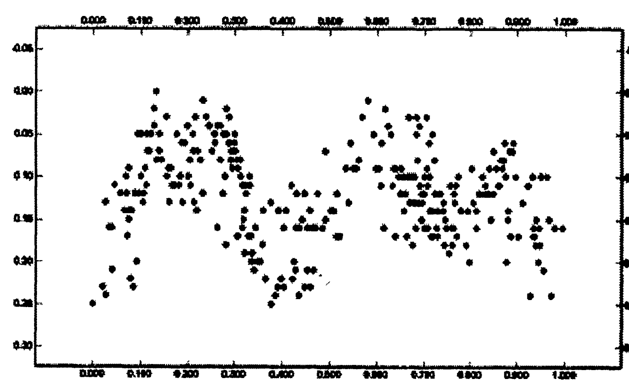

Figure 4: Lightcurve of 3687 Dzus based upon a derived period of 7.44 ± 0.01 hours. Zero phase corresponds to JD 2452443.740450 (corrected for light-time).

Acknowledgements

Many thanks to Brian Warner for his continuing work and enhancements to the software program "Canopus" which makes it possible for amateur astronomers to analyze and collaborate on asteroid rotational period projects and for maintaining the CALL Web site which helps coordinate collaborative projects between amateur astronomers.

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ASTEROID PHOTOMETRY AT THE PALMER DIVIDE OBSERVATORY: RESULTS FOR 1333 CEVENOLA AND 2460 MITLINCOLN

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Lightcurves for two asteroids were measured at the Palmer Divide Observatory in February 2002. For 1333 Cevenola a period of 4.88 ±0.02h and amplitude of 0.97 ±0.03 mag was found. A preliminary finding was also made for 2460 Mitlincoln, that being a period of 2.77 ±0.005h and amplitude of 0.04 ±0.02 mag. The large scatter of the data makes this finding a tentative one at best.

Asteroid lightcurve work has been the main focus at the Palmer Divide Observatory since 1999 April. Since that time the period and amplitudes of more than 40 asteroids have been measured. The current instrumentation is a 0.5m Ritchey-Chretien working at f/8.1. The camera is a Finger Lakes Instrumentation camera using the Kodak KAF-1001E non-antiblooming CCD chip working at –30°C and 2x2 binning (0.48um pixels). This yields a scale of about 2.4 arcseconds per pixel. Given that the average seeing at the Palmer Divide Observatory is on the order of 4-5 arcseconds, this is usually a satisfactory match. All observations for this paper were unfiltered with unguided exposures of either 60s or 70s. All images were dark subtracted and flat-fielded before measuring. About half the curves measured to date were done with this setup. The other half involved a 0.25m f/10 SCT and mostly SBIG ST-8 CCD camera.

Initial targets are determined by referring to the list of lightcurves maintained by Dr. Alan Harris (Harris 2001), with additions made by the author to include findings posted in subsequent issues of the Minor Planet Bulletin. In addition, reference is made to the Collaborative Asteroid Lightcurve Link (CALL) web site maintained by the author (http://www.MinorPlanetObserver.com/astlc/default.htm) where researchers can post their findings pending publication.

MPO Canopus, a custom software package written by the author, is used to measure the images since it allows automatic storage of the measured magnitudes of the comparison stars and targets. It uses aperture photometry with magnitudes determined by calibrating images against field or, preferably, standard stars. The package includes a Fourier analysis routine, the original FORTRAN code for which was supplied by Alan Harris (Harris et al, 1989) and converted to Delphi Pascal. If the data from a single night appears to cover at least half a period or more, then an estimate based on a plot of the raw data is used to help narrow the possibilities when using data from two or more nights.

1333 Cevenola

O. Bancilhon discovered this unclassified asteroid in February 1934. It is named after the Cevennes mountain range in southern France. The size is approximately 17km. The orbit has a semi-major axis of 2.63AU and inclination of 14.6°. The 2002 apparition was the second brightest in the interval between 1995 and 2050, when the asteroid reached 14.0 at brightest. This is considerably better than most approaches, when brightest magnitude is in the range 15-16. The asteroid was worked about a month after brightest, by which time it had faded nearly a magnitude to around 14.9. (References to diameters given here and below are from Tedesco et al. 1982. See Tholen 1989 for references to taxonomic classification. Asteroid names and discovery information are from Schmadel 1999. Data about asteroid oppositions and date of brightest for the period 1995-2050 are from Warner 2002.)

Approximately 250 observations of the asteroid were obtained on the nights of 2002 February 4, 6, and 7. The observations are plotted in Figure 1, which is phased against the derived period of 4.88 ±0.02h. The amplitude of the curve is 0.97 ±0.03 mag. Lightcurves such as this are a pleasure to work, as they have relatively short periods that can be covered by one station even during the short nights of summer. The large amplitude is nice because it is considerably greater than the system noise. Such was not the case for 2460 Mitlincoln.

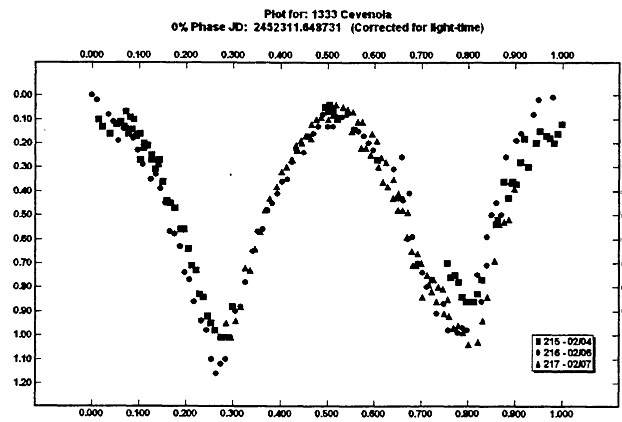

Figure 1. The lightcurve for 1333 Cevenola. The period is 4.88 ± 0.02h with an amplitude of 0.97 ±0.03 mag.

2460 Mitlincoln

This asteroid was discovered by L.G. Taff and D. Beatty at the LINEAR facility in Socorro, NM, USA, on 1980 October 1. The size of the asteroid is on the order of 12km. The orbit has a semi-major axis of 2.25AU and inclination 3.7°, putting the asteroid towards the inner part of the main belt. The range of opposition magnitudes in the period 1995 to 2050 is about 1.2 mag with a mean of about 15.0. The early 2002 apparition was the brightest in that period. Unfortunately, weather conditions and other circumstances did not allow a concentrated run on the asteroid. This was unfortunate since the low amplitude of the curve and faintness of the asteroid combined to make analysis difficult at best.

A total of about 100 observations for 2460 Mitlincoln was obtained on the nights of 2002 February 16 and 22. The system uncertainty of about 0.015m was about one-half the amplitude of the curve, and so the data proved quite noisy. However, it seemed to yield a reasonable result, especially when each night's data was analyzed independently. The period of the lightcurve was found to be 2.77 ±0.005h with an amplitude of 0.04 ±0.02 mag.

The next best opportunity to work this asteroid is not until 2009 March, when it reaches an opposition magnitude of 14.4. It does have an opposition in 2004 November, but the brightest the asteroid will get is about 14.8.

Acknowledgements

Thanks go to Dr. Alan Harris of the Jet Propulsion Laboratory for making available the source code to his Fourier Analysis program and his continuing support and advice.

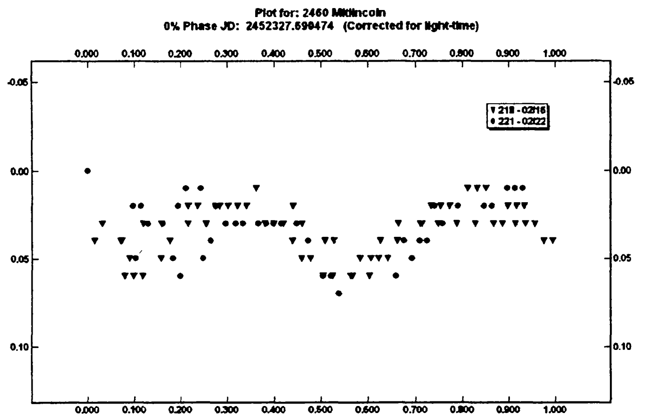

Figure 2. The lightcurve for 2460 Mitlincoln. The derived period is 2.77 ±0.005h with an amplitude of 0.04 ±0.02 mag.

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LIGHTCURVE PHOTOMETRY OF ASTEROID (1248) JUGURTHA

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Results of a collaborative asteroid lightcurve project between Thornton Observatory and Sonoran Skies Observatory are reported. Using observations from late 2000 and early 2002, asteroid 1248 Jugurtha was determined to have a synodic period of 12.1897 hours ± 0.0001 hours, with an amplitude ranging from 0.70 to 1.40 mag.

Equipment and Procedures

This is a report on a collaborative asteroid lightcurve investigation between Thornton Observatory and Sonoran Skies Observatory in the United States. Thornton Observatory is located in Thornton, Colorado, at an elevation of 1687 meters. Since 1997, the observatory, operating as Minor Planet Center observatory code 713, has been performing asteroid astrometry and photometry. The instrumentation used in this study consisted of an 0.20m Schmidt-Cassegrain telescope operating at f/10 and an SBIG ST-6 CCD camera. Sonoran Skies Observatory, Minor Planet Observatory code G94, is located near Benson, Arizona at an elevation of 1470m. Sonoran Skies currently uses a 0.35m f/6 Schmidt-Cassegrain telescope and an SBIG ST-9E CCD camera, with the camera operated in 1x1 binned mode.

Procedure

The target asteroid was originally selected by Thornton Observatory. No lightcurve data had been previously reported (Harris, 2001). The differential photometry was measured using the program "Canopus" by Brian Warner, which uses aperture photometry. Differential magnitudes were calculated using reference stars from the USNO-A 2.0 catalog. Comparison stars differed from night-to-night due to movement of the asteroid. Lightcurves were prepared using "Canopus", based on the method developed by Dr. Alan Harris (Harris et al, 1989). This program allows compensation for night-to-night comparison star variation by offsetting individual night's magnitude scales to obtain a best fit. Dark frames and flat fields were used to calibrate each image at both observatories. All images from both observatories were obtained in unfiltered light. A total of 413 observations were used in the solution.

Observations and Results

1248 Jugurtha

Jugurtha is a main-belt asteroid with an estimated diameter of 76 km. It was discovered in September of 1932 by C. Jackson at Johannesburg. No lightcurve was found for this object (Harris, 2001). It was observed initially by Thornton Observatory on November 29, 2000. Observations were made on six nights at Thornton Observatory during the period from November 29, 2000 to January 11, 2001. During the period of observation, the phase angle changed from 2.9 degrees to 17.7 degrees. The amplitude increased dramatically as the phase angle increased, going from 0.70 ±0.04 mag in November, 2000 to 1.40 ± 0.04 mag in January, 2001. (See the upper set of curves in Figure 1.) The amplitude change could indicate a change in aspect from higher to lower asterocentric latitude. Following these observations, the period of the lightcurve was estimated as 20.82 hours, but no firm solution was possible. These results were posted on the CALL website (Warner, 2001) as preliminary results only. The asteroid was then observed on four nights from March 24, 2002 to April 1, 2002 by Sonoran Skies Observatory. During the period of observation, the phase angle changed from 8.9 degrees to 11.5 degrees. No significant change in the amplitude of 0.75 ± 0.03 was observed. These data are shown as the lower set of curves in Figure 1. The data obtained were offered to Thornton Observatory for inclusion in the analysis. These new data ruled out the earlier period estimate. The two sets of data, however, allowed a unique synodic period of 12.1897 hours to be determined, with a formal error of ±0.0001 hours. The synodic period determined from only the Thornton data is 12.193 ± 0.001 hours. The synodic period determined from the Sonoran Skies observations is 12.196 ± 0.002 hours. Note that the error estimates for these periods are such that a change in synodic period between early 2001 and March, 2002 cannot be accurately determined. However, it is interesting to note that the overall period solution is shorter than either of the individual solutions.

Figure 1 shows the resulting lightcurves. The synodic period was determined to be 12.1897 hours ± 0.0001 hours, with an amplitude range of 0.4 to 1.4 mag. The zero point of the lightcurve is JD 2451877.75291.

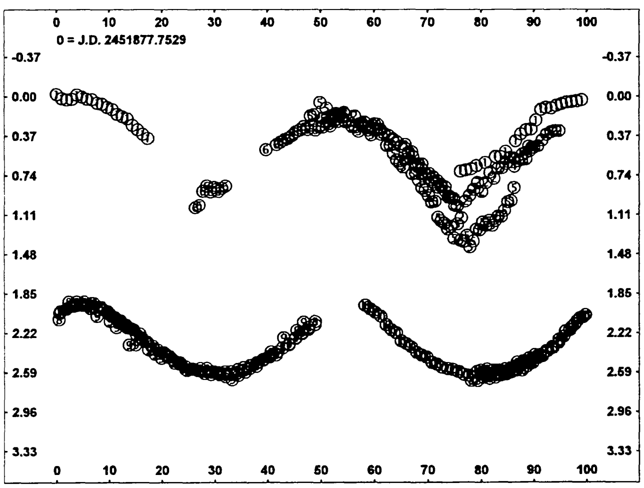

Figure 1. Lightcurve of 1248 Jugurtha, based on a period of 12.1897 hours. Curves 1 through 6 (upper set of curves) are Thornton Observatory data for 2000-2001. Curves 7 through 10 (lower set of curves) are Sonoran Skies Observatory observations from 2002. Zero point of the curve is J.D. 2451877.75291. Ordinate is relative magnitude.

Acknowledgments

Thanks to Brian Warner for his continuing work on the program "Canopus", which has made it possible for amateurs to analyze and share lightcurve data.

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LIGHTCURVES AND PERIOD DETERMINATIONS FOR 399 PERSEPHONE AND 976 BENJAMINA

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(Received: 30 May)

Minor planet 399 Persephone was observed over 40 days (58 rotations) during March and April, 2002. Lightcurves obtained on 6 nights with an unfiltered CCD yield a rotational (synodic) period of 9.136 ± 0.001 hrs. The lightcurve shows a total amplitude range of 0.40 ± 0.03 mag. Also in 2002 March-April, 976 Benjamina was observed for 5 nights over 38 days (59 rotations) yielding a synodic rotation of 9.746 ± 0.003 hours. The lightcurve shows a total amplitude range of 0.19 ± 0.04 mag.

Introduction

Asteroids 399 Persephone and 976 Benjamina were chosen for observation from the suggested targets in the observing list of Pravec et al (2002), where no previous amplitude or period information is quoted. The most recent tabulation examined for previous lightcurve data was that of Harris (updated March, 2001), but no lightcurve data are listed there. Persephone was discovered by Max Wolf at Heidelberg in 1895. Persephone was the daughter of Zeus and the wife of Pluto. Thus she was the Queen of Hades. This main-belt asteroid is approx 52 km in diameter. The absolute magnitude (H) is given as 9.0, while the albedo is quoted as 0.14. Benjamina was discovered by Jekhovsky at Algiers in 1922. It was named after the discoverer's son. It is approx 86 km in diameter. The absolute magnitude (H) is given as 9.22 and the color index (B-V) = 0.74. The albedo of this asteroid is quoted as 0.043 and its Tholen classification is XD.

Observations and Results

For their current oppositions, these two minor planets were at small southerly declinations, making them optimal for southern hemisphere observers. Observations were made from Mt Tarana Observatory near Bathurst, NSW. The site is at 880m and the Latitude is S 33.4348, Longitude E 149.7576. The equipment and methodology have been described by Bembrick (2001).

The observational circumstances for March and April, 2002 are summarized in Table I (Persephone) and Table II (Benjamina), which also show the percent of the rotational lightcurve covered on each night of observation. Preliminary results were posted on the CALL website on May 6th, 2002.

399 Persephone

The data from each night were plotted as differential instrumental magnitude vs. U.T. No light-time corrections were applied. These data show two maxima and two minima, with an exceptionally "clean" lightcurve with minimal noise. The epoch of zero phase was chosen as the prominent minimum of Mar 17 at 11.36 UT (JDGeo 2452350.9729).

In all, 12 extrema were identified and the time differences were used to estimate the rotational period as 9.136 ± 0.001 hours. On this basis the observations cover 58 rotational cycles. Using the above epoch and period, the data were phase folded (see Figure 1), with the magnitudes of the primary minima from other nights being adjusted to the magnitude of the zero phase minimum on the night of epoch. The overall amplitude of this lightcurve is considerable at 0.4 magnitudes.

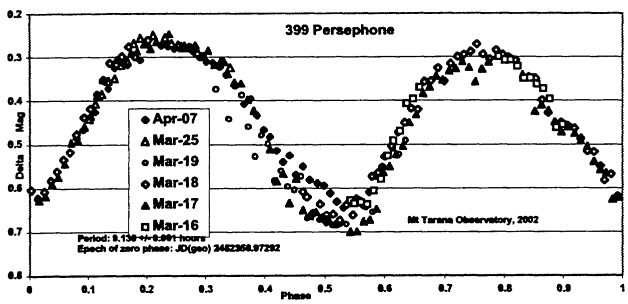

Figure 1. Lightcurve for 399 Persephone.

976 Benjamina

The data from each night were treated as above. No light-time corrections were applied. The epoch of zero phase was chosen as the prominent minimum on Apr 09 at 10.72 UT (JDGeo 2452373.9666). In all, 11 extrema were identified and the rotational (synodic) period was estimated as 9.746 ± 0.003 hours. On this basis the observations cover 59 rotational cycles. The phase folded data are presented in Figure 2. The overall amplitude of this light curve is 0.19 magnitudes.

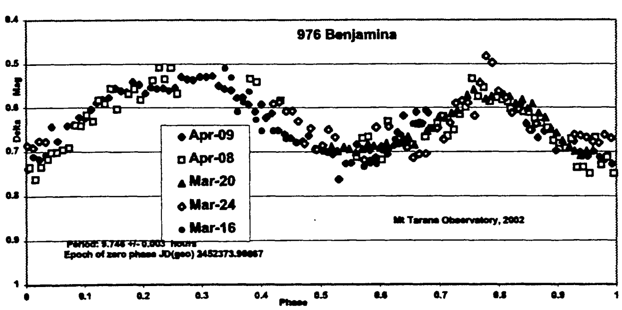

Figure 2. Lightcurve for 976 Benjamina.

Discussion

To a first approximation, the maximum overall amplitude of 0.4 magnitudes for Persephone implies a ratio a/b of 0.69, where a, b and c are the axes of a tri-axial ellipsoid and the rotation is about the shortest axis, c. The large overall amplitude suggests that we may be viewing this minor planet at a near "equator-on" aspect at this opposition. If this is so, then the relatively small a/b ratio also implies that Persephone is significantly elliptical around its equatorial circumference. A plot of the overall lightcurve delta magnitude vs. diameter for this asteroid falls neatly on the "best fit" line for S class asteroids (Burns & Tedesco, 1979), suggesting it is typical for its class. Given the large amplitude of the lightcurve and its "clean" nature, it is suggested that this minor planet may be a good candidate for further work at other oppositions to build up a suite of good quality light curves for the purpose of pole orientation studies.

In the case of Benjamina, the overall amplitude of 0.19 implies an a/b ratio of 0.84. The delta magnitude vs. diameter fits the C class asteroid plot of Burns & Tedesco (1979).

Conclusion

Minor planet 399 Persephone was observed over 58 rotational cycles and the synodic period determined as 9.136 ± 0.001 hours. Minor planet 976 Benjamina was observed over 59 rotational cycles and the synodic period was determined as 9.746 ± 0.003 hours. All rotational phases of both lightcurves were observed. The lightcurves show the two maxima and two minima typical of an irregularly shaped, tri-axial ellipsoid. Persephone may be significantly non-spherical, with the a/b ratio of 0.69. The maximum overall amplitude of the Persephone light curve at this opposition was 0.4 ± 0.03 magnitudes. The large amplitude suggests that at this opposition we may have been viewing the asteroid in an "equator-on" aspect. The difference between the two maxima was only 0.01 magnitudes, implying little or no difference in albedo between the opposite hemispheres.

The maximum amplitude of the Benjamina lightcurve was 0.19 ± 0.04. Here the difference between the two maxima was 0.04, implying a small albedo difference between the opposite hemispheres.

With respective revolution rates of 2.6 and 2.4 rev/day, both these asteroids are significantly faster than the 1.5 rev/day mean (Binzel et al. 1989) for asteroids between 50 and 125 km diameter.

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Table I – 399 Persephone
Observational Circumstances, 2002

Date of Obs.	Hel. Lat. (B°)	Hel. Long. (L°)	R (AU)	Solar Phase Angle	% Phase Coverage
16 Mar.	-7.22	194.14	2.853	6.77	35
17 Mar.	-7.30	193.95	2.853	6.42	94
18 Mar.	-7.39	193.76	2.854	6.08	74
19 Mar.	-7.47	193.57	2.854	5.73	31
25 Mar.	-7.94	192.35	2.855	3.84	24
07 Apr.	-8.82	189.57	2.857	4.11	51

Table II – 976 Benjamina
Observational Circumstances, 2002

Date of Obs.	Hel. Lat. (B°)	Hel. Long. (L°)	R (AU)	Solar Phase Angle	% Phase Coverage
16 Mar.	-10.21	186.47	2.906	5.02	33
20 Mar.	-10.18	185.68	2.905	4.02	45
24 Mar.	-10.12	184.87	2.904	3.49	61
08 Apr.	-9.69	181.92	2.902	6.47	87
09 Apr.	-9.65	181.74	2.902	6.80	84

ROTATION PERIODS AND LIGHT CURVES OF MINOR PLANETS (412) ELISABETHA, (547) PRAXEDIS, AND (7564) 1988 CA

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Unfiltered differential photometry for minor planets (412) Elisabetha, (547) Praxedis, and (7564) 1988 CA is presented. Data obtained by the several authors provide unambiguous light curves and synodic periods for two of the three asteroids. A proposed synodic period is presented for (547) Praxedis.

Observatories, Equipment, and Method

Walt Cooney – Blackberry Observatory 929, Port Allen, Louisiana

Blackberry Observatory (MPC code 929) consists of a roll-off building containing a permanently mounted 0.30m Meade LX-200 SCT operating at f/10 with an Apogee AP-7 CCD camera. Jeff Medkeff authored a scripting program for the ACP platform that was employed to run the telescope unattended, to image multiple asteroids alternately, and to perform on-the-fly astrometry of the CCD frames for pointing corrections over the course of the night. Imaging was done unfiltered to maximize signal to noise, S/N. Exposure times ranged from 90 seconds to 4 minutes depending on the brightness of the asteroid and available reference stars. Dark and flat field corrections were made to all images.

One to three reference stars were used for the photometry. More than one reference star was used when there was not a suitable single reference star with S/N significantly greater than the asteroid. Catalog values of the reference star magnitudes were not used for the reduction. Rather, a single arbitrary magnitude was assigned to the brightest reference star. The reference magnitudes for the other reference stars were measured against the first reference star and then used as a standard. In this way, the relative magnitudes of the reference stars were more accurately established than is possible using available catalog values. Since an arbitrary magnitude was chosen for the first reference, the asteroid data of each night were translated up or down the magnitude axis to phase correctly with data of other nights.

Larry Robinson - Sunflower Observatory 739, Olathe, Kansas

The current instrumentation at Sunflower Observatory is a 0.30m Meade LX-200 SCT and Santa Barbara Instruments Group ST9E CCD camera. The effective focal ratio of the system is f7.2 or 1.83m. yielding a pixel size of 2.3 arc sec. square. During October the camera is cooled to -12C and the usual exposure is 120 sec. using the tracking feature of the SBIG camera. The objective is to reach a S/N ratio ≥ 50 for the target. Exposures are generally started at 300 second intervals while the target is ≥ 30 degrees elevation. All images are unfiltered. All images are dark subtracted and flat fielded before measurement. Usually four comparison stars are chosen in the same field and selected on the basis of similar magnitude and spectra to the target.

Canopus software is used to measure the images and determine best fit of a lightcurve to the data. More information on this software may be obtained at http://www.MinorPlanetObserver.com.

Combined Data Reduction

The first author (Cooney) phased the data together. Data were corrected for light travel time from the asteroid and are for mid-exposure. No other corrections have been applied. A spreadsheet was used to phase the data and apply the light-time correction. The uncertainty in period is based on an "eyeball" estimate of the range over which the period may be adjusted while still providing a solution that appears consistent given the scatter in the data. Dates referenced are UT.

(412) Elisabetha

Harris (2001) roughly estimated a synodic period for (412) Elisabetha of 15 hours based on a partial light curve obtained by Lagerkvist (1992). Photometry over the course of five nights in January and February of 2002 at the Blackberry Observatory result in a phased light curve well described by a period of 19.67 ± 0.01 hours with an amplitude of 0.22 magnitudes. Data was taken for all but a few percent of the proposed light curve. The data show two prominent maxima and minima with a third much weaker maximum and minimum at a phase time of about 0.5.

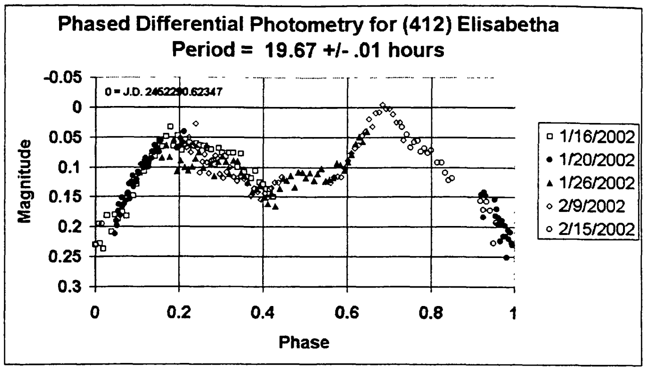

Figure 1. Phased light curve of (412) Elisabetha

(547) Praxedis

There is no previously published light curve or rotation period for Praxedis per Harris (2001). Sunflower and Blackberry Observatories combined for nine nights of data over a 29 night period during late September and October of 2001. A great deal of data were taken because this asteroid had a low amplitude (0.04 magnitudes) and a complex light curve. The best fit to the data is a period of 9.105 ± .01 hours as seen in Figure 2. Because the amplitude of the noise in the data is significant with respect to the amplitude of the variation in the asteroid's brightness, it is difficult to say with certainty that the proposed period is definitive.

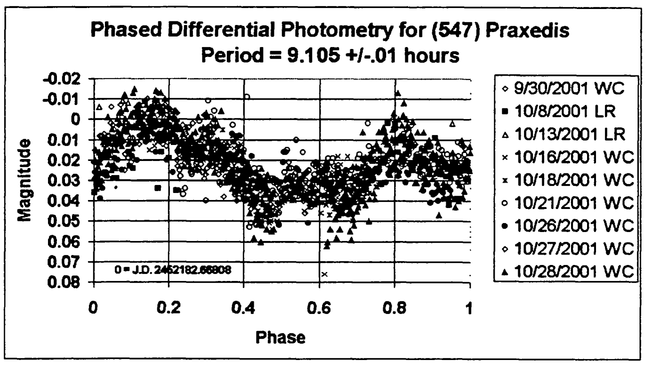

Figure 2. Phased light curve of (547) Praxedis

(7564) 1988 CA

There is no previously published light curve or rotation period for 1988 CA per Harris (2001). Six nights of data taken at the Blackberry Observatory in February and March of 2002 were phased together for a proposed period of 30.58 ± 0.03 hours and an amplitude of 0.65 magnitudes. The shape is quite symmetric and the data also fit a single maximum/minimum system with a period of 15.29 hours. The proposed period is based on the expected physical occurrence of two maxima/minima pairs. No data were taken between phase of 0.8 and 1.0. However, this does not compromise the solution which is unique.

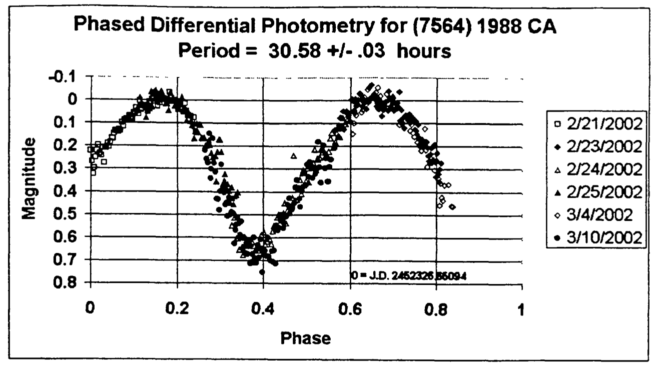

Figure 3. Phased light curve of (7564) 1988 CA

Acknowledgements

The authors wish to thank Brian Warner for writing and maintaining his Collaborative Asteroid Lightcurve Link (CALL) webpage at http://www.minorplanetobserver.com/astlc/default.htm through which the authors learned of each other's work and established this collaboration. Cooney would also like to thank Jeff Medkeff for his GetPhot script which allowed unattended night-long photometry of multiple targets. This has allowed the author to take advantage of clear nights and keep his day job. Jeff makes the script freely available at his Robotic Observatory Home Page, http://www.roboticobservatory.com/.

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THE MINOR PLANET OBSERVER: THE LONG STORY

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I didn't know the Mojave Desert could be so desolate. I was making my way across the bottom of the western U.S. towards California where I would have the pleasure of attending the IAPPP Western Wing 2002 Symposium at the end of May. I'd been in the area before but only at night. I know now that I hadn't missed anything in the darkness. I can see why Grofe wrote such eerie music in one of his suites to describe the landscape.

The IAPPP meeting truly was a pleasure, as not only did I meet old friends but I also heard about some of the latest research being done by amateurs and professionals working with amateurs. At times it was hard to tell who were the amateurs and who were the professionals. At least two talks centered on spectroscopy. Some very fine and detailed work is being done in this field and it will be interesting to see how things develop over the next few years.

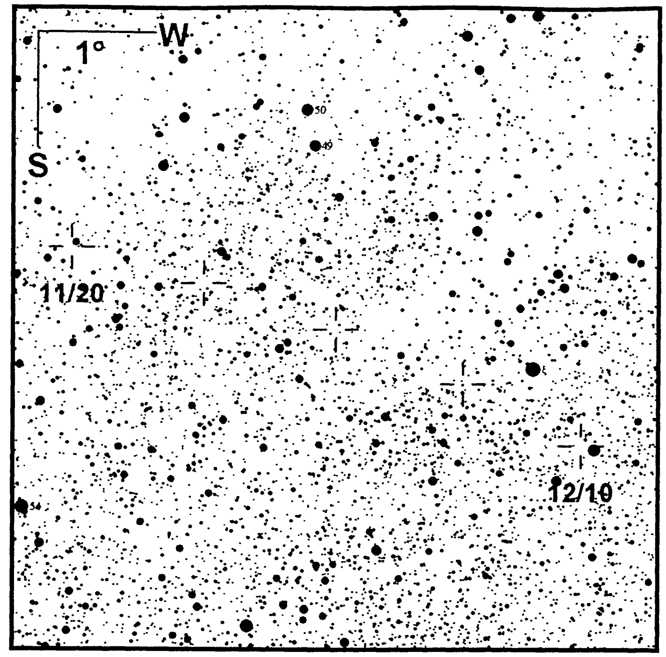
Of course, of prime interest to the readers of these pages would be the latest in the field of photometry. I tried to drum up more business for our Fearless Editor, Dr. Richard Binzel, tireless MPB Producer Bob Werner, and faithful MPB Distributor, Derald Nye. It seems there is still a growing interest in the field of asteroid photometry. John E. Hoot of SSC Observatory told of his experiences of trying to get filtered photometry for the least amount of money and effort. John was able to use standard photographic Wratten filters to achieve very respectable results. As I've said before, reducing to standard magnitudes is important, especially when working in collaboration with others.

Which brings me to the point of the story. Those who read the last edition of the MPB saw a large number of articles that were the result of collaborations. I think we'll see even more, especially if the readers take on the six asteroids charted this time around. All of them have periods of 16 hours or more, a couple go more than 40 hours. That makes these asteroids particularly good candidates for collaborations involving photometrists at widely scattered longitudes so that good coverage can be obtained for as many hours a day as possible.

Long period asteroids are particularly difficult because differing phase angles play havoc with amplitudes, synodic periods, and being able to combine data from several observers over a long period of time. The meeting and last edition showed that amateurs are more than up to the task. For more about the IAPPP-WW Symposium, visit

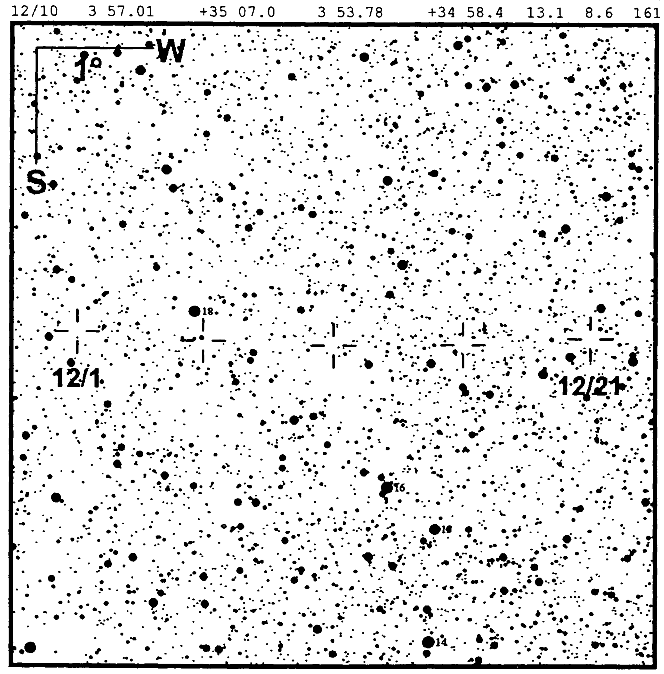
http://www.iapppwest.org/Past_Meetings/2002/2002.html

Clear Skies.



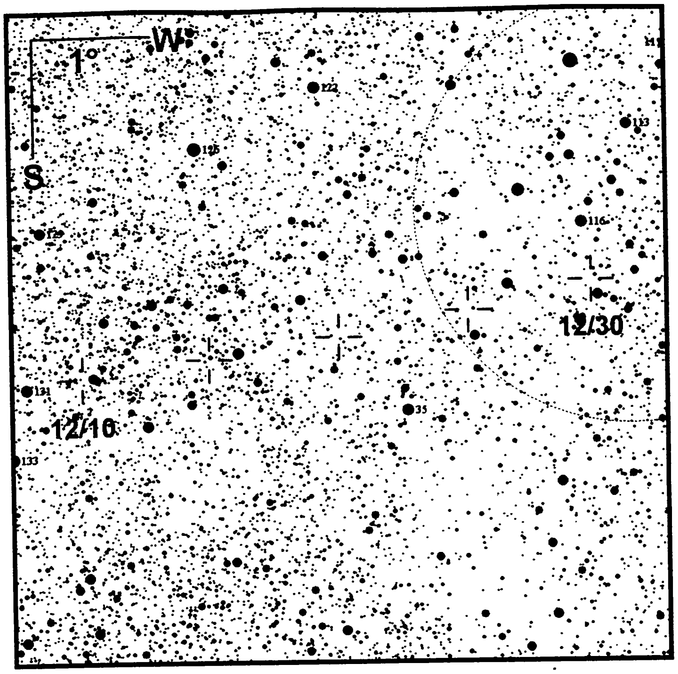
606 Brangane Discovered by A. Kopff in 1906 September, Brangane is named after a character in Wagner's opera, *Tristan and Isolde*. There is a preliminary set of parameters with a period of >24h and amplitude of >0.18m. The field is in Perseus, between Epsilon and Chi.

Date	RA2000	Dec2000	RA1950	Dec1950	M	PA	E
11/20	4 18.68	+36 49.6	4 15.36	+36 42.4	13.0	8.7	161
11/25	4 13.01	+36 32.5	4 09.71	+36 24.8	13.0	7.3	164
11/30	4 07.34	+36 09.1	4 04.07	+36 01.1	13.0	6.8	165
12/05	4 01.93	+35 40.2	3 58.68	+35 31.9	13.0	7.3	164
12/10	3 57.01	+35 07.0	3 53.78	+34 58.4	13.1	8.6	161



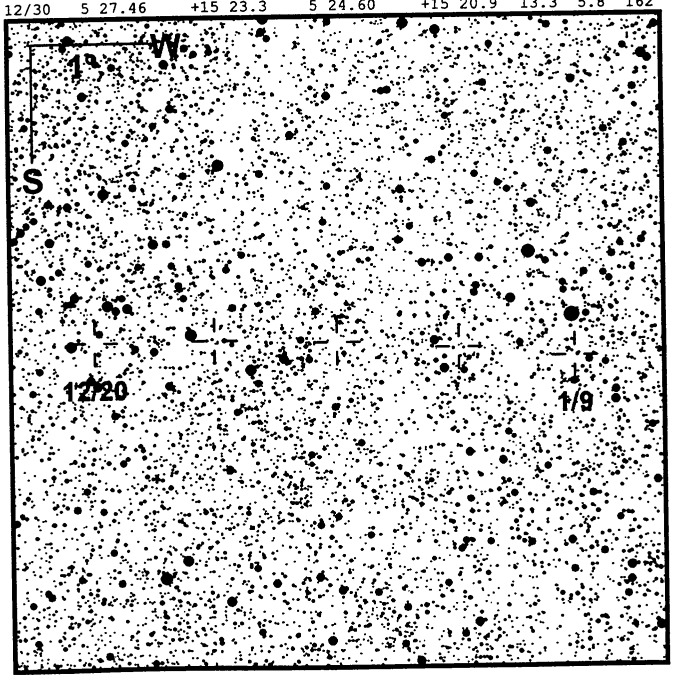
716 Berkeley This is the most difficult target of the group, at least based on magnitude. The type U asteroid is about 26km in size. Discovery by J. Palisa was in 1911 July. Preliminary parameters for the lightcurve are >17h and >0.2m. The field is in the northern reaches of Orion.

Date	RA2000	Dec2000	RA1950	Dec1950	M	PA	E
12/01	5 20.20	+11 09.9	5 17.42	+11 06.9	15.1	5.5	164
12/06	5 15.77	+11 05.5	5 13.00	+11 02.2	15.0	4.3	167
12/11	5 11.21	+11 03.4	5 08.44	+10 59.8	15.0	4.0	168
12/16	5 06.64	+11 03.8	5 03.87	+10 59.8	15.0	4.6	166
12/21	5 02.19	+11 06.6	4 59.42	+11 02.3	15.1	5.9	162



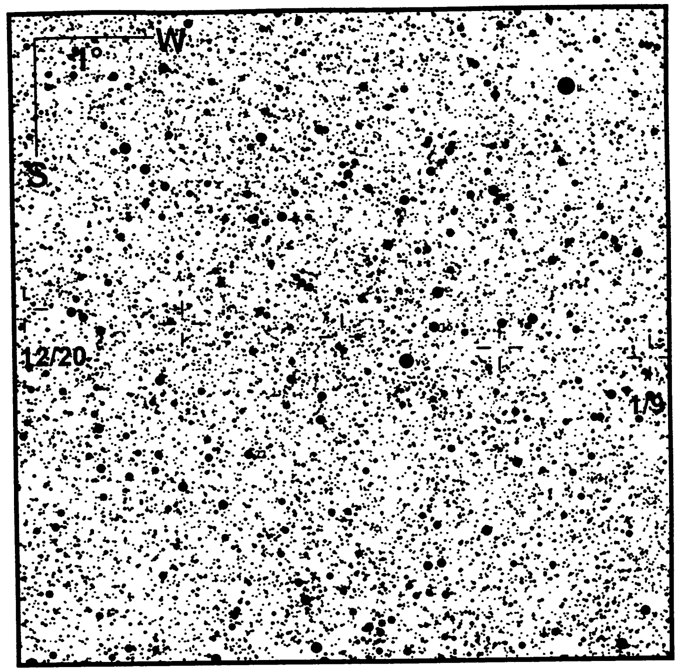
740 Cantabia J.H. Metcalf discovered the 96km type C Cantabia in 1913 February. The name is thought to be the Latin contraction for Cambridge, MA, where the asteroid was discovered. The period is probably >24h; there's no amplitude estimate. The field is 7° south of M1 in Taurus.

Date	RA2000	Dec2000	RA1950	Dec1950	M	PA	E
12/10	5 45.26	+14 34.8	5 42.41	+14 33.6	13.2	4.1	168
12/15	5 40.82	+14 44.5	5 37.96	+14 43.0	13.1	3.0	171
12/20	5 36.29	+14 55.9	5 33.43	+14 54.1	13.1	3.0	171
12/25	5 31.80	+15 08.9	5 28.94	+15 06.7	13.2	4.2	167
12/30	5 27.46	+15 23.3	5 24.60	+15 20.9	13.3	5.8	162



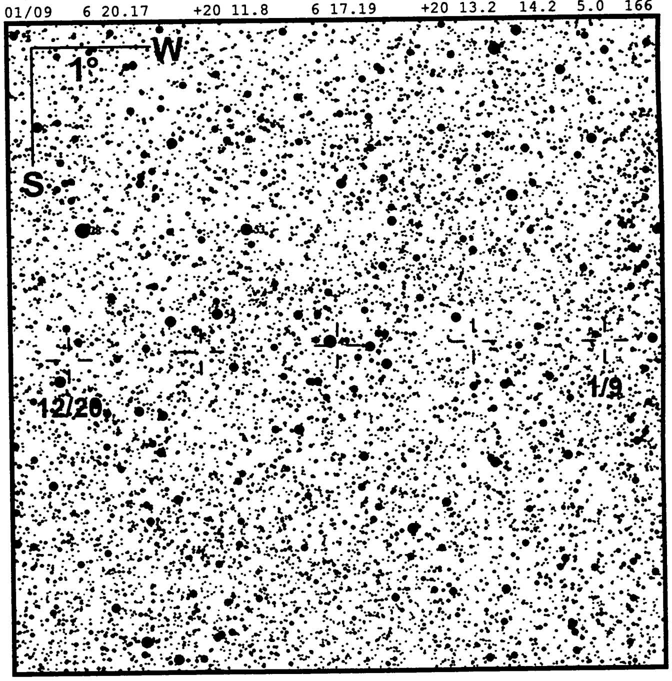
120 Lachesis Lachesis is a type C asteroid of about 170km size. The initial parameters are >20h and >0.1m. Discovery was in 1872 April by A. Borrelly with the name being one of the three Fates. The field is in Auriga, a little east of the famous open cluster, M37.

Date	RA2000	Dec2000	RA1950	Dec1950	M	PA	E
12/20	6 31.49	+32 29.4	6 28.23	+32 31.6	12.4	3.9	167
12/25	6 26.67	+32 31.0	6 23.40	+32 32.8	12.3	2.9	170
12/30	6 21.76	+32 30.2	6 18.49	+32 31.6	12.3	3.0	170
01/04	6 16.91	+32 26.7	6 13.64	+32 27.8	12.4	4.0	167
01/09	6 12.26	+32 20.8	6 08.99	+32 21.6	12.5	5.4	162



437 Rhodia Rhodia's the lazy one of the group. The preliminary period is 56h and the amplitude about 0.4m. This won't be an easy target because of the asteroid's path through parts of the Milky Way but give it a try. A. Charlois discovered the 38km unclassified asteroid in 1898 July.

Date	RA2000	Dec2000	RA1950	Dec1950	M	PA	E
12/20	6 42.72	+20 40.0	6 39.75	+20 43.0	14.1	4.5	168
12/25	6 37.02	+20 32.8	6 34.05	+20 35.4	14.0	2.3	174
12/30	6 31.25	+20 25.7	6 28.28	+20 27.8	13.9	1.1	177
01/04	6 25.58	+20 18.7	6 22.61	+20 20.4	14.1	2.8	172
01/09	6 20.17	+20 11.8	6 17.19	+20 13.2	14.2	5.0	166



203 Pompeja Discovered by C.H.F. Peters on the same date as (but a "few" years after) the destruction of Pompeii, Pompeja traverses the northern winter skies through Auriga. The preliminary period is 46.6h with an amplitude of >0.1m

Date	RA2000	Dec2000	RA1950	Dec1950	M	PA	E
12/20	6 45.26	+27 51.9	6 42.12	+27 55.0	12.4	4.9	167
12/25	6 40.18	+27 56.6	6 37.03	+27 59.4	12.2	2.8	172
12/30	6 34.93	+27 59.4	6 31.78	+28 01.9	12.2	1.8	175
01/04	6 29.70	+28 00.3	6 26.55	+28 02.3	12.3	3.0	172
01/09	6 24.65	+27 59.1	6 21.50	+28 00.8	12.4	5.0	166

ASTEROID PHOTOMETRY OPPORTUNITIES OCTOBER-DECEMBER 2002

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When preparing this article, we noticed that there are few remaining asteroids brighter than V=13 with unknown or uncertain periods. Beyond V=13, suitable targets are still plentiful. This indicates how strong the selection effect against fainter targets has been – observers, both in more distant and recent past, normally preferred the brighter of two targets whenever other factors were about equal. Since most asteroids are (at least at the first glance) similar one to each other in a lot of aspects, the observers' preference is a likely for the brighter object. Now the dividing magnitude is about V=13. There are still many targets for most observers with small telescopes just beyond V=13. Given the rapidly increasing number of asteroids with increasing magnitude, it will probably take some time (several years?) until the threshold is moved towards a new milestone, say V=14. The scientific value in determining periods of those fainter asteroids is that the more complete sample we have, the more details on processes working in asteroids we can find. Observers can contribute to the knowledge by observing those fainter targets.

In the Table below, we present a list of suitable photometric targets for October-December 2002. The objects have been selected from a more extensive list prepared by Brian Warner. We selected objects with the predicted V<14 in opposition and unknown or not well established periods. The asteroid 26 Proserpina is about the lowest numbered asteroid with an uncertain period; the other suggested period is 13.13 hours. The period of 459 Signe has been derived by Lagerkvist (1978) with a photographic photometry technique and it is worth checking with a modern device. Periods mentioned for some of the other objects are not reliable and some may even be completely wrong. In particular, observers should not depend on the values given to make phase connections from night to night. In order to be useful, new period determinations must be unique on their own, not depending on prior estimates for deriving a period. The Apollo asteroid 35396 1997 XF11 makes an approach to 0.064 AU on October 31 and it is a favorable photometry target (albeit not in opposition) in November. Observers interested in asteroids fainter than V=14 are encouraged to check the full list on the Brian Warner's CALL website (http://www.MinorPlanetObserver.com/astlc/default.htm). Note: Full references to the period and amplitude estimates cited in this article can be found in the list prepared by Alan Harris which is available at http://cfa-www.harvard.edu/iau/lists/LightcurveDat.html .

Asteroid	Opp'n Date 2002	Opp'n V	Dec [deg]	Per [h]	Ampl	Rem.
1112 Polonia	Oct 04	13.9	+19			
231 Vindobona	Oct 05	13.3	+ 7	5.547	0.81	
768 Struveana	Oct 07	13.9	- 8			
1005 Arago	Oct 08	13.8	+22			
1035 Amata	Oct 09	13.9	+16			
1734 Zhongolovich	Oct 13	13.9	+ 3			
793 Arizona	Oct 15	13.5	+ 1			
180 Garumna	Oct 19	13.8	+11			
817 Annika	Oct 20	13.5	-11			
907 Rhoda	Oct 20	13.8	+ 0			
408 Fama	Oct 26	13.4	+27			
799 Gudula	Oct 27	13.4	+ 6			
339 Dorothea	Oct 28	13.2	+ 3			
1275 Cimbria	Oct 28	13.3	+ 4			
294 Felicia	Oct 29	13.4	+ 4			
1015 Christa	Oct 31	13.3	- 1			
501 Urhixidur	Nov 04	13.3	+41	15.	0.1	
5142 Okutama	Nov 04	13.1	+12			
35396 1997 XF11	(Nov 04	13.4	-12)			NEA
881 Athene	Nov 06	13.7	+35			
731 Sorga	Nov 12	13.3	+18			
271 Penthesilea	Nov 17	13.4	+25			
380 Fiducia	Nov 18	12.8	+12			
2569 Madeline	Nov 18	13.8	+11			
623 Chimaera	Nov 19	13.8	+43			
26 Proserpina	Nov 20	11.3	+21	10.60	0.15	
459 Signe	Nov 24	12.7	+32	6.38	0.25	
963 Iduberga	Nov 25	13.8	+21			
1356 Nyanza	Nov 25	13.9	+19			
906 Repsolda	Nov 26	13.5	+29			
606 Brangane	Nov 27	13.0	+36	>24.	>0.18	
1003 Lilofee	Nov 27	13.7	+18			
1074 Beljawskya	Nov 28	13.2	+22			
1549 Mikko	Nov 30	13.6	+18			
1550 Tito	Dec 01	13.3	+23			
206 Hersilia	Dec 01	12.1	+16	7.33	0.08	
392 Wilhelmina	Dec 07	13.3	+ 7	8.54	0.11	
734 Benda	Dec 08	13.7	+31			
567 Eleutheria	Dec 08	13.7	+27			
1016 Anitra	Dec 08	13.8	+34			
977 Philippa	Dec 09	13.8	+23			
1052 Belgica	Dec 15	13.7	+21			
740 Cantabia	Dec 17	13.1	+15	>24.		
786 Bredichina	Dec 17	13.5	+22			
1187 Afra	Dec 18	13.9	+41			
366 Vincentina	Dec 21	13.3	+38	15.5	0.11	
215 Oenone	Dec 23	13.2	+26			
1071 Brita	Dec 26	13.3	+29	5.8	0.38	
120 Lachesis	Dec 27	12.3	+33	>20.	>0.1	
437 Rhodia	Dec 29	13.9	+20	56.	0.38	

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* * * * *

The deadline for the next issue (30-1) is October 15, 2002. The deadline for issue 30-2 is January 15, 2003.