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COLLABORATIVE PHOTOMETRY OF 1135 COLCHIS MARCH AND APRIL 2001

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Asteroid 1135 Colchis was observed from Santana Observatory (MPC Code 646) and Roach Motel Observatory (MPC Code 856). The rotational period was determined to be 23.47 ± 0.01 hours with an amplitude of 0.63 ± 0.09 magnitude.

Santana Observatory is located in Rancho Cucamonga, California and has been doing asteroid photometry since 1999. Roach Motel Observatory is located in Riverside, California. Details of the equipment used can be found in Stephens (2000) and Malcolm (2000).

Asteroid 1135 Colchis was selected from the "CALL" web site "List of Potential Lightcurve Targets" (Warner 2000). Colchis is a main-belt asteroid discovered October 3, 1929 by G. N. Neuymin. It is named for the ancient country bordering on the Black Sea south of the Caucasus Mountains, now part of the Georgian Republic. Colchis was initially observed from Santana Observatory on March 19, 2001.

From several night's observations, it became apparent that the rotational period was largely unchanging and likely close to 24 hours. One hundred thirty observations on the nights of March 27 and 28, 2001 were contributed by Roach Motel Observatory and 929 observations from Santana Observatory were contributed. Eventually, 1,059 observations over 14 sessions were used to derive the rotational period. All observations were unfiltered. Dark frames and flat fields were used to calibrate the images.

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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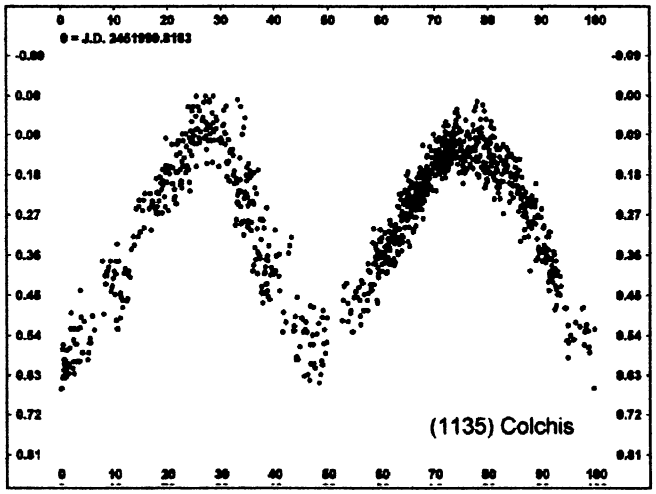

Figure 1: Lightcurve of 1135 Colchis based upon a derived period of 23.47 ± 0.01 hours.

2001MPBu...28...61S

AUTOMATED MINOR PLANET LIGHT CURVE GENERATION

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We describe a system that autonomously generates a lightcurve for one or more desired minor planets. Specifically, the automated process was started with the press of a button, it ran during the night, and the next morning the computer screen displayed the lightcurves for two simultaneously observed minor planets: 631 Philippina and 246 Asporina. Their lightcurves are consistent with their previously known periods.

This paper presents an automated system that generates a lightcurve for one or more minor planets. In short, the system allows one to "Press the start button at the beginning of the night, go to bed, and have the minor planet lightcurve greet you in the morning." Specifically, this method meets the challenge put forth by Professor Richard P. Binzel (Binzel 1991; 2001).

System Description

The components of the system include: a celestial object database program capable of recognizing the name of a minor planet, calculating its position, and providing positions of stars for astrometry and photometry purposes. The system also provides a telescope control and modeling program that controls the robotic telescope hardware and accurately positions the telescope by accounting for systematic telescope errors. Additional capabilities include a camera control and image-processing program capable of controlling a camera and computing astrometry and photometry for raw lightcurve data. Results are shown by a graphing program capable of displaying the lightcurve graph from the raw data.

The celestial object database program can be commanded externally to provide the position of any named minor planet. The list of all known minor planets maintained by the Minor Planet Center can be easily incorporated into the database program so that the position of any minor planet can be determined. Orbital integration is used to produce a very accurate minor planet position. This program also serves as a database for reference stars for astrometry and photometry purposes.

The telescope control program can be commanded externally to move the telescope to any desired position. Integrated with the telescope control program is telescope modeling to correct for systematic errors common to most every telescope mechanical system. The major systematic errors include out of round gears, non-perpendicular axis, polar misalignment, mechanical flexures and offset errors. The telescope-modeling program quantifies and rigorously corrects for these systematic errors, enabling the telescope to point to the desired minor planet.

The camera control program can be externally commanded to acquire digital images. The image-processing portion of this program analyses the images acquired. An astrometric solution is generated by recognizing and correlating stellar patterns on the image itself along with stellar patterns in the associated field of the celestial object database program. Through astrometry of the image and the celestial object database program, appropriate reference stars are used, their flux noted, along with the minor planet's flux. It should also be noted that as the images are acquired, they are reduced accounting for bias and dark current. Then a flat field is applied.

System Integration

An end-to-end demonstration of the system was performed successfully on UT 2001 July 17 at the Software Bisque Observatory using an SBIG ST-9 attached to a Celestron C-11 on a Paramount GT-1100S. At the beginning of the night, the process was initiated by the press of a button. The celestial object database program recognized the name of the first minor planet to be observed, 631 Philippina, and calculated its position. The telescope control and modeling program instructed the telescope to slew to this minor planet position. The camera control and image-processing program, acquired an image of the minor planet, reduced the image, computed an astrometric solution, and logged the instrumental magnitudes of the reference stars and the minor planet. This process was repeated for a second minor planet, 246 Asporina , and the system operated throughout the night by slewing between the two minor planets. At the conclusion, the resulting lightcurves were displayed on screen. The lightcurves for the two minor planets are shown in Figure 1 and Figure 2. The lightcurve of Philippina is consistent with its known period of 5.92 hours as is the lightcurve of Asporina consistent with its longer known period of 16.222 hours.

The system successfully met the challenge at hand by automating the process of generating light curve for two minor planets. It could be easily adapted to apply to most any type of celestial object, for example variable stars and satellites.

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EDITOR'S NOTE: The authors are to be congratulated for accomplishing this challenge set out a decade ago. The Editor hereby declares Matthew L. Bisque and his team as winners of both offered prizes.

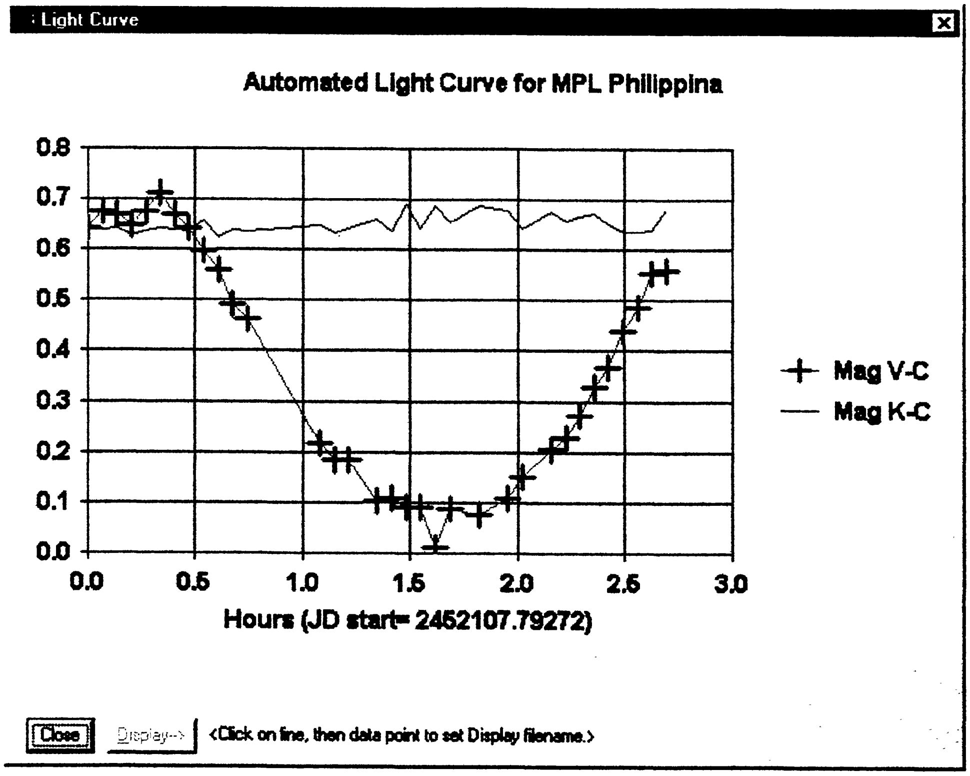

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Figure 1. Automated light curve for minor planet 631 Philippina obtained on 2001 July 17.

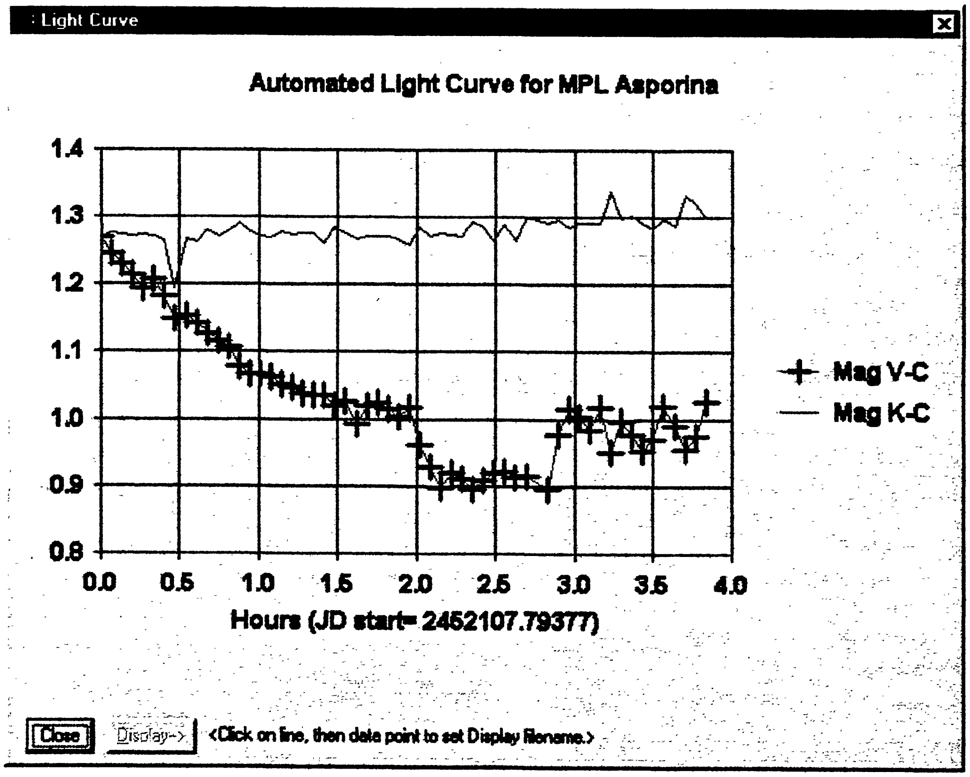

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Figure 2. Automated lightcurve for minor planet 246 Asporina obtained on 2001 July 17.

2001MPBu...28...64M

ROTATIONAL PERIODS AND LIGHTCURVES OF 1166 SAKUNTALA AND 1568 AISLEEN

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Lightcurves of two main belt asteroids were measured at Roach Motel Observatory (Minor Planet Center code 856). 1166 Sakuntala was determined to have a rotational period of 6.30 hours ± 0.02 hours and an amplitude of 0.69 ± 0.1 magnitude. 1568 Aisleen was found to have a rotational period of 6.68 hours ± 0.02 hours with an amplitude of 0.56 ± 0.05 magnitude.

The observations of 1166 Sakuntala, and 1568 Aisleen were made at Roach Motel Observatory in Riverside, California. The observatory has a 12-inch Schmidt-Cassegrain telescope combined with a focal reducer providing a F/8 focal length. Attached is a SBIG ST-8 CCD camera. Telescope and camera control were done using BDW Publishing's Connections 2000 program. This program controls the GOTO functions, tracking, synchronizing on nearby SAO stars, and automatic focusing. All images were taken while the astronomer was spending time with his family and resting for the next day of work, making data gathering easier. Data reductions and lightcurves were prepared using BDW Publishing's Canopus program, which was developed from Dr. Alan Harris' Fourier Analysis program (Harris et al, 1989).

1166 Sakuntala

Minor Planets are sometimes selected for observation by referring to "Asteroid Photometry Opportunities" published each quarter in the *Minor Planet Bulletin*. Minor planets were also chosen based on the eastern horizon to provide the longest period of observations per night.

1166 Sakuntala was observed on five nights from January 2 to 17, 2001. Images were taken unfiltered for 150 seconds and were flat fielded and dark subtracted. A total of 385 images were taken of which 285 were used. Observations covering the entire lightcurve were obtained with several nights of duplicated data confirming the period of rotation. The derived period is 6.30 hours ± 0.02 hours and amplitude of 0.69 ± 0.1 magnitude.

1568 Aisleen

1568 Aisleen was observed on five nights from August 7th to 22, 2000. Images were taken unfiltered for 180 seconds and were flat fielded and dark subtracted. A total of 252 images were taken and 226 were used. Observations covering the 95% of the lightcurve were obtained with several nights of duplicated data confirming the period of rotation. The derived period is 6.68 hours ± 0.02 hours and an amplitude of 0.56 ± 0.05 magnitude.

Acknowledgements

Many thanks to Brian Warner for his continuing help and guidance, and for the development of the software programs 'Connections 2000' and 'Canopus' which makes it possible for amateurs to automatically gather the data, measure and analyze the lightcurves. A special thanks to Robert D. Stephens at Santana Observatory (Minor Planet Center code 656) for his help in the evolution of Roach Motel Observatory.

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Harris, Alan W. (1997). "Minor Planet Lightcurve Parameters". On the Minor Planet Center website: http://cfa-www.harvard.edu/iau/lists/LightcurveDat.html, or on the CALL website: http://www.MinorPlanetObserver.com/astlc/default.htm (updated February 28, 2001)

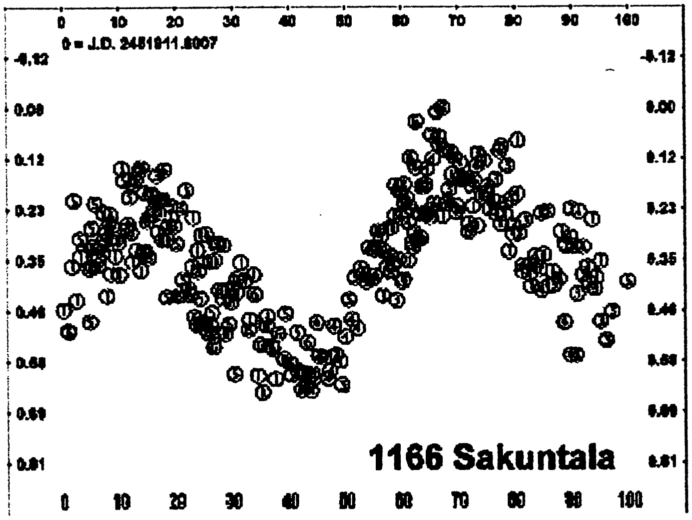

Figure 1. Lightcurve of 1166 Sakuntala based on a period of 6.30 ± 0.02 hours

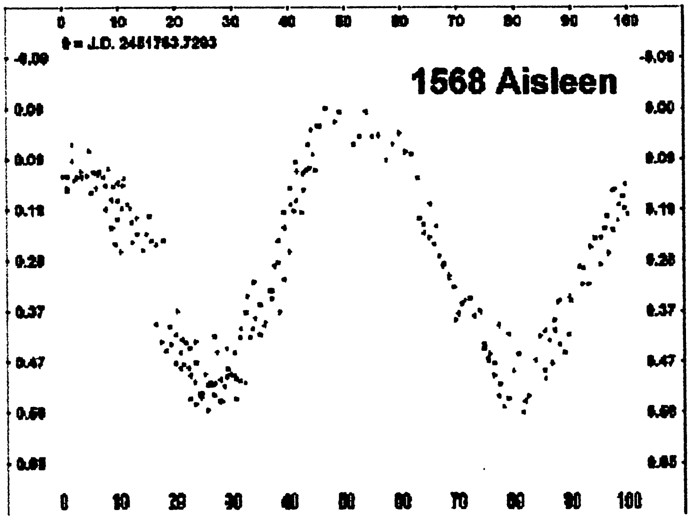

Figure 2. Lightcurve of 1568 Aisleen based on a period of 6.68 ± 0.02 hours

THE MINOR PLANET OBSERVER: A SENSE OF HISTORY

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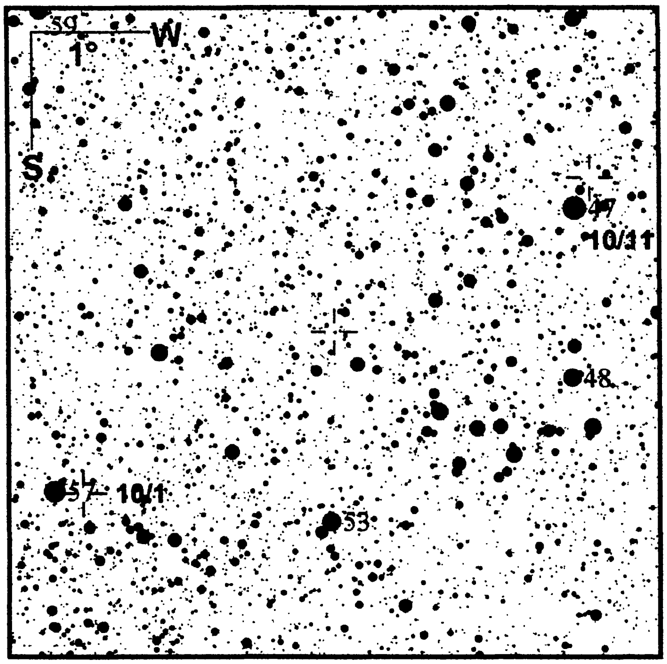
As I walked up the hill, I could almost hear the voices raised in fear and anger. The shouts and the sounds of a pitched and confused battle were mingled into a single chorus of chaos. It was a summer day, yet the wind was blowing and there was a chill in the air. I imagined if it might have been the same as on that day years ago. At the top of the hill, I could look over the valley, see what they had seen but not all. On that July day in 1876, the field was not empty; it was filled with the hunters and the hunted. I wondered what they might have been thinking at the time.

Around the summit of that hill near the Little Big Horn River in southern Montana, markers were strewn about, showing where the nearly 200 men of the U.S. 7th Calvary fell. There were none for the Sioux; none for the Cheyenne; none for the Arapaho. Some of the stones were in small clusters of two or three; others stood as solitary sentinels. Never before had I had such of sense of history or had the ghosts of the past seemed so real. The chill was more from the wind alone: it was from the flood of history passing by.

Nearly twenty years later, I would have a similar feeling. It was not the same one of foreboding, because the event that took place was one for celebration. There was still a hill to climb, this time it was the four flights of stairs up into the Palermo Observatory in Palermo, Sicily, to a small, dark room with an odd looking instrument crafted nearly 200 years ago. The instrument was the Ramsden Circle, the one that Giuseppe Piazzi used on the night of 1801 January 1 to confirm the discovery of the first minor planet, Ceres. The flood of discovery would soon begin. However, it appears that the rate of discovery *may* be slowing down.

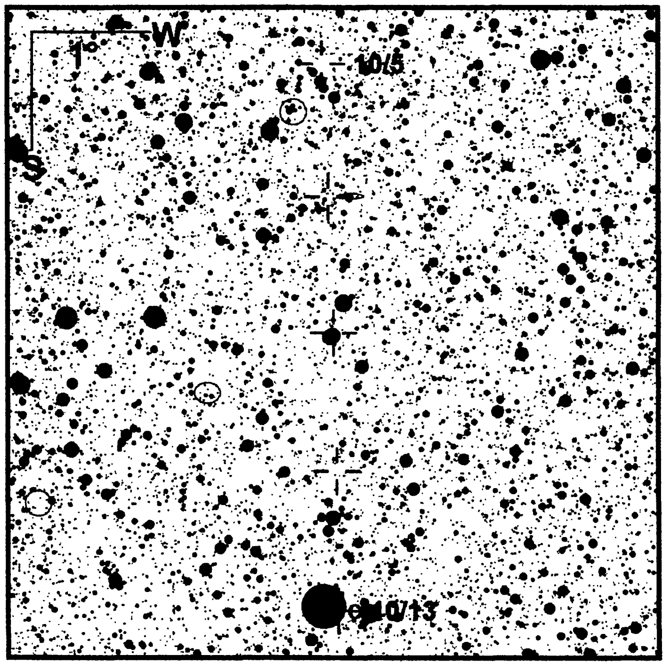
That possible slowing was just one of the topics covered at the Asteroids III Conference in Palermo in June. Margaret and I had the privilege to sit on the periphery of the historical gathering to watch and listen as the past ten years of asteroid research were summed and the next ten years planned. It would take thousands of pages to say all that was said in those five days but if there was a recurring theme it is that discovery, while still important, is not the critical mission of the coming years. Instead, the mission is now the characterization of the asteroids and what doing so can tell us about the evolution and future of the solar system as well as what we might do to mitigate the effects of another asteroid impact.

As Sherlock Holmes said time and again, "Data, Watson! I must have data!" Those in the asteroid community, amateurs in particular, can play a vital role in providing the data astronomers need. The push for asteroid lightcurves is stronger than ever but the effort must have some method or it may be mostly madness. As a formalization of the CALL site, a new group of amateurs and professionals is being formed. The Center for Asteroid Physical Studies (CAPS) will have the goal of helping coordinate amateur lightcurve work so that the maximum benefit can be gained from every observer. You can learn more about CAPS at http://www.MinorPlanetObserver .com/caps/default.htm. Even if you don't want to formally take part, I urge you in some way to participate in the next ten years of discovery and research and so become a part of the history yet to be written. Clear Skies!



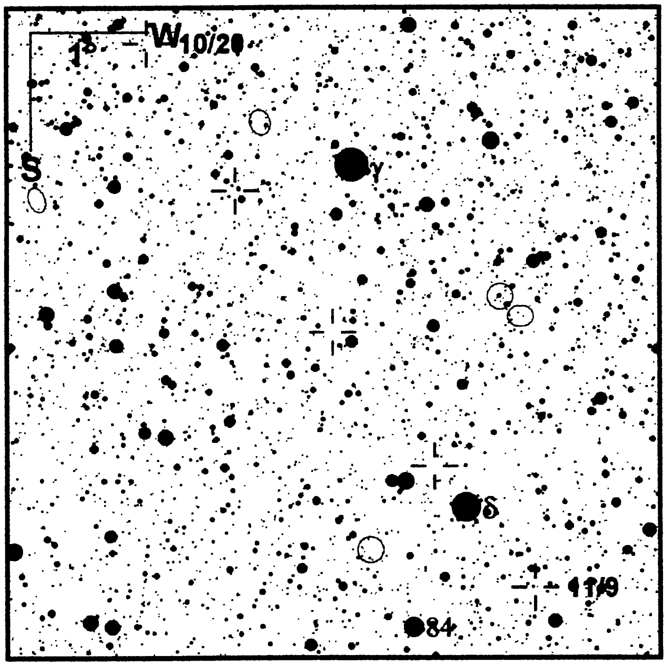
1170 Siva (F) Siva is a type S asteroid of about 12km size. E. Delporte discovered it in 1930 September. The name is that of the Hindu god of destruction and regeneration. The field is in Pisces. 47 Piscium is also known as the variable TV Piscium

Date	RA1950	Dec1950	RA2000	Dec2000	M	PA	E
09/26	0 53.78	+14 01.4	0 51.15	+13 45.1	13.8	9.3	163
10/01	0 45.52	+15 27.8	0 42.90	+15 11.4	13.6	7.4	167
10/06	0 36.66	+16 51.0	0 34.04	+16 34.5	13.5	6.9	168
10/11	0 27.51	+18 09.3	0 24.91	+17 52.7	13.6	8.3	165
10/16	0 18.44	+19 21.3	0 15.85	+19 04.7	13.7	10.9	161



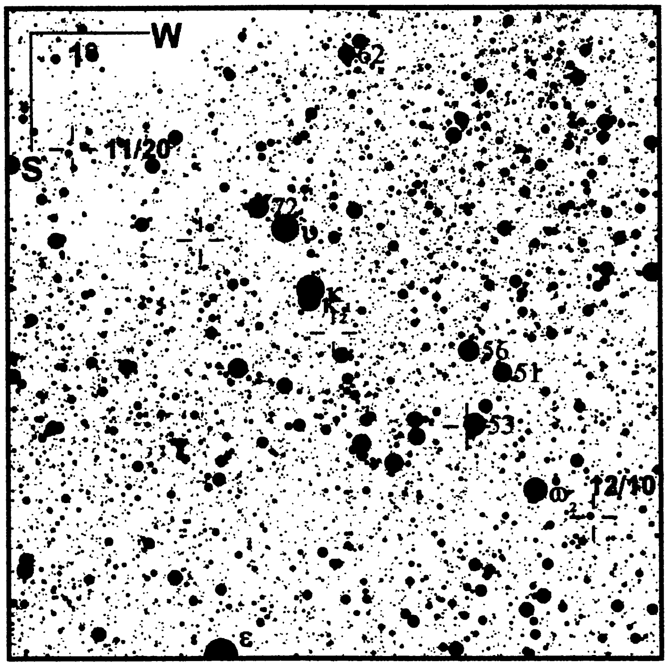
4451 Grieve (F) Grieve is named after Canadian geologist, Richard Grieve, who is known for his work on impact craters. Discovery was by C. and E. Shoemaker in 1988 May. The bright star at bottom is Alpha And.

Date	RA1950	Dec1950	RA2000	Dec2000	M	PA	E
10/05	0 08.46	+33 42.4	0 05.87	+33 25.7	13.7	17.0	150
10/07	0 08.19	+32 34.5	0 05.61	+32 17.8	13.7	16.3	151
10/09	0 07.99	+31 25.2	0 05.41	+31 08.5	13.7	15.6	152
10/11	0 07.86	+30 14.6	0 05.28	+29 57.9	13.7	15.1	153
10/13	0 07.82	+29 03.2	0 05.24	+28 46.5	13.7	14.7	154



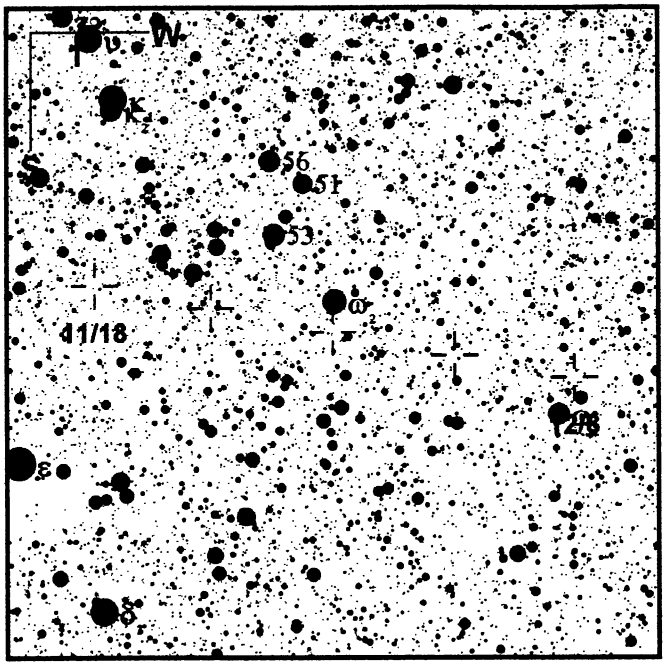
547 Praxedis (F) P. Gotz found this 47km type MEU asteroid in 1904 October. It is named after a character in von Scheffel's *Ekkehard*. The chart covers a section of Cetus between Gamma (top) and Delta (bottom). The galaxy southeast of Delta is the famous spiral, M77.

Date	RA1950	Dec1950	RA2000	Dec2000	M	PA	E
10/20	2 50.25	+ 4 16.6	2 47.64	+ 4 04.3	12.1	8.6	161
10/25	2 47.24	+ 3 01.4	2 44.64	+ 2 48.8	12.0	7.0	165
10/30	2 43.95	+ 1 48.8	2 41.36	+ 1 36.1	11.9	6.3	166
11/04	2 40.52	+ 0 40.7	2 37.95	+ 0 27.9	12.0	6.8	165
11/09	2 37.13	- 0 21.3	2 34.57	- 0 34.3	12.1	8.2	162



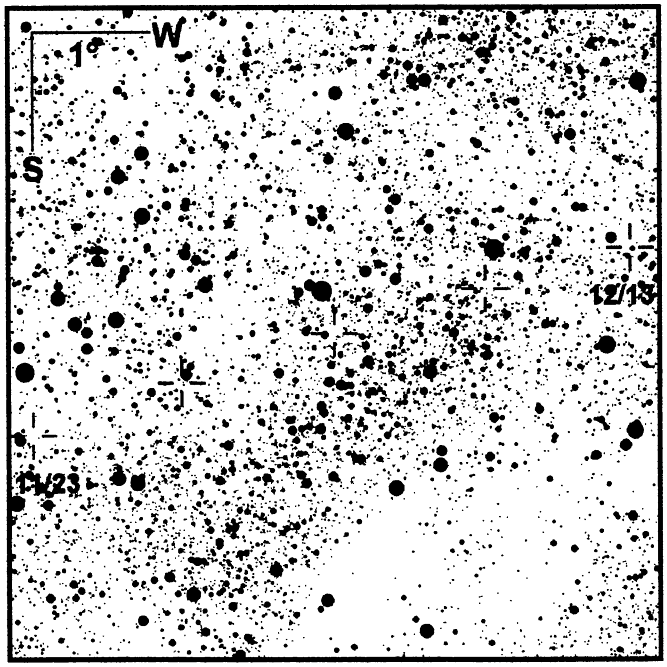
3182 Shimanto (F) This 16km asteroid was discovered by T. Seki in 1984 November. The name is that of a river in the Kochi prefecture. This is the brightest apparition for Shimanto through 2050 but it is not the closest approach it makes to earth. By only 0.006AU, the 2022 apparition is better. This will not be an easy target. The field lies in Taurus.

Date	RA1950	Dec1950	RA2000	Dec2000	M	PA	E
11/20	4 34.19	+23 28.9	4 31.18	+23 22.7	14.9	5.6	167
11/25	4 29.42	+22 42.9	4 26.43	+22 36.4	14.8	2.8	174
11/30	4 24.53	+21 55.5	4 21.56	+21 48.7	14.5	0.1	180
12/05	4 19.72	+21 07.7	4 16.77	+21 00.6	14.8	2.7	174
12/10	4 15.16	+20 20.6	4 12.23	+20 13.1	15.0	5.4	168



5138 Gyoda (F) Gyoda was discovered by T. Hioli and S. Hayakawa in 1990 November. It was later named after an ancient city and burial ground north of Tokyo. This is the second brightest apparition for Gyoda in the period 1995-2050. These stars in Taurus lie north and west of Aldebaran.

Date	RA1950	Dec1950	RA2000	Dec2000	M	PA	E
11/18	4 25.97	+20 42.2	4 23.03	+20 35.5	15.3	4.6	168
11/23	4 21.72	+20 31.0	4 18.78	+20 23.9	15.1	2.4	174
11/28	4 17.31	+20 19.1	4 14.38	+20 11.8	14.9	0.4	179
12/03	4 12.89	+20 07.1	4 09.97	+19 59.5	15.1	2.2	174
12/08	4 08.60	+19 55.2	4 05.68	+19 47.3	15.3	4.5	168



1024 Hale (F) George E. Hale was one of the preeminent astronomers of the early 20th century. Hale was honored in many ways, including the naming of this 28km asteroid after its discovery by G. Van Biesbroeck in 1923 December. The chart covers a section of northern Taurus, just south of its border with Auriga.

Date	RA1950	Dec1950	RA2000	Dec2000	M	PA	E
11/23	4 52.39	+27 21.6	4 49.28	+27 16.7	13.9	5.9	165
11/28	4 46.71	+27 49.9	4 43.59	+27 44.5	13.8	3.8	170
12/03	4 40.85	+28 15.3	4 37.73	+28 09.6	13.8	2.5	174
12/08	4 35.00	+28 37.8	4 31.87	+28 31.6	13.8	3.1	172
12/13	4 29.35	+28 57.2	4 26.22	+28 50.7	14.0	5.0	167

LIGHTCURVE PHOTOMETRY OF ASTEROID 490 VERITAS

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Overcoming the 24 hour commensurability of the Earth's rotation for mid-latitude observatories requires multiple sites widely separated in longitude. An ongoing collaborative lightcurve investigation between Thornton Observatory in the United States and Flarestar Observatory in Malta (separated in longitude by 119 degrees) reveals asteroid 490 Veritas to have a nearly commensurate period of 7.930 ± 0.005 hours. The lightcurve amplitude is 0.50 magnitude ± 0.03 magnitude

Thornton Observatory is located in Thornton, Colorado, at an elevation of 5530'. Since 1997, the observatory, operating as Minor Planet Center observatory code 713, has been performing asteroid astrometry and photometry. Flarestar Observatory is located in San Gwann, Malta at an altitude of 300 feet. In 1999, Flarestar started operation as Minor Planet Center observatory code 171 and has been performing asteroid astrometry and photometry. Details of both observatories' equipment may be found in Koff and Brincat (2000).

The target was selected based on its magnitude and position in the sky, to maximize the length of time it would be observable, particularly under the restricted sky visibility of Thornton Observatory. Veritas is a main belt asteroid, discovered in 1902 by M. Wolf. It is approximately 120 km in diameter. Initially, no light curve data were found for this object (Harris, 1997). However, an update of the available data by Dr. Harris revealed that the object had been studied, but the results were considered uncertain. In fact, this study revealed a different period than the published value.

Observation of this object began at Thornton Observatory on February 13, 2001 and continued until March 19, 2001. It became clear early on that the most likely period was close to 8 hours. In fact, the period turned out to be 7.93 hours, which complicated the analysis. Further complicating the analysis was the symmetry of the curve, which allowed for multiple solutions. Observations were requested from Flarestar Observatory in Malta, a frequent collaborator with Thornton. Flarestar was able to contribute two nights of data, but the data were found to overlap that from Thornton. Bad weather hampered both observatories throughout the project. Finally, the stubborn gap in the lightcurve was closed by observations at Thornton on March 16 and 19th, 2001. The final segments matched up at both ends of the gap, enhancing the confidence in the period solution. This is a graphic example of the problem of commeasurability.

Observations from Thornton were made on 10 nights during the period from February 13 to March 19, 2001. Exposure times at Thornton these investigations were two minutes each. Images were taken at 3-minute intervals in unfiltered light. Dark frames and flat fields were used to calibrate each image. Observations from Flarestar were made on two nights, February 24 and March 14. Images were of 3 minutes duration at an average interval of 7 minutes in unfiltered light. Dark frames and flat fields were used for calibration. The differential photometry was measured using the program "Canopus" by Brian Warner, which uses aperture photometry. Magnitudes were calculated using reference stars from the USNO-A 2.0 and GSC catalogs. 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 manually shifting individual night's magnitude scales to obtain a best fit. A total of 788 images were used in the solution.

Figure 1 shows the composite lightcurve for Veritas. The zero point of the curve is J.D. 2451953.7025. The period is 7.930 hours ± 0.005 hours. The amplitude is 0.50 magnitude ± 0.03. The mean measured magnitude is 12.85, which should be considered an instrumental magnitude.

Acknowledgments

Thanks go 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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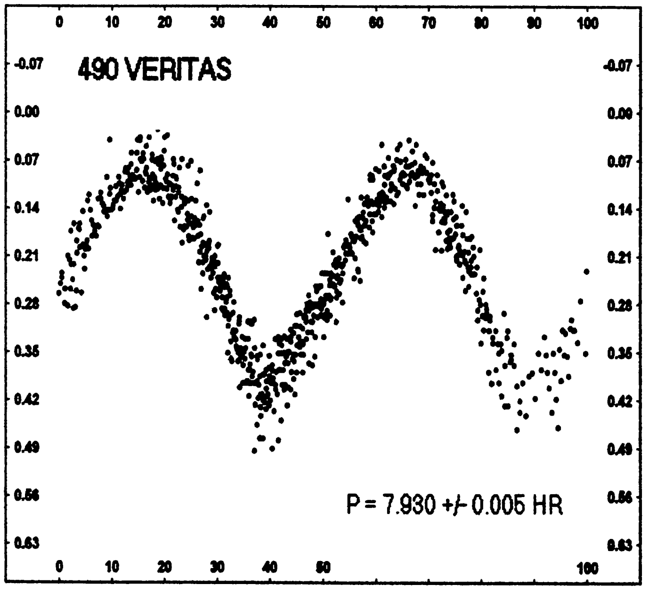

Figure 1. Lightcurve of 490 Veritas, based on a rotational period of 7.930 hours. Ordinate is relative magnitude.

LIGHTCURVES AND PERIOD DETERMINATION FOR 640 BRAMBILLA

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Minor planet 640 Brambilla was observed over a period of 16 days (46 rotations) during March and April, 2001. Lightcurves obtained on 6 nights with an unfiltered CCD have yielded a rotational (synodic) period of 7.768 ± 0.006 hrs. The complete lightcurve is doubly periodic, with a total amplitude range of 0.25 ± 0.02.

Introduction

Asteroid 640 Brambilla is one of the many discovered by A. Kopff from Heidelberg. Originally designated 1907 ZW, it was found on Aug. 29, 1907. This main-belt asteroid was subsequently named after the 1821 novel Prinzessin Brambilla by the German writer and composer E. Hoffmann. The tabulated data in *Asteroids II* (Binzel et al. 1989a) list a B-V of 0.75 and a low albedo of 0.063, with a diameter of 84.8 ± 2.3 km. The Tholen class is G, indicating spectral characteristics similar to C types, but with strong UV absorption. The tabulations of Harris (1999) were also examined. However, no lightcurve data are listed in either of these sources.

Observations and Results

Brambilla was chosen from the CALL list of Warner (2001). At this opposition it was at Declination -17^0, making it suitable for southern hemisphere observers. Observations were made from Mt Tarana Observatory near Bathurst, NSW. The site is at 880m and the Lat. is S 33.4348, Long. E 149.7576. The equipment and methodology have been described by Bembrick (2001). The observational circumstances summary (Table I), also shows the percent of the rotational lightcurve covered on each night.

Data from each night were plotted as differential instrumental magnitude vs U.T. No light-time corrections were applied. Data from the better nights show two maxima and two minima, with the least noisy light curve on 26 March. Thus the epoch of zero phase was chosen as the prominent maximum of Mar 26 at 13.09 UT (JDGeo 2451995.04792). In all, 18 extrema were identified from the lightcurves and the time differences between these were used to estimate the rotational period. This led to an estimate of 7.768 ± 0.006 hours. On this basis the observations cover 46 rotational cycles. Using the above epoch and period, the data were phase folded to produce the results shown in Figure 1. This figure displays data from -0.2 to +1.0 phase so as to show fully the most prominent maximum. Magnitudes of the primary maxima from other nights were adjusted to the magnitude of the zero phase maximum on the night of epoch. From Figure 1, the average amplitudes of the extrema were estimated. The zero phase maximum is approximately 0.23, whereas the following maximum (at 0.55 phase) is approximately 0.25 magnitudes. From the comparison and check star differences for each night an estimate of the sky stability was made. These differences were ± 0.02, giving an indication of the overall accuracy of the quoted amplitudes. Preliminary results were posted on the CALL website on April 13, 2001.

Discussion

Using AAVSO variable star software, a period search was made using data from all seven nights. The results agree well with the graphical method discussed above. The best frequency was found to be 3.0889 (cycles/day), which is the same 7.768 hour period.

To a first approximation, the maximum amplitude of 0.25 magnitudes implies a ratio a/b of approx 0.8, where a, b and c are the axes of a tri-axial ellipsoid and the rotation is about the shortest axis, c.The very small difference of around 0.02 magnitudes in the two maxima implies little difference in albedo between the opposite hemispheres. Slight variations in the shape and depth of the extrema from night to night indicate that there are topographic and/or shadowing effects present. A small positive anomaly in the lightcurve between 0.1 and 0.2 phase and also a flattening of the light curve between 0.4 and 0.5 phase are seen to repeat over several nights, suggesting the presence of small topographic features. On individual night lightcurves these are quite distinct, but tend to be less obvious in the stacked curve of Figure 1. Other small anomalies between 0.6 and 0.7 phase appear on the lightcurve, but these do not appear to repeat from night to night. Their cause is not known at this time.

Using the methodology of Schober et al (1980) it is possible to gain some idea of the linear dimensions of the surface features that are responsible for these anomalies. Their extent can be measured from the individual night lightcurves in terms of both delta phase and delta magnitude. These can then be turned into two separate estimates of the linear dimensions of the small-scale features present. In Table 2, the linear dimension L' is derived from delta phase and the linear dimension L is derived from the delta magnitude of the lightcurve anomaly. As can be seen, these two estimates give reasonably consistent values for the small-scale features present at two different points on the lightcurve (estimates from delta phase seem to give the best consistency). This gives some confidence that real features are being mapped here. The nature of these feature remains unresolved – they may be high albedo, young craters or craters with dark floors or other topographic &/or shadow effects.

Conclusion

Minor planet 640 Brambilla was observed over 46 rotational cycles and the synodic period determined as 7.768 ± 0.006 hours. This is believed to be a secure result as all rotational phases of the light curve were observed. The light curves show the doubly periodic features typical of an irregularly shaped, tri-axial

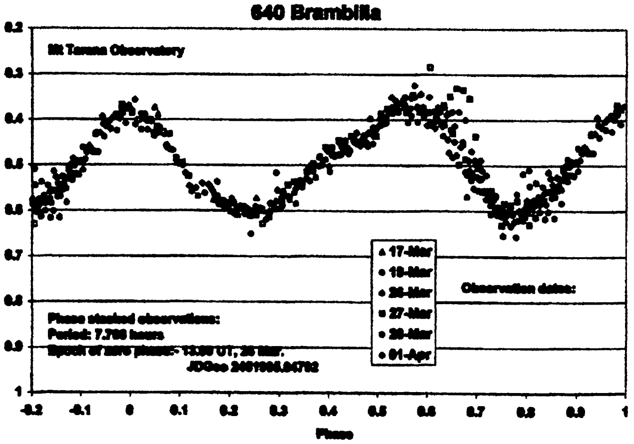

Figure 1. Lightcurve for asteroid 640 Brambilla.

ellipsoid. The maximum amplitude of the lightcurve at this opposition was 0.25 ± 0.02 magnitudes. This value is fairly typical of C class asteroids of this diameter (Burns and Tedesco, 1979). The difference between the two maxima was only 0.02 magnitudes, implying a very small difference in albedo between the opposite hemispheres. Small anomalies on the lightcurves indicate that this minor planet has small-scale surface features of the order of 10 – 15 km in linear extent. With a revolution rate of 3.089/day, Brambilla is one of the faster rotators among the asteroids between 50 and 125 km diameter. This group of asteroids have a unimodal distribution of rotation rates peaking at slightly less than 2 revs/day (Binzel et al. 1989b).

Acknowledgements

Many thanks to Brian Warner for providing historical details on several asteroid names.

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Table I. Observational Circumstances, 2001

Date of Obs.	Hel. Lat. (B°)	Hel. Long. (L°)	R (AU)	Solar Phase Angle	Phase Coverage (%)
17 Mar.	-9.85	188.22	3.108	6.8	25
19 Mar.	-9.79	188.58	3.107	6.3	90
26 Mar.	-9.59	189.85	3.102	4.9	125
27 Mar.	-9.56	190.04	3.101	4.7	125
28 Mar.	-9.53	190.22	3.100	4.6	125
01 Apr.	-9.41	190.94	3.097	4.4	51

Table II. Lightcurve Anomaly Interpretation

Date	Delta Phase	L' (km)	Delta M	L (km)
Positive Feature at 0.15 Phase				
Mar 26	0.05	13	0.03	12.6
Mar 28	0.05	13	0.04	14.6
Negative Feature at 0.47 Phase				
Mar 19	0.056	15	0.04	14.6
Mar 27	0.056	15	0.047	15.8

NEW LIGHTCURVE OBSERVATIONS OF 96 AEGLE

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CCD photometry of 96 Aegle during its 2001 apparition reveals a lightcurve with low amplitude of about 0.1 mag. The most self-consistent composite lightcurve is formed using a rotation period of 26.53 ± 0.03 hours, but other periods remain possible. The best-fit values of Lumme-Bowell phase coefficients to the linear part of its solar phase dependence are H = 7.54 ± 0.10 and G = –0.04 ± 0.03. A similar reduced magnitude and low amplitude at a differing aspect leads us to infer that Aegle isn't very elongated in shape.

Introduction

We observed asteroid asteroid 96 Aegle during its 2001 apparition in an effort to refine previous estimates of its rotation period and to also determine its previously unknown solar phase slope coefficient. This main belt object is the largest member of the relatively rare T spectral class (Tholen 1989). Though Aegle is of low albedo, its diameter of about 174 km (Tedesco 1989) made it bright enough to be a suitable target for a student observing project at Colgate University during the spring of 2001.

Aegle has been previously observed first in 1980 by Harris and Young (1989b), who suspected a possible period near 10 hours, then in 1996 January by Wetterer (1997), who was unable to further constrain the period, and finally in 1996 May by Blanco et al. (2000), who refined the possible period to 10.470 hours. None of these lightcurve data exhibit any definitively repeating features.

Observations

Our observations of Aegle were made during eight nights between 2001 Feb. 14 and Mar. 29 at Colgate's Foggy Bottom Observatory in Hamilton, NY. The asteroid and nearby reference stars were imaged through a V filter using a CCD detector mounted at the Newtonian focus of the 41-cm telescope. The IRAF software application packages were used for both image processing and synthetic aperture photometry (Massey 1997, Massey and Davis 1992).

All-sky photometric nights are rare at our central New York observing site, but since the on-chip comparison stars used on different nights are quite close together in the sky, we were able to measure their relative brightnesses within an hour or two of stable sky conditions on clear nights by imaging them rapidly enough to

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minimize differences in airmass and in time. The one-sigma uncertainties of these relative brightnesses are 0.01-0.02 mag. Additional observations of on-chip comparison stars were made on a photometric night along with primary standard star SA 101-262 (Landolt 1992) so that the observations could be transformed to V magnitudes. The standard's B-V color index of +0.78 is a close match to Aegle's value of 0.77 (Tedesco 1989) which minimizes color effects. The one-sigma uncertainty of the overall transformation of the asteroid observations to the standard V system is 0.05 mag.

Reduction for Phase Coefficients

Changes in distance, solar phase angle, and rotational phase all contribute to the observed brightness variations of Aegle. The effect of changing distance was removed by reducing the observed V magnitudes to the brightness the asteroid would appear if it were 1 AU from both the Sun and Earth.

The observations span a considerable range of solar phase angles, and the plot of mean reduced magnitude vs. phase angle presented as Fig. 1 shows that the overall brightness of Aegle decreased gradually by about 0.3 mag. between Feb. 14 and Mar. 21. To reduce systematic errors in the mean values caused by incomplete coverage of rotational phase, data are plotted only from the four nights on which the longest spans of lightcurve were recorded. A weighted fit of the Lumme-Bowell solar phase function (Bowell et al. 1989) was made to the mean brightnesses and their relative calibration errors (sigma in the legend of Fig. 1). The best-fit values of the phase coefficients, including the overall uncertainty in the transformation to standard V, are H = 7.54 ± 0.10 and G = –0.04 ± 0.03. This best-fit phase function for Aegle appears in Fig. 1 as a solid line.

Reduction for Rotation Period

To prepare the individual nights' lightcurves for rotation period analysis, the reduced magnitudes were adjusted to the solar phase angle on Feb. 14 using the slope parameter G determined from the observations, and the times of the observations were corrected for the light-travel time to Earth.

Reduction for rotation period is based on the assumption that the lightcurve exhibits repeating features. The three nights of highest-quality data from Feb. 14, 16, and 19 record a total of more than 15 hours of lightcurve and include a dozen well-defined local extrema, but none of the features reliably repeat in shape and in brightness. This implies that the lightcurve must have a period greater than 15 hours and also must have more than two maxima and minima per cycle. The brightness changes don't exceed 0.1 mag., and complicated structure is possible for low-amplitude lightcurves because the shape-induced doubly periodic sinusoid expected for ellipsoids is more easily hidden by signal variations caused by albedo or topographic features. Reliable period determination from lightcurves such as these can be difficult.

In absence of repeating features in the lightcurve data, the Fourier fitting approach described by Harris and Lupishko (1989) was used to identify trial rotation periods that yield self-consistent composite lightcurves with the smallest root-mean-square residuals. The data do not lead to a unique result, but the most favored period seems to be 26.53 ± 0.03 hours, where the uncertainty was estimated from the overlap in the data from Feb. 19 and Mar. 21. This result is based on less than full coverage and also may be an "alias" period wrong by an integer factor, so we assign a reliability code of 2. Other possible periods appear but yield less self-consistent composite lightcurves.

A plot of the composite lightcurve of Aegle assuming P=26.53 hours is presented as Fig. 2 showing reduced V magnitudes vs. UT hours on 2001 Feb. 14. Data have been adjusted to the solar phase angle on Feb. 14, antedated for the light-travel time to Earth, and translated into the plotted time span modulo the rotation period. The plot covers one cycle of the rotation period plus the earliest and latest 10% of the period span repeated. Error bars plotted on the data represent the estimated one-sigma standard uncertainty with respect to the local comparison star used. 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. 14, and finally the uncertainty (sigma) for the relative overall magnitude level of the lightcurve with respect to that of Feb. 14.

Clouds affected the data from the early part of Mar. 4 and the later part of Mar. 21. The data from Mar. 29 are differential magnitudes without V calibration which were excluded from the period determination, but are included on the plot with a shift in brightness for reasonable visual fit to the rest of the composite to show that their downslope is consistent with the calibrated data.

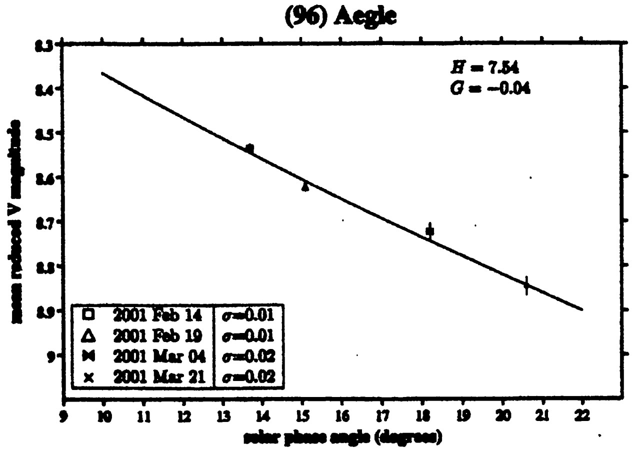

Figure 1. Solar phase function for 96 Aegle. The uncertainty in the overall transformation to standard V is 0.05 mag. for both Fig. 1 and Fig. 2.

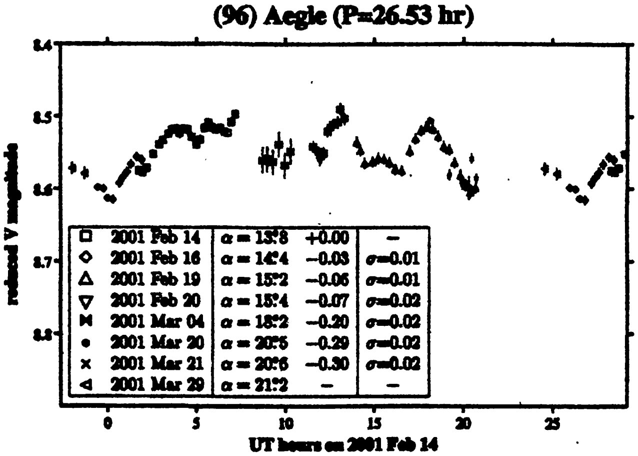

Figure 2. Composite lightcurve for 96 Aegle. The Mar. 29 data are shifted differential magnitudes as described in the text.

Discussion and Conclusions

It is now possible to rule out the previously suspected rotation periods because they don't yield self-consistent composite lightcurves of the new data. However, with only about 10% overlap coverage in the lightcurve composited with the new period, our result should be checked with additional observations. We also note that in absence of observations at small phase angles during this apparition, the fitted value of G doesn't reflect the unknown phase function behavior in the "opposition effect" range of small phase angles, and H itself remains poorly constrained.

The observations of Harris and Young (1989) from 1980 were recorded from a viewing aspect about 36 degrees away from that of the new data, but are of comparable low amplitude and of mean brightness only 0.02 mag. different from that predicted by the new phase coefficients. This similarity at different aspects suggests that Aegle isn't very elongated in shape.

On the other hand, the observations of Blanco et al. (2000) from 1996 May exhibit a brightness variation of about 0.4 mag. and only the faintest of their data are consistent with the new phase coefficients. Such lightcurves that are both larger-amplitude and brighter can't be explained solely by the 47 degree change in viewing aspect if Aegle is well-modeled by a featureless, uniformly bright object rotating about its shortest axis, because the model predicts that an increase in amplitude would correspond to a decrease in mean brightness, and vice versa. Some effect other than shape must be at work.

Acknowledgments

We thank Tom Balonek for generous and flexible telescope scheduling, Mariah Lyndaker for making extra observations of Aegle during her own telescope time, and Roger Williams for technical support.

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THE LIGHTCURVE OF 1069 PLANCKIA REVISITED

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Two of the authors independently observed the asteroid 1069 Planckia in 2000 April and May. The combined data were used to re-examine the previously published period of the asteroid. It is believed that the previously stated period of 10.58h is incorrect and should be replaced by one of 8.643h ± 0.05h. The amplitude was found to be increasing during the span of the observations, increasing from 0.17 mag. in late April to 0.25 mag. in late May.

In a previously published report in the *Minor Planet Bulletin* (Warner 2001), the lightcurve for the 43km asteroid, 1069 Planckia, was found to be 10.58h ± 0.05. After that paper had been submitted, the authors received word from Dr. Richard Binzel, editor of the *Minor Planet Bulletin*, that author Malcolm had also submitted a paper for the same asteroid, finding instead a period of 7.15h. At the encouragement of Dr. Binzel, Warner took the data obtained by Malcolm and made a combined data set in an effort to determine which period, if either, was correct. Also doing a parallel analysis was author Stephens. Since all of us use MPO Canopus, this was fairly easy to do since the software allows saving of data for a specific asteroid and merging it with other data. However, complicating the matter some was that the amplitude of the lightcurve changed as the asteroid's phase angle increased from about 8° in late April to 16° in late May.

Figure 1 shows the plot of the data obtained by Warner published previously in the *Minor Planet Bulletin*. The phased plot is against the period of 10.58h. Figure 2 shows the data obtained by Malcolm, phased against the period he reported in his unpublished paper of 7.15h. Independently, each might seem a reasonable solution. However, when the full data set was phased against one period or the other, no reasonable solution could be found. While working with Malcolm's data, Stephens found a solution of 8.655h that seemed to fit the data very reasonably. When Warner's data was applied against this solution, this also resulted in a reasonable fit. However, when the combined data set was phased against the period, the fit was not as good but still close. Eventually, a period of 8.643h ± 0.05h was found to provide a combined solution with a better fit than the two independently proposed periods. A phased plot of the data against the 8.6h period is shown in Figure 3. The points numbered 1 through 3 are from the Warner data. All others are from the Malcolm data.

This exercise showed the great capacity for collaborative efforts, both when acquiring and analyzing data, to help find a better solution than might be found by observers working independently. The much longer time span provided by combining data sets was a key factor in filtering out potential periods during the reduction process. What also would have helped is more data to fill in the parts of the phased curved that were not covered. Independent observers may not be able to get the missing data nor know that by observing on a given night and/or time, they would be providing the much-needed information.

It is for this reason the Collaborative Asteroid Lightcurve Link (CALL) was established. In addition, a group called the Center for Asteroid Physical Studies has been formed following the Asteroids III Conference in Palermo, Italy. This group is comprised mostly of amateurs who want to take asteroid photometric observations to the next level not only by using high precision techniques but coordinating observing programs with targeted objects so that the most is made of observing time. The CALL site is at http://www.MinorPlanetObserver.com/astlc/default.htm while the CAPS site can be found at http://www.MinorPlanetObserver.com/caps/ default.htm.

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. Our thanks also go to Dr. Richard Binzel for his suggestions and patience during the preparation of this paper.

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Editor's Note: The authors are to be congratulated on their collegial effort to determine the best period solution in the face of each having a seemingly correct answer. Such openness to new data and new interpretations is the hallmark of excellent science.

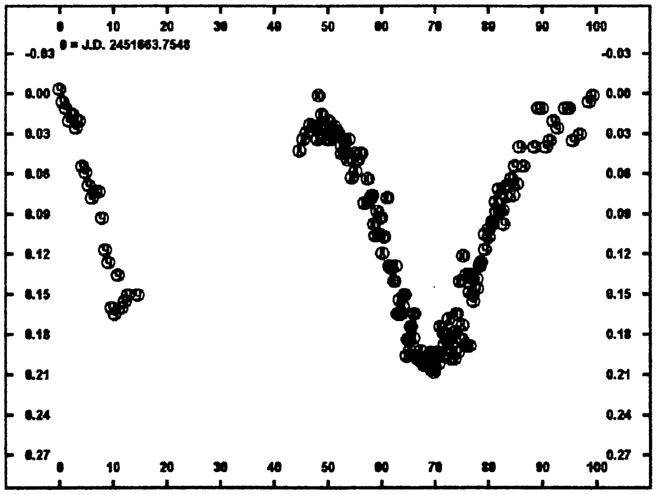

Figure 1. The lightcurve plot for 1069 Planckia using the data from Warner, phased to 10.58h.

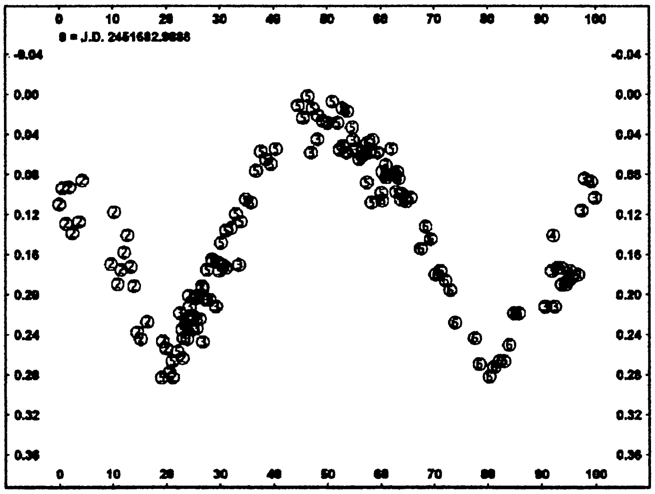

Figure 2. The lightcurve plot for 1069 Planckia using the data from Malcolm, phased to 7.15h.

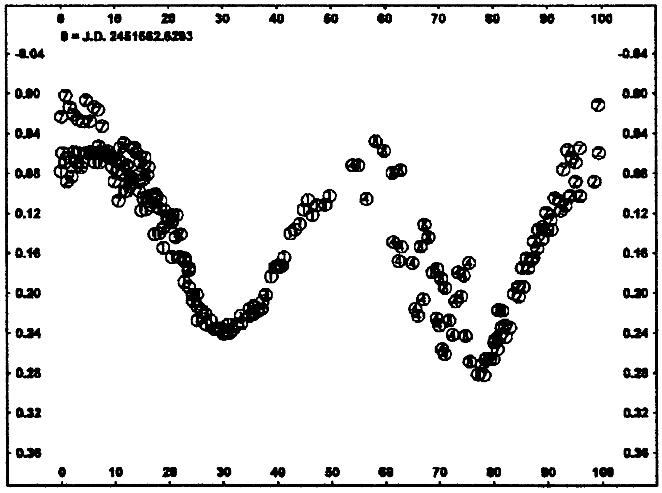

Figure 3. The lightcurve plot for 1069 Planckia using the data from both observers, phased against the revised period of 8.643h ± 0.05h. The amplitude of the curve changed from 0.17m in late 2000 April to 0.25m in late 2000 May.

COLLABORATIVE PHOTOMETRY OF 489 COMACINA MARCH THROUGH MAY 2001

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(Received: 12 June Revised: 11 July)

Asteroid 489 Comacina was observed from Santana Observatory (MPC Code 646), Flarestar Observatory (MPC Code 171), and Thornton Observatory (MPC Code 713). The rotational period was determined to be 9.02 ± 0.01 hours with an amplitude of 0.4 ± 0.05 magnitude.

Santana Observatory is located in Rancho Cucamonga, California at an elevation of 400 meters and is operated by Robert D. Stephens. Flarestar Observatory is located in San Gwann, Malta at an elevation of 100 meters and is operated by Stephen M. Brincat. Thornton Observatory is located in Thornton, Colorado and an elevation of 1,687 meters. Robert A. Koff operates it. Details of the equipment used can be found in Stephens (2000), Koff and Brincat (2000).

Asteroid 489 Comacina was independently selected by the amateur observatories from the "CALL" web site "List of Potential Lightcurve Targets" (Warner 2000) to refine its rotational period. The rotational period had previously been determined to be 9 hours by S. J. Weidenschilling. After observations began, the observers learned of each other's efforts and decided to combine observations into one study. Comacina is a main-belt asteroid discovered September 2, 1902 by L. Canera in Heidelberg. It is named for a little island in Lake Como in Northern Italy.

Aperture photometry was done 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. Eventually, 412 observations over 9 sessions spanning 46 days were used to derive the rotational period. All observations were unfiltered. Dark frames and flat fields were used to calibrate the images.

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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Table 1: Summary of Observations

Observer	Sessions/ Observations	Dates
S. M. Brincat	2/31	March 24 and April 25, 2001
R. A. Koff	1/103	April 18, 2001
R. D. Stephens	6/278	April 27,28,30 and May 1,2,9, 2001

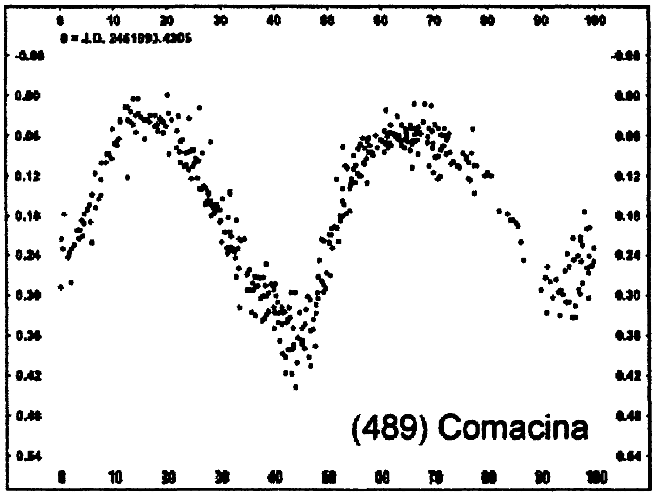

Figure 1: Lightcurve of 489 Comacina based upon a derived period of 9.02 ± 0.01 hours.

2001MPBu...28...73S

SUGGESTED REVISED H VALUES OF SELECTED ASTEROIDS – REPORT NUMBER 2

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(Received: 15 July Revised: 29 July)

We report 23 new minor planets for which visual and CCD measures indicate an average difference of magnitude from the current predicted values. Typical discrepancies are 0.3 to 0.5 mag., but are as high as 2.2 mag. We suggest a revision of their catalogued H magnitudes to permit better predicted magnitudes in the future ephemerides of these objects, notably by the Minor Planet Center.

Since its founding in 1997, the "Magnitude Alert Project" begun by Lawrence Garrett has continuously grown and now includes 55 members of 10 countries. The MAP is managed jointly by the ALPO Minor Planet Section (http://www.lpl.arizona.edu/~rhill/alpo/minplan.html) and by the French AUDE Association (Association des utilisateurs de Détecteurs Electroniques – http://www.ccdaude.com)

As of March 10, 2001 the MAP Database contained 2834 measures of magnitudes for a total of 275 asteroids suspected to have a magnitude discrepancy greater than 0.3 magnitude. Since 1997, new star catalogs with better accuracy than the GSC Catalog have been published, such as the USNO-A and SA catalogs and recently the Tycho 2 catalog, with its 2.5 million stars (magnitude accuracy about 0.05 magnitude). This new catalog and some modifications of our methods now permit MAP observers to obtain fairly good accuracy.

Various analyses of our data show an average difference of only 0.1 to 0.2 magnitude between visual, unfiltered CCD and now filtered CCD measures in V band. From these, we calculate our average H magnitude discrepancies without all GSC measures and R measures which are too frequently different from the other obtained magnitudes (often 0.4 magnitude and more).

This second report of MAP Results only include objects for which at least 3 observers found nearly equal magnitude discrepancies for the same asteroid. Some of these asteroids also are already observed during 2 or 3 oppositions, with a continual difference between observed and predicted ephemeris magnitudes. The impact of an eventual variability of the asteroid is statistically eliminated by many measures made at different nights.

Herein we report results for 23 asteroids for which repeated and accurate measurements indicate a consistent offset, implying the necessity for the H magnitude to be revised. Our reported offset values are based on the average magnitude discrepancy of all the discrepancies calculated night by night for each asteroid. Table I summarizes these results. Details on the observations producing these results are given in Table II.

Table I. Summary of Results

Minor Planet	MPC H Value	Revised H Value	Change (mag.)	Meas-ures	Obser-vers	Opposi-tions
457 Alleghania	11.0	10.7	-0.3	22	6	1
921 Jovita	10.6	9.3	-1.3	9	4	2
942 Romilda	10.3	10.8	-0.5	12	3	1
1002 Olbersia	11.1	10.5	-0.6	14	4	2
1067 Lunaria	10.99	10.7	-0.3	11	3	1
1166 Sakuntala	8.8	9.9	1.1	13	4	3
1239 Queteleta	12.5	11.8	-0.7	13	4	3
1296 Andree	10.9	11.3	0.4	5	3	3
1330 Spiridonia	10.17	9.8	-0.4	8	3	1
1388 Aphrodite	8.89	10.3	1.4	9	4	1
1444 Pannonia	9.1	11.3	2.2	5	4	2
4063 Euforbo	8.6	8.9	0.3	7	3	2
4339 Almamater	13.6	14.0	0.4	17	7	1
4483 Petofi	11.9	12.9	1.0	7	4	2
4497 Taguchi	11.5	12.3	0.8	11	4	1
4766 Malin	12.2	12.7	0.5	14	4	1
5092 Manara	11.0	11.5	0.5	8	3	1
5153 1940 GO	11.2	11.7	0.5	10	3	1
5231 Verne	11.1	11.8	0.7	12	4	2
5738 Billpickering	14.1	15.0	0.9	7	4	1
5785 Fulton	11.8	12.7	0.9	9	4	1
7776 Takeishi	12.8	13.3	0.5	7	4	1
9262 Bordovitsyna	13.0	13.7	0.7	14	5	1

Average (absolute value) change: 0.73 magnitude
Average of 7 negative value changes = -0.59 mag
Average of 16 positive value changes = +0.80 mag

Table II: Record of Observations

Column Legends:
M.T. = Magnitude type:
AMv= Visual magnitude with asteroid comparison
TMV= Filtered CCD magnitude with Tycho 2 comparison
UMv= Visual magnitude with USNO-SA comparison
UMu= Unfiltered CCD magnitude with USNO-SA comparison
UMV= CCD magnitude with V filter and USNO-SA comparison
O.M. = Observed V magnitude
P.M. = Predicted V magnitude
M.D. = Magnitude differences:
F/x.x = x.x magnitude fainter than predicted
B/x.x = x.x magnitude brighter than predicted
O.N. = Observer Name

O.D.	M.T.	O.T.	P.M.	M.D.	O.N.
457 Alleghenia					
98-09-17.10689	UMu	14.8	15.0	B/0.2	J-M. LLAPASSET
98-09-17.13150	UMu	14.6	15.0	B/0.4	J-M. LLAPASSET
98-09-17.94236	UMu	14.9	15.0	B/0.1	J-M. LLAPASSET
98-09-17.95166	UMu	14.8	15.0	B/0.2	J-M. LLAPASSET
98-09-24.06839	UMu	14.8	14.9	B/0.1	Robin CHASSAGNE
98-09-24.09892	UMu	14.8	14.9	B/0.1	Robin CHASSAGNE
98-09-24.13380	UMu	14.9	14.9	0.0	Robin CHASSAGNE
98-10-19.87311	UMu	14.6	14.4	F/0.2	Pierre ANTONINI
98-10-19.89571	UMu	14.5	14.4	F/0.1	Pierre ANTONINI
98-10-19.91950	UMu	14.5	14.4	F/0.1	Pierre ANTONINI
98-10-21.86805	UMv	14.0	14.4	B/0.4	Gerard FAURE
98-10-21.96250	UMv	13.9	14.4	B/0.5	Gerard FAURE
98-11-04.00790	UMv	14.2	14.5	B/0.3	Robin CHASSAGNE
98-11-04.03561	UMv	14.4	14.5	B/0.1	Robin CHASSAGNE
98-11-15.83716	UMu	14.4	14.8	B/0.4	S.MORATA/D.MORATA
98-11-15.84213	UMu	14.3	14.8	B/0.5	S.MORATA/D.MORATA
98-11-15.84811	UMu	14.3	14.8	B/0.5	S.MORATA/D.MORATA
98-11-21.76691	UMu	14.5	14.9	B/0.4	Bernard CHRISTOPHE
98-11-21.83060	UMu	14.4	14.9	B/0.5	Bernard CHRISTOPHE
98-11-23.89476	UMu	14.4	15.0	B/0.6	S.MORATA/D.MORATA
98-11-23.91899	UMu	14.6	15.0	B/0.4	S.MORATA/D.MORATA
98-11-23.92234	UMu	14.4	15.0	B/0.5	S.MORATA/D.MORATA

H= 11.19 (EMP 1988); H= 11.0 (EMP 1992 to 2001)
Actual MPC H value 11.0
Revised suggested H value is 10.7

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O.D.	M.T.	O.T.	P.M.	M.D.	O.N.
921 Jovita					
98-10-03.10392	UMu	13.9	15.5	B/1.6	Dennis CHESNEY
98-10-03.13022	UMu	13.7	15.5	B/1.8	Dennis CHESNEY
98-10-24.01311	AMv	14.4	15.9	B/1.5	Lawrence GARRETT
98-10-24.12501	AMv	14.4	15.9	B/1.5	Lawrence GARRETT
00-12-27.01944	AMv	15.6	16.1	B/0.5	Gerard FAURE
00-12-27.04097	UMv	15.3	16.1	B/0.8	Gerard FAURE
00-12-27.05486	AMv	14.8	16.1	B/1.3	Gerard FAURE
01-02-19.87986	UMu	16,1	16,8	B/0.7	Jean-Gabriel BOSCH
01-02-19.88854	UMu	14,8	16,8	B/2.0	Jean-Gabriel BOSCH

H = 10.03 (EMP 1988); H= 10.6 (EMP 1992 to 2001)
Actual MPC H value 10.6
Revised suggested H value is 9.3 with a possible great variability

O.D.	M.T.	O.T.	P.M.	M.D.	O.N.
942 Romilda					
99-11-05.10555	UMv	14.7	14.0	F/0.7	Gerard FAURE
99-11-05.12152	UMv	14.7	14.0	F/0.7	Gerard FAURE
99-11-05.12986	AMv	14.6	14.0	F/0.6	Gerard FAURE
99-11-27.92708	AMv	14.7	13.8	F/0.9	Gerard FAURE
99-11-27.96180	AMv	14.7	13.8	F/0.9	Gerard FAURE
99-11-28.1250.	AMv	14.2	13.8	F/0.4	Andrew SALTHOUSE
99-11-28.1596.	AMv	14.2	13.8	F/0.4	Andrew SALTHOUSE
99-11-29.0971.	AMv	14.2	13.9	F/0.3	Andrew SALTHOUSE
99-11-29.1529.	AMv	14.2	13.9	F/0.3	Andrew SALTHOUSE
99-11-30.1321.	AMv	14.2	13.9	F/0.3	Andrew SALTHOUSE
99-12-02.10417	AMv	14.7	13.9	F/0.8	Lawrence GARRETT
99-12-02.16668	AMv	14.7	13.9	F/0.8	Lawrence GARRETT

H=10.4 (EMP 1988); H=10.3 (EMP 1992 to 2001)
Actual MPC H value 10.3
Revised suggested H value 10.8

O.D.	M.T.	O.T.	P.M.	M.D.	O.N.
1002 Olbersia					
93-09-20.97500	AMv	13.5	13.9	B/0.4	Gerard FAURE
98-09-23.11461	UMu	14.7	15.2	B/0.5	Robin CHASSAGNE
98-09-23.15030	UMu	14.6	15.2	B/0.6	Robin CHASSAGNE
98-09-23.16963	UMu	14.4	15.2	B/0.8	Robin CHASSAGNE
98-11-05.05250	UMu	13.7	14.6	B/0.9	Robin CHASSAGNE
98-11-05.09165	UMu	13.9	14.6	B/0.7	Robin CHASSAGNE
98-11-05.10472	UMu	13.8	14.6	B/0.8	Robin CHASSAGNE
98-11-15.91031	UMu	14.1	14.7	B/0.6	S.MORATA/D.MORATA
98-11-15.91513	UMu	14.1	14.7	B/0.6	S.MORATA/D.MORATA
98-11-15.92082	UMu	14.0	14.7	B/0.6	S.MORATA/D.MORATA
98-11-21.78266	UMu	13.9	14.9	B/1.0	Bernard CHRISTOPHE
98-11-21.84421	UMu	14.3	14.9	B/1.0	Bernard CHRISTOPHE
99-02-13.75742	UMu	16.1	16.4	B/0.3	Bernard CHRISTOPHE
99-02-13.84054	UMu	15.7	16.4	B/0.7	Bernard CHRISTOPHE

H= 10.9 (EMP 1988); H= 11.1 (EMP 1992 to 2001)
Actual MPC H value 11.1
Revised suggested H value 10.5

O.D.	M.T.	O.T.	P.M.	M.D.	O.N.
1067 Lunaria					
99-10-03.1042.	AMv	14.0	14.1	B/0.1	Andrew SALTHOUSE
99-10-03.2049.	AMv	13.8	14.1	B/0.3	Andrew SALTHOUSE
99-10-04.0868.	AMv	14.0	14.1	B/0.1	Andrew SALTHOUSE
99-10-05.240..	AMv	13.7	14.1	B/0.4	Frederick PILCHER
99-10-05.282..	AMv	13.7	14.1	B/0.4	Frederick PILCHER
99-10-05.337..	AMv	13.7	14.1	B/0.4	Frederick PILCHER
99-10-06.1076.	AMv	13.8	14.1	B/0.3	Andrew SALTHOUSE
99-10-06.167..	AMv	13.7	14.1	B/0.4	Frederick PILCHER
99-10-06.257..	AMv	13.7	14.1	B/0.4	Frederick PILCHER
99-10-16.83958	AMv	13.7	14.2	B/0.5	Gerard FAURE
99-10-16.96041	AMv	13.8	14.2	B/0.4	Gerard FAURE

H=10.83 (EMP 88); H=10.99 (EMP 92 => EMP 2001)
EMP2000: Per=7.74 h / Var=0.13 mag
Actual MPC H value 10.99
Revised suggested H value 10.7

O.D.	M.T.	O.T.	P.M.	M.D.	O.N.
1166 Sakuntala					
98-02-25......	AMv	14.0	13.1	F/0.9	Andrew SALTHOUSE
98-02-26.95486	AMv	14.5	13.1	F/1.4	Gerard FAURE
98-02-26.99236	AMv	14.6	13.1	F/1.5	Gerard FAURE
98-03-01.02415	AMv	14.2	13.1	F/1.1	Lawrence GARRETT
98-03-06......	AMv	14.0	13.1	F/0.9	Andrew SALTHOUSE
98-05-18.88120	UMu	14.9	14.0	F/0.9	Rene ROY
98-05-18.90383	UMu	15.0	14.0	F/1.0	Rene ROY
99-07-08.1493.	AMv	12.2	11.1	F/1.1	Andrew SALTHOUSE
99-07-12.1528.	AMv	12.5	11.0	F/1.5	Andrew SALTHOUSE
99-07-15.1389.	AMv	12.5	10.9	F/1.6	Andrew SALTHOUSE
00-11-24.1667.	AMv	14,1	13,2	F/0,9	Andrew SALTHOUSE
00-11-29.2049.	AMv	14,0	13,1	F/0,9	Andrew SALTHOUSE
00-12-03.1840.	AMv	14,0	13,0	F/1,0	Andrew SALTHOUSE

H=11.5 (EMP 1988); H= 11.3 (EMP 1992 to 1997); H=8.8 (EMP 1998 to 2001)
Actual MPC H value 8.8
Revised suggested H value 9.9

O.D.	M.T.	O.T.	P.M.	M.D.	O.N.
1239 Queteleta					
97-01-06.18375	AMv	13.9	14.4	B/0.5	Frederick PILCHER
97-01-06.27792	AMv	13.9	14.4	B/0.5	Frederick PILCHER
97-01-08.17000	AMv	13.8	14.3	B/0.5	Frederick PILCHER
97-01-08.25000	AMv	13.8	14.3	B/0.5	Frederick PILCHER
98-05-18.99485	UMu	15.8	16.6	B/0.8	Pierre ANTONINI
99-08-15.85155	UMu	16.1	17.3	B/1.2	Rene ROY
99-08-15.87075	UMu	16.2	17.3	B/1.1	Rene ROY
99-08-15.88914	UMu	16.3	17.3	B/1.0	Rene ROY
99-08-20.86197	UMu	16.7	17.2	B/0.5	Rene ROY
99-08-20.88953	UMu	16.6	17.2	B/0.6	Rene ROY
99-08-20.91348	UMu	16.7	17.2	B/0.5	Rene ROY
00-12-26.81944	AMv	15,3	16,2	B/0,9	Gerard FAURE
00-12-26.89861	AMv	15,3	16,2	B/0,9	Gerard FAURE

H= 12.6 (EMP 1988); H= 12.5 (EMP 1992 to 2001)
Actual MPC H value 12.5
Revised suggested H value 11.8

O.D.	M.T.	O.T.	P.M.	M.D.	O.N.
1296 Andree					
87-01-30......	AMv	13.9	13.4	F/0.5	Frederick PILCHER
87-02.03......	AMv	13.8	13.3	F/0.5	Frederick PILCHER
97-12-28.02415	AMv	13.7	13.2	F/0.5	Lawrence GARRETT
97-12-29.87569	AMv	13.6	13.2	F/0.4	Gerard FAURE
99-05-17.02847	AMv	14.6	14.3	F/0.3	Gerard FAURE

H=11.5 (EMP 1988); H=10.9 (EMP 1992 to 2001)
Actual MPC H value 10.9
Revised suggested H value 11.3

O.D.	M.T.	O.T.	P.M.	M.D.	O.N.
1330 Spiridonia					
99-03-09.1215.	AMv	14.0	14.2	B/0.2	Andrew SALTHOUSE
99-03-09.1927.	AMv	14.0	14.2	B/0.2	Andrew SALTHOUSE
99-03-12.0573.	AMv	14.1?	14.2	B/0.1?	Andrew SALTHOUSE
99-03-20.96805	AMv	13.8	14.4	B/0.6	Gerard FAURE
99-03-21.02916	AMv	13.7	14.4	B/0.7	Gerard FAURE
99-04-06.06250	AMv	14.2	14.7	B/0.5	Lawrence GARRETT
99-04-16.87916	AMv	14.6	15.0	B/0.4	Gerard FAURE
99-04-16.90763	AMv	14.6	15.0	B/0.4	Gerard FAURE

H = 10.18 (EMP 1988); H= 10.17 (EMP 1992 to 2001)
Actual MPC H value 10.17
Revised suggested H value 9.8

O.D.	M.T.	O.T.	P.M.	M.D.	O.N.
1388 Aphrodite					
98-10-15.95138	UMv	14.1	13.0	F/1.1	Gerard FAURE
98-10-15.97222	UMv	14.0	13.0	F/1.0	Gerard FAURE
98-10-19.88348	UMu	14.7	12.9	F/1.8	Pierre ANTONINI
98-10-19.90760	UMu	14.6	12.9	F/1.7	Pierre ANTONINI
98-10-19.93125	UMu	14.5	12.9	F/1.5	Pierre ANTONINI
98-10-23.20843	UMu	14.3	12.9	F/1.4	Dennis CHESNEY
98-10-23.24512	UMu	14.5	12.9	F/1.6	Dennis CHESNEY
98-10-26.08334	AMv	14.5	12.9	F/1.6	Lawrence GARRETT
98-10-26.13881	AMv	14.5	12.9	F/1.6	Lawrence GARRETT

H= 11.10 (EMP 1988 to 1991); H= 10.81 (EMP 1992 to 1997) ; H= 8.89 (EMP 1998 to 2001)
Actual MPC H value 8.89
Revised suggested H value 10.3

O.D.	M.T.	O.T.	P.M.	M.D.	O.N.
1444 Pannonia					
98-01-20.81597	Mv	Unseen	15.0	F>0.8	Gerard FAURE
99-01-24.76622	UMu	17.4	15.0	F/2.4	Rene ROY
99-01-24.82469	UMu	17.5	15.0	F/2.5	Rene ROY
99-01-24.86887	UMu	17.2	15.0	F/2.2	Rene ROY
99-03-23.9....	Mu	Unseen	15.6	F>2.0	Rene ROY
00-02-27.88804	UMu	16.5	14.2	F/2.3	Christophe Demeautis
00-02-27.92625	UMu	16,2	14,2	F/2,0	Christophe DEMEAUTIS
00-02-28.01388	Mv	Unseen	14.2	F/>1.8	Gerard FAURE
00-04-26.86648	.Mu	Unseen	15,0	F>1.2	Antonio GIAMBERSIO

H= 11.0 (EMP 1988); H= 10.6 (EMP 1992 to 1997); H= 9.1 (EMP 1998 to 2001)
Actual MPC H value 9.1
Revised suggested H value 11.3

4063 Euforbo (East Trojan)

O.D.	M.T.	O.T.	P.M.	M.D.	O.N.
98-11-28.1....	AMv	15.5	15.0	F/0.5	Roger HARVEY(3 meas.)
98-12-17.87083	AMv	15.5	15.2	F/0.3	Gerard FAURE
01-02-15.90027	TMV	15,5	15,3	F/0,2	Raoul BEHREND
01-02-15.90714	TMV	15,5	15,3	F/0,2	Raoul BEHREND
01-02-15.91350	TMV	15,6	15,3	F/0,3	Raoul BEHREND

H=9.0 (EMP 1991 to 1997); H=8.6 (EMP 1998 to 2001)
Actual MPC H value 8.6
Revised suggested H value 8.9

4339 Almamater

O.D.	M.T.	O.T.	P.M.	M.D.	O.N.
98-10-17.1....	AMv	15.6	14.8	F/0.8	Roger HARVEY(3 meas.)
98-10-19.88985	UMu	14.8	14.7	F/0.1	Pierre ANTONINI
98-10-19.91354	UMu	14.9	14.7	F/0.2	Pierre ANTONINI
98-10-23.20037	UMu	15.2	14.8	F/0.4	Dennis CHESNEY
98-10-23.23880	UMu	15.4	14.8	F/0.4	Dennis CHESNEY
98-11-03.97978	UMu	15.4	15.2	F/0.2	Robin CHASSAGNE
98-11-04.02854	UMu	15.9	15.2	F/0.7	Robin CHASSAGNE
98-11-18.83142	UMu	15.9	15.7	F/0.2	Stefano SPOSETTI
98 11 18.83927	UMu	15.9	15.7	F/0.2	Stefano SPOSETTI
98 11 18.84712	UMu	15.9	15.7	F/0.2	Stefano SPOSETTI
98-11-21.76394	UMu	16.1	15.8	F/0.3	Bernard CHRISTOPHE
98-11-21.82713	UMu	16.1	15.8	F/0.3	Bernard CHRISTOPHE
98-11-23.84755	UMu	16.3	15.9	F/0.4	S.MORATA/D.MORATA
98-11-23.85317	UMu	16.3	15.9	F/0.4	S.MORATA/D.MORATA
98-11-23.87377	UMu	16.3	15.9	F/0.4	S.MORATA/D.MORATA

H=13.7 (EMP 1992 to 1997); H=13.6 (EMP 1998 to 2001)
Actual MPC H value 13.6
Revised suggested H value 14.0

4483 Petofi

O.D.	M.T.	O.T.	P.M.	M.D.	O.N.
91-06-08.1....	AMv	15.7	14.7	F/1.0	Roger HARVEY
99-06-12.95314	UMu	16.4	14.8	F/1.6	Rene ROY
99-06-12.97103	UMu	16.1	14.8	F/1.3	Rene ROY
99-06-12.98403	UMv	16.1	14.8	F/1.3	Gerard FAURE
99-06-13.02569	UMv	16.1	14.8	F/1.3	Gerard FAURE
99-08-12.84639	UMu	16.1	15.3	F/0.8	Bernard CHRISTOPHE
99-08-12.85814	UMu	16.0	15.3	F/0.7	Bernard CHRISTOPHE

H (EMP92 -> 2001 = 11.9)
EMP 2000: secure rotation period of 4.28 hours and light variation of 0.98 magnitude, but magnitude discrepancy >1/2 amplitude
Actual MPC H value 11.9
Revised suggested H value 12.9

4497 Taguchi

O.D.	M.T.	O.T.	P.M.	M.D.	O.N.
99-10-05.250..	AMv	13.8	13.2	F/0.6	Frederick PILCHER
99-10-05.303..	AMv	13.8	13.2	F/0.6	Frederick PILCHER
99-10-05.340..	AMv	13.8	13.2	F/0.6	Frederick PILCHER
99-10-06.1562.	AMv	14.0	13.2	F/0.8	Andrew SALTHOUSE
99-10-06.2049.	AMv	14.0	13.2	F/0.8	Andrew SALTHOUSE
99-10-06.243..	AMv	14.0	13.2	F/0.8	Frederick PILCHER
99-10-08.1354.	AMv	13.9	13.1	F/0.8	Andrew SALTHOUSE
99-10-12.1805.	AMv	14.0	13.1	F/0.9	Andrew SALTHOUSE
99-10-15.1....	AMv	14.0	13.1	F/0.9	Roger HARVEY
99-11-27.80833	AMv	14.6	13.7	F/0.9	Gerard FAURE
99-11-27.86319	AMv	14.6	13.7	F/0.9	Gerard FAURE

H=11.5 (EMP 1992 to 2001)
Actual MPC H value 11.5
Revised suggested H value 12.3

4766 Malin

O.D.	M.T.	O.T.	P.M.	M.D.	O.N.
99-01-11.083..	AMv	15.4	14.8	F/0.6	Roger HARVEY
99-01-11.125..	AMv	15.4	14.8	F/0.6	Roger HARVEY
99-01-11.166..	AMv	15.4	14.8	F/0.6	Roger HARVEY
99-01-14.89990	UMv	15.2	14.9	F/0.3	Stefano SPOSETTI
99-01-14.90774	UMv	15.3	14.9	F/0.4	Stefano SPOSETTI
99-01-14.91560	UMv	15.4	14.9	F/0.5	Stefano SPOSETTI
99-03-29.82310	UMu	17.0	16.6	F/0.4	Rene ROY
99-03-29.85571	UMu	17.0	16.6	F/0.4	Rene ROY
99-03-31.83420	UMu	16.8	16.7	F/0.1	Rene ROY
99-03-31.86731	UMu	17.1	16.7	F/0.4	Rene ROY
99-03-31.87852	UMu	17.1	16.7	F/0.4	Rene ROY
99-03-31.90061	UMu	17.0	16.7	F/0.3	Rene ROY
99-05-01.83991	UMu	17.8	17.1	F/0.7	Bernard CHRISTOPHE
99-05-01.85655	UMu	17.5	17.1	F/0.4	Bernard CHRISTOPHE

H= 12.0 (EMP 1993 to 1997); H= 12.2 (EMP 1998 to 2001)
Actual MPC H value 12.2
Revised suggested H value 12.7

5092 Manara

O.D.	M.T.	O.T.	P.M.	M.D.	O.N.
99-03-12.1....	AMv	15.7	15.2	F/0.5	Roger HARVEY
99-03-15.84644	UMu	15.4	15.1	F/0.3	Rene ROY
99-03-15.88800	UMu	15.3	15.1	F/0.2	Rene ROY
99-03-15.91660	UMu	15.3	15.1	F/0.2	Rene ROY
99-03-23.88117	UMu	15.9	15.3	F/0.6	Rene ROY
99-03-23.91187	UMu	15.8	15.3	F/0.5	Rene ROY
99-03-23.94194	UMu	15.9	15.3	F/0.6	Rene ROY
99-05-01.87204	UMu	16.7	16.0	F/0.7	Bernard CHRISTOPHE

H= 11.0 (EMP 1994 to 2001)
Actual MPC H value 11.0
Revised suggested H value 11.5

5153 1940 GO

O.D.	M.T.	O.T.	P.M.	M.D.	O.N.
00-01-06.1....	AMv	15.0	14.0	F/1.0	Roger HARVEY
00-02-14.79473	UMu	14.7	14.3	F/0.4	Rene ROY
00-02-14.85227	UMu	14.7	14.3	F/0.4	Rene ROY
00-02-14.87704	UMu	14.7	14.3	F/0.4	Rene ROY
00-02-14.89713	UMu	14.7	14.3	F/0.4	Rene ROY
00-02-27.80277	AMv	15.6	14.6	F/1.0	Gerard FAURE
00-02-27.88888	AMv	15.6	14.6	F/1.0	Gerard FAURE
00-03-05.78075	UMu	14.9	14.8	F/0.1	Rene ROY
00-03-05.82580	UMu	15.0	14.8	F/0.2	Rene ROY
00-03-05.90355	UMu	14.9	14.8	F/0.1	Rene ROY

H=11.5 (EMP 1994 to 1997); H=11.2 (EMP 1998 to 2001)
Actual MPC H value 11.2
Revised suggested H value 11.7

5231 Verne

O.D.	M.T.	O.T.	P.M.	M.D.	O.N.
91-02-05.1....	AMv	15.4	14.6	F/0.8	Roger HARVEY
98-10-30.08611	AMv	14.7	14.1	F/0.6	Gerard FAURE
98-10-30.13125	AMv	14.8	14.1	F/0.7	Gerard FAURE
98-11-05.87671	UMu	14.5	13.9	F/0.6	Pierre ANTONINI
98-11-05.89633	UMu	14.8	13.9	F/0.9	Pierre ANTONINI
98-11-05.91495	UMu	14.4	13.9	F/0.5	Pierre ANTONINI
98-11-07.90705	UMu	14.4	13.9	F/0.5	Rene ROY
98-11-07.95994	UMu	15.0	13.9	F/1.1	Rene ROY
98-11-07.99215	UMu	14.5	13.9	F/0.6	Rene ROY
98-11-23.92987	UMu	14.4	14.0	F/0.4	Pierre ANTONINI
98-11-23.95912	UMu	14.4	14.0	F/0.4	Pierre ANTONINI
98-11-23.98785	UMu	15.1	14.0	F/0.4	Pierre ANTONINI

H= 11.1 (EMP 1994 to 2001)
Actual MPC H value 11.1
Revised suggested H value 11.8

5738 Billpickering (Mars-crosser)

O.D.	M.T.	O.T.	P.M.	M.D.	O.N.
98 10 28.81119	UMu	17.8	16.6	F/1.2	Stefano SPOSETTI
98 10 28.81904	UMu	17.5	16.6	F/0.9	Stefano SPOSETTI
98-11-05.81694	UMu	17.1	16.5	F/0.6	Pierre ANTONINI
98-11-15.89196	UMu	17.7	16.5	F/0.8	S.MORATA/D.MORATA
98-11-15.90589	UMu	17.7	16.5	F/0.8	S.MORATA/D.MORATA
98-11-21.77546	UMu	17.3	16.6	F/0.7	Bernard CHRISTOPHE
98-11-21.83766	UMu	17.3	16.6	F/0.7	Bernard CHRISTOPHE

H=14.1 (EMP 1995 to 2001)
Actual MPC H value 14.1
Revised suggested H value 15.0

5785 Fulton

O.D.	M.T.	O.T.	P.M.	M.D.	O.N.
99-01-16.25000	AMv	15.5	14.6	F/1.1	Roger HARVEY
99-01-19.88424	UMu	15.7	14.5	F/1.2	Rene ROY
99-01-19.95442	UMu	15.3	14.5	F/0.8	Rene ROY
99-01-21.93103	UMu	15.6	14.4	F/0.8	Pierre ANTONINI
99-01-21.89952	UMu	15.4	14.4	F/1.0	Pierre ANTONINI
99-02-13.83363	UMu	16.4	15.0	F/1.4	Bernard CHRISTOPHE
99-02-13.87201	UMu	15.7	15.0	F/0.7	Bernard CHRISTOPHE
99-05-01.84955	UMu	17.2	16.5	F/0.7	Bernard CHRISTOPHE
99-05-01.86257	UMu	17.2	16.5	F/0.7	Bernard CHRISTOPHE

H= 11.7 (EMP 1995 to 1997); H= 11.8 (EMP 1998 to 2001)
Actual MPC H value 11.8
Revised suggested H value 12.7

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O.D.	M.T.	O.T.	P.M.	M.D.	O.N.
7776 Takeishi					
98-08-21.1....	AMv	15.2	14.5	F/0.7	Roger HARVEY
98-08-23.94306	AMv	15.1	14.6	F/0.5	Gerard FAURE
98-08-24.85209	UMu	14.8	14.6	F/0.2	Pierre ANTONINI
98-08-24.87090	UMu	14.8	14.6	F/0.2	Pierre ANTONINI
98-08-24.89405	UMu	14.8	14.6	F/0.2	Pierre ANTONINI
98-08-26.12501	AMv	15.2	14.7	F/0.5	Lawrence GARRETT
98-08-26.22560	AMv	15.2	14.7	F/0.5	Lawrence GARRETT

H=12.8 (EMP 1999 to 2001)
Actual MPC H value 12.8
Revised suggested H value 13.3

O.D.	M.T.	O.T.	P.M.	M.D.	O.N.
9262 Bordovitsyna					
98-10-21.92152	AMv	15.3?	15.7	B/0.4?	Gerard FAURE
98-10-26.06582	AMv	15.4	15.8	B/0.4	Lawrence GARRETT
98-10-26.07617	AMv	15.4	15.8	B/0.4	Lawrence GARRETT
98-10-27.04857	AMv	15.4	15.8	B/0.4	Lawrence GARRETT
98-10-27.10404	AMv	15.4	15.8	B/0.4	Lawrence GARRETT
98-10-27.80975	UMu	14.7	15.8	B/1.1	Stefano SPOSETTI
98-10-27.81758	UMu	14.8	15.8	B/1.0	Stefano SPOSETTI
98-10-27.82542	UMu	14.7	15.8	B/1.1	Stefano SPOSETTI
98-11-04.99425	UMu	15.4	16.1	B/0.7	Robin CHASSAGNE
98-11-05.77411	UMu	15.5	16.1	B/0.6	Pierre ANTONINI
98-11-05.80450	UMu	15.4	16.1	B/0.7	Pierre ANTONINI
98-11-05.85071	UMu	15.3	16.1	B/0.8	Pierre ANTONINI
98-12-06.81003	UMu	15.9	16.9	B/1.0	Robin CHASSAGNE
98-12-06.89810	UMu	16.3	16.9	B/0.6	Robin CHASSAGNE

H=13.0 (EMP 2001)
Known rotation period= 9h / var=0.08 mag
Actual MPC H value 13.0
Revised suggested H value 13.7

LIGHTCURVE PHOTOMETRY OF 611 VALERIA AND 986 AMELIA

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(Received: 12 July Revised: 25 July)

Through ongoing lightcurve observations at Thornton Observatory, asteroid 611 Valeria was found to have a period of 10.80 ± 0.02 hours, with an amplitude of 0.18 ± 0.04 magnitude. Asteroid 986 Amelia was determined to have a period of 9.52 hours ± 0.01 hours, with an amplitude of 0.61 ± 0.03 magnitude.

Thornton Observatory is located in Thornton, Colorado, at an elevation of 5530'. Since 1997, the observatory, operating as Minor Planet Center observatory code 713, has been performing asteroid astrometry and photometry.

Details of the observatory equipment may be found in Koff (2000). Targets were selected based on their magnitude and position in the sky, to maximize the length of time they would be observable, particularly under the restricted sky visibility of Thornton Observatory. Targets were selected for which no lightcurve data had been previously reported, or for which only uncertain data was available (Harris, 1997).

The images were obtained in unfiltered light. The differential photometry was performed using the program "Canopus" by Brian Warner, which uses aperture photometry. 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 manually shifting individual night's magnitude scales to obtain a best fit.

611 Valeria is a main-belt asteroid, discovered in 1906 by J. H. Metcalf. It is approximately 60 km in diameter. No previous lightcurve data were found for this object (Harris, 1997). Observation of this object began at Thornton Observatory on March 5, 2001 and continued until April 4, 2001. Exposure times for this investigation were two minutes each. Images were taken at 3-minute intervals. Dark frames and flat fields were used to calibrate each image. A total of 533 images were used in the solution. Figure 1 shows the composite lightcurve for Valeria. The zero point of the curve is J.D. 2451973.7142. The period is

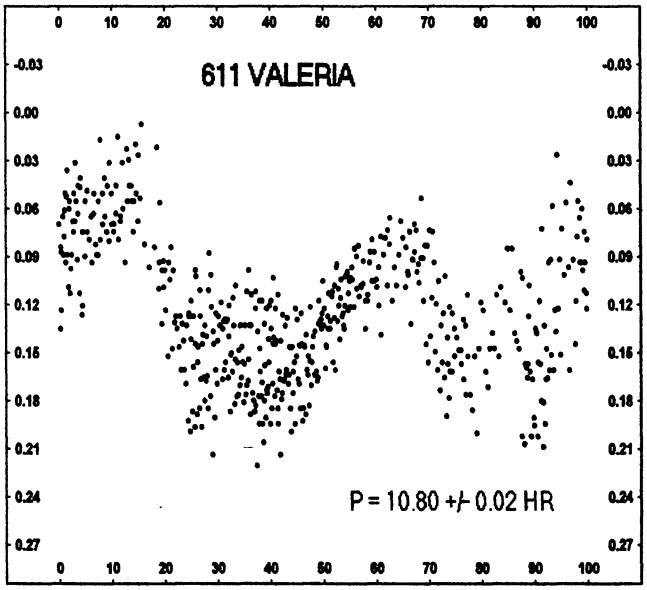

Figure 1. Lightcurve of 611 Valeria, based on a period of 10.80 hours. Ordinate is relative magnitude.

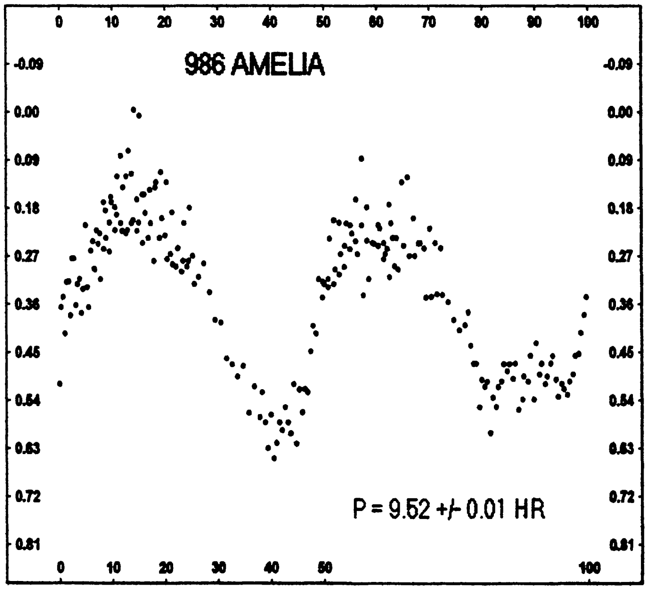

Figure 2. Lightcurve of 986 Amelia, based on a period of 9.52 hours. Ordinate is relative magnitude.

10.80 hours ± 0.02 hours. The amplitude is 0.18 magnitude ± 0.04. The lightcurve is unusually noisy. Similar noise is seen in the lightcurve of the comparison star, where the likely cause of the noise is the shorter integration time used (two minutes as opposed to the more typical four minutes). The mean measured magnitude was 12.9, which should be considered an instrumental magnitude.

986 Amelia, a main-belt asteroid, was discovered in October of 1922 by J. Colas Soma in Barcelona. It is approximately 53 km in diameter. No lightcurve was found for this object (Harris, 1997). It was observed initially by Thornton Observatory on October 10, 2000. Observations were made on 4 nights during the period from October 10, 2000 to October 19, 2000. Exposure times for this investigation were four minutes each. Images were taken at 6-minute intervals. Dark frames and flat fields were used to calibrate each image. A total of 222 observations were used in the solution. Figure 2 shows the resulting lightcurve. The zero point of the curve is J.D. 2451827.7124. The period was determined to be 9.52 hours ± 0.01 hours, with an amplitude of 0.61 ± 0.03. The mean measured magnitude was 12.9 magnitude, which should be considered an instrumental magnitude.

Acknowledgments

Many 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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ASTEROID PHOTOMETRY OPPORTUNITIES OCTOBER-DECEMBER 2001

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In June 2001 we attended the conference “Asteroids 2001: From Piazzi to the 3rd Millenium”. The conference was really great and we also much enjoyed meeting and discussing with several asteroid photometrists there. The exchange of ideas and experiences was really fruitful. As a result, Brian Warner has started to work on creating a new association of observers and a web site that will help develop and coordinate collaborations on specific targets or groups of targets. We shall keep you informed about progress. For the meantime we suggest to asteroid photometrists to continue coordinating their observations via the Collaborative Asteroid Lightcurve Link (CALL; http://www.MinorPlanetObserver.com/astlc/default.htm).

In the Table below, we present a list of suitable photometric targets for the October-December 2001 period. Most of 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 reliably established periods. Especially interesting is 1998 WT24, the 1-km sized Aten asteroid that will make a close approach in mid-December and it will be a good target for experienced photometrists. Among the other targets, there are three Mars-approaching asteroids (1170 Siva, 1310 Villigera, and 1997 YV13) with sizes around 10 km, one Cybele asteroid, 570 Kythera with diameter about 100 km, and twenty main belt asteroids with sizes in the range from 10 to more than 100 km. Probably the largest of the targets is 366 Vincentina with a diameter likely greater than 100 km. Observers interested in asteroids fainter than V=14 are encouraged to check the full list on the Brian Warner's CALL website.

Asteroid	Opp'n Date 2001	Opp'n V	Per [h]	Ampl	Rem.
2023 Asaph	Oct 01	13.7			PER
366 Vincentina	Oct 03	12.8			PER
1170 Siva	Oct 04	13.6			PER
492 Gismonda	Oct 08	13.1			PER
4222 Nancita	Oct 08	13.4			PER
1807 Slovakia	Oct 10	13.3			PER
1310 Villigera	Oct 15	13.0			PER
570 Kythera	Oct 22	12.8			PER
547 Praxedis	Nov 04	12.0			PER
1086 Nata	Nov 10	13.8			PER
973 Aralia	Nov 13	13.9			PER
1110 Jaroslawa	Nov 14	13.8			PER
904 Rockefellia	Nov 15	13.8			PER
551 Ortrud	Nov 24	12.7			PER
932 Hooveria	Nov 28	12.6			PER
1997 YV13	Nov 29	13.7			PER
559 Nanon	Dec 01	13.4			PER
1024 Hale	Dec 03	13.7			PER
2651 Karen	Dec 04	13.7			PER
1263 Varsavia	Dec 10	13.9			PER
1998 WT24	Dec 15	9.1			PER, ATEN
2245 Hekatostos	Dec 17	13.9			PER
538 Friederike	Dec 19	13.5			PER
1278 Kenya	Dec 20	13.9			PER
1639 Bower	Dec 28	13.6			PER

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* * * * *

The deadline for the next issue (29-1) is October 15, 2001. The deadline for issue 29-2 is January 15, 2002.