THE MINOR PLANET BULLETIN

BULLETIN OF THE MINOR PLANETS SECTION OF THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

VOLUME 19, NUMBER 4, A.D. 1992 OCTOBER-DECEMBER 27.

THE 1992 CLOSE APPROACH BY 4179 TOUTATIS: A CALL FOR OBSERVATIONS

Richard P. Binzel
Mail Code 54-426
Massachusetts Institute of Technology
Cambridge, MA 02139

Alan W. Harris
Mail Code 183-501
4800 Oak Grove Drive
Pasadena, CA 91109

(Received: 18 July Revised: 4 August)

On 1992 December 8, the near-Earth asteroid 4179 Toutatis will pass within 0.024 AU of the Earth, a distance of less than 10 times that of the Moon. As reported by Sicoli and Cavagna (*MPB* 19, No. 2, page 17), Toutatis will not make an encounter closer than this one until 2004. Thus this apparition marks a good chance for observers to see this small minor planet, estimated to be only about 3 km in diameter. During its close approach, observers who locate Toutatis or capture it on film should be able to detect its motion or record a trail within a few minutes.

Unfortunately, Toutatis will most likely be substantially fainter than was originally predicted. A recent analysis of Toutatis observations obtained after its discovery in 1989 (its preliminary designation was 1989 AC) suggests that it will be about 1.4 magnitudes fainter than originally estimated. Its absolute magnitude (H) is probably closer to a value of 15.4, rather than the value of 14.0 tabulated in the Ephemerides of Minor Planets. As such, Toutatis will probably not reach an apparent V magnitude brighter than 11.0 during the apparition. The full moon on December 9 will also interfere with observations near the time of closest approach.

While it may be exciting just to glimpse this small body as it whizzes past the Earth, an international observing campaign is being organized to obtain lightcurve measurements of Toutatis. Amateurs with suitable aperture telescopes and equipment are welcome to collaborate with this professional effort. Apart from just learning about the rotational properties of Toutatis, this information is also needed as part of an effort by Steven Ostro of JPL to obtain radar images of Toutatis. An image deconvolution of the radar returns requires knowledge of the spin rate and pole position of the asteroid. Observers with the capability to participate in the Toutatis lightcurve campaign should contact one of us (AWH) for further information.

To aid in all visual, photographic, and photometric observations, an ephemeris for Toutatis at 12 hour intervals is given below. Finder charts appear in the Near-Earth Asteroids Bulletin and are available for two stamped, self-addressed, legal-size envelopes. Contact Lawrence Garrett, 162 North Champlain Street, Burlington, VT 05401.

UT Date	Hour	R.A. (J2000) h m s	Dec. d m s	Phase Angle	V Mag
92/12/ 8	0	13 32 20.1	-25 3 55.	131.6	13.13
92/12/ 8	12	13 01 46.4	-22 0 16.	123.6	12.38
92/12/ 9	0	12 33 7.7	-18 40 24.	115.6	11.83
92/12/ 9	12	12 7 1.2	-15 16 14.	108.0	11.43
92/12/10	0	11 43 42.2	-11 58 7.	101.0	11.16
92/12/10	12	11 23 9.4	- 8 53 10.	94.5	10.98
92/12/11	0	11 5 11.0	- 6 5 11.	88.7	10.88
92/12/11	12	10 49 30.4	- 3 35 19.	83.6	10.82
92/12/12	0	10 35 49.7	- 1 23 2.	78.9	10.81
92/12/12	12	10 23 51.8	0 33 8.	74.8	10.81
92/12/13	0	10 13 21.5	2 14 60.	71.1	10.84
92/12/13	12	10 4 5.5	3 44 24.	67.8	10.88
92/12/14	0	9 55 52.5	5 3 3.	64.8	10.93
92/12/14	12	9 48 33.2	6 12 31.	62.1	10.98
92/12/15	0	9 41 59.6	7 14 6.	59.6	11.04
92/12/15	12	9 36 5.2	8 8 58.	57.4	11.10
92/12/16	0	9 30 44.6	8 58 3.	55.2	11.16
92/12/16	12	9 25 53.1	9 42 10.	53.3	11.22
92/12/17	0	9 21 26.9	10 21 59.	51.4	11.28
92/12/17	12	9 17 22.8	10 58 6.	49.7	11.34
92/12/18	0	9 13 38.0	11 30 58.	48.1	11.40
92/12/18	12	9 10 10.1	12 1 0.	46.6	11.46
92/12/19	0	9 6 57.2	12 28 34.	45.1	11.52
92/12/19	12	9 3 57.7	12 53 56.	43.7	11.57
92/12/20	0	9 1 10.0	13 17 21.	42.4	11.63
92/12/20	12	8 58 32.9	13 39 3.	41.1	11.69
92/12/21	0	8 56 5.3	13 59 13.	39.9	11.74
92/12/21	12	8 53 46.2	14 18 1.	38.7	11.79
92/12/22	0	8 51 34.8	14 35 34.	37.6	11.84
92/12/22	12	8 49 30.3	14 52 1.	36.5	11.89
92/12/23	0	8 47 32.2	15 7 27.	35.4	11.94
92/12/23	12	8 45 39.9	15 21 58.	34.4	11.99
92/12/24	0	8 43 52.9	15 35 40.	33.4	12.03
92/12/24	12	8 42 10.7	15 48 36.	32.4	12.08
92/12/25	0	8 40 32.9	16 0 50.	31.5	12.12
92/12/25	12	8 38 59.2	16 12 26.	30.5	12.17
92/12/26	0	8 37 29.3	16 23 27.	29.6	12.21
92/12/26	12	8 36 2.8	16 33 56.	28.7	12.25
92/12/27	0	8 34 39.6	16 43 55.	27.9	12.29
92/12/27	12	8 33 19.4	16 53 26.	27.0	12.33
92/12/28	0	8 32 2.1	17 2 31.	26.2	12.37
92/12/28	12	8 30 47.4	17 11 13.	25.4	12.41
92/12/29	0	8 29 35.1	17 19 32.	24.5	12.44
92/12/29	12	8 28 25.2	17 27 30.	23.8	12.48

CCD PHOTOMETRY OF ASTEROID 16 PSYCHE

A. William Neely
NF/ Observatory
Rt. 15 Box 760
San Lorenzo, NM 88041

(Received: 30 July Revised: 19 August)

Photometric observations of the asteroid 16 Psyche were made during its 1992 apparition using a CCD detector at the NF/ Observatory. The synodic rotational period was 4.196 ± 0.005 hrs. The lightcurve amplitude was 0.19 ± 0.02 magnitudes. These results agree well with previous studies.

Introduction

Asteroid 16 Psyche is listed as an M-type asteroid (Tholen 1989). It has a diameter of about 264 km and an albedo of about 0.10 with an absolute H magnitude of 5.99 (Tedesco 1989). It has been studied previously (Lagerkvist et al. 1989). Switches between the primary and secondary extrema occurring in some solutions have been a matter of debate (Magnusson et al. 1989). Therefore, continued monitoring has been important. During February and March of 1992, Psyche was in a favorable position and phase angle for observation. The asteroid was listed as a desirable target by Harris and Zappalà (1992).

Observations

Exposures were obtained through a Johnson V-filter with a CRAF-Cassini charge-coupled-device (CCD) detector having 1024x1024 pixels, where the opposite quadrants are silvered to allow the frame transfer of a 512x512 pixel image. The image scale was 1.2 arcseconds per pixel. The chip and amplifier read-out noise is 25 electrons. Full well is 100,000 electrons. The telescope used was a 0.45-m Newtonian. Control of the observatory was by digital radio link and is described elsewhere (Neely 1989). The images were stored on tape and analyzed with PCVISTA, written by M. Richmond.

The comparison and check stars were within the same frame of the CCD image. This reduced the differential atmospheric extinction to negligible levels and allowed data collection on nights with marginal photometric conditions. The comparison star calibration was unsuccessful due to bad weather during the nights when this was attempted.

Integrations of 90 seconds were obtained for all data points. Dark fields were taken before each exposure and approximately 60 exposures were taken per night. The dark and bias frames were subtracted at the time of readout and the images were flat-field corrected before being stored on tape for later analysis. All of the flat fields were obtained on the twilight sky.

Results

CCD observations of 16 Psyche were made on UT dates (1992): February 17 and 22, March 6, 12, and 13. Observational circumstances for these dates are shown in Table I.

The synodic rotation period was calculated using a minimum phase error method similar to Stellingworf (1978). A constant was added to each night's data to obtain the best vertical fit. A period solution of 4.196 ± 0.005 hours was obtained, in excellent agreement with previous results (Lagerkvist et al. 1989). The lightcurve, shown plotted for the rotational phase occurring on UT 1992 February 22, appears to display two unequal minima and maxima per rotation. Within the noise of the observations, we estimate the peak-to-peak amplitude to be 0.19 ± 0.02 magnitudes.

Acknowledgments

This work was supported by a grant from NASA, administered by the American Astronomical Society, and a grant from the Theodore Dunham Jr. Fund for Astronomical Research. Additional thanks to Larry Miller for his improvements to PCVISTA and to Fred Treasure who kept the radio link up through the difficult lightning season.

References

Harris, A. W. and Zappalà, V. (1992). "Photoelectric Photometry Opportunities." *MPB* 19, 5-6.

Lagerkvist, C.-I., Harris, A. W., Zappalà, V. (1989). "Asteroid Lightcurve Parameters." In *Asteroids II* (R. P. Binzel, T. Gehrels, M. S. Matthews, Eds.), pp. 1162-1179. University of Arizona Press, Tucson.

Magnusson, P., Barucci, M. A., Drummond, J. D., Lumme, K., Ostro, S. J., Surdej, J., Taylor, R. C., and Zappalà, V. (1989). "Determinations of Pole Orientations and Shapes of Asteroids." In *Asteroids II* (R. P. Binzel, T. Gehrels, M. S. Matthews, Eds.), pp. 66-98. University of Arizona Press, Tucson.

Neely, A. W. (1989). "The Automatic Radio Linked Telescope (ARLT) at the NF/ Observatory." In Remote Access Automatic Telescopes (D. Hayes and R. M. Genet, Eds.), pp. 141-150. Fairborn Press, Tucson.

Stellingwerf, R. F. (1978). "Period Determination Using Phase Dispersion Minimization." *Astrophys. J.* 224, 953.

Tedesco, E. F. (1989). "Asteroid Magnitudes, UBV Colors, and IRAS Albedos and Diameters." In *Asteroids II* (R. P. Binzel, T. Gehrels, M. S. Matthews, Eds.), pp. 1090-1138. University of Arizona Press, Tucson.

Tholen, D. J. (1989). "Asteroid Taxonomic Classifications." In *Asteroids II* (R. P. Binzel, T. Gehrels, M. S. Matthews, Eds.) , pp. 1139-1150. University of Arizona Press, Tucson.

Table I. Observational circumstances for 16 Psyche

Date	Long	RA(2000)	Dec	AU to Earth	α	VMag
2/17/92	158 42	10 59.1	7 11	2.236	4.8	10.6
2/22/92	159 20	10 56.2	7 33	2.226	2.2	10.5
3/06/92	161 36	10 45.3	8 50	2.229	1.8	10.5
3/12/92	162 24	10 41.5	9 17	2.244	4.1	10.6
3/13/92	162 34	10 40.8	9 22	2.248	4.4	10.6

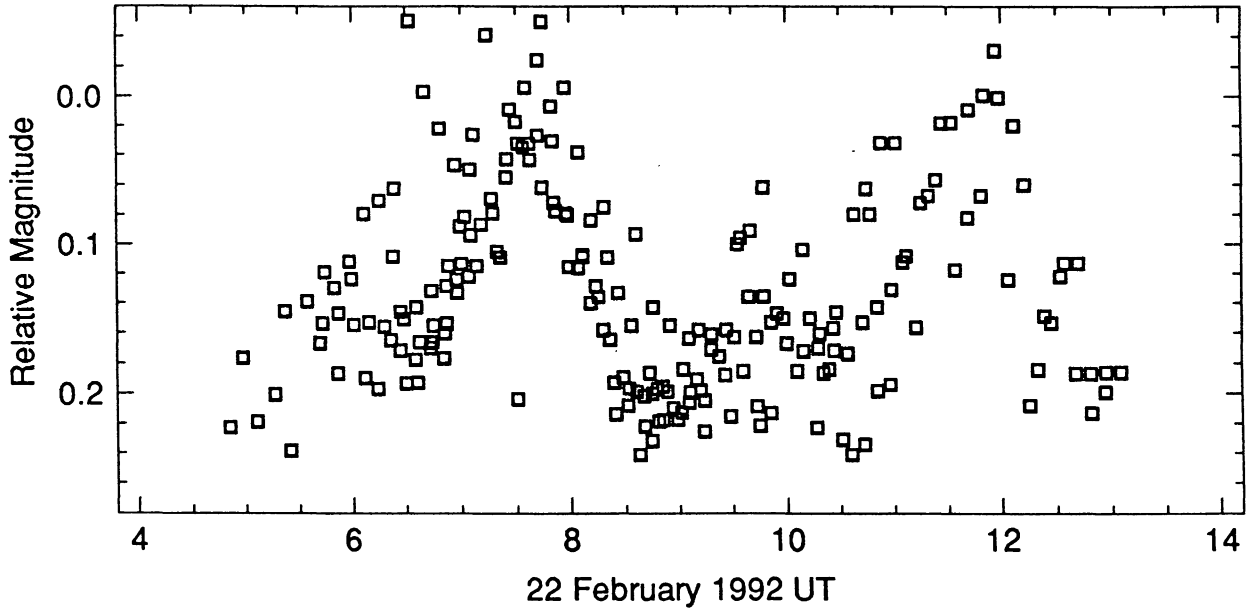

Figure 1. Lightcurve for asteroid 16 Psyche. Data from all nights have been placed into a single rotation cycle based on a period of 4.196 hours.

PHOTOELECTRIC PHOTOMETRY OF 10 HYGIEA

C-I. Lagerkvist[1], T. Oja[1], S. Pohjolainen[2], A. Erikson[1]

(Received: 2 June Revised: 17 August)

UBV photometry was performed of 10 Hygiea during nine nights in October, November and December 1992. A composite lightcurve is presented favouring a rotation period of 27.62 hours.

Introduction

The asteroid 10 Hygiea has been observed very frequently (for references see Lagerkvist et al., 1992) but for quite a long time the period was not known. Michalowski et al. (1991) determined the rotation period to 27.66 hours and also made an estimate of the pole orientation. Since 10 Hygiea is the fourth largest asteroid it seemed appropriate to make some additional observations to improve the rotation period and the pole determination.

[1] Astronomiska observatoriet, Box 515, 751 20 Uppsala, Sweden
[2] Metsähovi Radio Research Station, Helsinki Univ. of Technology, Otakaari 5A, SF-02150 Espoo, Finland

Observations

The observations were made with the 60-cm Cassegrain telescope at La Palma during eight nights in 1991 (October 29, 30, 31: November 5, 10, 14, 15, 18). Some additional data on December 2 were obtained with the 40-cm telescope at Kvistaberg Observatory. The aspect data are given in Table I.

Table I. Aspect data.

Date	λ	β	r	Δ	α
1991 Oct 30.0	54.7	4.2	3.507	2.555	5.47
1991 Oct 31.0	54.5	4.2	3.507	2.551	5.16
1991 Nov 1.0	54.3	4.2	3.507	2.547	4.85
1991 Nov 6.0	53.4	4.2	3.508	2.531	3.29
1991 Nov 11.0	52.4	4.2	3.509	2.523	1.82
1991 Nov 15.0	51.6	4.2	3.509	2.522	1.18
1991 Nov 16.0	51.4	4.2	3.509	2.522	1.22
1991 Nov 19.0	50.8	4.1	3.510	2.526	1.77
1991 Dec 3.0	48.2	3.9	3.512	2.577	6.00

Hygiea was measured differentially (La Palma) with respect to the KO IV star HR 1048 (V=6.025, B-V=0.956, U-B=0.683). Extinction coefficients were derived for each night from the measurements of HR 1048 and other primary UBV standards normally used at La Palma and Kvistaberg (see e.g. Oja, 1987, Table I.). One measurement generally consists of at least two ten-second integrations in each color. The mean error of one observation of Hygiea cannot be determined from the observations themselves, but the results for non-variable program stars indicate an error slightly below 0.01 mag for V and B-V.

Results

The results are presented in Figure 1 showing the composite lightcurve in V. A period of 27.62 hours (Erikson, priv. comm.) was used to construct the lightcurve. The magnitude shifts are given in the figure. In order to make the magnitude shifts consistent, a G-value of 0.40 had to be used which indicates that 10 Hygiea shows a much smaller opposition effect than predicted by the Lumme-Bowell relation. A rotation period half this value does not seem probable since such a rotation period gives a very much larger error in the pole determination (Erikson, priv. comm.), although the present observations can not rule out such a period. A lightcurve with one maximum and one minimum with an amplitude of 0.3 magnitudes also is less likely. Clearly more observations are needed in order to get a complete coverage of a whole rotational cycle.

The colors were determined to be B-V: 0.68 and U-B: 0.36.

References

Michalowski, T., Velichko, F.P., Lindgren, M., Oja, T., Lagerkvist, C.-I., Magnusson, P. (1991), Astron. Astrophys. Suppl. Ser. 91, 53-59.

Lagerkvist, C.-I., Barucci, M.A., Capria, M.T., Dahlgren, M. Erikson, A., Fulchignoni, M., Magnusson, P. (1992), Asteroid Photometric Catalogue, Second Update, Uppsala Astron. Obs.

Oja, T. (1987), Astron. Astrophys. Suppl. Ser. 71, 561-564.

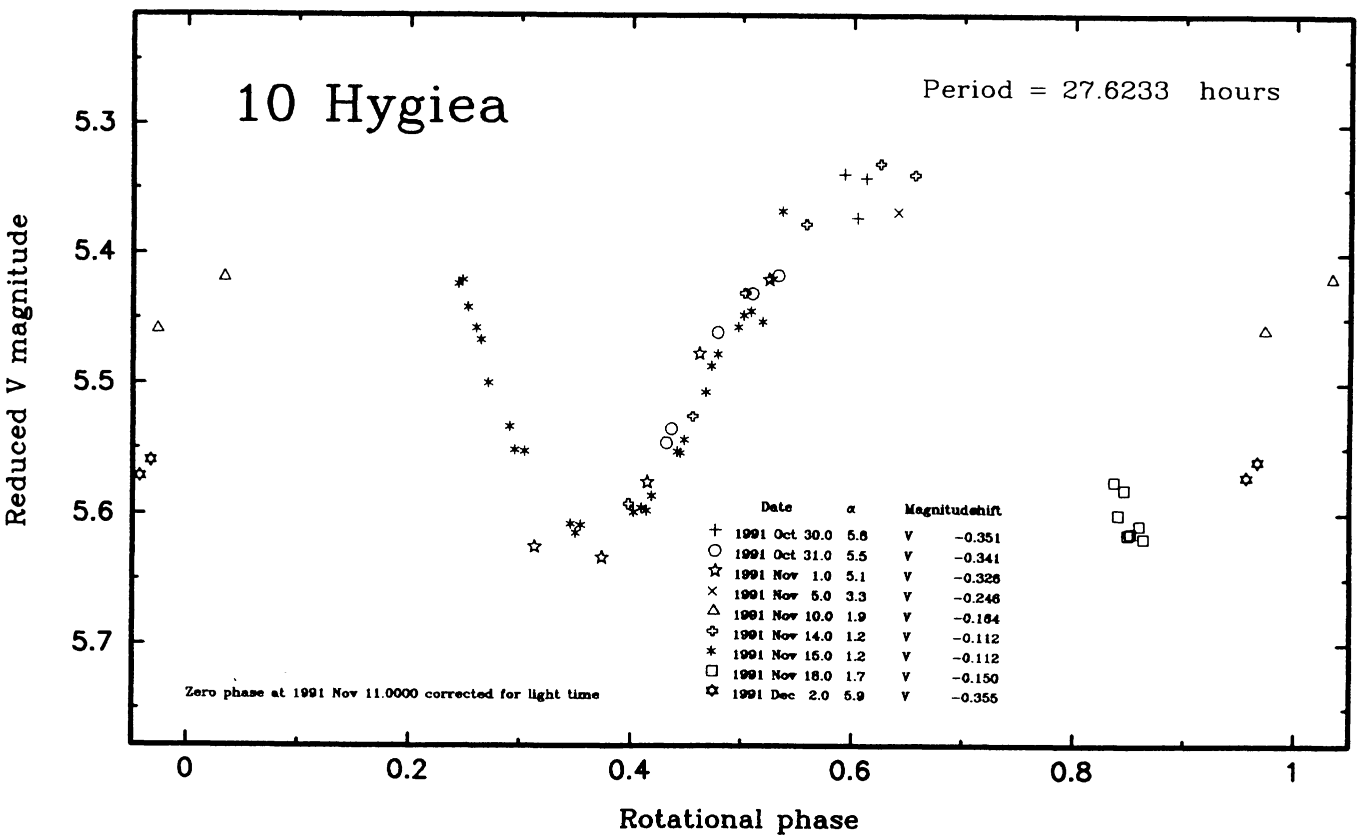

Figure 1. Composite lightcurve in V of 10 Hygiea.

OBSERVING PROGRAMS OF THE MINOR PLANETS SECTION CIRCOLO ASTROFILI DI MILANO

Sergio Foglia
Minor Planets Section Recorder
Circolo Astrofili di Milano
Via Bisleri, 11
I-20148 Milano
Italy

(Received: 18 May)

The Minor Planets Section of Circolo Astrofili di Milano was established in November 1991. It promotes observing programs and research activities for amateur astronomers. It also collaborates with the Minor Planets Sections of the Unione Astrofili Italiani (where I coordinate the visual programs) and the Association of Lunar and Planetary Observers. At the moment, our programs include visual astrometry, visual photometry, and photographic astrometry.

The Minor Planets Section of Circolo Astrofili di Milano maintains close contact with two Italian researchers: Mr. E. Colombini of the "S. Vittore" Observatory at Bologna, and Mr. M. Cavagna of Sormano's Observatory. Periodically I publish the *Bulletin of The Minor Planets Section of Circolo Astrofili di Milano* which contains articles and reports of the observing programs of the Section.

For our visual astrometry program, I give observers a finding chart with the asteroid's predicted path indicated. Using the overlay from the *Uranometria 2000* atlas, observers estimate the asteroid's position. If the asteroid is fainter than 9th magnitude, charts from the *Falkauer Atlas* are used.

For the visual photometry program, I give observers *AAVSO* charts for use in estimating the asteroid's visual magnitude. If a variation in excess of 0.5 magnitude is detected, it is very interesting to determine its lightcurve. Both the astrometry and photometry programs deal with asteroids brighter than V magnitude 10.5.

For our photographic astrometry program we require instrument focal lengths greater than 1 meter. Plates which are obtained for asteroids brighter than V magnitude 14 (whose ephemerides are published in our *Bulletin*) are sent to me for measurement.

I would be glad if many amateur astronomers would like to contact me to participate in these observing programs. The *Bulletin of The Minor Planets Section of Circolo Astrofili di Milano* will be published in both Italian and English. This *Bulletin* will also publish more information on observing programs and suggestions for observational techniques.

CCD PHOTOMETRY OF ASTEROID 487 VENETIA

A. William Neely
NF/ Observatory
Rt. 15 Box 760
San Lorenzo, NM 88041

(Received: 30 July Revised: 19 August)

Photometric observations of the asteroid 487 Venetia were made during its 1992 apparition using a CCD detector at the NF/ Observatory. The synodic rotational period, which was previously unknown, was determined to be 12.73 ± 0.12 hrs. The lightcurve amplitude was 0.30 ± 0.02 magnitudes.

Introduction

Asteroid 487 Venetia is listed as an S-type asteroid (Tholen 1989). It has a diameter of about 64 km and an albedo of about 0.22 with an absolute H magnitude of 8.21 (Tedesco 1989). No lightcurve results for Venetia have been previously published. During February and March of 1992, Venetia was in a favorable position and phase angle for observation. The asteroid was listed as a desirable target by Harris and Zappalà (1992).

Observations

Exposures were obtained through a Johnson V-filter with a CRAF-Cassini charge-coupled-device (CCD) detector having 1024x1024 pixels, where the opposite quadrants are silvered to allow the frame transfer of a 512x512 pixel image. The image scale was 1.2 arcseconds per pixel. The chip and amplifier read-out noise is 25 electrons. Full well is 100,000 electrons. The telescope used was a 0.45-m Newtonian. Control of the observatory was by digital radio link and is described elsewhere (Neely 1989). The images were stored on tape and analyzed with PCVISTA, written by M. Richmond.

The comparison and check stars were within the same frame of the CCD image. This reduced the differential atmospheric extinction to negligible levels and allowed data collection on nights with marginal photometric conditions. The comparison star calibration was performed on February 29 with respect to standard stars from Landolt (1983).

Integrations of 200 seconds were obtained for all data points. Dark fields were taken before each exposure and approximately 60 exposures were taken per night. The dark and bias frames were subtracted at the time of readout and the images were flat-field corrected before being stored on tape for later analysis. All of the flat fields were obtained on the twilight sky.

Results

CCD observations of 487 Venetia were made on UT dates (1992): February 29, March 14, 17, 20, 21, and 22. Observational circumstances for these dates are shown in Table I.

The synodic rotation period was calculated using a minimum phase error method similar to Stellingworf (1978). A constant was added to each night's data to obtain the best vertical fit. A period solution of 12.73 ± 0.12 hours was obtained. The lightcurve, shown plotted for the rotational phase occurring on UT 1992 February 29, appears to display two unequal minima per rotation. Within the noise of the observations, we estimate the peak-to-peak amplitude to be 0.30 ± 0.02 magnitudes.

Acknowledgments

This work was supported by a grant from NASA, administered by the American Astronomical Society, and a grant from the Theodore Dunham Jr. Fund for Astronomical Research. Additional thanks to Larry Miller for his improvements to PCVISTA and to Fred Treasure who kept the radio link up through the difficult lightning season.

References

Harris, A. W. and Zappalà, V. (1992). "Photoelectric Photometry Opportunities." *MPB* 19, 5-6.

Landolt, A. U. (1983). "UBVRI Stars Around the Celestial Equator." *Astron. J.* 88, 439-460.

Neely, A. W. (1989). "The Automatic Radio Linked Telescope (ARLT) at the NF/ Observatory." In Remote Access Automatic Telescopes (D. Hayes and R. M. Genet, Eds.), pp. 141-150. Fairborn Press, Tucson.

Stellingwerf, R. F. (1978). "Period Determination Using Phase Dispersion Minimization." *Astrophys. J.* 224, 953.

Tedesco, E. F. (1989). "Asteroid Magnitudes, UBV Colors, and IRAS Albedos and Diameters." In *Asteroids II* (R. P. Binzel, T. Gehrels, M. S. Matthews, Eds.), pp. 1090-1138. University of Arizona Press, Tucson.

Tholen, D. J. (1989). "Asteroid Taxonomic Classifications." In *Asteroids II* (R. P. Binzel, T. Gehrels, M. S. Matthews, Eds.) , pp. 1139-1150. University of Arizona Press, Tucson.

Table I. Observational circumstances for 487 Venetia

Date	Long	RA(2000)	Dec	AU to Earth	α	VMag*
2/29/92	152 27	10 17.2	21 1	1.7881	5.1	12.2
3/14/92	155 22	10 6.3	22 17	1.86	10.2	12.3
3/17/92	156 0	10 4.4	22 28	1.881	11.1	12.4
3/20/92	156 37	10 2.7	22 38	1.905	12.3	12.5
3/21/92	156 50	10 2.2	22 41	1.913	12.6	12.5
3/22/92	157 3	10 1.6	22 41	1.923	12.9	12.5

*magnitudes are estimated except for 2/29/92 which was calibrated to PG0918 ± .06.

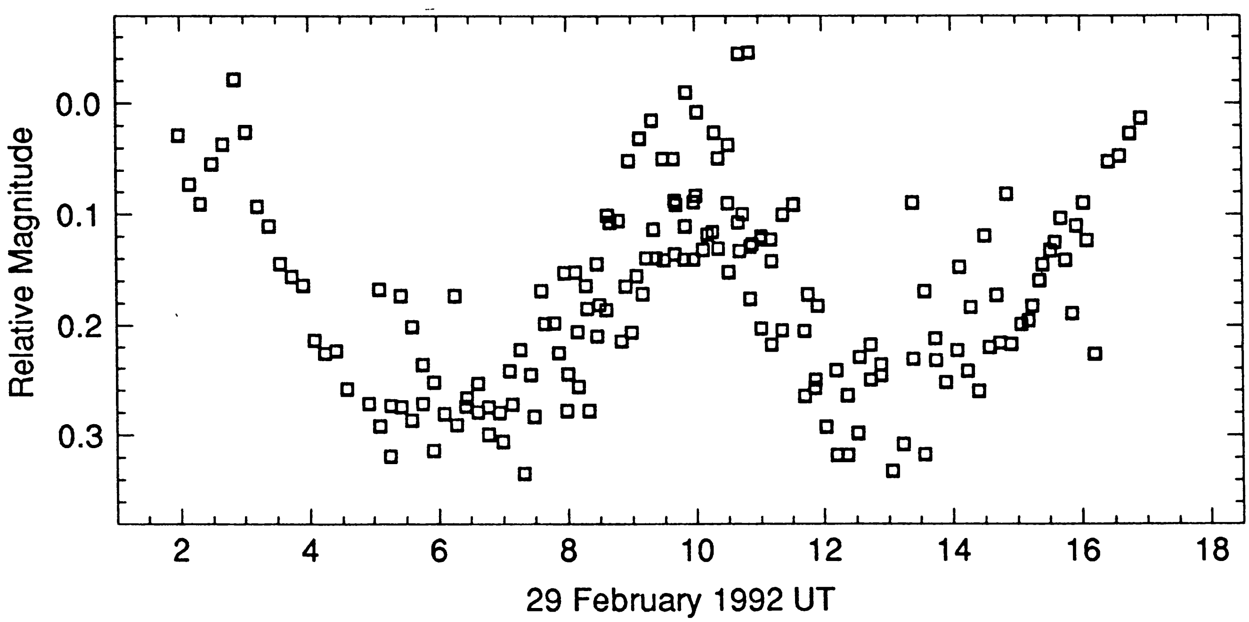

Figure 1. Lightcurve for asteroid 487 Venetia. Data from all nights have been placed into a single rotation cycle based on a period of 12.73 hours. Zero magnitude on the vertical scale corresponds to an apparent V magnitude of 12.10 ± 0.06.

CCD PHOTOMETRY OF 141 LUMEN

Charles J. Wetterer and Terrence F. Flower
Department of Physics
US Air Force Academy, CO 80840

(Received: 20 July Revised: 4 August)

CCD photometry of the asteroid 141 Lumen is reported. The observations indicate a rotation period greater than 18 hours with an amplitude of at least 0.2 magnitudes.

On UT 1992 January 29, we made observations of the minor planet 141 Lumen using the United States Air Force Academy's 40.6-cm Cassegrain reflector equipped with a Photometrics CCD. Six-minute exposures were made every ten minutes for four and a half hours through the V filter. The *Ephemerides of Minor Planets* for 1992 lists no lightcurve information for 141 Lumen.

Three stars appearing in the same image (within 10 minutes of arc) as 141 Lumen were selected as comparison and check stars. The light curves of the two check stars and 141 Lumen compared against the comparison star are shown in Figure 1. The two check stars were 0.8 magnitudes brighter than the comparison star and have been normalized to a zero magnitude difference on the figure. Both show standard deviations of under 0.02 magnitudes. 141 Lumen was an average of 0.25 magnitudes brighter than the comparison star.

No minima or maxima were observed in 141 Lumens' differential lightcurve, computed in the sense of Asteroid-Comparison star. Assuming four extrema (two maxima and two minima) in the lightcurve and equal times between extrema, however, we estimate the rotation period to be greater than 18 hours with an amplitude of at least 0.2 magnitudes.

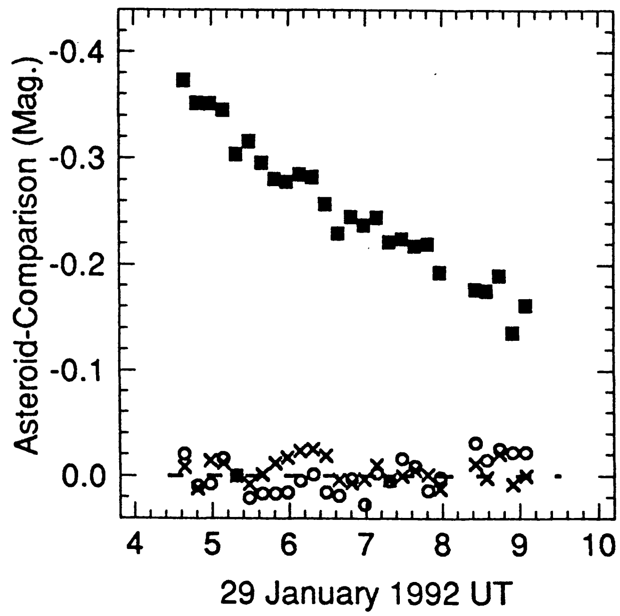

Figure 1. V lightcurve for 141 Lumen and two check stars.

ASTEROID NEWS NOTES

David J. Tholen
Institute for Astronomy
University of Hawaii
Honolulu, HI 96822

Two-hundred-twenty-six New Asteroids

Through the August 13 batch of Minor Planet Circulars, 226 asteroids were newly numbered since the last installment of News Notes, bringing the numbered total to 5297. Non-main-belt objects include:

(5119)	1988 RA1	L5 Trojan
(5120)	1988 TZ1	L5 Trojan
(5123)	1989 BL	L4 Trojan
(5126)	1989 CH2	L4 Trojan
(5130)	1989 SC7	L5 Trojan
(5131)	1990 BG	Apollo
(5143)	Heracles	Apollo
(5144)	1991 XX	L5 Trojan
(5145)	Pholus	Saturn crosser
(5164)	1984 WE1	Jupiter crosser
(5175)	1988 VS4	Hungaria
(5189)	1990 UQ	Apollo
(5201)	1983 XF	Mars crosser
(5209)	1989 CW1	L4 Trojan
(5230)	1988 EF	Mars crosser
(5233)	1988 RL10	L5 Trojan
(5244)	1973 SQ1	L4 Trojan
(5246)	1979 OB	Mars crosser
(5253)	1985 XB	Mars crosser
(5254)	1986 VG1	L4 Trojan
(5257)	1988 RS10	L5 Trojan
(5258)	1989 AU1	L4 Trojan
(5259)	1989 BB1	L4 Trojan
(5261)	1990 MB	Mars Trojan
(5264)	1991 KC	L4 Trojan
(5275)	1986 UU	Mars crosser
(5283)	1989 BW	L4 Trojan
(5284)	1989 CK2	L4 Trojan
(5285)	1989 EO11	L4 Trojan

New Asteroid Names

Many familiar names were attached to asteroids recently. Kenneth Lawrence, a member of Helin's near-Earth object team at Palomar, was honored with the naming of (4969) Lawrence. The long-time executive director of the Astronomical Society of the Pacific was honored with the naming of (4859) Fraknoi. Composers were common among the newly named asteroids once again, with the additions of (4818) Elgar, (4972) Pachelbel, (5063) Monteverdi, (5108) Lubeck, (5157) Hindemith, and (5210) Saint-Saens. In addition to composers, recent namings include a composition as well, namely (5039) Rosenkavalier, named after an opera. Continuing with the music theme, the famous maker of organs appears as (5184) Cavaille-Coll. Artists are represented by (4511) Rembrandt, and (4659) Roddenberry was named in memory of the creator of "Star Trek". (4763) Ride honors America's first woman in space. The names of astronomical places were common, including (4182) Mount Locke, the home of McDonald Observatory, (4432) McGraw-Hill, the observatory complex on Kitt Peak jointly operated by the Massachusetts Institute of Technology, Darmouth, and the University of Michigan, (4547) Massachusetts, the home of the Minor Planet Center, and (4636) Chile, the host country of several important observatory sites. The American Astronomical Society is now represented by (3654) AAS, (but be careful how you pronounce that one). The recent Saturn-crossing asteroid discovery, 1992 AD, was quickly numbered and named, thanks to the uncovering of some prediscovery images of it; the new moniker is (5145) Pholus, though it was briefly known as Chaos, the name proposed by the discoverer, but not accepted by the Minor Planet Names committee. Lastly, the winning name in the 1982 DB naming contest is (4660) Nereus.

Planet Crossing Asteroid Update

The recent pace of planet-crossing asteroid discoveries continues unabated. Since the last installment of News Notes, 19 new objects have been discovered, including 1 Aten, 7 Apollos, 6 Amors, and 5 Mars crossers. In addition, two unusual objects were recovered, although one of them might be better described as an accidental rediscovery. To top it all off, 7 objects discovered earlier have recently had their orbits determined, revealing them to be planet crossers as well.

The table below contains the principal provisional designation, orbit category, estimated diameter in kilometers, discovery or recovery date, discovery or recovery instrument, and discoverer(s) or recoverer(s).

McNaught's colleagues at Siding Spring include Barton, Cannon, Dawe, Drinkwater, Hartley, Hughes, Russell, Ryder, Savage, Steel, and Tritton. The Spacewatch team consists of Gehrels, Rabinowitz, and Scotti. Helin's group includes Alu, Bambery, Lawrence, and Rose. The Shoemakers also work with Leonard and Levy.

Here are some notes about the individual objects.

1984 WE1 is in a distinctly comet-like, Jupiter-crossing orbit, making it of particular interest. The recovery permitted the object to be numbered as (5164).

The two smallest objects of the bunch, 1992 DU and 1992 JD, both Spacewatch discoveries, made close approaches to Earth of approximately 0.041 AU and 0.016 AU on February 25 and May 2, respectively.

Helin found prediscovery images of 1992 LR on films dating from May 27.

1973 NA	Apollo	3.0	Jul 26	UKST	McNaught	== 1992 OA
1984 WE1	Jupiter crosser	18.	Nov 13	Palomar	Shoemaker, Levy	
1991 SS1	Mars crosser	1.9	Sep 29	Spacewatch		
1991 TR6	Mars crosser	3.8	Oct 2	Tautenberg	Borngen, Schmadel	
1991 UG1	Mars crosser	8.	Oct 29	UKST	McNaught?	
1991 XA	Apollo	0.6	Dec 3	Spacewatch		
1992 AX	Mars crosser	6.	Jan 4	Kushiro	Ueda	
1992 BA	Amor	0.30	Jan 27	Spacewatch		
1992 BB	Mars crosser	3.0	Jan 25	UKST	McNaught?	
1992 BL2	Amor	3.8	Jan 30	ESO	Elst, Pizarro	
1992 CC1	Apollo	4.8	Feb 9	Palomar	Shoemaker	
1992 CH1	Amor	0.8	Feb 8	Calar Alto	Birkle	
1992 DC	Mars crosser	1.2	Feb 26	Palomar	Shoemaker	
1992 DU	Apollo	0.038	Feb 26	Spacewatch		
1992 EB1	Mars crosser	3.5	Mar 10	UKST	McNaught	
1992 FE	Aten	1.5	Mar 26	UKST	McNaught	
1992 FL1	Mars crosser	1.9	Mar 26	UKST	McNaught	
1992 HE	Apollo	6.	Apr 25	UKST	McNaught	
1992 HF	Apollo	0.38	Apr 24	Spacewatch		
1992 JB	Apollo	1.5	May 1	Palomar	Alu, Lawrence	
1992 JD	Apollo	0.038	May 3	Spacewatch	Scotti	
1992 JE	Amor	2.4	May 2	Geisei	Seki	
1992 JG	Mars crosser	1.5	May 2	Spacewatch		
1992 KD	Mars crosser	2.4	May 27	Palomar	Helin	
1992 LC	Apollo	3.0	Jun 4	Palomar	Shoemaker	
1992 LR	Amor	1.0	Jun 3	Palomar	Shoemaker	
1992 NA	Amor	1.9	Jul 1	UKST	McNaught	
1992 OA	Apollo	3.0	Jul 26	UKST	McNaught	== 1973 NA
1992 OM	Amor	3.0	Jul 27	Palomar	Helin	

The following abbreviations were used for the discovery or recovery instrument:

- Calar Alto = 0.8-m Schmidt
- ESO = European Southern Observatory 1.0-m Schmidt
- Geisei = 0.6-m reflector
- Kushiro = 0.25-m reflector
- Palomar = Palomar 18" Schmidt telescope
- Spacewatch = Spacewatch Camera 36" scanning telescope on Kitt Peak
- Tautenberg = 1.3-m Schmidt
- UKST = United Kingdom Schmidt Telescope at Siding Spring

1992 NA misses being an Apollo-type object by 0.008 AU.

1992 OA was the designation assigned to the rediscovered Apollo asteroid 1973 NA before the identification was realized (it appears twice in the table above under both designations). 1973 NA is noteworthy because it has the highest known orbital inclination of any asteroid, namely 68 degrees.

Two objects that appeared in the previous News Notes planet crossing asteroid table have had their orbits improved, resulting in a change of orbit category. 1991 VE and 1992 BF, both listed as Apollo-type objects previously, are now classified as Aten-type objects.

And last but not least, in the pair discoveries department, we have 1992 CC1 and 1992 CH1 discovered just one night apart; 1992 DC and 1992 DU discovered on the same night; 1992 FE and 1992 FL1 discovered on the same night; 1992 HE and 1992 HF discovered just one night apart; 1992 JB, 1992 JD, 1992 JE, and 1992 JG were all discovered over the span of three nights, with the last two on the same night; and 1992 LC and 1992 LR were found just one night apart.

One-of-a-kind Asteroid

1992 AD, the Saturn-crossing asteroid mentioned in the last installment of News Notes, received a lot of publicity during the last few months. No fewer than four scientific papers have been written, and more may be on the way. Not surprisingly, prediscovery images of the asteroid were found on plates dating back as far as 1979, so a definitive orbit could be computed using 59 observations from 5 oppositions between 1979 and 1992. With a reasonably secure orbit in hand (though 86 percent of the orbit has yet to be traversed by the object), 1992 AD was added to the numbered asteroid catalog as (5145). Continuing with the theme started by the naming of Chiron, 1992 AD was also given the name of a centaur, Pholus, one of the only remaining "good" centaurs. Most of the rest were brutes, according to Brian Marsden of the Minor Planet Center. If any more trans-Saturnian asteroids are found, the naming process could prove difficult.

Many additional measurements of Pholus' spectral reflectivity have now been made. Although they all agree that the object is by far the reddest asteroid or comet yet observed, there are slight differences in the slope of the spectrum, presumably due to differences in the solar calibration used by the various observational techniques. No rotational variation in color has been detected. Interestingly, the best matches to the spectrum of Pholus are some organic materials made in the laboratory, called "tholins" by Carl Sagan and his colleagues (which is the source of several amusing anecdotes involving these materials and the writer). The suggestion has been made that the surface of Pholus is rich in organic materials, which supports the hypothesis that at least some of the building blocks for life on Earth may have originated elsewhere in the Solar System.

Second Comet Among the Numbered Asteroids

So you thought (2060) Chiron was the lone comet among the numbered asteroids, right? Wrong.

In the course of an examination of the original Palomar Sky Survey plates for prediscovery images of asteroids, Ted Bowell and Brian Skiff of Lowell Observatory discovered that (4015) 1979 VA had a very faint tail attached to it on the night of 1949 November 19. Brian Marsden of the Minor Planet Center quickly realized that this object was identical with comet Wilson-Harrington (1949g = 1949 III), seen over a span of only 6 days in 1949. On only the first of the 1949 plates was a tail present; on subsequent nights, the object was entirely asteroidal in appearance. Richard West has confirmed the presence of the tail on photographic enhancements of glass copies of the Sky Survey. The writer has also examined the available print copies of the Sky Survey, and the tail is quite obvious on the print of the blue plate, although the print of the red plate has only the slightest suggestion of a tail, no doubt due to the somewhat brighter limiting magnitude of the red plate.

The observational arc for comet Wilson-Harrington was too short in 1949 to permit the computation of a definitive orbit, otherwise the identification of 1979 VA as comet Wilson-Harrington might have been made long ago. Instead, the comet's orbit was assumed to be parabolic, thereby masking its true short-period nature. The object is a rapid rotator, spinning once in about 3.5 hours, though the lightcurve amplitude as measured in 1979 was a mere 0.06 mag. Interestingly, a recent measurement of the brightness shows the object to be approximately 0.6 mag fainter than in 1979, though at a different aspect and at a much higher phase angle. Could the difference be due to aspect, or does the object have an unusually steep phase function? These are the most likely explanations, but if so, then the object should not be seen much brighter than it was in 1979, when it was presumably near a polar aspect. Yet estimates of the brightness in 1949 are about 1.4 mag brighter than in 1979! Unfortunately, those brightness estimates from 1949 span a rather wide range of magnitudes, making the comparison with 1979 less certain. If the magnitude can be shown to be brighter than in 1979, then some other explanation needs to be invoked to account for the brightness difference. Radiation darkening is an intriguing possibility, though perhaps some mass loss should not be ruled out. In the latter case, a meteor shower might be expected in late September. In any case, a lightcurve during the current apparition is called for. It could answer many questions.

Third Comet Among the Numbered Asteroids???

For some time we've known that the surface of Ceres had some form of water on it, thanks to the telltale infrared absorption feature first observed by Larry Lebofsky, who had proposed that the feature was due to water frost, even though frosts were unstable on the surface of Ceres. More recently, Fraser Fanale has proposed that the frost at high latitudes could be replenished by outward propagation of subsurface water, with mass loss rates low enough to be maintained for the age of the Solar System. Once on the surface, the water would be vaporized and then undergo photodissociation into H and OH.

OH has an emission feature at 0.3085 microns that is difficult to detect from the ground, due to atmospheric extinction, so observations were made with the International Ultraviolet Explorer (IUE) satellite in both 1990 and 1991 by Mike A'Hearn and Paul Feldman. An exposure off the southern limb of Ceres before perihelion showed no OH emission, but one off the northern limb after perihelion did show a statistically significant emission feature. Their results were published in the July issue of Icarus.

Whether this probable outgassing of Ceres qualifies it as a comet is a rather subjective matter. The important point is that the distinction between the primitive asteroids and the comets may be mainly a matter of volatile content and its internal distribution.

ASTROMETRIC POSITIONS OF MINOR PLANETS

Jim Pryal
31909 3rd Place S.W. #A
Federal Way, WA 98023 USA

(Received: 7 April Revised: 22 May)

The following precise astrometric positions have been measured from photographs obtained by the author. The location of each observing site follows each set. The photographs were measured using the Digitized Stage Microscope, at the University of Washington. The reported UT time is that of mid-exposure. The magnitude listed is from the EMP, or obtained using G. Roger Harvey's orbit program. The number of stars used for determining the position is indicated in the last column by #*. The calculations for the positions were made on my 286 computer using the Astrometric Reduction Program which appeared in the July 1990 issue of Sky & Telescope. The listed Standard Deviation is from that program. The Std. Dev. is corrected to seconds of arc using std. dev × cos dec. × 15. Timing is from WWV, Ft. Collins, CO.

I wish to thank Dr. Paul W. Hodge, and Mark Wilber at the University of Washington, for allowing me time on the Digitized Stage Microscope; G. Roger Harvey for the orbit program to assist in locating those planets beyond their published ephemerides; also, Dr. Frederick Pilcher for his assistance and guidance.

Planet	Date (UT) Time 1991	RA (1950.0)	Dec	Std. Dev. RA	Std. Dev. Dec	Mv	#*
9 Metis	02 10 3:18:30	$8^h10^m21.39^s$	+28°44'22.5"	3.83	.35	9.1	4
	02 10 8:35:30	8 10 09.11	+28 44 54.0	4.45	2.26		6
15 Eunomia	02 10 3:25:30	8 38 06.24	+11 48 45.8	14.06	.71	9.0	4
	02 10 8:41:30	8 37 53.01	+11 48 55.1	3.83	2.16		8
27 Euterpe	02 10 3:11:30	8 46 30.04	+19 59 55.9	8.79	.57	9.2	4
	02 10 8:25:30	8 46 16.90	+20 00 56.1	0.18	.59		4
Longitude 121°43'23.9" W; Latitude 47°28'09.9" N; Altitude 195.8 Meters.							
1 Ceres	04 12 5:22:00	14 03 03.61	+2 20 02.4	6.10	3.25	7.0	8
	04 12 7:57:00	14 02 57.59	+2 20 15.5	1.03	3.17		4
Longitude 121°09'23.2" W; Latitude 47°13'24.2" N; Altitude 646.2 Meters.							
18 Melpomene	06 02 5:37:00	17 12 43.59	-6 31 17.3	4.98	0.74	9.8	4
Longitude 120°44'16.4" W; Latitude 47°12'15.6" N; Altitude 734.6 Meters.							
3 Juno	08 15 5:36:00	19 06 51.01	-7 40 59.7	1.18	1.28	9.6	5
6 Hebe	08 16 6:57:00	22 37 45.15	-14 34 19.2	4.43	4.08	7.9	4
25 Phocaea	08 15 5:56:30	20 59 10.58	+27 44 52.8	0.20	2.24	10.1	4
	08 16 6:31:30	20 58 34.98	+27 35 14.3	3.00	1.95		4
39 Laetitia	08 15 6:02:30	18 20 45.14	-12 42 43.3	3.36	1.14	10.3	4
Longitude 118°45'55.7" W; Latitude 46°18'56.1" N; Altitude 134.9 Meters.							
324 Bamberga	09 15 5:10:00	22 57 28.17	+3 25 18.1	2.53	0.50	8.1	4
	09 15 6:58:00	22 57 22.90	+3 25 47.6	2.37	1.61		4
Longitude 121°43'23.9" W; Latitude 47°28'09.9" N; Altitude 195.8 Meters.							

PHOTOELECTRIC PHOTOMETRY OPPORTUNITIES

NOVEMBER-JANUARY

Alan W. Harris
Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena, CA 91109

Vincenzo Zappalà
Observatorio Astronomico di Torino
10025 Pino Torinese
Italy

The table below lists asteroids which come to opposition during the months of November through January that represent useful targets for photoelectric photometry observations. Observations are needed because the asteroid has either an unknown or ambiguous rotational period or because the asteroid will be observable at a very low phase angle. The table also includes asteroids which are candidates for pole determinations (see the article by Di Martino and Zappalà in issue 12, No. 1), are targets for radar observations (see the article by Ostro in *MPB* 10, No. 4), or are subjects for shape modeling (see the article by Davis and Binzel in *MPB* 14, No. 3). The table gives (in order of opposition dates) the asteroid number and name, opposition date, opposition V magnitude, the rotational period (in hours), the estimated lightcurve amplitude (in magnitudes), and the designation PER if observations are needed to determine the rotational period. AMB implies that previous period determinations have given ambiguous results and these alternate periods are listed in the table. PHA indicates observations of the phase curve are desired because the asteroid will be at an unusually low phase angle, POL indicates the asteroid is a pole position candidate, RAD indicates the asteroid is a planned radar target, and MOD denotes an asteroid at a critical longitude for shape modeling. Question marks are used to denote uncertain or unknown values. An outline of recommended observing procedures in given in *MPB* 11, No. 1, page 7. Also recommended is the book *Solar System Photometry Handbook* published by Willmann-Bell. Ephemerides for all of the asteroids in the table are included in this issue. Finder charts for some of these asteroids may appear in the *Minor Planet Observer*. For information on this publication, contact: Brian D. Warner, Box 818, Florissant, CO 80816. In addition to the objects listed here, observers should especially note the opportunity to observe 4179 Toutatis, whose call for observations appears elsewhere in this issue.

Asteroid	Opp'n Date	Opp'n V Mag	Per	Amp	
441 Bathilde	Nov 29	11.7	10.35	0.1	PHA
455 Bruchsalia	Dec 9	11.6	?	?	PER
198 Ampella	Jan 14	11.7	?	?	PER
426 Hippo	Jan 29	11.7	?	?	PER

Photoelectric Photometry Opportunities

DATE	R.A. (2000) HR	MIN	DEC. DEG	MIN	MAG V	PHASE ANGLE
Minor Planet 198 Ampella						
1992 Dec 9	8	16.17	+15	30.3	12.41	16.2
19	8	9.84	+15	5.6	12.23	12.5
29	8	0.93	+14	49.7	12.03	8.3
1993 Jan 8	7	50.32	+14	41.7	11.83	4.1
18	7	39.20	+14	39.9	11.80	2.9
28	7	28.84	+14	42.4	12.08	6.6
Feb 7	7	20.35	+14	47.6	12.36	10.5
17	7	14.44	+14	53.8	12.62	13.9
27	7	11.43	+14	59.7	12.86	16.6
Minor Planet 426 Hippo						
1992 Dec 19	9	26.44	+20	35.3	12.88	16.4
29	9	22.37	+20	1.3	12.66	13.5
1993 Jan 8	9	15.40	+19	30.8	12.41	9.9
18	9	6.01	+19	1.5	12.14	5.7
28	8	55.05	+18	30.8	11.81	1.1
Feb 7	8	43.75	+17	56.7	11.98	3.6
17	8	33.37	+17	18.6	12.24	8.1
27	8	25.02	+16	36.8	12.46	12.2
Mar 9	8	19.39	+15	52.1	12.67	15.6
Minor Planet 441 Bathilde						
1992 Oct 20	4	49.64	+25	42.1	12.81	16.2
30	4	46.40	+25	16.7	12.59	13.1
Nov 9	4	40.41	+24	41.7	12.35	9.3
19	4	32.25	+23	57.2	12.08	4.9
29	4	22.93	+23	4.9	11.75	0.6
Dec 9	4	13.67	+22	8.7	12.04	4.4
19	4	5.65	+21	13.7	12.30	8.8
29	3	59.82	+20	25.0	12.53	12.7
1993 Jan 8	3	56.73	+19	46.3	12.75	16.0
Minor Planet 455 Bruchsalia						
1992 Oct 30	5	42.97	+20	10.2	12.52	19.2
Nov 9	5	38.23	+20	55.3	12.34	15.3
19	5	30.18	+21	42.9	12.15	10.7
29	5	19.62	+22	30.1	11.94	5.6
Dec 9	5	7.85	+23	13.7	11.63	0.3
19	4	56.41	+23	51.9	12.05	4.8
29	4	46.72	+24	24.6	12.40	9.4
1993 Jan 8	4	39.79	+24	53.4	12.72	13.3
18	4	36.09	+25	20.4	13.00	16.4