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MINOR PLANETS AT UNUSUALLY FAVORABLE OPPOSITION IN 1984

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A list is presented of minor planets which are much brighter than usual at their 1984 oppositions. Several planets for which observations are especially useful are individually detailed, including the closest approach of 2101 Adonis, as found by Edwin Goffin, until the year 2036.

The minor planets in the lists which follow will be much brighter at their 1984 oppositions than at their average opposition distances. Many years may pass before these planets will be again as bright as in 1984. Observers are encouraged to give special attention to those which lie near the limit of their equipment. This list has been compiled on the basis of a comparison of the magnitudes given in the 1984 Ephemerides of Minor Planets (EMP) with a list of the range of opposition magnitudes possible as computed privately by the author. Any planets whose perihelion and aphelion opposition magnitudes differ by 2.0 magnitudes or more and in 1984 will be within 0.3 magnitudes of the brightest possible; or which differ by 3.0 magnitudes or more and in 1984 will be within 0.5 magnitudes of the brightest possible, have been included. For planets brighter than magnitude 13.5 which are within the range of a large number of observers, these standards have been relaxed somewhat to include a larger number of planets.

Some planets which come to opposition at large distances from the ecliptic and therefore at large phase angles, will be fainter than listed in the 1984 ephemeris volume because phase coefficients are not included in the calculation of opposition magnitudes in this source. No systematic effort has been made by the writer to revise the published magnitudes for phase effects, and observers are cautioned that such planets may be slightly fainter than predicted.

The following planets are remarkable enough to merit special mention. Their opposition dates and opposition B magnitudes are provided along with their numbers and names at the start of the paragraphs describing them.

157 Dejanira, Jan. 24, 14.3, is the faintest of the first 221 or so asteroids to be discovered. In 1984, Dejanira will be in opposition at a mean anomaly of only 8 degrees and will appear as bright as it ever can become. This is the opportunity to fill an otherwise blank line in one's list.

958 Asplinda, Nov. 6, 16.1, and 1529 Oterma, Nov. 22, 15.6, are Hilda-type planets remarkable for their 3:2 commensurability with Jupiter.

1972 Yi Xing, Jan. 12, 16.3, is sufficiently close to the Galileo spacecraft trajectory to Jupiter that consideration is being made to slightly diverting the spacecraft en route to make a flyby. Physical observations with larger telescopes are urgently needed to provide a data baseline for anticipated spacecraft measurements. Unfortunately, Yi Xing is out of reach of smaller telescopes.

2046 Dwornik, Aug. 21, 15.3, is a Hungaria-type planet which will be crossing the descending node of its highly inclined orbit very near the date of opposition.

2099 Opik, Oct. 17, 15.8, is an intrinsically very faint asteroid, B(1,0)=16.5, which approaches the orbit of Mars every 3.5 years and has been observed only at 7-year intervals when opposition comes near perihelion, 1963, 1970, and 1977. No physical observations have been made at the time of this writing, and every effort should be expended to obtain them at the 1984 apparition.

The closest approach of any numbered asteroid to Earth in 1984 will be by 2101 Adonis, at B(1,0)=19.5, one of the intrinsically faintest asteroids known. Edwin Goffin, Vereniging voor Sterrenkunde, Belgium, has integrated the orbit forward until the year 2100 in work yet unpublished. He finds Adonis will not be so close to Earth again until the year 2036. Discovered 1936 Feb. 12 by E. Delporte, Uccle, Belgium, and recovered Feb. 1977 by Charles Kowal at Palomar, the 1984 apparition will be the first at which Adonis has ever been observed in the inbound side of its orbit. As the orbit of Adonis crosses south of the Earth's on the inbound segment, observers should plan to journey to southern latitudes to make observations. Adonis will be in opposition June 29 at -34 degrees declination and 0.145 AU distance from Earth. Subsequently Adonis will move swiftly westward and southward, reaching greatest brilliancy July 6 at B magnitude 14.4, -44 degrees declination, and closest approach July 9 at 0.045 AU. The next day it will pass inside the Earth's orbit and soon afterward disappear into evening twilight for even southern hemisphere observers. A preliminary ephemeris for Adonis from the 1984 EMP is presented in Table III as an aid to travel and observation plans. [A more detailed ephemeris will be provided in a future issue. - Ed.]

Separate lists arranged in numerical order (Table I) and in order of opposition date (Table II) are provided. All magnitudes given in this paper are in the photoelectric B system. Visually, most planets are 0.7 to 0.9 magnitudes brighter.

Reference

__Ephemerides of Minor Planets for the Year 1984__, Institute for Theoretical Astronomy, Leningrad (1983).

Table I
Numerical Order of Favorable Oppositions

Planet	Opposition Date	B Mag
7 Iris	Dec 14	8.1
8 Flora	Oct 18	8.8
14 Irene	Apr 18	9.6
16 Psyche	Aug 3	10.2
37 Fides	Oct 17	10.7
47 Aglaja	Sep 11	12.2
60 Echo	Feb 9	11.6
61 Danaë	Sep 28	11.9
63 Ausonia	Jun 20	10.7
66 Maja	Dec 20	12.8
70 Panopaea	Jul 8	10.9
71 Niobe	Jul 10	11.1
75 Eurydike	Jul 18	11.5
77 Frigga	Sep 19	12.5
97 Klotho	Nov 8	10.4
101 Helena	Aug 2	11.7
105 Artemis	Mar 16	11.5
112 Iphigenia	Oct 19	12.9
116 Sirona	Feb 21	11.5
134 Sophrosyne	Oct 13	12.1
144 Vibilia	Nov 6	11.0
157 Dejanira	Jan 24	14.3
185 Eunike	Aug 2	11.8
186 Celuta	Aug 2	12.1
188 Menippe	Jul 26	12.8
197 Arete	Sep 7	13.2
200 Dynamene	Nov 27	12.1
201 Penelope	Jul 13	11.6
233 Asterope	Sep 30	12.3
249 Ilse	Aug 21	13.7
262 Valda	Nov 6	14.5
264 Libussa	Sep 9	12.6
269 Justitia	Jul 21	12.7
295 Theresia	Oct 31	14.0
323 Brucia	Jan 15	13.0
326 Tamara	May 17	11.7
337 Devosa	Oct 7	12.2
351 Yrsa	Dec 16	13.1
364 Isara	Nov 12	12.3
445 Edna	Sep 6	13.5
464 Megaira	Dec 5	13.5
492 Gismonda	Aug 4	14.2
502 Sigune	Jan 4	13.6
503 Evelyn	Feb 10	12.8
554 Peraga	Oct 9	11.7
555 Norma	Feb 21	14.9
568 Cheruskia	Nov 17	13.3
612 Veronika	Sep 7	14.9
638 Moira	Jun 3	13.4
650 Amalasuntha	Oct 25	15.2
686 Gersuind	Aug 5	12.3
712 Boliviana	Sep 18	11.5
718 Erida	Apr 3	13.8
735 Marghanna	Nov 5	12.3
747 Winchester	Dec 28	10.9
751 Faïna	Dec 3	12.1
767 Bondia	Jul 15	14.4
800 Kressmannia	Sep 2	13.4
804 Hispania	Oct 19	12.0
809 Lundia	Aug 17	14.3
836 Jole	Aug 27	15.5
882 Swetlana	Oct 23	14.3
886 Washingtonia	Oct 4	12.2
900 Rosalinde	Jul 19	14.7
934 Thüringia	Sep 4	13.1
939 Isberga	Oct 5	14.4
949 Hel	May 17	13.7
958 Asplinda	Nov 6	16.1
959 Arne	Oct 28	14.9
997 Priska	Jul 5	14.8
998 Bodea	Sep 29	15.2
1006 Lagrangea	Aug 15	15.4
1040 Klumpkea	Oct 28	14.4
1057 Wanda	Aug 8	14.8
1065 Amundsenia	Aug 7	13.7
1099 Figneria	Sep 8	14.0
1110 Jaroslawa	Jun 20	14.1
1115 Sabauda	Feb 26	13.7
1120 Cannonia	Sep 5	14.7
1126 Otero	Feb 14	14.5
1133 Lugduna	Sep 29	14.0
1150 Achaia	Jul 31	15.3
1196 Sheba	Nov 19	14.0
1197 Rhodesia	Jan 24	13.8
1236 Thaïs	Nov 4	15.3
1239 Queteleta	Jan 17	15.5
1273 Helma	Oct 2	15.7
1279 Uganda	May 21	15.0
1299 Mertona	Oct 8	15.8
1346 Gotha	Jan 20	15.1
1369 Ostanina	Jul 17	14.6
1431 Luanda	Oct 8	14.8
1476 Cox	Jul 7	16.1
1529 Oterma	Nov 22	15.6
1534 Näsi	Jan 28	14.8
1545 Thernöe	Jan 14	14.8
1608 Muñoz	Sep 20	15.0
1609 Brenda	Jun 6	14.4
1626 Sadeya	Dec 18	14.3
1671 Chaika	Oct 17	14.6
1689 Floris-Jan	Nov 26	14.5
1714 Sy	Jul 28	15.0
1736 Floirac	Dec 29	14.8
1765 Wrubel	Oct 7	14.4
1938 Lausanna	Apr 11	15.4

Planet	Opposition Date	B Mag
1949 Messina	Aug 1	15.7
1962 Dunant	Oct 6	16.3
1972 Yi Xing	Jan 12	16.3
1986 1935 SV1	Oct 17	16.1
1991 Darwin	Jul 1	15.6
2014 Vasilevskis	Apr 14	14.9
2017 Wesson	Aug 12	15.7
2046 Leningrad	Aug 13	15.4
2048 Dwornik	Aug 21	15.3
2082 Galahad	Jun 14	16.6
2099 Öpik	Oct 17	15.8
2101 Adonis	Jun 29	15.6
2118 Flagstaff	Jan 22	13.9
2119 Schwall	Aug 16	16.2
2121 Sevastopol	Aug 3	14.4
2130 Evdokiya	Aug 6	15.9
2152 Hannibal	Dec 6	15.6
2156 Kate	Aug 22	15.3
2203 1935 SQ1	Aug 28	15.7
2228 Soyuz-Apollo	Dec 28	15.7
2236 Austrasia	Aug 10	14.4
2250 Stalingrad	Jul 20	15.6
2276 1933 QA	Jul 3	15.4
2292 Seili	Jun 17	14.8
2317 2524 P-L	Sep 22	16.5
2339 2509 P-L	Sep 13	16.1
2351 1964 VD	Sep 19	16.4
2360 Volgo-Don	Dec 11	15.7
2430 Bruce Helin	Sep 24	14.8
2440 Educatio	Aug 5	16.0
2464 Nordenskiold	Feb 5	15.6
2552 Remek	Jun 26	16.5
2571 Geisei	Aug 17	16.4
2599 Veseli	Sep 19	14.4
2612 Kathryn	Mar 23	15.0
2614 Torrence	Sep 11	15.9
2643 1973 SD	Sep 24	17.7
2650 1931 EG	Aug 2	14.7
2667 1967 UO	Nov 9	17.0

Table II
Temporal Order of Favorable Oppositions

Opposition Date (1984)	Planet	B Mag
Jan 4	502 Sigune	13.6
Jan 12	1972 Yi Xing	16.3
Jan 14	1545 Thernöe	14.8
Jan 15	323 Brucia	13.0
Jan 17	1239 Queteleta	15.5
Jan 20	1346 Gotha	15.1
Jan 22	2118 Flagstaff	13.9
Jan 24	157 Dejanira	14.3
Jan 24	1197 Rhodesia	13.8
Jan 28	1534 Näsi	14.8
Feb 5	2464 Nordenskiold	15.6
Feb 9	60 Echo	11.6
Feb 10	503 Evelyn	12.8
Feb 14	1126 Otero	14.5
Feb 21	116 Sirona	11.5
Feb 21	555 Norma	14.9
Feb 26	1115 Sabauda	13.7
Mar 16	105 Artemis	11.5
Mar 23	2612 Kathryn	15.0
Apr 3	718 Erida	13.8
Apr 11	1938 Lausanna	15.4
Apr 14	2014 Vasilevskis	14.9
Apr 18	14 Irene	9.6
May 17	326 Tamara	11.7
May 17	949 Hel	13.7
May 21	1279 Uganda	15.0
Jun 3	638 Moira	13.4
Jun 6	1609 Brenda	14.4
Jun 14	2082 Galahad	16.6
Jun 17	2292 Seili	14.8
Jun 20	63 Ausonia	10.7
Jun 20	1110 Jaroslawa	14.1
Jun 26	2552 Remek	16.5
Jun 29	2101 Adonis	15.6
Jul 1	1991 Darwin	15.6
Jul 3	2276 1933 QA	15.4
Jul 5	997 Priska	14.8
Jul 7	1476 Cox	16.1
Jul 8	70 Panopaea	10.9
Jul 10	71 Niobe	11.1
Jul 13	201 Penelope	11.6
Jul 15	767 Bondia	14.4
Jul 17	1369 Ostanina	14.6
Jul 18	75 Eurydike	11.5
Jul 19	900 Rosalinde	14.7
Jul 20	2250 Stalingrad	15.6
Jul 21	269 Justitia	12.7
Jul 26	188 Menippe	12.8
Jul 28	1714 Sy	15.0
Jul 31	1150 Achaia	15.3
Aug 1	1949 Messina	15.7
Aug 2	101 Helena	11.7
Aug 2	185 Eunike	11.8
Aug 2	186 Celuta	12.1
Aug 2	2650 1931 EG	14.7
Aug 3	16 Psyche	10.2
Aug 3	2121 Sevastopol	14.4
Aug 4	492 Gismonda	14.2
Aug 5	686 Gersuind	12.3
Aug 5	2440 Educatio	16.0
Aug 6	2130 Evdokiya	15.9
Aug 7	1065 Amundsenia	13.7
Aug 8	1057 Wanda	14.8
Aug 10	2236 Austrasia	14.4
Aug 12	2017 Wesson	15.7
Aug 15	1006 Lagrangea	15.4
Aug 16	2119 Schwall	16.2
Aug 17	809 Lundia	14.3
Aug 17	2571 Geisei	16.4
Aug 21	249 Ilse	13.7
Aug 21	2046 Dwornik	15.3
Aug 22	2156 Kate	15.3
Aug 27	836 Jole	15.5
Aug 28	2203 1935 SQ1	15.7
Sep 2	800 Kressmannia	13.4
Sep 4	934 Thüringia	13.1
Sep 5	1120 Cannonia	14.7
Sep 6	445 Edna	13.5
Spe 7	197 Arete	13.2
Sep 7	612 Veronika	14.9
Sep 8	1099 Figneria	14.0
Sep 9	264 Libussa	12.6
Sep 11	47 Aglaja	12.2
Sep 11	2614 Torrence	15.9
Sep 13	2339 2509 P-L	16.1
Sep 18	712 Boliviana	11.5
Sep 19	77 Frigga	12.5
Sep 19	2351 1964 VD	16.4
Sep 19	2599 Veseli	14.4
Sep 20	1608 Muñoz	15.0
Sep 22	2317 2524 P-L	16.5
Sep 24	2430 Bruce Helin	14.8
Sep 24	2643 1973 SD	17.7
Sep 28	61 Danaë	11.9
Sep 29	998 Bodea	15.2
Sep 29	1133 Lugduna	14.0
Sep 30	233 Asterope	12.3

Opposition Date (1984)	Planet	B Mag
Oct 2	1273 Helma	15.7
Oct 4	886 Washingtonia	12.2
Oct 5	939 Isberga	14.4
Oct 6	1962 Dunant	16.3
Oct 7	337 Devosa	12.2
Oct 7	1765 Wrubel	14.4
Oct 8	1299 Mertona	15.8
Oct 8	1431 Luanda	14.8
Oct 9	554 Peraga	11.7
Oct 13	134 Sophrosyne	12.1
Oct 17	37 Fides	10.7
Oct 17	1671 Chaika	14.6
Oct 17	1986 1935 SV1	16.1
Oct 17	2099 Öpik	15.8
Oct 8	8 Flora	8.8
Oct 19	112 Iphigenia	12.9
Oct 19	804 Hispania	12.0
Oct 23	882 Swetlana	14.3
Oct 25	650 Amalasuntha	15.2
Oct 28	959 Arne	14.9
Oct 28	1040 Klumpkea	14.4
Oct 31	295 Theresia	14.0
Nov 4	1236 Thaïs	14.3
Nov 5	735 Marghanna	12.3
Nov 6	144 Vibilia	11.0
Nov 6	262 Valda	14.5
Nov 6	958 Asplinda	16.1
Nov 8	97 Klotho	10.4
Nov 9	2667 1967 UO	17.0
Nov 12	364 Isara	12.3
Nov 14	1196 Sheba	14.0
Nov 17	568 Cheruskia	13.3
Nov 22	1529 Oterma	15.6
Nov 26	1689 Floris-Jan	14.5
Nov 27	200 Dynamene	12.1
Dec 3	751 Faïna	12.1
Dec 5	464 Megaira	13.5
Dec 6	2152 Hannibal	15.6
Dec 11	2360 Volgo-Don	15.7
Dec 14	7 Iris	8.1
Dec 16	351 Yrsa	13.1
Dec 18	1626 Sadeya	14.3
Dec 20	66 Maja	12.8
Dec 28	747 Winchester	10.9
Dec 28	2228 Soyuz-Apollo	15.7
Dec 29	1736 Floirac	14.8

Table III
Preliminary Ephemeris for 2101 Adonis

Date (0 hours UT)	R.A. (1950) h m	Dec. d m	B Mag.
1983 June 30	18 26.09	-34 45.8	15.6
July 2	18 04.03	-37 15.7	15.2
July 4	17 25.65	-40 39.1	14.8
July 6	16 10.56	-44 22.1	14.4
July 7	15 08.40	-44 57.3	14.4
July 8	13 49.61	-42 35.8	14.4
July 9	12 28.71	-35 59.9	14.7
July 10	11 22.37	-26 34.0	15.2
July 12	10 01.09	-09 32.7	16.3

EUROPEAN SATELLITE STUDIES OF MINOR PLANETS

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Three European Space Agency satellites capable of observing minor planets are reviewed. One, IRAS, has already been launched. The second, Hipparcos, is scheduled for launch in 1986, while the third, AGORA, is currently being considered.

IRAS

The Infrared Astronomy Satellite (IRAS) was launched on January 26, 1983 from the Western Test Range near Lompoc, California. According to Thomas (1983), the IRAS compares what it sees with a "Known Objects" catalog. If the observed and predicted detections match, the source is said to be "seconds confirming". The next stage in the analysis involves the "New Source Data Base". A source found to have the same position as a source observed on a previous scan is termed "hours confirming". This two-stage process is designed to enhance the reliability of detecting genuine sources, and to reject fast moving objects. Fast moving asteroids, particularly Mars and Earth crossers, will pass seconds confirmation, but will fail hours confirmation.

The first criteria to search among these rejects involves the IR fluxes. Sources too hot or too cold are eliminated. Next, only sources above a certain galactic latitude are accepted. The next step is to select pairs of sources if they are observed on different orbits of IRAS, and if their fluxes in each band agree to within certain tolerances. A listing of these pairs will be produced to be studied by project scientists.

IRAS will be capable of detecting 1800 of the numbered asteroids with known orbits. This includes nearly all objects larger than 3 km in diameter. The telescope measures IR radiation at 10, 25, 50, and 100 microns, and will determine the thermal fluxes of some 500 asteroids. These data can be used to estimate asteroidal diameters (Sky & Telescope 1980). The improved statistical base that IRAS will provide about the asteroids will give scientists a better understanding of the collisional history of the solar system. A major step towards such an understanding came in August, 1983, when it was announced that IRAS had detected a ring of particles, possibly including asteroids, orbiting the star Vega.

Hipparcos

Hipparcos, scheduled for launch in 1986, will be an astrometric satellite whose main task will be to establish the positions of 100,000 stars with great accuracy. It will also be able to search for binary asteroids by direct imaging. As detailed by Schober (1982), some 350 asteroids brighter than B=13.0 will be accessible to Hipparcos.

With Hipparcos, it will be possible to observe asteroids 100 km in diameter at a distance of 2 to 3 AU, corresponding to an apparent diameter of 0.05 arc second. A secondary component is expected to be more than 0.1 arc second from the primary. Periodic variations from a smooth orbit, or even direct observations of a faint secondary, are possible if the same asteroid is scanned several times. From the observed orbital rates and absolute distances within the binary system, masses and densities could be determined.

AGORA

Among the five proposals for new space science missions (ESA Bulletin) is AGORA, the Asteroidal Gravity, Optical and Radar Analysis mission. A description of the mission and model payload was provided by Marsden (1983). The baseline mission comprises a rendezvous with a main belt asteroid (diameter larger than 100 km, semi-major axis 2.5 AU or less), followed by at least two fly-by encounters of smaller objects. No choice of specific targets has been made, but previous studies by JPL have shown that a number of interesting missions exist for the AGORA launch time frame (1990-94).

The model payload consists of a wide-angle camera (150 mm focal length), a high-resolution camera (1500 mm focal length), an infrared spectograph (0.8 - 3.4 microns), a radar altimeter/microwave radiometer, and a gamma-ray spectrometer, together with a complement of instruments for measuring the interplanetary plasma enviroment during the cruise phases. In addition, the spacecraft will carry a number of small ejectable test masses, one of which will be released one or two days prior to each fly-by encounter. The trajectory of the test mass will pass between the spacecraft and the asteroid, allowing the relative perturbation due to the latter to be measured and thereby enabling the asteroid's mass to be estimated. Nominal fly-by distance will be 500 km with a relative velocity of 5 km/sec.

The AGORA craft will be rather complex, requiring 3-axis stabilization, a large steerable solar array, a deployable science instrument scan platform possessing 2 degrees of freedom, and possibly a steerable high gain antenna dish. Two propulsion systems are being considered. The first involves a chemical motor plus a single Mars gravity assist. The alternative is electric propulsion based on European ion drive technology. In either case, AGORA is constrained to launch using an Ariane rocket.

AGORA is a revised version of the Asterex probe, which was rejected by the Science Program Committee of ESA in 1981 (Thomson 1982). The proposed craft had a weight of 750 kg and was also 3-axis stabilized. Designed to carry an imaging camera, infrared spectrometer, and radar altimeter, Asterex would have had a three year lifetime.

References

European Space Agency Bulletin, no. 33, 1983.

Marsden, R.G. (1983) Space Science Dept., European Space Agency, (personal communication).

Schober, H.J. (1982). "Search for Binary Asteroids with the ESA Space Astrometry Satellite Hipparcos". Scientific Aspects of the Hipparcos Space Astrometry Mission, ESA SP-177, p. 169.

Thomas, G. R. (1983). "IRAS Preliminary Science Analysis at the OCC". J. British Interplan. Soc. 36, 38.

Thomson, A.A (1982). "Off to the Asteroids". Spaceflight 24, 7.

Sky & Telescope (1980). "IRAS and the Asteroids". 60, 12.

ASTEROIDS TARGETED FOR ARECIBO RADAR OBSERVATIONS IN 1984

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A list of radar targets currently planned for Arecibo observations in 1984 is presented to encourage observers to obtain supporting physical observations. Photoelectric lightcurves are especially needed to fully interpret the radar data.

The table below lists asteroids for which radar observations are currently planned using the National Astronomy and Ionosphere Center's Arecibo Observatory in Puerto Rico. The number and name of each target is given along with the UT dates on which observations will be attempted. S is the expected single-night signal-to-noise ratio. The final two columns give the opposition date and the opposition B magnitude of the asteroid.

This table is presented to encourage observers to make supporting physical observations of these asteroids, especially near simultaneous photoelectric lightcurve observations. These data can greatly enhance the interpretation of the radar observations for reasons described by Ostro (1983) (MPB 10, 10-11).

1984 Arecibo Radar Targets

Target	Observation Dates	S	Opp'n Date	Opp'n B Mag
60 Echo	Feb 26-Mar 3	5	Feb 9	11.6
9 Metis	Mar 13-Mar 18	5	Mar 22	10.5
27 Euterpe		5	Mar 9	10.5
2101 Adonis	Jul 13-Jul 18	150	Jun 29	15.6
554 Peraga	Oct 29-Nov 3	7	Oct 9	11.7
144 Vibilia		9	Nov 6	11.0
7 Iris	Dec 11-Dec 17	30	Dec 14	8.1

PHOTOELECTRIC PHOTOMETRY OPPORTUNITIES DECEMBER 1983 - APRIL 1984

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The table below lists asteroids which come to opposition during the months of December 1983 - April 1984 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. Asteroids which are planned as targets of radar observations are also included in the table (see the article in this issue by Ostro.) The table gives (in order of opposition dates) the asteroid number and name, opposition date, opposition B magnitude, (the V magnitude is about 0.8 brighter), the rotational period (in hours), the estimated lightcurve amplitude (in magnitudes), and the designation PER if observations are needed to determine the rotational period. PHA indicates observations of the phase curve are desired and RAD indicates the object is a radar target. Question marks are used to denote uncertain or unknown values. Recommended observational procedures are given in MPB 10, No. 1, pages 1-2. Ephemerides for 9 Metis, 30 Urania, 230 Athamantis, and 409 Aspasia are included in this issue. Ephemerides for all other asteroids appeared in the previous issue. Several of these objects will likely be included in finder charts prepared by Dr. J. U. Gunter, 1411 N. Mangum St., Durham, NC 27701, which are free for a self-addressed stamped envelope.

Of particular note for the objects below is 230 Athamantis which appears to have a period of 24.00 hours! This determination may be ambiguous, i.e. the period could really be 12.00 hours. In any case, the commensurate period makes observations of the complete rotational phase impossible from any single observatory. Observers (especially Europeans) who would be interested in a coordinated campaign to observe Athamantis are invited to contact me.

Asteroid	Opp'n Date	Opp'n B Mag	Per	Amp	
74 Galatia	Dec 15	12.4	?	?	PER
60 Echo	Feb 10	11.4	52?	0.2?	PER*
202 Chryseis	Feb 14	12.0	?	?	PER
116 Sirona	Feb 19	11.5	13.7?	0.3	PER
27 Euterpe	Mar 9	10.3	8.50	0.15	PHA*
105 Artemis	Mar 19	11.4	>24	>0.1	PER
9 Metis	Mar 22	10.5	5.04	0.3	RAD*
64 Angelina	Mar 23	11.4	8.75	0.3	PHA
409 Aspasia	Apr 11	11.4	?	>0.05	PER
30 Urania	Apr 11	11.9	13.69	0.45	PHA
230 Athamantis	Apr 25	11.6	24.00	0.25	PER

* = also a radar target

PHOTOELECTRIC PHOTOMETRY OPPORTUNITIES

Minor Planet 9 Metis

DATE			R.A. (1950.00) HR	MN	SEC	DEC. DEG	'	"	MAG B
1984	Feb	25	12	27	36.88	6	34	39.6	10.65
	Mar	6	12	20	14.22	7	33	46.2	10.46
		16	12	11	8.14	8	32	45.7	10.26
		26	12	1	27.04	9	23	17.2	10.35
	Apr	5	11	52	24.81	9	58	28.5	10.61
		15	11	45	5.20	10	14	19.1	10.85
		25	11	40	8.86	10	9	59.2	11.09
	May	5	11	37	52.71	9	46	50.4	11.33

Minor Planet 30 Urania

DATE			HR	MN	SEC	DEG	'	"	MAG B
1984	Feb	25	13	39	55.60	-13	7	48.1	12.86
	Mar	6	13	37	8.12	-13	4	18.5	12.64
		16	13	31	43.87	-12	44	43.3	12.42
		26	13	24	7.12	-12	9	49.1	12.19
	Apr	5	13	15	2.51	-11	22	24.5	11.90
		15	13	5	31.28	-10	27	35.1	11.87
		25	12	56	38.08	- 9	31	50.3	12.18
	May	5	12	49	18.71	- 8	41	43.0	12.41
		15	12	44	11.38	- 8	2	28.2	12.64
		25	12	41	34.03	- 7	37	15.9	12.87

Minor Planet 230 Athamantis

DATE			HR	MN	SEC	DEG	'	"	MAG B
	Mar	6	14	26	51.52	-22	47	50.6	12.43
		16	14	25	55.71	-22	44	16.9	12.24
		26	14	22	8.58	-22	21	19.7	12.05
	Apr	5	14	15	47.12	-21	37	41.1	11.87
		15	14	7	32.08	-20	34	13.5	11.65
		25	13	58	23.91	-19	14	53.6	11.44
	May	5	13	49	32.82	-17	46	45.5	11.64
		15	13	42	4.68	-16	18	41.5	11.83
		25	13	36	46.72	-14	58	59.2	12.01
	Jun	4	13	34	4.33	-13	53	41.0	12.19
		14	13	34	3.70	-13	5	59.4	12.37
		24	13	36	37.83	-12	36	33.9	12.54

Minor Planet 409 Aspasia

DATE			HR	MN	SEC	DEG	'	"	MAG B
1984	Feb	25	13	17	15.52	-22	20	59.1	12.33
	Mar	6	13	15	15.24	-22	28	51.8	12.09
		16	13	10	37.69	-22	11	30.3	11.85
		26	13	3	52.38	-21	27	14.5	11.62
	Apr	5	12	55	51.55	-20	17	33.5	11.42
		15	12	47	44.10	-18	48	11.2	11.40
		25	12	40	39.18	-17	8	20.7	11.56
	May	5	12	35	32.14	-15	28	36.8	11.77
		15	12	32	57.26	-13	58	26.8	11.99
		25	12	33	6.14	-12	44	15.1	12.22
	Jun	4	12	35	54.37	-11	49	13.6	12.43

ASTEROID NEWS NOTES

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New Names

Rarely do the newly named asteroids outnumber the newly numbered ones in any given month, but such was the case in September when 26 asteroids received names. Included was (1717) Arlon, the lowest numbered object without a name, until now. The distinction now falls on (1787) 1950 SK. Three objects in the 1800's still lack names. The highest numbered object to be named is (2906) Caltech, named after..., you guessed it!

Seventeen Newly Numbered Asteroids

After taking a vacation in August, the September batch of Minor Planet Circulars added another 17 asteroids to the numbered population. The total is now at 2927. At the reduced pace of recent months, it seems unlikely that number 3000 will be added in 1983, but that level should be reached in early 1984. The numbered asteroid population has increased nearly 50 percent in only five years! Man and machine have been very busy!

One Trojan asteroid is among the new 17: (2920) 1981 JR. It is a member of the leading cloud. We now have 38 Trojans among the numbered population.

It's Twins!

1984 will be remembered for the way earth-approaching asteroids are being discovered in pairs. Recall from the last issue, 1983 LB and 1983 LC were discovered on the same plate! After a four-month lull, two more earth-approachers have been found: one by Shoemaker (1983 RB), and one by Dunbar (1983 RD), both at Palomar. Astronomers will have a good chance to study 1983 RD, because its orbit is causing it to pace the earth for several months. At closest approach in mid-September, the object was only 0.08 AU from the earth, when it was measured to be V=12.6! 1983 RD will remain brighter than V=18 until early January.

Just as this column of News Notes was being wrapped up, another Amor asteroid, 1983 SA was discovered by Wild. The preliminary orbit shows a surprisingly large eccentricity of 0.7, a perihelion distance of 1.2 AU, a semi-major axis of 4.2 AU, and an inclination of 31 degrees! Now the question is, does this mean a second earth-approacher will be discovered in the next few days? For the answer, catch this column in the next issue.

Galileo to Flyby Asteroids?

If current plans for launching the Galileo spacecraft to Jupiter in May 1986 do not fall through, we should have a golden opportunity to study an asteroid close-up. The objects favored for flyby, at the moment, are 1219 Britta and 1972 Yi Xing. Although physical observations had not been obtained for either object prior to the announcement of the flyby opportunity, we can speculate on their nature based on the orbital characteristics. 1219 Britta is located near the inner edge of the main belt and is associated with one of the Flora region families. Virtually all studied objects in this region have S-type spectra (reddish, with a 0.95 micron absorption feature due to a mixture of pyroxene and olivine, and a moderate albedo). At least one D-type has been found in the region, as well as one E-type, so there is a remote possibility that Britta may be a more unusual object.

1972 Yi Xing is also in the inner part of the main belt and is associated with the Nysa asteroid family. Nysa itself is a high albedo E-type asteroid, but the other members of the family have flat to slightly bluish spectra and very low albedos. Yi Xing would appear to have a much better chance for being an unusual object, making it very worthwhile for Galileo to fly by and study at close range.

The uncertain nature of these objects should be vanishing as this issue reaches you, however. Britta came to opposition in October at B=14.6, and Yi Xing comes to opposition in January at B=16.3. Both are presently being studied intensively from ground-based telescopes.

PHOTOELECTRIC INVESTIGATIONS OF ASTEROIDS: SELECTED OBSERVATIONAL PROGRAMS FOR 1984

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In a preceding paper (Zappala' 1983), the significant contribution that small and/or medium size telescopes can still give in photoelectric observations of asteroids was emphasized. In particular, a program to determine rotational axes by means of complete and accurate V-lightcurves obtained at small phase angles was described.

Now, more generally, we would like to address observers' attention to a set of selected objects that have favorable oppositions in 1984 for which a better knowledge of rotational properties is especially important from a physical and statistical point of view. Almost all the listed asteroids have B magnitudes brighter than 13, so that observations can be performed by means of small telescopes too.

On the basis of considerations outlined in the preceding paper, let us state that in photoelectric observations of asteroids we have now arrived at the point where asteroids should be observed not only because they are "observable", but for their real statistical and/or physical interest. For example, a new period determination for a 100 km asteroid is "statistically" much less important than for an asteroid of 50 km. On the other hand, a complete knowledge of the rotational properties of all asteroids in the range 50-200 km is "physically" highly desirable for investigating the possible existence of triaxial equilibrium ellipsoids (Farinella et al. 1981) or binary systems (Zappala' et al. 1980; Weidenschilling 1981), which from theoretical investigation and observational evidence are thought to be particularly frequent in this size range.

Another problem was recently clearly demonstrated in the case of the large asteroid 52 Europa, whose previously adopted rotational period (thought to be of very high reliability because of the regular appearance of lightcurves obtained during the first observed opposition) is now probably to be rejected in favor of a new value which is shorter by a factor of two. This surprising result was recognized to pertain to some other objects as well, so that a conspicuous number of rotation periods, derived from lightcurves presenting pairs of maxima and minima of the same level and shape, should be carefully revised by means of new observations.

Taking into account, consequently, the above considerations, we have divided the entire program of asteroid photoelectric observations into four sub-programs, each devoted to a particular purpose. For the first program (POLE), presented in Table I, we need only one complete and accurate V lightcurve and magnitude at maximum brightness, obtained at a small phase angle. Generally, the asteroids were selected by considering periods shorter than 10 hours, in order that the rotational cycle can be fully covered in one night. A few objects with periods exceeding this limit are included in this category, because much high-quality observational data is already available on these bodies. Objects with well observed lightcurves from at least two oppositions, and therefore potentially ready for a preliminary pole calculation (because they require observations at only one more apparition) are marked by an asterisk. Asteroids of particular physical importance (peculiar equilibrium figures) are marked by two asterisks: they should be treated as having the highest priority.

PERIOD program objects are listed in Table II. These are asteroids with unknown or very uncertain periods. Again, objects of special statistical and/or physical interest are marked by an asterisk pointing out a higher priority. Table III (CAMPAIGN program) gives asteroids with unreliable periods thought to be very close to 24 hours or longer. For them we recommend collaboration and coordination of observing plans among all interested observers. Finally, Table IV (AMBIGUITY program) reports objects which can have a currently adopted period wrong by a factor of two.

For all tables the columns indicate the asteroid number, B magnitude, declination, opposition date (day/month), diameter in km, type, and adopted period. The types and diameters are taken from Bowell et al. (1979); when not listed, we assumed type from the semimajor axis and calculated the respective diameter. Note that asteroids included in POLE and AMBIGUITY programs are, in our opinion, the most important. Therefore, we strongly encourage interested observers to participate in these programs. Observers are welcome to contact us for any additional information they may need.

Moreover, we suggest that results obtained by observers should be communicated as soon as possible to other astronomers involved in asteroid research. Necessary assistance in this sense can be provided by A. W. Harris and V. Zappala', who head the IAU Commission 15 working group on asteroid rotational data, who will ensure fast circulation of new information, and include your result in an updated data file.

References

Bowell, E., Gehrels, T., and Zellner, B. (1979). "Magnitudes, Colors, Types, and Adopted Diameters of the Asteroids." In Asteroids, (T. Gehrels, ed.), University of Arizona Press, Tucson, pp. 1108-1129.

Farinella, P., Paolicchi, P., Tedesco, E.F., and Zappala', V. (1981). "Triaxial Equilibrium Ellipsoids Among the Asteroids?" Icarus 46, 114-123.

Zappala', V. (1983). "Photoelectric Investigations of Asteroids: The Contribution of Small Telescopes." MPB 10, 17-18.

Zappala', V., Scaltriti, F., Farinella, P., and Paolicchi, P. (1980). "Asteroidal Binary Sytems: Detection and Formation." Moon and Planets 22, 153-162.

[Ed. - Time and space do not allow ephemerides for these asteroids to be included in this issue. Observers interested in particular objects which come to opposition in early 1984 may obtain an ephemeris by writing to the editor or V. Zappala'.]

Table I

POLE Program

No.	B(mag)	Decl.	Opp.Date	D(km)	Type	Period(h)
36	11.9	+56°	2/I	103	C	9.93
12	12.0	+ 9	19/I	135	S	8.654
29*	9.9	+27	25/I	194	S	5.39
13	10.8	+47	27/I	241	C	7.045
88**	12.4	+14	28/I	207	C	6.042
43*	12.1	+14	29/I	77	S	5.751
423**	12.8	+32	31/I	209	C	4.62
85*	13.1	0	4/II	146	U	6.875
93**	12.7	+27	5/II	170	C	5.979
55**	12.6	+20	19/II	172	CMEU	4.804
675*	12.9	- 9	2/III	74	S	7.717
261	12.5	+14	2/III	84	C	8.
173**	13.0	+12	3/III	163	C	5.93
349**	11.4	+17	3/III	145	R	4.701
27	10.5	+ 7	9/III	116	S	8.5
19	11.7	+ 2	10/III	221	C	7.5
125**	13.3	+ 4	12/III	103	CMEU	3.969
64*	11.6	- 2	21/III	60	E	8.75
9**	10.5	+ 9	22/III	153	S	5.064
135	12.6	- 5	27/III	79	M	8.4
409*	11.1	-20	5/IV	194	C	9.03
72	12.5	-11	18/IV	60	U	8.098
14*	9.6	+ 5	18/IV	154	S	9.35 ?
192*	12.4	-21	23/IV	94	S	13.622
52**	11.8	- 2	25/IV	290	C	5.63
28*	11.6	0	2/V	122	S	15.695
79*	13.0	-14	4/V	75	S	5.979
21*	11.5	-13	5/V	112	M	8.167
115	12.5	-35	9/V	93	S	7.241
196*	11.8	-14	12/V	160	S	8.32
471*	12.5	- 9	17/V	149	S	7.105
386	12.9	+ 7	2/VI	203	C	9.76
18*	10.6	- 6	3/VI	152	S	11.572
15**	10.2	-33	7/VI	246	S	6.081
63*	10.7	-34	20/VI	89	S	9.297
216**	12.1	- 7	25/VI	219	CMEU	5.385
704*	11.1	-23	2/VII	339	C	8.723
218	12.8	+ 1	4/VII	59	S	6.636
5*	11.9	-18	4/VII	122	S	16.812
95	13.0	-10	6/VII	168	C	8.688
110*	11.8	-30	10/VII	90	M	10.927
201**	11.6	-14	13/VII	144	CMEU	3.747
75	11.5	-31	18/VII	99	CMEU	8.92
94	13.0	-31	21/VII	191	C	7.22
702	12.4	-14	22/VII	217	CU	8.36
87**	12.5	-32	27/VII	130	M	5.183
16**	10.2	-15	3/VIII	252	M	4.196
107**	13.3	- 7	10/VIII	252	C	4.85
354**	11.6	-16	26/VIII	169	U	4.277
118	12.9	-22	31/VIII	57	S+	7.78

2*	9.3	+ 4	3/IX	538	U	7.811
360	13.0	-16	6/IX	138	C	6.21
511*	11.5	-24	19/IX	341	C	5.13
77*	12.5	- 2	19/IX	57	M	9.01
451*	11.6	-23	27/IX	327	C	9.727
78*	12.6	+11	29/IX	140	C	7.22
337*	12.2	+10	7/X	100	C	4.61
65**	12.7	+ 3	10/X	311	C	6.07
308*	12.7	+ 6	16/X	139	U	12.032
37*	10.7	+11	17/X	93	S	7.33
8*	8.8	- 4	18/X	153	S	?
45**	12.1	+ 3	26/X	228	C	5.70
24*	12.5	+15	4/XI	210	C	8.371
23*	10.9	+10	9/XI	115	S	12.308
364	12.3	+ 7	12/XI	32	SRM	9.155
25	12.0	+ 7	14/XI	65	S	9.945
444	12.3	+ 8	3/XII	167	C	6.218
238	12.6	+ 4	5/XII	155	C	8.9
497	13.2	+31	9/XII	30	M	4.62
54*	12.9	+37	11/XII	177	C	7.04
124	13.0	+19	13/XII	72	S	9.921
7*	8.1	+23	14/XII	210	S	7.135
6*	9.2	+ 5	26/XII	195	S	7.274
747*	10.9	+ 5	28/XII	205	C	9.4
40	10.6	+24	28/XII	121	S	9.136

Table II

PERIOD Program

No.	B(mag)	Decl.	Opp.Date	D(km)	Type	Period(h)
323*	13.0	+33°	15/I	33	S	10. ?
266	13.0	0	22/I	115	C+	-
212*	13.1	+21	23/I	133	C	-
375*	13.2	+32	26/I	200	C	-
503	12.8	+24	10/II	92	C	-
202	12.6	+15	14/II	95	S	-
58	13.0	+ 9	22/II	103	C	-
416	12.8	+29	28/II	82	S	-
127	12.7	+11	14/III	115	C	-
11*	11.0	+ 5	25/III	152	S	10 ?
172*	13.0	-24	14/IV	66	S	-
14*	9.6	+ 5	18/IV	154	S	9.35 ?
760*	13.0	-33	25/IV	68	S	-
326	11.7	-44	17/V	90	C	-
241*	12.6	-25	23/V	186	C	-
269*	12.7	-14	21/VII	30	S+	-
188*	12.8	0	26/VII	70	C+	-
10*	10.3	-15	1/VIII	450	C	14. ?
686*	12.3	+16	5/VIII	34	S	-
369*	12.4	-30	18/VIII	120	CMEU	-
240	12.8	-13	22/VIII	98	C	-
934*	13.1	+ 1	4/IX	60	C+	-
407	13.1	+ 5	8/IX	104	C	-
264*	12.6	-22	9/IX	64	S	-
26	12.2	- 5	20/IX	91	S	10.6 ?
886	12.2	-22	4/X	110	C	-
419*	12.7	+11	14/X	77	EU	-
8*	8.8	- 4	18/X	153	S	-
83	12.9	+10	20/X	118	C	10.16 ?
480*	13.1	+26	24/X	63	S	-
735*	12.3	+16	5/XI	75	C	-
344*	12.6	+16	9/XI	147	C	13. ?
498	13.0	+ 9	21/XI	72	U	-
751	12.1	+18	3/XII	113	C	-
358	13.1	+17	6/XII	80	C+	-
322	13.1	+21	16/XII	80	C+	-
351*	13.1	+19	16/XII	47	S	-
206	13.0	+18	17/XII	111	C	-
66	12.8	+29	20/XII	83	C	-
626	12.7	+63	27/XII	96	C	-

Table III

CAMPAIGN Program

No.	B(mag)	Decl.	Opp.Date	D(km)	Type	Period(h)
60	11.6	+ 9°	9/II	51	S	52 ?
105	11.5	- 6	16/III	129	C	>24
914	12.7	-42	25/IV	75	C	>14
145	12.2	-13	20/V	137	C	20.6 ?
114	12.6	-13	25/V	131	C	20. ?
346	12.7	-16	29/V	102	S	26. ?
139	12.8	-40	29/VI	140	C	41.8 ?
389	12.8	- 1	22/VIII	70	S	>10
109	12.4	- 9	10/IX	76	C	26. ?
47	12.2	- 7	11/IX	156	C	>24
236	11.9	+ 4	10/X	77	S	24. ?
103	12.2	+11	22/XI	90	S	23.74
198	11.8	+26	10/XII	66	S	long
111	11.6	+27	31/XII	156	C	22.2

Table IV

AMBIGUITY Program

No.	B(mag)	Decl.	Opp.Date	D(km)	Type	Period(h)
92*	12.3	+23°	1/I	184	U	15.94
387	13.0	+12	5/I	113	S	16. ?
776*	12.2	+34	7/I	174	C	15.3
441*	12.5	+13	14/I	61	M	10.35
49*	12.3	+18	24/I	179	C	10.42
194*	13.1	+ 4	28/I	193	C	15.67
423*	12.8	+32	31/I	209	C	4.62
324*	11.8	+20	5/II	251	C	29.42
17	11.8	+10	14/III	97	S	12.275
409*	11.1	-20	5/IV	194	C	9.03
52*	11.8	- 2	25/IV	290	C	5.63
139*	12.8	-40	29/VI	140	C	41.8
70*	10.9	-41	8/VII	153	C	15.87
110*	11.8	-30	10/VII	90	M	10.927
702*	12.4	-14	22/VII	217	CU	8.36
179	12.5	+10	15/IX	68	S	11.17
712	11.5	+18	18/IX	128	C	11.87
532*	11.3	-23	22/IX	215	S	9.406
61	11.9	+21	28/IX	87	S	11.45
233	12.3	+11	30/IX	62	SU	19.7
37*	10.7	+11	17/X	93	S	7.33
804*	12.0	+28	19/X	175	C	14.853
83	12.9	+10	20/X	118	C	10.16 ?
23	10.9	+10	9/XI	115	S	12.308
103	12.2	+11	22/XI	90	S	23.74
200	12.1	+33	27/XI	121	SME	19.
124	13.0	+19	13/XII	72	S	9.921
111*	11.6	+27	31/XII	156	C	22.2