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V+B PHOTOELECTRIC PHOTOMETRY OF ASTEROIDS 121 HERMIONE, 264 LIBUSSA, AND 354 ELEONORA

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(Received: 16 April)

Photoelectric observations of the asteroids 121 Hermione, 264 Libussa and 354 Eleonora were made from Estacion de Altura "El Leoncito" of Felix Aguilar Observatory during the 1989 apparition. The synodic rotational period, lightcurve amplitude and average B-V color found for 121 Hermione are: P=8.97±0.07 hr., Δm=0.12±0.01, B-V=0.699±0.014. For 354 Eleonora the previously reported 4.277 hr. period is confirmed and the observed amplitude and colors are: Δm=0.16±0.01, B-V=0.931±0.014. For 264 Libussa the synodic rotational period is not less than 8 hr., with lightcurve amplitude >0.22 mag. and average B-V=0.838±0.014.

Observations

During October 1989 the asteroids 121 Hermione, 264 Libussa and 354 Eleonora were favorably placed for photoelectric study. Observations of asteroid 121 Hermione and 264 Libussa were conducted by the author as part of a program directed toward the study and determination of synodic periods of asteroids, and observations of 354 Eleonora were made in answer to a call made by Davis and Binzel (1987) for filling gaps in longitude coverage for large rapidly rotation asteroids. The described photometric studies were conducted from Estacion de Altura "El Leoncito" of Felix Aguilar Observatory (San Juan, Argentina).

The photoelectric measurements were made using the V and B filters of a cooled photon-counting photometer equipped with an RCA 31034A photomultiplier tube attached to a 0.76-m Cassegrain telescope. The photometric data were recorded using a microcomputer which was interfaced with the photometer.

A nearby comparison star of spectral class G was selected to minimize the effects of color dependent variation in the atmospheric extinction between the asteroid and comparison star. The selected comparison stars were in all cases within one degree of the asteroids, thus reducing the correction of differences in atmospheric extinction to less than 0.01 magnitude. In all cases the comparison stars were standardized using standard stars of the nearby Selected Areas 92, 93 and 115, Landolt (1973, 1983).

During each observing night and for both colors, 20 second photometric integrations were used on the asteroids and comparison stars, and 10 seconds on the sky. The standard observing procedure followed was to initially obtain photometric measurements of the comparison star and the sky background. These measurements were followed by two 20 second integrations of the asteroid and a 10 second integration of the sky between them, after which this comparison star-asteroid sequence was repeated. Magnitude measurements of 121 Hermione, 264 Libussa and 354 Eleonora are subject to an average uncertainty of 0.01 magnitude in both colors. Typically 7 to 9 photometric measurements were obtained in each color during each hour of the observing run. During each night the raw photometric data were stored in a computer disk file and a hard copy was produced.

Results

Photoelectric observations of these asteroids were conducted at "El Leoncito" Station of Felix Aguilar Observatory. On the nights of October 26 and 27, 1989 UT, 24 and 25 photometric measurements, respectively, were made in each color for 121 Hermione. On the night of October 28, 1989 UT, 27 photometric measurements were made in each color for 354 Eleonora, and on the night of October 29, 1989 UT, 35 photometric measurements were made in each color for 264 Libussa. Observational circumstances for the asteroids are shown in Table I.

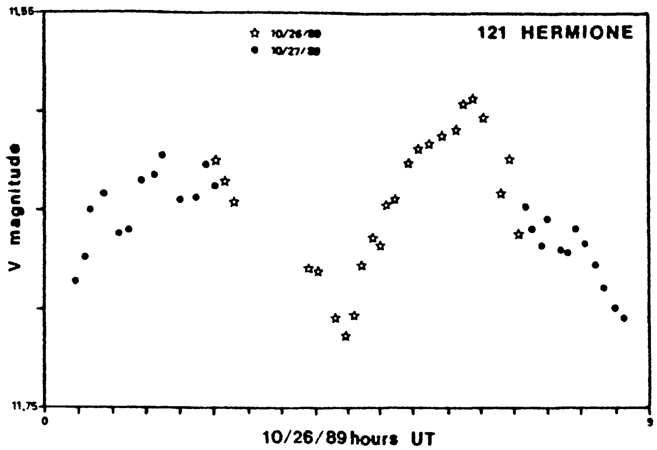

Figure 1. V lightcurve for 121 Hermione.

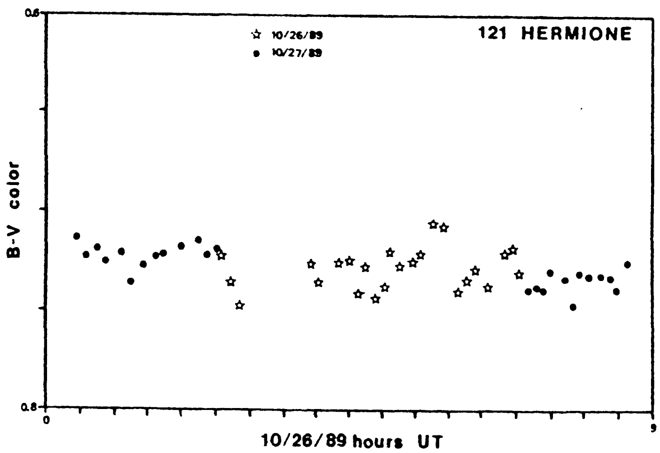

Figure 2. (B-V) lightcurve for 121 Hermione.

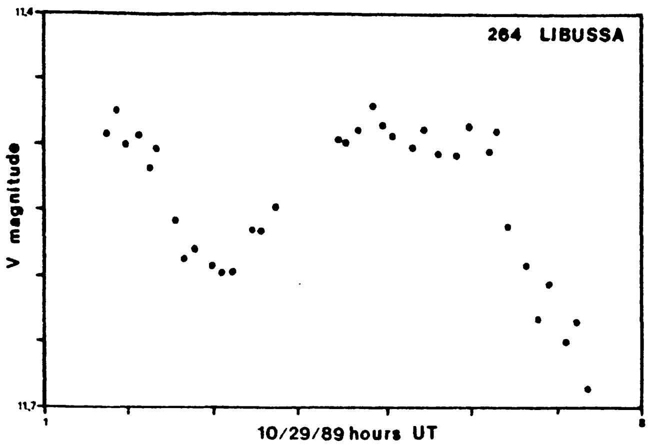

Figure 3. Partial V lightcurve for 264 Libussa.

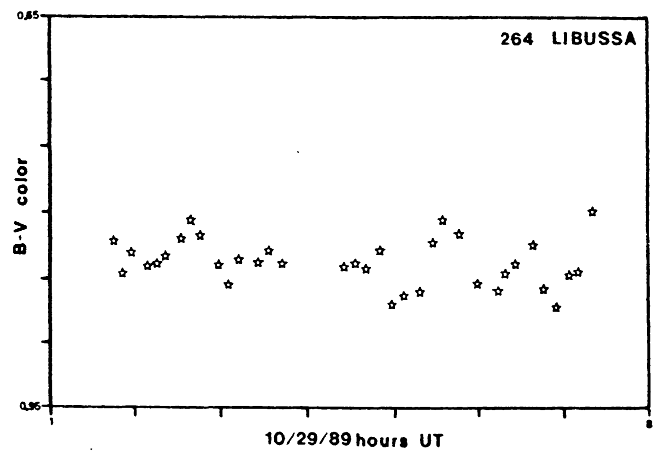

Figure 4. Partial (B-V) lightcurve for 264 Libussa.

121 Hermione

121 Hermione was discovered on May 12, 1872 by J.C. Watson and is listed by Bowell *et al.* (1979) as a C-type asteroid with a diameter of 209 km.

On the basis of the photoelectric data obtained during the two nights of observation it was determined that a synodic rotational period of 8.97±0.07 hr. best conformed to the observations. Composite lightcurves for V and B-V based upon this rotational period are shown in Figures 1 and 2, respectively. This solution agrees with a tentative period of 9 hr proposed by Debehogne *et al.*(1978). In the construction of these composite lightcurves, variations in the V magnitude and B-V color on different nights due to changing asteroid heliocentric and geocentric distance as well as changing phase angle were adjusted by sliding up and down the nightly lightcurves.

The lightcurve of 121 Hermione shows two maxima and two minima per rotational cycle, all well defined, with a lightcurve amplitude of 0.12±0.01 magnitude. The asteroid was observed to have unequal maxima.

Another solution is possible if the minima observed on each night are the same. Superposing the relative minima obtained on each night yield a rotational period of 7.45±0.05 hr. This is viewed by the author as being unlikely because of the great differences (>0.05 mag) near the maxima.

The average B-V color of 121 Hermione is 0.699±0.014 which is less than the value reported by Bowell *et al.* (1979). It is important to note the variations in the B-V lightcurve may represent true variations due to albedo features.

264 Libussa

Libussa was discovered on December 22, 1886 by C.H. Peters and is listed by Bowell *et al.* (1979) as an S-type asteroid with a diameter of 64.5 km.

The photometric data obtained is not enough to determine a rotational period, but assuming a symmetrical rise connecting the point at 7.5 hr. and 1.7 hr. the period is not less than 8 hr. Lightcurves for V and B-V are shown in Figures 3 and 4, respectively. The lightcurve amplitude is greater than 0.22±0.01 and the average B-V color is 0.838±0.014 which is consistent with the value offered by Bowell *et al.*(1979).

354 Eleonora

Eleonora was discovered on January 17, 1893 by A.

Charlois and is listed by Bowell *et al.* (1979) as a U-type asteroid with a diameter of 156 km.

The photometric data obtained agree with the well known period of 4.277 hr. Lightcurves for V and B-V are shown in Figures 5 and 6, respectively. The lightcurve of 354 Eleonora shows two unequal maxima and two unequal minima, with a lightcurve amplitude of 0.16±0.01. The average B-V color is 0.931±0.014 which agrees with the value listed by Bowell *et al.* (1979). It is important to note that the variations in the B-V color may be due to albedo features on the surface of the asteroid.

Acknowledgement

The author wishes to thank Ing.Jose A. Lopez and the staff of Felix Aguilar Observatory for the observing time and kindness during the course of this research program.

References

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Davis, D., and Binzel, R. (1987). "Filling the Gaps: Missing Longitude Coverage for large Rapidly Rotating Asteroids". *MPB* 14, 31-33.

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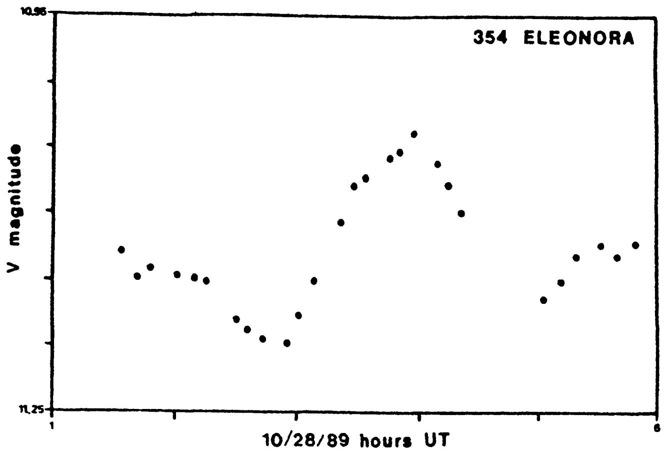

Figure 5. V lightcurve for 354 Eleonora.

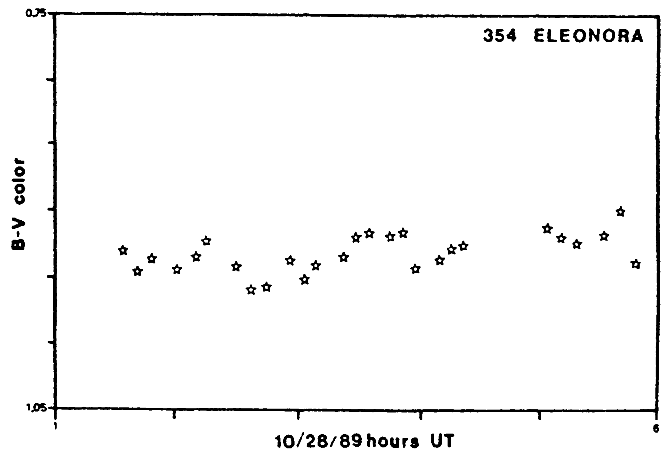

Figure 6. (B-V) lightcurve for 354 Eleonora.

Table I. Observational circumstances for 121 Hermione, 264 Libussa and 354 Eleonora.

AST	DATE	RA (1950)	DEC	LON (1950)	LAT	PHASE	COMP.STAR
121	Oct 26	00h 28m	-07° 25	3.4°	-09.6°	9.68°	SAO 128799
	Oct 27	00 27	-07 25	3.3	-09.5	9.99	SAO 128799
264	Oct 29	01 30	02 18	21.8	-06.7	6.01	- - - -
354	Oct 28	23 40	-19 59	347.2	-16.5	14.28	- - - -

ASTROMETRIC POSITIONS OF MINOR PLANETS

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(Received: 1 May Revised: 13 July)

The following precise astrometric positions have been measured from photographs obtained with a Newtonian reflector of 41 cm aperture, 1.943 meter focal length, and hypersensitized KODAK TP 2415 film. The location of the observatory is: Longitude 4°12'34" E; Latitude 45°22'50" N; Altitude 448 meters.

	UT	RA (1950.0)	Dec
148 Gallia	1989 05 08.050694	15 02 27.953	+18 55 44.87
264 Libussa	1989 10 22.920833	01 36 05.407	+02 16 21.39
264 Libussa	1989 10 23.949305	01 35 06.133	+02 16 30.99
264 Libussa	1989 10 26.987500	01 32 15.541	+02 16 45.07
264 Libussa	1989 11 28.889580	01 11 59.773	+03 39 58.12
264 Libussa	1989 11 29.924305	01 11 48.423	+03 45 02.55
365 Corduba	1989 10 22.872222	00 18 20.347	-01 34 43.66
365 Corduba	1989 10 23.912500	00 17 51.418	-01 43 50.15
365 Corduba	1989 10 25.906250	00 17 05.438	-02 00 33.36
365 Corduba	1989 10 26.960416	00 16 35.981	-02 09 04.99
365 Corduba	1989 11 29.898611	00 17 37.348	-04 21 40.15
433 Eros	1989 01 03.790277	00 55 48.401	+25 13 01.81
433 Eros	1989 01 03.869444	00 56 00.350	+25 12 42.49
433 Eros	1989 01 25.767361	02 04 37.855	+23 38 36.55
433 Eros	1989 01 25.788194	02 04 41.965	+23 38 31.43
433 Eros	1989 01 26.870138	02 08 27.125	+23 34 22.17
433 Eros	1989 01 27.785416	02 11 40.216	+23 30 49.23
433 Eros	1989 01 28.793750	02 15 13.434	+23 26 52.37
433 Eros	1989 02 01.859722	02 29 48.907	+23 10 10.22
1497 Tampere	1990 03 23.926388	10 25 33.968	+08 44 43.84
1497 Tampere	1990 03 23.993750	10 25 31.426	+08 44 59.72
1509 Esclangona	1990 01 21.972222	06 49 16.013	+15 18 49.85
1509 Esclangona	1990 01 21.990972	06 49 09.345	+15 17 43.33
1509 Esclangona	1990 01 22.918750	06 47 50.579	+15 04 09.49
1509 Esclangona	1990 02 17.899305	06 27 09.617	+10 04 18.30
1509 Esclangona	1990 02 19.913194	06 26 55.475	+09 47 48.10
1509 Esclangona	1990 02 20.931944	06 26 52.454	+09 39 48.73
1509 Esclangona	1990 02 23.888888	06 26 59.997	+09 17 40.40
1509 Esclangona	1990 02 24.904861	06 27 07.545	+09 10 26.04
1580 Betulia	1989 05 08.099305	17 04 54.606	+60 59 25.46
1629 Pecker	1989 03 06.069444	11 21 31.292	+15 03 46.37
1629 Pecker	1989 03 07.034027	11 20 40.704	+15 15 24.19
1917 Cuyo	1989 10 04.902777	20 43 23.099	-06 33 22.30
1917 Cuyo	1989 10 04.916666	20 43 26.855	-06 35 32.22
1917 Cuyo	1989 10 05.845949	20 48 10.146	-09 14 23.24
1917 Cuyo	1989 10 05.852893	20 48 12.353	-09 15 35.25
2001 Einstein	1989 02 09.028333	08 53 07.702	+51 21 16.03
2001 Einstein	1989 02 10.072222	08 50 53.918	+51 10 17.04
2001 Einstein	1989 03 05.918750	08 16 19.341	+44 34 49.32
3040 Kozai	1989 03 06.013888	10 29 14.917	+39 55 37.59
3040 Kozai	1989 03 06.979166	10 27 56.351	+40 29 09.52
3043 San Diego	1989 03 06.092361	10 55 08.865	+13 44 36.05
3043 San Diego	1989 03 07.002083	10 53 37.724	+13 40 24.82
3043 San Diego	1989 03 10.036111	10 48 39.600	+13 25 40.63
3119 Dobronravin	1989 02 08.993055	08 38 24.963	+21 15 54.74
3119 Dobronravin	1989 02 10.001666	08 37 36.031	+21 20 23.83
3398 1978 PC	1989 12 27.001388	05 46 35.039	+49 27 03.82
3398 1978 PC	1989 12 27.048611	05 46 29.601	+49 27 58.50
3410 1978 SZ7	1990 02 24.006944	10 50 14.629	+07 38 03.98
3410 1978 SZ7	1990 02 24.054861	10 50 11.591	+07 38 11.76
3410 1978 SZ7	1990 02 24.945139	10 49 15.540	+07 40 40.76
3410 1978 SZ7	1990 02 24.954861	10 49 14.881	+07 40 42.58
3410 1978 SZ7	1990 02 25.020833	10 49 10.620	+07 40 53.73
3410 1978 SZ7	1990 03 23.926388	10 23 40.459	+08 41 17.7
3410 1978 SZ7	1990 03 23.993750	10 23 37.637	+08 41 22.30
3629 1982 WK	1989 09 24.904166	23 19 05.730	+05 01 18.39
4179 1989 AC	1989 01 25.813194	05 56 10.643	+23 07 02.60
4179 1989 AC	1989 01 26.908333	05 59 56.773	+23 09 18.07
4197 1982 TA	1989 10 04.983333	00 37 30.395	+05 07 44.59
4197 1982 TA	1989 10 04.998263	00 37.28.570	+05 07 39.50
1967 DB	1990 03 23.955555	11 28 03.618	+18 02 35.59
1967 DB	1990 03 24.006250	11 28 01.337	+18 03 01.17
1989 OB	1989 08 25.947916	21 28 53.929	+12 05 31.80
1989 OB	1989 08 25.961805	21 28 53.977	+12 06 07.48
1989 OB	1989 08 30.916666	21 30 45.621	+15 20 52.39
1989 OB	1989 08 30.938888	21 30 46.099	+15 21 40.59
1989 OB	1989 08 30.958333	21 30 46.728	+15 22 30.87
1989 OB	1989 08 30.979166	21 30 46.938	+15 23 07.44
1989 OB	1989 09 04.923611	21 33 41.750	+18 31 32.69
1989 OB	1989 09 04.944444	21 33 42.039	+18 32 08.59
1989 PB	1989 08 23.965280	00 51 34.810	+46 01 57.30

ASTROMETRIC POSITIONS OF MINOR PLANETS

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(Received: 22 May Revised: 22 August)

The following astrometric positions of minor planets are reprinted in the *Minor Planet Bulletin* from the German periodical *KPM*, issues 11-13.

The following observations have been made by Dieter Ewald, Melchow, German Democratic Republic with a visual micrometer attached to a 7.5 cm refractor. Each is averaged from a listed number N of observations made on the night specified. The observatory coordinates are Longitude 13°42'06" East, Latitude 52°46'48" North, Altitude 50 meters.

Planet	1989 UT	RA (1950.0)	Dec	N	Mag
3	01 28 23.33	$10^h24^m06.7^s$	+01°04'19"	4	
6	01 26 21:41	08 20 35.4	+13 37 02	3	
6	02 10 20:57	08 06 50.0	+16 02 39	4	
6	02 20 21:10	08 00 07.4	+17 29 37	1	
6	03 06 20:55	07 55 17.9	+19 08 23	4	
6	03 09 19:32	07 55 02.3	+19 26 05	3	
7	02 04 22:31	09 25 09.9	+06 27 38	4	
7	02 10 21:19	09 18 50.7	+06 50 29	4	
7	03 06 21:13	08 58 42.0	+08 34 10	3	
7	03 07 20:08	08 58 11.8	+08 43 31	3	
7	03 09 18:52	08 57 14.7	+08 45 40	5	
8	02 11 22:12	11 28 37.5	+11 11 46	2	
8	03 07 20:56	11 05 31.6	+14 38 35	2	
8	03 09 20:23	11 04 32.1	+14 45 47	6	
11	09 05 22:17	23 34 40.3	-08 51 39	2	9.3
12	08 25 21.57	22 12 47.7	+07 54 29	3	8.8
12	08 29 21:41	22 09 42.9	+07 28 24	2	8.8
12	09 05 21:40	22 04 40.8	+06 55 53	3	8.9
12	09 07 21:36	22 03 23.4	+06 13 03	3	8.9
12	09 29 20:42	21 56 33.6	+02 58 07	3	9.4
12	10 20 20:33	22 03 51.8	+00 32 08	4	10.0
15	08 25 22:11	22 02 57.6	+02 23 54	3	7.9
15	09 05 21:57	21 52 28.7	+02 15 26	3	8.1
30	09 30 22:47	01 05 10.4	+10 59 12	3	9.8
30	10 20 21:43	00 47 12.8	+09 13 28	3	9.7
51	03 10 22:14	11 41 53.1	+01 01 30	3	
52	03 07 21:31	11 45 03.3	+09 55 17	4	
79	09 05 21:13	23 20 53.6	+01 42 49	3	10.2
79	09 29 21:08	23 02 07.2	-01 23 38	3	10.2
230	09 30 23:49	02 43 36.8	+23 56 13	3	10.6
747	10 27 23:31	04 10 25.8	-13 06 21	3	10.3
980	08 29 21:16	21 12 28.1	+04 19 51	4	10.6
980	08 31 21:37	21 10 46.4	+04 20 03	3	10.7

The following positions of 1989 PB have been obtained by Bernd Koch, Solingen, German Federal Republic, as measured off photographs by a 20 cm Newtonian reflector. The observatory coordinates are Longitude 07°00'45" East, Latitude 51°05'28" North, Altitude 133 meters.

Planet	1989 UT	RA (1950.0)	Dec	Mag
1989 PB	08 22 22:02:00	$00^h25^m24.02^s$	+31°50'26.8"	11.5
1989 PB	08 22 22:07:00	00 25 27.31	+31 52 46.7	11.5
1989 PB	08 22 22:11:00	00 25 30.54	+31 54 51.1	11.5

The following positions of 349 Dembowska have been obtained by Mike Kretlow, Wiesbaden, German Federal Republic, as measured off photographs by a 12.7 cm refractor. The observatory coordinates are Longitude 08°15'36" East, Latitude 50°03'00" North, Altitude 100 meters.

Planet	1989 UT	RA (1950.0)	Dec
349	07 03 00:38:57	$10^h51^m47.2^s$	+17°31'48"
349	07 03 00:45:57	10 51 46.8	+17 31 49
349	07 03 01:00:57	10 51 46.1	+17 31 50
349	07 03 01:07:57	10 51 45.9	+17 31 54

PHOTOGRAPHIC POSITIONS OF MINOR PLANETS

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The following positions of minor planets have been made photographically using a 75 mm f/9.2 achromatic photographic objective on T MAX 400 Kodak films. The reported UT time is that of mid-exposure. The estimated precision for each measurement is ±1.5 arcsecond.

Photographs of 216 Kleopatra and 1917 Cuyo were made from longitude 13°12'12" E, latitude 41°57'27" N, altitude 1820±5 meters. Photographs of 521 Brixia were obtained from longitude 11°10'29" E, latitude 42°23'08" N, altitude 635±5 meters.

Planet	1989 UT	RA (1950.0)	Dec
216 Kleopatra	Jul 28.95000	$20^h\ 09^m\ 52.6^s$	+ 1° 36' 03"
216 Kleopatra	Jul 28.98263	20 09 51.0	+ 1 35 56
1917 Cuyo	Oct 6.84791	20 53 39.2	-12 13 30
1917 Cuyo	Oct 6.87152	20 53 32.2	-12 09 20
521 Brixia	Oct 21.87708	1 10 01.0	-13 07 45
521 Brixia	Oct 22.85556	1 09 14.8	-13 06 46

REPORT FROM THE RECORDER

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(Received: 20 July)

I am attending the Corporation for Research Amateur Astronomy Baja '91 Symposium at La Paz, Mexico, around the time of the solar eclipse July 11, 1991. Here I shall present a paper, "The Minor Planets Section of the Association of Lunar and Planetary Observers." I shall appreciate the support of any Minor Planets Section members who can also attend. Even if you cannot attend the Symposium, please contact me about any of your activities which you wish for me to include. I shall peruse the last 2 years' issues of the *Minor Planet Bulletin*, plus those to be published up to the time of the Symposium, for as complete a range of our undertakings as I can find.

Persons who have not yet reserved spaces should immediately contact:

Corporation for Research Amateur Astronomy
P. O. Box 16542
San Francisco, CA 94116 USA

LETTER TO THE EDITOR

Dear Editor,

I was a bit surprised to find in the current issue of *MPB* a short article by Floyd Hutson in which he reported residuals between his astrometric observations and positions predicted by my ephemeris program. My program is intended only for finding objects, not reducing astrometric observations, as it does not include topocentric or aberration of light corrections, among others, and some arithmetic is done in single precision. The O-C residuals he reported are, if anything, smaller than the errors I would have expected in my computations alone, so it is no surprise that the residuals are larger than his solution error estimates. Indeed, it is entirely possible that his observations, if measured against a higher precision ephemeris, might yield much smaller residuals.

Sincerely yours,

Alan Harris

OPPOSITIONS OF 944 HIDALGO — REVISED

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(Received: 30 July)

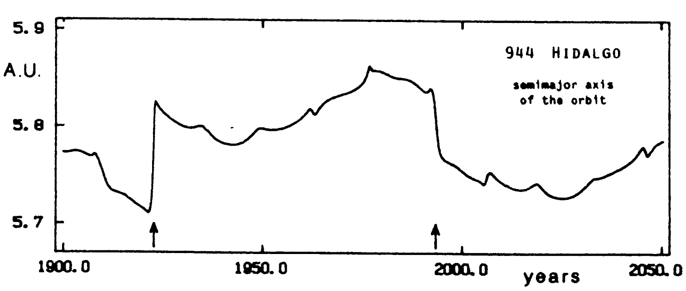
Harris (1990) gives a list of favorable oppositions of minor planet 944 Hidalgo between the years 1900 and 2050. We were rather surprised to read that for this purpose an unperturbed orbit was used, with the statement that the opposition dates "far from the current epoch may be off by a day or so". This "current epoch" itself is not mentioned in the article, and we fear that the author has been too optimistic. Indeed, our Table II shows that, of the 22 opposition dates given by Harris, only five are less than two days in error. For many others, the error amounts to several months, with the consequence that the corresponding data are completely meaningless.

Using the orbital elements from the *Ephemerides of Minor Planets* 1990, one finds that the present perihelion and aphelion distances of Hidalgo are 2.00 and 9.67 AU, respectively. The latter value is close to Saturn's mean distance to the Sun (9.55 AU). But due to the high inclination of its orbit (42°), Hidalgo cannot approach Saturn to less than 3.66 AU. However, it can approach Jupiter to 0.29 AU, this value being the least distance between the orbits (in 1990). Actually, Hidalgo passed 0.90 AU from the giant planet in October 1922, while in May 1993 there will be an approach to 1.80 AU.

Author Goffin calculated the motion of Hidalgo, from A.D. 1900 to 2050, by numerical integration. The first author then used these results to derive the data presented in this article.

Table I gives the dates and the values of the least distances of Hidalgo to the Sun, between the years 1900 and 2050. The second column shows that the actual period of revolution is not constant. During the 150 years considered here, the extreme values are 13.69 and 14.11 years. This evidently illustrates that using an unperturbed orbit for a time lapse of more than one century cannot but give results which are grossly inaccurate.

Table II lists the apparitions of Hidalgo from 1900 to 2050, in which it was or will be brighter than V magnitude 17.0. The date (first column) is that of the opposition with the Sun in ecliptical longitude, not in right ascension. The second column gives the least distance of Hidalgo to the Earth during that apparition; this distance may differ somewhat from the distance at the instant of the opposition.



The visual magnitude is that of greatest brilliancy. The declination (equinox of date) is for the time of the opposition. In the last column, the minimum value of the phase angle is given.

It appears from Table II that the opposition of 2004

Table I : Perihelia of 944 Hidalgo

Date of perihelion	Difference (days)	Perihelion distance (AU)
1907 Jun 29		2.0128
	5002	
1921 Mar 9		1.9834
	5109	
1935 Mar 5		1.9970
	5086	
1949 Feb 5		1.9949
	5102	
1963 Jan 25		1.9989
	5138	
1977 Feb 18		2.0137
	5155	
1991 Apr 1		1.9997
	5044	
2005 Jan 21		1.9509
	5026	
2018 Oct 26		1.9475
	5014	
2032 Jul 18		1.9474
	5046	
2046 May 12		1.9615

Table II : Favorable oppositions of Hidalgo

Date of opposition	Distance (AU)	Visual magnitude	Decli- nation	Phase angle
			°	°
1906 sep 21	2.233	15.6	-27	8.7
1908 Mar 10	2.182	15.6	+38	11.2
1920 Oct 14	1.393	13.6	+ 7	0.5
1922 Mar 27	2.849	16.4	+14	4.7
1934 Oct 17	1.377	13.6	+12	1.2
1936 Mar 27	2.880	16.4	+13	4.3
1948 Oct 25	1.251	13.5	+29	7.4
1950 Mar 30	3.054	16.6	+ 9	3.4
1962 Oct 30	1.226	13.6	+37	10.3
1964 Mar 31	3.122	16.6	+ 8	3.1
1976 Oct 21	1.316	13.6	+21	4.4
1978 Mar 28	2.975	16.5	+12	4.0
1990 Oct 9	1.550	14.1	- 1	3.1
1992 Mar 24	2.717	16.2	+18	5.5
2004 Oct 29	1.171	13.4	+36	10.1
2006 Apr 1	3.147	16.7	+ 6	2.8
2017 Aug 31	3.197	16.9	-46	9.4
2019 Jan 15	1.448	14.3	+80	(*)
2031 Sep 15	2.425	15.9	-34	9.5
2033 Mar 7	2.042	15.4	+41	12.3
2045 Sep 27	1.868	15.0	-19	7.6
2047 Mar 19	2.453	15.9	+25	7.5

(*) No minimum near that opposition. At the date of opposition, the phase angle will be 25°.7.

will be the best one of the whole period 1900-2050.

The drawing shows the variation of the semimajor axis of the osculating orbit, from 1900 to 2050. It appears that the extremes are 5.710 and 5.863 AU, respectively in 1921 and in 1976. The arrows indicate the rather rapid changes due to the approaches to Jupiter in 1922 and 1993.

During the period 1900-2050, the eccentricity of Hidalgo's osculating orbit varies between the extremes 0.649 (in 1901) and 0.662 (in 2025).

The authors are most indebted to Dr. Joseph De Kerf, General Manager of the Scientific Computer Center of Agfa-Gevaert N.V., Mortsel, Belgium.

Reference

Harris, A. W. (1990). "Opposition Magnitudes for 944 Hidalgo: 1900-2050". *MPB* 17, 38.

INSTRUCTIONS FOR AUTHORS

The *Minor Planet Bulletin* is open to papers on all aspects of minor planet study. Theoretical, observational, historical, review, and other topics from amateur and professional astronomers are welcome. The level of presentation should be such as to be readily understood by most amateur astronomers. The preferred language is English. All observational and theoretical papers will be reviewed by another researcher in the field prior to publication to insure that results are presented clearly and concisely. It is hoped that papers will be published within three months of receipt.

The *MPB* will not generally publish articles on instrumentation. Persons interested in details of photoelectric instrumentation should join the International Association of Amateur and Professional Photoelectric Photometers (IAPPP) and subscribe to their journal. Write to: Mr. Robert C. Reisenweber, Rolling Ridge Observatory, P.O. Box 8125, Piscataway, New Jersey 08854. The *MPB* will carry only limited information on asteroid occultations because detailed information on observing these events is given in the *Occultation Newsletter* published by the International Occultation Timing Association (IOTA). Persons interested in subscribing to this newsletter should write to: H. F. DaBoll, 6N106 White Oak Lane, St. Charles, Illinois 60174.

Manuscripts

All manuscripts should be typed double-spaced and should be less than 1000 words. Longer manuscripts may be returned for revision or delayed pending available space. Manuscripts should consist of the following: a title page giving the names and addresses of all authors (editorial correspondence will be conducted with the first author unless otherwise noted), a brief abstract not exceeding four sentences, the text of the paper, acknowledgments, references, tables, figure captions, and figures. Please compile your manuscripts in this order.

In most cases, the number of tables plus figures should not exceed two. Tables should be numbered consecutively in Roman numerals, figures in Arabic numerals. Tables must be neatly typed, single-spaced, on white paper with a very black ribbon to allow direct reproduction. Figures should be drawn on white paper with black ink. Labeling should be large enough to be easily readable after a 25 percent reduction. Tables and figures which fit in a single column may be no wider than 11.5 cm. Double column tables and figures may be no wider than 23 cm. Constrain your tables and figures to fit in a single column whenever possible. Limit the vertical length of your figures as much as possible. In general this should be 11.5 cm or less.

References should be cited in the text such as Harris and Young (1980) for one or two authors or Bowell et al. (1979) for more than two authors. The reference section should list papers in alphabetical order of the first author's last name. The reference format for a journal article, book chapter, and book are as follows:

Harris, A.W., and Young, J.W. (1980). "Asteroid Rotation Rates III: 1978 Results". Icarus 43, 20-32.

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

Wood, F.B. (1963). *Photoelectric Astronomy for Amateurs.* Macmillan, New York.

Authors are asked to carefully comply with the above guidelines in order to minimize the time required for editorial tasks. Authors with access to Apple Macintosh or IBM compatible computers are *strongly* encouraged to submit their manuscripts on diskette. Files must be saved as ASCII text files and a printed version of the file must accompany the diskette. When time permits, proofs of articles will be sent to authors. Submit two complete copies of the manuscript and the original tables and figures to: Dr. Richard P. Binzel, MIT 54-426, Cambridge, MA 02139, USA.

PHOTOELECTRIC PHOTOMETRY OPPORTUNITIES NOVEMBER-JANUARY

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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 modelling (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 modelling. 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* (see the review by Tholen in *MPB* 11, No. 4). 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, 1075 Wagon Wheel Ave., Colorado Springs, CO 80915 USA.

Asteroid	Opp'n Date	Opp'n V Mag	Per	Amp	
409 Aspasia	Nov 21	11.1	9.03	0.1	PHA
121 Hermione	Dec 23	12.0	6.1?	0.1	PER
11 Parthenope	Jan 15	9.9	7.830	0.1	PHA
98 Ianthe	Jan 18	11.9	?	?	PER
34 Circe	Jan 28	11.4	15?	0.2	PER
27 Euterpe	Jan 31	8.7	8.50	0.2	PHA

Photoelectric Photometry Opportunities

DATE	R.A. (1950) HR	MIN	DEC. DEG	MIN	MAG V	PHASE ANGLE
Minor Planet 11 Parthenope						
1990 Dec 10	8	14.71	+17	43.0	10.80	15.2
20	8	9.76	+18	8.1	10.61	11.8
30	8	2.21	+18	42.8	10.40	7.7
1991 Jan 9	7	52.74	+19	23.8	10.17	3.3
19	7	42.40	+20	6.7	10.06	1.5
29	7	32.40	+20	47.4	10.33	6.0
Feb 8	7	23.94	+21	22.7	10.56	10.2
18	7	17.86	+21	51.2	10.78	13.8
28	7	14.64	+22	12.5	10.98	16.7
Minor Planet 27 Euterpe						
1990 Dec 20	9	20.39	+16	31.0	9.87	22.5
30	9	19.90	+16	48.0	9.63	18.5
1991 Jan 9	9	15.66	+17	22.2	9.39	13.6
19	9	8.18	+18	9.3	9.14	8.0
29	8	58.58	+19	1.8	8.86	2.0
Feb 8	8	48.52	+19	50.8	9.04	4.5
18	8	39.77	+20	29.1	9.37	10.2
28	8	33.71	+20	52.8	9.67	15.2
Mar 10	8	31.11	+21	1.2	9.96	19.3
Minor Planet 34 Circe						
1990 Dec 20	9	1.50	+ 9	16.7	12.49	17.5
30	8	58.88	+ 9	13.1	12.24	14.3
1991 Jan 9	8	53.58	+ 9	26.5	11.96	10.4
19	8	46.10	+ 9	56.4	11.67	6.2
29	8	37.36	+10	39.8	11.44	3.1
Feb 8	8	28.55	+11	31.7	11.60	5.5
18	8	20.92	+12	26.2	11.87	9.8
28	8	15.48	+13	17.9	12.13	13.9
Mar 10	8	12.85	+14	2.6	12.37	17.4
Minor Planet 98 Ianthe						
1990 Dec 10	8	51.07	+40	34.1	12.63	19.4
20	8	49.63	+41	26.0	12.40	16.7
30	8	43.87	+42	14.4	12.18	13.8
1991 Jan 9	8	34.16	+42	48.6	11.99	11.1
19	8	21.68	+42	57.3	11.88	9.8
29	8	8.39	+42	32.8	11.91	10.9
Feb 8	7	56.47	+41	34.3	12.04	13.6
18	7	47.68	+40	7.6	12.22	16.9
28	7	42.97	+38	21.7	12.41	20.0
Minor Planet 121 Hermione						
1990 Nov 10	6	34.68	+24	56.5	12.84	13.5
20	6	31.46	+25	20.1	12.68	11.1
30	6	26.03	+25	45.0	12.52	8.2
Dec 10	6	18.78	+26	9.3	12.33	5.0
20	6	10.36	+26	31.1	12.13	1.7
30	6	1.63	+26	48.6	12.19	2.3
1991 Jan 9	5	53.47	+27	1.4	12.43	5.5
19	5	46.67	+27	9.8	12.64	8.6
29	5	41.83	+27	15.1	12.84	11.2
Minor Planet 409 Aspasia						
1990 Oct 11	4	16.68	+24	28.4	12.05	16.1
21	4	13.14	+23	54.1	11.85	13.1
31	4	6.97	+23	8.1	11.65	9.6
Nov 10	3	58.70	+22	11.1	11.44	5.5
20	3	49.22	+21	5.6	11.18	1.1
30	3	39.64	+19	56.1	11.33	3.4
Dec 10	3	31.09	+18	48.4	11.56	7.7
20	3	24.46	+17	48.4	11.77	11.5
30	3	20.32	+17	0.2	11.97	14.7

ASTEROID NEWS NOTES

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Fifty-one New Asteroids

Through the August 6 batch of Minor Planet Circulars, 51 asteroids were newly numbered since the last installment of News Notes, bring the numbered total to 4559. Non-main-belt objects include:

(4531)	1985 FC	Hungaria
(4543)	1989 CQ1	Trojan
(4544)	1989 FB	Apollo
(4558)	1988 NF	Mars crosser

New Asteroid Names

The July batch of Minor Planet Circulars contained several new asteroid names. *MPB* readers should recognize (4278) Harvey, named after Roger Harvey of Charlotte, North Carolina, who has visually observed over 2600 different minor planets. Other amateurs honored with asteroid namings include (3722) Urata (codiscoverer of periodic comet Urata-Niijima), and (4282) Endate. Continuing a recent trend, more composers' names appeared among the asteroids, including (4040) Purcell, (4079) Britten, (4081) Tippett, (4087) Part, (4152) Weber, and (4347) Reger. (4457) van Gogh was named to mark the 100th anniversary of the Dutch artist's death.

The highest numbered asteroid with a name is (4460) Bihoro.

New Trojan Asteroid

Ho-hum. What's so special about a new Trojan asteroid? There are over 140 Trojan asteroids with well-established orbits, and many more have been discovered. Ah, but all of these are found in the Lagrangian points of Jupiter's orbit. For the first time, an asteroid has been discovered to occupy a Lagrangian point of some other planet's orbit. Saturn, right? Good guess — after all, it is the second largest planet — but wrong. The planet is Mars, and the new discovery has been assigned the designation 1990 MB. The discoverer of this unique minor planet is David Levy, the same person who found the best comet of the year (so far), Comet Levy (1990c). H. Holt also participated in the observations, which were made with the 0.46-m Schmidt telescope at Palomar. Not much is known about this asteroid yet. Several orbit integrations have been performed to determine the stability of the orbit, and all studies done so far show the orbit to be quite stable. The available observations suggest that the object has a fairly large lightcurve amplitude, so this 2 km-sized object is apparently somewhat elongated. Needless to say, this unique asteroid will be the subject of intense study during its next opposition (late July, 1992).

Planet Crossing Asteroid Update

In addition to 1990 MB, which might have otherwise been called a Mars crosser, three new Apollo asteroids, one new Amor, and one other deep Mars crosser have been found since the last installment of News Notes.

The first of the new discoveries came on June 23, when R. McNaught identified the streak that became known as 1990 MU on a United Kingdom Schmidt plate taken by M. Hartley. This object is a fairly large Apollo-type asteroid, with an estimated diameter of 4 km.

Just a few days later, E. Helin spied 1990 MF on a Palomar 0.46-m Schmidt film taken on June 26 by herself, B. Roman, K. Lawrence, and J. Michaud. The fact that the designation 1990 MF precedes 1990 MU, even though the discovery date is later, simply reflects the order in which the discovery information reached the Minor Planet Center. 1990 MF is also an Apollo-type asteroid, but it is about half the size of 1990 MU, with an estimated diameter of 2 km.

Helin's Palomar team had a bonanza of a run in July, when they discovered the other three new planet crossers. In a four night span, they picked up 1990 OA (July 19), 1990 OS (July 21), and 1990 OL (July 22), all with the 0.46-m Schmidt telescope. 1990 OA is a kilometer-sized object of the Amor variety, whereas 1990 OL turned out to be a deep Mars crosser of about 2 km diameter, although a preliminary orbit solution had originally suggested that it might be another Amor. The tiniest object of the new crop is the Apollo asteroid 1990 OS, which is probably subkilometer in size. It also came the closest to Earth of the new discoveries; on August 6, 1990 OS passed a scant 0.041 AU from the Earth, prompting another wave of newspaper articles.

In the pair discoveries department, 1990 MF and 1990 MU were found only three days apart, and 1990 OA and 1990 OS were found only two days apart. If one includes 1990 MB and 1990 OL, then we have a pair of triple discoveries, with 1990 MB, 1990 MF, and 1990 MU occurring between June 20 and 26; and 1990 OA, 1990 OL, and 1990 OS occurring between July 19 and 22.