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

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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.

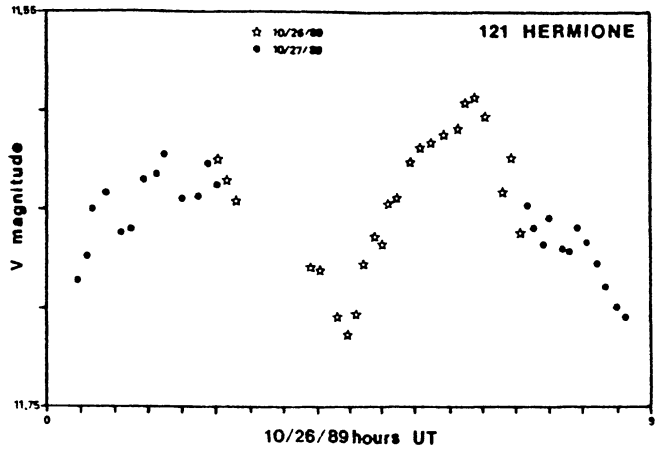

Figure 1. V lightcurve for 121 Hermione.

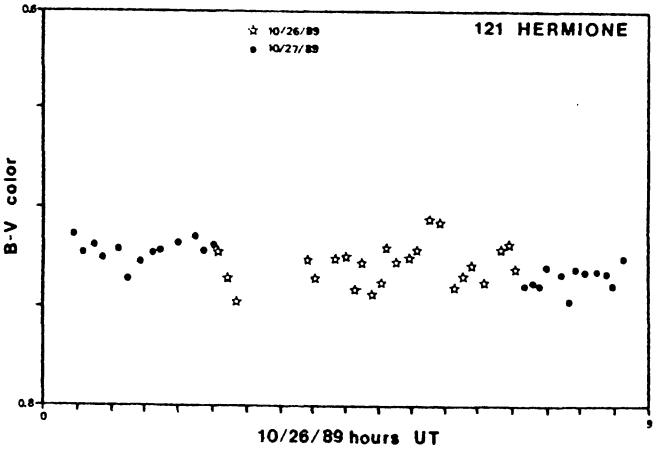

Figure 2. (B-V) lightcurve for 121 Hermione.

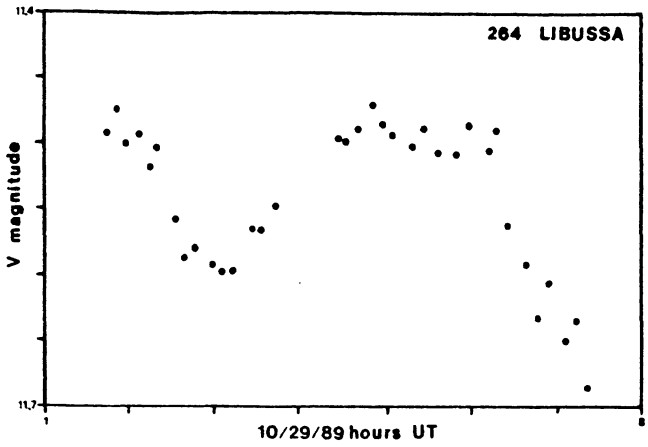

Figure 3. Partial V lightcurve for 264 Libussa.

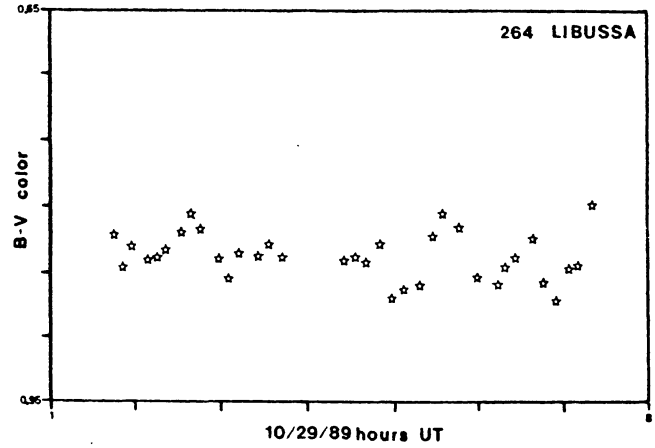

Figure 4. Partial (B-V) lightcurve for 264 Libussa.

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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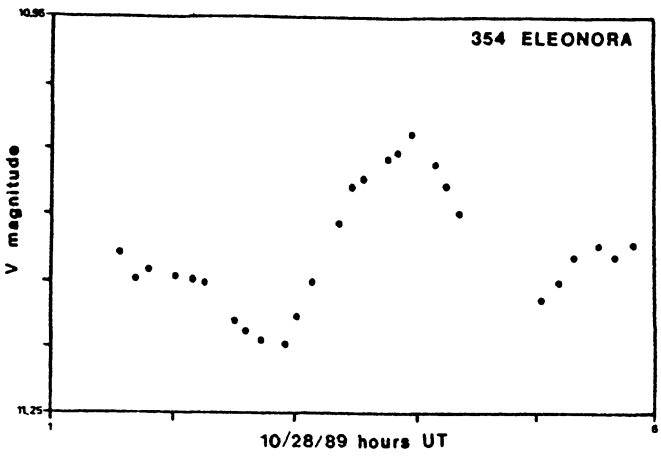

Figure 5. V lightcurve for 354 Eleonora.

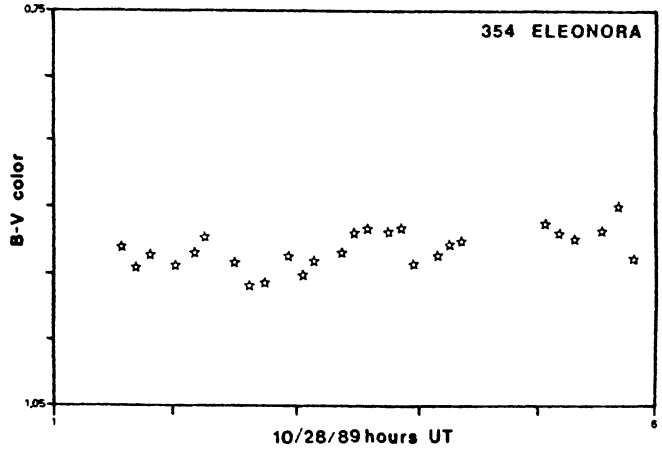

Figure 6. (B-V) lightcurve for 354 Eleonora.

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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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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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