OPPOSITIONS OF 944 HIDALGO — REVISED

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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.

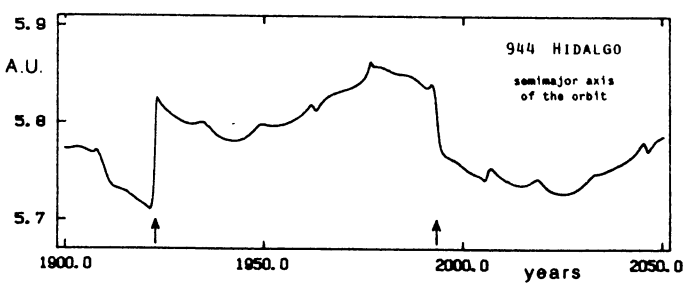

Table I : Perihelia of 944 Hidalgo

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	Declination	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.

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

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.

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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.

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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