

THE MINOR PLANET BULLETIN

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

VOLUME 16, NUMBER 4, A.D. 1989 OCTOBER-DECEMBER

41.

CLOSE APPROACHES OF MINOR PLANETS TO NAKED EYE STARS IN 1990

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(Received: 28 June)

A list is presented of approaches of minor planets brighter than magnitude 14 to naked eye stars. This may be helpful in finding some faint minor planets.

The accompanying table lists close approaches of minor planets to stars during 1990 where:

- The event takes place more than 31° from the Sun.
- The minor planet is brighter than visual magnitude 14.
- The star is brighter than magnitude 6.
- The minimum angular separation is smaller than $120''$.

This list can be helpful in locating some otherwise faint minor planets. By carefully drawing the star field around the predicted position down to the magnitude of the minor planet and comparing it to the situation some time later, one can detect the intruder by its apparent motion.

The information contained in the list is divided into 5 groups:

1. Date: gives the date and time in U.T. of the closest geocentric approach. All subsequent data pertain to this instant.

2. Closest approach: the two columns give the position of the minor planet with respect to the star:

- the minimum geocentric distance in seconds of arc
- the position angle in degrees, measured from north over east

3. Minor planet: gives information about the minor planet:

- number and name
- visual magnitude
- apparent motion in seconds of arc per hour
- parallax in seconds of arc

4. Star: the following data of the star are given:

- AGK3 or SAO number
- visual magnitude
- right ascension for the equinox 1950.0
- declination (1950.0)

5. Sun and Moon:

- elongation of the Sun in degrees
- elongation of the Moon (degrees)
- illuminated fraction of the Moon in %

The *observed* minimum distance depends on the location of the observer on the Earth's surface but is always comprised between the minimum *geocentric* distance plus and minus the parallax. An occultation will be visible somewhere on the Earth when the parallax is greater than the geocentric separation.

It is my pleasant duty to thank Dr. Joseph De Kerf, General Manager of the Scientific Computer Centre of Agfa-Gevaert N.V., Mortsel, Belgium, for allowing me to use the computing facilities. The author would be pleased to receive reports from observers of these events.

Close approaches of minor planets to stars

" 0
(Dist. < 120 ; El. Sun > 30
Star < 6.0 ; Min. pl. < 14.0)

Date (U.T.)			Minim. dist.	Pos. ang.	Minor planet Name	Vis. mag.	App. mot.	Hor. par.	Star Designation	Vis. mag.	Right ascens. (1950.0)	Declination (1950.0)	Elongation Sun	Moon	Ill. frac Moon	
h m			"	0			" / h "				h m	0'	0	0	%	
1989	dec	16	2 26.0	108.62	338	61 Danae	12.8	40.15	3.67	AGK3+08°3195	5.4	23 6.99	+ 8 23.8	87	135	85
	dec	16	2 55.4	84.55	338	61 Danae	12.8	40.17	3.67	AGK3+08°3196	5.5	23 7.00	+ 8 24.3	87	135	85
	dec	16	7 22.7	77.10	341	96 Aegle	12.4	32.42	4.33	AGK3+43°0552	3.5	4 58.38	+43 45.1	158	55	84
	dec	19	14 7.1	82.74	342	16 Psyche	11.3	57.20	2.97	SAO 164713	5.2	21 50.59	-13 47.3	58	152	54
	dec	24	5 11.5	9.63	330	90 Antiope	13.7	17.16	3.32	AGK3+05°0132	5.7	1 5 5.78	+ 5 23.0	105	149	14
	dec	26	1 2.7	117.94	145	192 Nausikaa	9.9	26.00	7.72	AGK3+34°0480	5.6	4 21.24	+34 1.0	152	173	4
	dec	29	8 47.7	80.79	346	409 Aspasia	12.9	57.25	2.86	SAO 145837	4.7	22 0.73	- 2 23.9	54	42	2
	dec	30	7 5.0	99.09	177	77 Frigga	11.5	33.37	6.39	AGK3+27°0559	4.5	5 50.18	+27 36.1	168	144	5
1990	jan	5	11 30.2	102.05	190	32 Pomona	12.7	66.71	3.00	SAO 159442	5.0	15 39.06	-19 31.2	47	150	62
	jan	6	12 21.7	71.12	190	579 Sidonia	12.6	27.06	3.93	SAO 77201	5.9	5 26.20	+25 6.7	156	40	73
	jan	10	15 37.9	113.88	197	55 Pandora	13.5	49.05	2.43	SAO 183901	5.4	15 50.95	-23 49.9	48	138	100
	jan	11	15 44.7	12.39	9	32 Pomona	12.7	65.40	3.06	SAO 183895	5.1	15 50.43	-20 1.2	50	123	100
	jan	12	6 58.9	97.42	16	88 Thisbe	12.6	52.94	2.82	SAO 183328	5.7	15 13.48	-22 12.9	59	107	99
	jan	12	20 40.7	83.38	163	980 Anacostia	12.7	70.83	3.47	AGK3+09°3217	4.7	23 4.49	+ 9 8.3	60	140	97
	jan	13	21 30.3	32.70	335	43 Ariadne	12.1	11.61	4.95	AGK3+21°0401	5.6	4 15.43	+21 27.5	132	81	92
	jan	18	21 44.8	37.35	184	233 Asterope	12.5	19.28	4.72	AGK3+14°0519	5.6	5 31.06	+14 16.3	143	124	50
	jan	24	6 32.8	57.02	334	9 Metis	11.1	70.40	3.04	SAO 146598	4.5	23 13.29	- 9 21.6	42	72	7
	jan	26	20 34.0	98.11	51	183 Istria	13.0	51.45	6.01	AGK3+09°1210	5.5	9 25.78	+ 9 16.5	164	164	0
	feb	1	14 48.1	52.80	352	387 Aquitania	12.3	45.50	3.77	AGK3+02°1804	4.6	15 0.37	+ 2 17.2	90	152	37
	feb	3	8 15.7	22.72	200	92 Undina	11.7	27.68	3.60	AGK3+25°0928	5.9	7 57.91	+25 31.9	162	65	56
	feb	10	11 28.1	16.35	169	779 Nina	13.6	72.47	2.93	SAO 187448	2.1	18 52.17	-26 21.7	39	133	99
	feb	12	18 19.3	71.31	213	404 Arsinoe	13.3	11.95	4.70	AGK3+29°0683	4.5	6 12.19	+29 30.9	129	86	91
	feb	12	22 14.4	66.54	159	2 Pallas	9.5	53.72	2.93	SAO 147812	5.7	1 24.39	-13 18.9	53	152	90
	feb	14	17 23.2	39.01	201	593 Titania	12.4	27.37	6.96	AGK3+43°0883	5.3	9 10.54	+43 25.5	148	79	77
	feb	17	8 47.6	66.33	207	405 Thia	12.0	46.82	6.03	SAO 182570	5.0	14 25.24	-29 16.1	103	13	54
	feb	26	4 28.6	49.91	354	40 Harmonia	11.9	69.90	3.13	SAO 188121	5.6	19 23.34	-21 52.6	47	58	1
	feb	28	12 17.1	86.48	348	21 Lutetia	12.4	36.79	3.65	AGK3+22°0422	5.4	4 22.44	+22 5.2	88	46	13
	mar	1	1 57.3	101.80	10	115 Thyra	11.6	55.40	4.96	AGK3+28°0444	5.7	4 38.20	+28 31.2	92	42	18
	mar	1	23 17.1	0.45	167	28 Bellona	13.3	50.55	2.22	SAO 163771	5.3	20 36.48	-15 7.9	33	94	27
	mar	3	18 48.2	42.33	47	1963 Bezovec	13.8	37.06	7.30	AGK3+43°1021	5.1	11 20.09	+43 45.4	142	81	47
	mar	4	8 18.2	80.98	30	639 Latona	13.7	15.52	3.16	SAO 183619	3.8	15 33.98	-27 58.3	104	161	53
	mar	6	7 34.8	79.77	157	369 Aeria	13.7	46.95	3.34	AGK3+18°0306	5.8	3 57.94	+18 3.3	76	43	74
	mar	10	7 3.9	18.12	167	135 Hertha	13.4	54.81	3.16	AGK3+20°0309	5.9	3 21.55	+20 37.6	64	102	99
	mar	10	12 41.8	16.78	165	30 Urania	12.1	72.66	3.55	AGK3+18°0224	5.9	2 52.99	+18 7.8	57	112	99
	mar	12	0 26.8	52.13	171	22 Kalliope	12.4	52.49	2.37	SAO 189856	5.8	20 53.83	-26 29.3	42	130	100
	mar	12	19 47.6	70.56	210	268 Adorea	12.5	19.53	4.85	SAO 139324	5.8	13 21.95	- 4 54.2	150	16	98
	mar	13	3 4.7	91.19	209	73 Klytia	13.8	9.85	4.01	SAO 183646	5.9	15 35.36	-20 51.2	115	46	97
	mar	13	18 21.5	29.76	352	154 Bertha	13.2	34.25	2.58	AGK3+34°0431	5.5	3 53.25	+34 56.2	71	134	95
	mar	15	3 54.3	96.14	171	21 Lutetia	12.6	43.87	3.35	AGK3+22°0456	4.3	4 39.24	+22 51.8	77	143	87
	mar	18	11 25.0	118.74	337	185 Eunike	12.9	66.57	2.90	SAO 130228	5.5	2 57.16	- 2 39.8	47	139	61
	mar	21	1 40.6	35.02	357	804 Hispania	13.6	46.84	2.72	AGK3+34°0418	5.7	3 48.69	+34 12.6	63	136	36
	mar	24	15 5.5	65.26	178	404 Arsinoe	13.9	29.11	3.86	AGK3+30°0688	5.0	6 25.35	+30 31.5	92	122	7
	mar	29	9 3.1	78.08	165	70 Panopaea	13.8	50.36	2.58	AGK3+24°0329	4.4	3 42.23	+24 18.7	51	15	10
	mar	30	20 55.0	95.75	331	790 Pretoria	13.9	57.70	2.46	AGK3+02°2779	5.5	21 44.00	+ 2 27.3	42	95	22
	apr	3	7 6.5	25.83	354	190 Ismene	13.8	27.95	2.68	AGK3+17°0680	5.1	6 39.49	+17 41.7	86	16	59
	apr	6	5 25.8	106.55	188	196 Philomela	11.9	22.93	3.22	SAO 186981	5.7	18 30.84	-24 4.3	98	126	86
	apr	6	6 11.2	28.91	208	78 Diana	12.2	41.06	5.35	AGK3+21°0900	5.4	8 4.82	+21 43.7	103	33	86
	apr	10	0 11.5	95.74	186	895 Helio	14.0	41.36	3.07	AGK3+09°0685	5.3	6 14.35	+ 9 57.7	74	103	100
	apr	17	20 19.1	64.22	147	790 Pretoria	13.9	54.23	2.57	SAO 127340	3.7	22 7.69	+ 5 57.1	52	48	54
	apr	19	16 59.5	20.60	182	247 Eukrate	13.1	35.44	3.66	SAO 204812	4.4	13 42.81	-32 47.6	158	99	36
	apr	20	16 16.8	59.94	73	683 Lanzia	13.4	22.47	4.06	SAO 156301	5.3	10 51.05	-19 52.3	136	147	26
	apr	21	10 58.9	50.54	12	96 Aegle	13.7	50.96	2.75	AGK3+31°0570	5.8	5 51.73	+31 41.6	58	109	19
	apr	22	17 16.2	87.34	172	30 Urania	12.3	76.66	3.05	AGK3+22°0423	4.4	4 23.32	+22 42.1	36	71	9
	apr	22	19 49.0	58.98	338	194 Prokne	12.0	55.27	4.63	AGK3-00°2566	5.8	20 1.81	- 0 51.1	89	57	8
	apr	23	11 4.8	21.48	157	148 Gallia	13.2	28.63	3.19	AGK3-00°2566	5.8	20 1.81	- 0 51.1	90	66	5
	apr	24	6 7.5	45.98	176	230 Athamantis	12.4	68.52	2.93	AGK3+18°0392	5.1	4 48.45	+18 45.4	39	54	2
	apr	27	0 42.4	86.24	2	1 Ceres	8.7	53.08	3.03	AGK3+29°0752	5.5	6 35.21	+29 1.7	61	35	5
	apr	29	19 14.3	64.39	355	236 Honoria	14.0	56.21	2.59	AGK3+17°0505	5.4	5 34.16	+17 0.6	45	21	28
	apr	30	0 10.0	105.93	342	599 Luisa	12.8	81.95	3.85	SAO 191683	3.8	23 6.79	-21 26.6	60	126	30
	apr	30	22 6.4	108.73	183	1 Ceres	8.8	54.28	2.99	AGK3+29°0765	5.5	6 41.59	+29 1.4	59	20	40
	may	1	15 1.6	79.85	11	363 Padua	13.9	19.06	3.96	SAO 188337	4.7	19 33.67	-24 59.7	109	163	48
	may	5	7 50.3	111.08	9	77 Frigga	13.7	57.91	3.15	AGK3+24°0793	5.8	7 9.40	+24 12.8	61	69	82
	may	5	16 4.9	23.70	192	92 Undina	12.9	31.14	2.46	AGK3+25°0954	5.8	8 7.44	+25 39.3	74	61	85
	may	6	3 47.9	8.30	162	599 Luisa	12.8	80.98	3.95	SAO 191858	4.2	23 20.34	-20 22.5	63	151	88
	may	7	2 38.5	43.89	189	337 Devosa	12.2	37.59	5.53	SAO 183058	5.7	14 55.69	-27 27.5	169	34	93

may 7	2 51.7	78.19	4	731	Sorga	13.5	32.76	4.30	SAO 158836	5.3	14 47.91	-15 47.5	178	29	93
may 13	8 6.1	46.73	344	94	Aurora	13.6	30.01	2.80	SAO 164888	5.7	22 6.24	-18 45.9	84	56	89
may 15	15 46.0	52.96	342	487	Venetia	13.6	63.30	2.88	SAO 128839	5.2	0 32.69	- 3 52.1	48	67	71
may 16	9 54.1	3.13	13	106	Dione	13.1	20.22	3.10	SAO 139390	4.8	13 29.36	- 5 59.9	148	105	64
may 18	23 48.3	61.62	338	86	Semele	13.9	9.92	3.48	SAO 187468	5.9	18 52.98	-23 14.4	135	59	38
may 19	20 13.4	95.71	121	660	Crescentia	13.2	14.32	5.56	AGK3-01°2388	4.3	19 34.13	- 1 24.0	120	59	29
may 22	6 55.9	93.18	179	308	Polyxo	13.8	57.23	2.39	AGK3+20°0615	4.7	6 0.95	+20 8.5	30	62	8
may 26	16 18.2	68.51	125	702	Alauda	12.9	27.16	3.10	SAO 145731	5.9	21 51.56	- 4 30.7	96	126	7
jun 2	4 45.7	112.55	331	678	Fredegundis	13.5	61.22	3.74	AGK3+03°3043	5.3	23 43.83	+ 3 12.5	73	176	68
jun 5	22 37.0	107.06	193	675	Ludmilla	12.6	31.95	3.93	SAO 185470	4.9	17 28.36	-23 55.6	171	36	94
jun 6	19 27.4	60.89	13	192	Nausikaa	12.6	63.61	2.72	AGK3+24°0877	3.7	7 41.43	+24 31.1	37	124	97
jun 7	7 52.5	16.70	23	372	Palma	12.5	67.92	2.78	AGK3+26°0876	5.0	7 50.44	+26 53.8	39	129	99
jun 27	9 17.2	82.57	164	81	Terpsichore	13.5	74.38	2.93	AGK3+23°0323	3.0	3 44.50	+23 57.1	35	96	25
jun 27	19 37.2	56.77	196	92	Undina	13.1	45.15	2.09	AGK3+22°1066	5.2	9 6.49	+22 14.9	37	29	29
jun 28	11 56.8	115.30	203	739	Mandeville	13.7	58.55	3.40	AGK3+20°1243	2.6	11 11.46	+20 47.8	65	20	36
jul 4	0 0.4	11.30	206	31	Euphrosyne	12.0	68.21	2.62	SAO 61387	5.8	9 15.35	+35 34.5	34	107	85
jul 6	0 10.1	24.92	201	165	Loreley	13.8	46.92	2.18	AGK3+09°1213	5.3	9 29.28	+ 9 56.2	38	118	96
jul 6	10 40.0	8.36	158	329	Svea	13.3	29.01	5.79	AGK3+02°2098	5.6	17 28.85	+ 2 45.7	146	30	97
jul 8	10 3.1	11.06	171	481	Emita	13.1	31.30	4.32	SAO 209803	5.6	18 6.87	-30 44.3	164	19	100
jul 8	13 16.5	102.00	336	505	Cava	13.1	33.25	4.31	SAO 188722	4.8	19 52.79	-26 26.0	168	5	100
jul 9	2 25.5	0.91	29	39	Laetitia	11.8	29.45	2.97	SAO 119674	3.7	12 53.06	+ 3 40.1	84	107	99
jul 12	0 45.7	44.92	202	97	Klotho	13.4	46.39	2.73	AGK3+08°1499	5.5	11 35.88	+ 8 24.7	62	163	84
jul 16	0 43.9	23.73	170	24	Themis	13.2	49.40	2.37	AGK3+21°0401	5.6	4 15.43	+21 27.5	46	36	44
jul 17	16 27.9	17.93	152	58	Concordia	13.2	16.04	4.63	SAO 145991	4.3	22 14.20	- 8 2.0	141	81	25
jul 25	13 6.9	6.47	14	111	Ate	13.3	36.08	3.45	SAO 158131	5.7	13 41.79	-15 55.7	87	44	14
jul 25	23 44.8	23.22	345	46	Hestia	12.9	58.78	4.31	AGK3+15°0237	5.8	2 41.79	+15 6.1	79	128	17
jul 27	0 24.2	80.54	357	324	Bamberga	12.7	20.58	3.01	SAO 182152	5.8	13 57.19	-24 46.1	92	32	26
jul 28	19 3.9	65.01	344	80	Sappho	11.6	64.04	5.64	AGK3+19°0168	5.9	2 7.86	+19 15.9	88	170	42
jul 29	22 32.1	19.38	197	82	Alkmene	13.6	28.02	3.49	SAO 158719	-0.9	14 37.58	-17 26.6	96	5	53
aug 7	10 41.4	81.68	349	10	Hygiea	10.4	16.43	3.81	SAO 128186	4.9	23 24.37	+ 0 58.8	141	28	99
aug 8	1 40.9	34.02	194	393	Lampetia	13.4	54.98	3.33	SAO 139189	4.5	13 7.36	- 5 16.4	62	135	98
aug 10	2 25.1	91.58	351	409	Aspasia	12.9	38.86	3.16	AGK3+24°0336	5.9	3 42.92	+24 24.0	77	59	86
aug 11	20 36.7	12.63	276	41	Daphne	11.0	27.19	5.84	AGK3-01°2222	5.8	18 29.37	- 1 2.4	134	103	70
aug 13	10 38.0	100.93	169	138	Tolosa	13.9	49.57	3.56	AGK3+20°0395	5.9	4 20.59	+20 52.0	72	21	53
aug 24	4 4.8	1.22	5	441	Bathilde	13.9	27.94	3.08	SAO 159572	5.9	15 52.11	-19 14.2	89	46	14
aug 24	23 34.2	55.12	190	337	Devosa	14.0	41.09	3.28	SAO 183139	3.4	15 1.13	-25 5.2	79	26	20
aug 26	10 3.6	3.79	185	639	Latona	13.8	35.30	2.91	SAO 183328	5.7	15 13.48	-22 12.9	79	10	32
aug 27	5 49.9	46.38	78	660	Crescentia	13.1	26.26	5.65	SAO 142692	5.9	18 48.22	- 9 50.0	127	54	40
aug 29	0 45.8	104.26	290	357	Ninina	13.8	14.70	3.75	SAO 162201	5.9	19 4.00	-16 18.4	130	35	57
aug 31	8 42.4	49.74	335	44	Nysa	10.5	35.93	5.22	SAO 164861	4.4	22 3.74	-14 6.8	170	47	78
sep 6	23 17.3	4.01	17	156	Xanthippe	13.4	79.69	3.08	SAO 157739	5.3	13 5.27	-10 28.4	35	169	95
sep 9	14 21.7	42.19	183	17	Thetis	13.4	39.86	3.01	AGK3+19°0560	5.2	6 11.90	+19 10.3	73	48	75
sep 10	12 38.7	47.88	2	451	Patientia	11.8	18.08	3.59	AGK3+07°0442	5.4	4 10.86	+ 7 35.4	104	19	65
sep 14	15 48.5	117.98	123	51	Nemausa	11.3	21.52	5.40	SAO 144968	5.7	20 54.20	- 9 53.4	141	162	21
sep 15	16 52.1	4.67	27	387	Aquitania	11.9	70.32	3.98	SAO 141022	4.9	16 9.26	- 9 56.2	70	110	12
sep 19	23 38.8	108.99	171	454	Mathesis	14.0	35.62	3.85	SAO 209696	3.1	18 2.59	-30 25.7	94	83	1
sep 29	8 42.7	41.45	192	102	Miriam	13.7	34.86	4.50	AGK3+20°0615	4.7	6 0.95	+20 8.5	95	149	72
oct 5	20 41.7	75.68	161	250	Bettina	13.8	27.37	2.51	SAO 210075	5.6	18 20.11	-36 15.9	82	117	97
oct 6	15 30.0	53.82	177	98	Ianthe	13.8	50.98	3.78	AGK3+37°0865	5.5	7 43.32	+37 38.4	81	68	93
oct 7	5 25.8	39.24	191	349	Dembowska	11.8	49.02	2.47	SAO 184068	5.1	16 0.31	-25 43.7	50	167	90
oct 11	2 48.3	98.67	171	366	Vincentina	12.9	30.71	4.17	AGK3+18°0116	5.6	1 23.99	+18 58.9	166	80	50
oct 11	16 3.1	87.07	351	366	Vincentina	12.9	30.81	4.17	AGK3+18°0115	5.3	1 23.55	+18 54.8	167	88	44
oct 14	17 47.8	51.82	21	980	Anacostia	13.1	30.50	3.48	AGK3+25°0907	5.4	7 41.07	+25 54.3	87	43	15
oct 14	21 31.9	32.97	26	187	Lamberta	13.2	74.47	2.83	AGK3+08°1499	5.5	11 35.88	+ 8 24.7	30	16	14
oct 26	17 26.3	72.17	25	43	Ariadne	13.1	62.70	2.96	AGK3+03°1449	5.0	10 57.98	+ 3 53.2	48	137	49
oct 31	14 32.3	92.72	31	599	Luisa	11.0	40.74	7.53	SAO 129204	5.5	1 14.06	- 2 45.8	156	18	92
nov 3	23 3.1	69.37	208	31	Euphrosyne	12.3	55.67	2.49	AGK3+10°1563	5.0	12 39.36	+10 30.6	38	126	98
nov 7	19 19.1	111.17	353	494	Virtus	13.4	31.95	4.05	SAO 93328	4.5	3 8.77	+19 32.3	174	62	69
nov 16	19 48.0	25.22	169	705	Erminia	13.0	25.13	4.40	AGK3+26°0099	5.9	0 53.28	+26 56.3	144	152	1
nov 21	3 9.7	69.28	175	4	Vesta	6.5	38.55	5.56	SAO 111195	3.8	3 24.46	+ 9 33.6	168	131	12
nov 23	1 9.5	95.71	164	59	Elpis	10.6	34.32	5.94	AGK3+06°0398	5.6	3 49.33	+ 6 23.2	166	114	26
nov 28	23 6.0	24.86	180	508	Princetonia	12.9	31.17	3.90	AGK3+24°0305	5.9	3 31.48	+24 17.9	169	38	84
nov 30	4 17.0	107.52	355	354	Eleonora	10.2	22.74	5.01	AGK3+00°0688	5.3	6 24.66	+ 0 19.9	143	65	93
nov 30	7 51.1	15.84	173	264	Libussa	13.5	23.24	3.59	AGK3+23°1078	5.9	10 14.47	+23 21.4	99	107	94
dec 6	21 10.9	15.99	206	31	Euphrosyne	12.3	45.53	2.68	AGK3+05°1822	5.9	13 19.63	+ 5 25.0	58	61	73
dec 7	13 45.6	38.63	335	276	Adelheid	13.0	34.09	4.35	AGK3+00°0468	5.9	4 52.27	+ 0 23.3	157	75	66
dec 12	2 13.0	71.22	27	207	Hedda	13.4	20.87	6.09	AGK3+26°0876	5.0	7 50.44	+26 53.8	144	90	22
dec 15	18 9.7	51.99	192	259	Aletheia	13.7	38.04	2.80	AGK3+07°1666	5.5	12 39.41	+ 7 4.8	76	63	2
dec 24	19 14.0	66.45	192	110	Lydia	11.7	34.65	4.76	AGK3+29°0765	5.5	6 41.59	+29 1.4	170	101	46
dec 26	4 18.6	71.77	356	488	Kreusa	12.7	30.82	4.01	SAO 99809	2.2	11 46.49	+14 51.0	102	149	61
dec 28	19 55.6	86.04	142	105	Artemis	13.0	16.69	4.88	SAO 154953	5.8	9 6.79	-12 9.3	127	91	87
1991 jan 6	12 36.6	101.80	333	602	Marianna	13.3	66.82	3.06	SAO 146067	5.9	22 21.51	- 5 5.4	50	155	63

INTERNATIONAL METEOR ORGANIZATION

Founded in 1988, the International Meteor Organization is a scientific non-profit organization created in response to an ever growing need for international cooperation in amateur meteor work. Its main objectives are to encourage, support, and coordinate meteor observing, to improve the quality of amateur observations, to disseminate observations and to make global analyses of observations received world-wide.

The International Meteor Organization is comprised of members from all over the world. Activities are coordinated through its bimonthly journal *WGN* (printed in English) which annually contains about 220 pages of general meteor news, observing program guidelines, reports and analyses, and other articles by amateurs and professionals.

New membership in the International Meteor Organization is \$15 US or 500 BEF (Belgian francs) and includes a one year subscription to *WGN*. To join or for more information contact one of the following persons: (North America) Peter Brown, 181 Sifton Ave., Ft. McMurray, Alberta T9H 4V7 Canada; (Japan) Masahiro Koseki, 4-3-5 Annaka Annaka-shi, Gunmaken 379-01 Japan; (all others) Ann Schroyens, Stuivenbergvaart 48, B-2800 Mechelen, Belgium.

CLOSE MUTUAL APPROACHES OF MINOR PLANETS IN 1990

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(Received: 28 June)

The table below lists 54 cases where one minor planet comes to within 120" of another and both are of magnitude 16 or brighter. A challenge for minor planet observers!

Here I present a list of close approaches between numbered minor planets larger than 20 km during 1990 where:

- the elongation of the Sun is more than 31°.
- both minor planets are brighter than visual magnitude 16.
- and the minimum geocentric separation is less than 120".

The table gives the following data:

1. Date: date and time of closest geocentric approach (in U.T.). All other information is given for this instant.
2. Closest approach: gives the minimum geocentric distance (in seconds of arc) and the position angle (in degrees) of the *nearest* minor planet with respect to the *farthest* one.
3. Minor planet 1: contains information about the *nearest* minor planet:
 - number and name
 - visual magnitude
 - parallax in seconds of arc
 - apparent motion in seconds of arc per hour
 - position angle of the direction of motion in degrees
4. Minor planet 2: information about the *farthest* minor planet. The same data as for the nearest one are given. In addition the right ascension and declination (1950.0) are printed.
5. Sun and Moon:
 - elongation of the Sun in degrees
 - elongation of the Moon (degrees)
 - illuminated fraction of the Moon in %

The author is most indebted to Dr. Joseph De Kerf, General Manager of the Scientific Computer Centre of Agfa-Gevaert N.V., Mortsels, Belgium. The author would be pleased to receive reports from observers of these events.

Close mutual approaches of minor planets

Date (U.T.)		Min. dist.	Pos. ang.	Minor planet 1			Minor planet 2			(Dist. < 120 ; El. Sun > 30 ; magn. < 16.0)		Elon- gation Sun Moon	Ill. frac. Moon				
h	m	"	0	N a m e	Vis. mag.	Hor. par.	Motion per hour ang.	N a m e	Vis. mag.	Hor. par.	Motion per hour ang.	Right ascens. (1950.0)	Declination (1950.0)	0	0	%	
							" /h					h m s	° ' "				
1989	dec 30	1 47.5	53.00	72	1 Ceres	6.99	5.22	34.96	283	425 Cornelia	13.92	4.59	31.74	272	5 39.94	+26 18.1	167 145 4
1990	jan 2	23 34.0	108.03	340	792 Metcalfia	15.96	2.55	51.48	73	583 Klotilde	15.84	2.07	39.91	74	21 58.11	- 4 51.7	48 23 34
	jan 5	15 29.0	114.46	181	1036 Ganymed	12.24	5.35	148.55	85	409 Aspesia	12.96	2.78	58.71	75	22 11.67	- 1 40.0	50 56 63
	jan 12	4 25.2	68.53	344	298 Baptistina	15.37	4.72	33.39	72	280 Philia	15.94	3.70	25.84	71	1 41.96	+16 32.2	98 94 99
	jan 14	10 3.9	101.58	44	161 Athor	14.19	3.35	55.37	113	73 Klytia	14.41	2.98	46.42	109	14 48.50	-16 57.6	68 72 88
	jan 19	0 19.5	106.74	122	584 Semiramis	11.73	6.29	37.49	257	1319 Disa	14.99	4.22	30.55	273	6 49.48	+20 52.8	163 108 49
	jan 24	5 15.6	106.19	103	2151 Hadwiger	15.92	3.01	55.42	57	48 Doris	12.85	2.58	46.40	69	0 10.21	- 0 31.7	58 90 7
	jan 28	21 2.9	34.06	5	1030 Vitja	15.74	3.38	59.61	90	547 Praxedis	15.88	2.68	21.44	87	14 27.67	-11 40.9	89 116 5
	feb 7	1 2.5	13.70	102	1197 Rhodesia	15.61	2.80	57.74	84	363 Padua	14.66	2.64	55.66	94	17 52.72	-24 09.3	49 165 9
	feb 11	21 50.8	103.02	70	914 Palisana	14.03	3.56	55.50	108	288 Glauke	15.25	3.29	18.26	65	3 56.92	+17 15.1	98 106 95
	feb 16	13 55.2	4.88	348	1242 Zambesia	14.95	4.19	24.40	277	108 Hecuba	12.96	4.04	18.34	284	11 59.75	+ 0 04.0	147 44 61
	feb 20	23 18.8	27.21	284	976 Benjaminia	13.73	4.36	27.86	289	681 Gorgo	15.72	3.60	29.25	302	8 56.72	+ 6 00.2	160 140 21
	mar 18	4 35.3	36.07	16	696 Leonora	14.42	3.77	4.94	162	665 Sabine	14.17	3.20	5.54	238	7 58.39	+15 53.3	121 132 63
	mar 27	23 15.8	49.52	146	578 Happelia	13.14	5.02	34.77	286	555 Norma	14.45	4.62	30.83	295	12 41.42	- 0 43.8	175 165 2
	apr 11	23 46.8	90.10	207	230 Athaamantis	12.29	3.56	55.59	82	986 Amelia	15.32	2.54	51.43	70	4 06.82	+17 15.1	51 33 45
	apr 4	6 10.1	97.94	180	42 Isis	11.76	3.83	84.46	78	949 Hel	15.37	2.67	48.80	69	21 23.12	-18 49.2	56 169 69
	apr 15	8 5.1	27.79	228	99 Dike	12.87	6.32	27.31	157	845 Naema	15.42	3.93	12.41	184	17 12.13	-28 49.0	124 2 77
	apr 16	7 19.7	13.83	262	180 Garuma	15.08	3.66	59.64	93	240 Vanadis	13.95	3.55	59.26	91	6 25.11	+23 29.2	70 175 69
	apr 17	15 25.4	69.79	36	255 Oppavia	15.17	4.01	31.07	127	769 Tatjana	15.15	2.61	13.79	129	8 39.27	+26 27.4	98 163 56
	apr 22	3 6.4	56.34	211	194 Prokne	11.96	4.61	55.59	68	148 Gallia	13.18	3.17	29.37	68	20 00.89	- 0 57.1	89 48 13
	may 3	1 12.8	47.09	324	336 Lacadiara	14.49	3.50	70.31	65	313 Chaldaea	14.66	2.74	50.11	70	23 01.01	- 1 09.2	55 160 62
	may 21	11 24.4	56.15	178	93 Minerva	11.81	5.17	17.57	112	1351 Uzbekistania	15.68	3.24	8.10	149	20 20.17	-31 46.7	118 78 13
	may 29	21 43.7	33.62	320	847 Agnia	15.57	2.69	64.36	69	1353 Maartje	15.76	2.42	54.91	72	1 47.75	+13 06.1	38 111 35
	jun 8	20 19.2	112.69	235	1248 Jugurtha	14.65	4.13	14.40	123	2562 1973FF1	15.62	3.70	5.95	79	21 40.68	-22 14.3	116 58 100
	jun 9	10 6.0	56.34	211	2407 1973DH	14.81	5.14	7.60	249	1092 Lillium	14.85	4.84	11.40	270	20 03.73	-23 39.8	139 30 99
	jun 16	9 0.9	49.64	207	604 Tekmessa	15.69	2.39	37.50	114	175 Andromache	15.32	2.07	29.40	114	10 08.76	+13 23.2	65 152 48
	jun 17	3 39.8	107.81	279	140 Siwa	13.50	3.43	28.00	119	1796 Riga	15.44	2.99	26.37	94	11 49.25	+ 4 55.5	90 166 39
	jun 22	22 10.6	40.26	43	757 Portlandia	15.39	3.07	64.32	114	307 Nike	15.82	2.59	52.04	110	9 43.87	+18 16.7	51 49 0
	jun 30	4 55.3	68.57	281	527 Euryanthe	13.57	6.05	33.01	252	368 Haidea	13.54	5.55	28.74	281	17 32.12	-14 48.5	163 73 53
	jul 29	11 4.4	85.58	320	714 Ulula	14.21	2.83	66.43	96	189 Phthia	14.62	2.83	65.79	91	5 44.78	+20 25.4	39 127 49
	jul 30	23 52.6	35.88	51	1013 Tombecka	14.88	2.93	73.04	119	622 Esther	15.94	2.49	55.47	111	11 11.02	+ 9 39.7	38 68 63
	aug 5	18 4.0	0.81	130	11 Parthenope	11.92	2.71	60.47	91	12 Victoria	12.66	2.64	56.75	96	6 12.40	+20 45.5	39 150 99
	aug 11	10 31.0	103.73	176	25 Phocaea	13.22	2.72	60.42	102	397 Vienna	15.59	2.19	46.38	107	11 32.97	- 4 39.8	38 157 74
	aug 15	13 21.2	95.45	144	155 Scylla	15.94	3.46	82.34	85	1067 Lunaria	16.00	2.99	65.04	95	6 19.25	+28 09.1	47 17 29
	aug 21	12 54.7	108.69	267	357 Ninina	13.71	3.86	18.45	217	420 Bertholda	14.09	3.20	12.24	255	19 05.69	-15 35.1	137 126 1
	sep 4	0 2.7	60.96	60	1200 Imperatrix	15.74	3.77	16.27	242	139 Juewa	12.92	3.69	18.70	270	1 10.46	+ 9 25.6	140 53 99
	sep 24	6 57.4	95.39	192	119 Althaea	12.73	4.60	23.15	102	755 Quintilla	15.90	2.75	7.94	103	4 48.10	+19 11.3	107 164 25
	oct 2	11 56.3	26.81	28	352 Gisela	14.99	2.90	69.79	113	190 Ismene	14.20	2.03	46.49	110	10 25.32	+ 7 15.6	33 173 95
	oct 6	3 46.2	20.05	24	1132 Hollandia	15.69	3.46	78.56	103	1306 Scythia	15.97	2.19	43.10	94	15 50.16	-24 48.8	48 154 96
	oct 6	19 22.2	11.92	149	488 Kreusa	13.33	2.76	61.05	103	399 Serpenthone	14.95	2.55	53.13	112	9 57.82	+19 27.3	48 100 92
	oct 14	5 45.5	16.94	222	512 Taurinensis	15.57	2.99	71.34	108	798 Ruth	15.39	2.41	57.07	102	15 34.39	-15 11.8	35 87 19
	oct 14	10 24.5	54.19	30	43 Ariadne	13.15	2.84	64.04	114	190 Ismene	14.24	2.07	44.30	111	10 38.97	+ 6 00.1	41 8 17
	oct 25	9 42.3	35.37	188	155 Scylla	15.53	4.63	64.81	94	70 Panopsea	13.83	2.86	31.29	89	9 02.21	+27 46.4	81 154 36
	nov 1	11 54.7	45.07	13	533 Sara	15.43	2.67	47.18	111	168 Sibylla	14.41	2.26	37.62	113	10 33.41	+ 5 06.9	60 140 97
	nov 7	20 41.0	98.81	207	449 Hamburga	14.51	3.16	74.33	112	103 Hera	13.47	2.48	53.50	110	12 09.77	+ 1 32.5	43 68 68
	nov 19	9 14.7	68.93	225	30 Urania	12.51	3.38	50.72	115	542 Susanna	15.20	2.58	35.85	106	11 10.18	+ 4 44.5	69 91 4
	nov 24	5 53.4	30.27	80	46 Hestia	11.13	6.90	33.19	253	886 Washingtonia	12.01	5.49	36.45	285	3 09.74	+14 16.7	167 93 37
	dec 17	5 24.1	53.20	347	670 Ottegebe	15.59	2.45	35.36	107	175 Andromache	15.22	2.13	30.15	113	13 05.45	- 6 00.5	67 68 0
	dec 21	20 56.3	15.70	170	625 Xenia	15.04	3.13	83.34	82	472 Roma	14.49	2.61	62.66	83	20 18.54	-21 11.8	32 19 19
1991	jan 1	4 52.3	10.31	344	476 Hedwig	14.10	2.77	63.41	105	134 Sophrosyne	14.51	2.54	55.11	110	15 29.46	-27 09.9	43 131 100
	jan 2	18 18.4	55.53	158	1018 Arnolda	15.42	3.31	89.87	69	327 Columbia	15.68	2.60	64.55	69	21 11.62	-18 56.0	33 173 94
	jan 4	7 59.5	15.32	82	941 Murrey	15.11	5.73	21.75	270	401 Ottilia	14.62	3.46	21.55	263	4 51.33	+28 25.0	151 77 83
	jan 5	23 40.8	20.92	310	30 Urania	12.04	4.32	18.66	121	172 Baucis	13.53	4.00	18.69	138	11 51.82	- 0 27.8	106 6 68
	jan 6	20 9.1	8.00	206	628 Christine	14.50	2.81	60.53	100	633 Zelima	15.90	2.40	50.24	97	15 49.56	-10 52.2	48 55 59

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 Zappalá 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 is 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).

Asteroid	Opp'n Date	Opp'n V Mag	Per	Amp	
201 Penelope	Nov 1	11.4	3.747	0.4	MOD
43 Ariadne	Dec 5	11.2	5.751	0.3	MOD
122 Gerda	Dec 10	12.0	?		PER+PHA
240 Vanadis	Dec 11	11.1	?		PER
758 Mancunia	Dec 14	11.9	?		PER

	DATE	R.A. (1950) HR MIN DEG	DEC. MIN	MAG V	PHASE ANGLE
Minor Planet	43 Ariadne				
1989	Oct 26	5 24.39	+24 56.3	11.98	17.9
	Nov 5	5 19.70	+24 45.5	11.78	14.5
	15	5 11.80	+24 28.7	11.57	10.4
	25	5 1.39	+24 4.9	11.35	5.7
	Dec 5	4 49.61	+23 34.2	11.06	0.8
	15	4 37.90	+22 59.1	11.32	4.4
	25	4 27.67	+22 23.6	11.59	9.0
1990	Jan 4	4 19.97	+21 52.0	11.83	13.1
	14	4 15.37	+21 27.8	12.07	16.5
Minor Planet	122 Gerda				
1989	Nov 5	5 36.06	+21 13.5	12.71	12.1
	15	5 31.44	+21 4.8	12.53	9.3
	25	5 24.84	+20 55.1	12.34	6.0
	Dec 5	5 16.84	+20 44.4	12.12	2.5
	15	5 8.24	+20 33.5	12.05	1.6
	25	4 59.98	+20 23.3	12.27	5.2
1990	Jan 4	4 52.90	+20 15.3	12.45	8.6
	14	4 47.67	+20 10.8	12.63	11.6
	24	4 44.71	+20 10.9	12.79	14.1
Minor Planet	201 Penelope				
1989	Sep 26	2 49.29	+ 8 59.9	12.04	16.4
	Oct 6	2 45.25	+ 8 3.3	11.83	12.4
	16	2 38.74	+ 7 0.7	11.62	8.0
	26	2 30.60	+ 5 58.3	11.44	4.1
	Nov 5	2 21.98	+ 5 3.7	11.51	4.6
	15	2 14.10	+ 4 23.1	11.79	8.5
	25	2 7.97	+ 4 0.8	12.07	12.5
	Dec 5	2 4.23	+ 3 58.3	12.34	15.9
	15	2 3.16	+ 4 14.5	12.59	18.6
Minor Planet	240 Vanadis				
1989	Nov 5	5 42.73	+20 49.6	12.16	19.0
	15	5 39.88	+20 49.2	11.91	14.8
	25	5 33.67	+20 49.7	11.65	9.9
	Dec 5	5 24.96	+20 50.8	11.36	4.5
	15	5 15.15	+20 52.5	11.19	1.7
	25	5 5.87	+20 55.5	11.57	6.9
1990	Jan 4	4 58.61	+21 1.1	11.89	12.0
	14	4 54.37	+21 10.8	12.19	16.2
	24	4 53.58	+21 25.1	12.46	19.7
Minor Planet	758 Mancunia				
1989	Nov 5	5 53.87	+19 11.8	12.85	15.4
	15	5 50.72	+19 16.8	12.64	12.3
	25	5 45.03	+19 24.4	12.43	8.7
	Dec 5	5 37.35	+19 34.6	12.19	4.6
	15	5 28.57	+19 46.7	11.96	1.2
	25	5 19.79	+20 0.6	12.20	4.5
1990	Jan 4	5 12.10	+20 16.3	12.45	8.5
	14	5 6.40	+20 34.1	12.68	12.0
	24	5 3.23	+20 54.4	12.90	15.0

Photoelectric Photometry Opportunities

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 USA. 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 USA.

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.

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