

MINOR PLANETS AT UNUSUALLY FAVORABLE ELONGATIONS IN 2023

Frederick Pilcher
4438 Organ Mesa Loop
Las Cruces, NM 88011 USA
pilcher@ic.edu

(Received: 2022 September 26)

A list is presented of minor planets which are much brighter than usual at their 2023 apparitions.

The minor planets in the lists which follow will be much brighter at their 2023 apparitions than at their average distances at maximum elongation. Many years may pass before these objects will be again as bright as in 2023. Observers are encouraged to give special attention to those objects reaching peak brightness near the limit of their equipment.

These lists have been prepared by an examination of the maximum elongation circumstances of minor planets computed by the author for all years through 2060 with a full perturbation program written by Dr. John Reed, and to whom he expresses his thanks. Elements are from EMP 1992, or for more recently discovered minor planets from the MPC in which they were also assigned permanent numbers. Planetary positions are from the JPL DE-200 ephemeris, courtesy of Dr. E. Myles Standish.

Any minor planets whose brightest magnitudes near the time of maximum elongation vary by at least 2.0 in this interval and in 2023 will be within 0.3 of the brightest occurring, or vary by at least 3.0 and in 2023 will be within 0.5 of the brightest occurring; and which are visual magnitude 14.5 or brighter, are included. For planets brighter than visual magnitude 13.5, which are within the range of a large number of observers, these standards have been relaxed somewhat to include a larger number of planets. Magnitudes have been computed from the updated magnitude parameters published in MPC28104-28116, on 1996 Nov. 25, or more recently in the Minor Planet Circulars.

Oppositions may be in right ascension or in celestial longitude. Here we use still a third representation, maximum elongation from the Sun, instead of opposition. Though unconventional, it has the advantage that many close approaches do not involve actual opposition to the Sun near the time of minimum distance and greatest brightness and are missed by an opposition-based program. Other data are also provided according to the following tabular listings: Minor planet number, date of maximum elongation from the Sun in format yyyy/mm/dd, maximum elongation in degrees, right ascension on date of maximum elongation, declination on date of maximum elongation, both in J2000 coordinates, date of brightest magnitude in format yyyy/mm/dd, brightest magnitude, date of minimum distance in format yyyy/mm/dd, and minimum distance in AU.

Users should note that when the maximum elongation is about 177° or greater, the brightest magnitude is sharply peaked due to enhanced brightening near zero phase angle. Even as near as 10 days before or after predicted greatest brightest, the appearance is generally about 0.4 magnitudes brighter. This effect takes place in greater time interval for smaller maximum elongations. There is some interest in very small minimum phase angles. For maximum elongations E near 180° at Earth distance Δ, an approximate formula for the minimum phase angle φ is

$$\phi = (180^\circ - E) / (\Delta + 1)$$

A special list of asteroids approaching the Earth more closely than 0.3 AU is provided following the list of temporal sequence of favorable elongations.

Table I. Numerical Sequence of Favorable Elongations

Planet	Max	Elon	D	Max	E	RA	Dec	Br	Mag	D	Br	Mag	Min	Dist	D	Min	Dist
9	2023/12/22	176.1°	6h 2m	+27°				2023/12/22	8.4	2023/12/21	1.119						
18	2023/11/05	159.2°	3h 7m	-4°				2023/11/03	8.1	2023/10/30	0.859						
32	2023/05/04	179.4°	14h43m	-15°				2023/05/04	10.2	2023/05/03	1.384						
37	2023/12/18	174.5°	5h42m	+28°				2023/12/18	9.7	2023/12/16	1.211						
47	2023/08/25	175.7°	22h22m	-14°				2023/08/25	10.9	2023/08/23	1.504						
53	2023/02/02	178.3°	9h 1m	+15°				2023/02/02	11.0	2023/01/29	1.169						
54	2023/07/21	174.1°	20h 4m	-26°				2023/07/21	10.0	2023/07/21	1.164						
55	2023/07/21	177.3°	23h57m	-3°				2023/07/21	10.5	2023/07/21	1.372						
64	2023/01/03	179.0°	6h55m	+23°				2023/01/03	10.3	2023/01/05	1.389						
95	2023/11/30	178.3°	4h24m	+19°				2023/11/30	11.2	2023/11/27	1.661						
96	2023/03/20	163.9°	11h33m	-14°				2023/03/19	11.3	2023/03/20	1.653						
103	2023/07/22	177.4°	20h 3m	-17°				2023/07/22	10.7	2023/07/23	1.491						
114	2023/07/29	176.5°	12h35m	+0°				2023/07/29	11.0	2023/07/27	1.351						
144	2023/11/16	176.6°	3h28m	+15°				2023/11/16	10.1	2023/11/09	1.142						
146	2023/06/17	179.2°	17h42m	-24°				2023/06/17	11.3	2023/06/16	1.554						
162	2023/04/21	179.0°	13h53m	-10°				2023/04/20	12.1	2023/04/16	1.660						
182	2023/11/21	177.0°	3h49m	+16°				2023/11/21	10.7	2023/11/20	0.977						
234	2023/07/29	168.1°	20h11m	-3°				2023/07/30	10.5	2023/08/04	0.850						
288	2023/03/07	174.5°	11h17m	+10°				2023/03/07	12.4	2023/03/13	1.282						
343	2023/10/30	179.7°	2h17m	+13°				2023/10/30	12.7	2023/10/31	0.871						
353	2023/12/27	178.5°	6h24m	+21°				2023/12/27	11.2	2023/12/19	0.919						
368	2023/09/27	171.3°	23h57m	+9°				2023/09/26	13.3	2023/09/21	1.560						
380	2023/07/09	177.8°	19h14m	-24°				2023/07/09	12.3	2023/07/13	1.442						
393	2023/07/06	150.1°	18h57m	+7°				2023/07/10	10.5	2023/07/12	0.930						
413	2023/07/10	176.7°	19h23m	-25°				2023/07/11	11.9	2023/07/25	0.982						
428	2023/10/04	178.3°	0h39m	+2°				2023/10/04	12.9	2023/10/06	0.918						
429	2023/09/27	170.0°	23h57m	+10°				2023/09/28	12.6	2023/09/29	1.315						
449	2023/01/04	178.1°	7h 2m	+24°				2023/01/05	11.6	2023/01/08	1.168						
453	2023/05/03	174.0°	14h35m	-21°				2023/05/03	12.2	2023/05/05	0.941						
459	2023/10/14	176.9°	1h20m	+5°				2023/10/14	12.5	2023/10/17	1.112						
481	2023/11/21	177.6°	3h47m	+1°				2023/11/21	11.2	2023/11/20	1.321						
485	2023/12/05	159.0°	5h 0m	+1°				2023/12/07	11.3	2023/12/09	1.332						
492	2023/10/01	178.3°	0h32m	+1°				2023/10/01	13.0	2023/09/27	1.587						
503	2023/11/24	178.9°	3h58m	+19°				2023/11/24	11.8	2023/11/28	1.382						
505	2023/01/13	173.2°	7h44m	+28°				2023/01/12	11.0	2023/01/06	1.174						
512	2023/07/20	176.4°	20h 1m	-24°				2023/07/21	11.7	2023/08/01	0.780						
538	2023/11/01	169.9°	2h35m	+4°				2023/10/31	12.9	2023/10/28	1.683						
542	2023/09/28	169.1°	0h38m	-7°				2023/09/28	12.6	2023/09/27	1.500						
545	2023/09/12	175.3°	23h11m	-0°				2023/09/11	12.5	2023/09/06	1.762						
598	2023/11/14	165.0°	3h27m	+3°				2023/11/13	12.0	2023/11/08	1.137						
601	2023/08/29	173.7°	22h19m	-3°				2023/08/29	13.4	2023/08/28	1.800						
602	2023/09/23	166.6°	23h45m	+12°				2023/09/24	11.2	2023/09/25	1.335						
629	2023/01/05	175.2°	7h 8m	+27°				2023/01/05	13.3	2023/01/07	1.668						
648	2023/02/01	174.2°	8h50m	+11°				2023/01/31	13.0	2023/01/30	1.592						
678	2023/10/02	168.2°	0h11m	+14°				2023/10/03	11.2	2023/10/06	1.076						
704	2023/12/18	173.0°	5h37m	+30°				2023/12/17	9.9	2023/12/13	1.850						
709	2023/09/18	165.8°	23h25m	+11°				2023/09/18	12.6	2023/09/16	1.604						
717	2023/10/20	178.0°	1h33m	+11°				2023/10/20	13.7	2023/10/15	1.334						
756	2023/03/31	169.3°	12h15m	-13°				2023/03/31	13.4	2023/04/03	1.767						
758	2023/11/30	174.6°	4h28m	+16°				2023/11/30	11.8	2023/11/29	1.737						
759	2023/07/24	167.2°	20h15m	-32°				2023/07/25	12.8	2023/07/27	1.100						
760	2023/03/04	175.6°	10h51m	+2°				2023/03/04	10.9	2023/03/06	1.427						
765	2023/12/04	168.9°	4h33m	+33°				2023/12/03	14.0	2023/11/26	0.903						
767	2023/08/24	176.2°	22h18m	-14°				2023/08/24	13.2	2023/08/26	1.557						
773	2023/08/16	179.6°	21h40m	-13°				2023/08/16	12.3	2023/08/14	1.642						
774	2023/06/07	178.9°	16h58m	-21°				2023/06/07	11.7	2023/06/10	1.555						
776	2023/12/20	175.6°	5h51m	+27°				2023/12/19	11.1	2023/12/15	1.661						
800	2023/09/14	175.8°	23h20m	+0°				2023/09/13	12.7	2023/09/06	0.805						
817	2023/11/13	159.7°	3h32m	-1°				2023/11/13	13.4	2023/11/12	1.165						
882	2023/11/17	176.0°	3h22m	+22°				2023/11/16	13.3	2023/11/11	1.367						
899	2023/12/18	175.1°	5h43m	+18°				2023/12/17	13.4	2023/12/11	1.593						
900	2023/08/11	164.1°	20h57m	-0°				2023/08/10	14.1	2023/08/08	1.085						
937	2023/05/29	179.5°	16h23m	-21°				2023/05/29	13.3	2023/06/09	0.943						
985	2023/08/22	173.7°	21h54m	-5°				2023/08/22	13.3	2023/08/27	0.675						
988	2023/11/24	179.1°	3h56m	+21°				2023/11/24	14.2	2023/11/17	1.532						
1066	2023/10/26	172.7°	1h52m	+19°				2023/10/25	14.2	2023/10/20	0.953						
1133	2023/11/24	179.3°	3h57m	+21°				2023/11/24	13.5	2023/11/16	0.916						
1150	2023/08/29	175.5°	22h20m	-5°				2023/08/29	13.5	2023/08/30	0.740						
1178	2023/02/08	173.5°	9h15m	+9°				2023/02/08	13.9	2023/02/12	1.239						
1187	2023/09/16	171.2°	23h21m	+5°				2023/09/17	13.7	2023/09/22	1.179						
1196	2023/11/27	161.5°	4h18m	+2°				2023/11/25	13.4	2023/11/20	1.387						
1227	2023/09/25	179.2°	0h 7m	+1°				2023/09/25	13.7	2023/09/19	1.804						
1270	2023/09/03	167.8°	23h 7m	-18°				2023/09/03	13.7	2023/09/05	0.783						
1283	2023/11/28	165.6°	4h22m	+6°				2023/11/26	13.8	2023/11/22	1.580						
1362	2023/11/10	137.0°	3h32m	-25°				2023/11/03	14.1	2023/10/31	1.203						

Planet	Max	Elon	D	Max	E	RA	Dec	Br	Mag	D	Br	Mag	Min	Dist	D	Min	Dist
1369	2023/09/30	177.5°	0h27m	+ 0°		2023/09/29	14.1	2023/09/22	1.670								
1407	2023/09/11	168.7°	23h 1m	+ 5°		2023/09/13	12.7	2023/09/17	1.041								
1419	2023/11/17	175.9°	3h33m	+14°		2023/11/17	13.0	2023/11/20	1.004								
1429	2023/11/10	179.8°	2h59m	+16°		2023/11/10	13.9	2023/10/26	0.943								
1456	2023/07/08	179.0°	19h 8m	-21°		2023/07/08	14.4	2023/07/15	1.735								
1525	2023/09/16	168.6°	23h18m	+ 7°		2023/09/16	14.3	2023/09/13	0.996								
1590	2023/07/31	170.9°	20h29m	- 9°		2023/07/30	13.3	2023/07/26	0.901								
1655	2023/01/04	177.5°	6h55m	+20°		2023/01/04	13.3	2022/12/30	1.204								
1659	2023/09/23	167.5°	23h44m	+11°		2023/09/23	12.3	2023/09/24	1.078								
1662	2023/09/30	175.6°	0h18m	+ 6°		2023/09/30	13.9	2023/10/02	1.303								
1694	2023/09/18	171.7°	23h51m	- 9°		2023/09/19	12.6	2023/09/21	0.791								
1699	2023/07/19	178.3°	19h52m	-19°		2023/07/19	13.7	2023/07/23	0.861								
1817	2023/06/15	174.7°	17h30m	-18°		2023/06/15	13.5	2023/06/11	0.956								
1914	2023/07/14	178.2°	19h31m	-19°		2023/07/14	14.2	2023/07/12	1.042								
2036	2023/06/21	171.5°	17h59m	+ 3°		2023/06/22	14.1	2023/06/25	0.840								
2081	2023/08/02	173.2°	20h57m	-24°		2023/08/02	14.2	2023/07/30	1.060								
2259	2023/06/30	179.3°	18h32m	-23°		2023/06/30	13.7	2023/07/02	0.862								
2374	2023/09/28	172.0°	0h 6m	+ 9°		2023/09/28	14.5	2023/09/26	1.424								
2382	2023/06/12	156.8°	17h56m	- 1°		2023/06/17	13.6	2023/06/23	1.010								
2397	2023/12/16	165.3°	21h58m	+ 8°		2023/12/16	14.4	2023/12/16	1.584								
2433	2023/03/30	179.4°	12h32m	- 3°		2023/03/30	14.3	2023/04/08	1.299								
2536	2023/08/05	173.7°	20h52m	-11°		2023/08/06	14.5	2023/08/14	0.903								
2569	2023/09/27	160.3°	0h44m	-33°		2023/09/28	14.0	2023/09/29	1.261								
2699	2023/11/16	174.4°	3h26m	+13°		2023/11/15	14.4	2023/11/10	1.336								
2763	2023/08/21	177.5°	21h55m	- 9°		2023/08/21	13.9	2023/08/23	0.879								
2831	2023/10/01	170.8°	0h41m	- 5°		2023/09/30	13.8	2023/09/27	0.795								
2873	2023/07/17	177.1°	19h47m	-24°		2023/07/17	14.4	2023/07/13	0.903								
2880	2023/06/27	169.4°	18h27m	-33°		2023/06/27	14.0	2023/06/29	0.830								
3099	2023/03/18	164.3°	12h 9m	+15°		2023/03/18	14.3	2023/03/20	1.326								
3127	2023/09/11	172.5°	23h 3m	+ 2°		2023/09/10	14.4	2023/09/06	1.108								
3173	2023/07/17	169.0°	19h59m	-31°		2023/07/17	14.2	2023/07/18	0.733								
3184	2023/08/20	167.0°	22h21m	-24°		2023/08/21	14.0	2023/08/21	0.972								
3563	2023/06/21	179.6°	17h58m	-23°		2023/06/21	14.3	2023/06/19	1.288								
3662	2023/08/26	172.1°	22h28m	-18°		2023/08/26	14.4	2023/08/25	1.193								
3738	2023/06/03	177.3°	16h44m	-24°		2023/06/04	13.9	2023/06/06	0.843								
3855	2023/09/03	167.1°	23h 9m	-19°		2023/09/02	14.3	2023/09/01	0.771								
3921	2023/10/03	165.1°	1h 5m	- 8°		2023/10/03	14.4	2023/10/02	0.907								
3958	2023/11/19	173.1°	3h29m	+26°		2023/11/18	14.0	2023/11/15	0.976								
4222	2023/11/28	174.2°	4h21m	+15°		2023/11/28	13.0	2023/11/27	0.680								
4226	2023/09/07	172.4°	0h 1m	+ 0°		2023/09/07	13.5	2023/09/06	1.127								
4265	2023/09/30	172.3°	0h36m	- 4°		2023/09/30	14.5	2023/09/29	0.946								
4288	2023/09/27	162.4°	0h34m	-15°		2023/09/27	14.4	2023/09/27	1.189								
4340	2023/06/07	173.9°	16h55m	-16°		2023/06/07	14.4	2023/06/08	0.830								
4349	2023/12/10	175.8°	5h 8m	+18°		2023/12/10	14.2	2023/12/01	1.248								
4486	2023/02/17	171.0°	10h24m	+19°		2023/03/20	14.5	2023/04/11	0.163								
4608	2023/10/28	176.8°	2h13m	+10°		2023/10/28	14.1	2023/10/29	0.858								
4729	2023/09/21	175.2°	23h43m	+ 3°		2023/09/21	14.3	2023/09/23	0.850								
4770	2023/08/05	176.9°	21h 4m	-19°		2023/08/05	14.0	2023/08/08	0.103								
4797	2023/12/13	177.0°	5h18m	+26°		2023/12/13	14.4	2023/12/07	1.060								
4860	2023/09/28	167.9°	0h 1m	+13°		2023/09/27	14.5	2023/09/25	1.264								
5090	2023/12/12	163.4°	5h19m	+ 6°		2023/12/09	14.5	2023/11/29	1.065								
5199	2023/07/11	177.0°	19h21m	-25°		2023/07/11	14.2	2023/07/10	1.136								
5445	2023/05/31	177.8°	16h31m	-24°		2023/05/31	14.0	2023/05/29	0.993								
5747	2023/12/29	173.5°	6h21m	+29°		2023/12/28	13.8	2023/12/28	0.839								
6016	2023/08/30	172.8°	22h18m	- 2°		2023/08/30	14.2	2023/09/01	0.841								
6037	2023/08/05	157.8°	21h13m	+ 4°		2023/08/19	14.3	2023/08/23	0.041								
6193	2023/05/13	162.5°	14h56m	-35°		2023/05/15	14.3	2023/05/18	0.909								
6265	2023/08/07	170.3°	21h22m	-25°		2023/08/08	14.5	2023/08/09	0.747								
6325	2023/05/05	178.5°	14h46m	-17°		2023/05/05	14.5	2023/05/03	1.211								
6572	2023/09/13	177.2°	23h29m	- 6°		2023/09/13	13.7	2023/09/08	0.880								
6649	2023/07/12	171.0°	19h28m	-30°		2023/07/13	14.5	2023/07/18	0.912								
7965	2023/04/05	130.5°	11h57m	-54°		2023/04/18	14.3	2023/04/22	0.945								
8356	2023/09/14	175.9°	23h27m	- 7°		2023/09/14	14.1	2023/09/23	0.854								
14870	2023/08/09	178.8°	21h11m	-15°		2023/08/09	14.5	2023/08/11	0.850								
15127	2023/10/13	167.1°	0h57m	+20°		2023/10/12	14.5	2023/10/09	1.197								
26853	2023/10/29	170.8°	2h16m	+ 4°		2023/10/28	14.2	2023/10/24	0.978								
30105	2023/07/02	166.7°	19h 2m	-35°		2023/07/06	14.0	2023/07/16	0.549								
37638	2023/03/15	157.4°	11h13m	+24°		2023/02/25	14.6	2023/02/21	0.044								
88264	2023/07/07	177.1°	18h51m	-22°		2023/07/08	14.3	2023/07/19	0.175								
97034	2023/03/02	165.2°	11h 8m	- 6°		2023/03/03	13.9	2023/03/06	0.381								
139622	2024/02/10	141.4°	9h56m	+52°		2023/12/10	14.1	2023/12/06	0.037								
154244	2023/05/21	174.2°	16h01m	-14°		2023/08/06	13.8	2023/08/05	0.064								
154244	2023/10/12	176.7°	1h01m	+10°		2023/08/06	13.8	2023/08/05	0.064								
164121	2023/10/31	129.2°	1h20m	-34°		2023/11/02	12.1	2023/11/03	0.059								
199145	2023/02/06	155.6°	10h29m	- 1°		2023/02/14	13.2	2023/02/16	0.031								

Table II. Temporal Sequence of Favorable Elongations

Planet	Max	Elon	D	Max	E	RA	Dec	Br	Mag	D	Br	Mag	Min	Dist	D	Min	Dist
64	2023/01/03	179.0°		6h55m	+23°			2023/01/03	10.3		2023/01/05		2023/01/05		1.389		
449	2023/01/04	178.1°		7h 2m	+24°			2023/01/05	11.6		2023/01/08		2023/01/08		1.168		
1655	2023/01/04	177.5°		6h55m	+20°			2023/01/04	13.3		2022/12/30		2022/12/30		1.204		
629	2023/01/05	175.2°		7h 8m	+27°			2023/01/05	13.3		2023/01/07		2023/01/07		1.668		
505	2023/01/13	173.2°		7h44m	+28°			2023/01/12	11.0		2023/01/06		2023/01/06		1.174		
648	2023/02/01	174.2°		8h50m	+11°			2023/01/31	13.0		2023/01/30		2023/01/30		1.592		
53	2023/02/02	178.3°		9h 1m	+15°			2023/02/02	11.0		2023/01/29		2023/01/29		1.169		
199145	2023/02/06	155.6°		10h29m	- 1°			2023/02/14	13.2		2023/02/16		2023/02/16		0.031		
1178	2023/02/08	173.5°		9h15m	+ 9°			2023/02/08	13.9		2023/02/12		2023/02/12		1.239		
4486	2023/02/17	171.0°		10h20m	+19°			2023/03/20	14.5		2023/04/11		2023/04/11		0.163		
97034	2023/03/02	165.2°		10h 8m	- 6°			2023/03/03	13.9		2023/03/06		2023/03/06		0.381		
760	2023/03/04	175.6°		11h15m	+ 2°			2023/03/04	10.9		2023/03/06		2023/03/06		1.427		
288	2023/03/07	174.5°		11h17m	+10°			2023/03/07	12.4		2023/03/13		2023/03/13		1.282		
37638	2023/03/15	157.4°		11h13m	+24°			2023/02/25	14.6		2023/02/21		2023/02/21		0.044		
3099	2023/03/18	164.3°		12h 9m	+15°			2023/03/18	14.3		2023/03/20		2023/03/20		1.326		
96	2023/03/20	163.9°		11h33m	- 14°			2023/03/19	11.3		2023/03/20		2023/03/20		1.653		
114	2023/03/29	176.5°		12h35m	+ 0°			2023/03/29	11.0		2023/03/27		2023/03/27		1.351		
2433	2023/03/30	179.4°		12h32m	- 3°			2023/03/30	14.3		2023/04/08		2023/04/08		1.299		
756	2023/03/31	169.3°		12h15m	-13°			2023/03/31	13.4		2023/04/03		2023/04/03		1.767		
7965	2023/04/05	130.5°		11h57m	-54°			2023/04/18	14.3		2023/04/22		2023/04/22		0.945		
162	2023/04/21	179.0°		13h53m	-10°			2023/04/20	12.1		2023/04/16		2023/04/16		1.660		
453	2023/05/03	174.0°		14h35m	-21°			2023/05/03	12.2		2023/05/05		2023/05/05		0.941		
32	2023/05/04	179.4°		14h43m	-15°			2023/05/04	10.2		2023/05/03		2023/05/03		1.284		
6325	2023/05/05	178.5°		14h46m	-17°			2023/05/05	14.5		2023/05/03		2023/05/03		1.311		
6193	2023/05/13	162.5°		14h56m	-35°			2023/05/15	14.3		2023/05/18		2023/05/18		0.909		
154244	2023/05/21	174.2°		16h01m	-14°			2023/05/26	13.8		2023/06/05		2023/06/05		0.064		
937	2023/05/29	179.5°		16h23m	-21°			2023/05/29	13.3		2023/06/09		2023/06/09		0.943		
5445	2023/05/31	177.8°		16h31m	-24°			2023/05/31	14.0		2023/05/29		2023/05/29		0.993		
3738	2023/06/03	177.3°		16h44m	-24°			2023/06/04	13.9		2023/06/06		2023/06/06		0.843		
774	2023/06/07	178.9°		16h58m	-21°			2023/06/07	11.7		2023/06/10		2023/06/10		1.555		
4340	2023/06/07	175.9°		16h55m	- 1°			2023/06/07	14.6		2023/06/08		2023/06/08		0.830		
2382	2023/06/12	136.8°		17h56m	-16°			2023/06/17	13.6		2023/06/23		2023/06/23		1.010		
1817	2023/06/15	174.7°		17h30m	-18°			2023/06/15	13.5		2023/06/11		2023/06/11		0.956		
146	2023/06/17	179.2°		17h42m	-24°			2023/06/17	11.3		2023/06/16		2023/06/16		1.554		
2036	2023/06/21	171.5°		17h58m	-31°			2023/06/22	14.1		2023/06/25		2023/06/25		0.840		
3563	2023/06/21	179.6°		17h58m	-23°			2023/06/21	14.3		2023/06/19		2023/06/19		1.288		
2880	2023/06/27	169.4°		18h27m	-33°			2023/06/27	14.0		2023/06/29		2023/06/29		0.830		
2259	2023/06/30	179.3°		18h32m	-23°			2023/06/30	13.7		2023/07/02		2023/07/02		0.862		
30105	2023/07/02	166.7°		19h 2m	-35°			2023/07/06	14.0		2023/07/16		2023/07/16		0.549		
393	2023/07/06	150.1°		18h57m	+ 7°			2023/07/10	10.5		2023/07/12		2023/07/12		0.930		
88264	2023/07/07	177.1°		18h51m	-22°			2023/07/08	14.3		2023/07/19		2023/07/19		0.175		
1456	2023/07/08	179.0°		19h 8m	-21°			2023/07/08	14.4		2023/07/15		2023/07/15		1.735		
380	2023/07/09	177.8°		19h14m	-24°			2023/07/09	12.3		2023/07/13		2023/07/13		1.442		
413	2023/07/10	176.7°		19h23m	-25°			2023/07/11	11.9		2023/07/25		2023/07/25		0.982		
5199	2023/07/11	177.0°		19h21m	-25°			2023/07/11	14.2		2023/07/10		2023/07/10		1.136		
6649	2023/07/12	171.0°		19h28m	-30°			2023/07/13	14.5		2023/07/18		2023/07/18		0.912		
1914	2023/07/14	178.2°		19h31m	-19°			2023/07/14	14.2		2023/07/12		2023/07/12		1.042		
2873	2023/07/17	177.1°		19h47m	-24°			2023/07/17	14.4		2023/07/13		2023/07/13		0.903		
3173	2023/07/17	169.0°		19h59m	-31°			2023/07/17	14.2		2023/07/18		2023/07/18		0.733		
1699	2023/07/19	178.3°		19h52m	-19°			2023/07/19	13.7		2023/07/23		2023/07/23		0.861		
512	2023/07/20	176.4°		20h 1m	-24°			2023/07/21	11.7		2023/08/01		2023/08/01		0.780		
54	2023/07/21	174.1°		20h 4m	-26°			2023/07/21	10.0		2023/07/21		2023/07/21		1.164		
103	2023/07/22	177.4°		20h 3m	-17°			2023/07/22	10.7		2023/07/23		2023/07/23		1.491		
759	2023/07/24	167.2°		20h15m	-32°			2023/07/25	12.8		2023/07/27		2023/07/27		1.100		
234	2023/07/29	168.1°		20h11m	- 8°			2023/07/30	10.5		2023/08/04		2023/08/04		0.850		
1590	2023/07/31	170.9°		20h29m	- 9°			2023/07/30	13.3		2023/07/26		2023/07/26		0.901		
2081	2023/08/02	173.2°		20h57m	-24°			2023/08/02	14.2		2023/07/30		2023/07/30		1.060		
2536	2023/08/05	173.7°		20h52m	-11°			2023/08/06	14.5		2023/08/14		2023/08/14		0.903		
4770	2023/08/05	176.9°		21h 4m	-4°			2023/08/05	14.0		2023/08/08		2023/08/08		1.013		
6037	2023/08/05	157.8°		21h13m	+ 19°			2023/08/19	14.3		2023/08/23		2023/08/23		0.041		
6265	2023/08/07	170.3°		21h22m	-25°			2023/08/08	14.5		2023/08/09		2023/08/09		0.747		
14870	2023/08/09	178.8°		21h11m	-15°			2023/08/09	14.5		2023/08/11		2023/08/11		0.850		
900	2023/08/11	164.1°		20h57m	- 0°			2023/08/10	14.1		2023/08/08		2023/08/08		1.085		
773	2023/08/16	179.6°		21h40m	-13°			2023/08/16	12.3		2023/08/14		2023/08/14		1.642		
3184	2023/08/20	167.0°		22h21m	-24°			2023/08/21	14.0		2023/08/21		2023/08/21		0.972		
2763	2023/08/21	177.5°		21h55m	- 9°			2023/08/21	13.9		2023/08/23		2023/08/23		0.879		
985	2023/08/22	173.7°		21h54m	- 5°			2023/08/22	13.2		2023/08/27		2023/08/27		0.675		
767	2023/08/24	176.2°		22h18m	-14°			2023/08/24	13.2		2023/08/26		2023/08/26		1.557		
47	2023/08/25	175.7°		22h28m	-14°			2023/08/25	10.9		2023/08/23		2023/08/23		1.504		
3662	2023/08/26	172.1°		22h28m	-18°			2023/08/26	14.4		2023/08/25		2023/08/25		1.193		
601	2023/08/29	173.7°		22h19m	- 3°			2023/08/29	13.4		2023/08/28		2023/08/28		1.800		
1150	2023/08/29	175.5°		22h20m	- 5°			2023/08/29	13.5		2023/08/30		2023/08/30		0.740		
6016	2023/08/30	172.8°		22h18m	- 2°			2023/08/30	14.2		2023/09/01		2023/09/01		0.841		
1270	2023/09/03	167.8°		23h 7m	-18°			2023/09/03	13.7		2023/09/05		2023/09/05		0.783		
3855	2023/09/03	167.1°		23h 9m	-19°			2023/09/02	14.3		2023/09/01		2023/09/01		0.771		

Planet	Max	Elon	D	Max	E	RA	Dec	Br	Mag	D	Br	Mag	Min	Dist	D	Min	Dist
4226	2023/09/07	172.4°	22h48m	+	0°	2023/09/07	13.5	2023/09/06	1.127								
1407	2023/09/11	168.7°	23h 1m	+	5°	2023/09/13	12.7	2023/09/17	1.041								
3127	2023/09/11	172.5°	23h 3m	+	2°	2023/09/10	14.4	2023/09/06	1.108								
545	2023/09/12	175.3°	23h11m	-	0°	2023/09/11	12.5	2023/09/06	1.762								
6572	2023/09/13	177.2°	23h29m	-	6°	2023/09/13	13.7	2023/09/08	0.880								
800	2023/09/14	175.8°	23h20m	+	0°	2023/09/13	12.7	2023/09/06	0.805								
8356	2023/09/14	175.9°	23h27m	-	7°	2023/09/14	14.1	2023/09/23	0.854								
1187	2023/09/16	171.2°	23h21m	+	5°	2023/09/17	13.7	2023/09/22	1.179								
1525	2023/09/16	168.6°	23h18m	+	7°	2023/09/16	14.3	2023/09/13	0.996								
709	2023/09/18	165.8°	23h25m	+11°		2023/09/18	12.6	2023/09/16	1.604								
1694	2023/09/18	171.7°	23h51m	-	9°	2023/09/19	12.6	2023/09/21	0.791								
55	2023/09/21	177.3°	23h57m	-	3°	2023/09/21	10.5	2023/09/22	1.372								
4729	2023/09/21	175.2°	23h43m	+	3°	2023/09/21	14.3	2023/09/23	0.850								
602	2023/09/23	166.6°	23h45m	+12°		2023/09/24	11.2	2023/09/25	1.335								
1659	2023/09/23	167.5°	23h44m	+11°		2023/09/23	12.3	2023/09/24	1.078								
1227	2023/09/25	179.2°	0h 7m	+	1°	2023/09/25	13.7	2023/09/19	1.804								
368	2023/09/27	171.3°	23h57m	+	9°	2023/09/26	13.3	2023/09/21	1.560								
429	2023/09/27	170.0°	23h57m	+10°		2023/09/28	12.6	2023/09/29	1.315								
2569	2023/09/27	160.3°	0h44m	-16°		2023/09/28	14.0	2023/09/29	1.261								
4288	2023/09/27	162.4°	0h34m	-15°		2023/09/27	14.4	2023/09/27	1.189								
542	2023/09/28	169.1°	0h38m	-	7°	2023/09/28	12.6	2023/09/27	1.500								
2374	2023/09/28	172.0°	0h 6m	+	9°	2023/09/28	14.5	2023/09/26	1.424								
4860	2023/09/28	167.9°	0h 1m	+13°		2023/09/27	14.5	2023/09/25	1.264								
1369	2023/09/30	177.5°	0h27m	+	0°	2023/09/29	14.1	2023/09/22	1.670								
1662	2023/09/30	175.6°	0h18m	+	6°	2023/09/30	13.9	2023/10/02	1.303								
4265	2023/09/30	172.3°	0h36m	-	4°	2023/09/30	14.5	2023/09/29	0.946								
492	2023/10/01	178.3°	0h32m	+	1°	2023/10/01	13.0	2023/09/27	1.587								
2831	2023/10/01	170.8°	0h41m	-	5°	2023/09/30	13.8	2023/09/27	0.795								
678	2023/10/02	168.2°	0h11m	+14°		2023/10/03	11.2	2023/10/06	1.076								
3921	2023/10/03	165.1°	1h 5m	-	8°	2023/10/03	14.4	2023/10/02	0.907								
428	2023/10/04	178.3°	0h39m	+	2°	2023/10/04	12.9	2023/10/06	0.918								
154244	2023/10/12	176.7°	1h01m	+10°		2023/08/06	13.8	2023/08/05	0.064								
15127	2023/10/13	167.1°	0h57m	+20°		2023/10/12	14.5	2023/10/09	1.197								
459	2023/10/14	176.9°	1h20m	+	5°	2023/10/14	12.5	2023/10/17	1.112								
717	2023/10/20	178.0°	1h33m	+11°		2023/10/20	13.7	2023/10/15	1.334								
1066	2023/10/26	172.7°	1h52m	+19°		2023/10/25	14.2	2023/10/20	0.953								
4608	2023/10/28	176.8°	2h13m	+10°		2023/10/28	14.1	2023/10/29	0.858								
26853	2023/10/29	170.8°	2h16m	+	4°	2023/10/28	14.2	2023/10/24	0.978								
343	2023/10/30	179.7°	2h17m	+13°		2023/10/30	12.7	2023/10/31	0.871								
164121	2023/10/31	129.2°	1h20m	-34°		2023/11/02	12.1	2023/11/03	0.059								
538	2023/11/01	169.9°	2h35m	+	4°	2023/10/31	12.9	2023/10/28	1.683								
18	2023/11/05	159.2°	3h 7m	-	4°	2023/11/03	8.1	2023/10/30	0.859								
1362	2023/11/10	137.0°	3h32m	-25°		2023/11/03	14.1	2023/10/31	1.203								
1429	2023/11/10	179.8°	2h59m	+16°		2023/11/10	13.9	2023/10/26	0.943								
817	2023/11/13	159.7°	3h32m	-	1°	2023/11/13	13.4	2023/11/12	1.165								
598	2023/11/14	165.0°	3h27m	+	3°	2023/11/13	12.0	2023/11/08	1.137								
144	2023/11/16	176.6°	3h28m	+15°		2023/11/16	10.1	2023/11/09	1.142								
2699	2023/11/16	174.4°	3h26m	+13°		2023/11/15	14.4	2023/11/10	1.336								
882	2023/11/17	176.0°	3h22m	+22°		2023/11/16	13.3	2023/11/11	1.367								
1419	2023/11/17	175.9°	3h33m	+14°		2023/11/17	13.0	2023/11/20	1.004								
3958	2023/11/19	173.1°	3h29m	+26°		2023/11/18	14.0	2023/11/15	0.976								
182	2023/11/21	177.0°	3h49m	+16°		2023/11/21	10.7	2023/11/20	0.977								
481	2023/11/21	177.6°	3h47m	+17°		2023/11/21	11.2	2023/11/20	1.321								
503	2023/11/24	178.9°	3h58m	+19°		2023/11/24	11.8	2023/11/28	1.382								
988	2023/11/24	179.1°	3h56m	+21°		2023/11/24	14.2	2023/11/17	1.532								
1133	2023/11/24	179.3°	3h57m	+21°		2023/11/24	13.5	2023/11/16	0.916								
1196	2023/11/27	161.5°	4h18m	+	2°	2023/11/25	13.4	2023/11/20	1.387								
1283	2023/11/28	165.6°	4h22m	+	6°	2023/11/26	13.8	2023/11/22	1.580								
4222	2023/11/28	174.2°	4h21m	+15°		2023/11/28	13.0	2023/11/27	0.680								
95	2023/11/30	178.3°	4h24m	+19°		2023/11/30	11.2	2023/11/27	1.661								
758	2023/11/30	174.6°	4h28m	+16°		2023/11/30	11.8	2023/11/29	1.737								
765	2023/12/04	168.9°	4h33m	+33°		2023/12/03	14.0	2023/11/26	0.903								
485	2023/12/05	159.0°	5h 0m	+	1°	2023/12/07	11.3	2023/12/09	1.332								
4349	2023/12/10	175.8°	5h 8m	+18°		2023/12/10	14.2	2023/12/01	1.248								
5090	2023/12/12	163.4°	5h19m	+	6°	2023/12/09	14.5	2023/11/29	1.065								
4797	2023/12/13	177.0°	5h18m	+26°		2023/12/13	14.4	2023/12/07	1.060								
2397	2023/12/16	165.3°	5h34m	+	8°	2023/12/16	14.4	2023/12/16	1.584								
37	2023/12/18	174.5°	5h42m	+28°		2023/12/18	9.7	2023/12/16	1.211								
704	2023/12/18	173.0°	5h37m	+30°		2023/12/17	9.9	2023/12/13	1.850								
899	2023/12/18	175.1°	5h43m	+18°		2023/12/17	13.4	2023/12/11	1.593								
776	2023/12/20	175.6°	5h51m	+27°		2023/12/19	11.1	2023/12/15	1.661								
9	2023/12/22	176.1°	6h 2m	+27°		2023/12/22	8.4	2023/12/21	1.119								
353	2023/12/27	178.5°	6h24m	+21°		2023/12/27	12.4	2023/12/19	0.919								
5747	2023/12/29	173.5°	6h21m	+29°		2023/12/28	13.8	2023/12/28	0.839								
139622	2024/02/10	141.4°	9h56m	+52°		2023/12/10	14.1	2023/12/06	0.037								

Table III. Numerical list of approaches closer than 0.3 AU

Planet	Max	Elon	D	Max	E	RA	Dec	Br	Mag	D	Br	Mag	Min	Dist	D	Min	Dist
4486	2023/02/17	171.0°	10h20m	+19°		2023/03/20	14.5	2023/04/11	0.163								
6037	2023/08/05	157.8°	21h13m	+	4°	2023/08/19	14.3	2023/08/23	0.041								
37638	2023/03/15	157.4°	11h13m	+24°		2023/02/25	14.6	2023/02/21	0.044								
88264	2023/07/07	177.1°	18h51m	-22°		2023/07/08	14.3	2023/07/19	0.175								
139622	2024/02/10	141.4°	9h56m	+52°		2023/12/10	14.1	2023/12/06	0.037								
154244	2023/05/21	174.2°	16h01m	-14°		2023/08/06	13.8	2023/08/05	0.064								
154244	2023/10/12	176.7°	1h01m	+10°		2023/08/06	13.8	2023/08/05	0.064								
164121	2023/10/31	129.2°	1h20m	-34°		2023/11/02	12.1	2023/11/03	0.059								
199145	2023/02/06	155.6°	10h29m	-	1°	2023/02/14	13.2	2023/02/16	0.031								