



Date	UT	Occulting Body	Star	Mag.	RA (2000)			Dec		Dur.		Path
					h	m	s	°	'	"	ΔMag.	
Mar.17	03:31	3200 Phaethon	TYC 1219-01612-1	10.1	02 32 41.3	+18 16 41	7.4	0.27			BC-KY	
Apr. 9	08:43	99942 Apophis	TYC 5782-01139-1	8.5	21 02 38.3	-14 07 51	11.8	0.02			MS-SC	
Apr.26	04:57	163693 Atira	TYC 3769-00890-1	10.8	06 37 06.1	+54 57 57	7.3	0.11			CA-Baja	
Apr.30	00:24	163693 Atira	TYC 3771-01267-1	10.3	06 56 27.8	+54 55 53	7.9	0.11			ON-NY	
Aug.16	08:36	3122 Florence	TYC 2463-00303-1	9.9	07 12 22.4	+37 22 46	7.4	0.11			FL-NL	
Sep. 3	10:44	65803 Didymos	TYC 6989-00024-1	10.4	00 11 53.9	-30 58 01	4.8	0.19			Baja-GA	
Oct. 3	10:49	3200 Phaethon	TYC 3312-02354-1	11.4	03 26 00.4	+46 18 30	6.3	0.29			Cuba-Baja	
Oct. 9	01:58	3200 Phaethon	TYC 3310-01992-1	10.7	03 10 44.9	+46 16 50	6.8	0.26			MB-Baja	
Oct.15	07:05	65803 Didymos	UCAC4 395-013761	10.4	06 28 25.0	-11 02 05	4.9	0.16			AZ-ON	
Oct.18	00:30	3200 Phaethon	UCAC4 678-015381	10.8	02 43 32.7	+45 31 21	6.6	0.23			NL-Cuba	
Oct.21	10:13	65803 Didymos	TYC 4818-00021-1	9.3	07 04 46.4	-03 41 43	6.3	0.18			BC	
Nov. 6	07:14	65803 Didymos	TYC 0780-01085-1	10.4	07 59 40.9	+09 07 48	5.7	0.27			DR-NL	
Nov. 8	10:44	65803 Didymos	TYC 0785-01766-1	10.5	08 04 12.1	+10 23 02	5.6	0.28			Mex-ON	
Nov.10	05:34	3200 Phaethon	UCAC4 647-005831	11.8	01 35 45.5	+39 21 32	5.6	0.22			AB-WA	
Nov.14	10:32	65803 Didymos	TYC 0806-00754-1	10.2	08 14 07.4	+13 30 54	6.0	0.33			FL-NL	
Nov.16	07:59	65803 Didymos	HIP 40525	9.3	08 16 30.0	+14 24 43	6.9	0.34			DR-NL	
Nov.26	07:39	1866 Sisyphus	TYC 3020-00440-1	11.5	12 29 18.8	+41 51 25	5.8	0.29			Mex-ON	
Dec.29	06:46	65803 Didymos	UCAC4 595-042049	10.6	07 48 47.5	+28 55 57	5.8	0.25			Cuba-Baja	

Above is the map of 2022 NEA occultations that's in the Handbook, and the corresponding table of information about each of the plotted occultations. The orbital elements are all from the NASA JPL Horizons Web site at <https://ssd.jpl.nasa.gov/horizons.cgi> and the stellar data are from the Early third release (EDR3) of the European Space Agency's Gaia mission, as implemented with UCAC4, Tycho, and Hipparcos catalog identifiers with IOTA's free *Occult* software.

The successive columns in the table list: (1) the date and central time of the event; (2) the name of the occulting body; (3) the catalogue and number of the occulted star; (4) the star's apparent visual magnitude; (5) the star's right ascension and (6) declination; (7) the expected magnitude change from the combined brightness; (8) the predicted maximum duration of the occultation in seconds; and, (9) the path location specified by the lands crossed by the eastern and western ends of the path shown on the map. The two-letter abbreviations for the US States and Canadian Provinces are given, with the order indicating the direction of motion of the shadow. "Baja" is Baja California, either Norte or Sur, while "Mex" denotes the rest of Mexico. Note that the times are for the geocentric time of closest approach; for any specific location in North America, the event time can be several minutes earlier or later.

As noted above for Didymos, when a NEA occultation is first observed, it generally must be done by a large team of observers to cover the relatively large uncertainty zone. But after one occultation is observed, that data can refine the orbit to allow more accurate prediction of future events that can then be covered by only a few observers.

Some information about the occulting NEAs portrayed above is given below:

**(1866) Sisyphus:** Observations of occultations by this large NEA would be valuable since Sisyphus is out of radar range for at least the next 20 years. IOTA plans a large campaign for the only event on November 26<sup>th</sup>.

**(3122) Florence:** 2017 radar observations show that Florence has two moons, one about 200m across and about 5 km away, while the other is a little more than 300m across and about 10 km away.

**(3200) Phaethon:** The paths should be quite accurate, with the orbit well-determined from the 2019 and

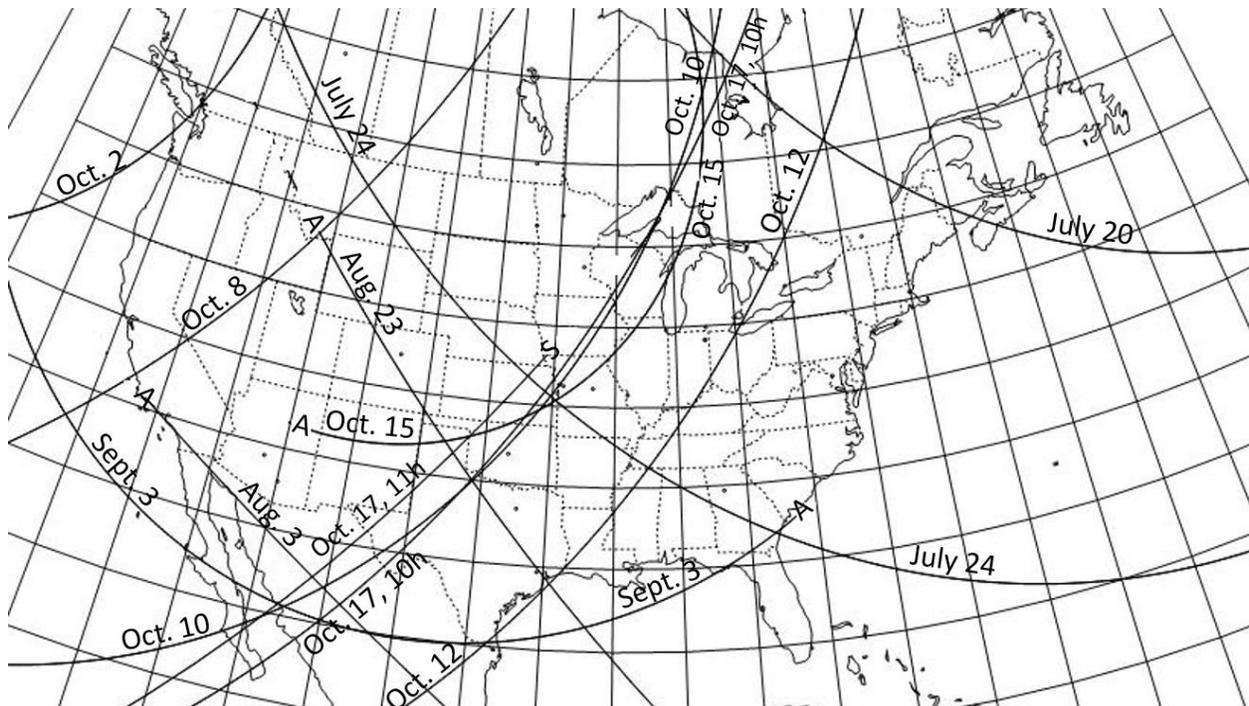
2020 occultations. But more observations are desired, to check for variations in Phaethon's non-gravitational forces caused by mass shedding (Geminid meteoroids) from its extreme thermal environment.

**(65803) Didymos:** The occultations by Didymos have the highest priority since NASA's DART mission plans to impact Dimorphos, Didymos' 160m moon that is 1.2 km away, on September 26<sup>th</sup>. Once a first occultation is observed, the following ones can be predicted more accurately; then, especially valuable would be any observations of occultations by Dimorphos as well as by Didymos, to help measure the effect of the DART impact. The 6.6-km/sec impact is expected to change the orbital period of Dimorphos around Didymos by several minutes. Besides the events in North America, there is also an occultation of a 12.4-mag. star that will occur over the southern part of Hawaii Island on September 15 at 13:20 UT. Below are more predictions for occultations by Didymos.

**(99942) Apophis:** Unfortunately, all of the occultations by Apophis in 2022 are very short, lasting only 0.02s. Thus, the only event that might be observed is the bright one (star mag. 8.5) shown, on April 9. The altitude is low, at best 10° on the Atlantic coast near Savannah, Georgia.

**(163693) Atira:** Atira has an approximately 1-km moon orbiting perhaps 6 km from the primary.

### Occultations by (65803) Didymos in North America to Oct. 17, 2022



Occultations by (65803) Didymos (diam. 0.8 km) in 2022 to Oct. 17 and to mag. 12.0

Date	U.T.	Diam.	Durn	Star	dMag	Elon	Star	d RUWE	Moon	Star R.A. (J2000)	Dec.	Path
m d	h m	"	sec	mag		o	No.	<1.4	Dist ill	h m s	o ' "	
Jul 20	7 19	0.003	0.18s	11.2	6.8	144	UCAC4 354-192857	W 1.10	52 53	22 31 50.718	-19 19 14.00	ON-NS
Jul 24	8 48	0.003	0.19s	11.7	6.0	146	TYC 6389-01164-1	1.25	100 16	22 37 58.052	-19 47 29.20	AB-GA
Aug 3	5 42	0.004	0.21s	11.5	5.6	151	UCAC4 344-200889	1.15	142 27	22 53 26.421	-21 22 31.71	CA-Mex
Aug 23	6 9	0.006	0.21s	11.9	4.0	155	TYC 6983-01234-1	1.05	121 15	23 34 0.807	-26 45 57.35	MT-TX
Sep 3	10 49	0.008	0.19s	10.4	4.8	150	TYC 6989-00024-1	1.20	100 47	0 11 53.866	-30 58 1.44	Baja-GA
Oct 2	10 56	0.015	0.13s	11.3	3.3	115	TYC 6470-00344-1	D 0.85	119 44	4 28 37.288	-28 32 9.25	WA-BC
Oct 8	12 23	0.015	0.14s	11.3	3.6	107	TYC 5924-00164-1	V 4.90	83 98	5 32 52.757	-20 31 3.36	CA-MB
Oct 10	9 31	0.015	0.14s	11.4	3.6	105	TYC 5922-00731-1	2.00	69 100	5 50 6.221	-17 49 23.11	Baja-ON
Oct 12	9 51	0.015	0.15s	11.9	3.3	103	UCAC4 376-011231	1.05	55 93	6 6 55.894	-14 57 49.89	Mex-QC
Oct 15	7 3	0.014	0.16s	10.4	4.9	101	UCAC4 395-013761	1.20	40 72	6 28 24.994	-11 2 4.64	AZ-ON
Oct 17	10 26	0.013	0.16s	11.7	3.7	100	TYC 5378-02094-1	0.85	37 53	6 42 22.253	- 8 18 7.19	Baja-ON
Oct 17	11 46	0.013	0.16s	11.8	3.6	100	UCAC4 409-017214	s 0.95	37 52	6 42 40.991	- 8 14 2.37	Baja-ON

Times are for a point near the center of the path; they will be a few minutes earlier or later for other locations along the path. Listed diam. is in arc seconds.  
 RUWE is a measure of the astrometric reliability of the Gaia astrometric data for the star. Values >1.4 means that the astrometric data probably have large errors so the event is unsuitable for mobile efforts.  
 An entry under "d" indicates probable duplicity or variability of the star. "ill" is the percent of the Moon that is sunlit.

The map and table above augment the RASC Handbook NEA maps near the top of this page, to show only occultations by (65803) Didymos with mag. <12.0, to show more of the observable Didymos occultations. The map was too cluttered to show all of these Didymos events to the end of the year; another map will be posted here later, to show the 24 such occultations that will occur from 2022 Oct. 18 to 2023 Jan. 1. Paths only over Cuba or in the ocean in the southeastern part of the map were removed. Here is a PowerPoint file for a presentation about Didymos occultations that David gave at a meeting of NASA's Small Bodies Assessment Group (SBAG) in late January. [[DunhamDidymosOccultationsNew.pptx](#)]

The maps were produced with IOTA's free *Occult* software; see <http://www.lunar-occultations.com/iota/occult4.htm>. You can download and use this software and use it to compute your own local lists and information about these and many other occultations. The information for doing this is at <http://www.lunar-occultations.com/iota/2022iotapredictions.pdf>. This describes a prediction input file for planetary and asteroidal files called **All2002.xml**. You can use that file to generate local predictions, but you can replace it with the other files listed below to generate predictions for more occultations, mainly of fainter stars than shown on the maps, or for other parts of the world:

**2022NA-NEAs.xml** – This is the input for the 18 occultations by NEAs in North America listed in the first table above, plus the 2023 Jan. 1<sup>st</sup> Didymos occultation shown on the map.

**2022WorldDidymosToMag13.xml** – This is an input for the 1259 occultations by Didymos worldwide to mag. 13.0. The fainter events will be more difficult to observe, so you might want to set the magnitude limit to, for example, 12.0; there are 563 events worldwide to that limit.

**2022World-NEAminusPhaethonToMag14.xml** – This is an input for 4713 occultations by all of NEA's described above worldwide to mag. 14.0, but excluding (3200) Phaethon, due to the special precautions needed to compute its occultations caused by the high eccentricity of its orbit. The Didymos occultations before July, and all of the Apophis occultations, have very short durations, making them very difficult to observe.

**2022WorldPhaethonEarly.xml** – This is an input for 5 occultations by Phaethon worldwide to mag. 13.0 during early 2022, before its perihelion passage on May 15.

**2022WorldPhaethonLateToMag13.xml**– This is an input for 24 occultations by Phaethon worldwide to mag. 13.0 during late 2022, after its perihelion passage on May 15.

For worldwide occultations by major and minor planets worldwide for the whole year, use the **All2002.xml** file noted above, but even more occultations can be found with Occult Watcher (it is also limited to the next two months); links to it are given above.

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