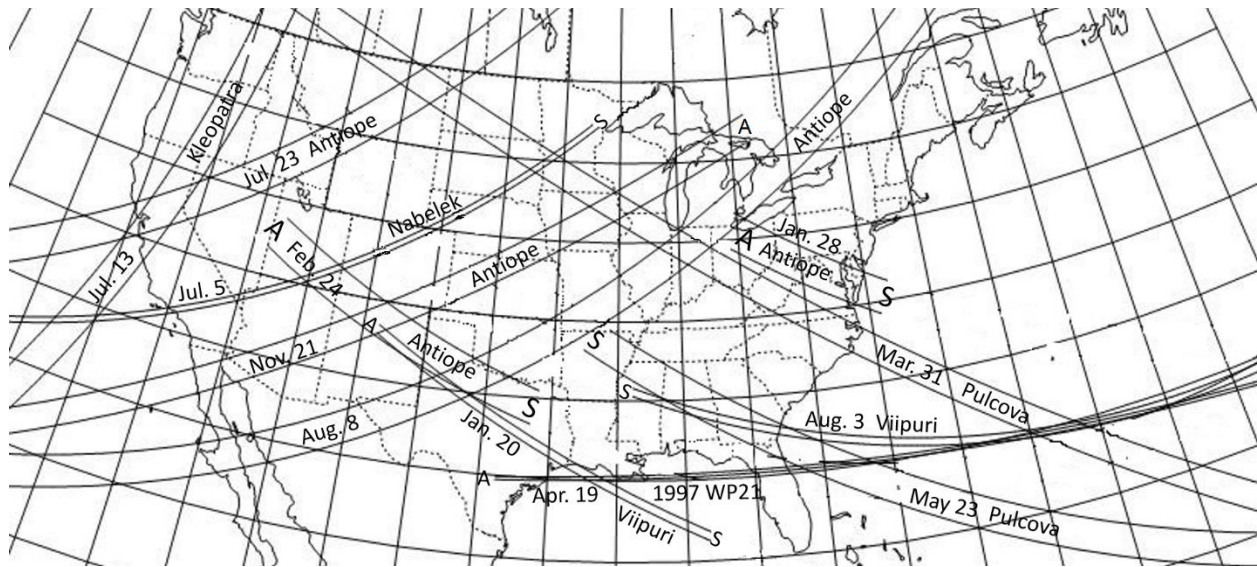


## 2022 Occultations by Special Main-Belt Asteroids

The map, and the corresponding table, similar to those of the previous subsections, shows the paths for occultations of a selected group of Main-Belt asteroids that will be occulted in 2022. These are objects that have unusual shapes, or known or suspected significant moons, for which new observations will be valuable to better characterize them.

A good example of a successful campaign for an occultation by an unusual main-belt asteroid was the discovery and confirmation of the large moon of (4337) Arecibo by occultations in 2021 described at <https://occultations.org/publications/rasc/2022/AreciboMoonAccount.pdf>, adopted from an article that was published in the October 2021 issue of *Stardust*, publication of the National Capital Astronomers. We hope to have some further special-object successes in 2022, with the opportunities portrayed below; unfortunately, there are no opportunities with Arecibo in North America in 2022, but there are some chances in other parts of the world.

### The best occultations of stars by Special Main-Belt Asteroids in North America during 2022



Date	UT	Occulting Body	Star	Mag.	RA (2000)	Dec	$\Delta$ Mag.	Dur.	Path
					h m s	° ' "			
Jan 20	12:12	2258 Viipuri	Gaia 174049.8-241757	13.3	17 40 49.8	-24 17 57	4.5	0.9	NM-LA
Jan 28	11:24	90 Antiope	UCAC4 332-153057	13.4	18 22 39.7	-23 45 24	1.0	2.7	OH-VA
Feb 24	12:12	90 Antiope	UCAC4 335-198707	12.4	19 10 13.1	-23 06 02	1.7	3.1	UT-TX
Mar 31	01:18	762 Pulcova	UCAC4 562-038652	13.3	07 07 47.8	+22 19 58	0.8	9.9	IL-NC
Apr 19	01:46	33074 1997 WP21	UCAC4 467-051017	13.2	15 14 00.3	+03 13 51	4.2	1.4	FL-TX
May 23	02:06	762 Pulcova	TYC 1380-01148-1	10.1	08 05 48.2	+17 48 11	3.7	4.3	AR-FL
Jul 5	09:47	4552 Nabelek	TYC 0637-00163-1	11.3	02 21 21.5	+14 47 33	6.8	0.2	CA-MN
Jul 13	09:10	216 Kleopatra	UCAC4 512-137831	14.0	23 09 46.6	+12 22 20	0.1	17.2	CA-AB
Jul 23	09:54	90 Antiope	UCAC4 347-187017	13.9	20 52 47.1	-20 38 05	0.1	13.2	ON-CA
Aug 3	01:34	2258 Viipuri	UCAC4 334-192515	13.3	18 56 14.7	-23 23 06	3.2	2.8	GA-AL
Aug 8	07:22	90 Antiope	TYC 6343-01777-1	9.2	20 40 17.3	-21 34 20	2.6	13.1	NL-Baja
Nov 21	03:10	90 Antiope	TYC 6351-01431-1	10.0	21 12 37.3	-18 23 42	3.6	4.6	Baja-ON

The map, and the corresponding table, similar to those for main-belt and other types of occultations published in the *RASC Observer's Handbook for 2022*, shows the paths for occultations of some of the better distant-object occultations during 2022. The version of the table in the printed Handbook has an extraneous "J" in front of "Jan" in the line for the first event that has been whited out here. Also, ignore the "N" after "Baja" at the end of the last entry of the table. 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.

With fewer objects than considered for the brighter Main Belt occultations, occultations of fainter stars had to be considered, so these usually require larger telescopes to observe. But three of the stars are relatively bright, one almost reaching the bright Main Belt list. Information about the special objects we considered is given below:

**(16) Psyche:** The largest M-class (metallic) asteroid and target of a NASA mission. No occultations of stars brighter than mag. 14 in North America in 2022.

**(90) Antiope:** This is a binary asteroid, with each component just under 90 km across.

**(216) Kleopatra:** This is the "Dog-bone" asteroid, the 2<sup>nd</sup>-largest M-class (metallic) asteroid, and has two small moons.

**(294) Felicia:** A recent occultation shows this has an unusual shape, but no <14<sup>th</sup> mag. events in N. Amer.

**(234) Barbara:** This is probably a contact binary asteroid, possibly detached but very close. It is the prototype for the "Barbarian" asteroids that display a strong infrared absorption band at 2 $\mu$ m. No occultations of stars brighter than mag. 14 in North America in 2022.

**(513) Centesima:** A 2021 occultation showed this is probably a peanut-shaped asteroid. No occultations of stars brighter than mag. 14 in North America in 2022.

**(762) Pulcova:** Pulcova is 137 km across and has a 15-km moon orbiting 800 km away with a 4-day period.

**(2258) Viipuri:** Viipuri, 26 km across, may have a 5+ km moon with events recorded in 2013 and 2018 occultations.

**(4337) Arecibo:** New discovery of large moon from 2021 occultations; see the 2<sup>nd</sup> paragraph near the top of the page. Unfortunately, there will be no occultations of stars brighter than mag. 16 in North America in 2022. But there will be occultations in other parts of the world, with the brightest being of an 11.2-mag. star visible from Tasmania on Nov. 13.

**(4552) Nabelek:** This was thought to be 6 km across, but a recent paper argues that it is much larger, about 20 km.

**(33074) 1997 WP21:** This object, 18 km across, may have a 9 km moon with events recorded in a 2021 occultation.

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. Since the orbits are often updated, for any event noted here, you should check to see if there is a more recent and more accurate prediction for the event at IOTA's main asteroidal occultation prediction Web

site at <https://www.asteroidoccultation.com/> .

The above objects were the ones we decided upon in August last year when we computed the predictions. But other unusually-shaped asteroids, mostly apparently peanut-shaped objects that produced two occultations for some observers, have come to light in subsequent months and will be included in the predictions for 2023, including (398) Admete, (885) Ulrike, (1721) Wells, (14758) 6519 P-L, and (243267) 2008 AM10 . We'll also add (3825) Nürnberg, (3819) Robinson, and (21976) 1999 XV2, which, like (4552) Nabelek, are expected to be larger than the standard thermal IR models predict, according to "Probabilistic Modeling of Asteroid Diameters from Gaia DR2 Errors" in Research Notes of the AAS, Aug. 2021, DOI: 10.3847/2515-5172/ac205e, by Rafael S. de Souza et al. Let us know of any other asteroids that you think should be added to the Main-Belt special asteroids list.

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-MBspecialFinal.xml** – This is the input for the 12 special main-belt occultations for North America shown on the main (top) map above.

**2022WorldMBspecial.xml** – This is the input for 511 occultations worldwide by selected special main-belt asteroids of stars to mag. 14.

**2022WorldAreciboToMag16.xml** – This is the input for 62 occultations worldwide by (4337) Arecibo of stars to mag. 16.

**2022WorldToMag14Viipuri.xml** – This is the input for 149 occultations worldwide by (2258) Viipuri of stars to mag. 14.

**2022World1997WP21.xml** – This is the input for 29 occultations worldwide by (33074) 1997 WP21 of stars to mag. 14.

**2022WorldNabelskToMag14.xml** – This is the input for 59 occultations worldwide by (4552) Nabelsk of stars to mag. 14.

For worldwide occultations by major and all types of minor planets (mainly main-belt) worldwide for the whole year, fairly comprehensive only to about mag. 12.5, 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); it is a free download from <http://www.occultwatcher.net/> .

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