

NEA, Trojan, special Main Belt, and Quaoar Occultations in 2023

David Dunham, IOTA meeting,
2022 Aug. 14; updated 2022 Sept. 4

Near-Earth Asteroids

(433) Eros: To improve the post-NEAR-Shoemaker orbit.

(1620) Geographos:

(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.

(2102) Tantalus: 2-4km PHA asteroid. Check for its occultations.

(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.

(4179) Toutatis:

(29886) Randytung: Possible Hera secondary target.

(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 30th. 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. Describe ACROSS and get their latest orbit from OW cloud.

(95802) Francismuir: Possible Hera secondary target.

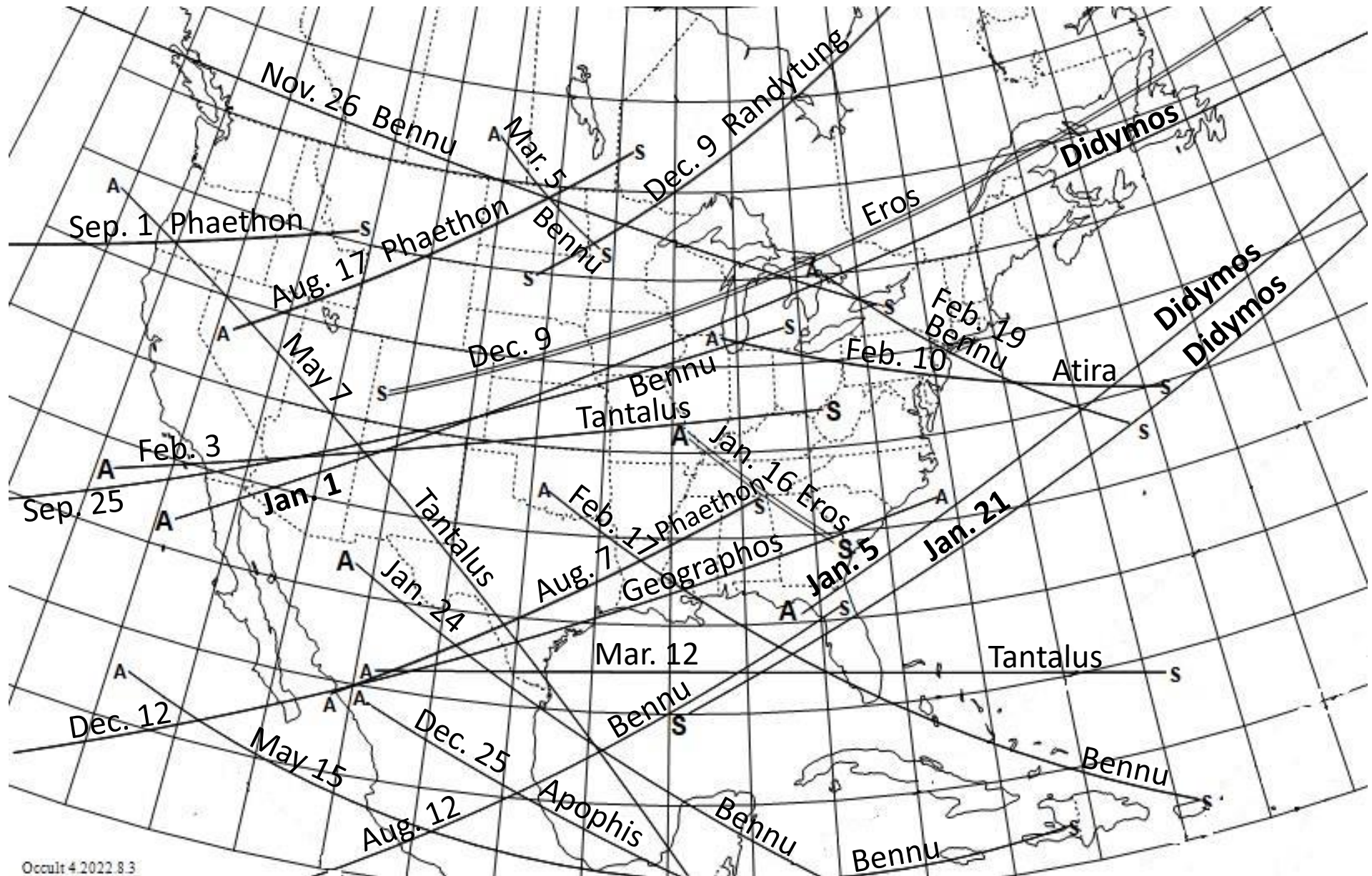
(99942) Apophis: Unfortunately, all of the occultations by Apophis in 2023 are very short, lasting only 0.02s. Thus, the only event that might be observed is the bright one (star mag. 8.5) shown, on April 9. The altitude is low, at best 10° on the Atlantic coast near Savannah, Georgia.

(101955) Bennu: OSIRIS-REx target.

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

The above are the objects used in my 2023 NEA occultation search, but some of them did not produce any 2023 occultations over North America of stars brighter than my mag. 12 limit.

Occultations by NEAs in North America during 2023 to mag. 12.0 (to mag. 13.0 for Phaethon)



Occultations by NEAs in North America during 2023 to mag. 12.0 (to mag. 13.0 for Phaethon)

Date	UT	Occulting	Body	Star	Mag	R.A.(2000) h m s	Dec. ° ' "	ΔMag	Dur. s Path
Jan	1 01:41	65803	Didymos	HIP 37693	9.0	07 43 59.0	+29 24 22	7.4	0.20 NL-Baja
Jan	5 23:47	65803	Didymos	TYC 2453-00085-1	11.4	07 35 47.5	+30 04 10	5.1	0.26 FL
Jan	16 11:30	433	Eros	UCAC4 301-121701	11.6	17 13 08.6	-29 56 10	2.6	0.41 IL-GA
Jan	22 00:16	65803	Didymos	TYC 2451-01892-1	9.1	07 16 02.8	+30 50 49	8.3	0.41 FL
Jan	24 10:50	101955	Bennu	TYC 6813-00643-1	11.3	16 47 08.2	-25 09 32	12.5	0.01 Mex
Feb	3 11:29	2102	Tantalus	TYC 1592-00588-1	11.1	18 55 49.6	+19 17 25	7.2	0.09 CA-WV
Feb	10 10:12	163693	Atira	UCAC4 398-105724	10.5	18 58 07.3	-10 30 17	7.9	0.06 IL-NJ
Feb	17 10:13	101955	Bennu	TYC 6850-01892-1	9.0	18 02 49.1	-27 22 21	14.8	0.05 OK-PR
Feb	19 10:08	101955	Bennu	UCAC4 313-159522	12.0	18 09 08.2	-27 27 23	11.8	0.01 ON-NY
Mar	5 12:01	101955	Bennu	TYC 6868-01265-1	10.7	18 53 34.2	-27 36 47	13.0	0.01 SK-MN
Mar	12 09:43	2102	Tantalus	TYC 1072-01065-1	11.0	20 06 50.9	+08 58 57	7.6	0.10 Mex-BS
May	7 10:14	2102	Tantalus	HIP 106281	8.4	21 31 35.0	-11 56 18	10.0	0.11 OR-Mex
May	15 09:26	101955	Bennu	TYC 6388-00279-1	11.1	22 29 26.9	-17 59 53	12.0	0.01 Mex-HT
Aug	7 09:53	3200	Phaethon	UCAC4 587-029902	12.9	06 27 01.2	+27 17 38	5.1	0.13 Mex-AL
Aug	12 10:01	101955	Bennu	TYC 1253-00686-1	10.3	03 53 35.9	+17 04 52	11.6	0.02 Mex-FL
Aug	17 09:36	3200	Phaethon	UCAC4 582-034437	12.6	06 55 59.8	+26 13 24	5.1	0.12 NV-ON
Sep	1 11:40	3200	Phaethon	UCAC4 567-040387	12.6	07 47 40.0	+23 19 16	4.6	0.11 OR-MT
Sep	25 10:27	101955	Bennu	UCAC4 582-040467	11.4	07 58 18.8	+26 13 27	10.8	0.02 CA-MI
Nov	26 11:08	101955	Bennu	TYC 287-00022-1	11.0	12 14 54.7	+05 44 37	11.5	0.01 BC-NY
Dec	9 00:12	29886	Randytung	UCAC4 396-133733	11.1	22 20 24.9	-10 51 06	9.4	0.13 SD-QC
Dec	9 00:49	433	Eros	TYC 5211-00132-1	11.3	21 54 44.7	-01 46 28	2.5	0.74 CO-NL
Dec	12 02:28	1620	Geographos	UCAC4 398-133629	11.2	21 18 14.5	-10 25 25	7.1	0.07 Baja-SC
Dec	25 11:24	99942	Apophis	TYC 6195-00365-1	11.1	15 54 06.7	-20 07 58	10.3	0.01 Mex

Near-Earth Asteroid (NEA) Occultations to mag. 12.0, but to mag. 13.0 for Phaethon

Date	U.T.	Diameter	Durn	Star	Mag-Drop	Elon	%	Star	d	Rely	Planet	Min	Moon
m d	h m	km "	sec/m	mag	V R *	o Ill	o Ill	No.	<1.4		No Name	D Error	Dist ill
Jan 1	1 13.8	0.78 0.004	0.25s	9.0	7.6 7.7	165		HIP 37693	s	1.25	65803 Didymos	0.20 ±0.00	79 70
Jan 5	23 14.6	0.80 0.004	0.26s	11.4	5.2 5.5	170		TYC 2453-00085-1		0.95	65803 Didymos	0.18 ±0.00	17 99
Jan 6	8 35.0	0.80 0.004	0.26s	10.8	5.8 5.8	170		TYC 2453-00503-1		1.40	65803 Didymos	0.71 ±0.00	12 100
Jan 16	11 32.4	17 0.011	0.40s	11.6	2.2 3.0	37		UCAC4 301-121701	s	0.85	433 Eros	0.67 ±0.00	37 36
Jan 16	13 0.3	0.80 0.003	0.32s	11.6	5.6 5.9	168		TYC 2452-01843-1		0.90	65803 Didymos	0.82 ±0.00	116 35
Jan 21	23 33.3	0.77 0.003	0.41s	9.1	8.5 8.2	163		TYC 2451-01892-1	s	1.10	65803 Didymos	0.25 ±0.00	163 0
Jan 24	10 52.9	0.50 0.000	0.01s	11.3	10.7 10.8	50		TYC 6813-00643-1	W	1.30	101955 Bennu	0.39 ±0.04	87 10
Jan 26	9 30.2	1.71 0.002	0.07s	8.7	9.5 9.7	50		TYC 1582-01409-1	s	5.75	2102 Tantalus	0.64 ±0.00	90 27
Feb 3	11 33.5	1.70 0.002	0.07s	11.1	7.2 7.1	48		TYC 1592-00588-1		0.95	2102 Tantalus	0.09 ±0.00	133 95
Feb 6	11 34.5	17 0.011	0.43s	11.9	2.0 2.4	44		UCAC4 300-202533		0.55	433 Eros	0.45 ±0.00	128 99
Feb 10	10 13.9	1.75 0.002	0.06s	10.5	7.9 8.8	38		UCAC4 398-105724	v	0.90	163693 Atira	0.59 ±0.00	91 81
Feb 17	10 16.3	0.52 0.000	0.06s	9.0	0.15 0.15	58		TYC 6850-01892-1	s	0.60	101955 Bennu	0.60 ±0.04	17 12
Feb 19	10 10.0	0.49 0.000	0.02s	12.0	9.9 10.4	58		UCAC4 313-159522	s	0.50	101955 Bennu	0.79 ±0.04	46 1
Mar 5	12 3.0	0.50 0.000	0.02s	10.7	11.0 10.8	63		TYC 6868-01265-1	K	0.90	101955 Bennu	0.91 ±0.03	140 96
Mar 12	9 48.3	1.70 0.002	0.08s	11.0	7.6 7.9	52		TYC 1072-01065-1	s	1.05	2102 Tantalus	0.14 ±0.00	80 78
Apr 17	3 53.5	1.88 0.002	0.07s	11.6	7.1 7.7	59		TYC 2404-00938-1	s	0.95	1620 Geographos	0.88 ±0.00	98 12
May 7	10 18.4	1.73 0.002	0.08s	8.4	10.0 9.9	85		HIP 106281	d	1.05	2102 Tantalus	0.24 ±0.00	73 96
May 15	9 28.0	0.50 0.001	0.02s	11.1	9.6 9.7	82		TYC 6388-00279-1	K	1.05	101955 Bennu	0.69 ±0.02	29 20
Jul 9	0 46.3	1.80 0.001	0.04s	11.6	7.1 7.2	23		TYC 1949-01707-1		1.10	163693 Atira	0.04 ±0.01	124 62
Aug 7	9 56.0	5.0 0.003	0.13s	12.9	5.2 5.2	39		UCAC4 587-029902		0.95	3200 Phaethon	0.32 ±0.00	64 61
Aug 12	10 3.2	0.46 0.001	0.03s	10.3	8.6 9.0	79		TYC 1253-00686-1	s	1.00	101955 Bennu	0.38 ±0.01	37 14
Aug 15	6 30.1	0.46 0.001	0.03s	11.5	7.4 7.9	78		UCAC4 542-008311	s	1.00	101955 Bennu	0.59 ±0.01	67 1
Aug 17	9 38.8	5.0 0.004	0.12s	12.6	5.2 5.5	41		UCAC4 582-034437		1.15	3200 Phaethon	0.55 ±0.00	52 1
Sep 1	11 42.2	5.0 0.004	0.11s	12.6	4.7 4.7	44		UCAC4 567-040387		1.00	3200 Phaethon	0.36 ±0.00	116 97
Sep 25	10 31.5	0.50 0.001	0.03s	11.4	7.4 7.7	65		UCAC4 582-040467		1.00	101955 Bennu	0.32 ±0.01	170 78
Oct 28	22 43.9	1.92 0.002	0.05s	11.0	6.7 7.0	56		UCAC4 322-127122	s	0.75	1620 Geographos	0.46 ±0.00	126 100
Oct 31	23 58.4	1.82 0.002	0.05s	10.3	7.3 7.5	57		UCAC4 325-151345	s	0.60	1620 Geographos	0.31 ±0.00	164 88
Nov 15	22 39.3	1.90 0.002	0.05s	11.5	6.3 6.3	59		TYC 6306-00952-1		2.45	1620 Geographos	0.93 ±0.00	28 8
Nov 26	11 11.5	0.50 0.001	0.02s	11.0	8.5 8.6	63		TYC 287-00022-1		1.00	101955 Bennu	0.38 ±0.02	128 99
Dec 9	0 10.9	3.21 0.002	0.15s	11.1	9.4 9.8	77		UCAC4 396-133733	v	0.75	29886 Randytung	0.75 ±0.00	125 17
Dec 9	0 47.1	17 0.016	0.74s	11.3	2.0 2.3	74		TYC 5211-00132-1		0.95	433 Eros	0.56 ±0.00	121 17
Dec 12	2 26.1	1.90 0.002	0.05s	11.2	1.4 4.8†	59		UCAC4 398-133629	w	1.15	1620 Geographos	0.17 ±0.00	71 1
Dec 22	23 2.0	1.80 0.005	0.14s	11.6	7.3 7.3	31		TYC 7947-00628-1		1.05	163693 Atira	0.05 ±0.00	105 83
Dec 25	11 26.6	0.30 0.000	0.01s	11.1	10.3 10.4	32		TYC 6195-00365-1		1.20	99942 Apophis	0.27 ±0.00	165 97
Dec 26	12 36.4	0.30 0.000	0.01s	11.5	9.9 10.0	32		TYC 6195-00260-1	K	1.25	99942 Apophis	0.89 ±0.00	153 100

Some of these are not included on the map because the path crossed only oceans, or places with no known observers or astronomy clubs. This list has some information that is not included in the list on the previous page.

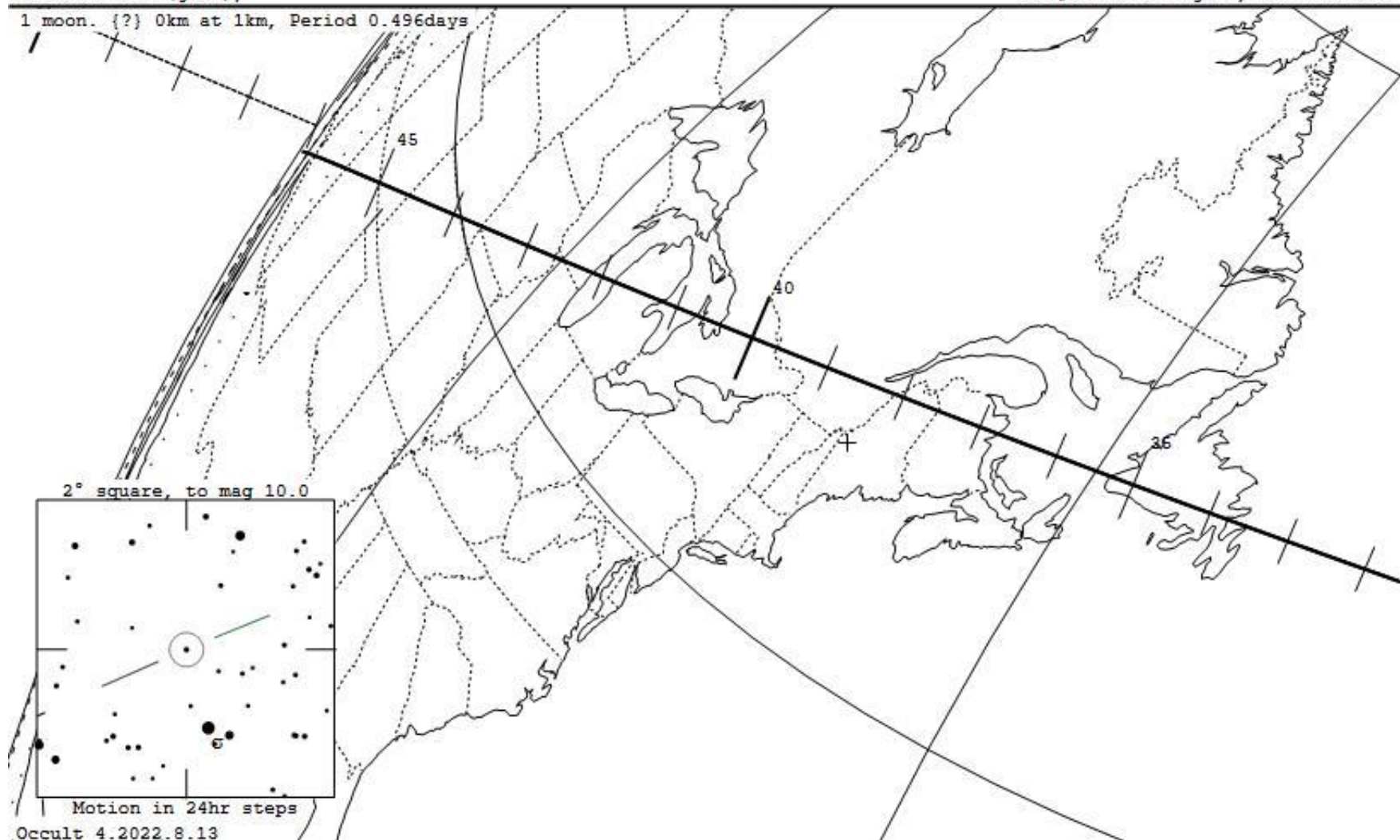
65803 Didymos occults HIP 37693 on 2023 Jan 1 from 0h 42m to 1h 46m UT

Star: (Dia = 0.1 mas)
 Mv 9.0; Mb 9.4; Mr 8.3
 RA = 7 43 58.9874 (astrometric)
 Dec = 29 24 21.677
 [of Date: 7 45 26, 29 21 2]
 Prediction of 2022 Aug 13.2
 Reliable 1.3 (good),

Durations: Max = 0.25 secs
 1km = 0.32 secs, 1mas = 0.061 secs
 Mag Drop: 7.6 [100%]v, 7.7 [100%]r
 Sun : Dist = 165°
 Moon: Dist = 79°, illum = 70%
 Error 17.7 x 6.0 mas in PA 111°

Asteroid:
 Mag = 16.5
 Dia = 0.78 ± 0.10km, 4.1 mas
 Parallax = 33.349"
 Hourly dRA = -4.289s
 dDec = 23.87"
 JPL#185:2022-Aug-03, Known errors

1 moon. {?} 0km at 1km, Period 0.496days



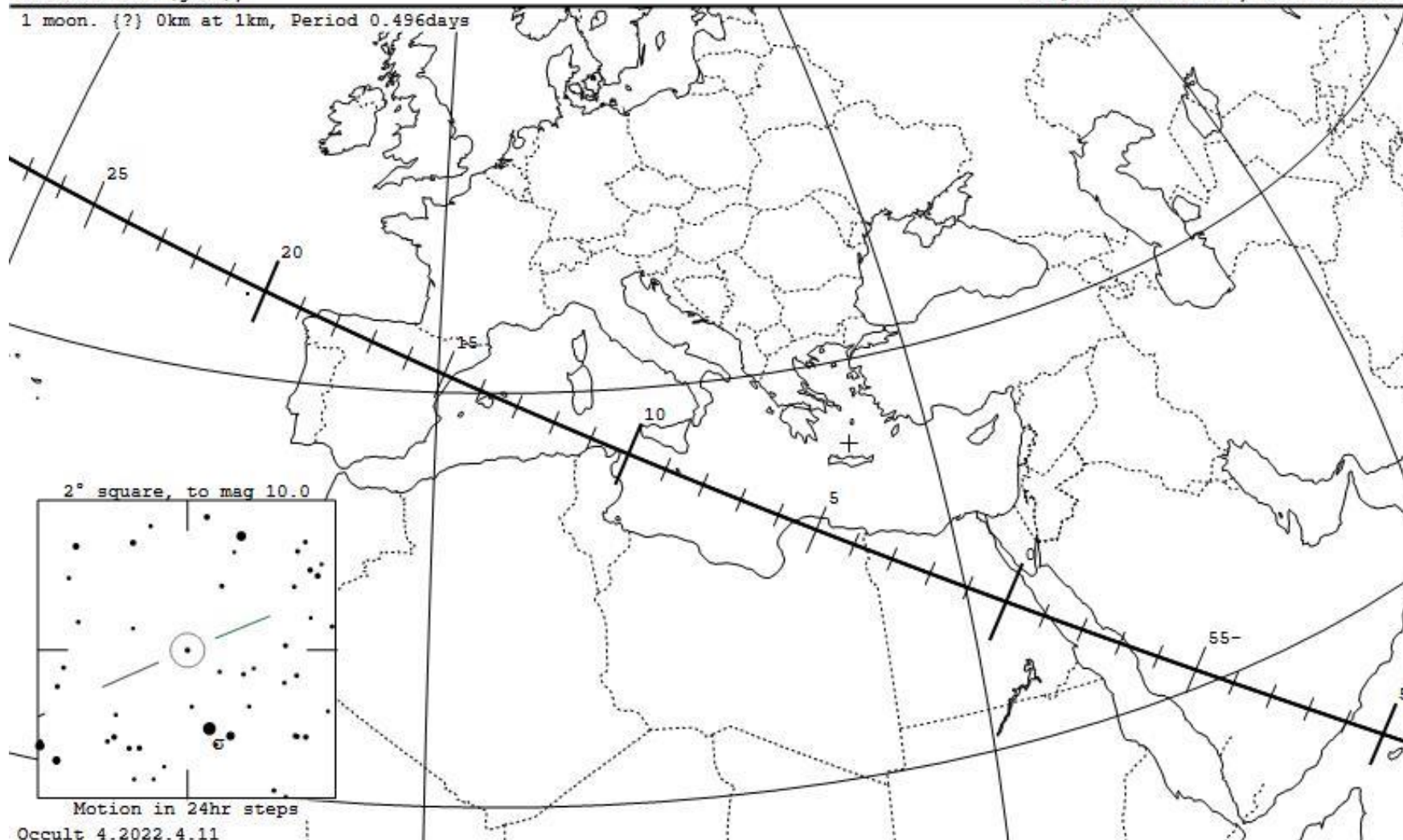
65803 Didymos occults HIP 37693 on 2023 Jan 1 from 0h 42m to 1h 46m UT

Star: (Dia = 0.1 mas)
Mv 9.0; Mb 9.4; Mr 8.7
RA = 7 43 58.9874 (astrometric)
Dec = 29 24 21.677
[of Date: 7 45 26, 29 21 2]
Prediction of 2021 Aug 20.0
Reliable 1.3 (good),

Durations: Max = 0.25 secs
1km = 0.32 secs, 1mas = 0.061 secs
Mag Drop: 7.4 [100%]v, 7.2 [100%]r
Sun : Dist = 165°
Moon: Dist = 79°, illum = 70%
Error 4.7 x 0.6 mas in PA 106°

Asteroid:
Mag = 16.4
Dia = 0.78 ± 0.10km, 4.1 mas
Parallax = 33.349"
Hourly dRA = -4.289s
dDec = 23.87"
JPL#181:2021-Feb-13, Known errors

1 moon. {?} 0km at 1km, Period 0.496days



Occult 4.2022.4.11

Occultations by Trojan Asteroids in 2023

Trojan Asteroids for 2023

(617) Patroclus: Patroclus is about 113 km across, but its large (104 km) moon Menoetius is almost as large, so this is a binary pair with a separation of about 680 km in a nearly circular orbit, which is known well enough that we can predict separate paths for the two components. But only SwRI has the orbital data to calculate accurate paths. My 2022 predicted paths for Patroclus occultations were about two path-widths from SwRI's predictions, so for any events of this object in your area, consult the SwRI Web site given above and, if not there, ask Marc Buie, buie@boulder.swri.edu, to add it.

(624) Hektor: The largest Trojan and a contact binary object.

(911) Agamemnon: This is not a Lucy target, but it is the second or third largest Trojan asteroid. A 2012 occultation showed a size of about 160 km, but more well-observed events are sought to better determine its size and shape. The 2021 occultation also revealed a satellite, some 10 km across with a projected separation of 278 km.

(1143) Odysseus: One of the larger Trojans.

(1173) Anchises: Use LS orbit

(2241) Alcahous: Get LS orbit that predicted 2022 Aug. 11 event in UK well.

(3548) Eurybates: It has a small moon, Queta, only about a km across, discovered by Hubble Space Telescope images taken in 2018. Queta orbits about 2310 km from Eurybates in a nearly circular orbit. Eurybates is also the main object of one of the few Trojan asteroid families, with 218 known members of carbonaceous and/or primitive composition.

(11351) Leucus: A LUCY target with an unusual elongated shape.

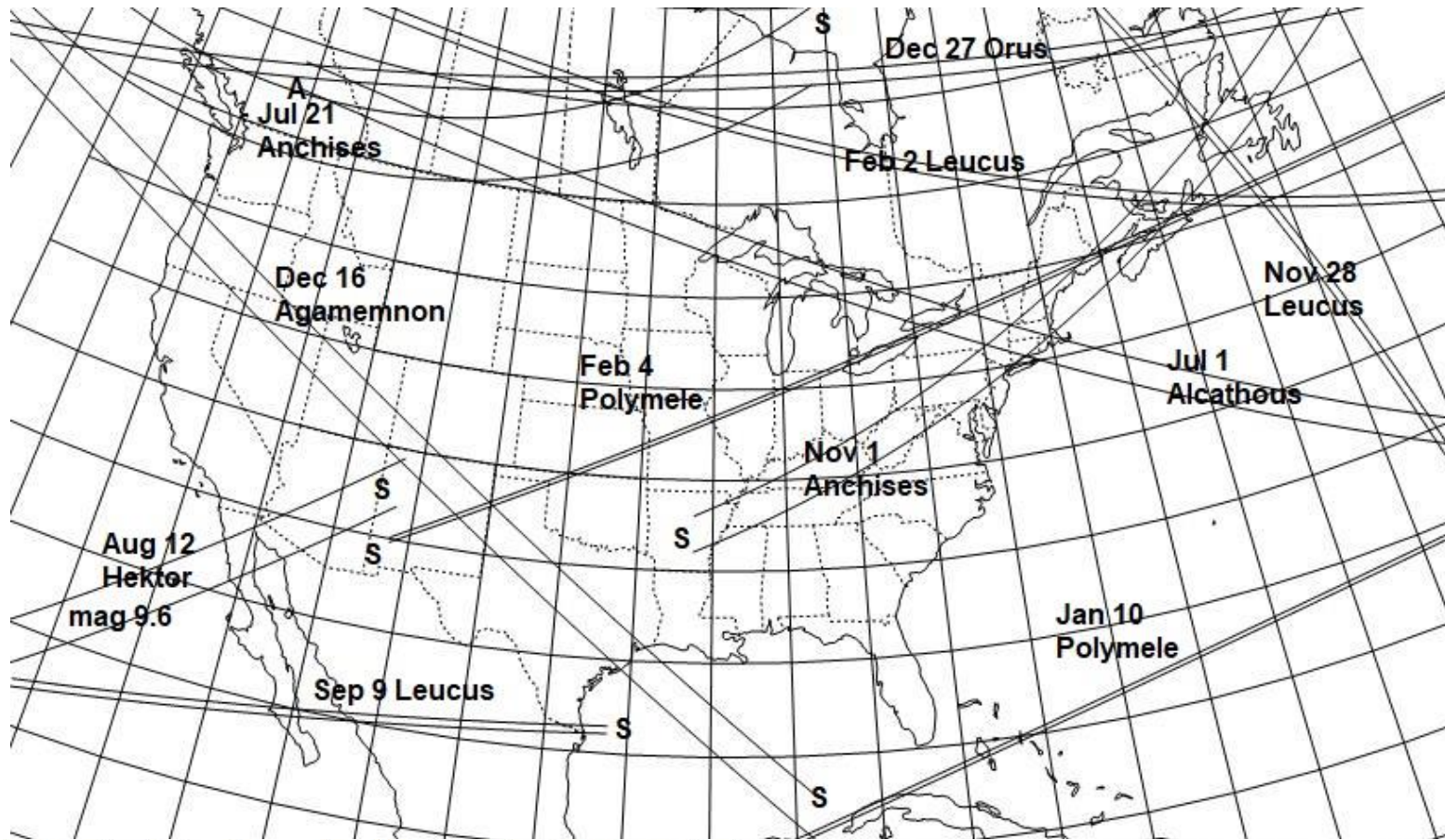
(15094) Polymele: A 5km moon, less than 200 km away, was discovered with 2 chords during the 2021 Oct. 27th occultation.

(21900) Orus:

(58931) Palmys: In 2021, it caused two occultations for Wayne Thomas, likely by ends of a peanut-shaped asteroid, but could be a close binary object. JPL prediction should be good now.

The above are the objects used in my 2023 Trojans occultation search, but some of them did not produce any 2023 occultations over North America of stars brighter than my mag. 14 limit. The 2021 Polymele occultation was observed on Mar. 27th, not Oct. 27th as stated above. (617) Patroclus, (3548) Eurybates, (11351) Leucus, (15094) Polymele, and (21900) Orus are flyby targets of NASA's Lucy mission, and special efforts, especially by the Southwest Research Institute (SwRI) will be made to observe them.

Occultations by Trojan Asteroids in 2023



2023 Trojans North America L following date is a Lucy mission target

Date	U.T.	Diameter	Durn	Star	Mag-Drop	Elon	%	Star	d Rely	Path	Planet	Min	Moon
m d	h m	km "	sec/m	mag	V R *	o	Ill	No.	<1.4	No Name		D Error	Dist ill
Jan 10	L 1 50	21 0.008	1.31s	12.8	5.7 5.7	165		UCAC4 630-037427	1.05	BS-Mex15094 Polymele &TZ-SMor		0.15 ±0.03	42 91
Feb 2	L 6 26	36 0.012	3.7s	14.0	4.2 4.3	138		UCAC4 535-023400	1.05	NS-AK 11351 Leucus		0.62 ±0.01	11 89
Feb 4	L 1 43	21 0.007	1.97s	13.3	5.5 5.4	141		UCAC4 631-037227	0.95	NS-NM 15094 Polymele		0.17 ±0.03	11 93
Jul 1	6 3	116 0.034	11.6s	11.2	5.0 5.4	128		UCAC4 464-127791	1.10	MA-BC 2241 Alcathous		0.36 ±0.01	82 93
Jul 21	7 6	111 0.043	7.5s	12.8	2.4 2.6	176		UCAC4 364-177314	1.10	ON-BC 1173 Anchises		0.92 ±0.01	144 11
Aug 12	11 41	181 0.041	4.7s	9.6	5.8 5.8	33		UCAC4 627-040447	W 1.15	Baja-NM 624 Hektor		0.32 ±0.02	16 14
Sep 9	L 11 9	36 0.008	1.01s	13.2	5.6 5.6	42		UCAC4 509-045671	0.95	Baja-TX11351 Leucus		0.04 ±0.01	24 26
Nov 1	0 15	111 0.033	5.7s	12.9	3.4 3.5	81		UCAC4 364-176248	0.95	AR-NL 1173 Anchises		0.73 ±0.01	126 95
Nov 28	L 6 32	36 0.010	5.5s	13.5	5.1 5.1	110		UCAC4 483-047928	0.95	QC-NL 11351 Leucus &BR-UY		0.29 ±0.01	60 99
Dec 16	11 26	157 0.051	13.3s	13.2	2.2 2.3	140		UCAC4 642-044054	1.00	TX-OR 911 Agamemnon		0.12 ±0.01	163 16
Dec 27	6 39	50 0.017	3.0s	13.4	3.4 3.4	169		UCAC4 541-037650	1.00	ON-BC 21900 Orus		0.58 ±0.01	12 100

Occultations by Special Main-Belt Asteroids in 2023

Special Main-Belt Asteroids for 2023

(16) **Psyche:** This is the target of the NASA mission with the same name.

(90) **Antiope:** This is a binary asteroid, with each component just under 90 km across. With the ISAM shape model, special methods are needed to compute the separate component paths.

(216) **Kleopatra:** This is the “Dog-bone” asteroid, the 2nd-largest M-class (metallic) asteroid, and has two small moons.

(234) **Barbara:** This may be a contact binary; occultation obs. reveal two lobes.

(253) **Mathilde:** NEAR imaged half the asteroid in 1997; occultations could probe the other half.

(319) **Leona:** We want to improve the orbit for the Dec. 12th occultation of Betelgeuse (see the bright Main-Belt asteroids events).

(513) **Centesima:** This asteroid has an unusual shape.

(762) **Pulcova:** Pulcova is 137 km across and has a 15-km moon orbiting 800 km away with a 4-day period. [NONE]

(957) **Camelia:** This asteroid has an unusual shape.

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

(4337) **Arecibo:** Binarity discovered during 2021 occultations and confirmed by Gaia to have a 1.3d period.

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

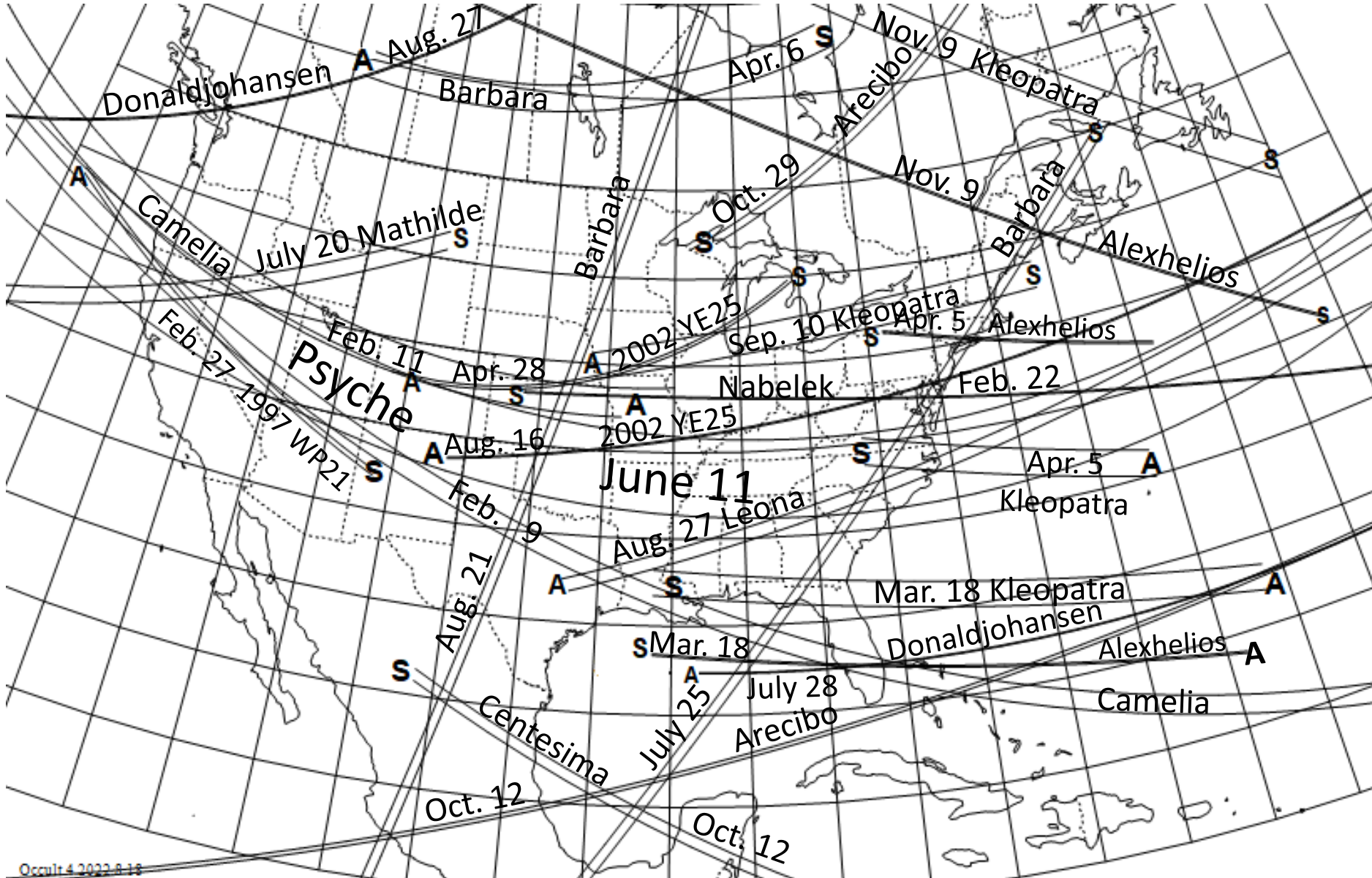
(33074) **1997 WP21:** This object, 18 km across, may have a 9 km moon with events recorded in a 2021 occultation.

(52246) **Donaldjohanson:** A LUCY target on its way to the Jupiter Trojan clouds.

(172376) **2002 YE25:** This is likely a binary asteroid, like a small version of Antiope, from 2023 May observations by P. Nosworthy and D. Gault.

The above are the objects used in my 2023 special Main-Belt occultation search, but some of them did not produce any 2023 occultations over astronomically populated parts of North America of stars brighter than my mag. 14 limit.

Occultations by special Main Belt asteroids in North America during 2023 to mag. 14.0



Occultations by Special Main-Belt Asteroids in 2023

2023 North American special Main Belt Occultations

Date	U.T.	Diameter	Durn	Star	Mag-Drop	Elon	%	Star	d Rely	Path	Planet	Min	Moon
m d h m	h m	km "	sec/m	mag	V R *	o	Ill	No.	<1.4	No Name	No Name	D Error	Dist ill
Feb 9	6 08	74 0.057	6.5s	13.2	1.2 1.2	157		UCAC4 425-048350	1.00	BS-CA	957 Camelia	0.59 ±0.01	51 89
Feb 11	10 40	74 0.057	6.6s	13.7	0.9 0.9	156		UCAC4 426-047968	1.05	IL-OR	957 Camelia	0.87 ±0.01	74 72
Feb 22	1 30	6.3 0.004	0.31s	12.8	5.8 5.9	84		TYC 1247-00212-1	1.15	KS-DE	4552 Nabelek	0.26 ±0.01	74 1
Feb 27	12 44	18 0.006	0.56s	12.6	6.4 6.8†	56		UCAC4 340-175407	0.85	CA-NM	33074 1997 WP21	0.72 ±0.01	148 52
Mar 18	1 00	9.0 0.004	0.20s	10.7	1.4 1.6	39		TYC 634-00190-1	1.15	FL-BS	216 Alexhelios	0.19 ±0.01	104 29
Mar 18	1 00	125 0.062	2.8s	10.7	1.4 1.6	39		TYC 634-00190-1	1.15	LA-FL	216 Kleopatra	0.24 ±0.01	104 29
Apr 5	0 48	125 0.059	2.7s	12.4	0.48 0.5	31		UCAC4 514-004708	1.10	VA-NC	216 Kleopatra	0.38 ±0.01	124 95
Apr 5	0 48	9.0 0.004	0.19s	12.4	0.48 0.5	31		UCAC4 514-004708	1.10	NY-LI	216 Alexhelios	0.47 ±0.01	124 95
Apr 6	9 11	46 0.033	1.98s	13.9	0.6 0.8†	86		UCAC4 415-122294	1.00	AB-ON	234 Barbara	0.93 ±0.00	92 100
Apr 28	9 17	5.7 0.002	0.19s	12.1	8.8 9.1	64		UCAC4 432-115773	0.85	CO-MI	172376 2002 YE25	0.94 ±0.00	156 55
Jun 11	5 53	249 0.146	28.3s	13.6	0.11 0.13	144		UCAC4 391-062150	1.00	NC-OR	16 Psyche	0.78 ±0.00	132 45
Jul 20	10 4	58 0.033	1.80s	13.1	2.2 2.3	62		UCAC4 531-006629	K 1.95	CA-MT	253 Mathilde	0.71 ±0.00	91 6
Jul 25	7 00	46 0.073	5.6s	11.9	0.31 0.38	167		UCAC4 416-141013	0.95	NB-Mex	234 Barbara	0.10 ±0.00	99 44
Jul 28	2 52	3.90 0.003	0.58s	11.5	8.5 8.8	141		TYC 5234-00643-1	K 0.75	DZ-FL	52246 Donaldjohanson	0.52 ±0.00	115 61
Aug 16	2 49	5.7 0.004	0.51s	13.0	6.5 6.6	154		UCAC4 488-143179	1.15	NJ-NM	172376 2002 YE25	0.57 ±0.00	139 2
Aug 21	5 16	46 0.072	5.9s	10.7	0.9 0.9	150		TYC 5750-00865-1	1.35	ON-Mex	234 Barbara	0.05 ±0.00	98 20
Aug 27	6 23	3.90 0.003	0.31s	12.3	6.9 7.1	172		UCAC4 438-122513	0.95	SK-BC	52246 Donaldjohanson	0.83 ±0.00	58 80
Aug 27	7 1	61 0.030	2.2s	13.8	2.0 2.4	73		UCAC4 525-012493	1.00	TX-NC	319 Leona	0.41 ±0.00	156 80
Sep 10	8 59	125 0.056	3.2s	13.1	0.41 0.39	43		UCAC4 497-050188	1.25	IA-ME	216 Kleopatra	0.37 ±0.01	18 19
Oct 12	1 9	44 0.024	4.8s	8.2	6.7 7.4	106		TYC 5749-00630-1	v 0.95	Mex	513 Centesima	0.50 ±0.00	146 13
Oct 12	7 20	19 0.010	1.73s	12.5	5.5 5.6	150		UCAC4 537-005401	1.25	BS-Mex	4337 Arecibo	0.11 ±0.00	123 6
Oct 29	23 51	19 0.010	1.32s	11.7	5.9 6.1	170		UCAC4 534-004986	1.00	QC-MI	4337 Arecibo	0.86 ±0.00	6 98
Nov 9	8 59	9.0 0.005	0.43s	12.7	0.5 0.6	80		UCAC4 451-048971	0.95	SK-NS	216 Alexhelios	0.40 ±0.01	37 15
Nov 9	8 59	125 0.066	5.9s	12.7	0.5 0.6	80		UCAC4 451-048971	0.95	QC-NL	216 Kleopatra	0.49 ±0.01	37 15

Alexhelios is a small (9 km) moon of (216) Kleopatra.

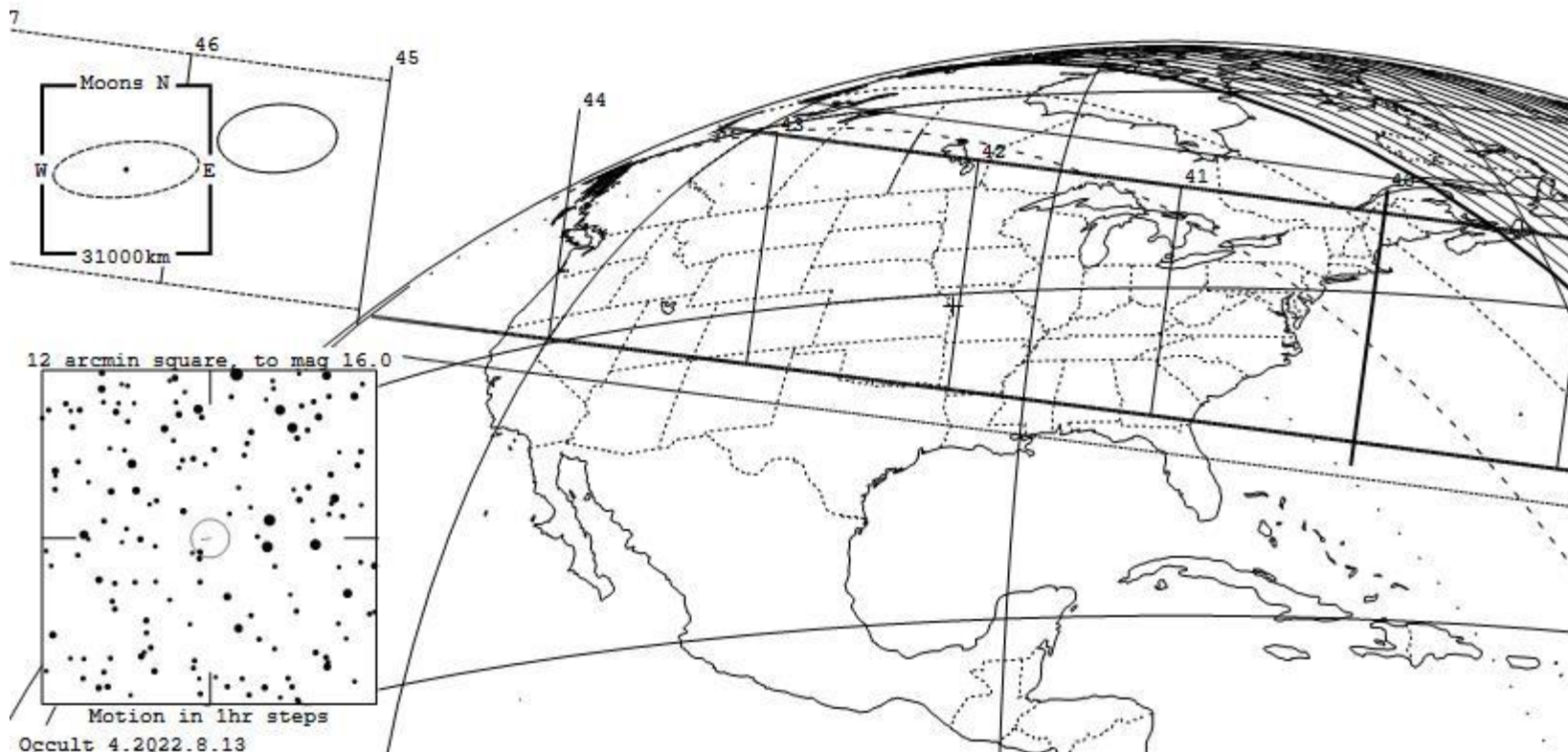
50000 Quaoar occults UCAC4 375-130264 on 2023 May 13 from 8h 35m to 8h 45m UT

Star: (Dia < 0.1 mas)
 Mv 15.2; Mb 15.7; Mr 14.4
 RA = 18 33 31.7127 (astrometric)
 Dec = -15 4 52.194
 [of Date: 18 34 52, -15 3 52]
 Prediction of 2022 Aug 14.8
 Reliable 1.1 (good),

Durations: Max = 69.2 secs
 1km = 0.063 secs, 1mas = 1.9 secs
 Mag Drop: 3.7 [97%]v, 4.0 [97%]r
 Sun : Dist = 134°
 Moon: Dist = 55°, illum = 41%
 Error 9.3 x 5.3 mas in PA 86°

Asteroid:
 Mag = 18.8
 Dia = 1096 ±7km, 36 mas
 Parallax = 0.209"
 Hourly dRA = -0.127s
 dDec = 0.25"
 JPL#43:2022-Aug-09, Known errors

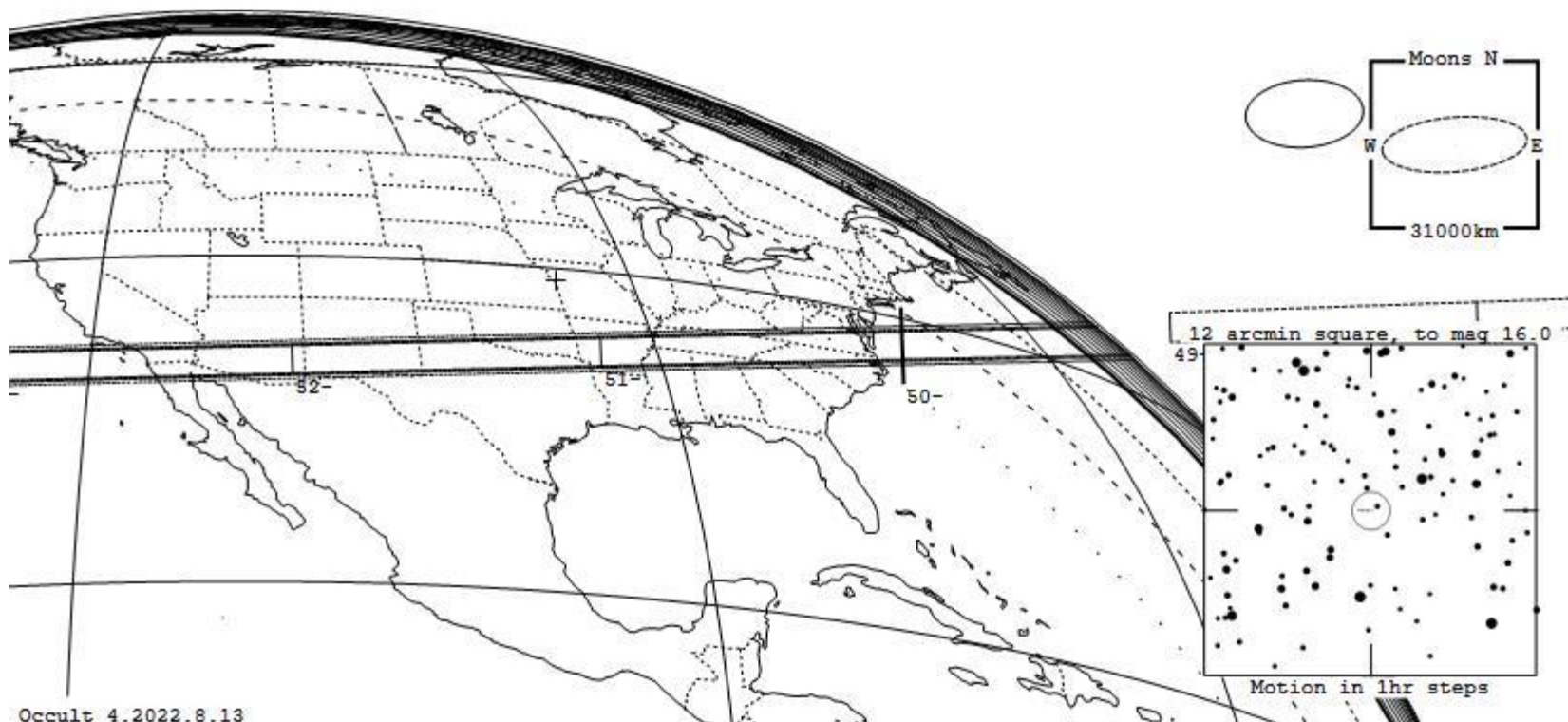
1 moon. {Weywot} 81km at 13800km, Period 12.260days Orbit@Miriade



50000 Weywot #1 occults UCAC4 375-126076 on 2023 Jun 22 from 7h 56m to 8h 5m UT

Star: (Dia < 0.1 mas)	Durations: Max = 5.8 secs	Asteroid:
Mv 15.8; Mb 17.2; Mr 14.6 [+2 near]	1km = 0.041 secs, 1mas = 1.2 secs	Mag = 18.7
RA = 18 30 45.7824 (astrometric)	Mag Drop: 3.0 [94%]v, 3.7 [97%]r	Dia = 140 ±20km, 5 mas
Dec = -15 3 33.642	Sun : Dist = 169°	Parallax = 0.211"
[of Date: 18 32 7, -15 2 36]	Moon: Dist = 139°, illum = 16%	Hourly dRA = -0.200s
Prediction of 2022 Aug 14.8	Error 9.3 x 5.3 mas in PA 86°	dDec = -0.10"
Reliable 1.1 (good),	JPL#43:2022-Aug-09 Binary solution 1 : Kepler, Known errors + binary orbit	

1 moon. {Weywot} 81km at 13800km, Period 12.260days Orbit@Miriade



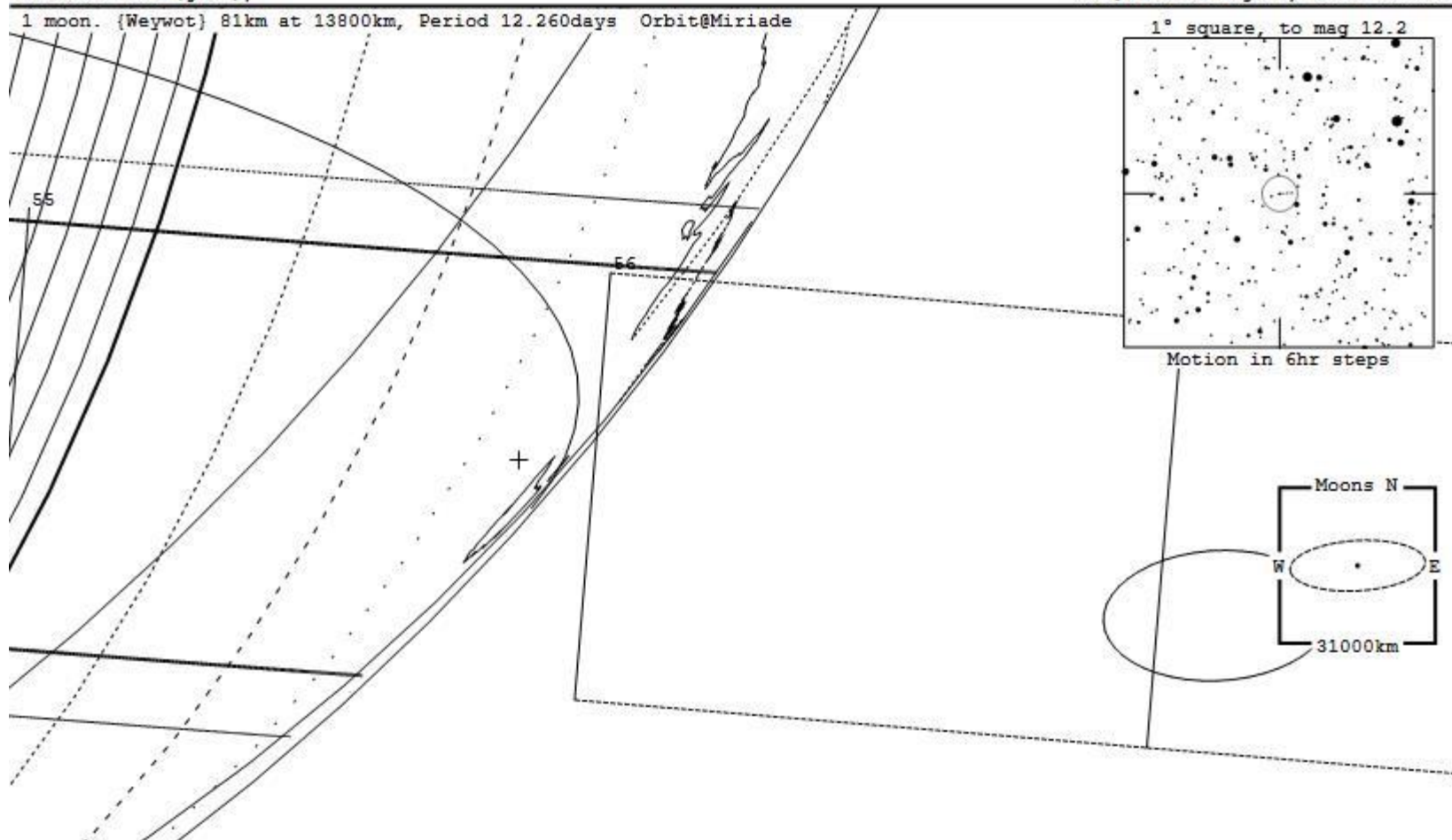
50000 Quaoar occults UCAC4 373-126179 on 2022 Nov 8 from 11h 48m to 11h 57m UT

Star: (Dia < 0.1 mas)
 Mv 11.2; Mb 12.0; Mr 10.4
 RA = 18 22 35.9100 (astrometric)
 Dec = -15 27 51.835
 [of Date: 18 23 53, -15 27 11]
 Prediction of 2022 Aug 14.8
 Reliable 0.8 (good),

Durations: Max = 44.8 secs
 1km = 0.041 secs, 1mas = 1.3 secs
 Mag Drop: 7.7 [100%]v, 8.1 [100%]r
 Sun : Dist = 50°
 Moon: Dist = 130°, illum =100%
 Error 9.3 x 5.3 mas in PA 87°

Asteroid:
 Mag = 18.9
 Dia = 1096 ±7km, 35 mas
 Parallax = 0.203"
 Hourly dRA = 0.193s
 dDec = -0.23"
 JPL#43:2022-Aug-09, Known errors

1 moon. {Weywot} 81km at 13800km, Period 12.260days Orbit@Miriade



50000 Weywot #1 occults UCAC4 373-126179 on 2022 Nov 8 from 11h 48m to 11h 57m UT

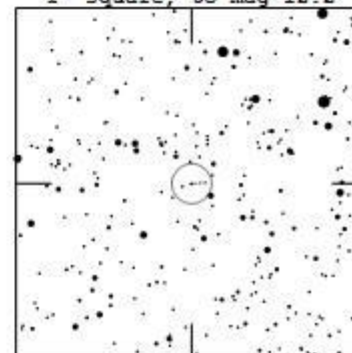
Star: (Dia < 0.1 mas)
 Mv 11.2; Mb 12.0; Mr 10.4
 RA = 18 22 35.9100 (astrometric)
 Dec = -15 27 51.835
 [of Date: 18 23 53, -15 27 11]
 Prediction of 2022 Aug 14.8
 Reliable 0.8 (good),

Durations: Max = 5.8 secs
 1km = 0.041 secs, 1mas = 1.3 secs
 Mag Drop: 7.7 [100%]v, 8.1 [100%]r
 Sun : Dist = 50°
 Moon: Dist = 130°, illum =100%
 Error 106.9 x 9.3 mas in PA 90°
 JPL#43:2022-Aug-09 Binary solution 1 : Kepler, Known errors + binary orbit

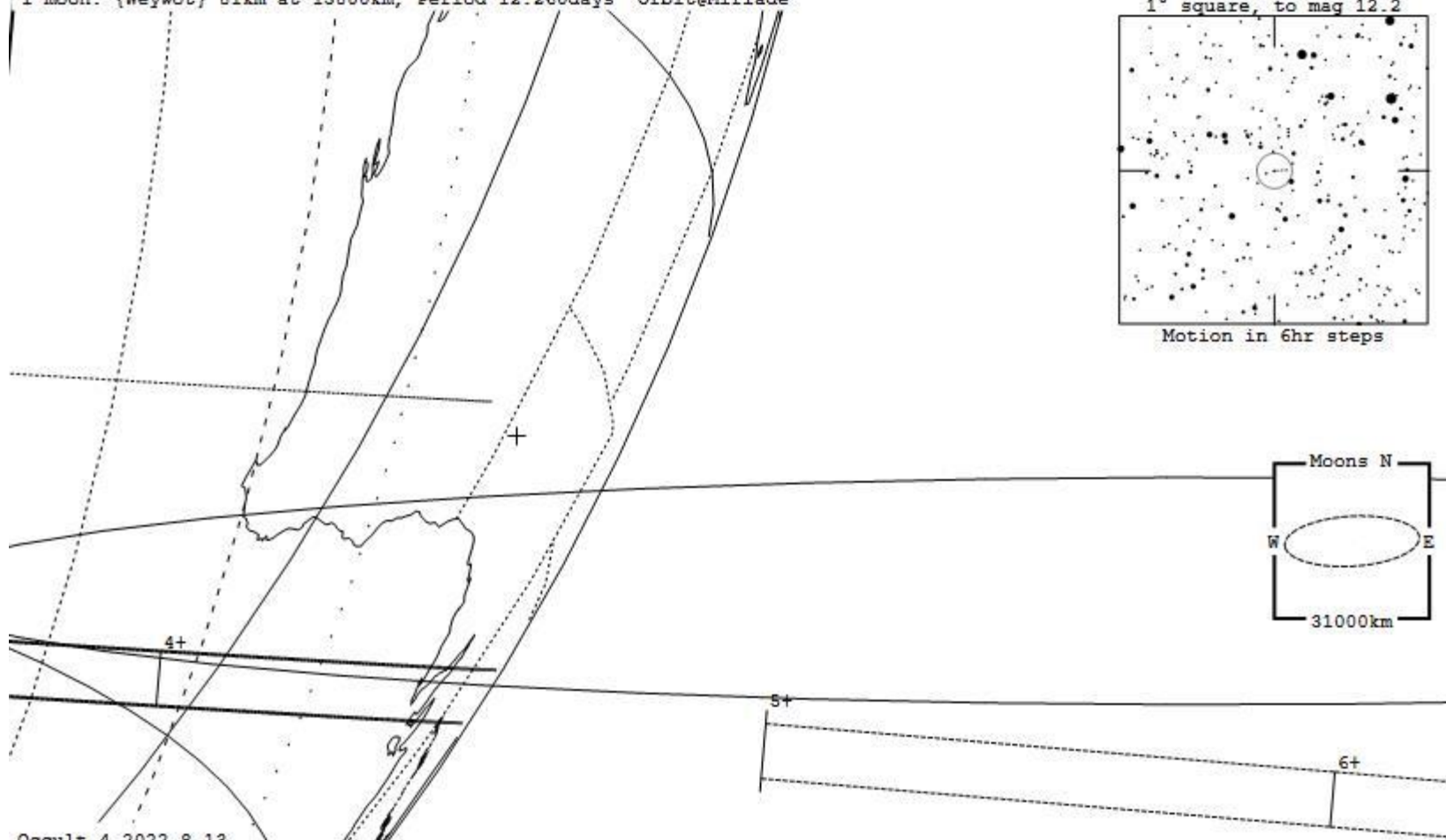
Asteroid:
 Mag = 18.9
 Dia = 140 ±20km, 4 mas
 Parallax = 0.203"
 Hourly dRA = 0.193s
 dDec = -0.23"

1 moon. {Weywot} 81km at 13800km, Period 12.260days Orbit@Miriade

1° square, to mag 12.2



Motion in 6hr steps



Occult 4.2022.8.13

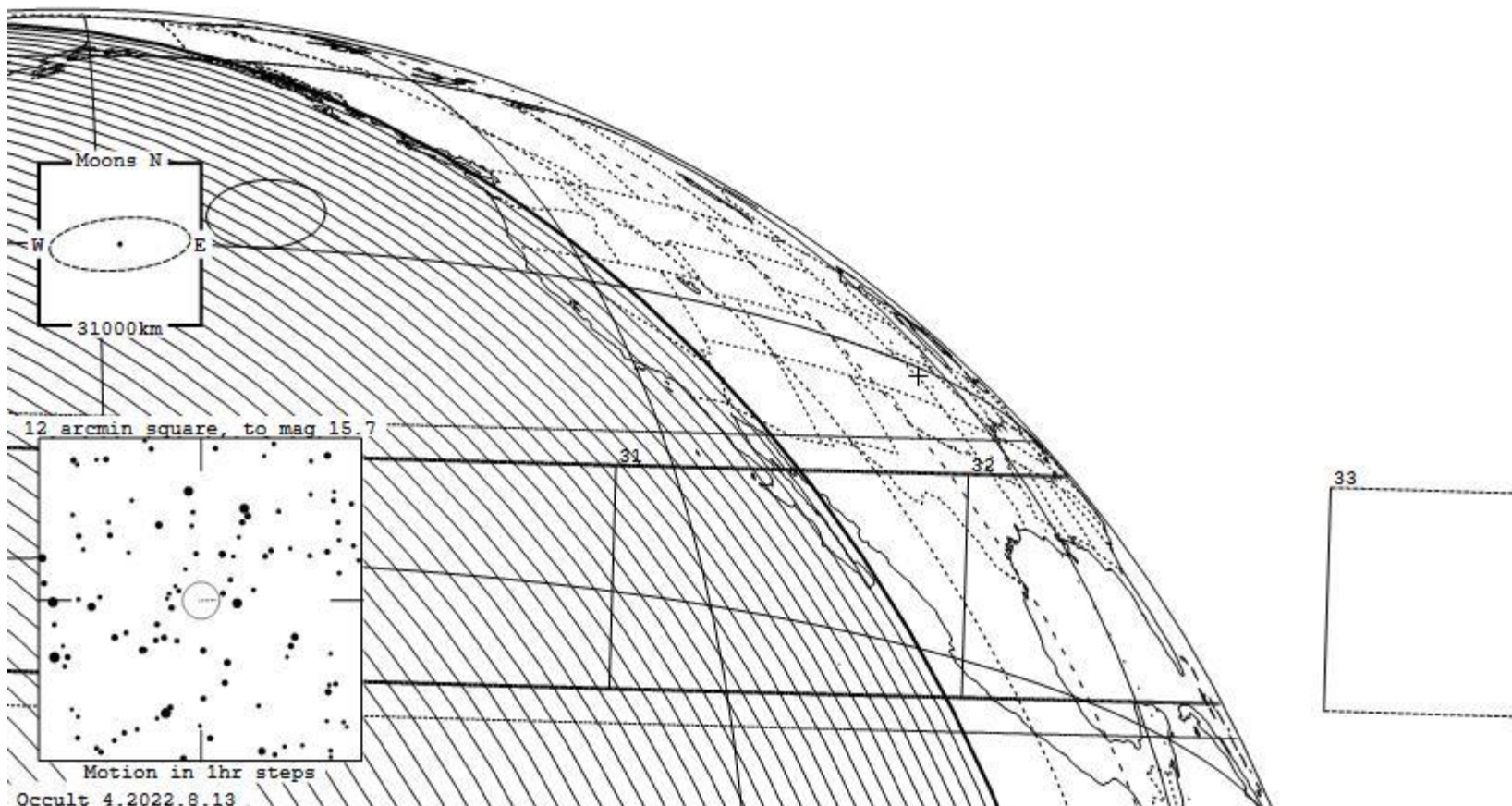
50000 Quaoar occults UCAC4 373-131780 on 2023 Nov 23 from 0h 26m to 0h 34m UT

Star: (Dia < 0.1 mas)
 Mv 14.7; Mb 16.4; Mr 13.5
 RA = 18 29 5.7300 (astrometric)
 Dec = -15 24 54.019
 [of Date: 18 30 26, -15 24 0]
 Prediction of 2022 Aug 14.8
 Reliable 0.9 (good),

Durations: Max = 37.9 secs
 1km = 0.035 secs, 1mas = 1.1 secs
 Mag Drop: 4.2 [98%]v, 5.0 [99%]r
 Sun : Dist = 37°
 Moon: Dist = 87°, illum = 78%
 Error 9.3 x 5.3 mas in PA 87°

Asteroid:
 Mag = 18.9
 Dia = 1096 ±7km, 35 mas
 Parallax = 0.202"
 Hourly dRA = 0.228s
 dDec = -0.10"
 JPL#43:2022-Aug-09, Known errors

1 moon. {Weywot} 81km at 13800km, Period 12.260days Orbit@Miriade



Occult 4.2022.8.13

50000 Weywot #1 occults UCAC4 373-131780 on 2023 Nov 23 from 0h 26m to 0h 33m UT

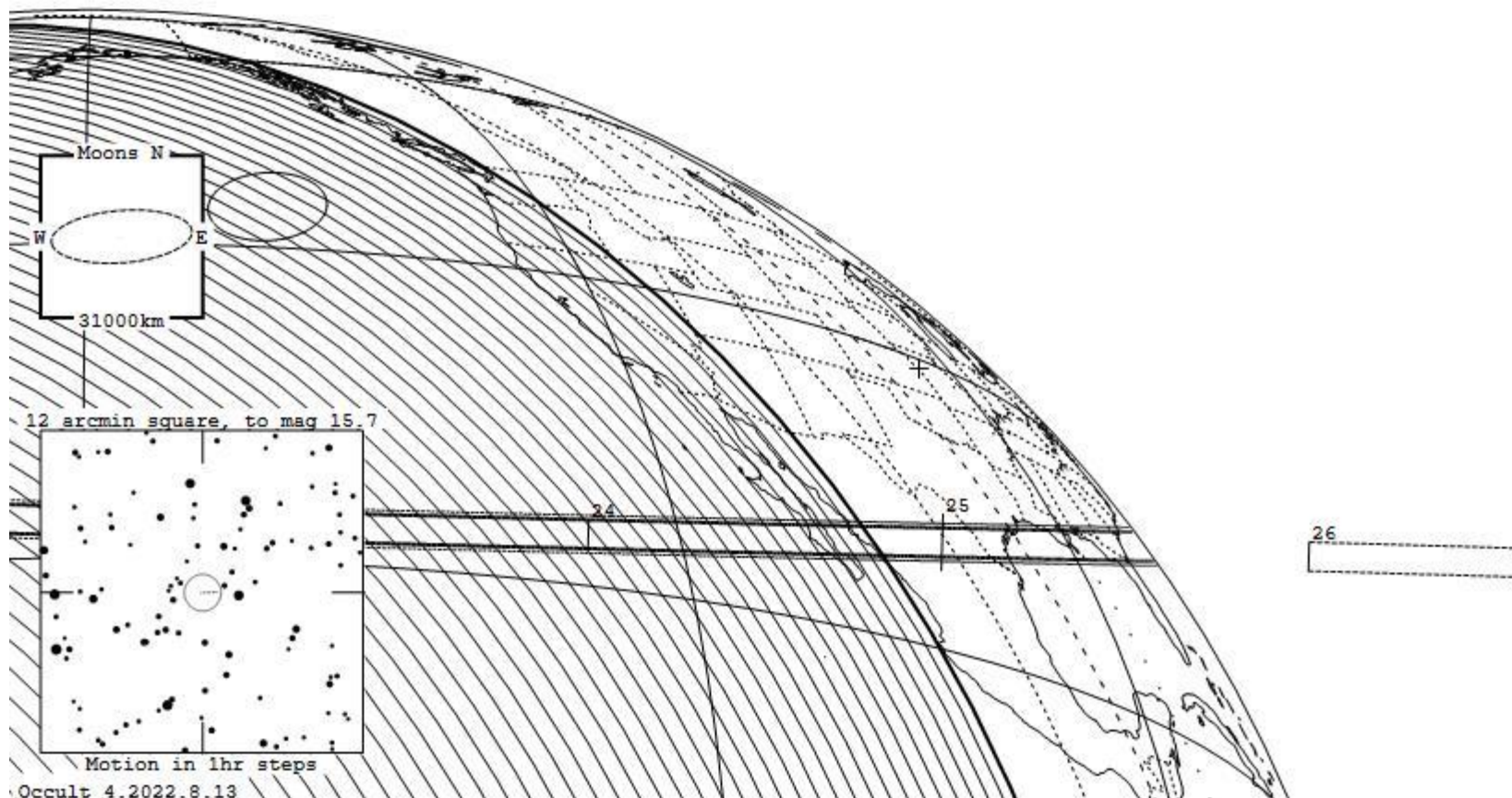
Star: (Dia < 0.1 mas)
 Mv 14.7; Mb 16.4; Mr 13.5
 RA = 18 29 5.7300 (astrometric)
 Dec = -15 24 54.019
 [of Date: 18 30 26, -15 24 0]
 Prediction of 2022 Aug 14.8
 Reliable 0.9 (good),

Durations: Max = 4.9 secs
 1km = 0.035 secs, 1mas = 1.1 secs
 Mag Drop: 4.2 [98%]v, 5.0 [99%]r
 Sun : Dist = 37°
 Moon: Dist = 87°, illum = 78%
 Error 9.3 x 5.3 mas in PA 87°

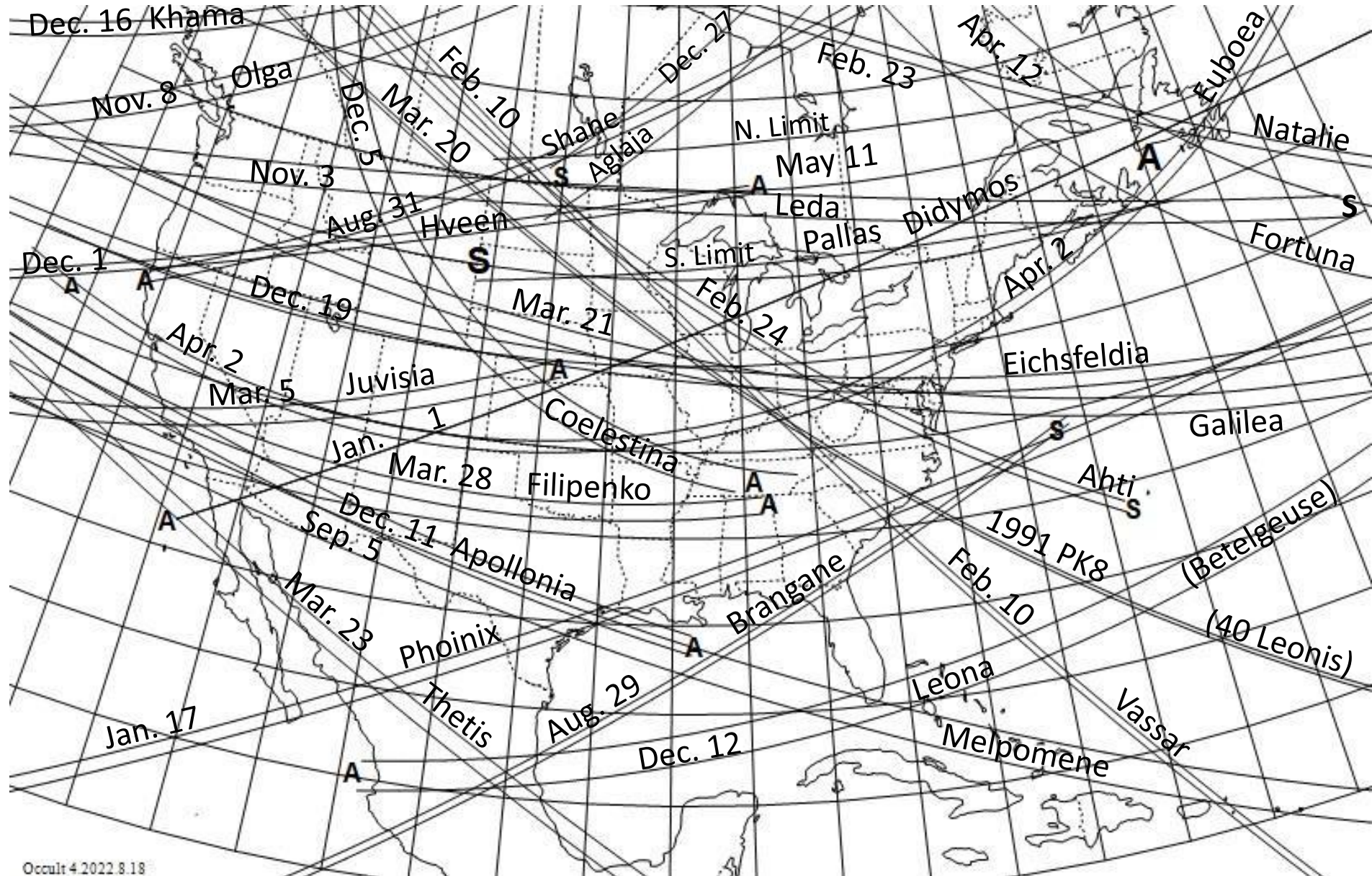
Asteroid:
 Mag = 18.9
 Dia = 140 ±20km, 4 mas
 Parallax = 0.202"
 Hourly dRA = 0.228s
 dDec = -0.10"

JPL#43:2022-Aug-09 Binary solution 1 : Kepler, Known errors + binary orbit

1 moon. {Weywot} 81km at 13800km, Period 12.260days Orbit@Miriade



Occultations by Main-Belt Asteroids in North America, 2023 to mag. 9.0



Occultations by Main-Belt Asteroids in North America during 2023 to mag. 9.0

Date	UT	Occulting Body	Star	Mag	R.A.(2000) h m s	Dec. ° ' "	ΔMag	Dur. s Path
Jan	1 01:41	65803 Didymos	HIP 37693	9.0	07 43 59.0	+29 24 22	7.4	0.2 NL-Baja
Jan	17 03:34	4543 Phoinix	TYC 2456-00727-1	8.6	07 28 59.3	+32 40 38	7.9	3.9 NC-Baja
Feb	10 07:05	1312 Vassar	HIP 54381	8.7	11 07 35.0	+20 16 17	7.1	2.1 SC-AB
Feb	23 02:05	448 Natalie	TYC 2371-00436-1	8.4	04 15 58.7	+31 42 15	7.9	3.6 QC-NL
Feb	24 10:25	2826 Ahti	HIP 58521	8.6	12 00 05.7	+17 55 12	7.2	3.5 VA-AB
Mar	5 12:16	605 Juvisia	HIP 60711	8.2	12 26 31.8	-13 47 42	7.1	4.7 CA-NE
Mar	20 05:38	7585 1991 PK8	HIP 50564	4.7	10 19 43.8	+19 28 10	13	1.5 NC-BC
Mar	21 06:11	697 Galilea	HIP 58372	8.7	11 58 09.4	+07 32 46	5.6	4.8 DE-OR
Mar	23 06:26	17 Thetis	HIP 66212	7.5	13 34 16.0	-00 18 49	3.4	10.5 Mex-Baja
Mar	28 09:59	2892 Filipenko	TYC 4916-00388-1	8.7	10 45 20.2	-03 16 38	6.7	4.8 AL-CA
Apr	2 06:37	1119 Euboea	HIP 75879	8.2	15 29 56.7	-14 48 51	6.9	11.2 NL-CA
Apr	12 06:57	19 Fortuna	HIP 81844	8.6	16 43 01.4	-21 20 40	3.5	80.1 NL-QC
May	11 03:07	2 Pallas	HIP 39848	7.3	08 08 27.6	+05 21 59	1.8	16.8 ND-NS
Aug	29 09:24	606 Brangane	HIP 26712	6.0	05 40 35.9	+31 21 29	8.9	1.3 Mex-GA
Aug	31 08:21	1994 Shane	HIP 28166	5.6	05 57 07.4	+22 50 20	12.1	1.7 CA-QC
Sep	5 08:22	18 Melpomene	TYC 0061-01117-1	8.5	03 06 19.9	+05 18 53	1.3	14.7 CA-VI
Nov	3 08:59	38 Leda	TYC 1401-02070-1	8.8	09 10 43.9	+17 02 14	4.4	5.1 OR-NS
Nov	8 09:45	304 Olga	HIP 12204	8.1	02 37 08.7	-11 11 51	4.6	8.7 SK-BC
Dec	1 05:47	1678 Hveen	HIP 113718	7.2	23 01 52.2	-03 51 01	9.7	3.5 CA-ON
Dec	5 08:26	237 Coelestina	HIP 8454	7.3	01 49 00.4	+01 19 53	6.5	7.1 TN-AB
Dec	11 11:19	358 Apollonia	HIP 19499	8.6	04 10 40.9	+15 14 13	3.9	10.1 TX-CA
Dec	12 01:16	319 Leona	HIP 27989	0.5	05 55 10.2	+07 24 25	13.7	11.6 Mex-BS
Dec	16 09:58	1357 Khama	HIP 58012	8.9	11 53 56.3	+15 54 30	8.5	3.0 BC-AB
Dec	19 02:13	442 Eichsfeldia	HIP 15099	7.6	03 14 47.9	+08 58 41	6.3	9.5 NJ-CA
Dec	27 23:40	47 Aglaja	HIP 113379	8.4	22 57 43.7	-06 35 10	5.1	4.8 ND-ON

Occultations by Asteroids in North America, 2023 to mag. 9.0

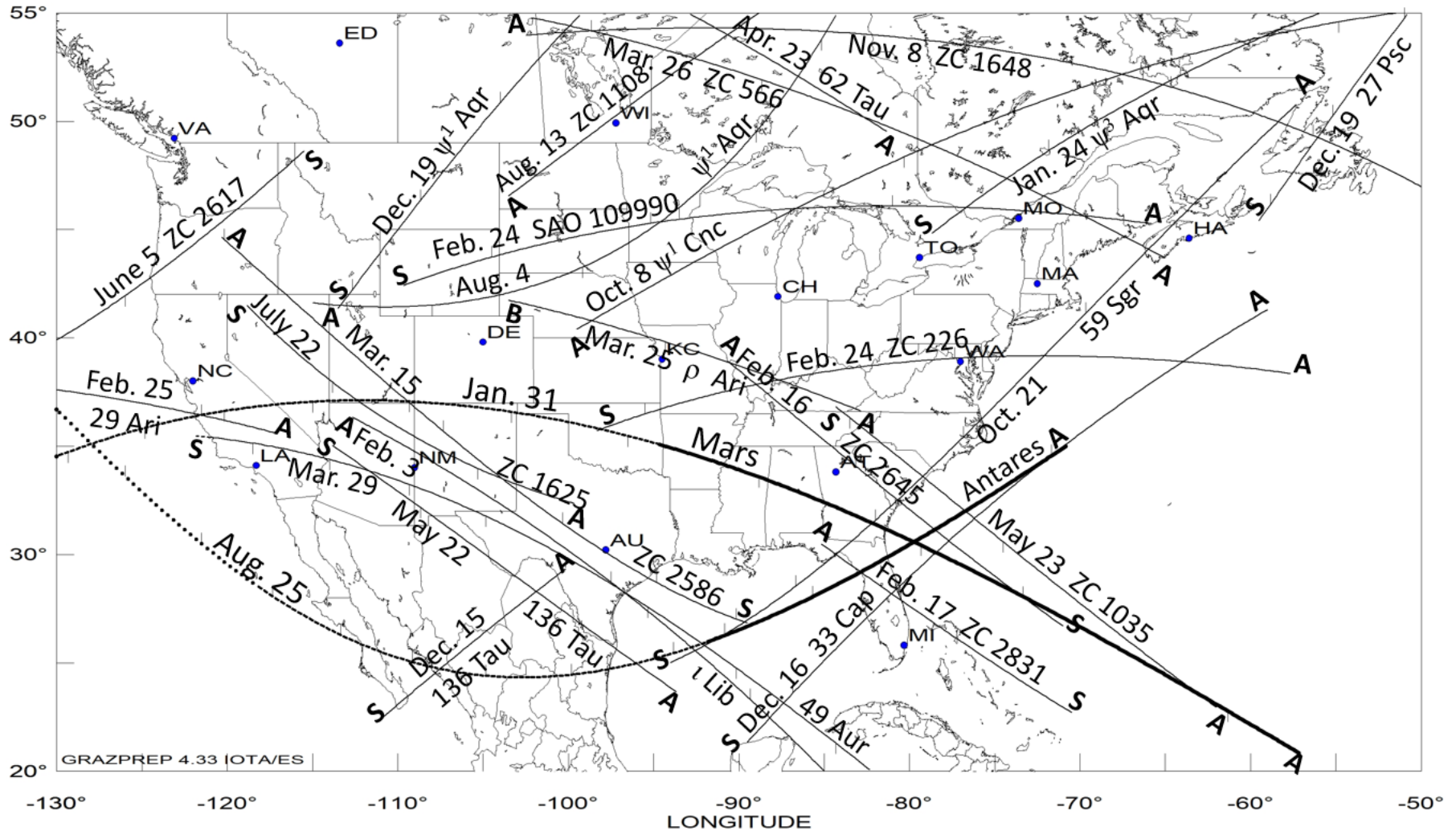
Occultations by asteroids of stars of mag. 9.0 and brighter during 2023

Date	U.T.	Diameter	Durn	Star	Mag-Drop	Elon	%	Star	d Rely	Planet	Min	Moon
y m d	h m	km "	sec/m	mag	V	R *	o Ill	No.	<1.4	No Name	D Error	Dist ill
2023 Jan 1	1 34.4	0.78 0.004	0.25s	9.0	7.4	7.2	165	HIP 37693	s	65803 Didymos	0.20 ±0.00	79 70
2023 Jan 17	3 30.6	65 0.023	3.9s	8.6	7.9	7.7	167	TYC 2456-00727-1	s	4543 Phoinix	0.07 ±0.01	123 29
2023 Feb 10	7 4.4	34 0.019	2.1s	8.7	7.1	6.8	157	HIP 54381	s	1312 Vassar	0.15 ±0.01	33 82
2023 Feb 23	2 4.7	48 0.022	3.6s	8.4	7.9		94	TYC 2371-00436-1		448 Natalie	0.47 ±0.01	56 11
2023 Feb 24	10 24.2	40 0.026	3.5s	8.6	7.2		156	HIP 58521		2826 Ahti	0.62 ±0.01	139 22
2023 Mar 5	12 17.4	66 0.036	4.7s	8.2	7.1		151	HIP 60711		605 Juvisia	0.65 ±0.01	51 96
2023 Mar 20	5 36.7	17 0.009	1.51s	4.7	13.0	12.6	150	HIP 50564	s	7585 1991 PK8	0.44 ±0.01	170 3
2023 Mar 21	6 14.2	76 0.045	4.8s	8.7	5.6		172	HIP 58372	V	697 Galilea	0.54 ±0.01	176 0
2023 Mar 23	6 28.4	84 0.085	10.5s	7.5	1.2	‡	158	HIP 66212		17 Thetis	0.05 ±0.00	172 3
2023 Mar 28	9 59.8	59 0.035	4.8s	8.7	6.7		155	TYC 4916-00388-1		2892 Filipenko	0.72 ±0.01	75 43
2023 Apr 2	6 53.3	31 0.027	11.2s	8.2	6.9		138	HIP 75879		1119 Euboea	0.85 ±0.00	86 86
2023 Apr 12	6 54.0	201 0.136	80.1s	8.6	3.5	3.2	130	HIP 81844	s	19 Fortuna	0.82 ±0.00	26 62
2023 May 11	3 5.6	532 0.331	16.8s	7.3	1.8		74	HIP 39848		2 Pallas	0.48 ±0.01	160 67
2023 Jul 7	9 16.6	6.8 0.007	0.79s	8.8	7.5	9.8	160	G195906.6-075303	V	6127 Hetherington	0.45 ±0.01	43 79
2023 Aug 29	9 26.2	35 0.022	1.26s	6.0	8.9	8.5	70	HIP 26712	v	606 Brangane	0.21 ±0.00	134 96
2023 Aug 31	8 23.2	21 0.010	1.66s	5.6	2.3	2.3	68	HIP 28166	v	1994 Shane	0.59 ±0.00	108 100
2023 Sep 5	8 19.3	142 0.177	14.7s	8.5	1.3		116	TYC 0061-01117-1		18 Melpomene	0.21 ±0.01	16 66
2023 Nov 3	8 57.9	105 0.066	5.1s	8.8	4.4		85	TYC 1401-02070-1		38 Leda	0.34 ±0.00	27 69
2023 Nov 8	9 43.6	69 0.080	8.7s	8.1	1.7	‡	152	HIP 12204		304 Olga	0.69 ±0.00	132 23
2023 Dec 1	5 45.6	41 0.019	3.5s	7.2	9.7		97	HIP 113718		1678 Hveen	0.29 ±0.01	129 85
2023 Dec 5	8 31.2	43 0.029	7.1s	7.3	6.5		132	HIP 8454		237 Coelestina	0.94 ±0.00	138 49
2023 Dec 11	11 19.6	88 0.082	10.1s	8.6	3.9		164	HIP 19499		358 Apollonia	0.35 ±0.01	171 3
2023 Dec 12	1 28.4	61 0.046	11.6s	0.5	2.9		162	HIP 27989 = Betelgeuse		319 Leona	0.58 ±0.01	152 1
2023 Dec 16	10 2.8	44 0.018	3.0s	8.9	8.5		92	HIP 58012		1357 Khama	0.76 ±0.01	137 15
2023 Dec 19	2 20.1	65 0.054	9.5s	7.6	6.3		141	HIP 15099		442 Eichsfeldia	0.49 ±0.00	61 42
2023 Dec 27	23 43.6	144 0.071	4.8s	8.4	5.1		67	HIP 113379		47 Aglaja	0.70 ±0.01	124 99

Some of these are not included on the map because the path crossed only oceans, or places with no known observers or astronomy clubs. This list has some information that is not included in the list on the previous page.

2023 Bright Lunar Grazing Occultations in North America

Grazing Occultations RASC 2023



2023 Bright Lunar Grazing Occultations in North America

Date	Object Name	ZC/SAO	d	m	%sl	L	W.U.T.		Lo.	La.
							h	m		
Jan. 24	ψ^3 Aqr	ZC 3428	A	5.0	13+	S	22	12.6	-78	45
Jan. 31	Mars			-0.3	74+	N	4	38.8	-130	35
Feb. 13	ι Librae	ZC 2172	Z	4.5	54-	S	8	32.0	-112	36
Feb. 16		ZC 2645		6.2	21-	S	10	56.5	-90	39
Feb. 17		ZC 2831		6.0	12-	S	10	58.5	-85	30
Feb. 24		ZC 226	Y	6.5	17+	S	0	35.7	-98	36
Feb. 24		SAO 109990		7.0	18+	S	1	13.2	-109	42
Feb. 25	29 Arietis	ZC 374	V	6.0	29+	S	5	44.4	-130	38
Mar. 15		ZC 2586	K	6.0	46-	S	11	20.7	-120	45
Mar. 25	ρ Arietis	ZC 433		5.6	13+	N	2	32.4	-122	44
Mar. 26		ZC 566		6.0	21+	N	2	41.1	-102	55
Mar. 29	49 Aur	ZC 1008		5.3	49+	N	2	32.7	-122	35
Apr. 23	62 Tauri	ZC 652	Y	6.3	10+	N	3	11.9	-92	55
May 22	136 Tauri	ZC 890	V	4.6	6+	N	2	35.4	-114	35
May 23		ZC 1035	X	6.7	11+	N	0	59.0	-84	37
Jun. 5		ZC 2617	K	4.5	98-	N	11	34.5	-130	40
Jul. 22		ZC 1625	Y	5.8	16+	N	3	30.7	-118	41
Aug. 4	ψ^1 Aqr	ZC 3419	A	4.2	91-	N	4	56.4	-115	42
Aug. 13		ZC 1108	V	7.0	8-	N	9	22.5	-103	47
Aug. 25	Antares	ZC 2366	O	1.1	57+	S	1	52.5	-130	37
Oct. 8	υ^1 Cancr	ZC 1274	K	5.7	34-	N	7	2.7	-99	40
Oct. 21	59 Sgr	ZC 2912		4.5	48+	S	23	42.5	-94	25
Nov. 8		ZC 1648		6.9	23-	S	9	9.1	-102	54
Dec. 15		ZC 2831		6.0	5+	S	0	51.1	-110	23
Dec. 16	33 Cap	ZC 3130		5.4	19+	S	23	24.5	-89	21
Dec. 19	ψ^1 Aqr	ZC 3419	A	4.2	40+	S	0	7.8	-113	41
Dec. 19	27 Psc	ZC 3526	A	4.9	50+	S	20	18.1	-59	45