

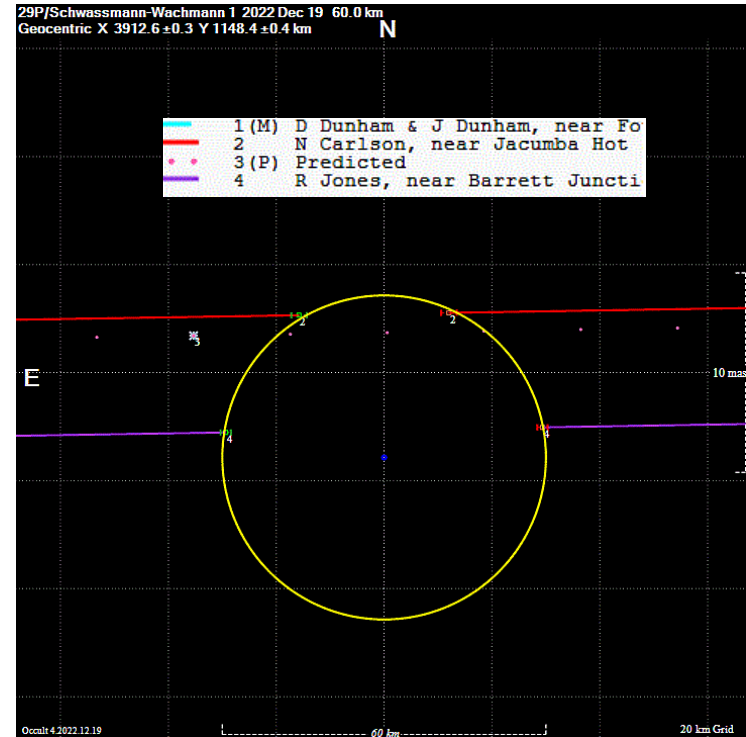
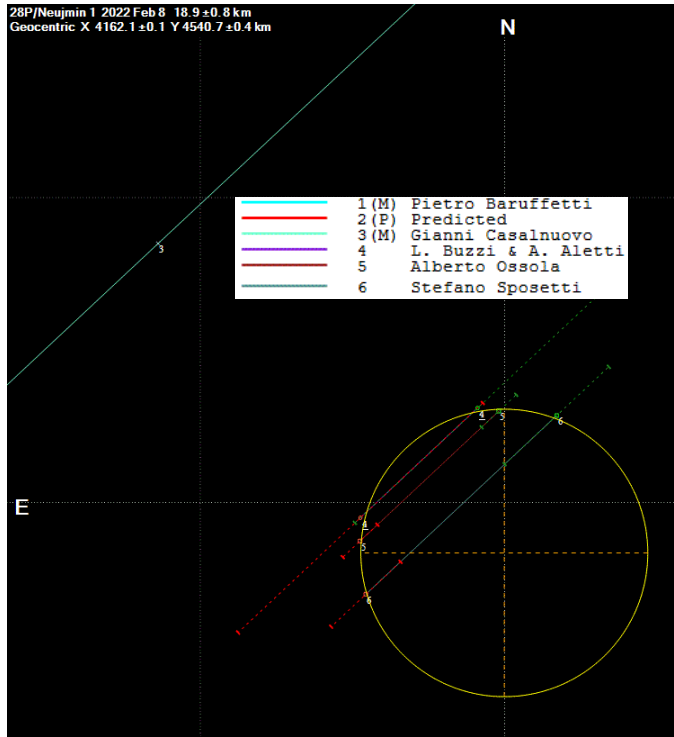
OCCULTATIONS BY CENTAURS, TNOs, AND SPECIAL MAIN-BELT ASTEROIDS DURING THE REST OF 2023 AND BY TROJAN ASTEROIDS IN 2023 & EARLY 2024

For the IOTA meeting by zoom, July 15, 2023

David W. Dunham



IOTA Observations of Occultations by Comets



On 2022 February 8, 3 amateur observers in Europe working with IOTA obtained what we believe to be the first unambiguous observations of an occultation by the nucleus of a comet, 28P/Neujmin 1.

On 2022 Dec. 4, a first occ'n of a 15th-mag. star by SW-1 was observed at SOAR in Chile, allowing Lucky Star to update the orbit accurately. On 2022 Dec. 19, IOTA observers worked with Lucky Star & others to record the 1st multi-chord occultation by 29P/Schwassmann-Wachmann 1 (SW1). IOTA observed at least 2 more SW1 events, on 2022 Dec 29 in NM and 2023 May 7 in the UK. But for the best info. about SW1 occultations, see Buie et al.'s ACM 2023 E-Poster #2445.

Other observed occultations by SW-1

Vadim Nikitin recorded the 2022 Dec. 29th Event near Roswell, NM and Richard Nugent saw it in cen. Texas, but wasn't able to record it.

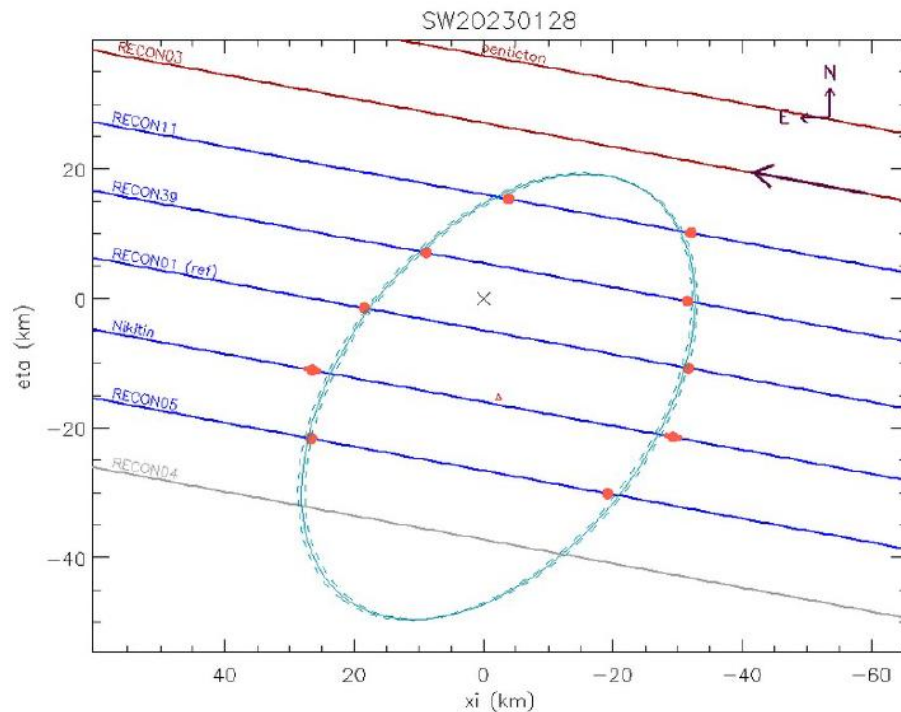
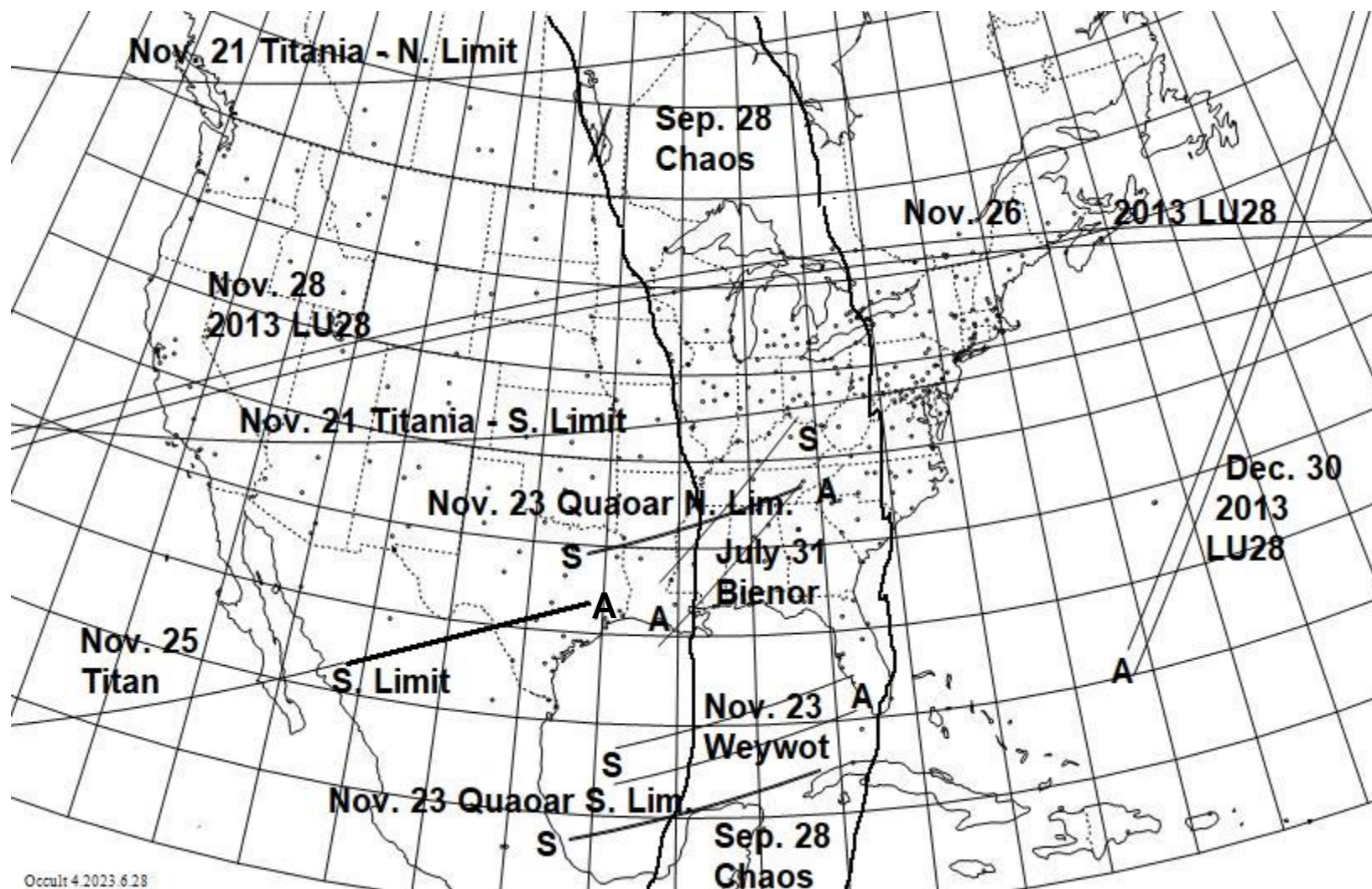


Figure 1: Sky-plane profile of SW1 from PO20230128. Blue lines show detections, red are negative, and gray are for no data. The formal elliptical fit is shown.

The earlier successful events allowed Marc Buie at SwRI to mount a multi-station mobile effort with RECON systems in eastern Washington for the 2023 Jan. 28th event, left, from his ACM 2023 abstract, but it was not included in his ePoster so this should not be shared until it is published. Note that this was just a week before the huge Polymele effort in Kansas on 2023 Feb. 4 UT.

Occultations by Distant Objects, rest of 2023 in North America

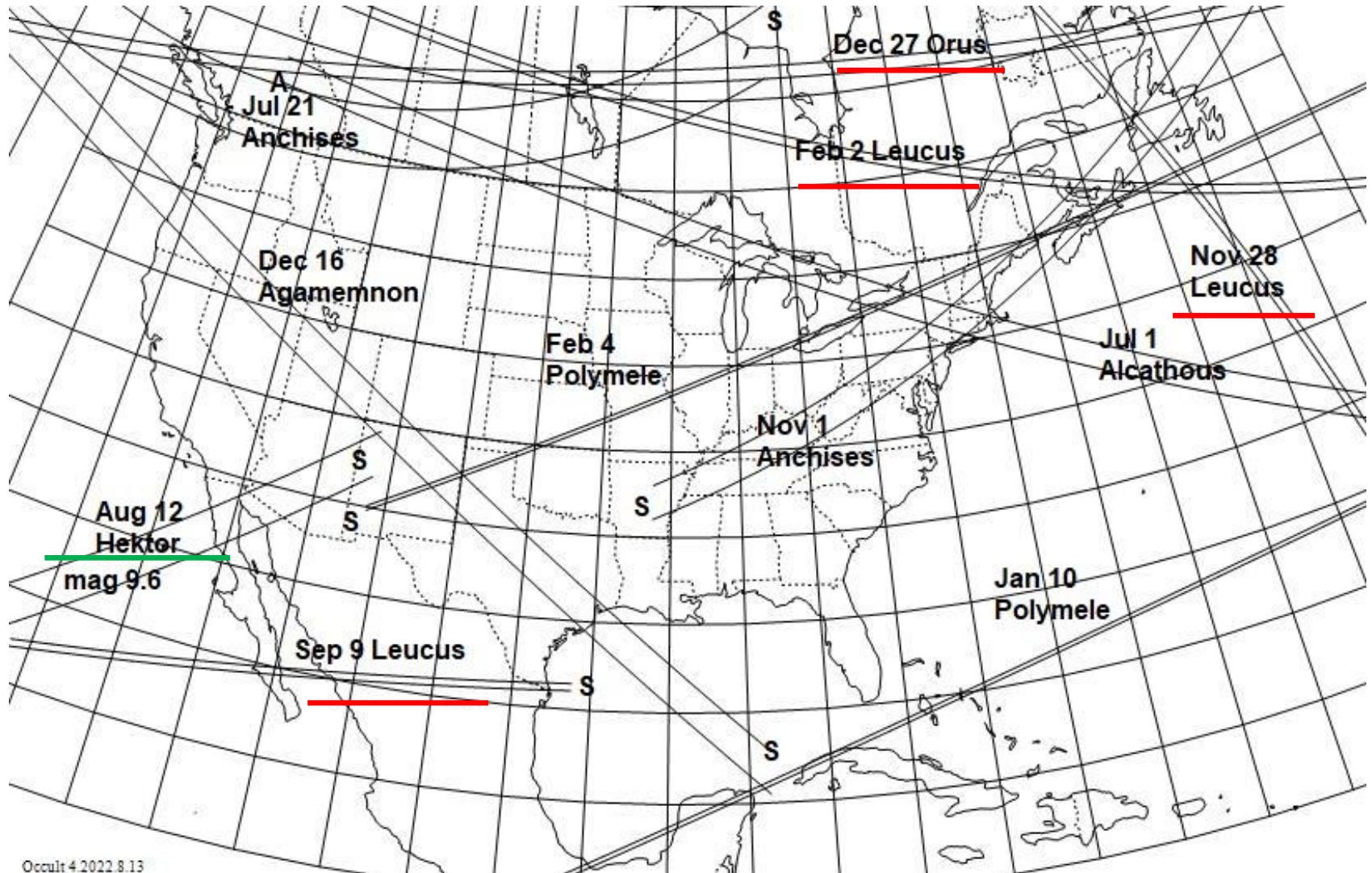


Occultations by Distant Objects, rest of 2023 in North America

Date	U.T.	Diam	Dur.	Star	Mag	Eln	Star	d	Path	Planet	Moon	R.A. (J2000)			Dec.		
m d	h m	km	sec	mag	Drop	o				No Name	Dist	ill	h m s	o ' "			
Jul 31	9 25	188	5.5s	14.6	4.6	34	UCAC4 653-044855	LA-KY	54598	Bienor	164	97	6 42 17.421	40 26 37.59			
Sep 28	7 11	364	63.5s	13.5	7.5	92	UCAC4 607-028826	FL-ON	19521	Chaos	103	98	6 9 56.940	31 21 23.25			
Nov 21	5 18	1577	72.8s	11.8	2.2	172	TYC 1236-00841-1	NL-CA		Titania	72	59	3 12 17.324	17 32 27.04			
Nov 23	0 25	139	4.9s	14.8	4.2	38	UCAC4 373-131780	s FL-low		Weywot	87	78	18 29 5.730	-15 24 54.02			
Nov 23	0 32	1095	37.9s	14.8	4.2	38	UCAC4 373-131780	s TX-GA	50000	Quaoar	87	78	18 29 5.730	-15 24 54.02			
Nov 25	3 55	5150	367s	14.4	0.01	88	UCAC4 386-150960	wNA		Titan	64	94	22 12 47.559	-12 50 56.62			
Nov 26	7 43	76	3.2s	14.7	3.5	112	UCAC4 695-050057	CA-NS	468861	2013 LU28	78	99	9 24 15.663	48 54 52.09			
Dec 30	0 9	76	2.0s	15.8	2.3	141	UCAC4 703-049020	Berm	468861	2013 LU28	29	91	8 59 57.152	50 30 12.43			

Occultations by Trojan Asteroids during 2023 in North America

Upcoming Lucy events underlined in **red**, bright Hektor event in **green**



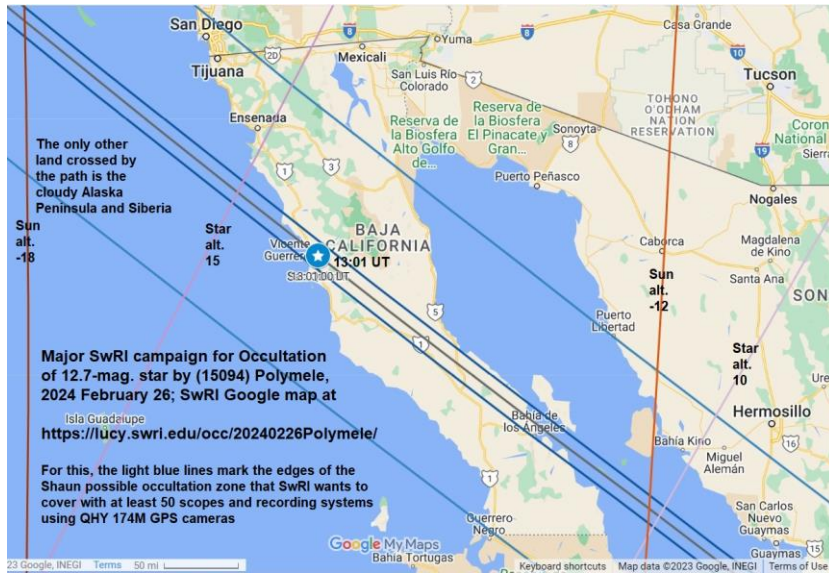
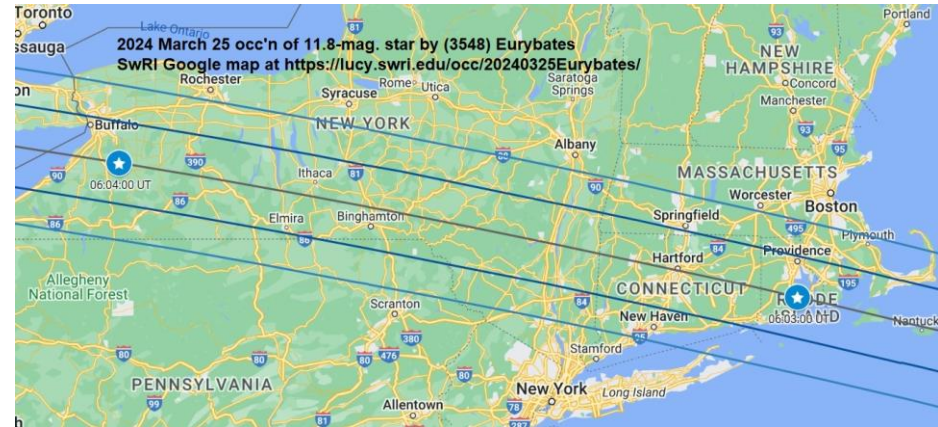
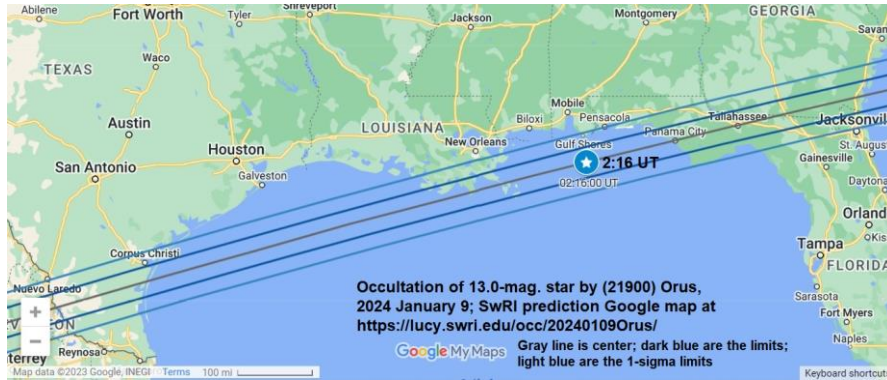
Occultations by Trojan Asteroids during 2023 in North America

2023 OCCULTATIONS BY TROJAN ASTEROIDS

Date	UT	Occulting Body	Star	Mag.	RA (2000)			Dec			Dur. s	Path
					h	m	s	°	'	"		
Jan. 10	01:50	15094 Polymele	UCAC4 630-037427	12.8	06 53 22.1	+35 52 58	5.6	1.3	BS-Mex			
Feb. 2	06:26	11351 Leucus	UCAC4 535-023400	14.0	06 05 56.5	+16 59 57	4.1	3.7	NS-AK			
Feb. 4	01:43	15094 Polymele	UCAC4 631-037227	13.3	06 38 54.7	+36 01 27	5.5	2.0	NS-NM			
Jul. 1	06:03	2241 Alcahous	UCAC4 464-127791	11.2	21 44 08.5	+02 40 08	5.0	11.6	MA-BC			
Jul. 21	07:06	1173 Anchises	UCAC4 364-177314	12.9	20 12 04.4	-17 20 56	2.4	7.5	ON-BC			
Aug. 12	11:41	624 Hektor	UCAC4 627-040447	9.6	07 34 34.7	+35 18 58	5.7	4.8	Baja-NM			
Sep. 9	11:09	11351 Leucus	UCAC4 509-045671	13.2	08 23 22.7	+11 43 06	5.6	1.0	Baja-TX			
Nov. 1	00:15	1173 Anchises	UCAC4 364-176248	12.9	20 02 18.5	-17 12 23	3.4	5.7	AR-NL			
Nov. 28	06:32	11351 Leucus	UCAC4 483-047928	13.5	08 58 22.4	+06 33 35	5.1	5.5	QC-NL			
Dec. 16	11:26	911 Agamemnon	UCAC4 642-044054	13.2	08 29 48.3	+38 16 06	2.2	13.3	TX-OR			
Dec. 27	06:39	21900 Orus	UCAC4 541-037650	13.5	07 05 38.8	+18 05 05	3.4	3.0	ON-BC			

Lucy Target Occultations, Early 2024

from <https://lucy.swri.edu/occ/predictions.html>



The Southwest Research Institute (SwRI) is also interested in occultations by other Jupiter Trojan asteroids, to extend the science that will be obtained by NASA's Lucy mission.

Discovery and confirmation of the satellite of (4337) Arecibo, 2021

Discovery by Peter Nosworthy & Dave Gault, May 19, west of Sydney, NSW, Australia
Confirmation by Richard Nolthenius and Kirk Bender, June 9, central California, USA

Sky plane plot of the observations; the fitted circle for (4337) Arecibo is 24.4 km in diameter, while that for the satellite is 13.5 km

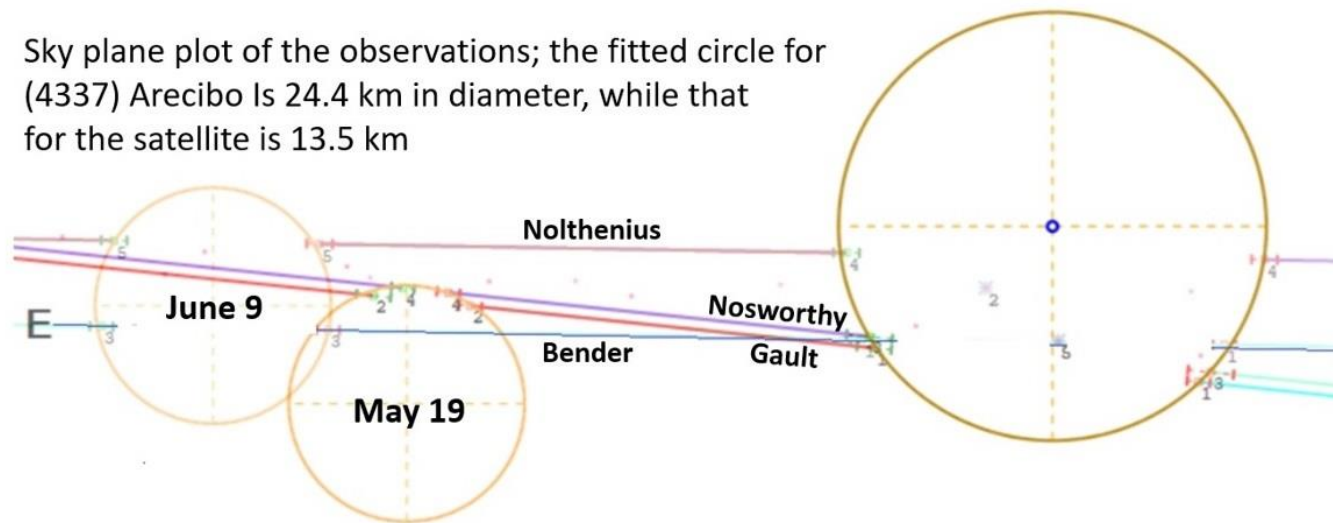
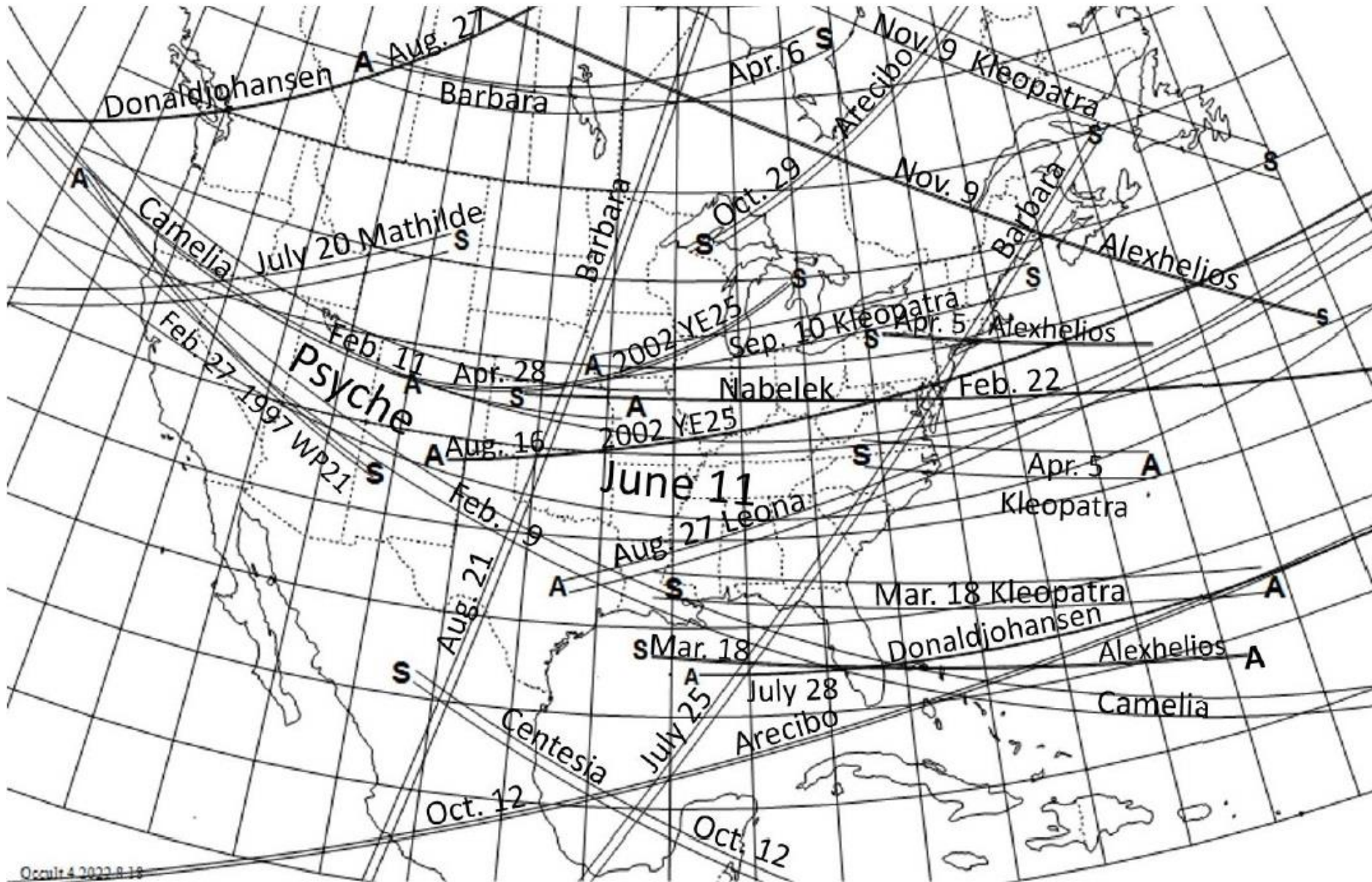


Diagram by Dave Herald using the Occult4 program. For more, including the videos, please visit https://www.youtube.com/watch?v=w_Cc5Or1FFw. Gaia confirmed the duplicity from the small wobble of the center of figure, finding a period of 1.3 days. On 2022 May 16, Nosworthy and Gault found from another occultation that (172376) 2002 YE25 is likely a binary with ~3-km objects about 15 km apart; see

<http://hazelbrookobservatory.com/ye25/#:~:text=Introduction,is%20probably%20two%20smaller%20objects>.

The best occultations of stars by Special Main-Belt Asteroids in North America during 2023



From the RASC Observer's Handbook and <https://occultations.org/publications/rasc/2023/nam23MBspecialoccs.pdf>.

Table of information for events on the map on the previous slide.

2023 OCCULTATIONS BY SPECIAL MAIN-BELT ASTEROIDS

Date	UT	Occulting Body	Star	Mag.	RA (2000)			Dec			Dur. s	Path	
					h	m	s	°	'	"			ΔMag.
Feb. 9	06:08	957 Camelia	UCAC4 425-048350	13.3	08	39	41.6	-05	05	33	1.2	6.5	BS-CA
Feb. 11	10:40	957 Camelia	UCAC4 426-047968	13.7	08	37	57.0	-04	56	29	0.9	6.6	IL-OR
Feb. 22	01:30	4552 Nabelek	TYC 1247-00212-1	12.8	03	36	01.0	+21	44	22	5.8	0.3	KS-DE
Feb. 27	12:44	33074 1997 WP21	UCAC4 340-175407	12.6	18	55	07.6	-22	08	29	6.4	0.6	CA-NM
Mar. 18	01:00	Alexhelios	TYC 0634-00190-1	10.7	02	19	49.1	+10	35	22	1.5	0.20	FL-BS
Mar. 18	01:00	216 Kleopatra	TYC 0634-00190-1	10.7	02	19	49.1	+10	35	22	1.5	2.9	LA-FL
Apr. 5	00:48	216 Kleopatra	UCAC4 514-004708	12.4	02	57	59.8	+12	41	49	0.5	2.7	VA-NC
Apr. 5	00:48	Alexhelios	UCAC4 514-004708	12.4	02	57	59.8	+12	41	49	0.5	0.19	NY-LI
Apr. 6	09:11	234 Barbara	UCAC4 415-122294	13.9	19	19	54.0	-07	00	60	0.6	2.0	AB-ON
Apr. 28	09:17	172376 2002 YE25	UCAC4 432-115773	12.1	22	14	10.4	-03	41	46	8.8	0.12	CO-MI
Jun. 11	05:53	16 Psyche	UCAC4 391-062150	13.6	14	50	37.7	-11	56	48	0.1	28.3	NC-OR
Jul. 20	10:04	253 Mathilde	UCAC4 531-006629	13.1	03	35	31.9	+16	08	10	2.1	1.8	CA-MT
Jul. 25	07:00	234 Barbara	UCAC4 416-141013	11.9	20	14	26.2	-06	57	13	0.3	5.6	NB-Mex
Jul. 28	02:52	52246 Donaldjohanson	TYC 5234-00643-1	11.5	22	48	20.6	-01	08	58	8.3	0.6	DZ-FL
Aug. 16	02:49	172376 2002 YE25	UCAC4 488-143179	13.0	22	39	09.8	+07	32	19	6.5	0.3	NJ-NM
Aug. 21	05:16	234 Barbara	TYC 5750-00865-1	10.7	19	58	20.0	-14	41	46	0.9	5.9	ON-Mex
Aug. 27	06:23	52246 Donaldjohanson	UCAC4 438-122513	12.3	22	25	23.5	-02	35	50	6.7	0.3	SK-BC
Aug. 27	07:01	319 Leona	UCAC4 525-012493	13.8	05	21	37.5	+14	51	37	2.0	2.2	TX-NC
Sep. 10	08:59	216 Kleopatra	UCAC4 497-050188	13.1	08	21	04.9	+09	15	05	0.4	3.2	IA-ME
Oct. 12	01:09	513 Centesima	TYC 5749-00630-1	8.2	20	21	10.9	-11	45	55	6.6	4.8	Mex
Oct. 12	07:20	4337 Arecibo	UCAC4 537-005401	12.6	03	05	18.8	+17	22	48	5.3	1.7	BS-Mex
Oct. 29	23:51	4337 Arecibo	UCAC4 534-004986	11.7	02	53	22.8	+16	40	34	5.8	1.3	QC-MI
Nov. 9	08:59	Alexhelios	UCAC4 451-048971	12.7	09	38	44.5	+00	07	14	0.6	0.4	SK-NS
Nov. 9	08:59	216 Kleopatra	UCAC4 451-048971	12.7	09	38	44.5	+00	07	14	0.6	5.9	QC-NL

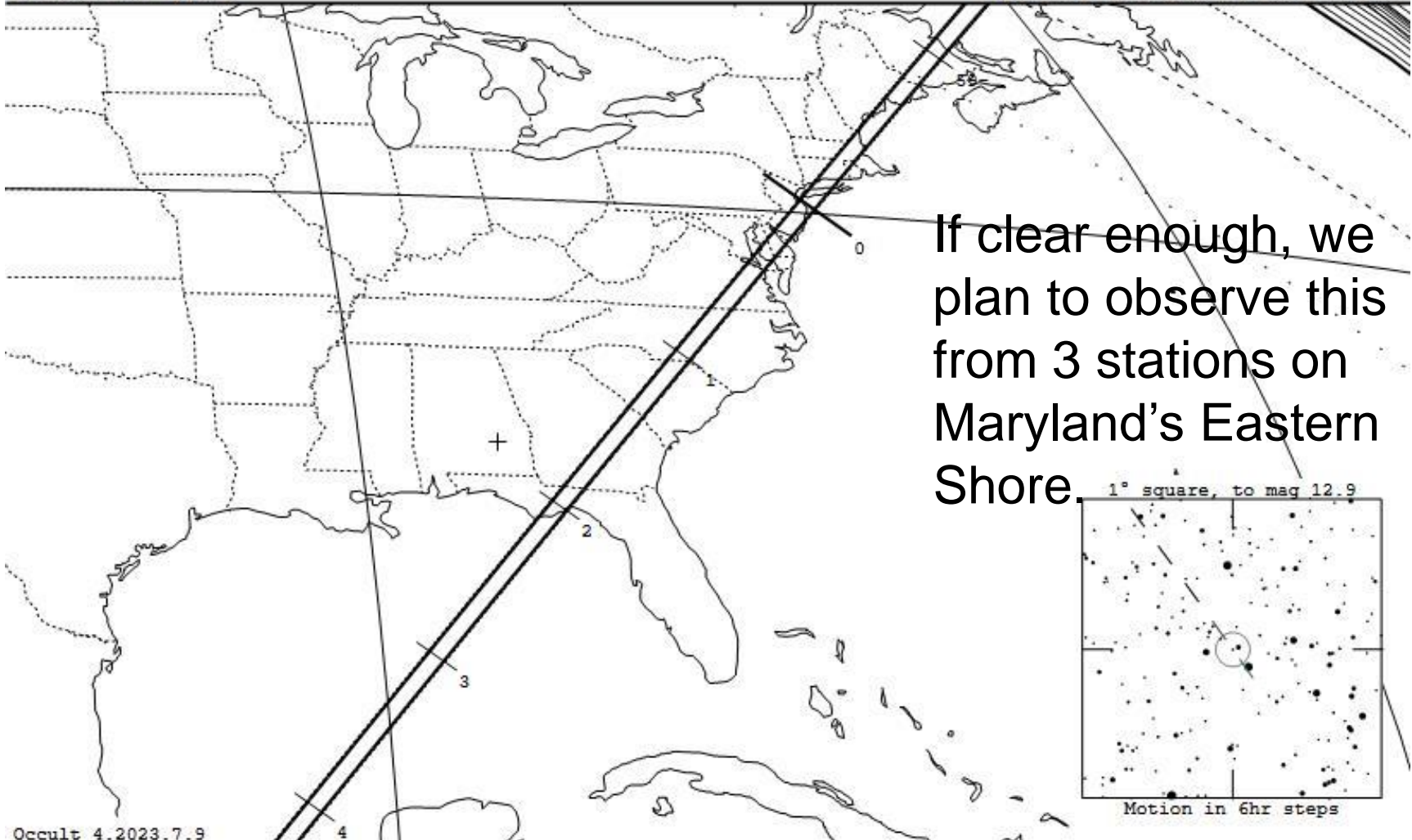
234 Barbara occults UCAC4 416-141013 on 2023 Jul 25 from 6h 57m to 7h 24m UT

Star: (Dia < 0.1 mas)
Mv 11.9; Mb 12.4; Mr 11.2
RA = 20 14 26.2267 (astrometric)
Dec = - 6 57 13.156
[of Date: 20 15 43, - 6 52 54]
Prediction of 2023 Apr 3.1
Reliable 1.0 (good),

Durations: Max = 5.6 secs
1km = 0.12 secs, 1mas = 0.077 secs
Mag Drop: 0.31 [25%]v, 0.38 [30%]r
Sun : Dist = 167°
Moon: Dist = 99°, illum = 44%
Error 6.3 x 1.7 mas in PA 106°

Asteroid: (in DAMIT)
Mag = 10.7
Dia = 46 ±3km, 73 mas
Parallax = 10.203"
Hourly dRA = -1.819s
dDec = -38.30"

JPL#98:INTG:2022-Aug-01, Known errors



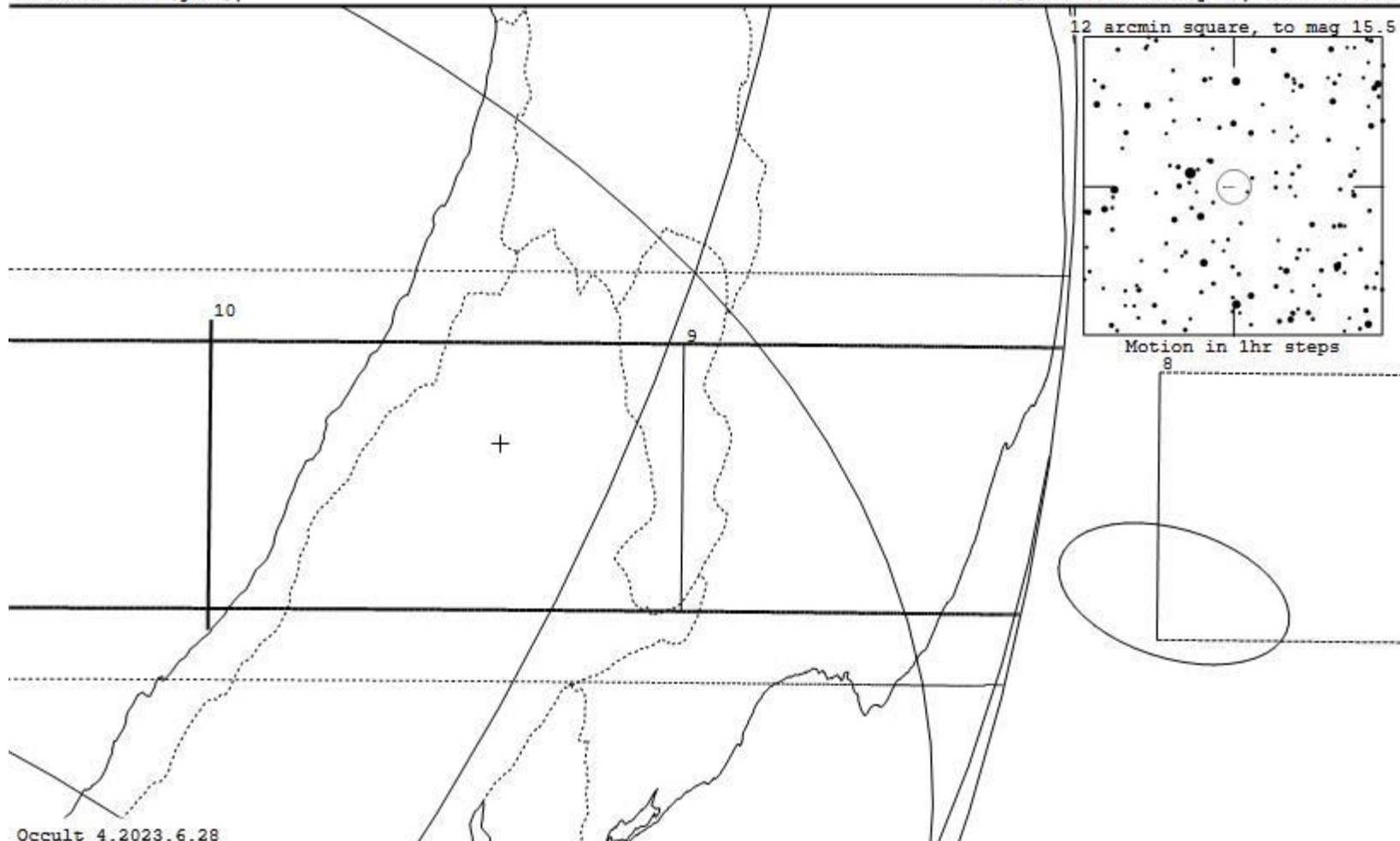
If clear enough, we plan to observe this from 3 stations on Maryland's Eastern Shore

28978 Ixion occults UCAC4 294-163948 on 2023 Jul 28 from 6h 8m to 6h 19m UT

Star: (Dia < 0.1 mas)
 Mv 14.5; Mb 15.8; Mr 13.4 [+1 near]
 RA = 18 11 3.2665 (astrometric)
 Dec = -31 15 22.518
 [of Date: 18 12 36, -31 15 7]
 Prediction of 2023 Jul 15.2
 Reliable 0.9 (good),

Durations: Max = 35.2 secs
 1km = 0.050 secs, 1mas = 1.3 secs
 Mag Drop: 4.9 [99%]v, 5.5 [99%]r
 Sun : Dist = 147°
 Moon: Dist = 30°, illum = 74%
 Error 11.7 x 6.3 mas in PA 107°

Asteroid:
 Mag = 19.4
 Dia = 710 ±0km, 26 mas
 Parallax = 0.236"
 Hourly dRA = -0.209s
 dDec = 0.03"
 JPL#19:INTG:2023-May-22, Known errors



Occult 4.2023.6.28

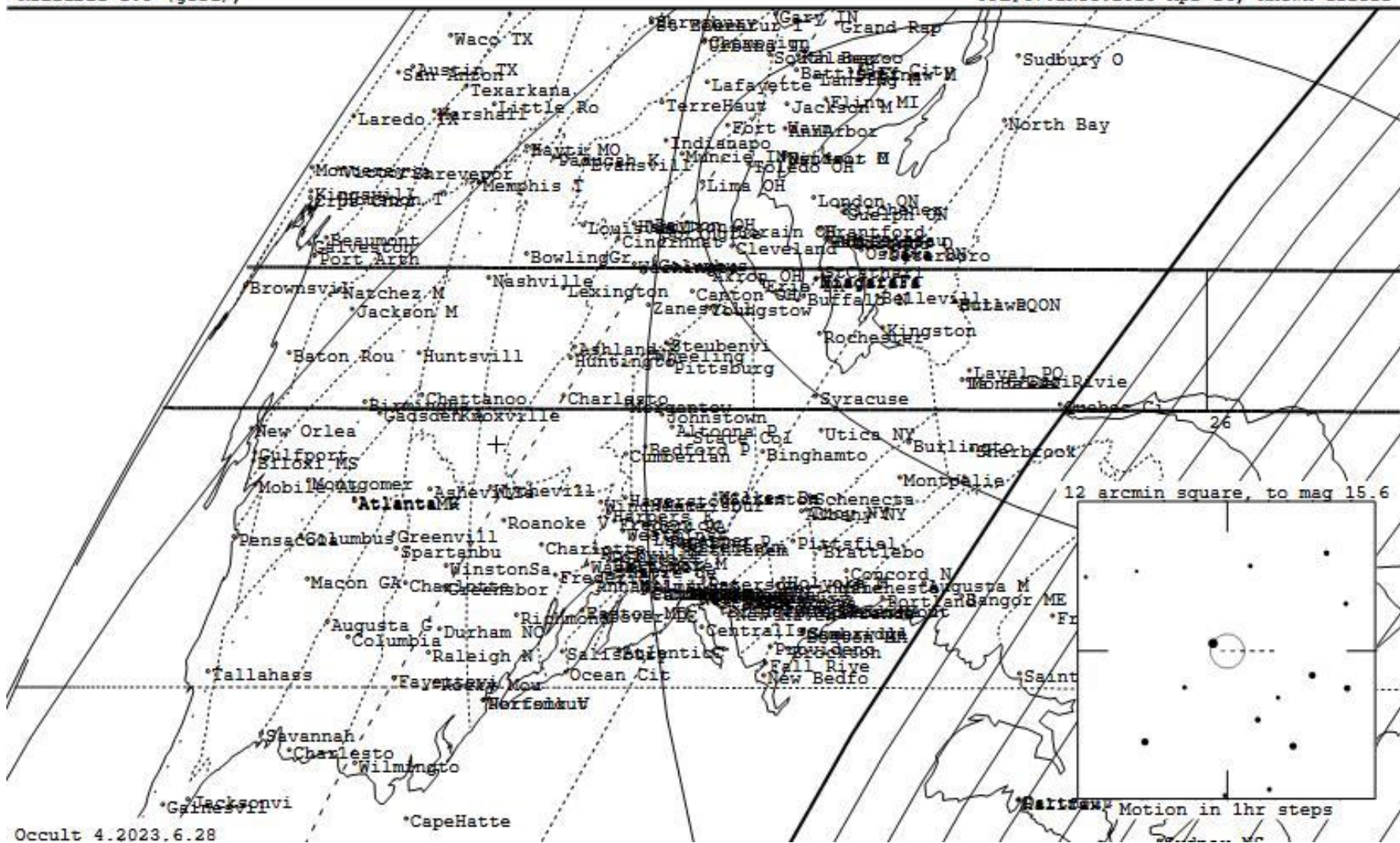
54598 Bienor occults UCAC4 653-044855 on 2023 Jul 31 from 9h 25m to 9h 31m UT

Star: (Dia < 0.1 mas)
 Mv 14.6; Mb 15.5; Mr 13.6
 RA = 6 42 17.4211 (astrometric)
 Dec = 40 26 37.588
 [of Date: 6 43 54, 40 25 16]
 Prediction of 2023 Jul 15.2
 Reliable 1.3 (good),

Durations: Max = 5.5 secs
 1km = 0.029 secs, 1mas = 0.31 secs
 Mag Drop: 4.6 [99%]v, 5.1 [99%]r
 Sun : Dist = 34°
 Moon: Dist = 164°, illum = 97%
 Error 61.7 x 31.7 mas in PA 106°

Asteroid:
 Mag = 19.2
 Dia = 188 ± 24km, 18 mas
 Parallax = 0.608"
 Hourly dRA = 1.030s
 dDec = 0.00"

JPL#67:INTG:2023-Apr-26, Known errors



<https://lesia.obspm.fr/lucky-star/occ.php?p=122624>



P5M02 Europa (II) occults UCAC4 524-004702 on 2023 Aug 1 from 21h 54m to 21h 59m

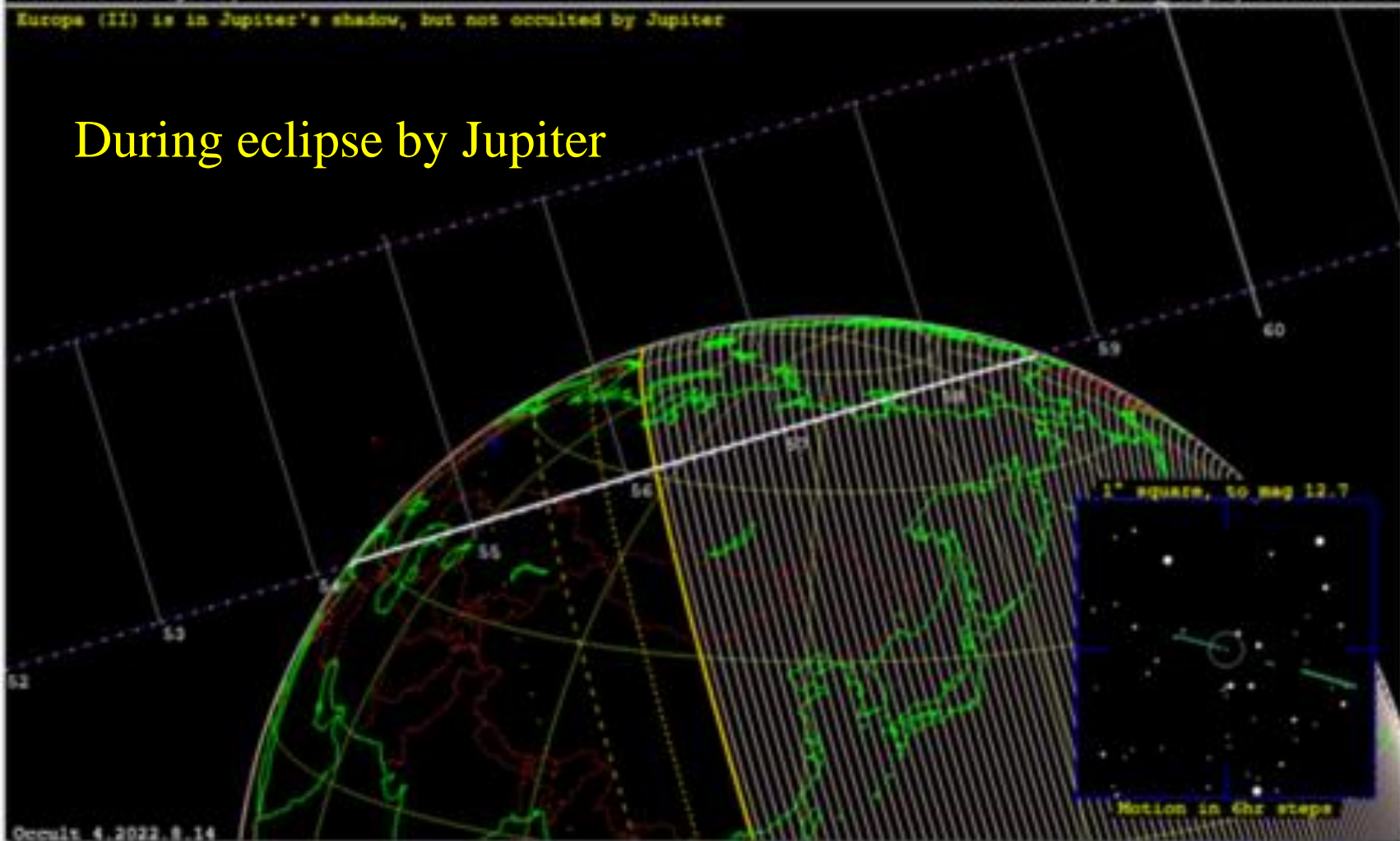
Star: (Dia < 0.1 mas)
Mv 11.7; Mb 12.4; Mr 11.7
RA = 2 45 27.7084 (astrometric)
Dec = 14 42 33.713
[of Date: 2 46 45, 14 48 31]
Prediction of 2023 Aug 14.2
Reliable 1.1 (good).

Durations: Max = 107.8 secs
1km = 0.035 secs, 1mas = 0.12 secs
Mag Drop: 4.4 [98%]v, 3.9 [97%]z
Sun : Dist = 86"
Moon: Dist = 32", illum =100%
Error 2.0 x 2.0 mas in PA 0°

Asteroid:
Mag = 16.0
Dia = 3122 ±1km, 871 mas
Parallax = 1.780"
Hourly dRA = 1.926s
dDec = 8.45"
DR440+JPL4jup345 merged, Star+Assumed

Europa (II) is in Jupiter's shadow, but not occulted by Jupiter

During eclipse by Jupiter



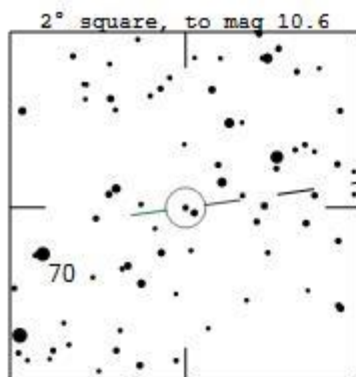
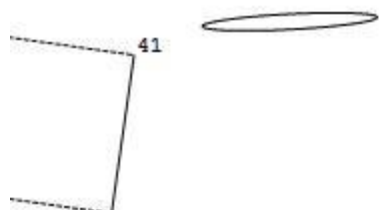
624 Hektor occults UCAC4 627-040447 on 2023 Aug 12 from 11h 41m to 11h 47m UT

Star: (Dia = 0.1 mas)
 Mv 9.6; Mb 9.9; Mr 9.2
 RA = 7 34 34.7196 (astrometric)
 Dec = 35 18 58.004
 [of Date: 7 36 6, 35 15 56]
 Prediction of 2022 Aug 14.7
 Reliable 1.2 (good),

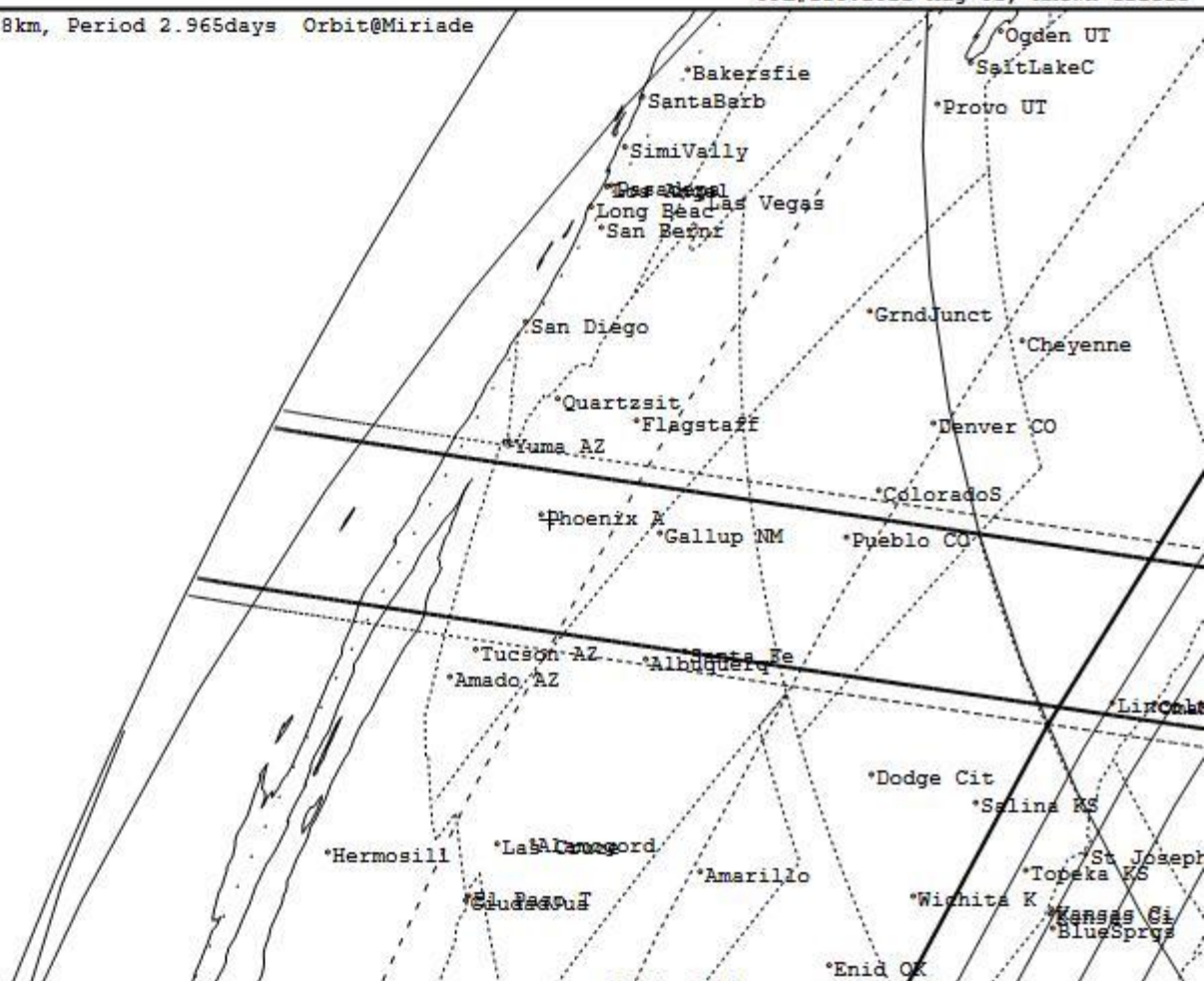
Durations: Max = 4.7 secs
 1km = 0.026 secs, 1mas = 0.11 secs
 Mag Drop: 5.8 [100%]v, 5.8 [100%]r
 Sun : Dist = 32°
 Moon: Dist = 16°, illum = 14%
 Error 22.7 x 2.0 mas in PA 87°

Asteroid: (in DAMIT)
 Mag = 15.4
 Dia = 181 ±10km, 41 mas
 Parallax = 1.457"
 Hourly dRA = 2.547s
 dDec = -4.43"
 JPL#118:2022-Aug-01, Known errors

1 moon. {Skamandrios} 12km at 958km, Period 2.965days Orbit@Miriade
 Double, in WDS



Motion in 24hr steps
 Occult 4.2023.6.5

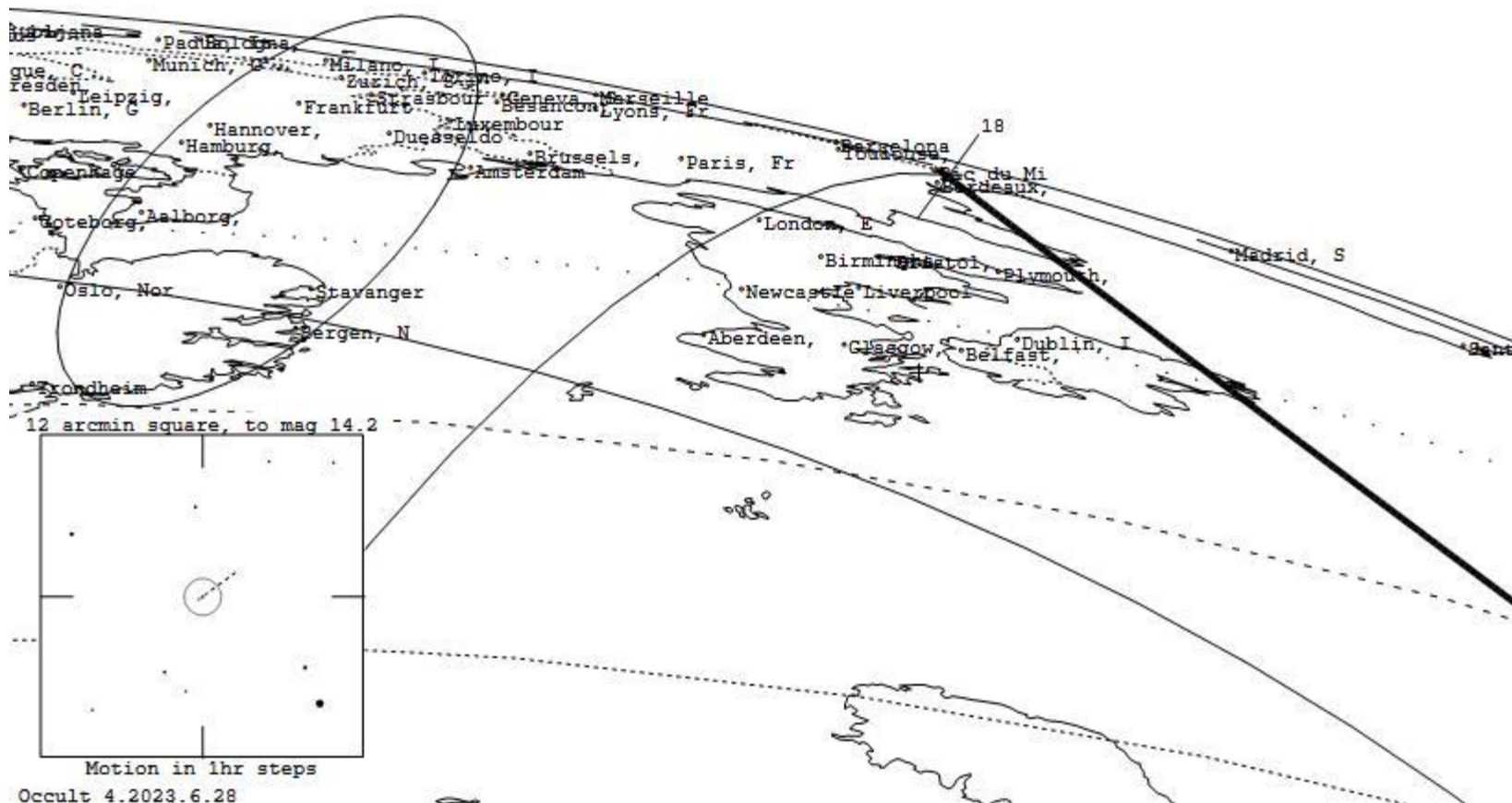


468861 2013 LU28 occults UCAC4 690-050703 on 2023 Aug 18 from 22h 18m to 22h 22m U

Star: (Dia < 0.1 mas)
 Mv 13.2; Mb 13.5; Mr 12.7
 RA = 9 21 51.8236 (astrometric)
 Dec = 47 56 21.994
 [of Date: 9 23 25, 47 50 27]
 Prediction of 2023 Jul 15.2
 Reliable 1.0 (good),

Durations: Max = 4.1 secs
 1km = 0.054 secs, 1mas = 0.38 secs
 Mag Drop: 5.2 [99%]v, 5.3 [99%]r
 Sun : Dist = 36°
 Moon: Dist = 52°, illum = 6%
 Error 45.3 x 21.3 mas in PA 48°

Asteroid:
 Mag = 18.4
 Dia = 76 ±7km, 11 mas
 Parallax = 0.905"
 Hourly dRA = 0.765s
 dDec = -5.62"
 JPL#28:INTG:2023-Apr-26, Known errors

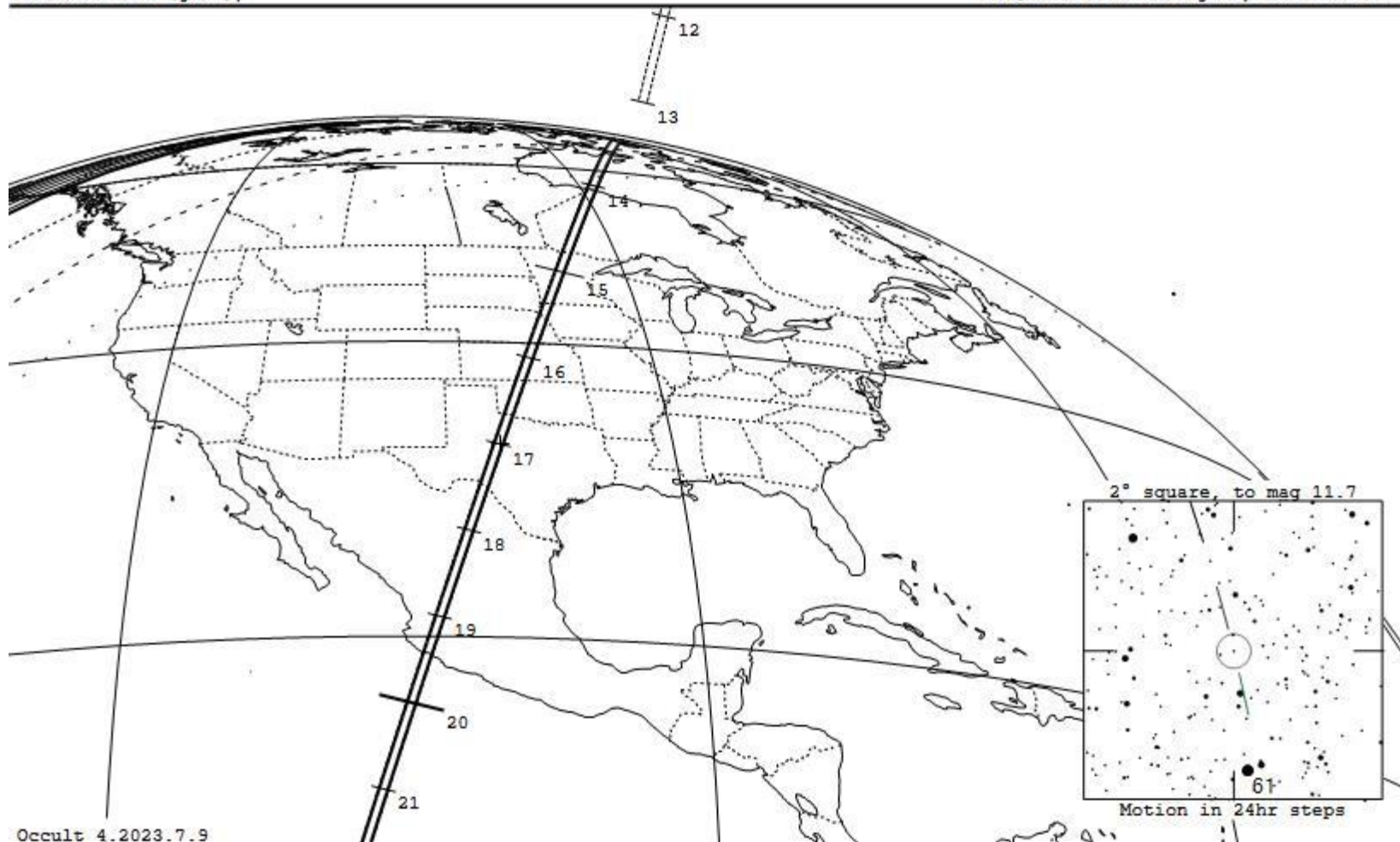


234 Barbara occults TYC 5750-00865-1 on 2023 Aug 21 from 5h 13m to 5h 41m UT

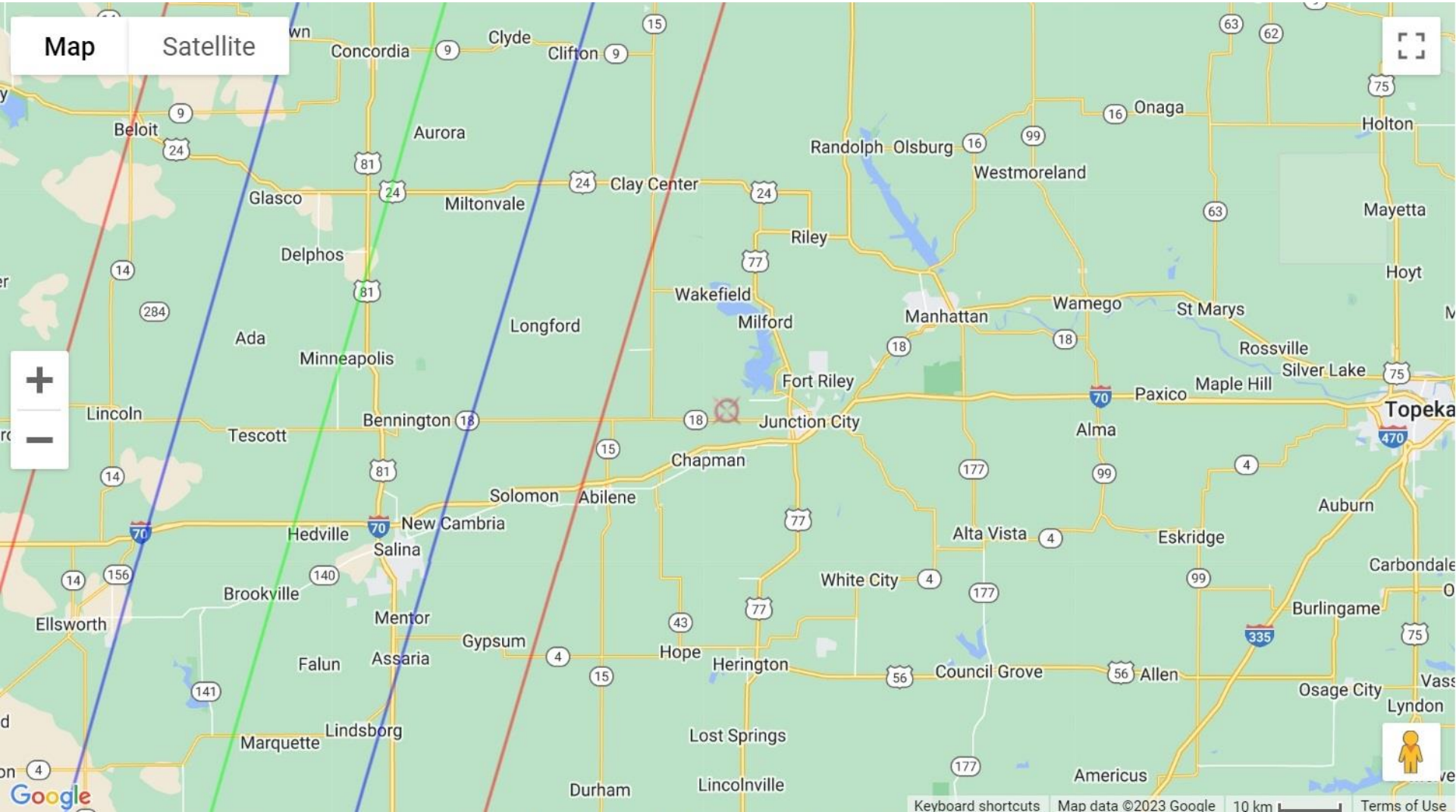
Star: (Dia < 0.1 mas)
 Mv 10.7; Mb 11.1; Mr 10.2
 RA = 19 58 19.9545 (astrometric)
 Dec = -14 41 46.151
 [of Date: 19 59 41, -14 37 55]
 Prediction of 2023 Apr 3.1
 Reliable 1.4 (good),

Durations: Max = 5.9 secs
 1km = 0.13 secs, 1mas = 0.081 secs
 Mag Drop: 0.9 [56%]v, 0.9 [58%]r
 Sun : Dist = 151°
 Moon: Dist = 98°, illum = 20%
 Error 6.3 x 1.7 mas in PA 106°

Asteroid: (in DAMIT)
 Mag = 11.0
 Dia = 46 ± 3km, 72 mas
 Parallax = 9.999"
 Hourly dRA = -0.725s
 dDec = -43.00"
 JPL#98:INTG:2022-Aug-01, Known errors



2023 Aug. 21, back to Salina, KS for the Barbara Occultation?



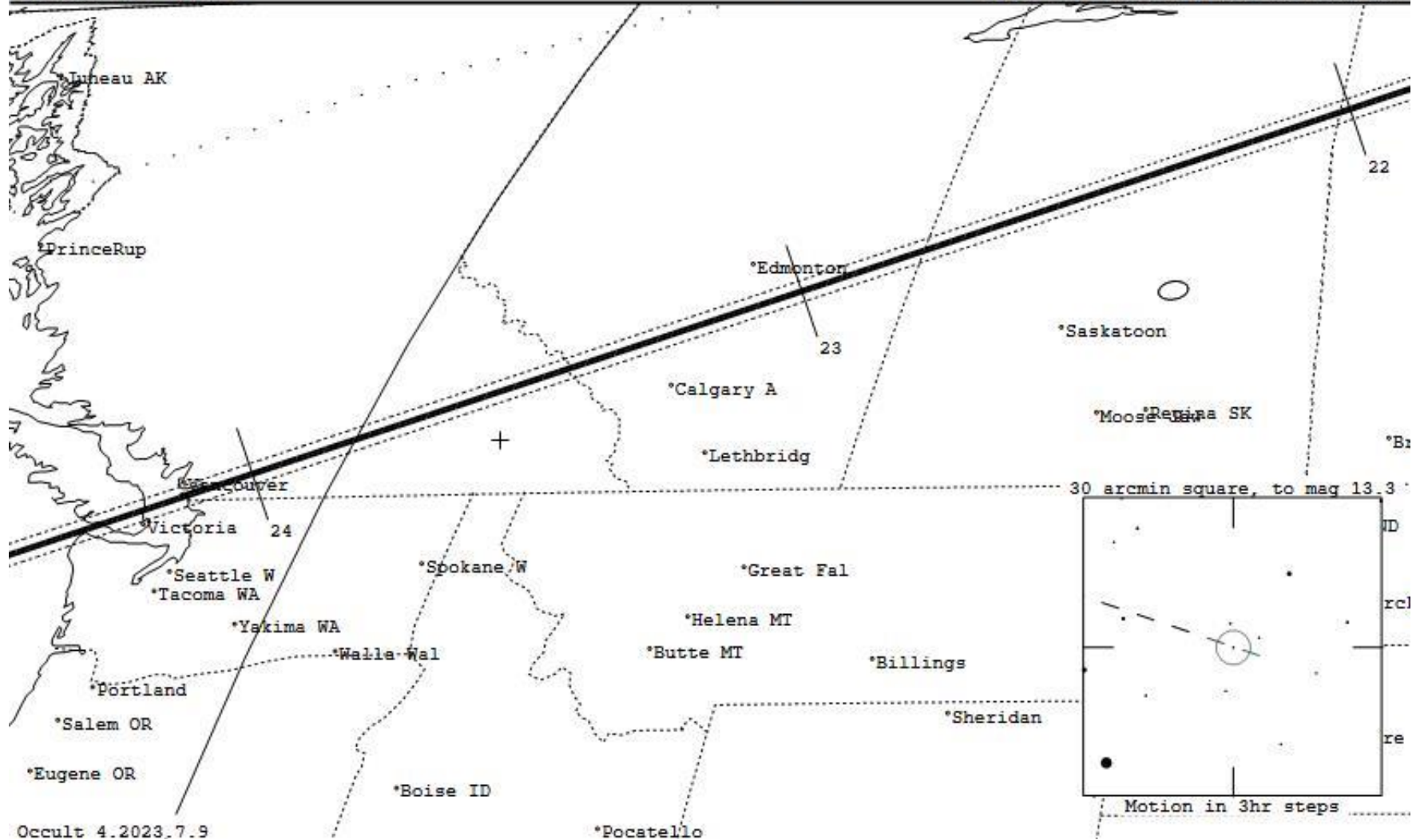
52246 Donaldjohanson occults UCAC4 438-122513 on 2023 Aug 27 from 6h 19m to 6h 2

Star: (Dia < 0.1 mas)
 Mv 12.3; Mb 12.8; Mr 11.7
 RA = 22 25 23.5272 (astrometric)
 Dec = - 2 35 49.931
 [of Date: 22 26 38, - 2 28 34]
 Prediction of 2023 Apr 3.1
 Reliable 1.0 (good),

Durations: Max = 0.31 secs
 1km = 0.079 secs, 1mas = 0.097 secs
 Mag Drop: 6.9 [100%]v, 7.1 [100%]r
 Sun : Dist = 172°
 Moon: Dist = 58°, illum = 80%
 Error 16.3 x 9.7 mas in PA 80°

Asteroid:
 Mag = 19.3
 Dia = 3.90 ± 0.40km, 3.2 mas
 Parallax = 5.235"
 Hourly dRA = -2.346s
 dDec = -11.95"

JPL#20-INTG:2022-Feb-04, Known errors



Lucy mission main-belt target

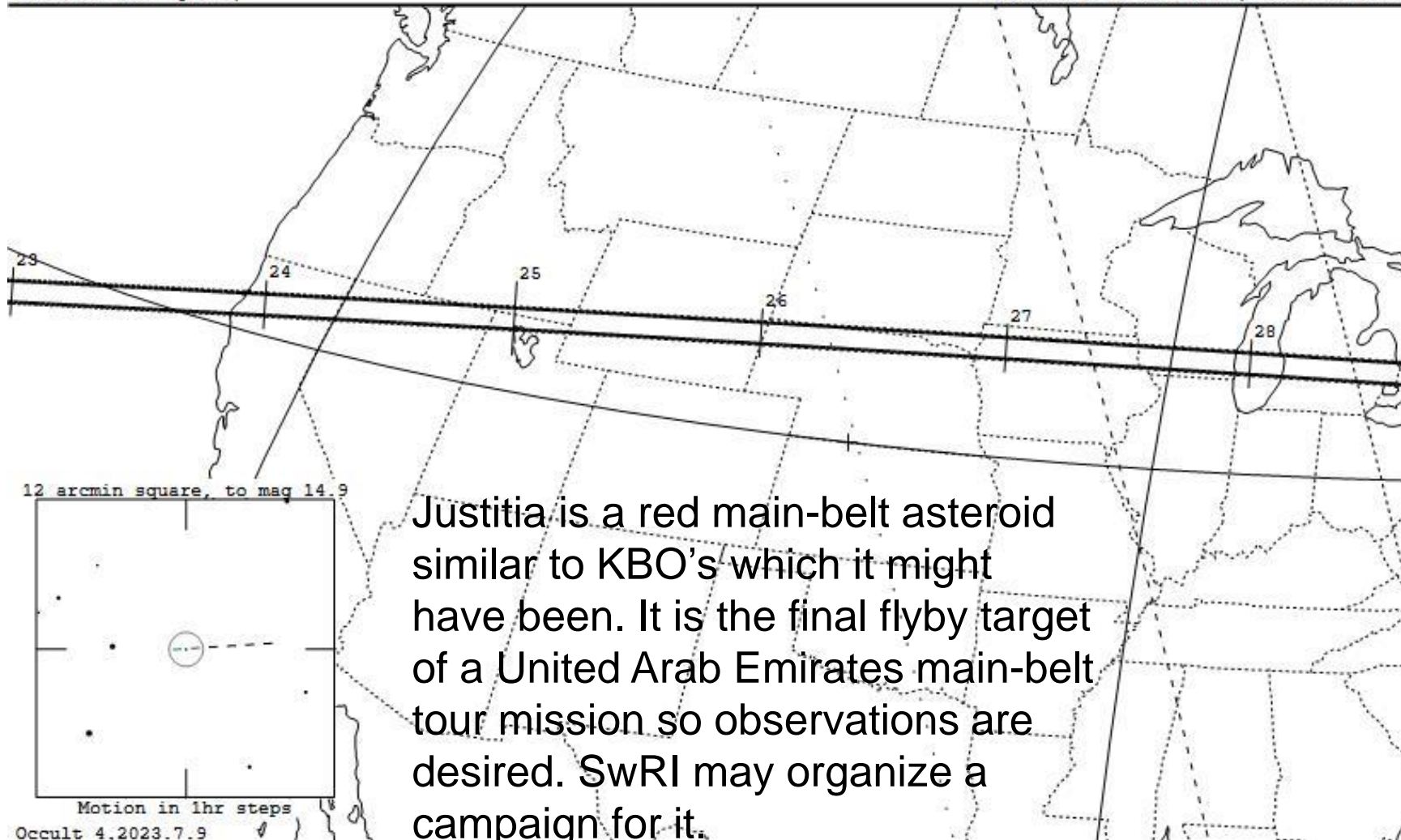
269 Justitia occults UCAC4 526-007495 on 2023 Aug 31 from 10h 21m to 10h 38m UT

Star: (Dia < 0.1 mas)
Mv 13.9; Mb 14.5; Mr 13.2
RA = 4 1 7.9080 (astrometric)
Dec = 15 2 32.056
[of Date: 4 2 28, 15 6 34]
Prediction of 2023 Jul 15.7
Reliable 1.0 (good),

Durations: Max = 5.0 secs
1km = 0.090 secs, 1mas = 0.17 secs
Mag Drop: 1.5 [75%]v, 1.7 [79%]r
Sun : Dist = 97°
Moon: Dist = 78°, illum =100%
Error 6.7 x 1.5 mas in PA 74°

Asteroid: (in DAMIT)
Mag = 15.1
Dia = 56 ±3km, 30 mas
Parallax = 3.455"
Hourly dRA = 1.497s
dDec = -1.47"

JPL#98:INTG:2023-Feb-07, Known errors



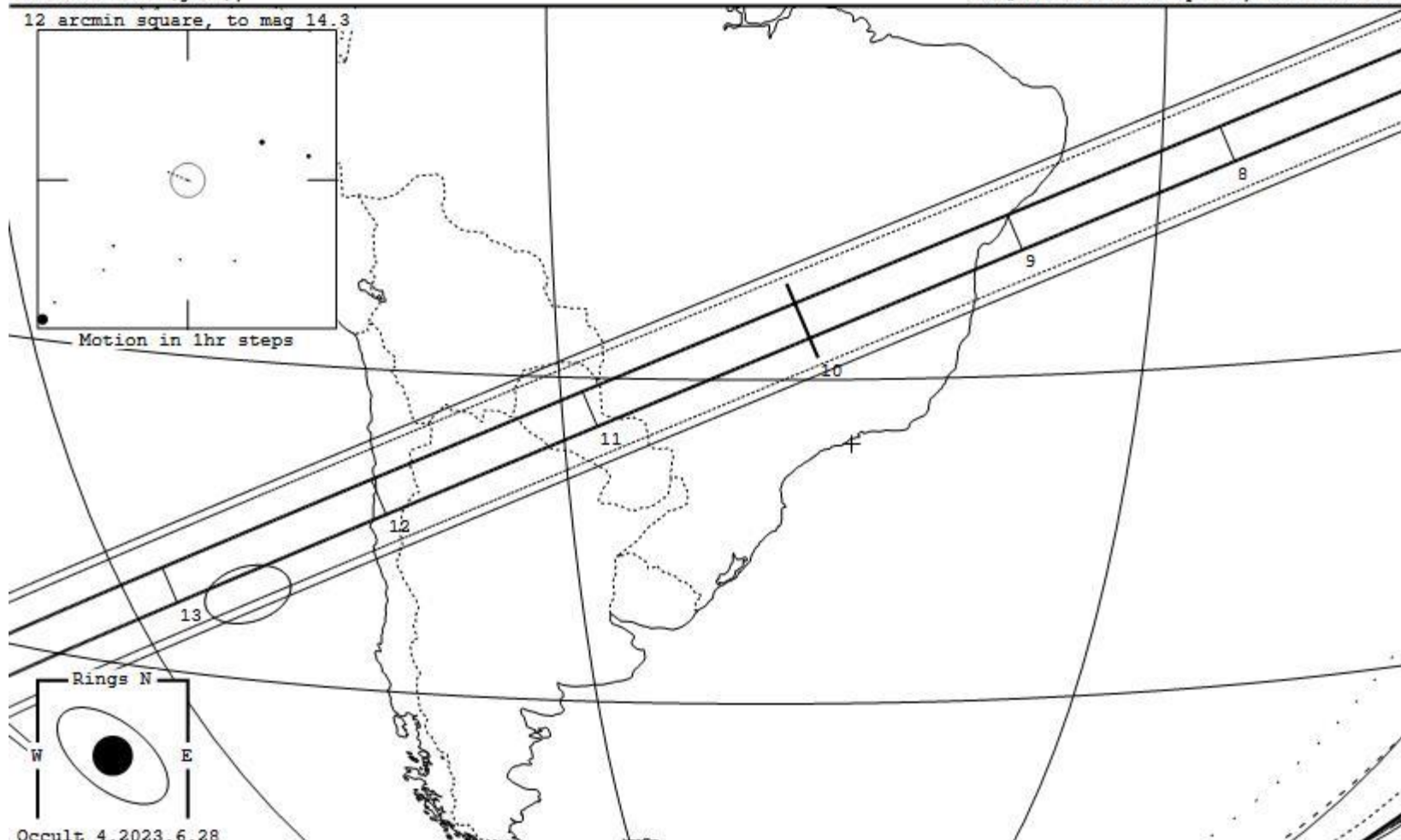
2060 Chiron occults UCAC4 494-001531 on 2023 Sep 10 from 5h 4m to 5h 15m UT

Star: (Dia < 0.1 mas)
 Mv 13.3; Mb 13.7; Mr 12.7
 RA = 1 6 30.3761 (astrometric)
 Dec = 8 44 41.750
 [of Date: 1 7 45, 8 52 23]
 Prediction of 2023 Jul 15.2
 Reliable 1.0 (good),

Durations: Max = 10.1 secs
 1km = 0.050 secs, 1mas = 0.65 secs
 Mag Drop: 5.2 [99%]v, 5.4 [99%]r
 Sun : Dist = 149°
 Moon: Dist = 95°, illum = 20%
 Error 18.0 x 11.3 mas in PA 74°

Asteroid:
 Mag = 18.5
 Dia = 201 ±14km, 16 mas
 Parallax = 0.492"
 Hourly dRA = -0.343s
 dDec = -2.16"
 JPL#149:INTG:2023-Apr-27, Known errors

12 arcmin square, to mag 14.3



Occult 4.2023.6.28

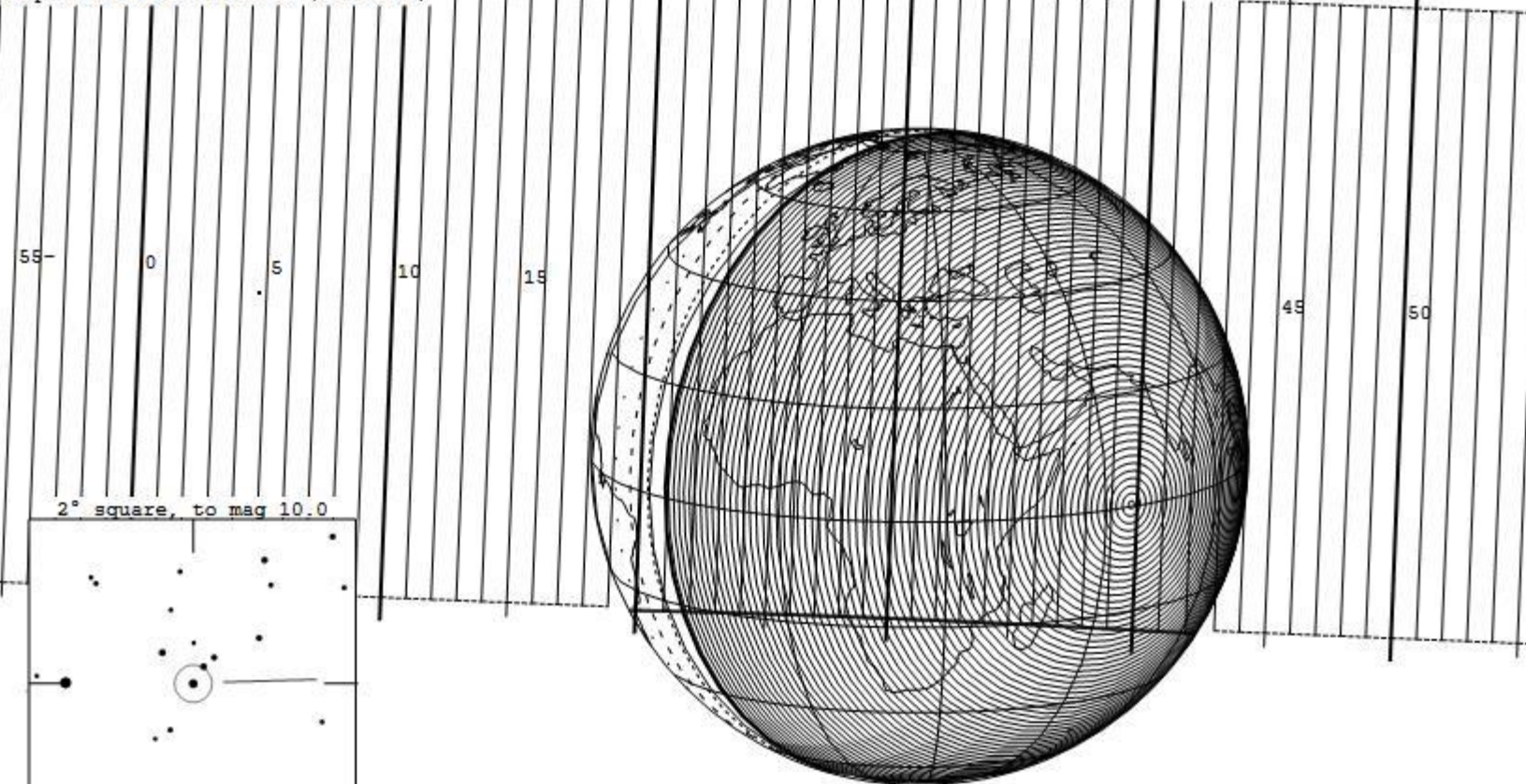
P2M00 Venus occults HIP 45363 on 2023 Sep 22 from 7h 6m to 7h 56m UT

Star: (Dia = 0.3 mas)
 Mv 7.4; Mb 8.1; Mr 7.4
 RA = 9 14 40.9734 (astrometric)
 Dec = 11 29 48.373
 [of Date: 9 15 57, 11 24 4]
 Prediction of 2022 Jun 15.1
 Reliable 1.0 (good),

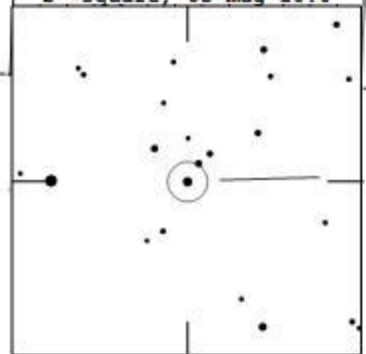
Durations: Max = 1496.9 secs
 1km = 0.12 secs, 1mas = 0.041 secs
 Mag Drop = 0.00 [0%]v
 Sun : Dist = 41°
 Moon: Dist = 124°, illum = 45%
 Error 50.0 x 50.0 mas in PA 90°

Asteroid:
 Mag = -4.8
 Dia = 12244 ±2km, 36595 mas
 Parallax = 19.064"
 Hourly dRA = 5.987s
 dDec = -3.59"
 DE440, Start+Assumed

Expect fades >0.01 secs (star dia)



2° square, to mag 10.0



Motion in 24hr steps

Occult 4.2022.6.11

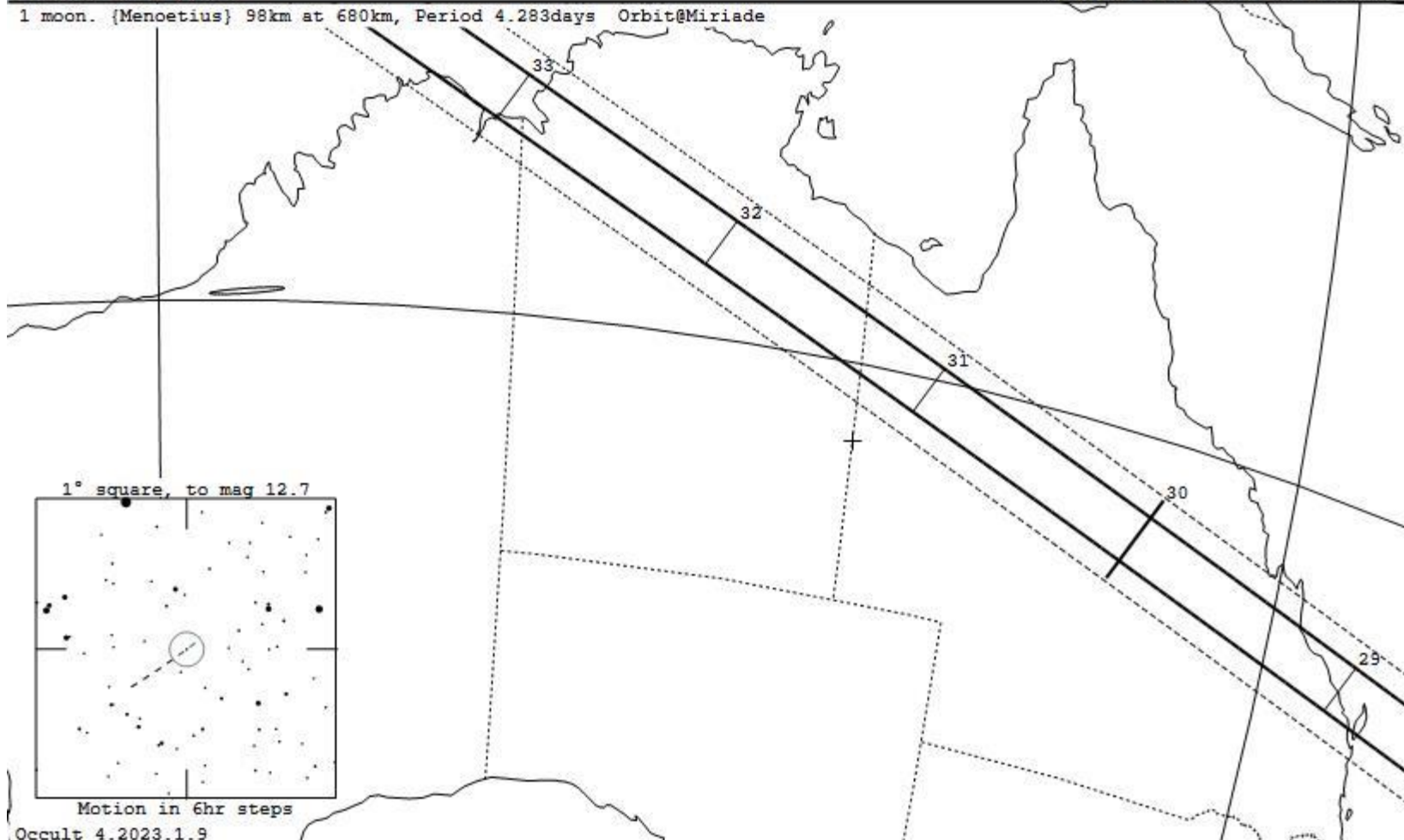
617 Patroclus occults UCAC4 242-181361 on 2023 Sep 22 from 13h 22m to 13h 40m UT

Star: (Dia < 0.1 mas)
 Mv 11.7; Mb 11.8; Mr 11.5
 RA = 21 39 25.0561 (astrometric)
 Dec = -41 40 20.652
 [of Date: 21 40 55, -41 33 59]
 Prediction of 2022 Aug 14.7
 Reliable 0.9 (good),

Durations: Max = 13.0 secs
 1km = 0.092 secs, 1mas = 0.26 secs
 Mag Drop: 3.5 [96%]v, 3.2 [95%]r
 Sun : Dist = 129°
 Moon: Dist = 50°, illum = 47%
 Error 35.3 x 2.4 mas in PA 86°

Asteroid:
 Mag = 15.1
 Dia = 141 ±9km, 50 mas
 Parallax = 2.276"
 Hourly dRA = -0.996s
 dDec = 8.28"
 JPL#82:2021-Apr-23, Known errors

1 moon. {Menoetius} 98km at 680km, Period 4.283days Orbit@Miriade

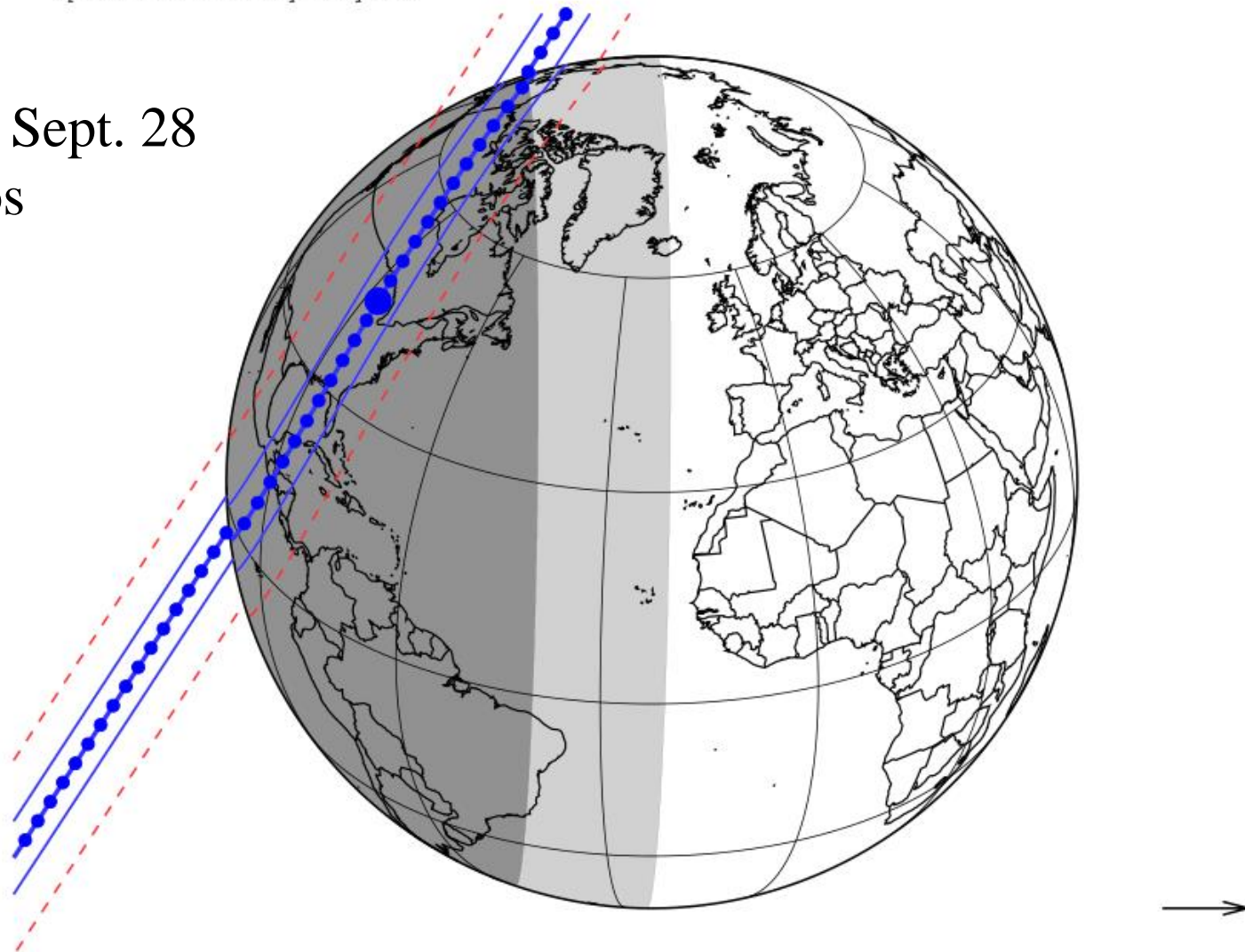


From <https://lesia.obspm.fr/lucky-star/occ.php?p=124402>

Chaos, GaiaDR3+pmGaiaDR3, NIMAv10
updated: 2023-03-29 by Lucky Star

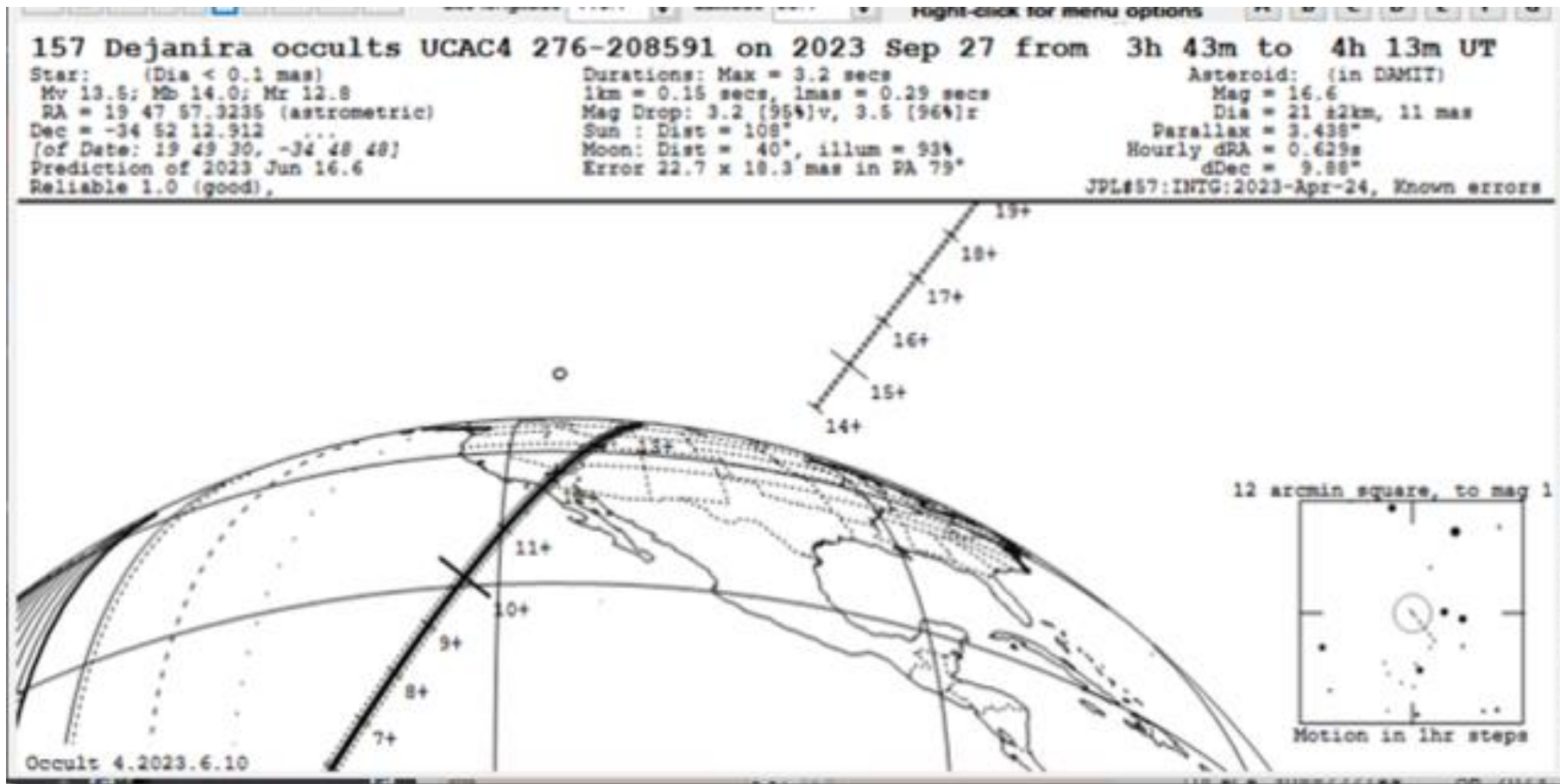
Offset: 0.0mas 0.0mas

2023 Sept. 28
Chaos



yyyy mm dd hh:mm:ss.s	RA_star_J2000	DE_star_J2000	C/A	P/A	vel	Delta	G*	RP*	H*
2023-09-28 07:14:48.1	06 09 56.9405	+31 21 23.245	0.165	303.39	5.73	41.0980	12.1	11.1	8.8

My path for this is wrong; here's the correct one from Lucky Star



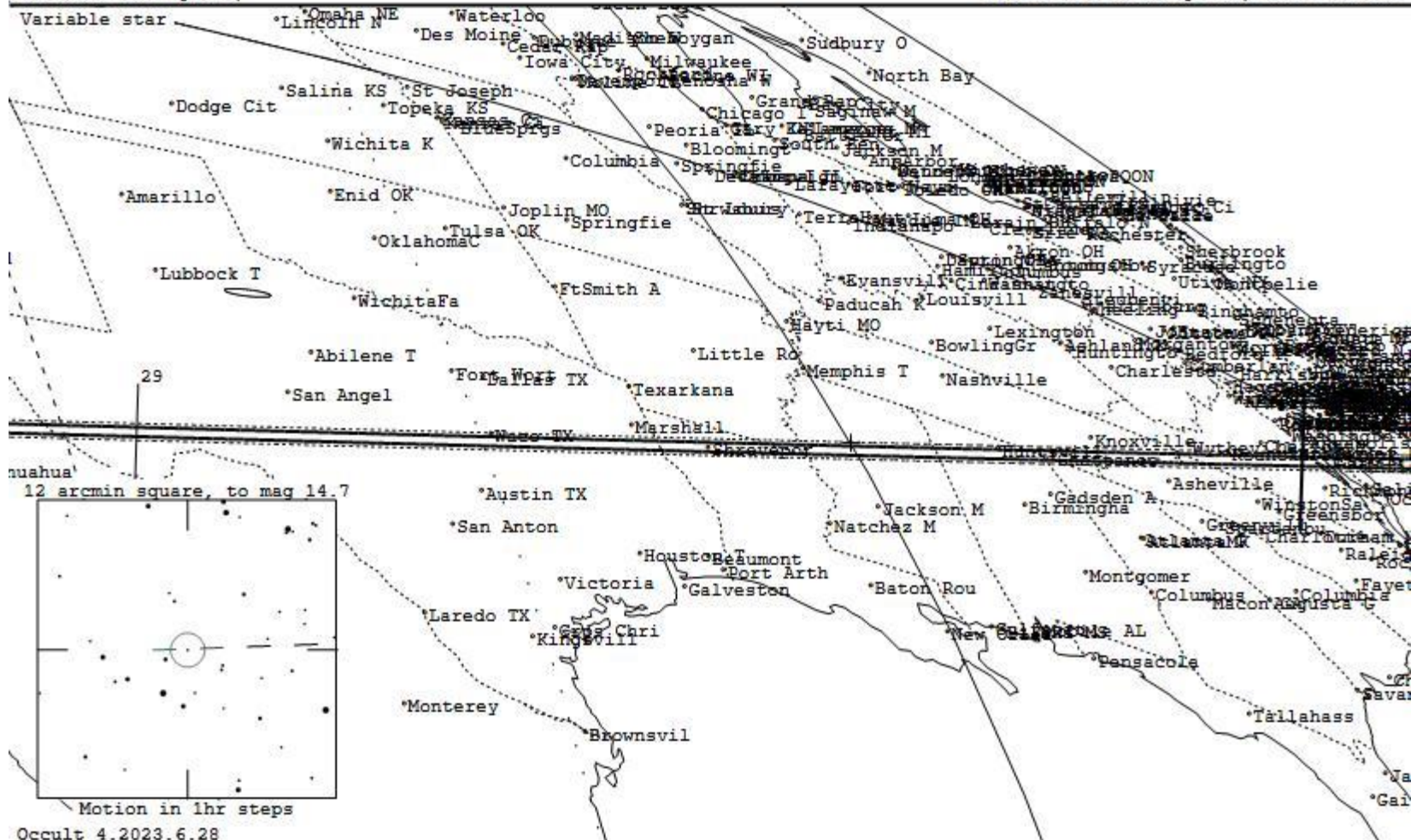
One of the lowest-numbered unobserved (by occultations) asteroids

3123 Dunham occults UCAC4 335-129271 on 2023 Oct 8 from 1h 25m to 1h 30m UT

Star: (Dia < 0.1 mas)
 Mv 13.7; Mb 15.3; Mr 12.5
 RA = 17 57 57.9724 (astrometric)
 Dec = -23 10 9.447
 [of Date: 17 59 24, -23 10 21]
 Prediction of 2023 Jul 2.2
 Reliable 1.0 (good),

Durations: Max = 0.48 secs
 1km = 0.039 secs, 1mas = 0.064 secs
 Mag Drop: 4.6 [99%]v, 5.4 [99%]r
 Sun : Dist = 75°
 Moon: Dist = 148°, illum = 36%
 Error 18.7 x 2.7 mas in PA 97°

Asteroid:
 Mag = 18.3
 Dia = 12 μ km, 7 mas
 Parallax = 3.885"
 Hourly dRA = 4.109s
 dDec = -1.83"
 JPL#59:INTG:2023-Apr-27, Known errors



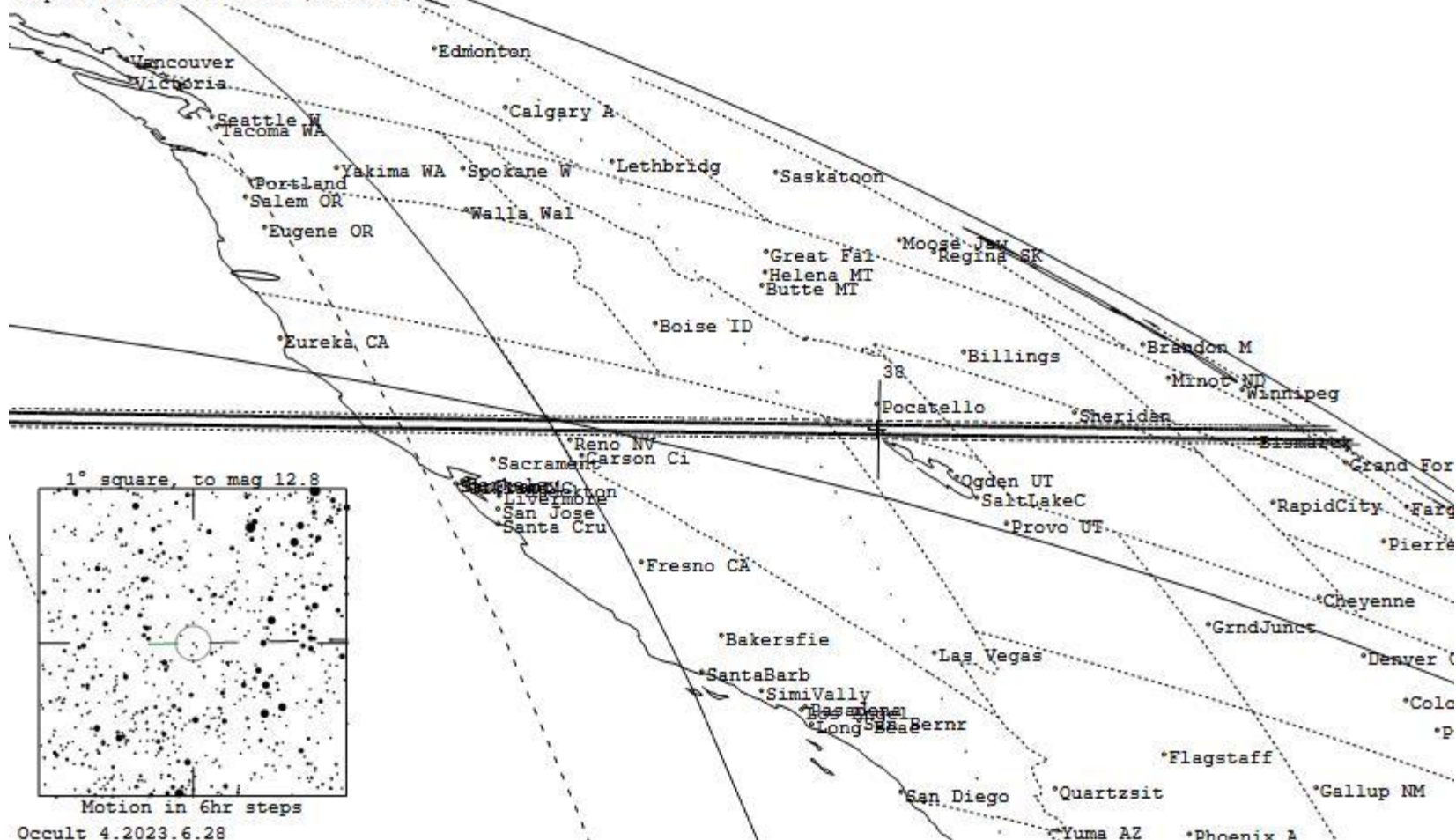
3123 Dunham occults UCAC4 334-133336 on 2023 Oct 12 from 2h 34m to 2h 38m UT

Star: (Dia = 0.2 mas)
 Mv 11.8; Mb 13.7; Mr 10.6
 RA = 18 4 43.8653 (astrometric)
 Dec = -23 12 46.029
 [of Date: 18 6 10, -23 12 44]
 Prediction of 2023 Jul 2.2
 Reliable 0.9 (good),

Durations: Max = 0.46 secs
 1km = 0.038 secs, 1mas = 0.063 secs
 Mag Drop: 6.5 [100%]v, 7.3 [100%]r
 Sun : Dist = 73°
 Moon: Dist = 102°, illum = 7%
 Error 18.7 x 2.7 mas in PA 97°

Asteroid:
 Mag = 18.3
 Dia = 12 ±1km, 7 mas
 Parallax = 3.815"
 Hourly dRA = 4.247s
 dDec = -1.08"
 JPL#59:INTG:2023-Apr-27, Known errors

Expect fades >0.01 secs (star dia)



Occult 4.2023.6.28

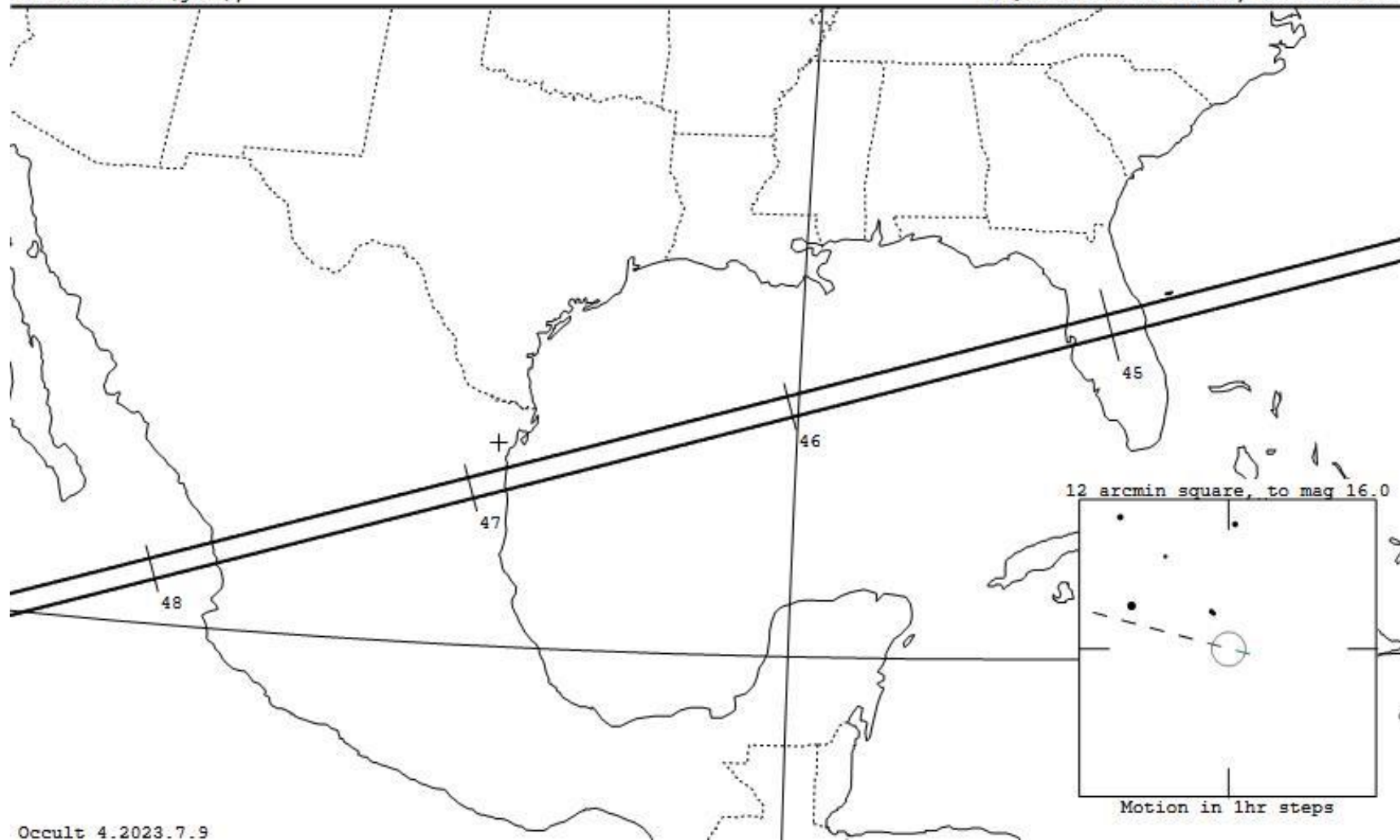
269 Justitia occults UCAC4 508-005956 on 2023 Nov 14 from 5h 39m to 5h 53m UT

Star: (Dia < 0.1 mas)
Mv 15.2; Mb 15.7; Mr 14.5
RA = 3 41 50.6356 (astrometric)
Dec = 11 26 19.952
[of Date: 3 43 10, 11 31 0]
Prediction of 2023 Jul 15.7
Reliable 1.0 (good),

Durations: Max = 3.9 secs
1km = 0.070 secs, 1mas = 0.10 secs
Mag Drop: 0.30 [24%]v, 0.36 [28%]r
Sun : Dist = 171°
Moon: Dist = 168°, illum = 1%
Error 6.7 x 1.5 mas in PA 74°

Asteroid: (in DAMIT)
Mag = 13.9
Dia = 56 ±3km, 39 mas
Parallax = 4.425"
Hourly dRA = -2.345s
dDec = -9.07"

JPL#98:INTG:2023-Feb-07, Known errors



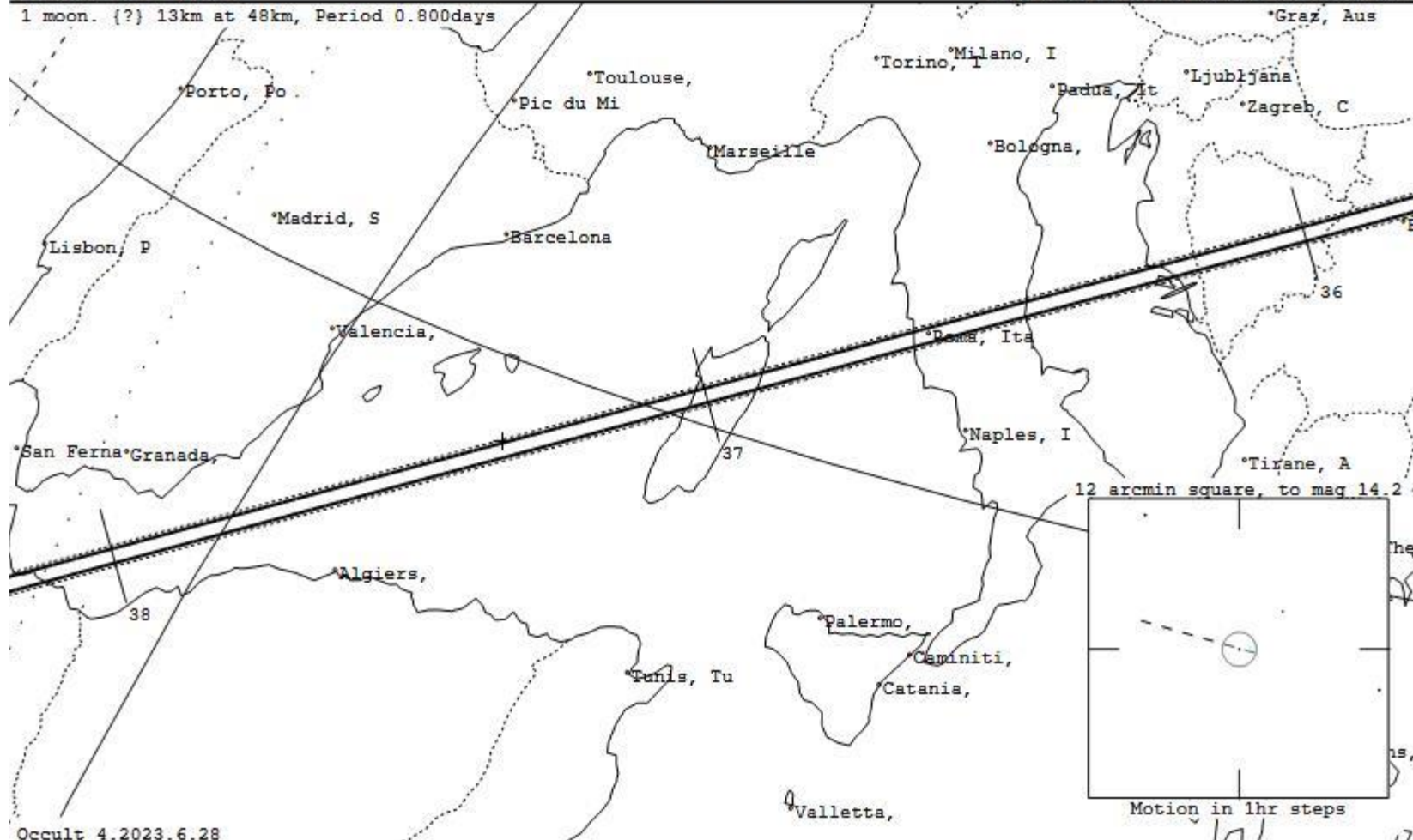
4337 Arecibo occults UCAC4 528-004534 on 2023 Nov 22 from 18h 27m to 18h 40m UT

Star: (Dia < 0.1 mas)
 Mv 13.2; Mb 13.7; Mr 12.6
 RA = 2 35 29.4410 (astrometric)
 Dec = 15 30 24.860
 [of Date: 2 36 49, 15 36 46]
 Prediction of 2023 Apr 3.1
 Reliable 1.0 (good),

Durations: Max = 1.43 secs
 1km = 0.074 secs, 1mas = 0.14 secs
 Mag Drop: 4.6 [99%]v, 4.8 [99%]r
 Sun : Dist = 162°
 Moon: Dist = 41°, illum = 75%
 Error 13.3 x 1.1 mas in PA 66°

Asteroid: (in DAMIT)
 Mag = 17.8
 Dia = 19 ± 2km, 10 mas
 Parallax = 3.353"
 Hourly dRA = -1.706s
 dDec = -6.92"
 JPL#46:INTG:2022-Aug-03, Known errors

1 moon. [?] 13km at 48km, Period 0.800days



Occult 4.2023.6.28

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

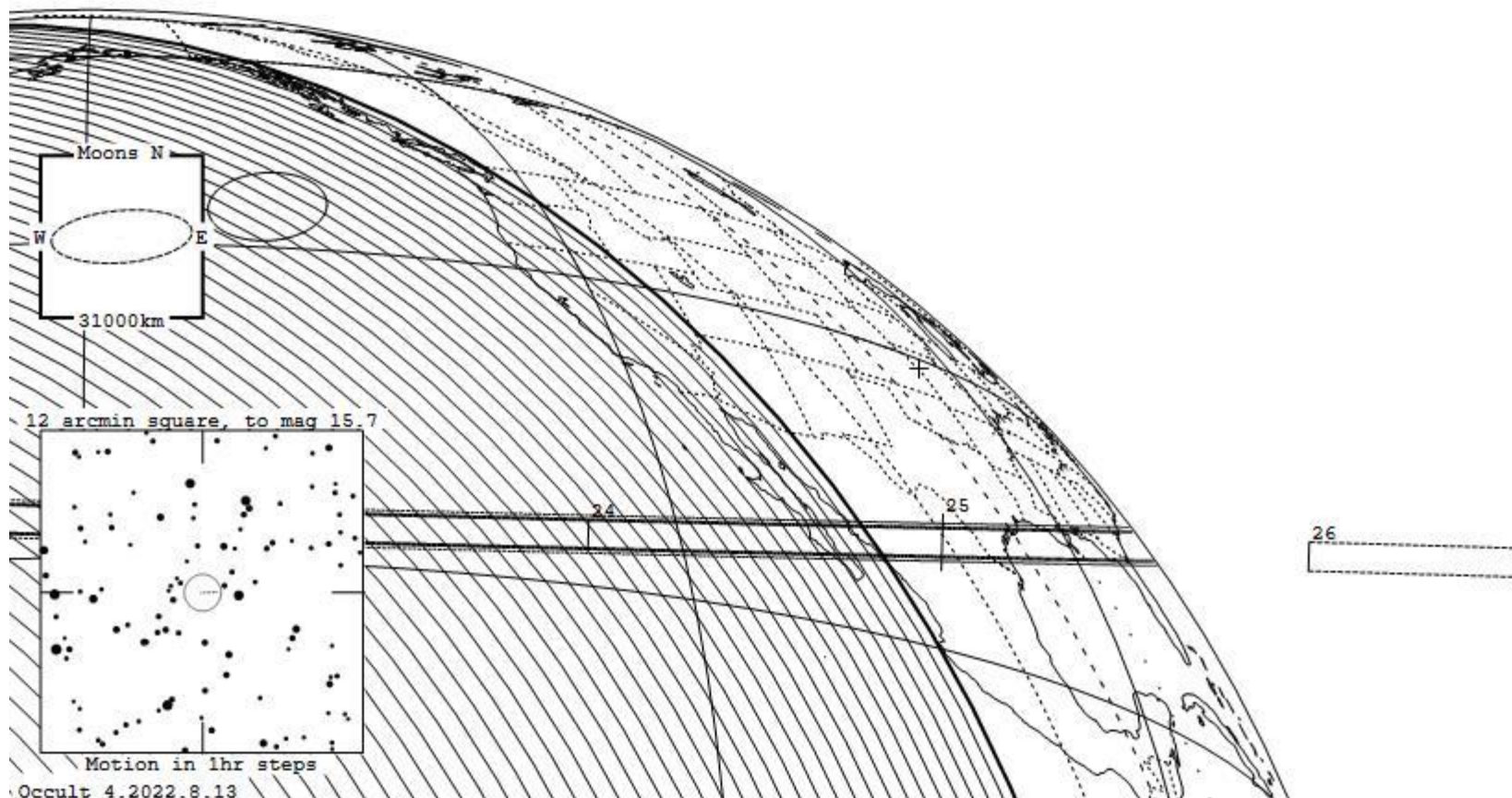
Star: (Dia < 0.1 mas)
 Mv 14.7; Mb 16.4; Mr 13.5
 RA = 18 29 5.7300 (astrometric)
 Dec = -15 24 54.019
 [of Date: 18 30 26, -15 24 0]
 Prediction of 2022 Aug 14.8
 Reliable 0.9 (good),

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



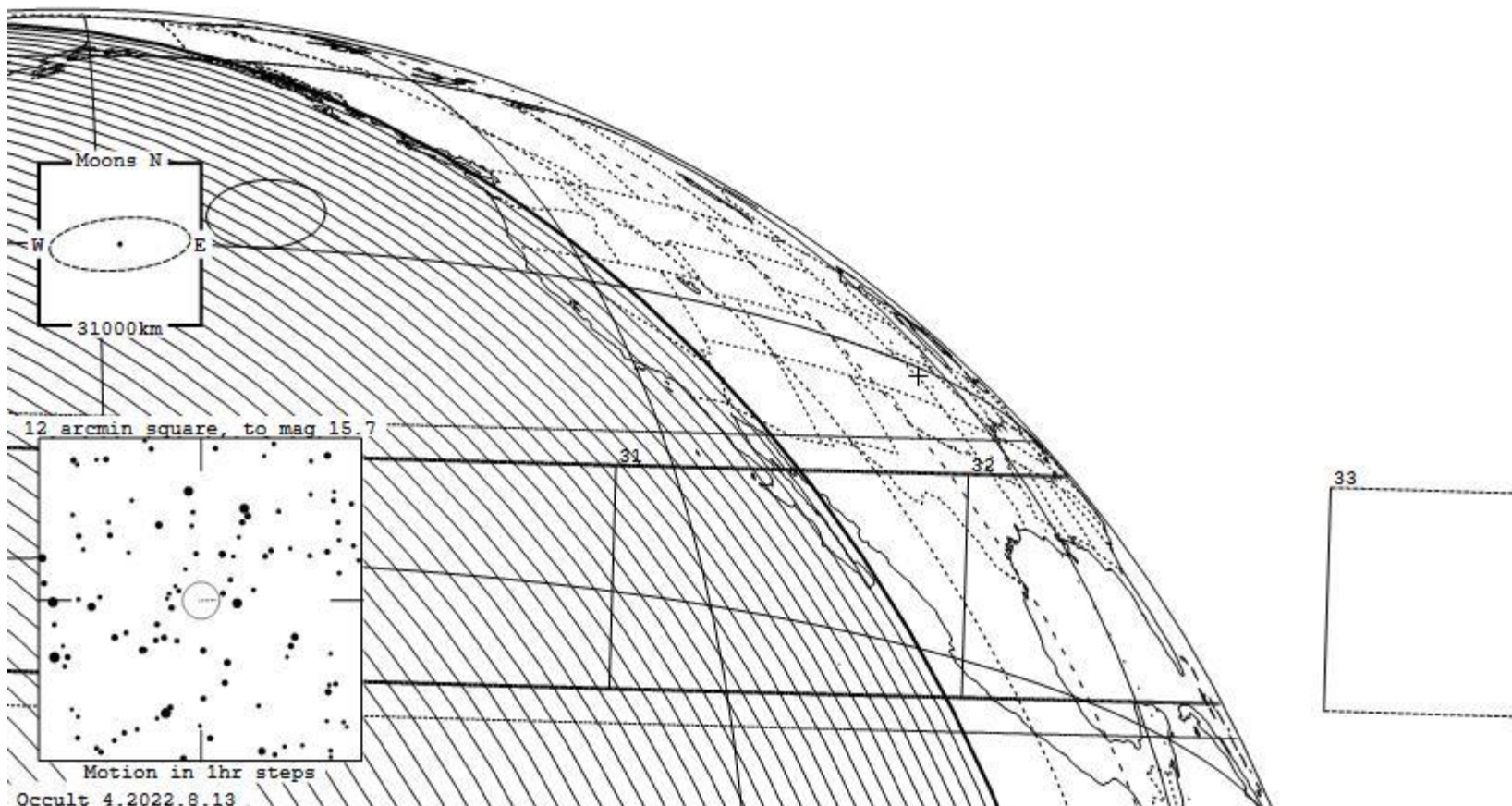
50000 Quaoar occults UCAC4 373-131780 on 2023 Nov 23 from 0h 26m to 0h 34m UT

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

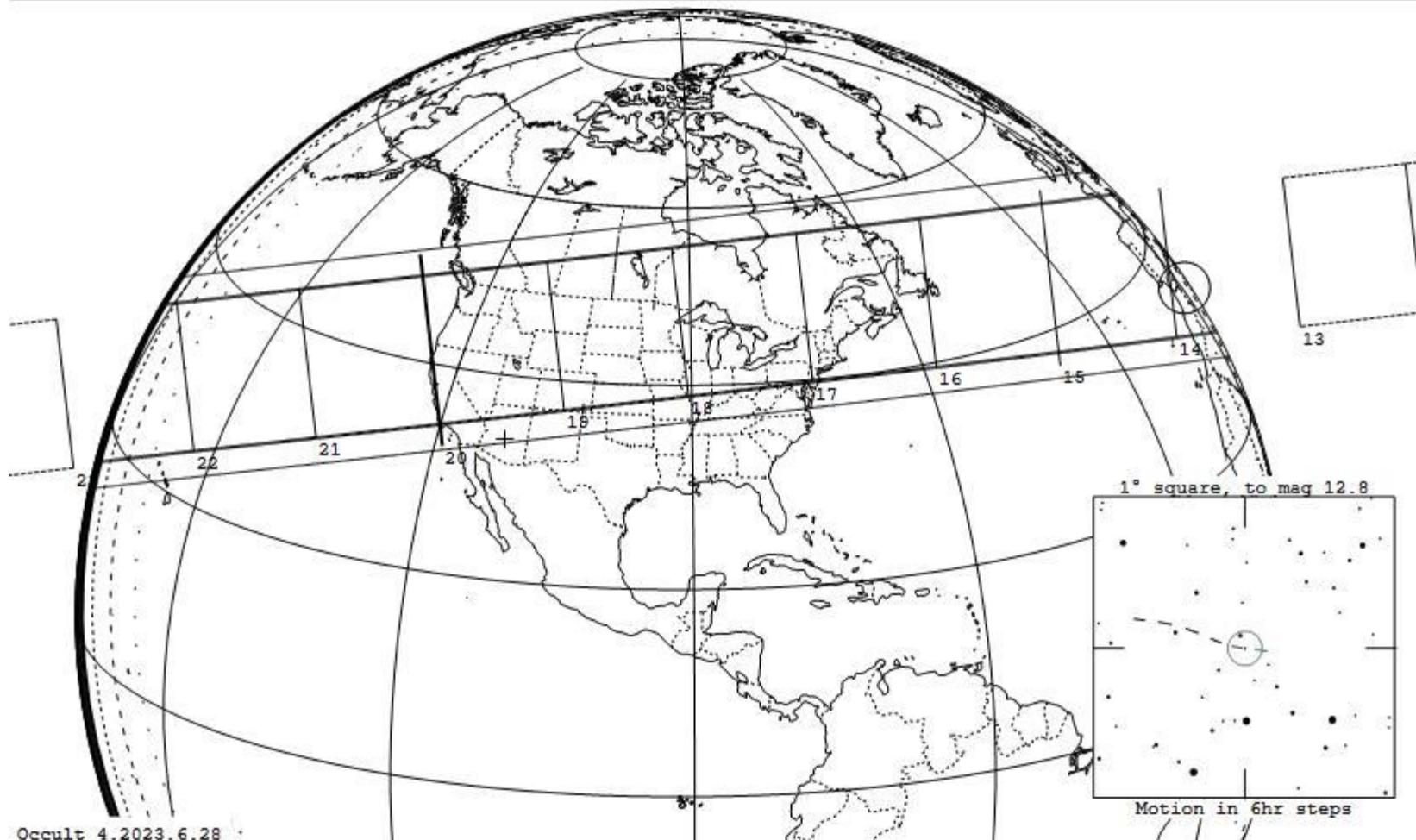


P7M03 Titania (III) occults TYC 1236-00841-1 on 2023 Nov 21 from 5h 13m to 5h 24m

Star: (Dia < 0.1 mas)
 Mv 11.8; Mb 12.1; Mr 11.8
 RA = 3 12 17.3241 (astrometric)
 Dec = 17 32 27.039
 [of Date: 3 13 39, 17 37 55]
 Prediction of 2022 Jun 15.1
 Reliable 1.1 (good),

Durations: Max = 72.8 secs
 1km = 0.046 secs, 1mas = 0.62 secs
 Mag Drop: 2.2 [87%]v, 1.9 [82%]r
 Sun : Dist = 172°
 Moon: Dist = 72°, illum = 59%
 Error 20.0 x 20.0 mas in PA 0°

Asteroid:
 Mag = 13.8
 Dia = 1577 ±1km, 117 mas
 Parallax = 0.472"
 Hourly dRA = -0.402s
 dDec = -0.66"
 DE440+JPL#ura111, Start+Assumed

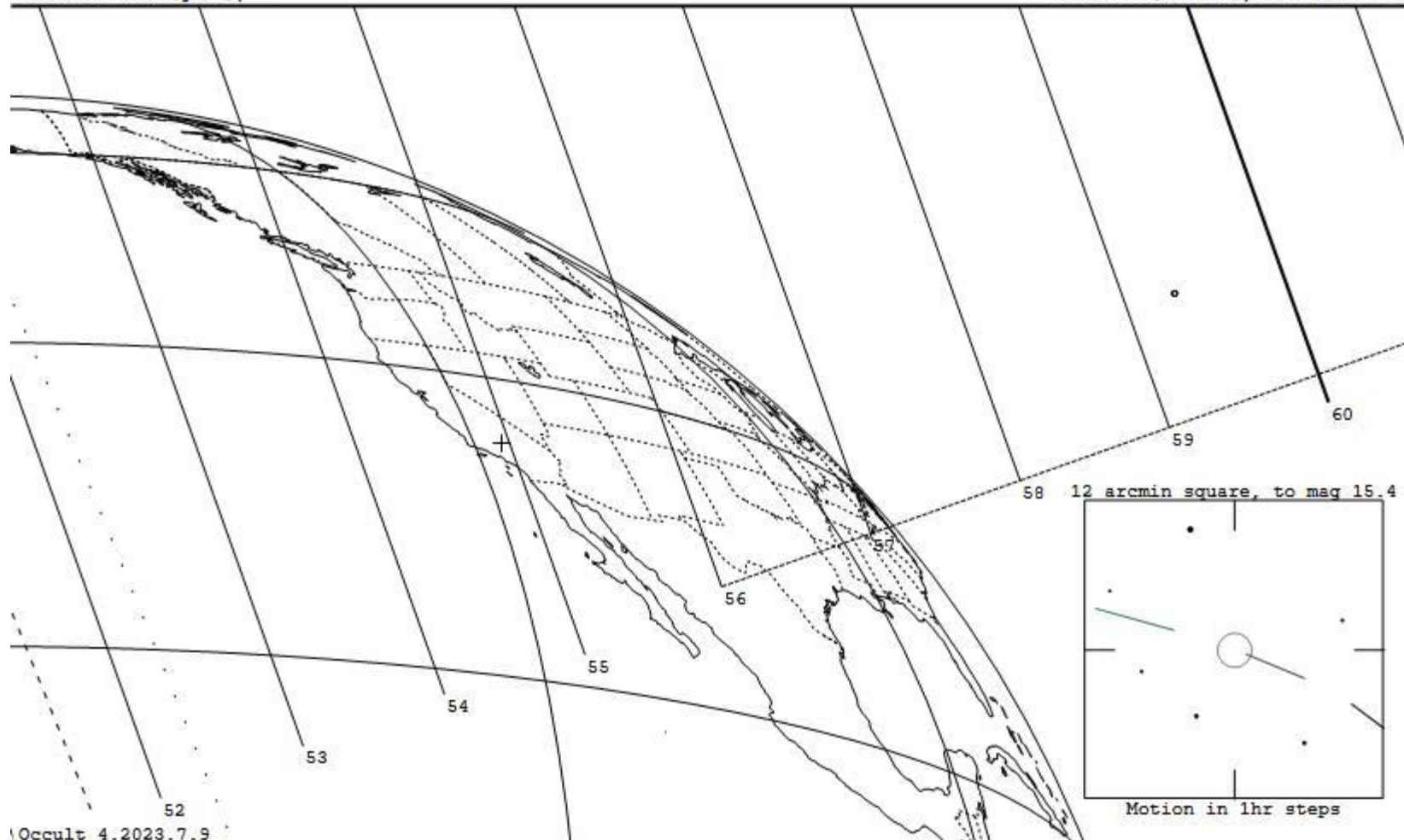


P6M06 Titan (VI) occults UCAC4 386-150960 on 2023 Nov 25 from 3h 41m to 3h 59m U

Star: (Dia < 0.1 mas)
 Mv 14.4; Mb 15.4; Mr 14.4
 RA = 22 12 47.5593 (astrometric)
 Dec = -12 50 56.615
 [of Date: 22 14 4, -12 43 56]
 Prediction of 2022 Jun 15.1
 Reliable 1.1 (good),

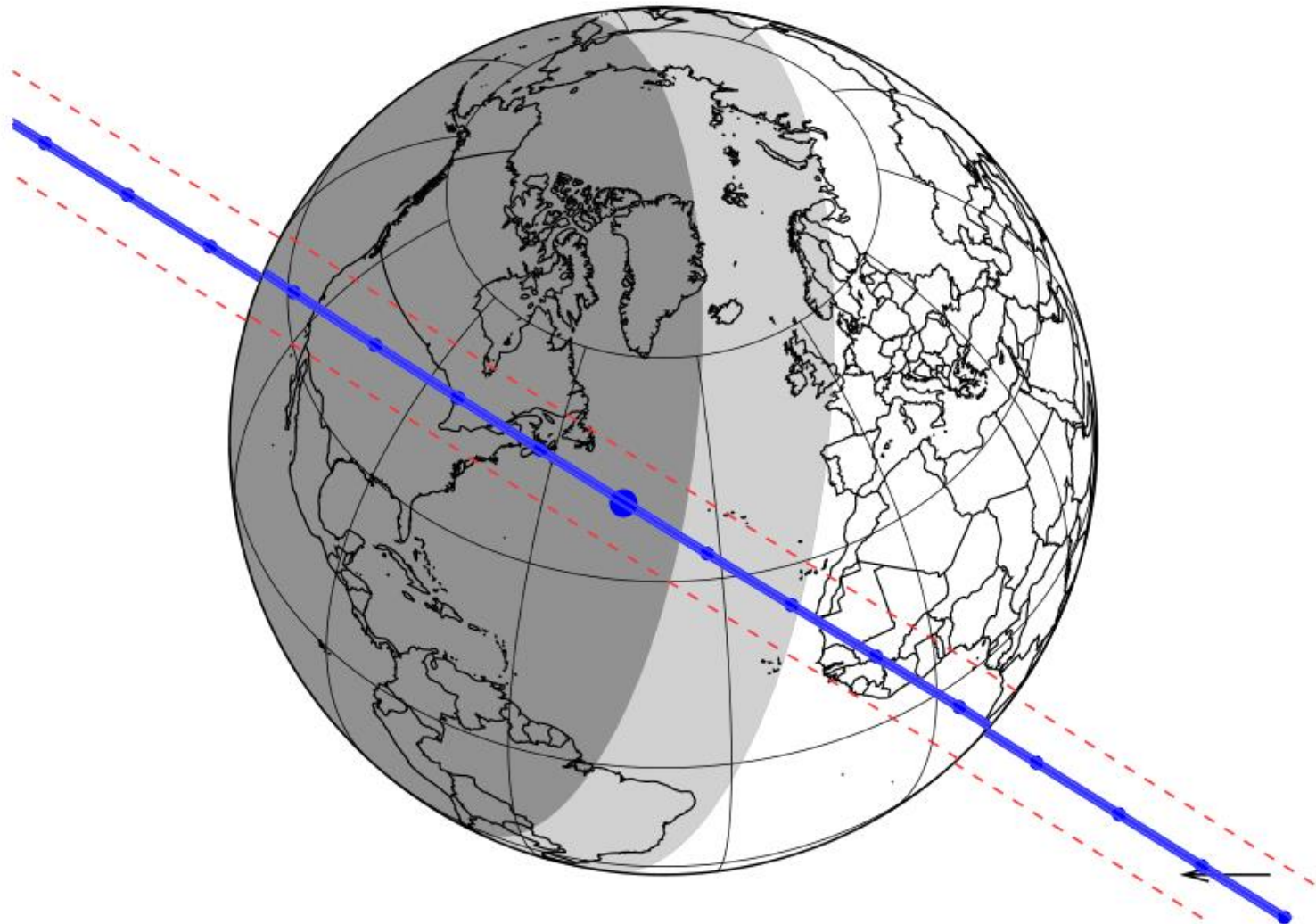
Durations: Max = 367.2 secs
 1km = 0.071 secs, 1mas = 0.50 secs
 Mag Drop = 0.01 [1%]v
 Sun : Dist = 88°
 Moon: Dist = 63°, illum = 94%
 Error 2.0 x 2.0 mas in PA 0°

Asteroid:
 Mag = 8.6
 Dia = 5150 ±0km, 730 mas
 Parallax = 0.904"
 Hourly dRA = 0.461s
 dDec = 2.40"
 DE440+JPL#sat4411, Start+Assumed



2013LU28, GaiaDR3+pmGaiaDR3, NIMAv6
updated: 2023-03-27 by Lucky Star

Offset: 0.0mas 0.0mas



yyyy mm dd hh:mm:ss.s	RA_star_J2000	DE_star_J2000	C/A	P/A	vel	Delta	G*	RP*	H*
2023-11-26 07:40:35.4	09 24 15.6631	+48 54 52.086	0.181	212.21	-23.87	8.4002	14.9	14.5	13.7

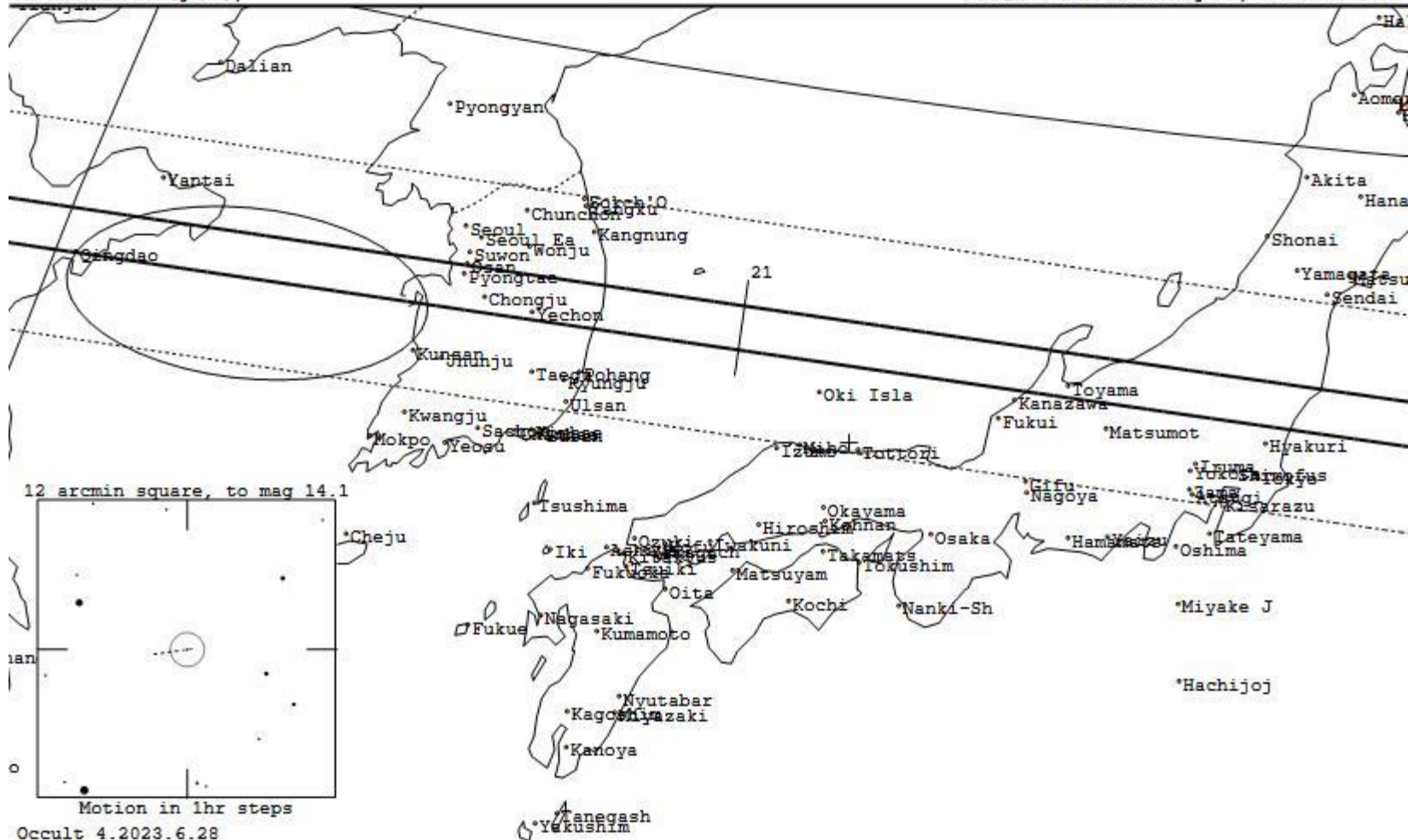
From Lucky Star (errors better), but my path for this is similar

60558 Echeclus occults UCAC4 537-043188 on 2023 Dec 19 from 15h 14m to 15h 24m UT

Star: (Dia < 0.1 mas)
 Mv 13.1; Mb 13.4; Mr 12.6
 RA = 7 42 12.1158 (astrometric)
 Dec = 17 13 17.981
 [of Date: 7 43 36, 17 9 55]
 Prediction of 2023 Jul 15.2
 Reliable 1.0 (good),

Durations: Max = 2.9 secs
 1km = 0.050 secs, 1mas = 0.42 secs
 Mag Drop: 7.2 [100%]v, 7.3 [100%]r
 Sun : Dist = 153°
 Moon: Dist = 119°, illum = 48%
 Error 28.3 x 13.3 mas in PA 96°

Asteroid:
 Mag = 20.3
 Dia = 59 ± 7km, 7 mas
 Parallax = 0.749"
 Hourly dRA = -0.590s
 dDec = 1.20"
 JPL#109:INTG:2023-May-04, Known errors

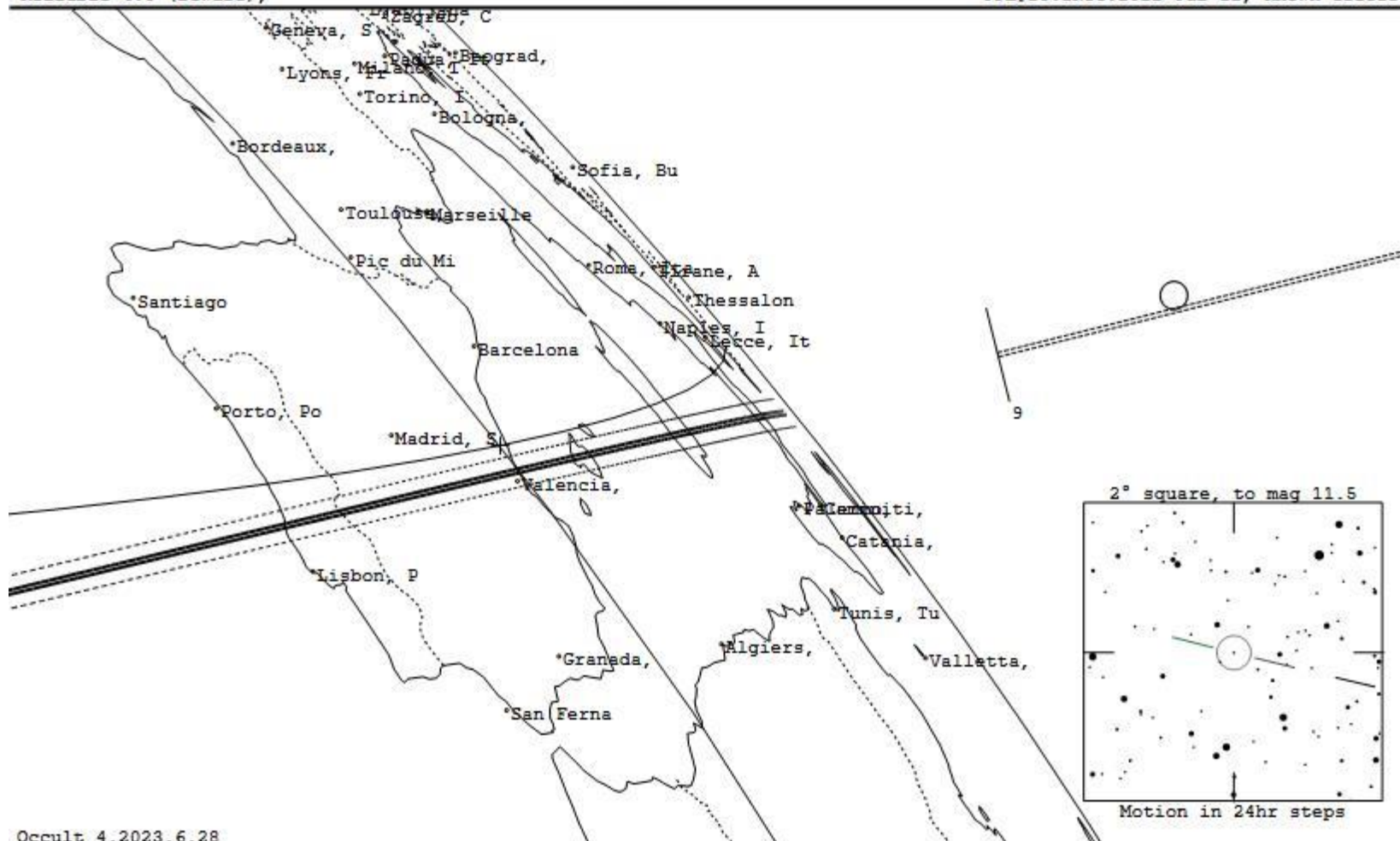


172376 2002 YE25 occults TYC 571-01269-1 on 2023 Dec 26 from 21h 2m to 21h 9m U

Star: (Dia < 0.1 mas)
 Mv 10.5; Mb 10.8; Mr 10.1
 RA = 22 45 9.7420 (astrometric)
 Dec = 4 19 7.567
 [of Date: 22 46 22, 4 26 39]
 Prediction of 2023 Apr 3.1
 Reliable 4.0 (beware),

Durations: Max = 0.21 secs
 1km = 0.036 secs, 1mas = 0.084 secs
 Mag Drop: 10.2 [100%]v, 10.1 [100%]r
 Sun : Dist = 70°
 Moon: Dist = 107°, illum =100%
 Error 8.0 x 7.8 mas in PA 9°

Asteroid:
 Mag = 20.7
 Dia = 5.8 ±0.6km, 3 mas
 Parallax = 2.752"
 Hourly dRA = 2.737s
 dDec = 10.25"
 JPL#28:INTG:2022-Jul-11, Known errors



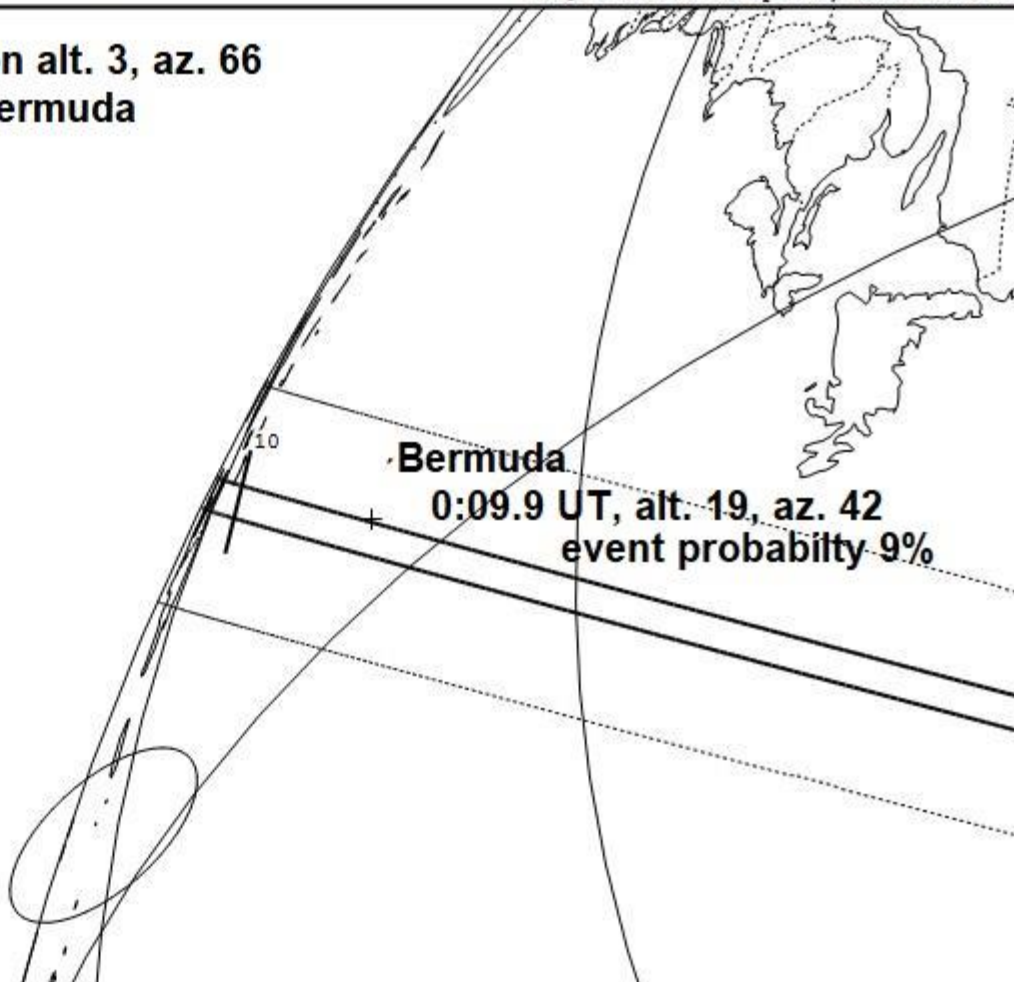
468861 2013 LU28 occults UCAC4 703-049020 on 2023 Dec 30 from 0h 4m to 0h 10m U

Star: (Dia < 0.1 mas)
 Mv 15.8; Mb 16.1; Mr 15.4
 RA = 8 59 57.1518 (astrometric)
 Dec = 50 30 12.431
 [of Date: 9 1 40, 50 24 28]
 Prediction of 2023 Jul 15.2
 Reliable 1.0 (good),

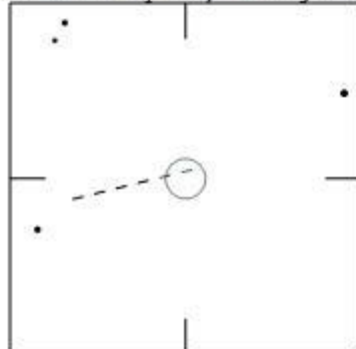
Durations: Max = 2.0 secs
 1km = 0.027 secs, 1mas = 0.16 secs
 Mag Drop: 2.3 [88%]v, 2.3 [88%]r
 Sun : Dist = 141°
X Moon: Dist = 29°, illum = 91%**X**
 Error 45.3 x 21.3 mas in PA 48°

Asteroid:
 Mag = 18.0
 Dia = 76 ±7km, 13 mas
 Parallax = 1.097"
 Hourly dRA = -2.338s
 dDec = 5.56"
 JPL#28:INTG:2023-Apr-26, Known errors

waning Moon alt. 3, az. 66
 at Bermuda



12 arcmin square, to mag 16.0



Motion in 1hr steps

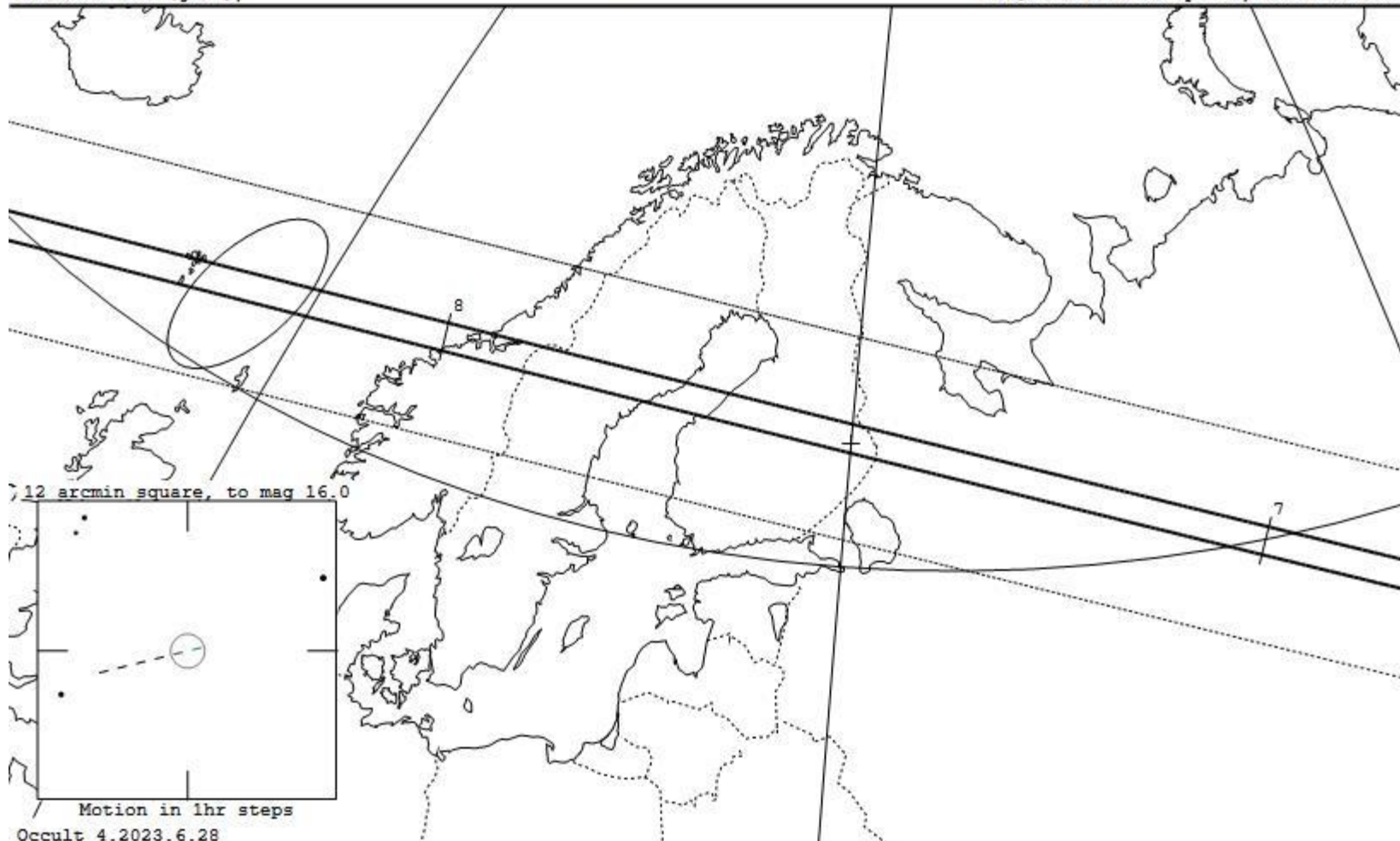
Occult 4.2023.6.28

468861 2013 LU28 occults UCAC4 703-049020 on 2023 Dec 30 from 0h 4m to 0h 10m U

Star: (Dia < 0.1 mas)
 Mv 15.8; Mb 16.1; Mr 15.4
 RA = 8 59 57.1518 (astrometric)
 Dec = 50 30 12.431
 [of Date: 9 1 40, 50 24 28]
 Prediction of 2023 Jul 15.2
 Reliable 1.0 (good),

Durations: Max = 2.0 secs
 1km = 0.027 secs, 1mas = 0.16 secs
 Mag Drop: 2.3 [88%]v, 2.3 [87%]r
 Sun : Dist = 141°
 Moon: Dist = 29°, illum = 91%
 Error 45.3 x 21.3 mas in PA 48°

Asteroid:
 Mag = 18.0
 Dia = 76 ±7km, 13 mas
 Parallax = 1.097"
 Hourly dRA = -2.338s
 dDec = 5.56"
 JPL#28:INTG:2023-Apr-26, Known errors

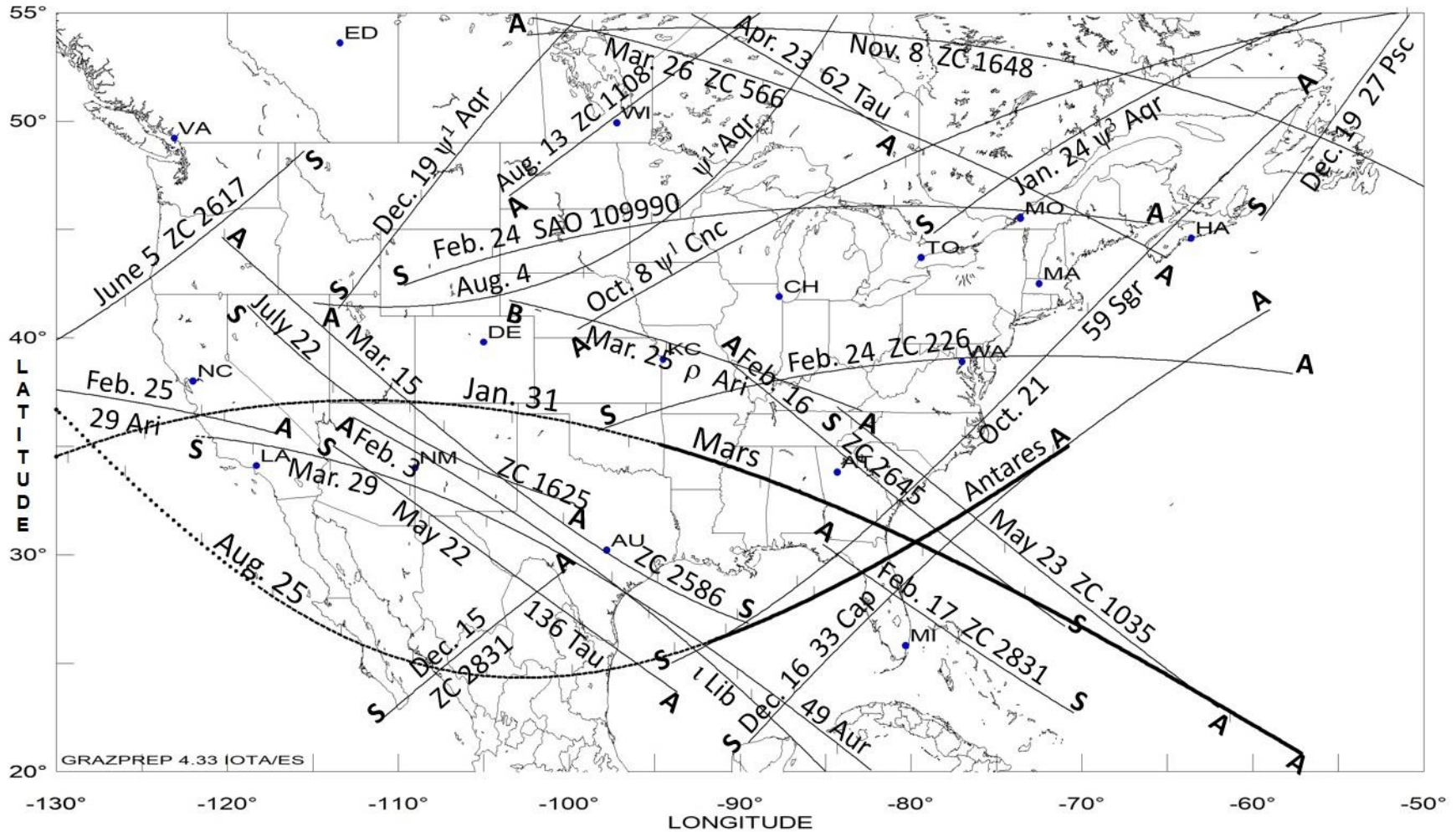


12 arcmin square, to mag 16.0

Motion in 1hr steps

Occult 4.2023.6.28

Best 2023 Lunar Grazing Occultations, from RASC Handbook and <https://occultations.org/publications/rasc/2023/nam23grazes.pdf> (E. Riedel and D. Dunham)



Also, remember the annular solar eclipse of 2023 October 14

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	ν^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

Best 2023
Lunar Grazing
Occultations,
from RASC
Handbook and

<https://occultations.org/publications/rasc/2023/nam23grazes.pdf>

(E. Riedel and
D. Dunham)

Conclusions

- Information about the sizes, shapes, rings, satellites, and even atmospheres of Kuiper Belt objects, Centaurs, Trojans, and other asteroids is proportional to the number of stations that can be deployed for occultations by them
- We encourage as many others as possible to time occultations by NEA's, TNO's and by other asteroids (and sometimes comets) from their observatories
- We want others to learn to make the necessary mobile observations, including the multi-station techniques pioneered by IOTA, to observe NEA and other occultations, to support planetary defense and asteroid science.

Please visit <https://occultations.org/publications/rasc/2023/ACM2023.htm> to get this presentation, and for links to IOTA's, and other's, Web sites that have predictions and much other information that will allow you, and others at your institution, to take part in this exciting field of astronomy.

Contact: dunham@starpower.net; cell +1-301-526-5590 and local IOTA member Bruce Hohenstein, BHolenstein@gravic.com .