



OCCULTATIONS BY ASTEROIDS - HIGHLIGHTS FOR EUROPE IN 2023

JIŘÍ KUBÁNEK, EFP ESOP XLI, GRANADA, 10-11 SEPTEMBER 2022

INTERNATIONAL OCCULTATION TIMING ASSOCIATION / EUROPEAN SECTION

CZECH ASTRONOMICAL SOCIETY – OCCULTATION AND TIMING SECTION

The background is a dark blue gradient with a subtle pattern of small white dots. Overlaid on this are several white circular and semi-circular elements. On the left side, there is a large circular scale with tick marks and numbers ranging from 140 to 260. Other elements include smaller circles, some with dashed outlines, and curved arrows pointing in various directions, creating a sense of motion and technical precision.

Introduction

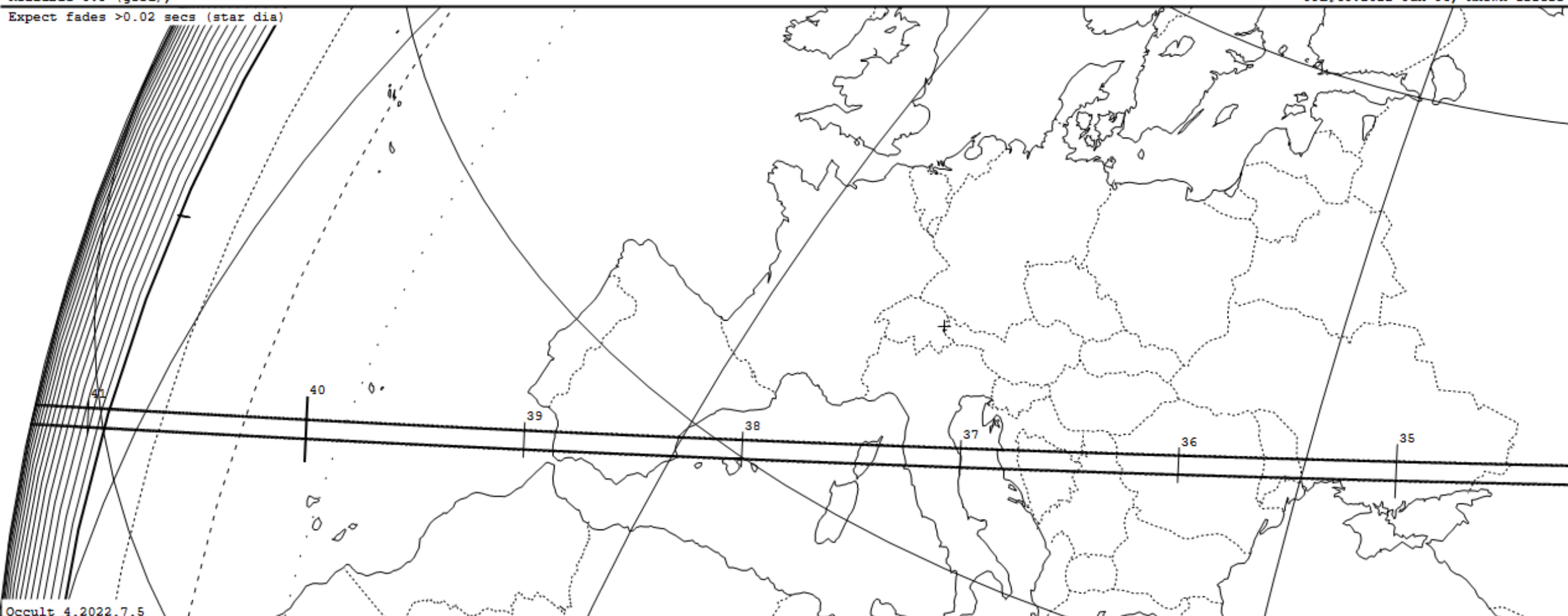
906 Repsolda occults TYC 2418-00635-1 on 2023 Jan 2 from 19h 25m to 19h 41m UT

Star: (Dia = 0.2 mas)
Mv 8.7; Mb 9.3; Mr 8.0
RA = 5 56 3.4104 (astrometric)
Dec = 37 23 17.026
[of Date: 5 57 38, 37 23 31]
Prediction of 2022 Jul 5.3
Reliable 0.9 (good),

Durations: Max = 5.4 secs
1km = 0.078 secs, 1mas = 0.12 secs
Mag Drop: 5.2 [99%]v, 5.5 [99%]r
Sun : Dist = 161°
Moon: Dist = 35°, illum = 85%
Error 14.7 x 1.2 mas in PA 100°

Asteroid:
Mag = 13.9
Dia = 69 ±4km, 46 mas
Parallax = 4.282"
Hourly dRA = -2.601s
dDec = 1.41"
JPL#60:2022-Jun-06, Known errors

Expect fades >0.02 secs (star dia)



Occult 4.2022.7.5



Content:

1. TOP 20 events

Part I

Part II

2. Asteroids with satellites

3. Other interesting
asteroids

Center: VADUZ, LI
Radius 2000 km

precalculations April 2022
final calculations July 2022

Occult (author D. Herald)

Catalogue – stars:

Gaia EDR3

Elements of asteroids:

JPL Horizons (final)

(MPC, helpful calculations)

Miriade (binary asteroids

ephemerides)

Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image IBCAO
Image U.S. Geological Survey
Image Landsat / Copernicus

Google Earth

Datum snímku: 12/14/2015 46°44'32.67" S 9°23'09.09" V výš. 482 m výška pohledu 8095.92 km

1. TOP 20 events

stars ≤ 12 mag

asteroids ≥ 5 km

duration ≥ 4 s

drop $\geq 0,4$ mag

From 282 events were chosen 20 best phenomena with bright stars or with long durations;

the condition of inclusion was also a small uncertainty of the belt;

(some good events with low altitude or dusk/dawn events were discarded)

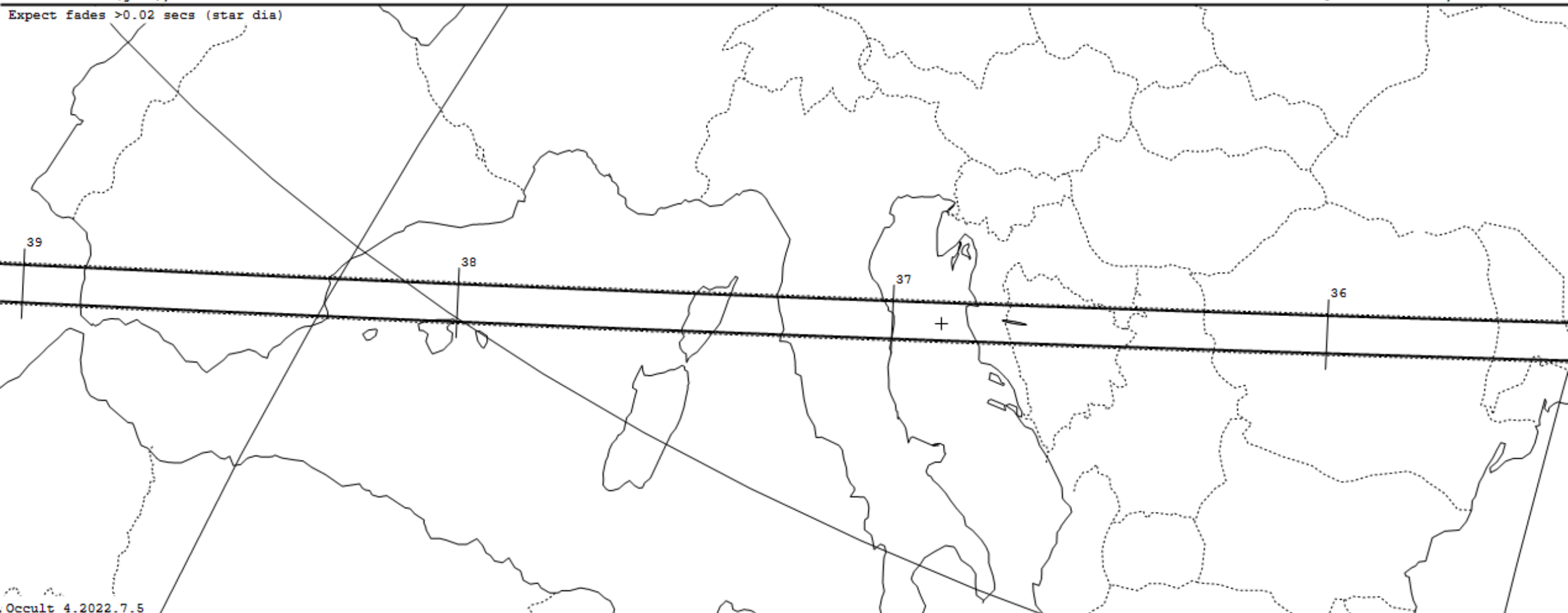
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JPL#60:2022-Jun-06, Known errors

Expect fades >0.02 secs (star dia)



Occult 4.2022.7.5

333 Badenia occults TYC 6158-00192-1 on 2023 Feb 25 from 2h 55m to 3h 48m UT

Star: (Dia < 0.1 mas)
Mv 11.6; Mb 12.1; Mr 10.9
RA = 14 42 4.1233 (astrometric)
Dec = -18 23 48.708
[of Date: 14 43 22, -18 29 44]
Prediction of 2022 Jul 5.3
Reliable 1.1 (good),

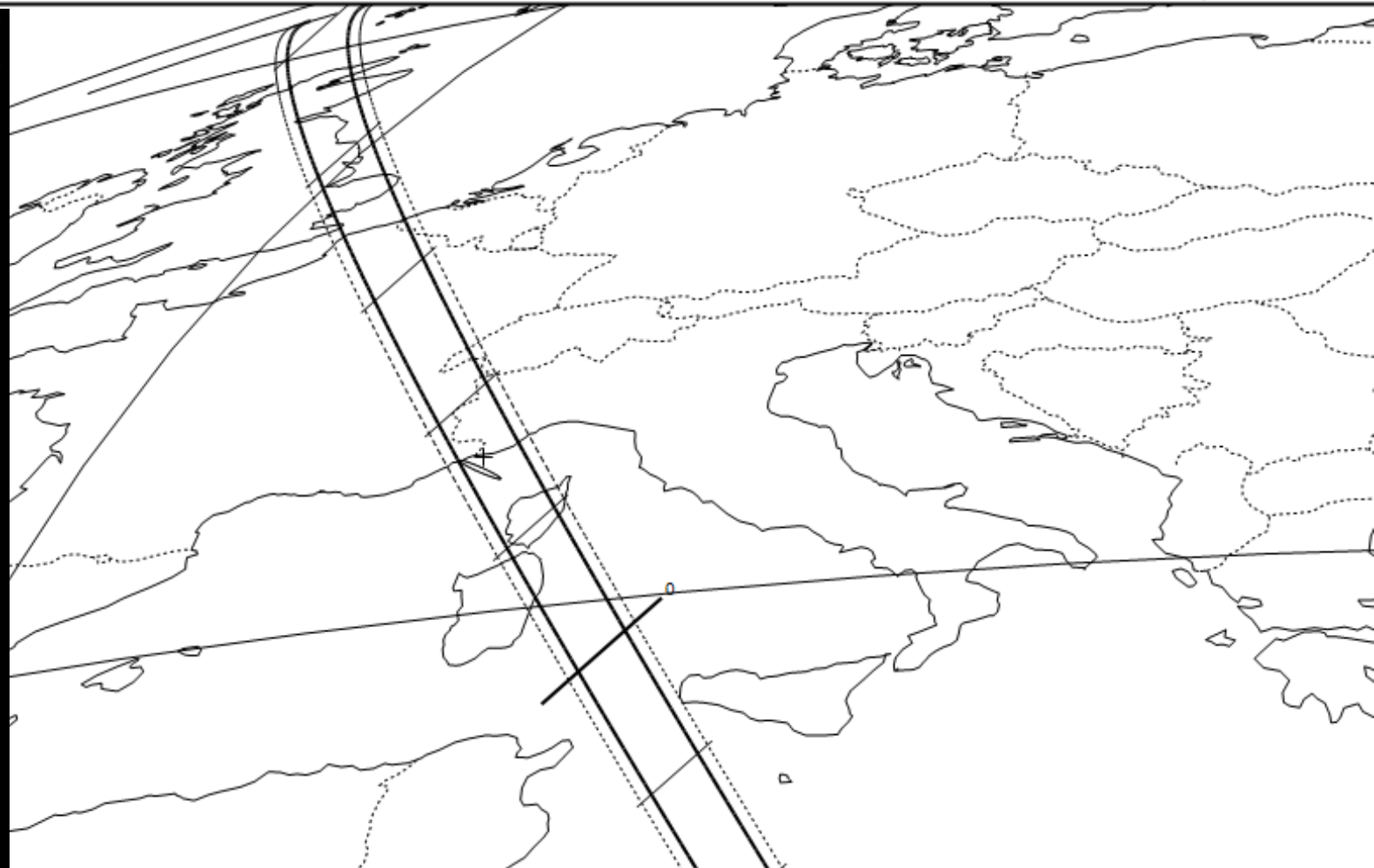
Durations: Max = 20.7 secs
1km = 0.28 secs, 1mas = 0.63 secs
Mag Drop: 4.1 [98%]v, 4.3 [98%]r
Sun : Dist = 112°
Moon: Dist = 176°, illum = 28%
Error 12.7 x 1.4 mas in PA 114°

Asteroid: (in DAMIT)
Mag = 15.6
Dia = 74 ±5km, 33 mas
Parallax = 2.814"
Hourly dRA = 0.265s
dDec = -4.26"
JPL#59:2022-Jun-06, Known errors

DAMIT #3298 2019-05-07
Earth Plane



Mean diameter by: Volt Surf.



(712) Boliviana, comb. 8,7 mag / 12,1 s / drop 3,8 mag

2023 Feb 27, 19:28

IIT

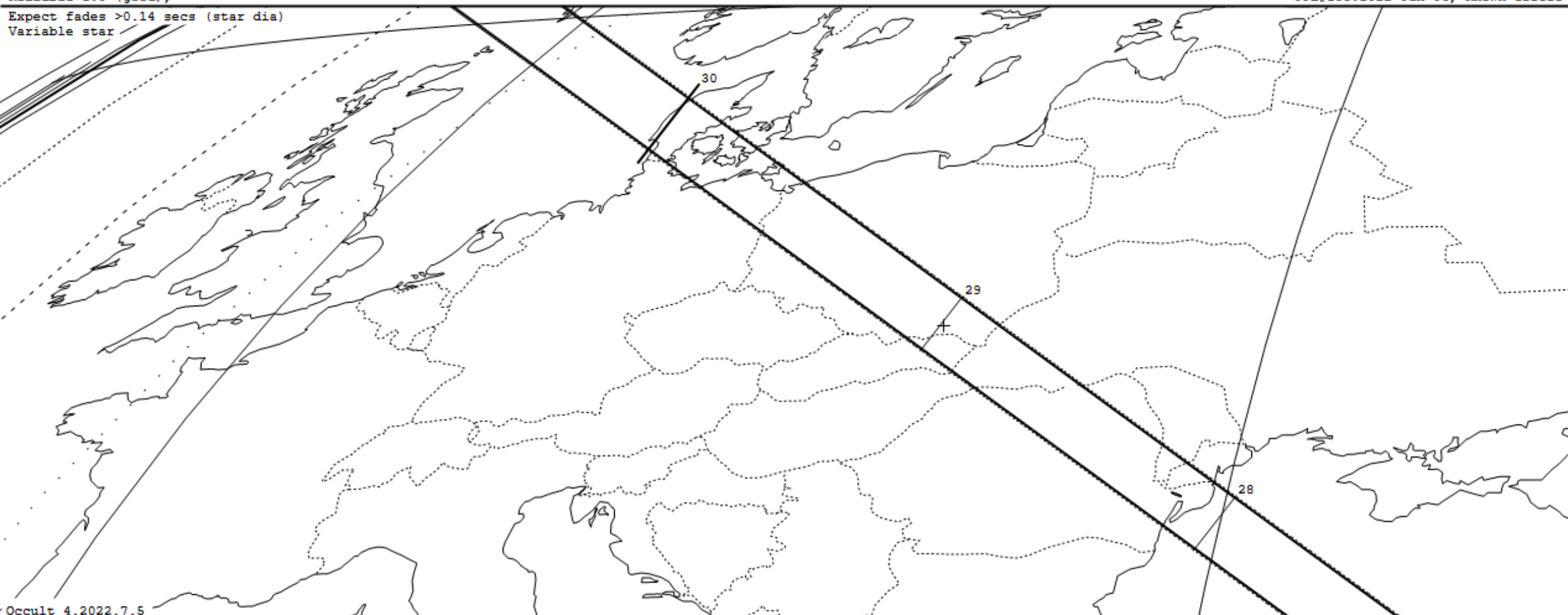
712 Boliviana occults UCAC4 432-048345 on 2023 Feb 27 from 19h 12m to 19h 31m UT

Star: (Dia = 1.2 mas)
Mv 8.8; Mb 10.7; Mr 7.4
RA = 8 55 3.2352 (astrometric)
Dec = - 3 39 7.717
[of Date: 8 56 14, - 3 44 30]
Prediction of 2022 Jul 5.3
Reliable 1.0 (good),

Durations: Max = 12.1 secs
1km = 0.10 secs, 1mas = 0.12 secs
Mag Drop: 3.8 [97%]v, 4.6 [99%]r
Sun : Dist = 151°
Moon: Dist = 66°, illum = 55%
Error 8.0 x 1.3 mas in PA 111°

Asteroid:
Mag = 12.5
Dia = 118 ±7km, 101 mas
Parallax = 5.484"
Hourly dRA = -1.602s
dDec = 18.72"
JPL#138:2022-Jun-06, Known errors

Expect fades >0.14 secs (star dia)
Variable star



Occult 4.2022.7.5

(96) Aegle, comb. 10,1 mag / 15,0 s / drop 1,3 mag

2023 Mar 11, 22:45

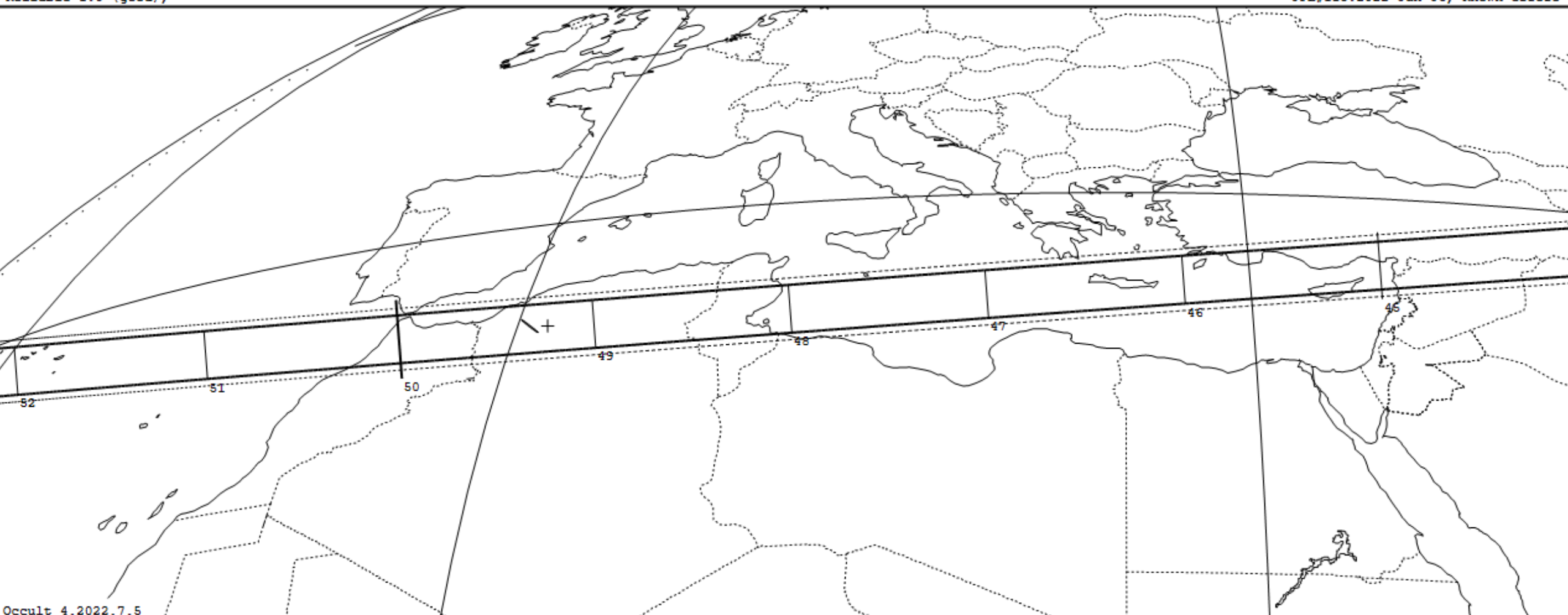
IIT

96 Aegle occults TYC 5516-01389-1 on 2023 Mar 11 from 22h 41m to 22h 53m UT

Star: (Dia < 0.1 mas)
Mv 10.6; Mb 11.1; Mr 9.8
RA = 11 41 49.4534 (astrometric)
Dec = -14 38 39.992
[of Date: 11 43 1, -14 46 26]
Prediction of 2022 Jul 5.3
Reliable 1.0 (good),

Durations: Max = 15.0 secs
1km = 0.086 secs, 1mas = 0.10 secs
Mag Drop: 1.3 [69%]v, 1.5 [74%]r
Sun : Dist = 161°
Moon: Dist = 42°, illum = 81%
Error 30.7 x 1.8 mas in PA 128°

Asteroid:
Mag = 11.4
Dia = 174 ±10km, 145 mas
Parallax = 5.290"
Hourly dRA = -2.387s
dDec = -2.61"
JPL#118:2022-Jun-06, Known errors



Occult 4.2022.7.5

(444) Gyptis, comb. 11,4 mag / 12,4 s / drop 1,6 mag

2023 Mar 22, 22:10

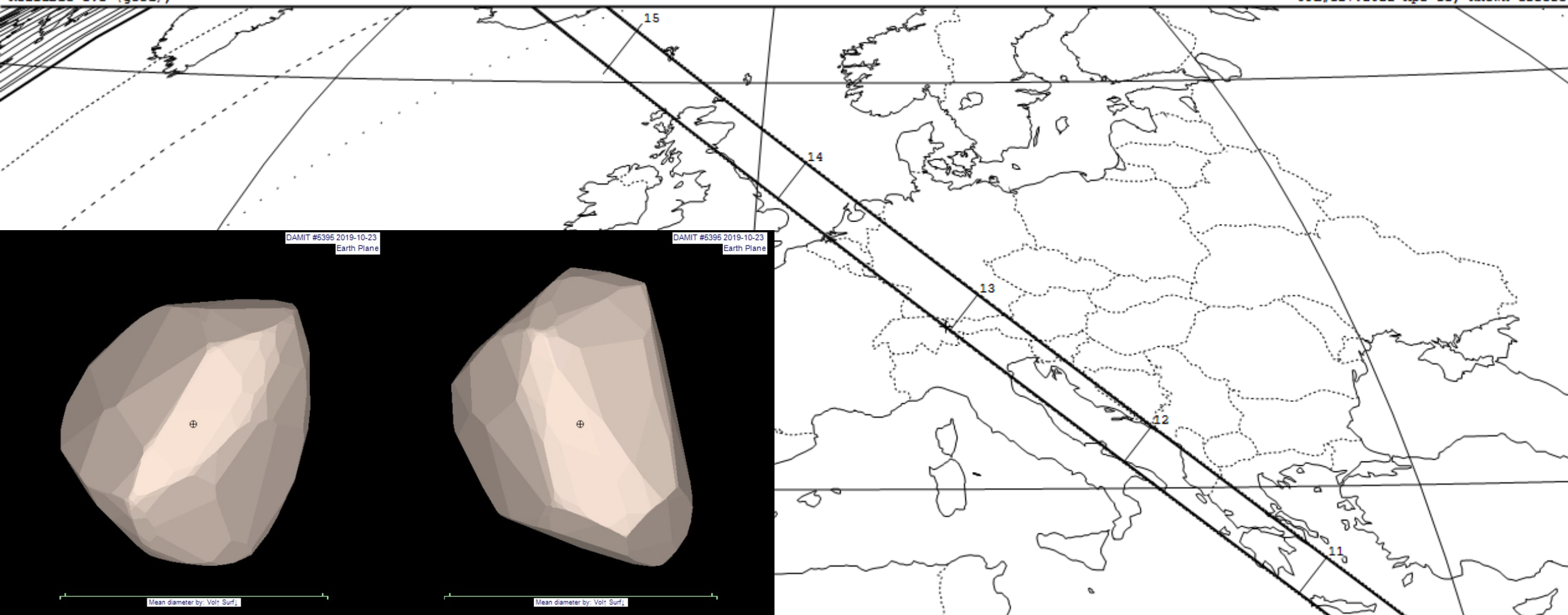
IIT

444 Gyptis occults UCAC4 461-048046 on 2023 Mar 22 from 22h 4m to 22h 17m UT

Star: (Dia < 0.1 mas)
Mv 11.7; Mb 12.0; Mr 11.2
RA = 10 22 37.8591 (astrometric)
Dec = 2 1 14.058
[of Date: 10 23 50, 1 54 9]
Prediction of 2022 Jul 5.3
Reliable 1.1 (good),

Durations: Max = 12.4 secs
1km = 0.077 secs, 1mas = 0.13 secs
Mag Drop: 1.6 [76%]v, 1.6 [76%]r
Sun : Dist = 154°
Moon: Dist = 138°, illum = 2%
Error 8.3 x 0.8 mas in PA 108°

Asteroid: (in DAMIT)
Mag = 13.0
Dia = 162 ±11km, 96 mas
Parallax = 3.783"
Hourly dRA = -1.467s
dDec = 17.03"
JPL#127:2022-Apr-11, Known errors



(377) Campania, comb. 11,2 mag / 17,3 s / drop 2,7 mag

2023 Apr 08, 23:17

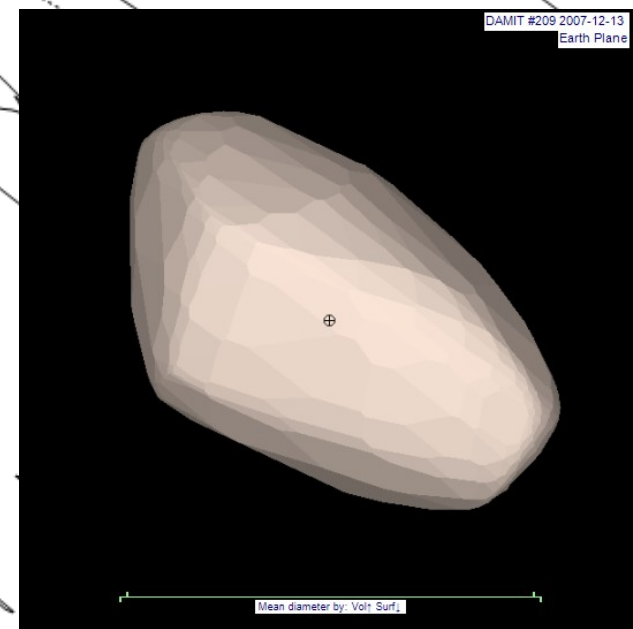
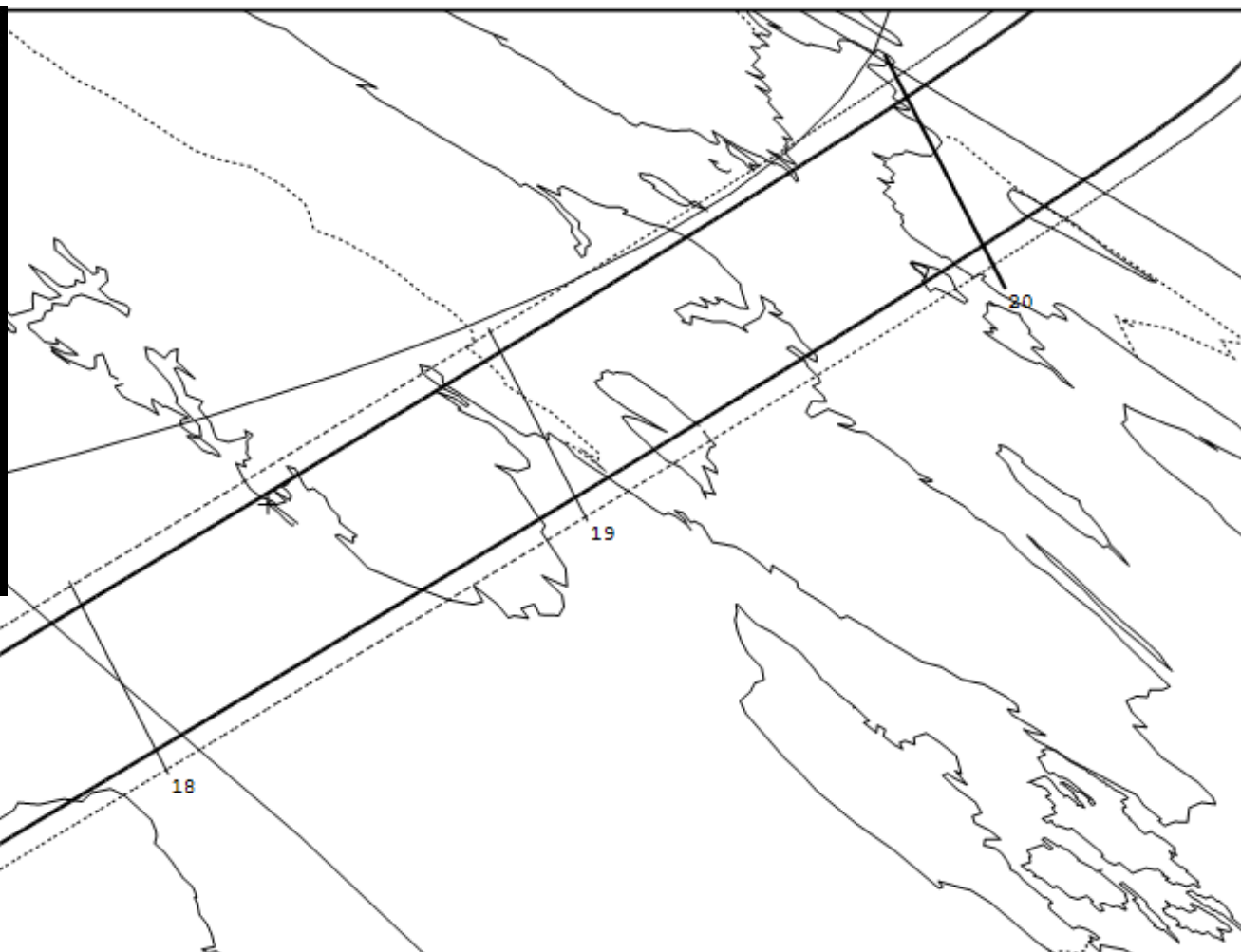
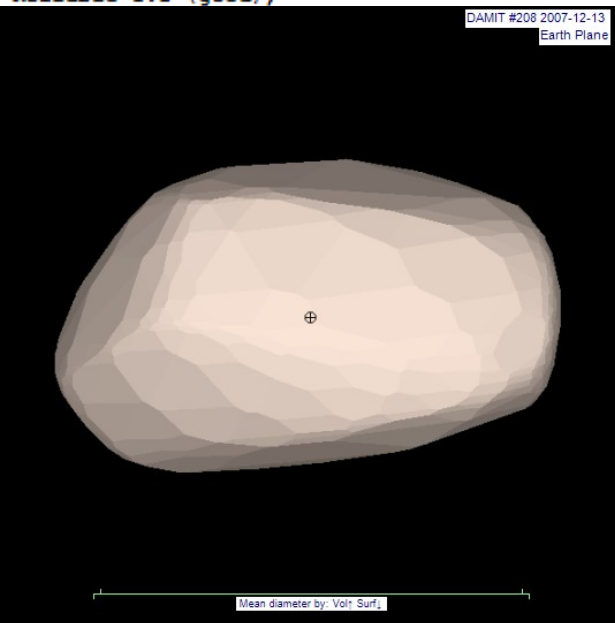
IIT

377 Campania occults UCAC4 499-052055 on 2023 Apr 8 from 22h 47m to 23h 21m UT

Star: (Dia < 0.1 mas)
Mv 11.4; Mb 11.9; Mr 10.7
RA = 8 58 25.9508 (astrometric)
Dec = 9 46 15.263
[of Date: 8 59 41, 9 40 51]
Prediction of 2022 Jul 5.3
Reliable 1.1 (good),

Durations: Max = 17.3 secs
1km = 0.19 secs, 1mas = 0.29 secs
Mag Drop: 2.7 [91%]v, 2.9 [93%]r
Sun : Dist = 115°
Moon: Dist = 97°, illum = 92%
Error 10.0 x 3.7 mas in PA 111°

Asteroid: (in DAMIT, ISAM)
Mag = 13.9
Dia = 93 ±5km, 60 mas
Parallax = 4.088"
Hourly dRA = 0.748s
dDec = 5.68"
JPL#67:2022-Jun-06, Known errors



(213) Lilaea, comb. 11,1 mag / 12,7 s / drop 1,5 mag

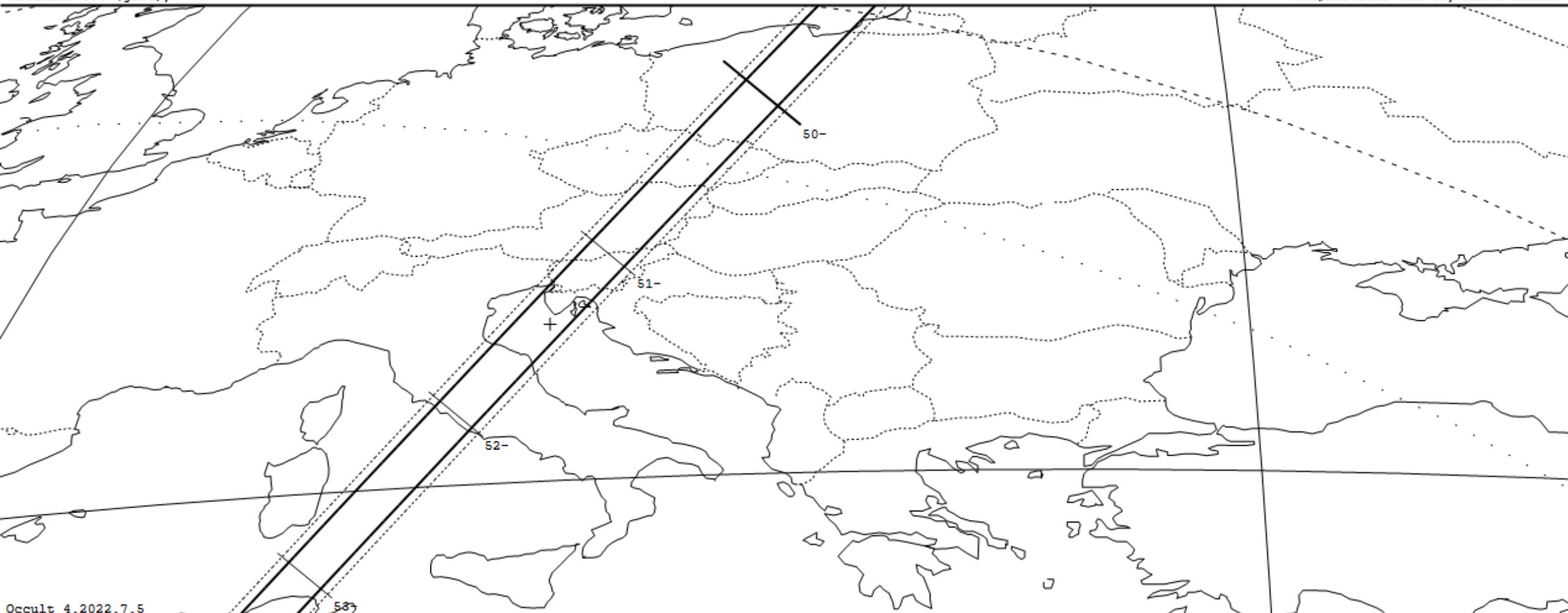
2023 Jul 28, 00:49 UT

213 Lilaea occults UCAC4 387-145932 on 2023 Jul 28 from 0h 48m to 1h 14m UT

Star: (Dia < 0.1 mas)
Mv 11.4; Mb 11.9; Mr 10.7
RA = 22 43 0.6263 (astrometric)
Dec = -12 36 52.538
[of Date: 22 44 16, -12 29 24]
Prediction of 2022 Jul 5.3
Reliable 0.9 (good),

Durations: Max = 12.7 secs
1km = 0.16 secs, 1mas = 0.17 secs
Mag Drop: 1.5 [76%]v, 1.7 [79%]r
Sun : Dist = 147°
Moon: Dist = 97°, illum = 72%
Error 24.3 x 2.6 mas in PA 74°

Asteroid:
Mag = 12.6
Dia = 80 ±4km, 73 mas
Parallax = 5.811"
Hourly dRA = -0.897s
dDec = -15.91"
JPL#122:2022-Jun-06, Known errors



Occult 4.2022.7.5

53

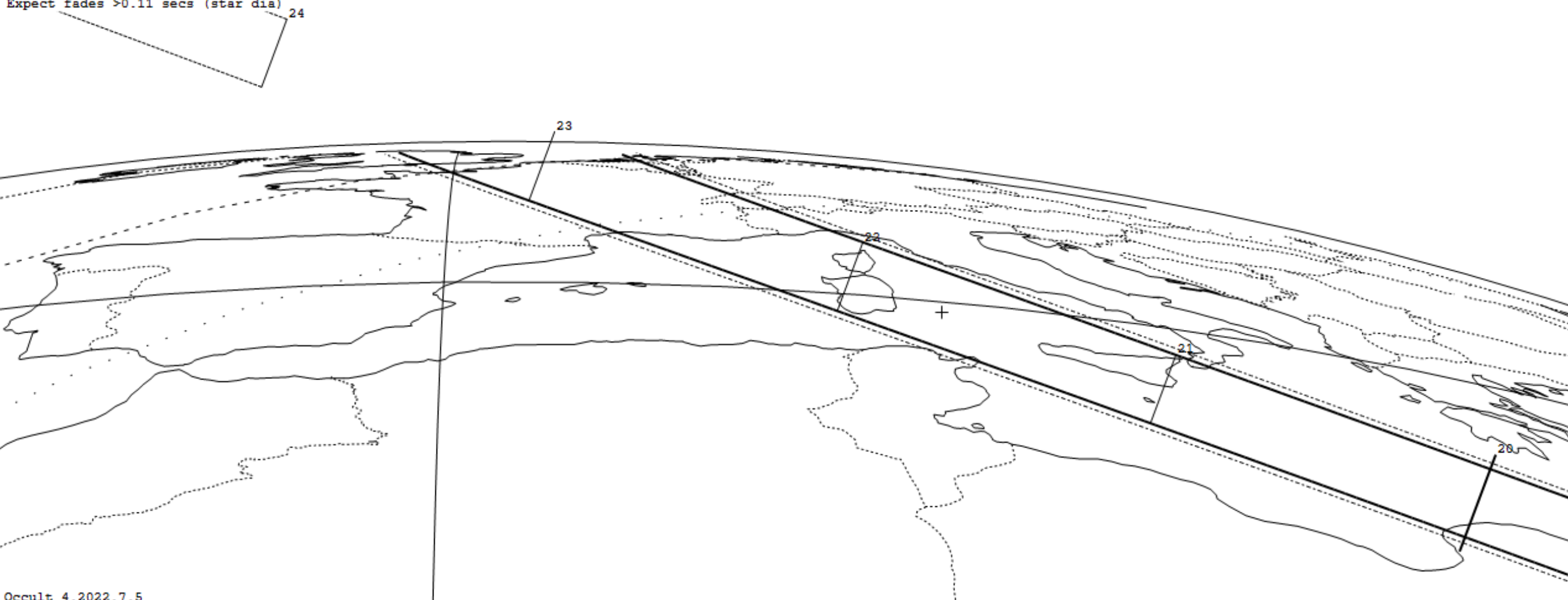
356 Liguria occults UCAC4 280-132312 on 2023 Jul 28 from 21h 15m to 21h 24m UT

Star: (Dia = 0.6 mas)
Mv 11.1; Mb 13.3; Mr 9.8
RA = 17 48 30.5762 (astrometric)
Dec = -34 9 16.720
[of Date: 17 50 5, -34 9 49]
Prediction of 2022 Jul 5.3
Reliable 0.7 (good),

Durations: Max = 13.5 secs
1km = 0.10 secs, 1mas = 0.18 secs
Mag Drop: 2.7 [92%]v, 3.6 [96%]r
Sun : Dist = 141°
Moon: Dist = 17°, illum = 80%
Error 13.7 x 3.2 mas in PA 87°

Asteroid:
Mag = 13.7
Dia = 131 ±7km, 73 mas
Parallax = 3.556"
Hourly dRA = -1.487s
dDec = 6.89"
JPL#83:2022-Jun-10, Known errors

Expect fades >0.11 secs (star dia) 24



Occult 4.2022.7.5

(309) Fraternitas (slow rotator), comb. 10,8 mag / 16,6 s / drop

2023 Aug 29, 02:34

4.3 mag

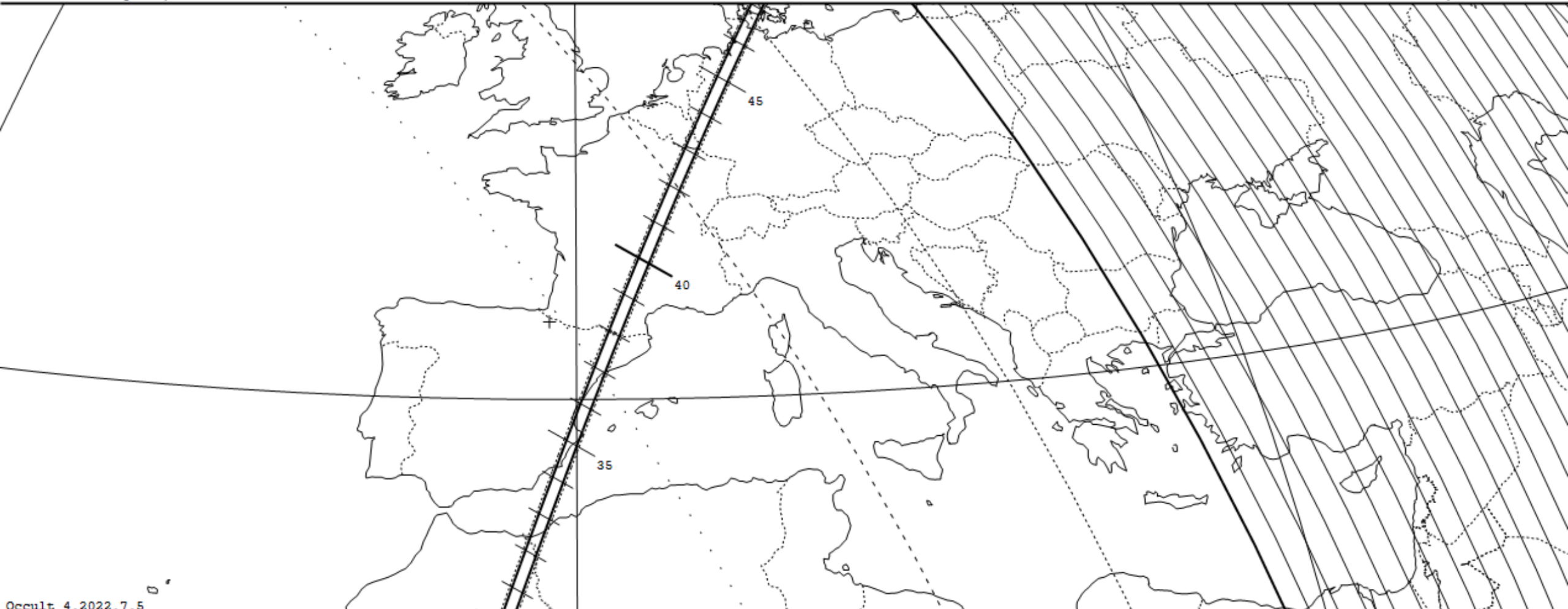
UT

309 Fraternitas occults TYC 636-00468-1 on 2023 Aug 29 from 2h 40m to 4h 2m UT

Star: (Dia < 0.1 mas)
Mv 10.8; Mb 11.2; Mr 10.2
RA = 2 6 52.0868 (astrometric)
Dec = 14 29 17.053
[of Date: 2 8 9, 14 36 5]
Prediction of 2022 Jul 5.3
Reliable 1.0 (good),

Durations: Max = 16.6 secs
1km = 0.39 secs, 1mas = 0.52 secs
Mag Drop: 4.3 [98%]v, 4.4 [98%]r
Sun : Dist = 121°
Moon: Dist = 87°, illum = 94%
Error 10.3 x 2.5 mas in PA 56°

Asteroid:
Mag = 15.1
Dia = 43 ±2km, 32 mas
Parallax = 4.762"
Hourly dRA = 0.232s
dDec = 6.00"
JPL#66:2022-Jun-06, Known errors



Occult 4.2022.7.5

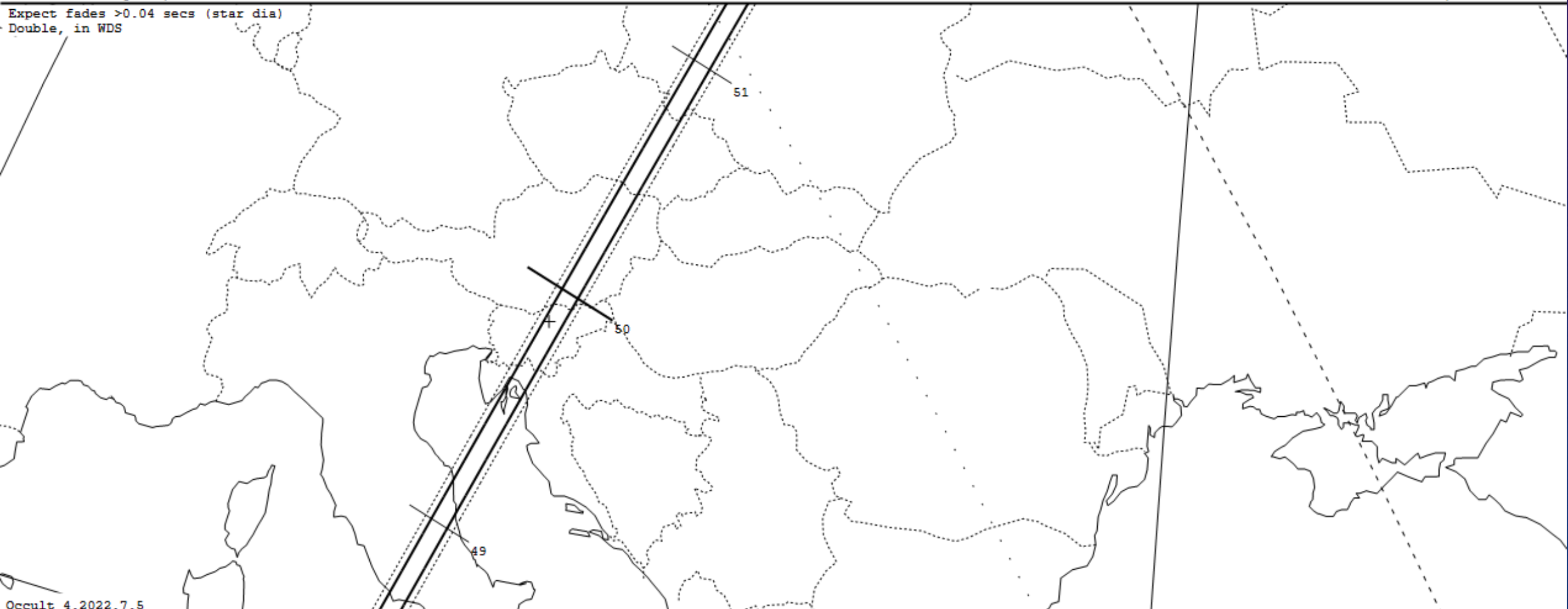
3152 Jones occults HIP 13210 on 2023 Aug 31 from 1h 36m to 2h 0m UT

Star: (Dia = 0.2 mas)
Mv 6.7; Mb 6.8; Mr 6.3
RA = 2 50 0.4138 (astrometric)
Dec = 30 31 33.170
[of Date: 2 51 26, 30 37 23]
Prediction of 2022 Jul 5.3
Reliable 1.2 (good),

Durations: Max = 4.1 secs
1km = 0.12 secs, 1mas = 0.21 secs
Mag Drop: 10.5 [100%]v, 10.4 [100%]r
Sun : Dist = 108°
Moon: Dist = 73°, illum =100%
Error 10.7 x 1.1 mas in PA 70°

Asteroid:
Mag = 17.2
Dia = 34 ±2km, 19 mas
Parallax = 3.709"
Hourly dRA = 0.707s
dDec = 14.50"
JPL#50:2022-Jun-06, Known errors

Expect fades >0.04 secs (star dia)
Double, in WDS



Occult 4.2022.7.5

(3152) Jones, comb. 6,7 mag / 4,1 s / drop 10,5 mag
part of the path

2nd

2023 Aug 31, 01:48
UT

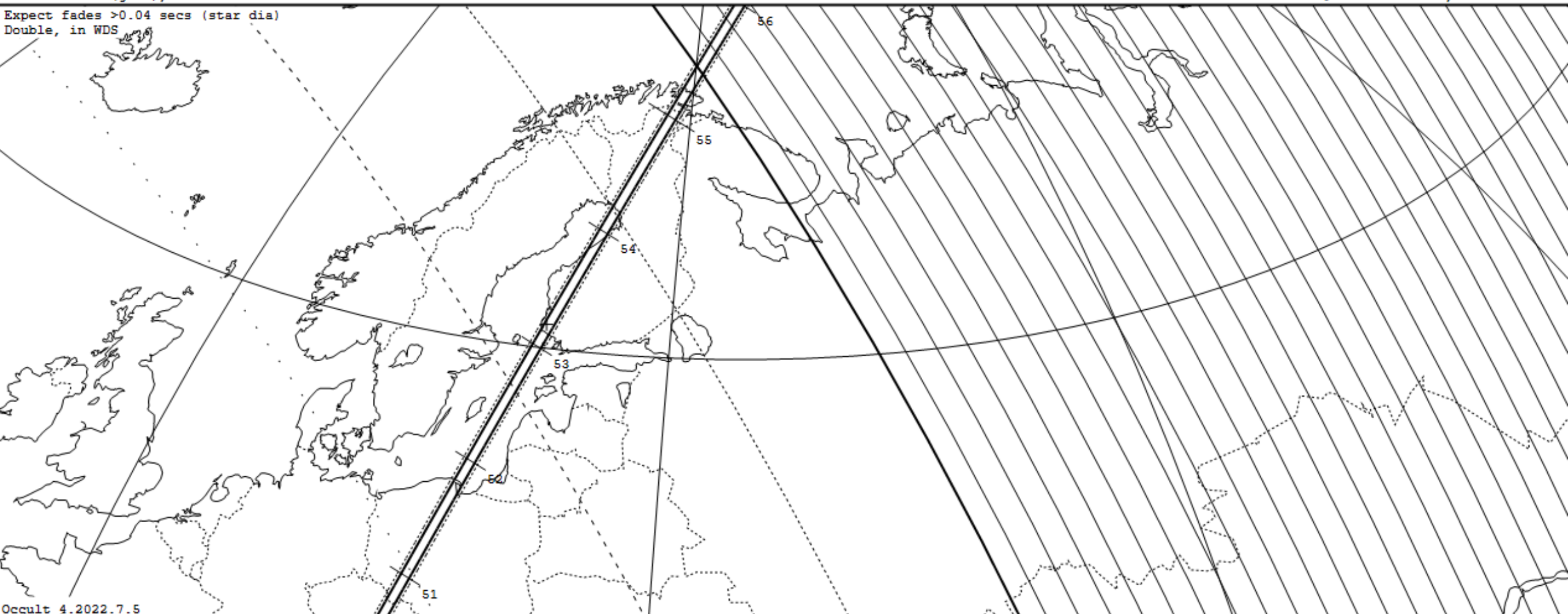
3152 Jones occults HIP 13210 on 2023 Aug 31 from 1h 36m to 2h 0m UT

Star: (Dia = 0.2 mas)
Mv 6.7; Mb 6.8; Mr 6.3
RA = 2 50 0.4138 (astrometric)
Dec = 30 31 33.170
[of Date: 2 51 26, 30 37 23]
Prediction of 2022 Jul 5.3
Reliable 1.2 (good),

Durations: Max = 4.1 secs
1km = 0.12 secs, 1mas = 0.21 secs
Mag Drop: 10.5 [100%]v, 10.4 [100%]r
Sun : Dist = 108°
Moon: Dist = 73°, illum =100%
Error 10.7 x 1.1 mas in PA 70°

Asteroid:
Mag = 17.2
Dia = 34 ±2km, 19 mas
Parallax = 3.709"
Hourly dRA = 0.707s
dDec = 14.50"
JPL#50:2022-Jun-06, Known errors

Expect fades >0.04 secs (star dia)
Double, in WDS



Occult 4.2022.7.5

(598) Octavia, comb. 8,7 mag / 9,4 s / drop 4,6 mag

2023 Sep 12, 00:53
UT

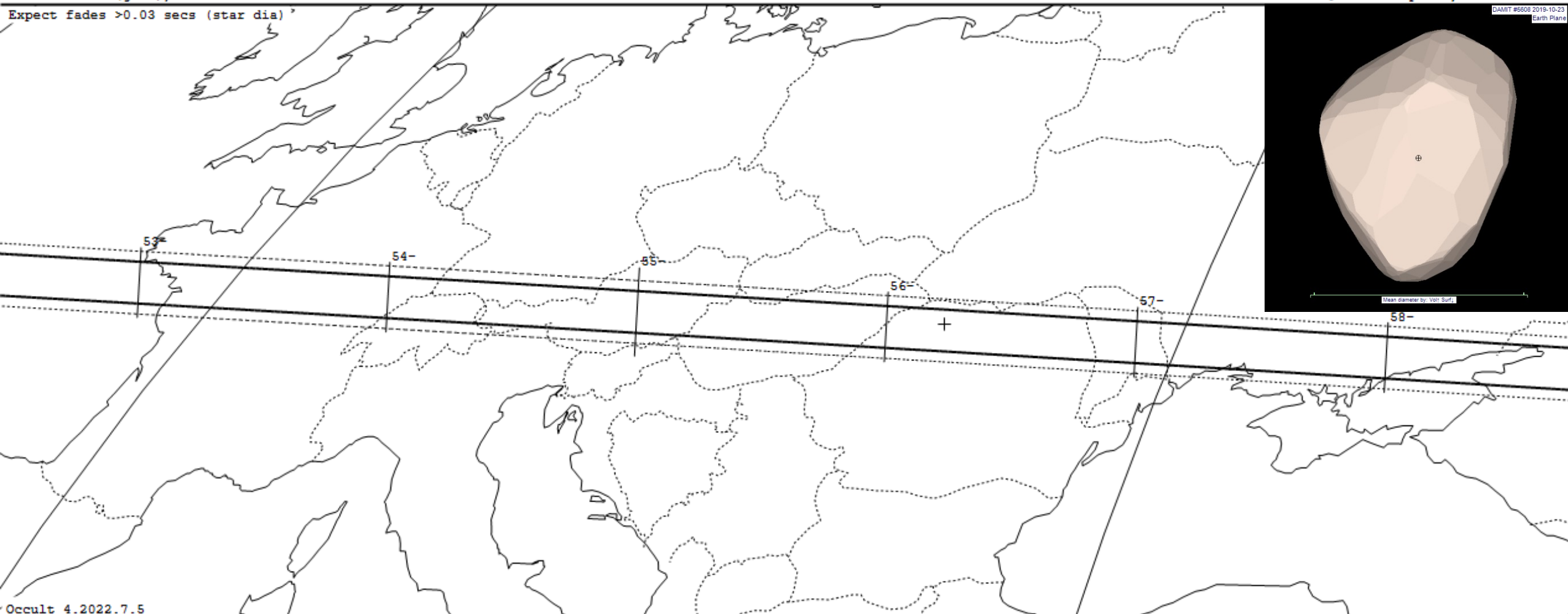
598 Octavia occults TYC 68-00951-1 on 2023 Sep 12 from 0h 51m to 1h 11m UT

Star: (Dia = 0.2 mas)
Mv 8.7; Mb 9.6; Mr 7.8
RA = 3 44 3.4590 (astrometric)
Dec = 3 35 0.897
[of Date: 3 45 18, 3 39 38]
Prediction of 2022 Jul 5.3
Reliable 1.1 (good),

Durations: Max = 9.4 secs
1km = 0.12 secs, 1mas = 0.13 secs
Mag Drop: 4.6 [99%]v, 5.0 [99%]r
Sun : Dist = 113°
Moon: Dist = 83°, illum = 8%
Error 30.0 x 11.7 mas in PA 63°

Asteroid: (in DAMIT)
Mag = 13.3
Dia = 76 ±5km, 72 mas
Parallax = 6.054"
Hourly dRA = 1.840s
dDec = -1.55"
JPL#52:2022-Apr-12, Known errors

Expect fades >0.03 secs (star dia)



Occult 4.2022.7.5

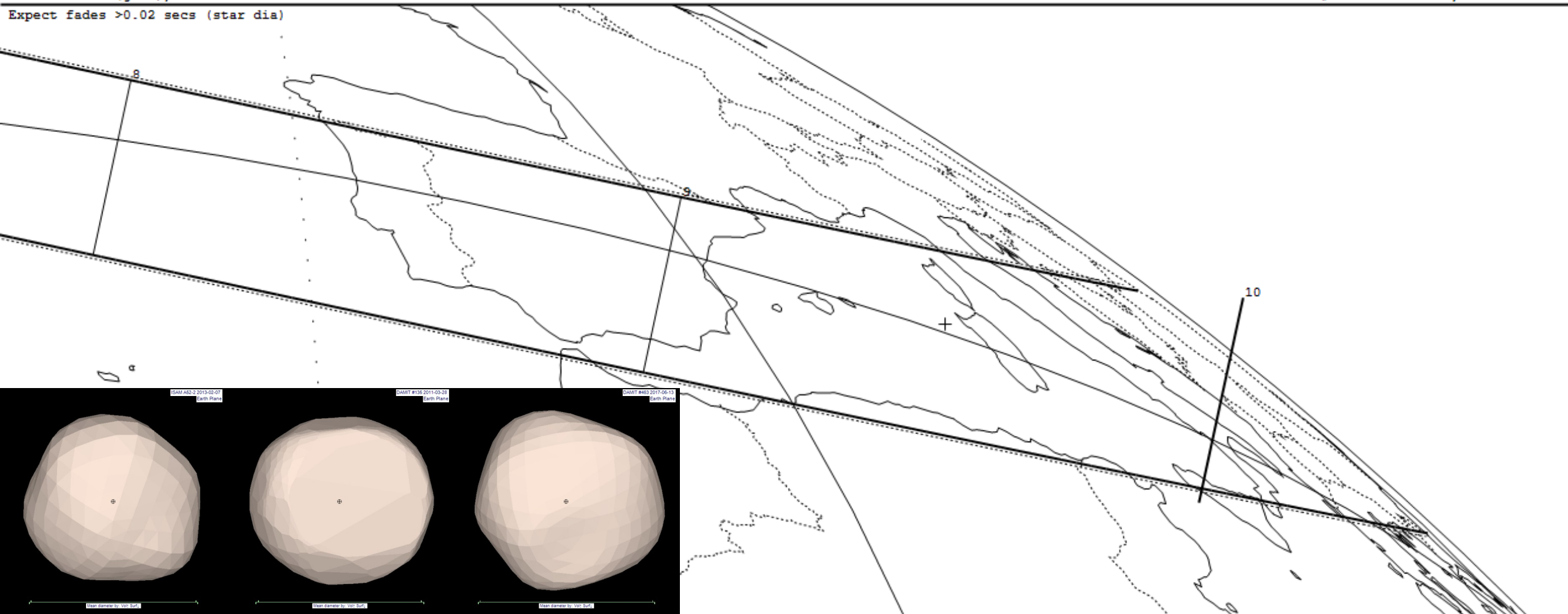
52 Europa occults UCAC4 350-112253 on 2023 Sep 23 from 20h 4m to 20h 10m UT

Star: (Dia = 0.1 mas)
Mv 11.7; Mb 13.0; Mr 10.6
RA = 17 44 0.0594 (astrometric)
Dec = -20 5 33.505
[of Date: 17 45 24, -20 6 12]
Prediction of 2022 Jul 5.3
Reliable 0.8 (good),

Durations: Max = 18.8 secs
1km = 0.058 secs, 1mas = 0.14 secs
Mag Drop: 1.4 [73%]v, 1.9 [83%]r
Sun : Dist = 86°
Moon: Dist = 19°, illum = 61%
Error 21.3 x 1.3 mas in PA 97°

Asteroid: (in DAMIT, ISAM)
Mag = 12.8
Dia = 326 ±16km, 134 mas
Parallax = 2.623"
Hourly dRA = 1.785s
dDec = -5.42"
JPL#115:2022-Jun-10, Known errors

Expect fades >0.02 secs (star dia)



(921) Jovita (slow rotator), comb. 7,9 mag / 4,6 s / drop 8,6 mag

2023 Oct 27, 00:17
UT

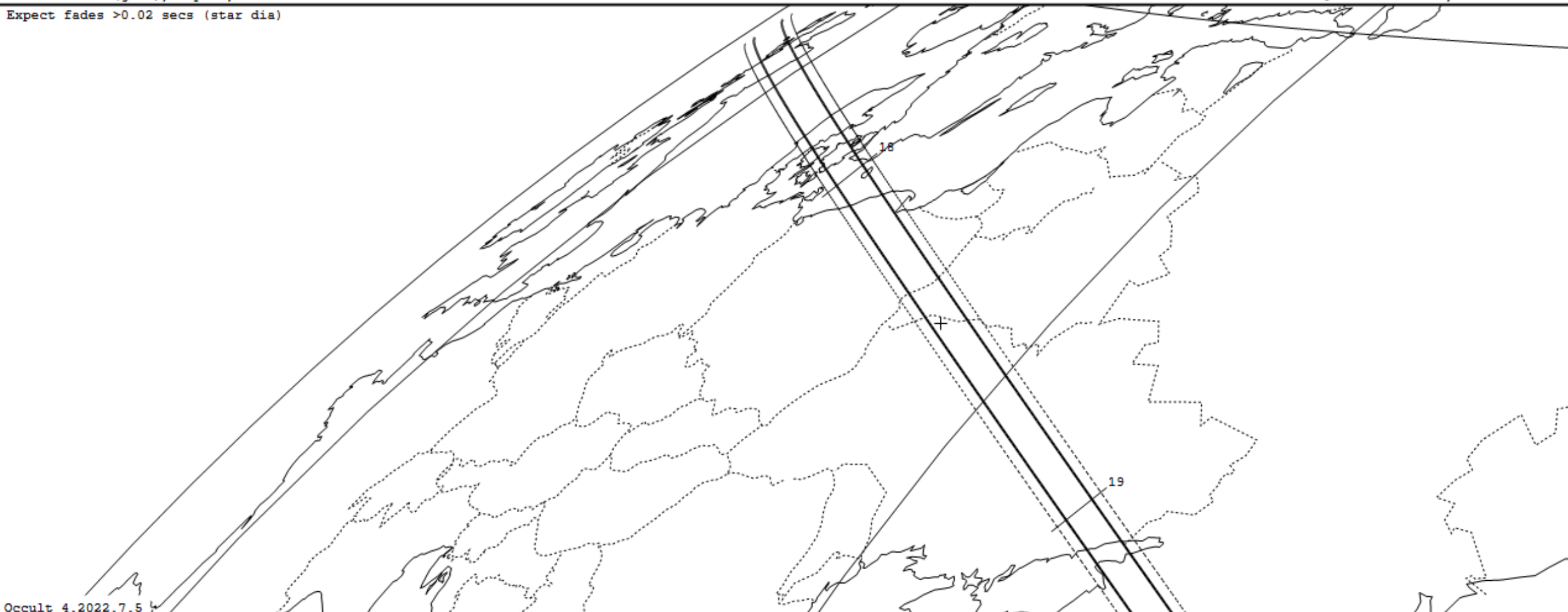
921 Jovita occults HIP 37584 on 2023 Oct 27 from 0h 17m to 0h 34m UT

Star: (Dia = 0.1 mas)
Mv 7.9; Mb 8.1; Mr 7.5
RA = 7 42 45.9316 (astrometric)
Dec = 4 4 14.488
[of Date: 7 44 1, 4 1 1]
Prediction of 2022 Jul 5.3
Reliable 0.9 (good), DupSrc,

Durations: Max = 4.6 secs
1km = 0.077 secs, 1mas = 0.20 secs
Mag Drop: 8.6 [100%]v, 8.6 [100%]r
Sun : Dist = 96°
Moon: Dist = 107°, illum = 95%
Error 11.3 x 2.1 mas in PA 98°

Asteroid:
Mag = 16.5
Dia = 60 ±3km, 24 mas
Parallax = 2.502"
Hourly dRA = 0.766s
dDec = -14.36"
JPL#71:2022-Jun-06, Known errors

Expect fades >0.02 secs (star dia)



Occult 4.2022.7.5

(13) Egeria, comb. 10,0 mag / 15,5 s / drop 2,1 mag

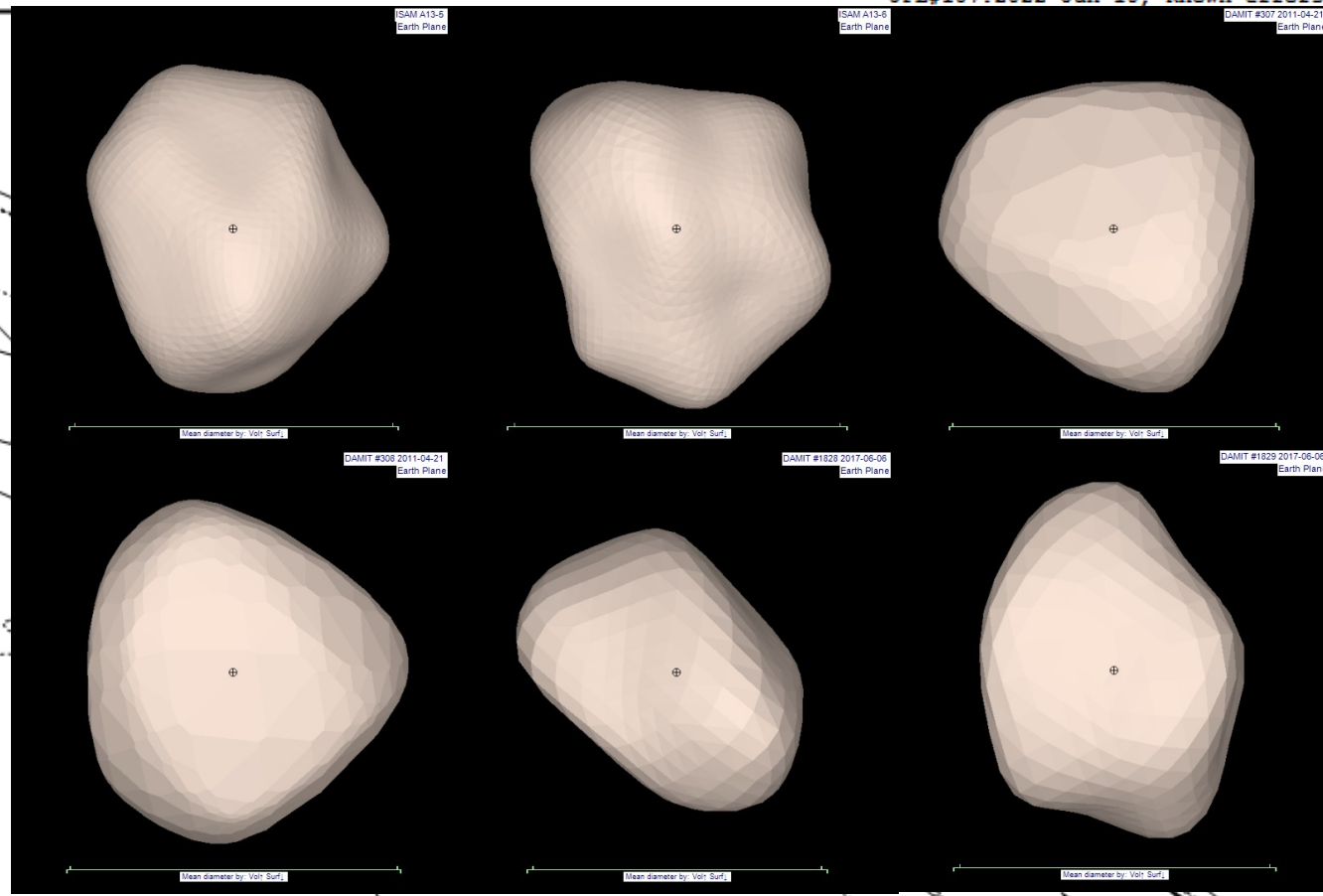
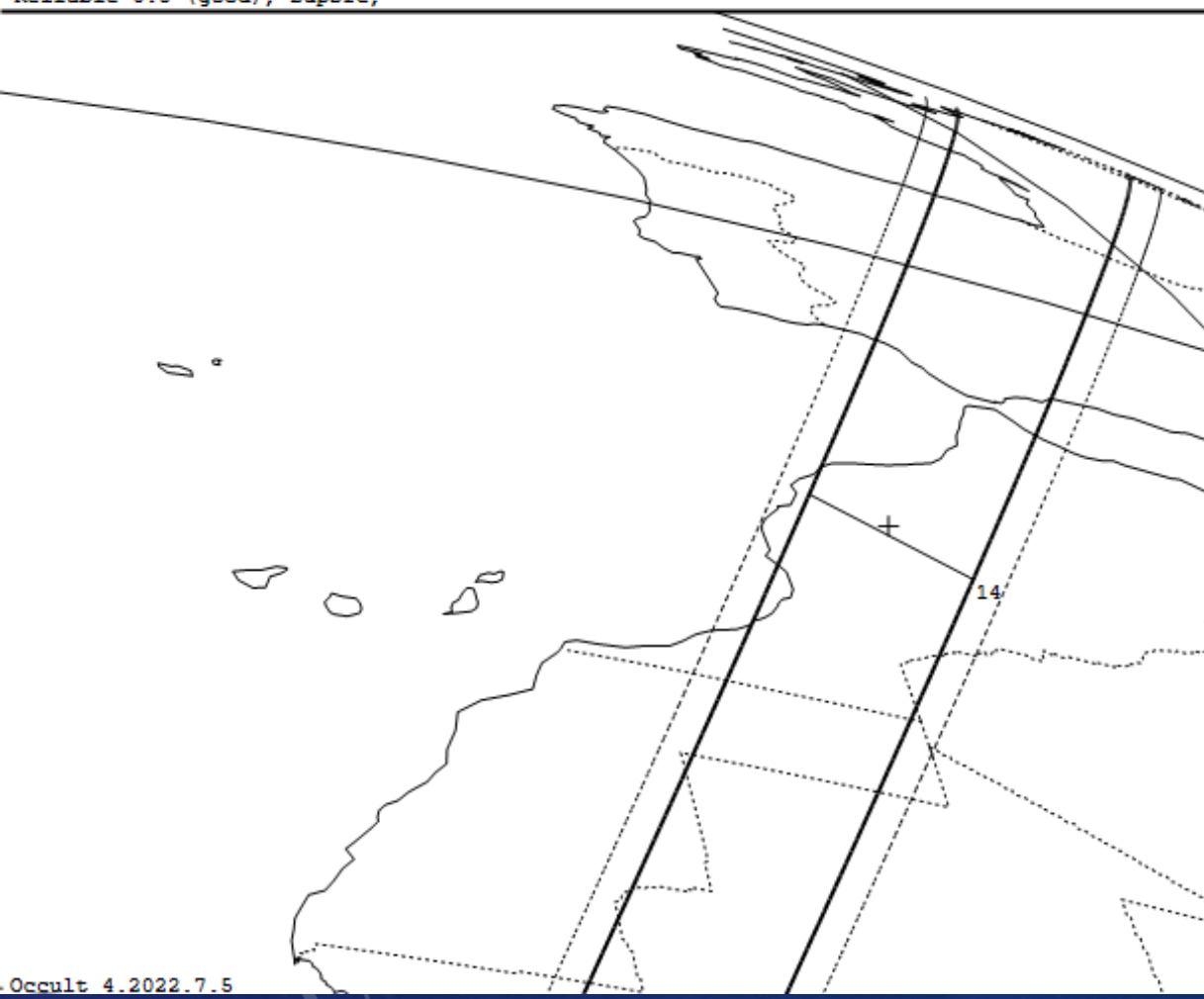
2023 Oct 28, 21:14
UT

13 Egeria occults TYC 7487-01616-1 on 2023 Oct 28 from 20h 59m to 21h 15m UT

Star: (Dia < 0.1 mas)
Mv 10.2; Mb 10.5; Mr 9.7
RA = 21 43 20.4601 (astrometric)
Dec = -32 14 35.987
[of Date: 21 44 45, -32 8 12]
Prediction of 2022 Jul 5.3
Reliable 0.8 (good), DupSrc,

Durations: Max = 15.5 secs
1km = 0.075 secs, 1mas = 0.13 secs
Mag Drop: 2.1 [85%]v, 2.1 [86%]r
Sun : Dist = 101°
Moon: Dist = 79°, illum =100%
Error 27.3 x 18.0 mas in PA 59°

Asteroid: (in DAMIT, ISAM)
Mag = 12.1
Dia = 208 ±14km, 121 mas
Parallax = 3.711"
Hourly dRA = 1.020s
dDec = 24.93"
JPL#107:2022-Jun-10, Known errors



Occult 4.2022.7.5

(407) Arachne, comb. 10,8 mag / 39,6 s / drop 2,5 mag

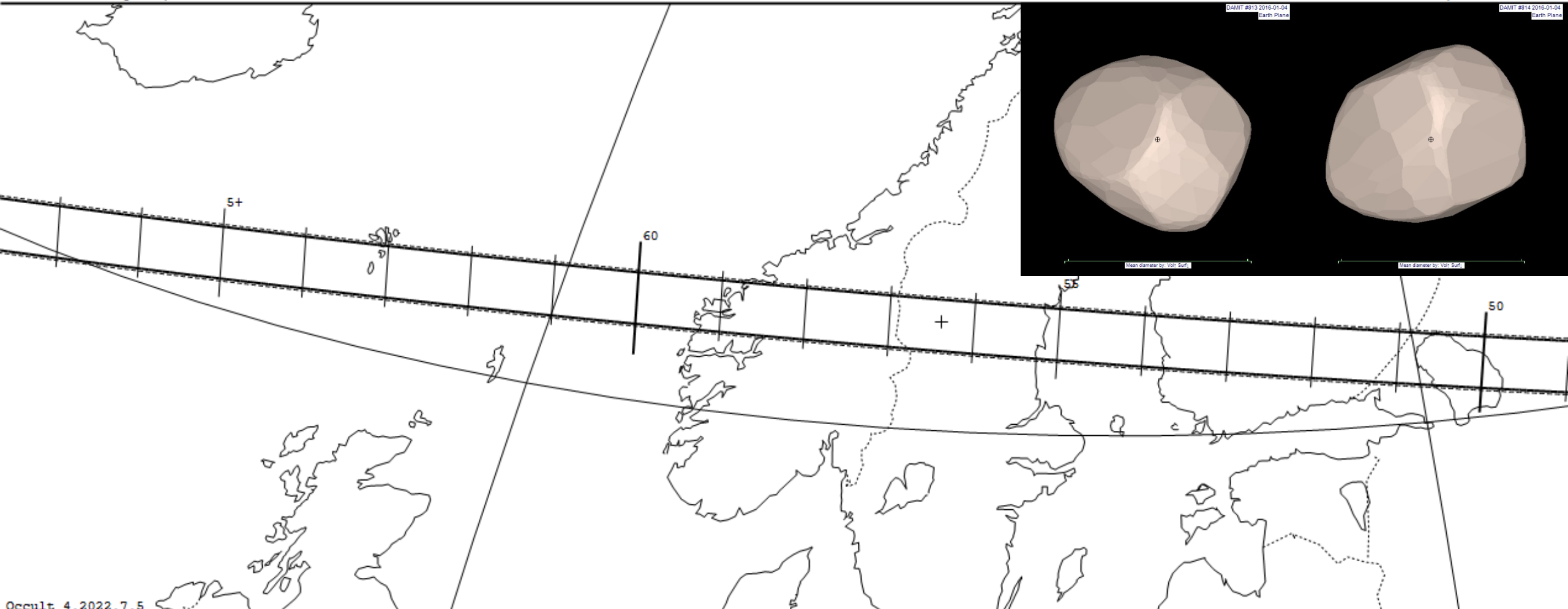
2023 Nov 05, 01:50
UT

407 Arachne occults UCAC4 603-029598 on 2023 Nov 5 from 1h 15m to 2h 32m UT

Star: (Dia < 0.1 mas)
Mv 11.0; Mb 11.0; Mr 10.8
RA = 6 2 57.4229 (astrometric)
Dec = 30 34 12.407
[of Date: 6 4 30, 30 34 11]
Prediction of 2022 Jul 5.3
Reliable 0.9 (good),

Durations: Max = 39.6 secs
1km = 0.42 secs, 1mas = 0.53 secs
Mag Drop: 2.5 [90%]v, 2.2 [87%]r
Sun : Dist = 131°
Moon: Dist = 38°, illum = 53%
Error 8.0 x 2.5 mas in PA 77°

Asteroid: (in DAMIT, ISAM)
Mag = 13.3
Dia = 94 ± 6km, 74 mas
Parallax = 5.022"
Hourly dRA = -0.521s
dDec = 0.45"
JPL#59:2022-Jun-06, Known errors



Occult 4.2022.7.5

(205) Martha, comb. 10,9 mag / 12,3 s / drop 3,1 mag

2023 Nov 08, 00:23

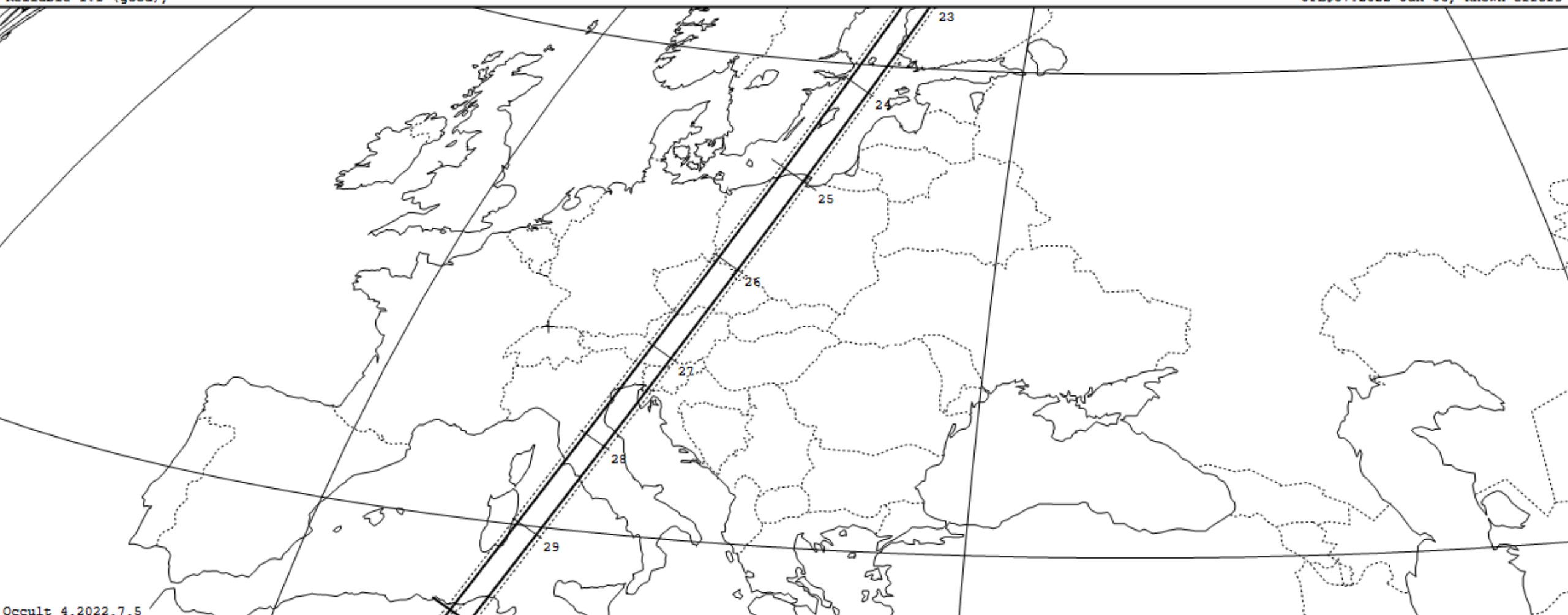
IIT

205 Martha occults UCAC4 515-019690 on 2023 Nov 8 from 0h 18m to 0h 46m UT

Star: (Dia < 0.1 mas)
Mv 10.9; Mb 11.5; Mr 10.2
RA = 6 4 10.0876 (astrometric)
Dec = 12 56 38.150
[of Date: 6 5 31, 12 56 39]
Prediction of 2022 Jul 5.3
Reliable 1.1 (good),

Durations: Max = 12.3 secs
1km = 0.15 secs, 1mas = 0.21 secs
Mag Drop: 3.1 [94%]v, 3.4 [96%]r
Sun : Dist = 133°
Moon: Dist = 74°, illum = 26%
Error 13.3 x 1.0 mas in PA 89°

Asteroid:
Mag = 14.0
Dia = 81 ±4km, 58 mas
Parallax = 4.537"
Hourly dRA = -0.666s
dDec = -13.81"
JPL#57:2022-Jun-06, Known errors



Occult 4.2022.7.5

(319) Leona, comb. 0,5 mag / 11,6 s / drop 2,9 mag – annular occultation

2023 Dec 12, 01:08 UT

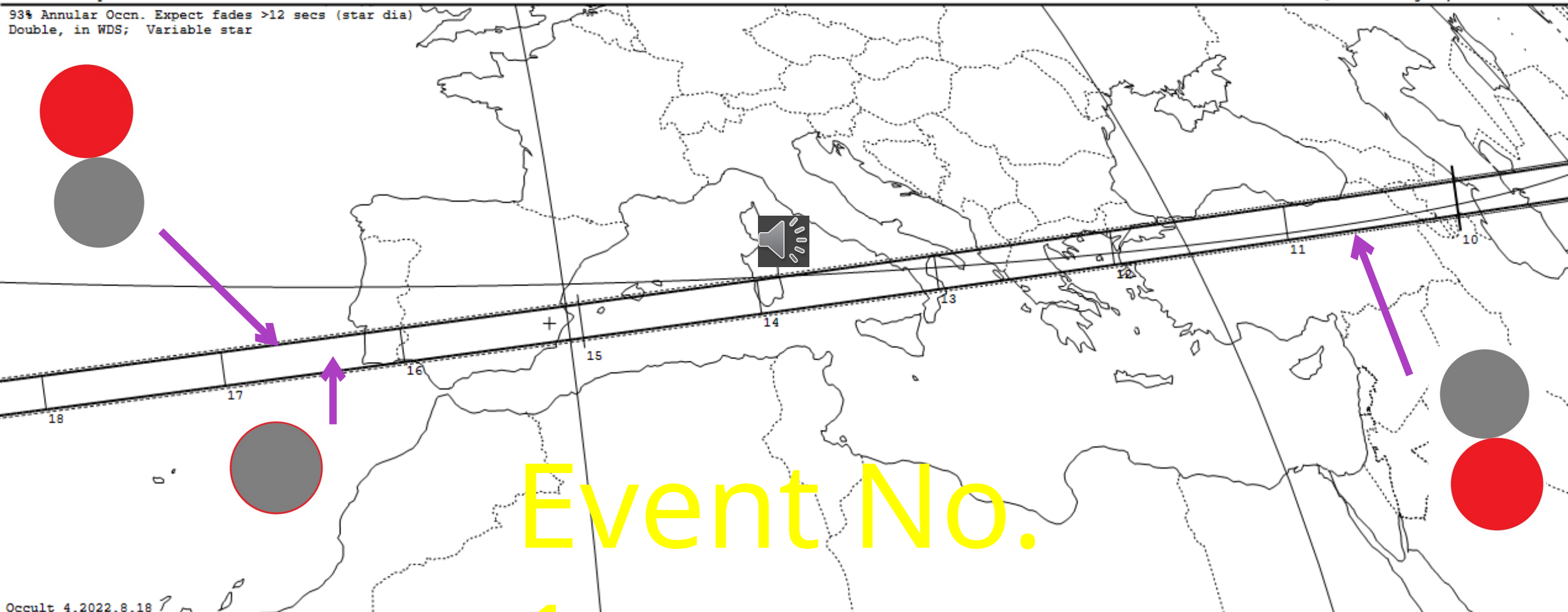
319 Leona occults HIP 27989 on 2023 Dec 12 from 1h 8m to 1h 26m UT

Star: (Dia = 48.1 mas)
Mv 0.5; Mb 2.0; Mr -1.8
RA = 5 55 10.3441 (astrometric)
Dec = 7 24 25.652
[of Date: 5 56 29, 7 24 43]
Prediction of 2022 Aug 21.7
Reliable - position from UBSC

Durations: Max = 11.6 secs
1km = 0.19 secs, 1mas = 0.25 secs
Mag Drop: 2.9 [93%]v, 2.9 [93%]r
Sun : Dist = 162°
Moon: Dist = 151°, illum = 1%
Error 37.1 x 4.0 mas in PA 92°

Asteroid:
Mag = 14.2
Dia = 61 ±3km, 46 mas
Parallax = 4.864"
Hourly dRA = -1.949s
dDec = -3.98"
JPL#61:2022-Aug-03, Known errors

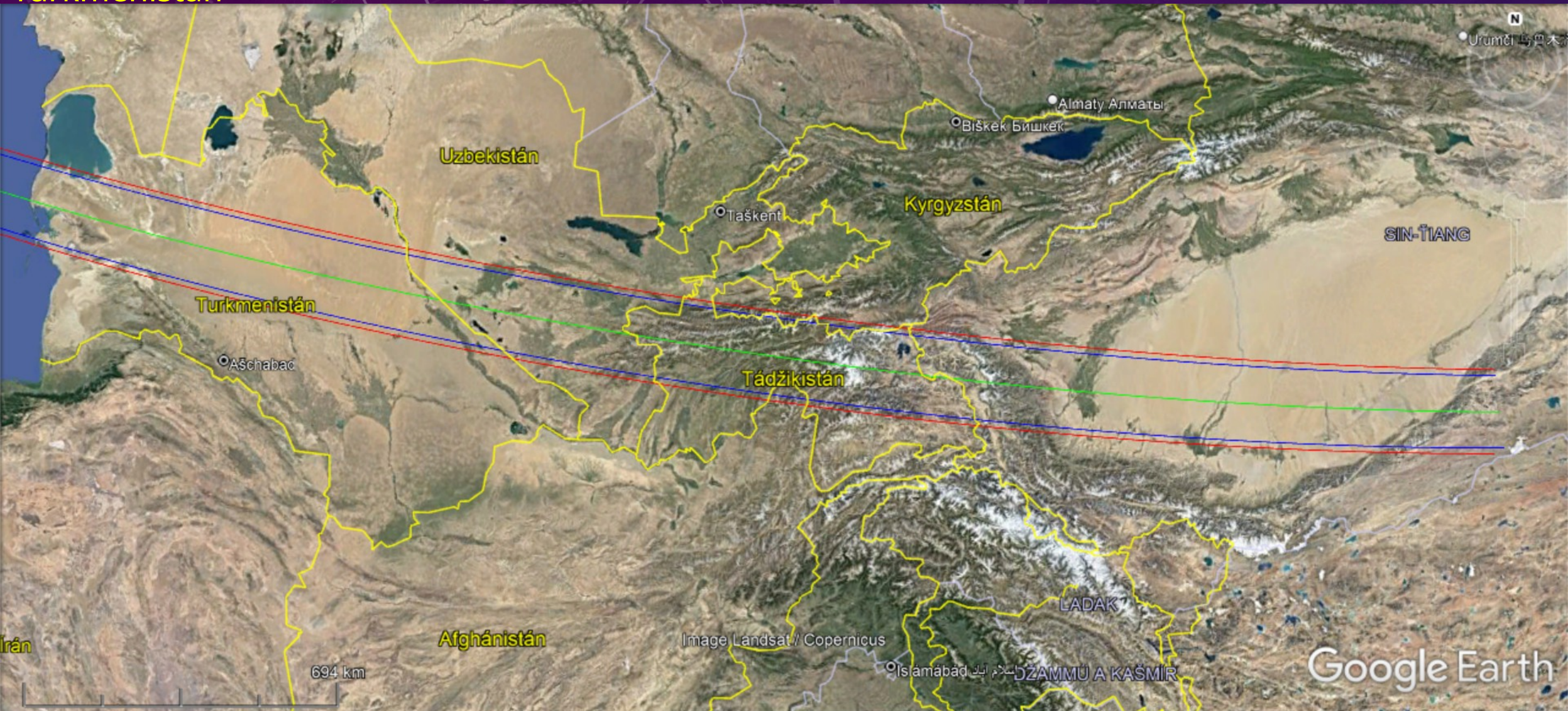
93% Annular Occn. Expect fades >12 secs (star dia)
Double, in WDS; Variable star



Occult 4.2022.8.18

1

(319) Leona, comb. 0,5 mag / 11,6 s / drop 2,9 mag – China, Tajikistan, Uzbekistan, Dec 12, 01:08 UT
Turkmenistan



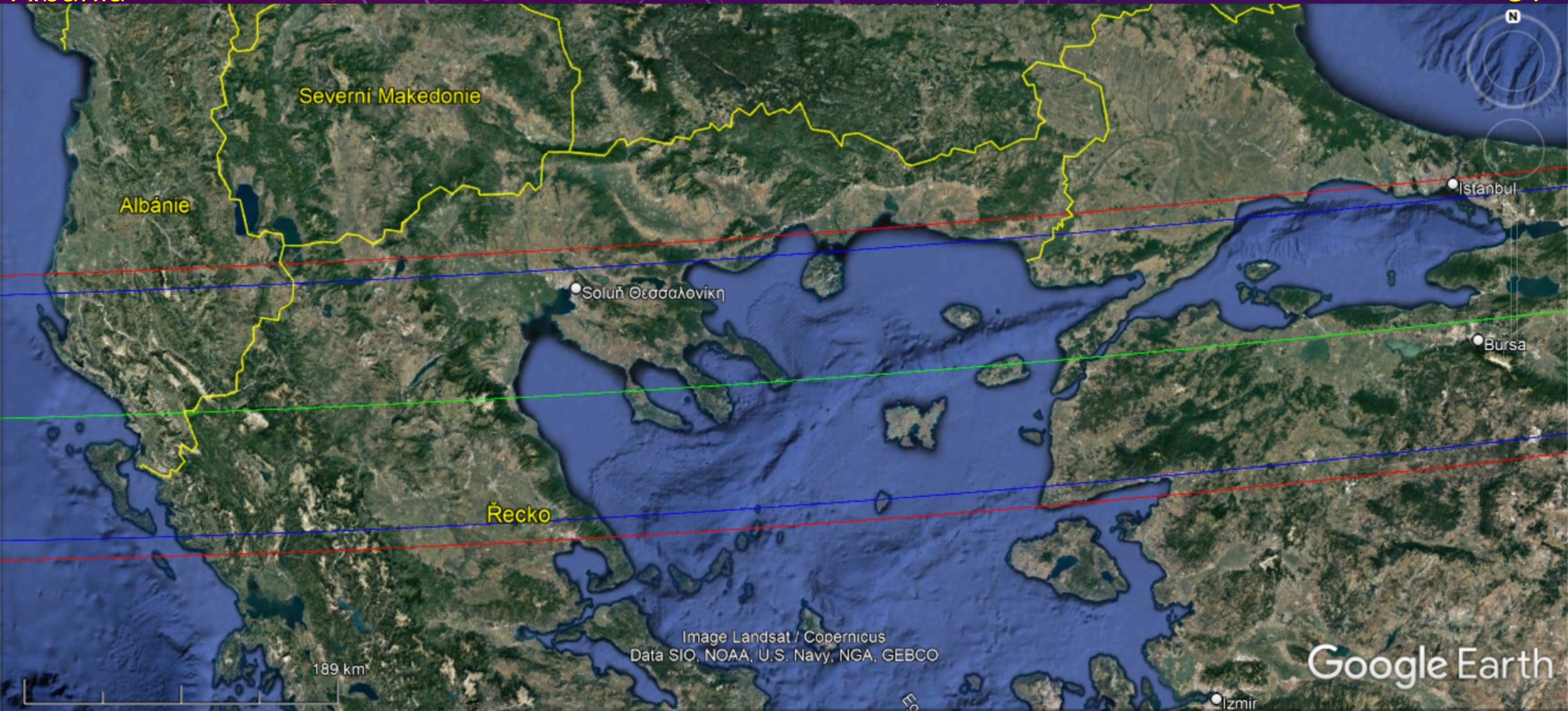
(319) Leona, comb. 0,5 mag / 11,6 s / drop 2,9 mag – Azerbaijan, Armenia,
Turkey

2023 Dec 12,
01:09UT



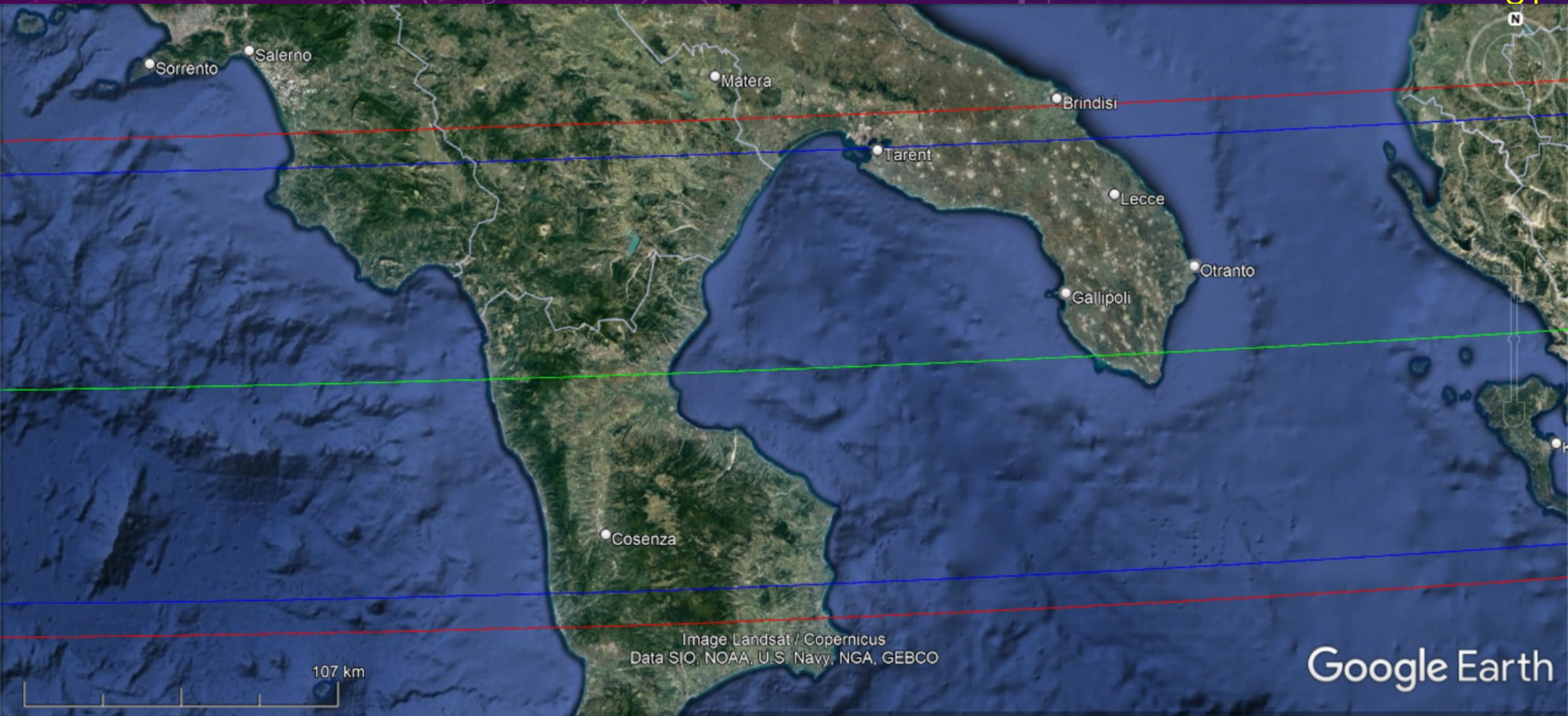
(319) Leona, comb. 0,5 mag / 11,6 s / drop 2,9 mag – Turkey (W part), Greece,
Albania

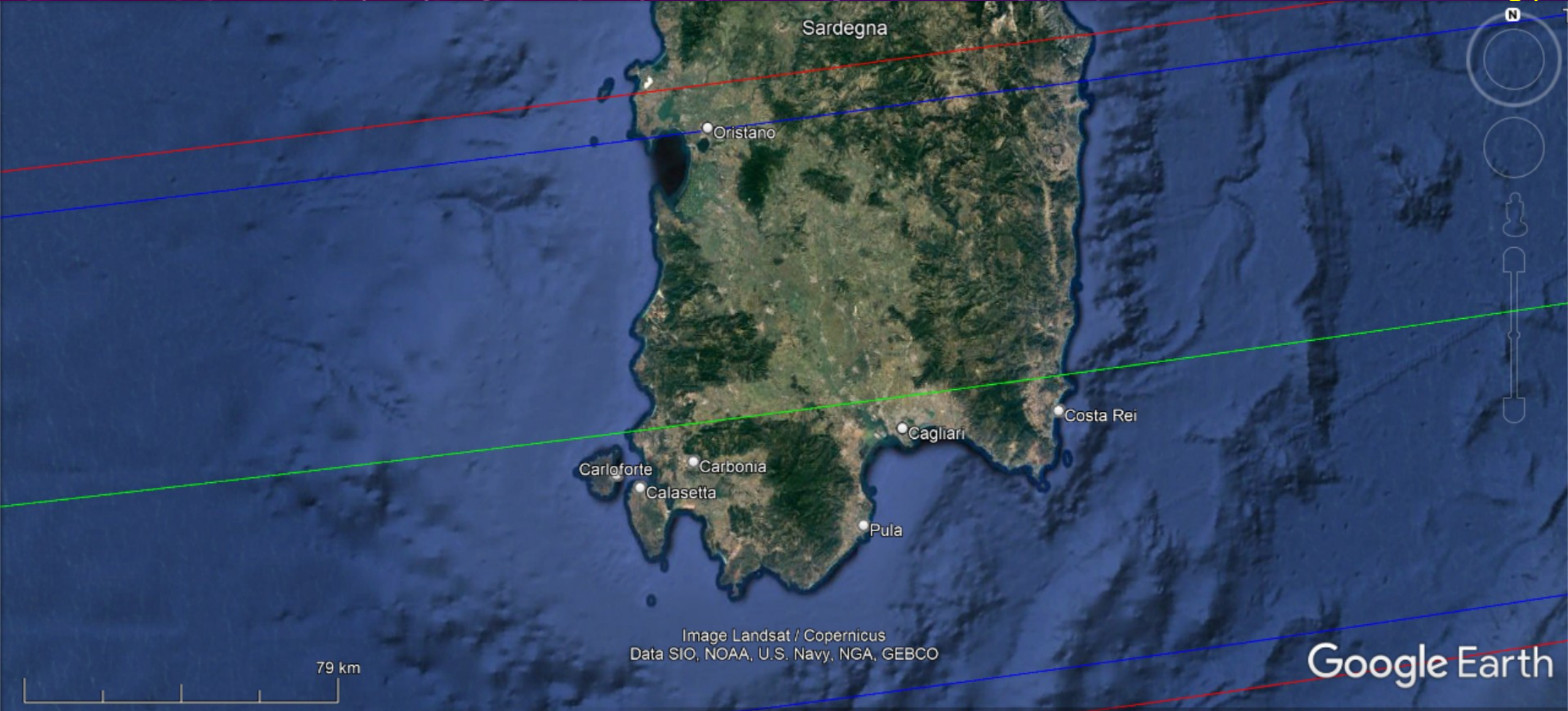
2023 Dec 12, 01:11
UT



(319) Leona, comb. 0,5 mag / 11,6 s / drop 2,9 mag – Italy

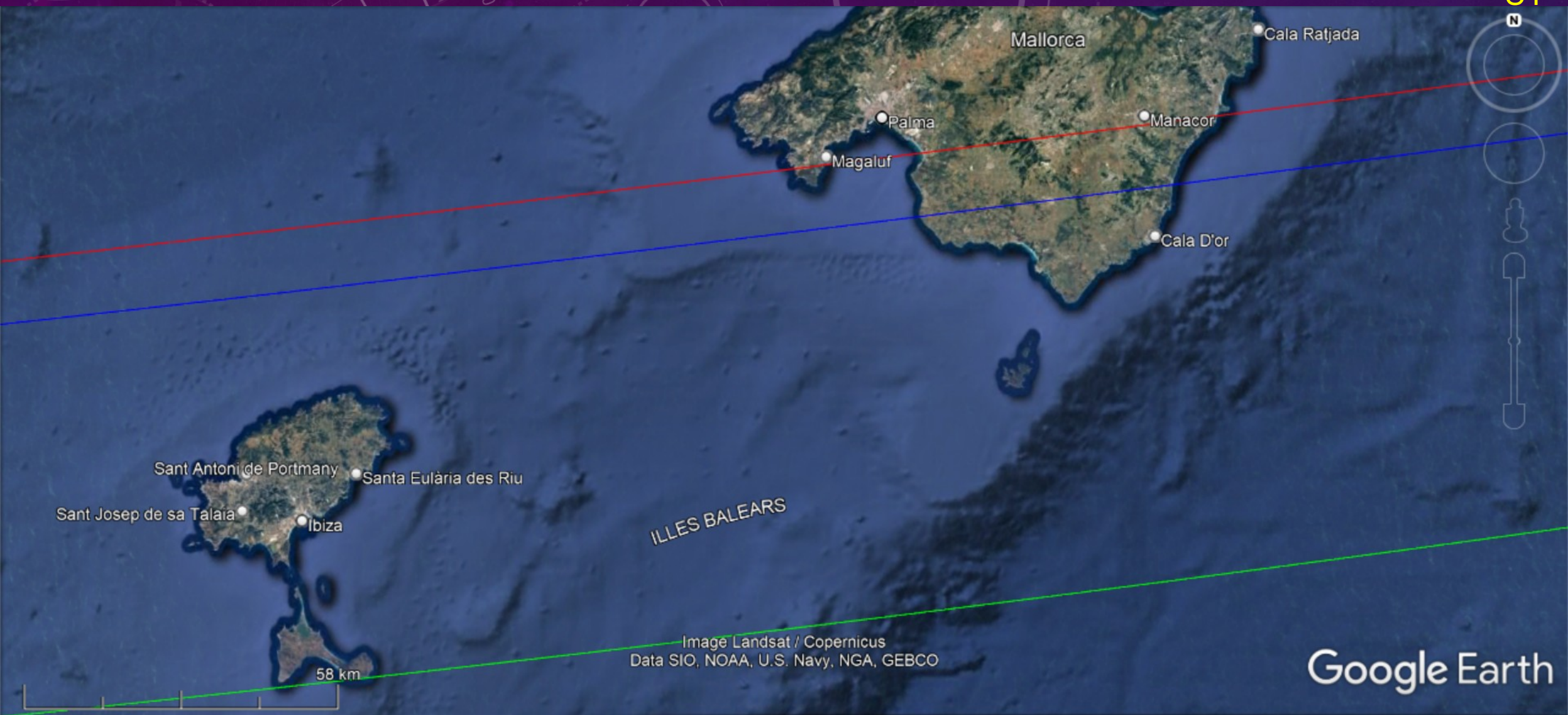
2023 Dec 12, 01:12
UT





(319) Leona, comb. 0,5 mag / 11,6 s / drop 2,9 mag – Balearic Islands

2023 Dec 12, 01:14
UT



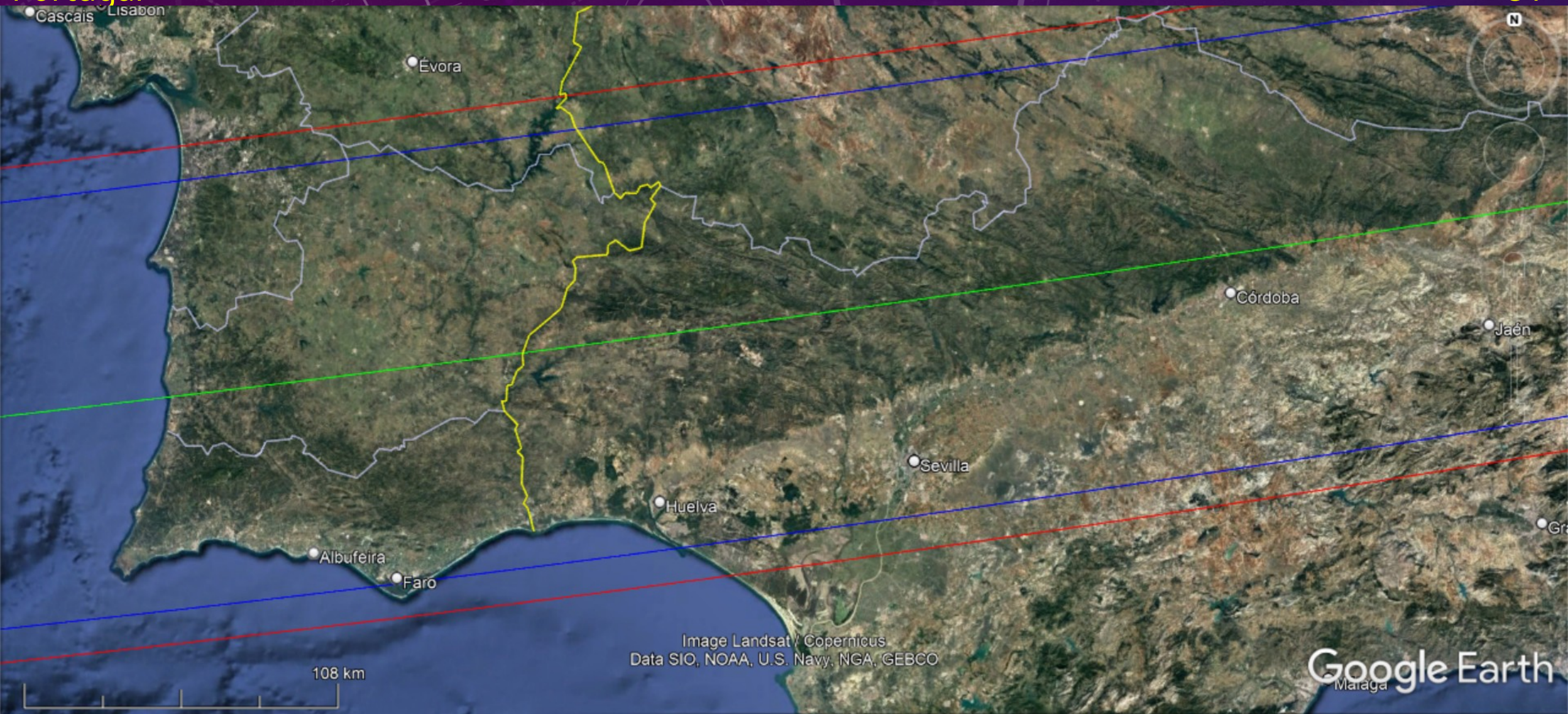
(319) Leona, comb. 0,5 mag / 11,6 s / drop 2,9 mag – Spain (eastern part)

2023 Dec 12, 01:15
UT



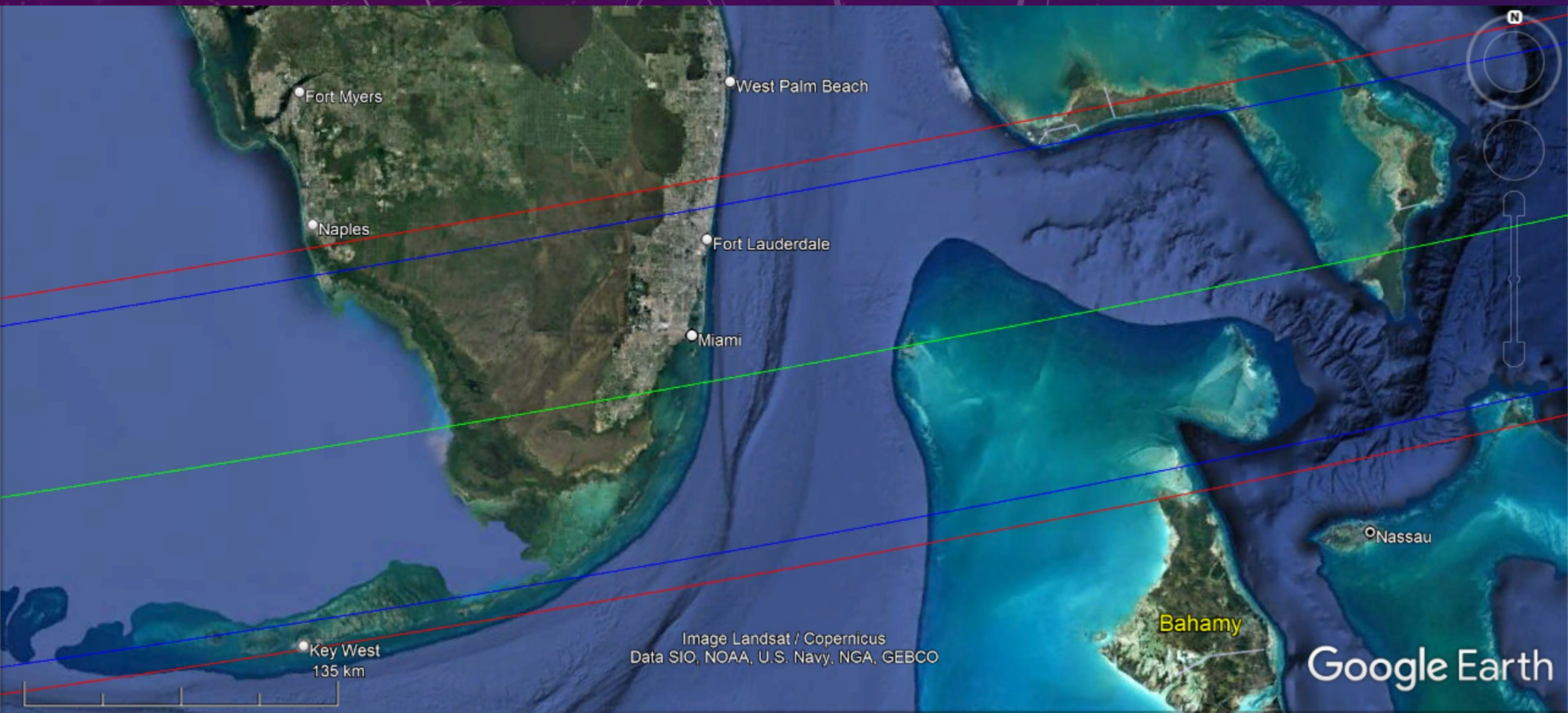
(319) Leona, comb. 0,5 mag / 11,6 s / drop 2,9 mag – Spain (western part),
Portugal

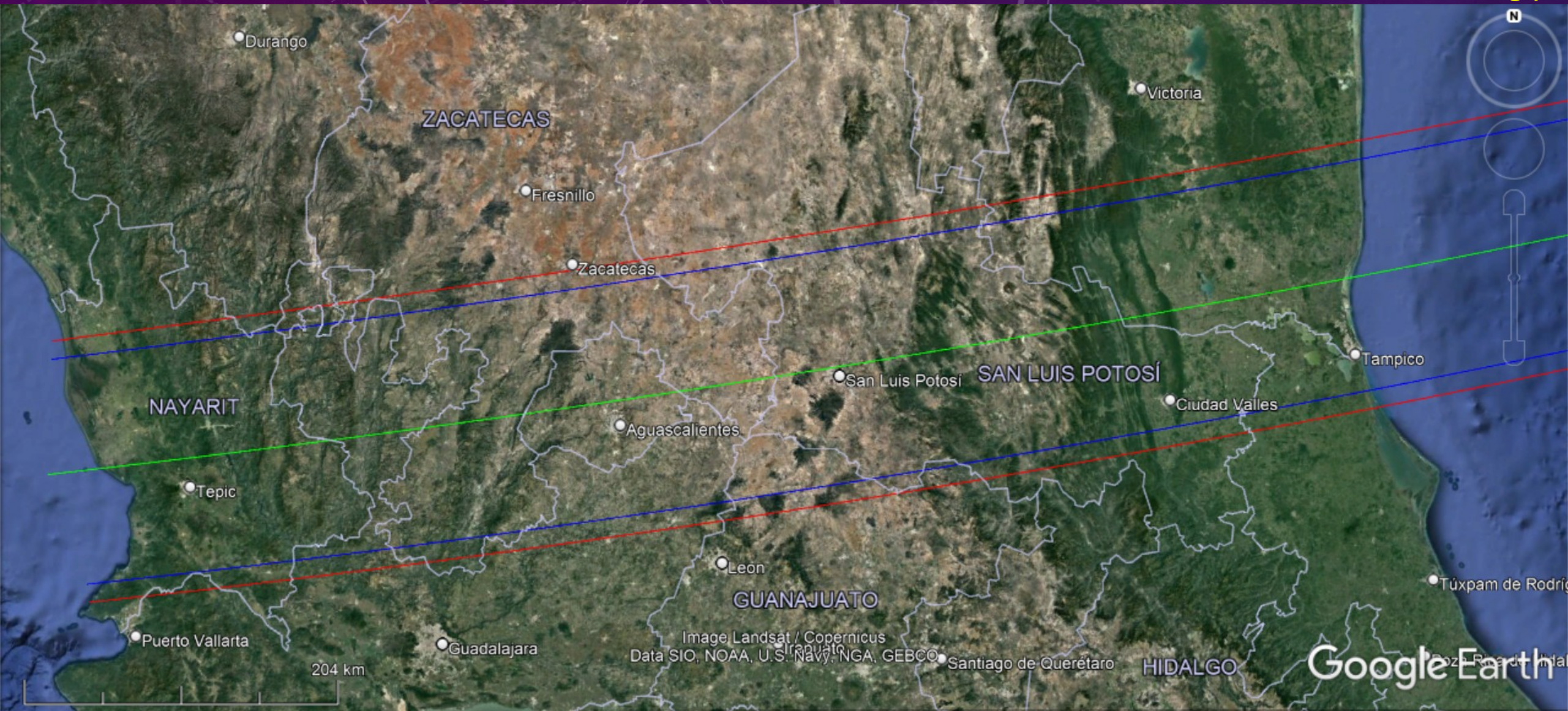
2023 Dec 12, 01:15
UT



(319) Leona, comb. 0,5 mag / 11,6 s / drop 2,9 mag – Bahamas, USA (FL)

2023 Dec 12, 01:24
UT





(319) Leona, comb. 0,5 mag / 11,6 s / drop 2,9 mag – annular
occultation

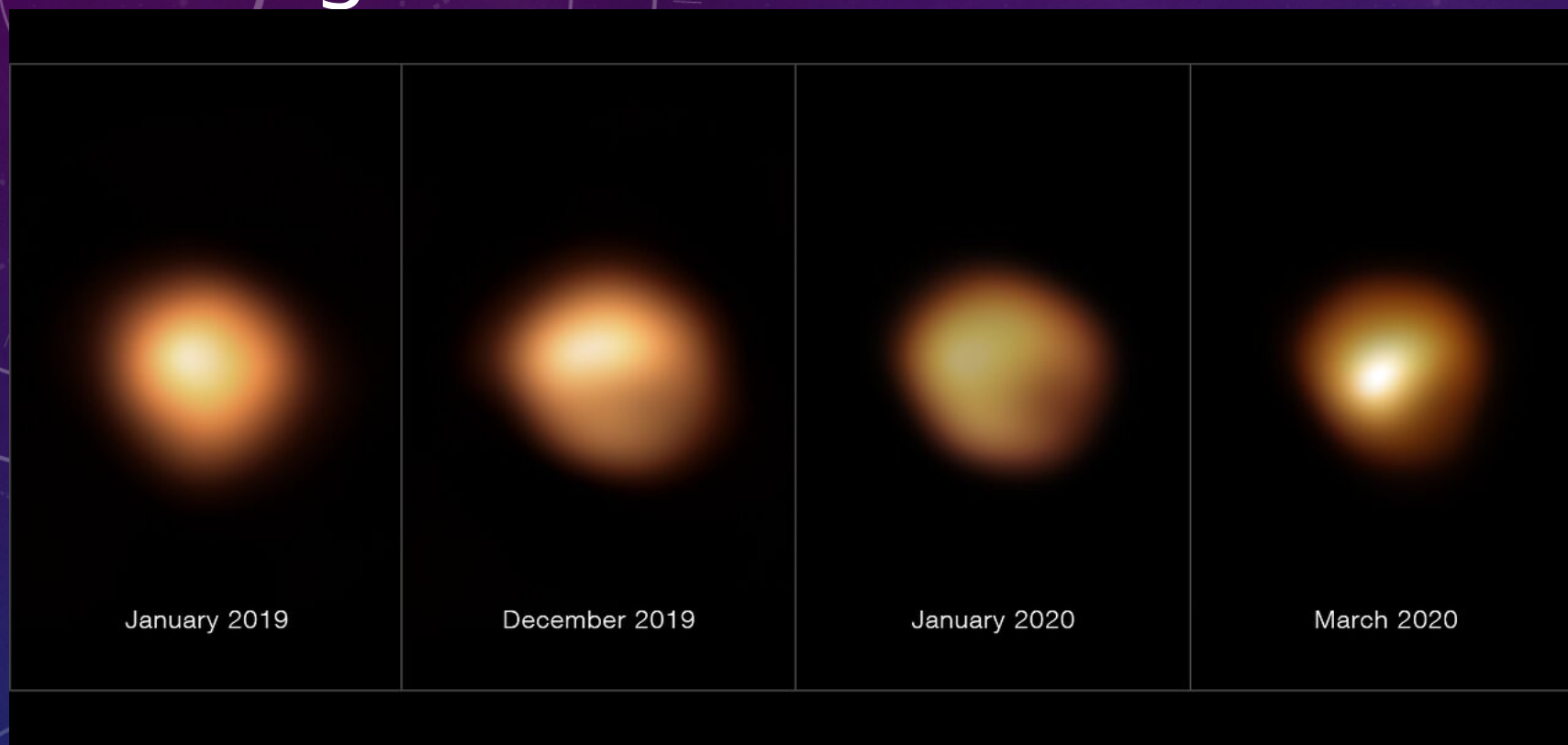
2023 Dec 12, 01:08
UT



(319) Leona, comb. 0,5 mag / 11,6 s / drop 2,9 mag – annular
occultation

2023 Dec 12, 01:08
UT

Betelgeuse – red supergiant, spectral type M1 – M2
Semiregular variable star.

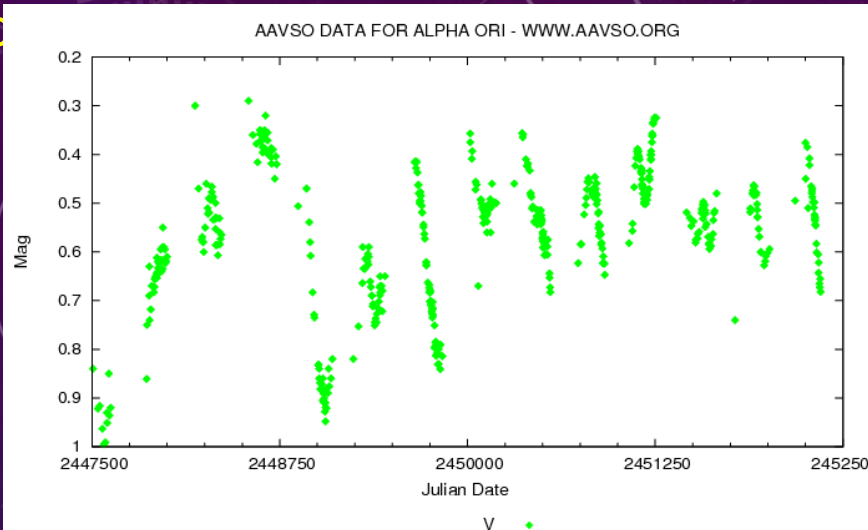


Great dimming 2019/2020

Kredit: ESO/M. Montargès et al.

(319) Leona, comb. 0,5 mag / 11,6 s / drop 2,9 mag – annular

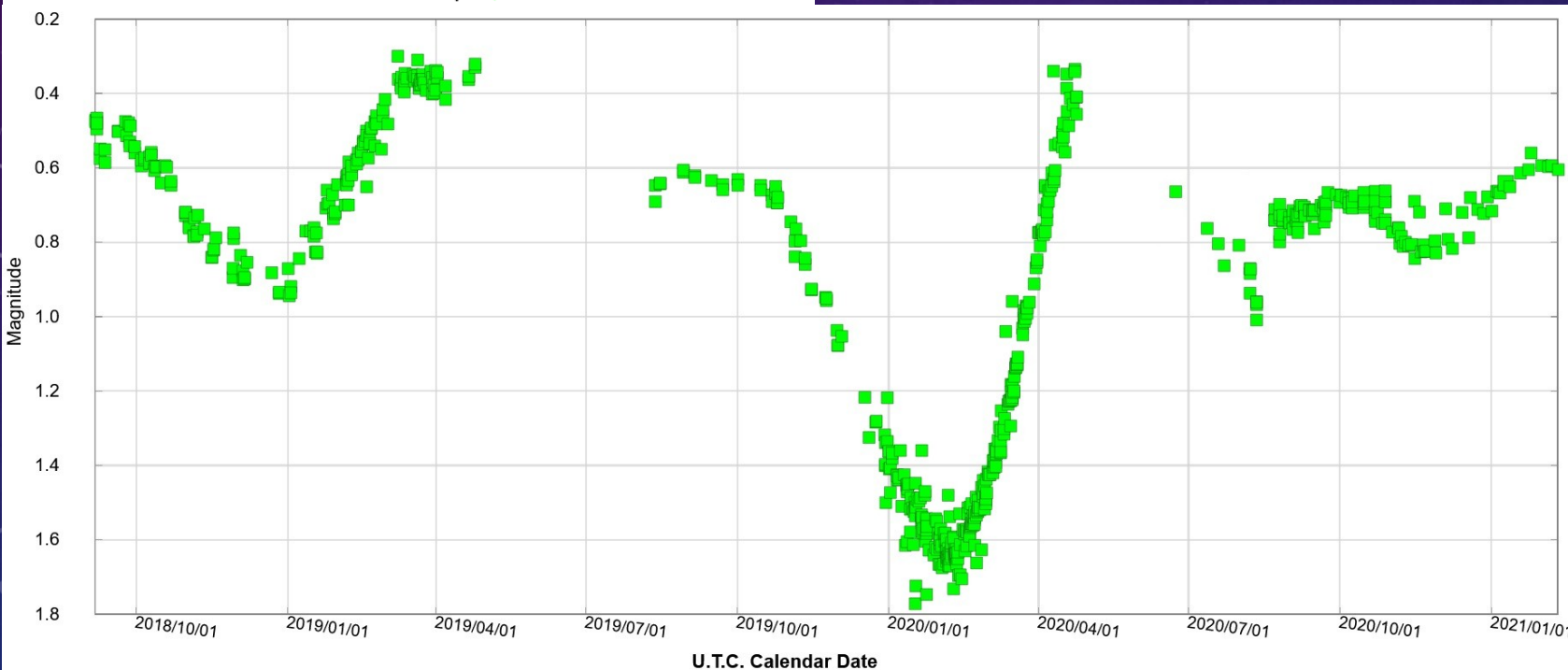
2023 Dec 12, 01:08
UT



Left - Mag of Betelgeuse 1988 – 2022

Down - Mag of Betelgeuse 9/2018 – 2/2021

Kredit: AAVSO



Betelgeus

Mag (V) 0,0 – 1,6 (1,7); mid value about 0,5 (0,6) mag.

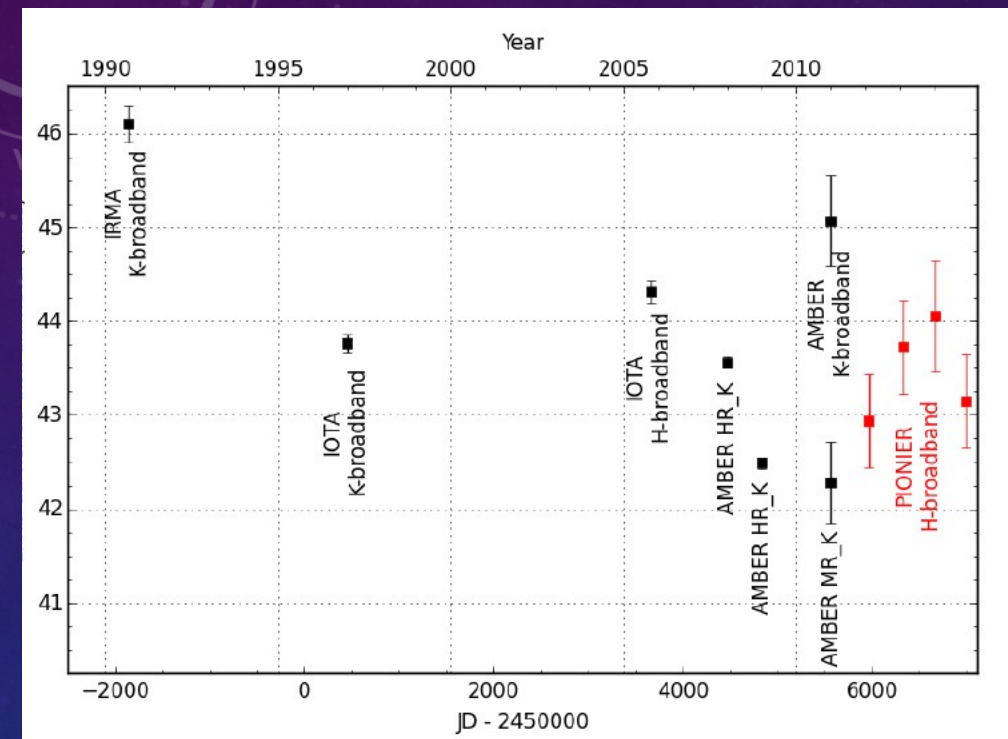
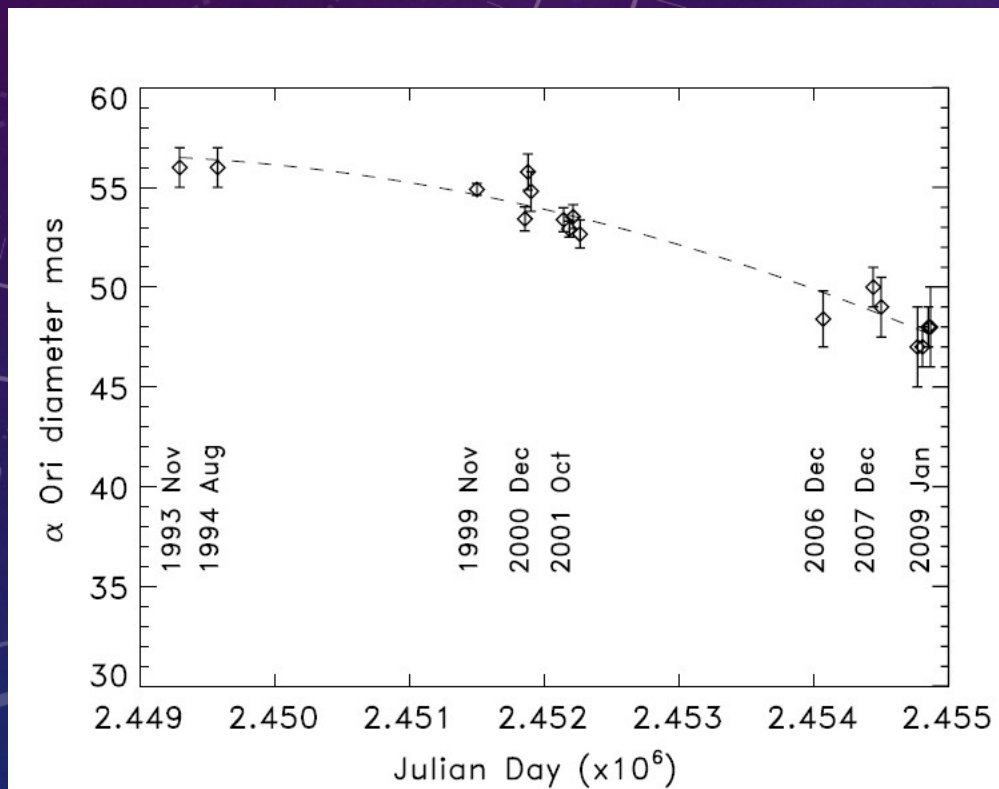
Angular diameter:
Occult calculated: 48,1 mas;
Values 41,9 mas to 60 (or more)
It is not easy!

(319) Leona, comb. 0,5 mag / 11,6 s / drop 2,9 mag – annular occultation

2023 Dec 12, 01:08 UT

Betelgeuse

Betelgeuse was the first star to be measured in size. Michelson & Pease (1921) reported a diameter of 47 mas. With add limb-darkening + 17% \Rightarrow 55 mas.



Angular diameter of Betelgeuse:
Left – 1993 – 2009 - Diameter of α Ori measured at $11.15 \mu\text{m}$ (Infrared Spatial Interferometer).
Top – 1990 – 2014 - Evolution of the near infrared diameter of Betelgeuse.

(319) Leona, comb. 0,5 mag / 11,6 s / drop 2,9 mag – annular
occultation

2023 Dec 12, 01:08
UT

Leona

Mag (V) 14,2
Delta 1,808 AU
Very slow
rotator:
430 ± 2 h
Tumbler

Occult calculated 60.8 ± 3 km

From Occult:

Satellite IR diameters for asteroid
(319)

NEOWISE 50.0 ± 5.0km

AcuA 65.0 ± 4.2km

IRAS 68.2 ± 11.0km

MSX 81.3 ± 11.8km

Another source: 89 ± 28 km

(Nugent, C. R.; Mainzer, A.; Bauer, J.;
Cutri, R. M.; Kramer, E. A.; Grav, T.)

From Occult:

319 Leona occults HIP 27989, on 2023 Dec 12

Star Diameter

diameter = .0481" [CHARM/CADARS, 51 measures]

= 104% of the asteroid's diameter

*** WARNING - special processing required ***

*** WARNING: Occultation is ANNULAR. Mag drop adjusted

=> fades of about 8.4 secs might be expected.

Fresnel diffraction

diffraction for light drop of 2 mag (to 16%) = 0.0002"

=> fades of about 0.05 secs might be expected

diffraction for light drop of 4 mag (to 2.5%) = 0.0006"

=> fades of about 0.14 secs might be expected

* * *

(319) Leona, comb. 0,5 mag / 11,6 s / drop 2,9 mag – annular occultation

2023 Dec 12, 01:08 UT

Leona

Mag (V) 14,2
Delta 1,818 AU
Very slow rotator:
430 ± 2 h
Tumbler

Profile a/c

Profile a/b

Profile b/c

light curve amplitude 0,68 mag

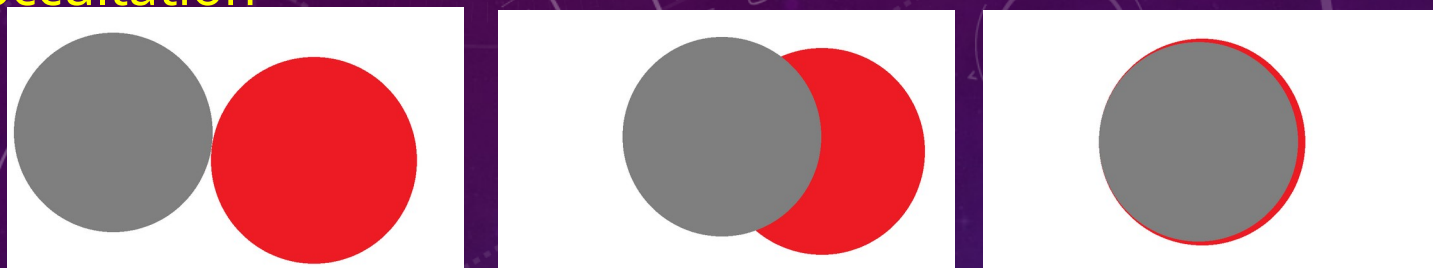
lower limit for axis ratio
(longest/shortest)
 $a/c \geq 1,7$

Volume of ellipsoid $\frac{4}{3} * \pi * a * b * c$

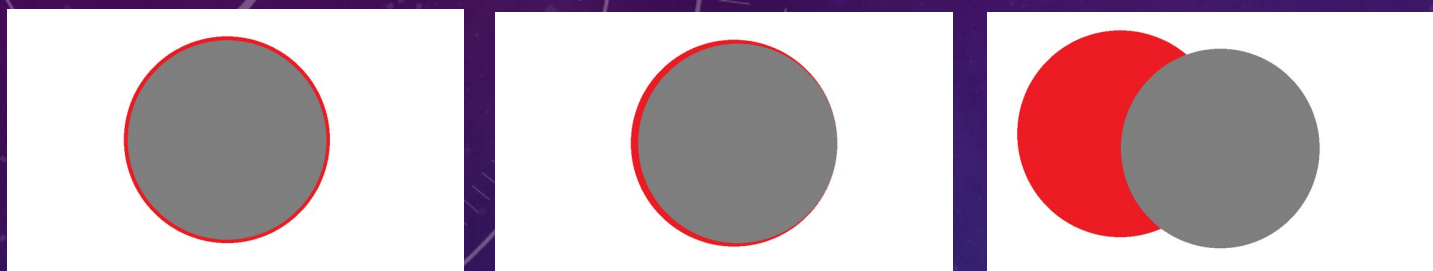
For $a/b/c = 1,7/1,3/1$
(for $b=1,3$ is $V(\text{elipsoid}) \cong V(\text{sphere}, r=b)$)
And If $b=68 \text{ km} \Rightarrow a=52 \text{ km}, c=89 \text{ km}$

(319) Leona, comb. 0,5 mag / 11,6 s / drop 2,9 mag – annular
occultation

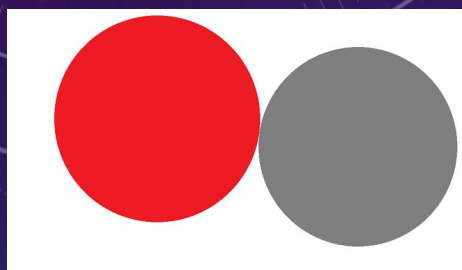
2023 Dec 12, 01:08
UT



Betelgeuse – 48,1 mas



Leona – 46,4 mas (60,8
km)



Duration 11,6 s is the interval
between moments pic. 1 and
pic. 7
Sky motion of Leona is 8,4 mas/s (for Córdoba) or 8,1 mas/s
(for start or end of the path) – (PA 262,1) - MPC, Minor Planet
Ephemeris Service

This annular occultation means that 93,06% of
the disk occulted and 6,94% of the disk of the star will not be occulted. Drop of
the magnitude 2,90.

What will the phenomenon look

like? to summarize in the following tables of options (for sky

motion 8,4 mas/s):

occultation

UT

Leona km	Leona mas	Betelgeu se mas	Dur. Partial Phase (s)	Dur. annular / total phase (s)	Dur. Partial Phase (s)	Type	occulted	Drop (mag) /without limb darkening/
50	38,1	41,9	4,5	0,5	4,5	annula r	82,68%	1,90
50	38,1	43	4,5	0,6	4,5	annula r	78,51%	1,67
50	38,1	48,1	4,5	1,2	4,5	annula r	62,74%	1,07
50	38,1	60	4,5	2,6	4,5	annula r	40,32%	0,56
60,8	46,4	41,9	5,0	0,5	5,0	total	122,63 %	13,70
60,8	46,4	43	5,1	0,4	5,1	total	116,44 %	13,70

occultation

UT

Leona km	Leona mas	Betelgeu se mas	Dur. Partial Phase (s)	Dur. annular / total phase (s)	Dur. Partial Phase (s)	Type	occulted	Drop (mag) /without limb darkening/
65	49,6	41,9	5,0	0,9	5,0	total	140,13 %	13,70
65	49,6	43	5,1	0,8	5,1	total	133,05 %	13,70
65	49,6	48,1	5,7	0,2	5,7	total	106,33 %	13,70
65	49,6	60	5,9	1,2	5,9	annul ar	68,34%	1,25
68,2	52	41,9	5,0	1,2	5,0	total	154,02 %	13,70
68,2	52	43	5,1	1,1	5,1	total	146,24 %	13,70

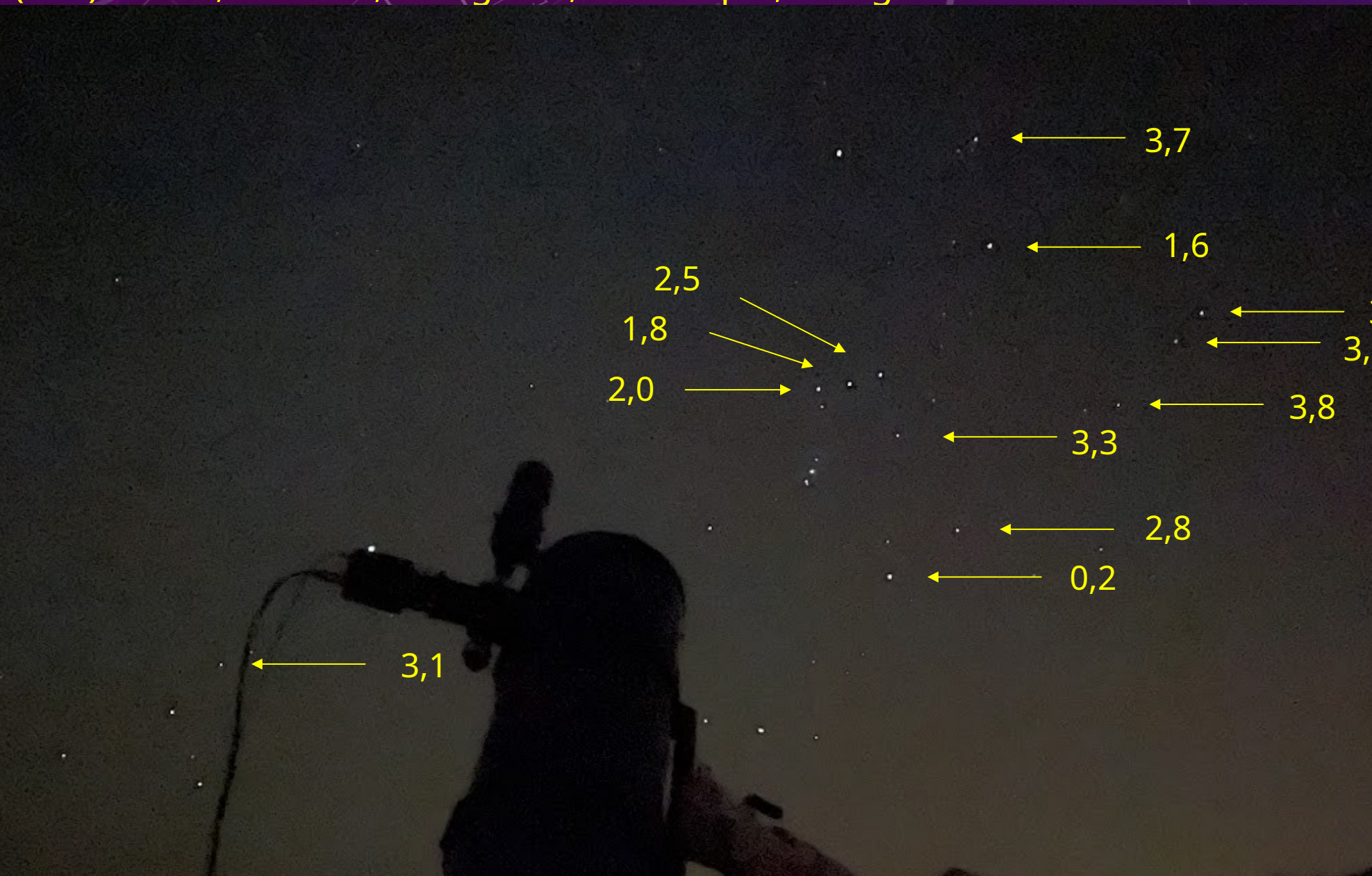
occultation

UT

Leona km	Leona mas	Betelgeu se mas	Dur. Partial Phase (s), beg.	Dur. annular / total phase (s)	Dur. Partial Phase (s), end.	Type	occulted	Drop (mag) /without limb darkening/
81,3	62	41,9	5,0	2,4	5,0	total	218,96 %	13,7
81,3	62	43	5,1	2,3	5,1	total	207,90 %	13,7
81,3	62	48,1	5,7	1,7	5,7	total	166,15 %	13,7
81,3	62	60	7,1	0,2	7,1	total	106,78 %	13,7
89	67,9	41,9	5,0	3,1	5,0	total	262,61 %	13,7
89	67,9	43	5,1	3,0	5,1	total	249,35 %	13,7

(319) Leona, comb. 0,5 mag / 11,6 s / drop 2,9 mag – annular

2023 Dec 12, 01:08
UT



Annular
occultation of
Betelgeuse, star
like 3,4 mag? (in
V) or 1,1 mag?
(in R)

Conclusion:

On the central line can be total occultation or annular due to unclear values of angular sizes of both bodies (Betelgeuse and Leona).

Drop can be from several tenths mag to more than 1 mag or star can disappear completely.

Recommendation:

Test your cameras of different exposures and gain on bright stars in advance.

(128) Nemesis, comb. 11,0 mag / 34,2 s / drop 1,3 mag

2023 Dec 13, 01:03

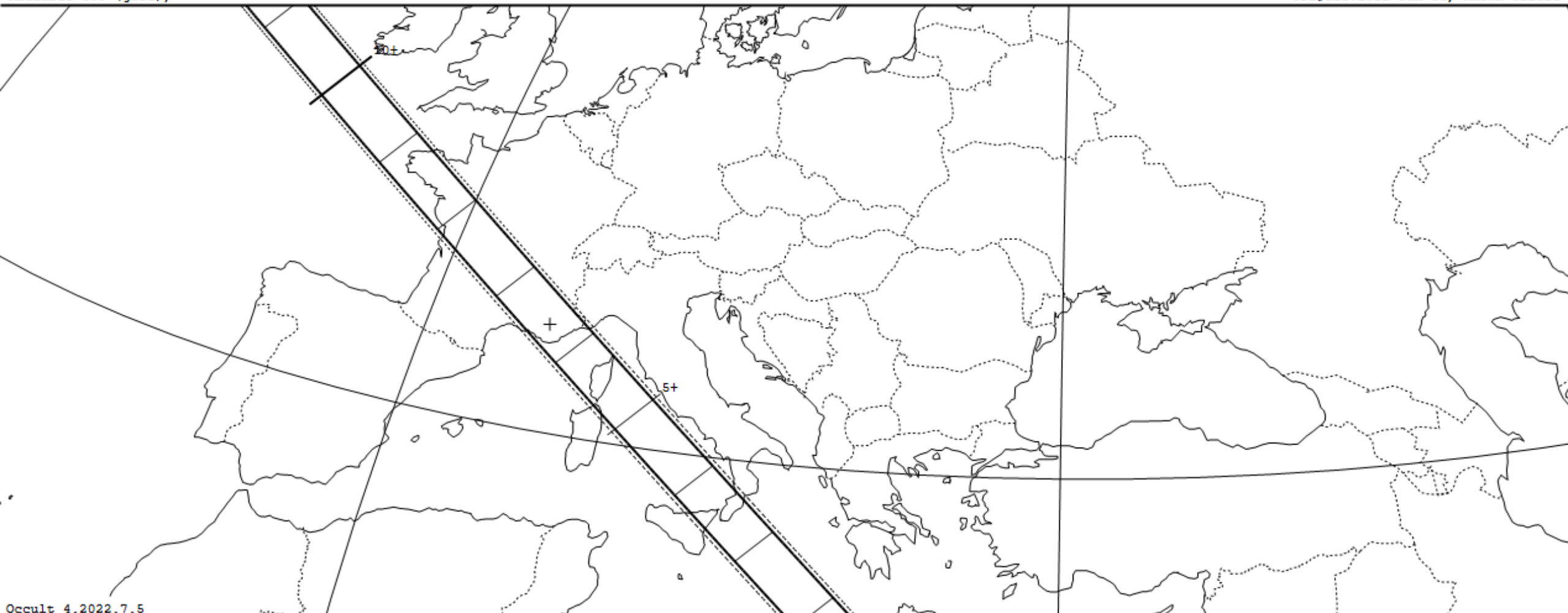
IIT

128 Nemesis occults UCAC4 567-043588 on 2023 Dec 13 from 0h 35m to 1h 17m UT

Star: (Dia < 0.1 mas)
Mv 11.3; Mb 11.7; Mr 10.7
RA = 8 44 51.0748 (astrometric)
Dec = 23 21 43.698
[of Date: 8 46 16, 23 16 29]
Prediction of 2022 Jul 5.6
Reliable 1.0 (good),

Durations: Max = 34.2 secs
1km = 0.20 secs, 1mas = 0.28 secs
Mag Drop: 1.3 [71%]v, 1.5 [74%]r
Sun : Dist = 133°
Moon: Dist = 134°, illum = 0%
Error 12.0 x 2.6 mas in PA 82°

Asteroid:
Mag = 12.3
Dia = 175 ±8km, 123 mas
Parallax = 4.494"
Hourly dRA = -0.576s
dDec = 10.26"
JPL#121:2022-Jun-06, Known errors



Occult 4.2022.7.5

(366) Vincentina (slow rotator), comb. 8,2 mag / 4,0 s / drop 6,3

2023 Dec 16, 20:00

mag

UT

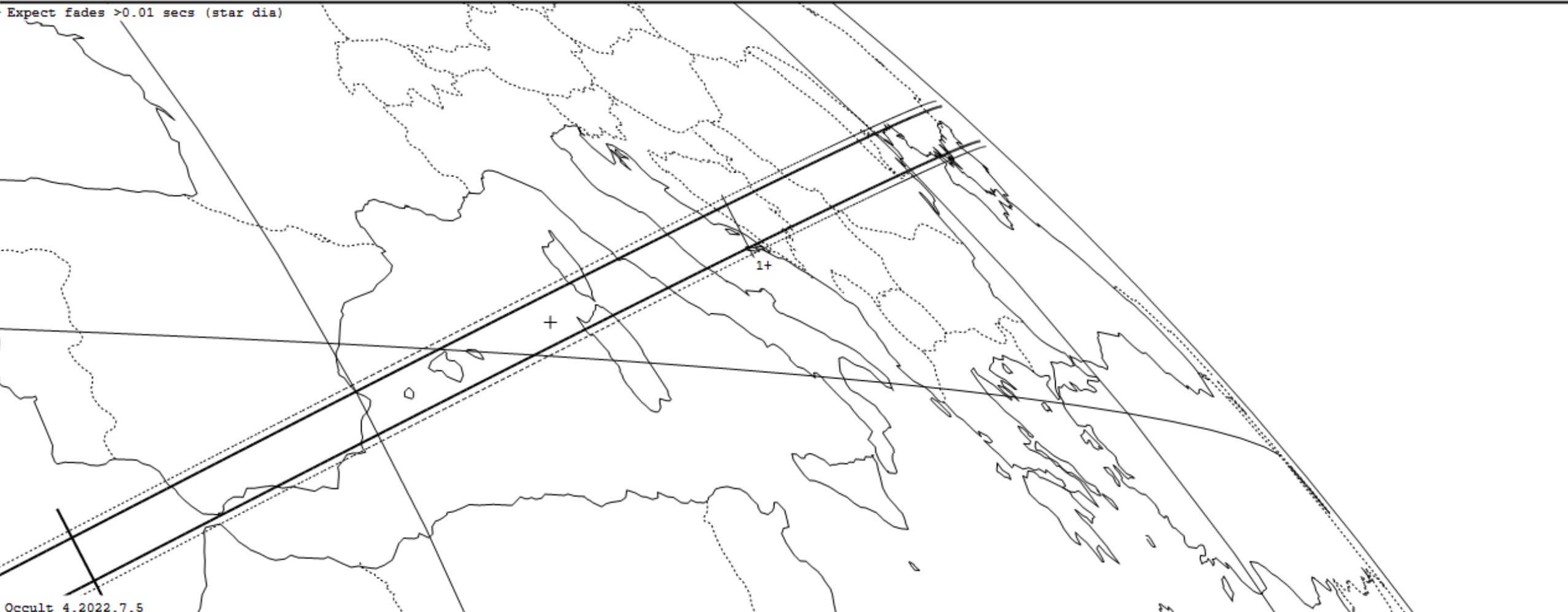
366 Vincentina occults HIP 113303 on 2023 Dec 16 from 19h 52m to 20h 1m UT

Star: (Dia = 0.1 mas)
Mv 8.2; Mb 8.5; Mr 7.8
RA = 22 56 43.3695 (astrometric)
Dec = - 3 31 37.863
[of Date: 22 57 57, - 3 24 1]
Prediction of 2022 Jul 5.6
Reliable 1.1 (good),

Durations: Max = 4.0 secs
1km = 0.045 secs, 1mas = 0.099 secs
Mag Drop: 6.3 [100%]v, 6.3 [100%]r
Sun : Dist = 79°
Moon: Dist = 30°, illum = 19%
Error 28.0 x 4.7 mas in PA 55°

Asteroid:
Mag = 14.5
Dia = 88 ±4km, 40 mas
Parallax = 2.912"
Hourly dRA = 2.154s
dDec = 16.68"
JPL#65:2022-Jun-06, Known errors

Expect fades >0.01 secs (star dia)



Occult 4.2022.7.5

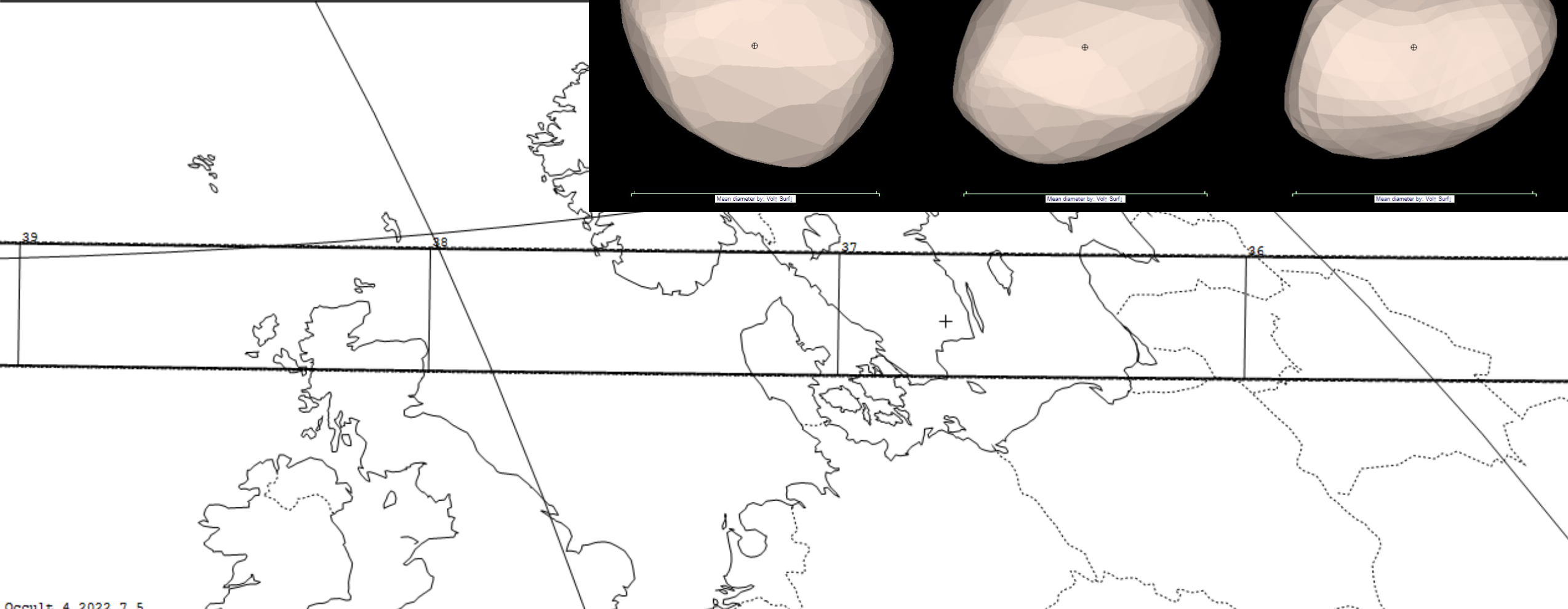
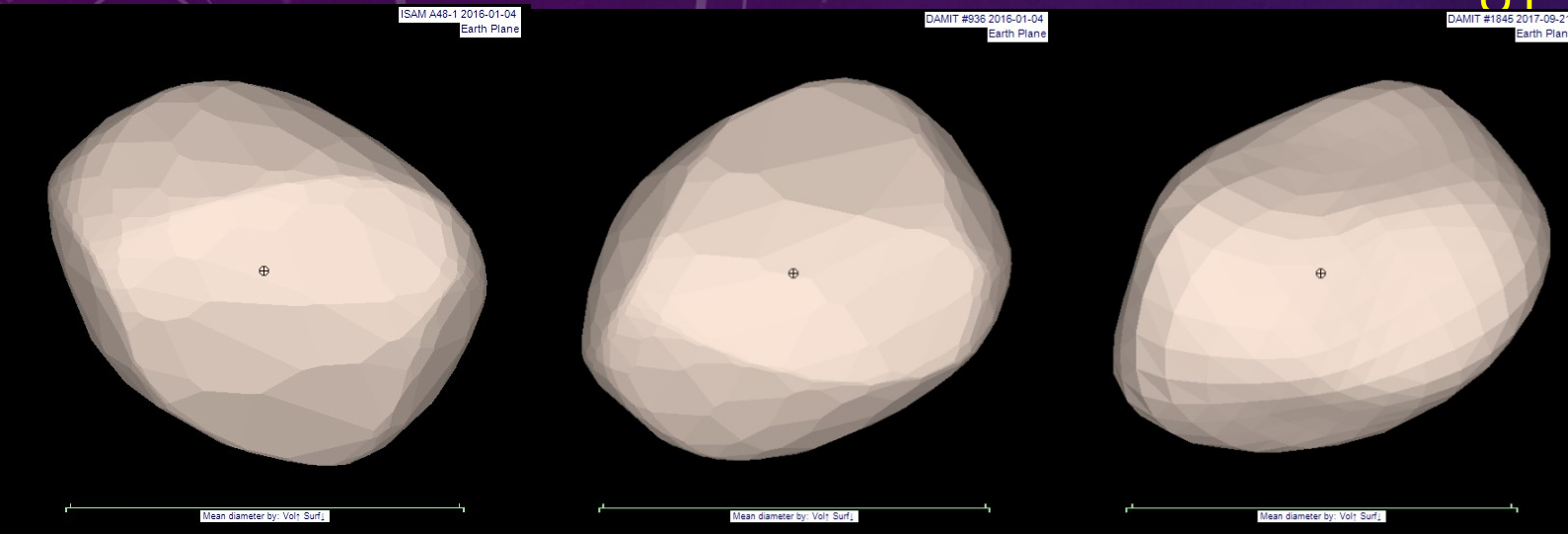
(48) Doris, comb. 10,7 mag / 18,2 s / drop 0,6 mag

2023 Dec 23, 01:35

UT

48 Doris occults UCAC4 518-023743 on 2023 Dec 23

Star: (Dia < 0.1 mas)
Mv 11.7; Mb 11.9; Mr 11.3
RA = 6 19 29.3668 (astrometric)
Dec = 13 29 20.344
[of Date: 6 20 52, 13 28 46]
Prediction of 2022 Jul 5.6
Reliable 1.0 (good),



Occult 4.2022.7.5

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- 2) www.euraster.net (Europe, author Eric Frappa)
- 3) <https://www.asteroidoccultation.com/observations/Results/Reviewed/index.html> (North America)
- 4) <http://www.occultations.org.nz/> (New Zealand and Australia)
- 5) communication with Petr Pravec, Josef Hanuš, Anna Marciniak, Dave Herald, Jan Mánek, Michal Rottenborn
- 6) <https://sirrah.troja.mff.cuni.cz/~mira/tmp/kleopatra2/jan2023.html>
- 7) <http://www.johnstonsarchive.net/astro/asteroidmoons.html>
- 8) https://ssd.jpl.nasa.gov/tools/sbdb_lookup.html#/
- 9) <https://ssp.imcce.fr/webservices/miriade/api/ephemsys/>
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- 11) Program Google Earth
- 12) 319 LEONA AND 341 CALIFORNIA – TWO VERY SLOWLY ROTATING ASTEROIDS, Frederick Pilcher, Lorenzo Franco and Petr Pravec, The Minor Planet Bulletin, Vol. 44, Num. 2, 2017 April-June
- 13) The close circumstellar environment of Betelgeuse - V. Rotation velocity and molecular envelope properties from ALMA, Pierre Kervella, Leen Decin, Anita M. S. Richards, Graham M. Harper, Iain McDonald, Eamon O’Gorman, Miguel Montargès, Ward Homan, and Keiichi Ohnaka, Astronomy and Astrophysics, A&A 609, A67 (2018)
- 14) HOW BIG IS BETELGEUSE REALLY?, Monica Young, Sky and Telescope, Nov 2020, <https://skyandtelescope.org/astronomy-news/how-big-is-betelgeuse-really/>

15) Záhadný pokles jasnosti hvězdy Betelgeuse vysvětlen

References, quotes and advice:

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<https://medium.com/amazing-science/all-about-betelgeuse-how-big-is-it-815d4e3c00e8>, 2020
Feb
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- 20) <https://astro.troja.mff.cuni.cz/projects/damit/>
- 21) <http://isam.astro.amu.edu.pl/>
- 22) IAU, Minor Planet and Comet Ephemeris Service,
<https://www.minorplanetcenter.net/iau/MPEph/MPEph.html>
- 23) <https://www.wikipedia.org/>
- 24) <https://unsplash.com/>, free picture of Alhambra, Photo Jorge Fernandez Salas
- 25) Logo of ESOP

End of Part I



OCCULTATIONS BY ASTEROIDS - HIGHLIGHTS FOR EUROPE IN 2023

JIŘÍ KUBÁNEK, EFP ESOP XLI, GRANADA, 10-11 SEPTEMBER 2022

INTERNATIONAL OCCULTATION TIMING ASSOCIATION / EUROPEAN SECTION

CZECH ASTRONOMICAL SOCIETY – OCCULTATION AND TIMING SECTION