

Part II



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

2. Asteroids with satellites

3. Other interesting
asteroids

A: Jupiter Trojans

B: Interesting asteroids from past
observations

C: Occultations by (319) Leona before the
event with Betelgeuse

2. Asteroids with satellites

469 asteroids with companions (453 binary systems, 14 triple systems, 1 quadruple s., 1 sextuple s.), July 2022.
Chosen **10 events** with good path accuracy for the main body.



(243) IDA AND DACTYL, CREDIT: NASA/JPL

(4492) Debussy, comb. 12,9 mag / 0,79 s / drop 6,2 mag

2023 Jan 02, 03:40
UT

4492 Debussy occults UCAC4 389-058365 on 2023 Jan 2 from 3h 41m to 3h 47m UT

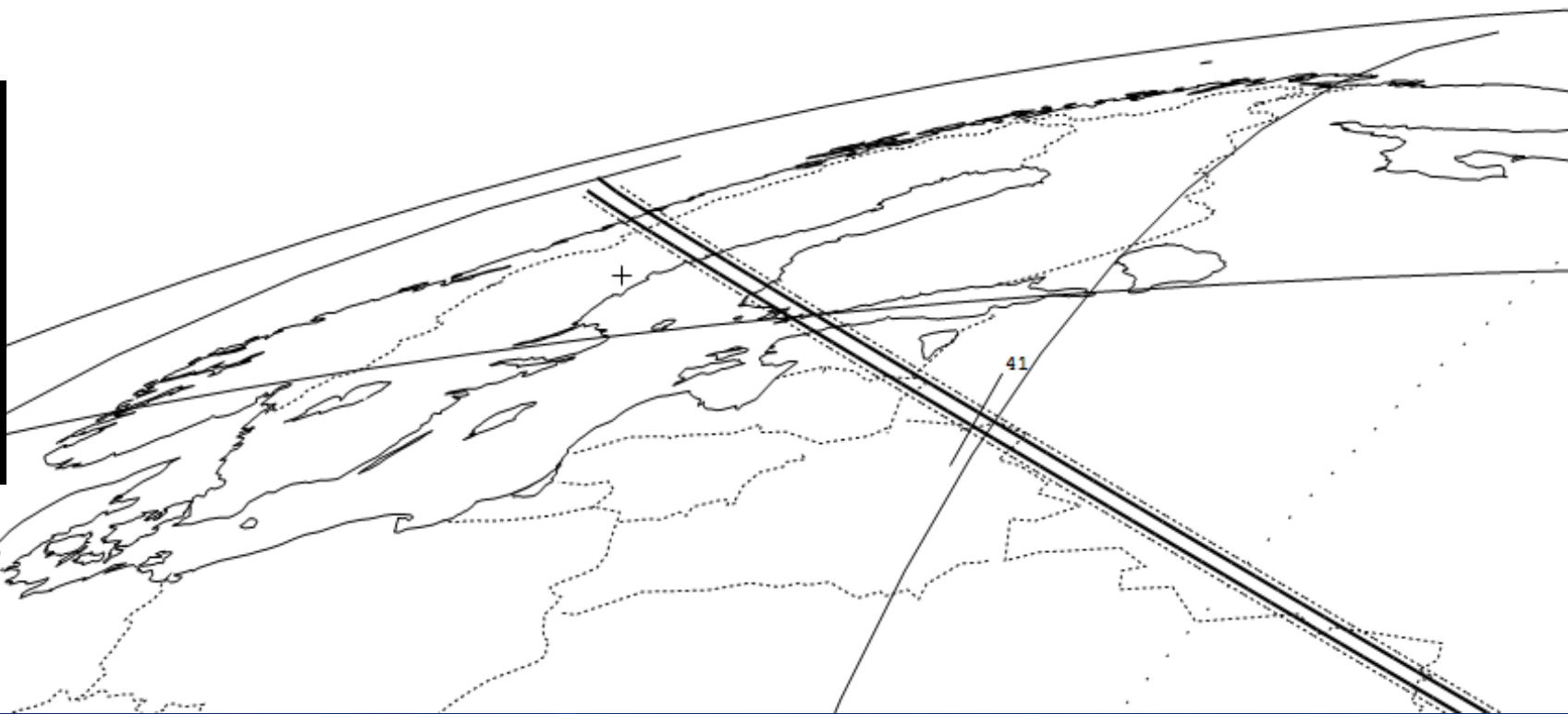
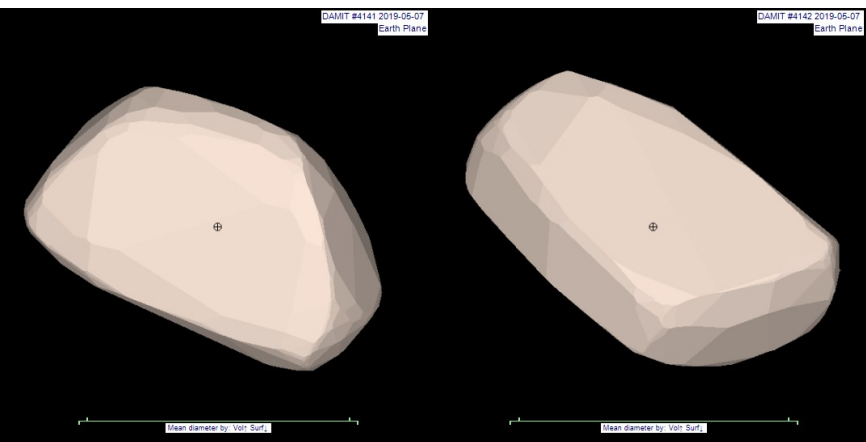
Star: (Dia < 0.1 mas)
Mv 12.9; Mb 13.2; Mr 12.4
RA = 13 32 20.9051 (astrometric)
Dec = -12 18 47.118
[of Date: 13 33 33, -12 25 47]
Prediction of 2022 Jul 15.8
Reliable 1.0 (good),

Durations: Max = 0.79 secs
1km = 0.045 secs, 1mas = 0.11 secs
Mag Drop: 6.2 [100%]v, 6.2 [100%]r
Sun : Dist = 76°
Moon: Dist = 158°, illum = 80%
Error 12.0 x 3.3 mas in PA 118°

Asteroid: (in DAMIT)
Mag = 19.1
Dia = 17 ±1km, 7 mas
Parallax = 2.715"
Hourly dRA = 2.008s
dDec = -16.69"
JPL#79:2022-Jun-07, Known errors

1 moon. {?} 9km at 31km, Period 1.109days

Diameter (primary) 14,6 km – duration 0,66 s
Diameter (secondary) 9,39 km – duration 0,42 s
Semimajor axis 31 km



Occult 4.2022.7.5

216 Kleopatra #1 occults TYC 13-01531-1 on 2023 Jan 21 from 19h 48m to 19h 54m UT

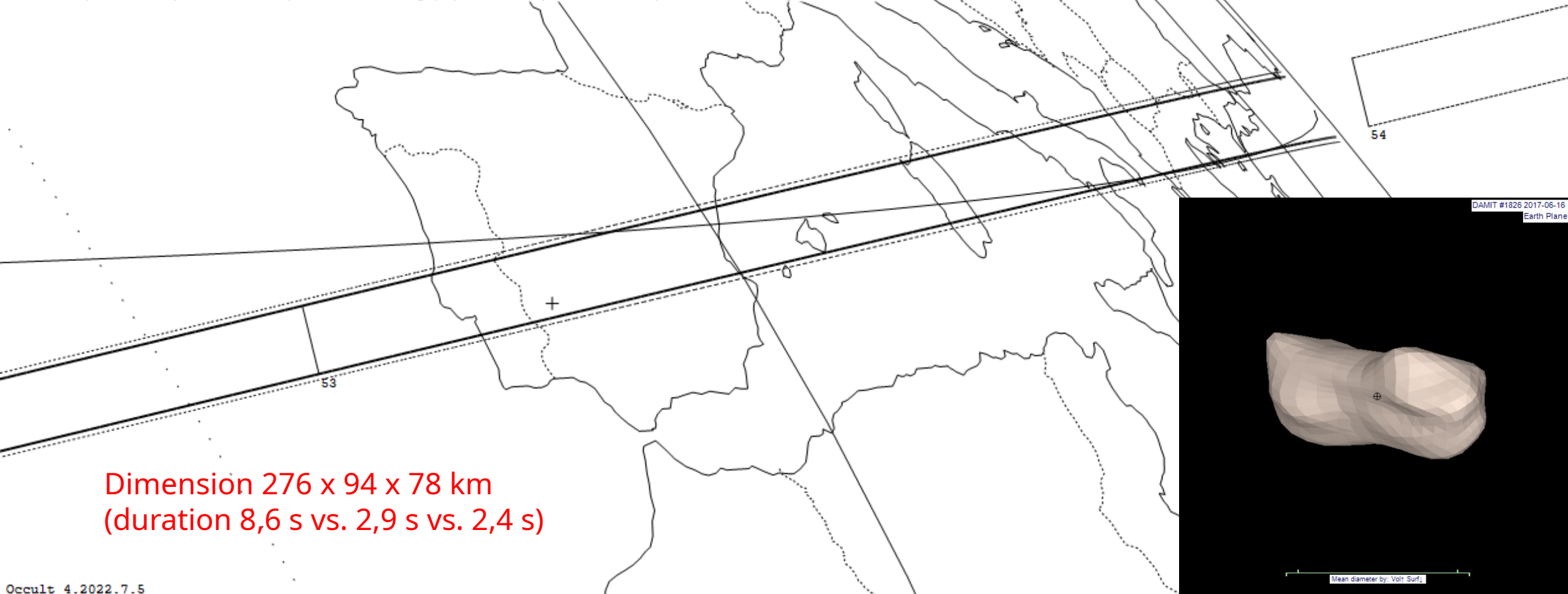
Star: (Dia < 0.1 mas)
Mv 11.2; Mb 11.5; Mr 10.8
RA = 0 30 31.9984 (astrometric)
Dec = 3 34 27.829
[of Date: 0 31 42, 3 42 0]
Prediction of 2022 Jul 14.9
Reliable 1.0 (good),

Durations: Max = 4.0 secs
1km = 0.031 secs, 1mas = 0.051 secs
Mag Drop: 0.9 [55%]v, 0.8 [54%]r
Sun : Dist = 67°
Moon: Dist = 68°, illum = 0%
Error 14.7 x 1.9 mas in PA 100°

Asteroid: (in DAMIT, ISAM)
Mag = 11.4
Dia = 128 ±20km, 78 mas
Parallax = 3.881"
Hourly dRA = 4.579s
dDec = 16.73"

JPL#136:2022-Jun-10 Binary solution 1 : Kepler, Known errors + binary orbit

2 moons. {Alexhelios} 9km at 678km, Period 2.320days, {Cleoselene} 7km at 454km, Period 1.240days Orbit@Miriade



(216) Kleopatra I = Alexhelios, comb. 10,5 mag / 0,28 s / drop
0,9 mag

2023 Jan 21, 19:52
UT

216 Alexhelios #1 occults TYC 13-01531-1 on 2023 Jan 21 from 19h 48m to 19h 54m UT

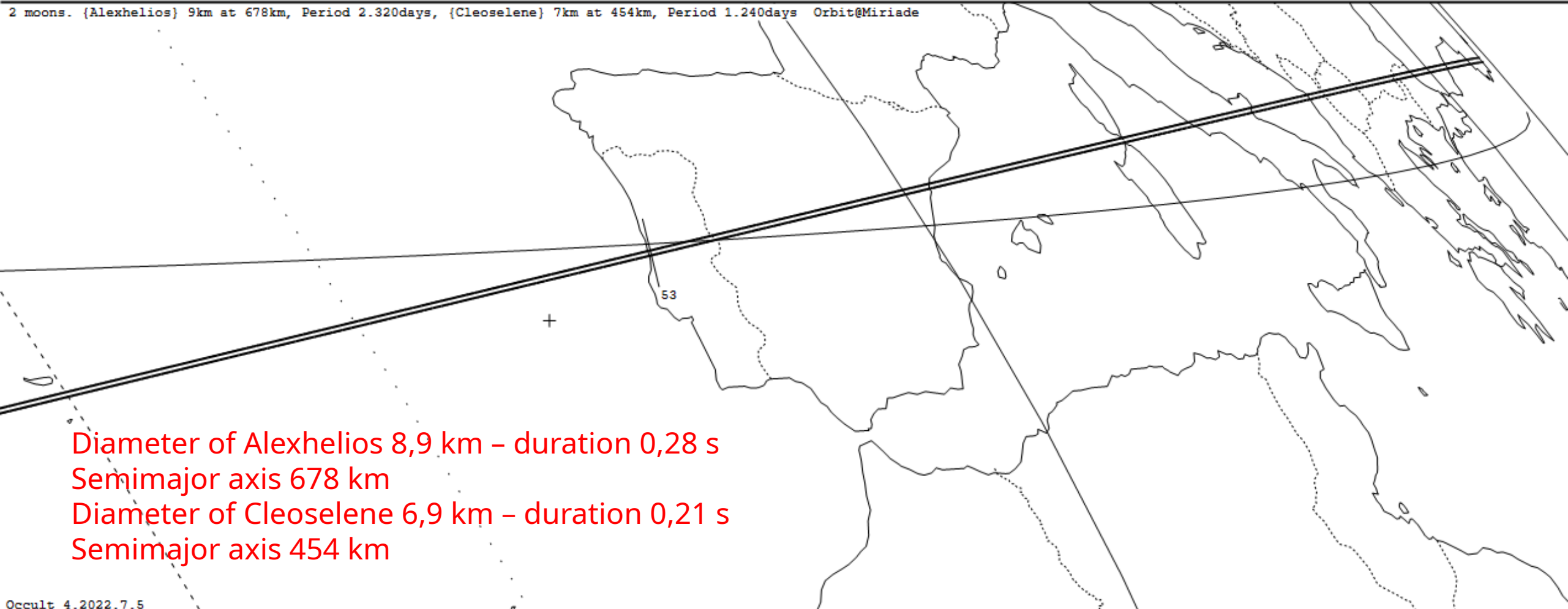
Star: (Dia < 0.1 mas)
Mv 11.2; Mb 11.5; Mr 10.8
RA = 0 30 31.9984 (astrometric)
Dec = 3 34 27.829
[of Date: 0 31 42, 3 42 0]
Prediction of 2022 Jul 14.9
Reliable 1.0 (good),

Durations: Max = 0.28 secs
1km = 0.031 secs, 1mas = 0.051 secs
Mag Drop: 0.9 [55%]v, 0.8 [54%]r
Sun : Dist = 67°
Moon: Dist = 68°, illum = 0%
Error 14.7 x 1.9 mas in PA 100°

Asteroid: (in DAMIT, ISAM)
Mag = 11.4
Dia = 9.0 ±4.0km, 5 mas
Parallax = 3.881"
Hourly dRA = 4.579s
dDec = 16.73"

JPL#136:2022-Jun-10 Binary solution 1 : Kepler, Known errors + binary orbit

2 moons. {Alexhelios} 9km at 678km, Period 2.320days, {Cleoselene} 7km at 454km, Period 1.240days Orbit@Miriade

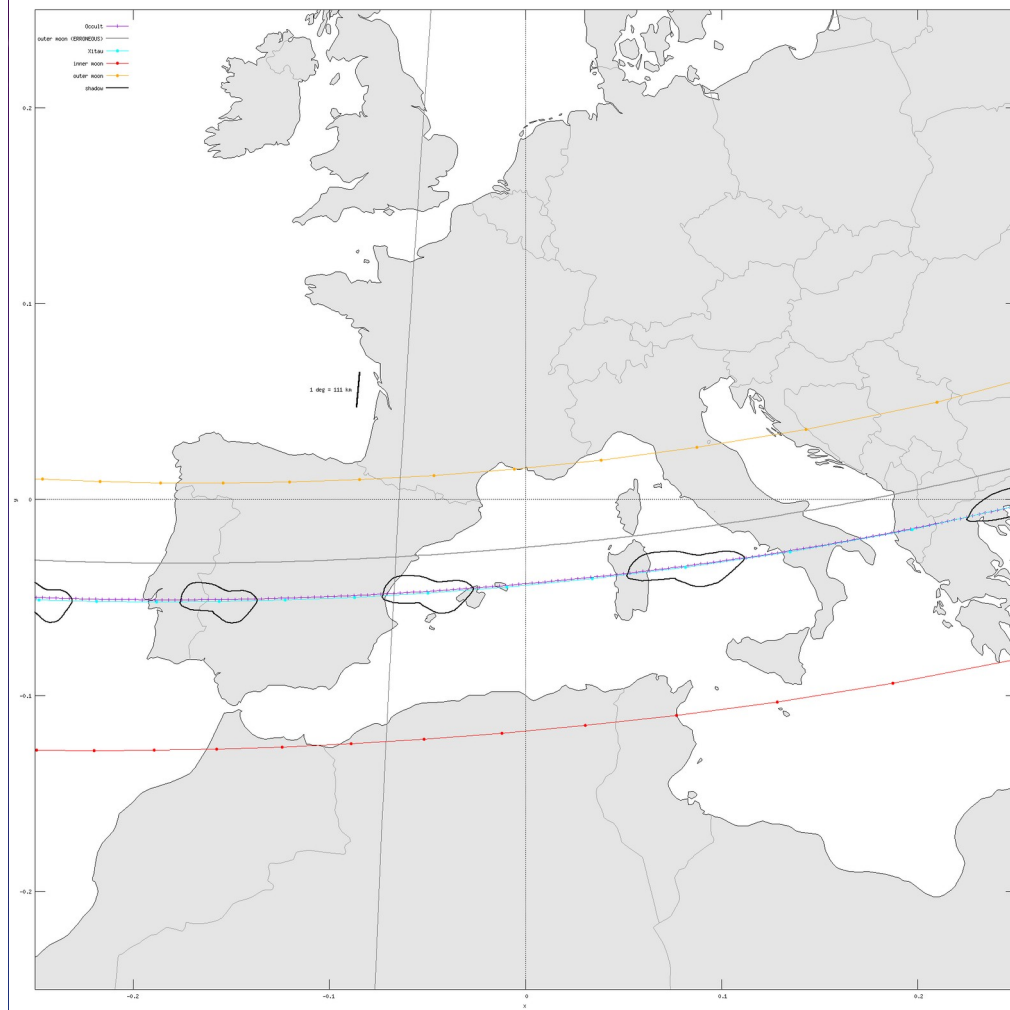
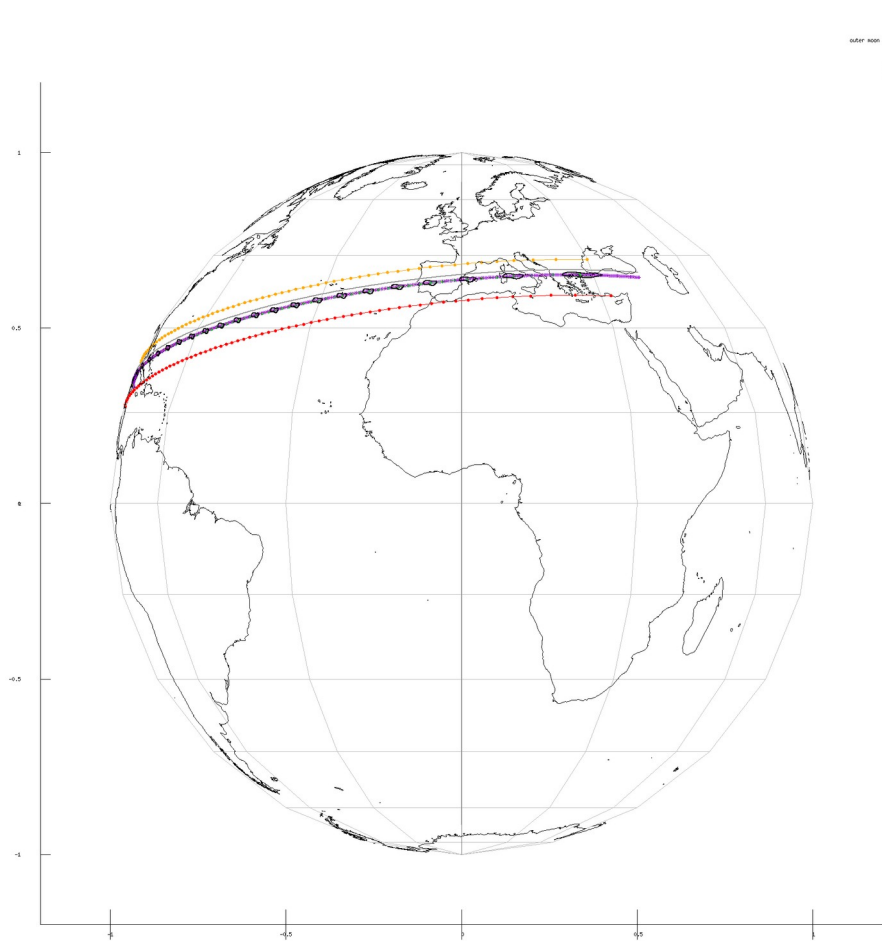


Diameter of Alexhelios 8,9 km – duration 0,28 s
Semimajor axis 678 km
Diameter of Cleoselene 6,9 km – duration 0,21 s
Semimajor axis 454 km

Occult 4.2022.7.5

(216) Kleopatra, comb. 10,5 mag / 4,0 s / drop 0,9 mag

2023 Jan 21, 19:53
UT



OCCULTATION COMPUTATION WITH XITAU, CREDIT: MIROSLAV BROŽ,
JOSEF HANUŠ;
[HTTPS://SIRRAH.TROJA.MFF.CUNI.CZ/~MIRA/TMP/KLEOPATRA2/JAN2023.H](https://sirrah.troja.mff.cuni.cz/~mira/tmp/kleopatra2/jan2023.h)

ESOP XLI, GRANADA, 2022

JIŘÍ KUBÁNEK, IOTA/ES

(216) Kleopatra, comb. 10,5 mag / 4,0 s / drop 0,9 mag

2023 Jan 21, 19:53



OCCULTATION COMPUTATION WITH XITAU, CREDIT: MIROSLAV BROŽ, JOSEF HANUŠ

ESOP XLI, GRANADA, 2022

JIŘÍ KUBÁNEK, IOTA/ES

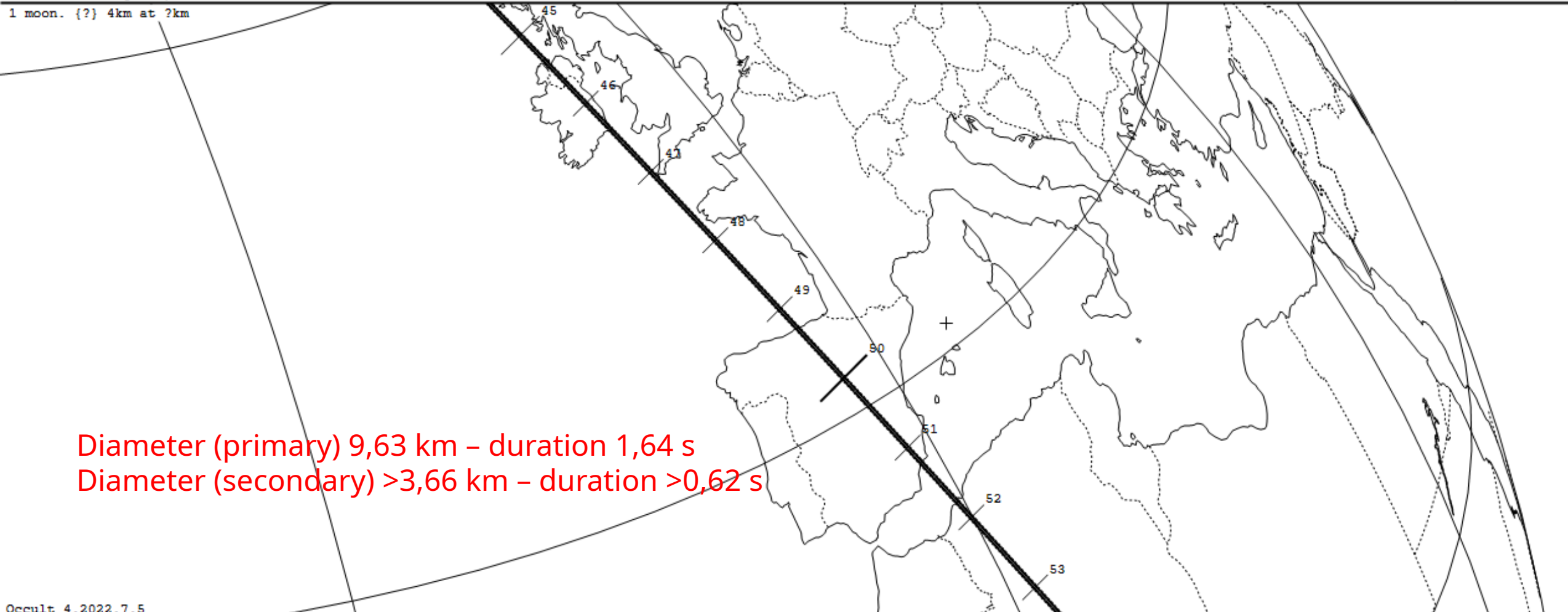
1016 Anitra occults UCAC4 601-040298 on 2023 Mar 6 from 23h 33m to 24h 1m UT

Star: (Dia < 0.1 mas)
Mv 12.8; Mb 13.3; Mr 12.1
RA = 7 15 9.0871 (astrometric)
Dec = 30 1 44.691
[of Date: 7 16 38, 29 59 23]
Prediction of 2022 Jul 15.3
Reliable 1.0 (good),

Durations: Max = 1.65 secs
1km = 0.17 secs, 1mas = 0.18 secs
Mag Drop: 2.7 [92%]v, 3.0 [93%]r
Sun : Dist = 120°
Moon: Dist = 53°, illum =100%
Error 8.7 x 2.6 mas in PA 118°

Asteroid:
Mag = 15.4
Dia = 9.5 ±1.0km, 9 mas
Parallax = 6.270"
Hourly dRA = 1.118s
dDec = -14.43"
JPL#49:2022-Jun-06, Known errors

1 moon. {?} 4km at ?km



Diameter (primary) 9,63 km – duration 1,64 s
Diameter (secondary) >3,66 km – duration >0,62 s

(1016) Anitra, comb. 11,2 mag / 1,19 s / drop 4,4 mag

2023 Mar 14, 03:38
UT

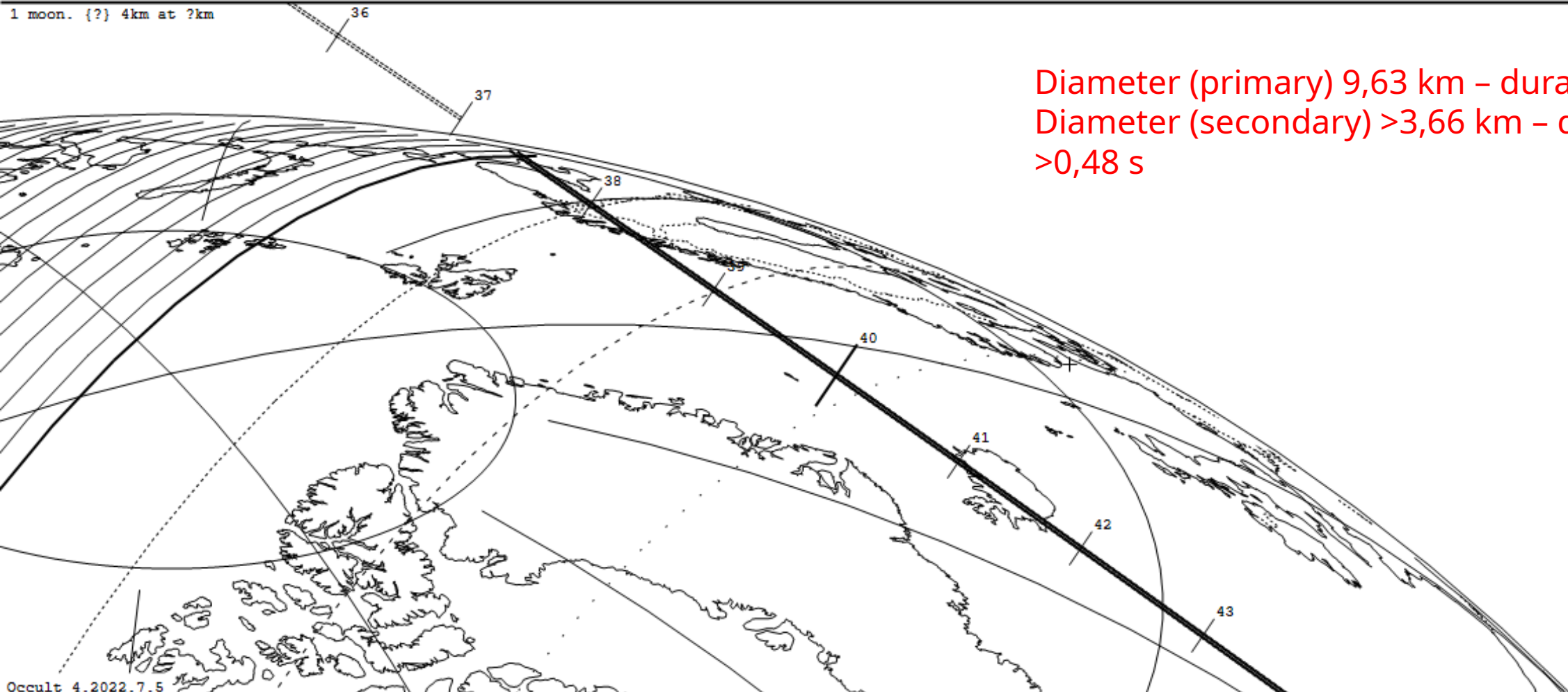
1016 Anitra occults TYC 1921-02300-1 on 2023 Mar 14 from 3h 37m to 3h 48m UT

Star: (Dia < 0.1 mas)
Mv 11.2; Mb 11.4; Mr 10.9
RA = 7 19 12.7699 (astrometric)
Dec = 29 19 40.355
[of Date: 7 20 41, 29 17 11]
Prediction of 2022 Jul 15.3
Reliable 0.9 (good),

Durations: Max = 1.19 secs
1km = 0.13 secs, 1mas = 0.13 secs
Mag Drop: 4.4 [98%]v, 4.3 [98%]r
Sun : Dist = 114°
Moon: Dist = 144°, illum = 60%
Error 8.7 x 2.6 mas in PA 118°

Asteroid:
Mag = 15.6
Dia = 9.5 ±1.0km, 9 mas
Parallax = 5.929"
Hourly dRA = 1.700s
dDec = -14.99"
JPL#49:2022-Jun-06, Known errors

1 moon. {?} 4km at ?km



Diameter (primary) 9,63 km – duration 1,25 s
Diameter (secondary) >3,66 km – duration >0,48 s

Occult 4.2022.7.5

379 Huenna #1 occults TYC 4940-00408-1 on 2023 Mar 23 from 1h 13m to 1h 20m UT

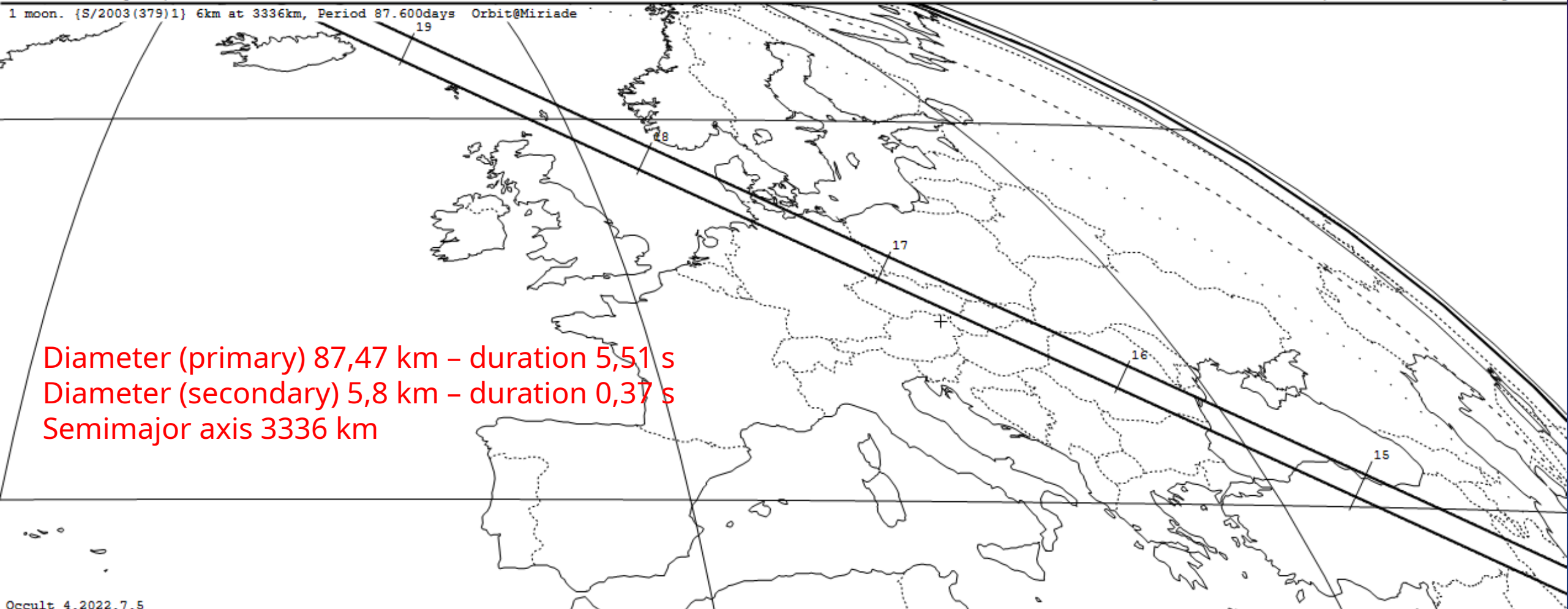
Star: (Dia < 0.1 mas)
Mv 10.3; Mb 10.5; Mr 9.9
RA = 12 12 57.4705 (astrometric)
Dec = - 0 55 32.089
[of Date: 12 14 10, - 1 3 21]
Prediction of 2022 Jul 14.9
Reliable 1.0 (good),

Durations: Max = 5.6 secs
1km = 0.063 secs, imas = 0.12 secs
Mag Drop: 3.9 [97%]v, 3.8 [97%]r
Sun : Dist = 179°
Moon: Dist = 164°, illum = 2%
Error 19.0 x 1.1 mas in PA 112°

Asteroid:
Mag = 14.1
Dia = 88 ±4km, 45 mas
Parallax = 3.258"
Hourly dRA = -1.760s
dDec = 12.25"

JPL#127:2022-Jun-06 Binary solution 1 : NumInt, Known errors + binary orbit

1 moon. {S/2003(379)1} 6km at 3336km, Period 87.600days Orbit@Miriade



Diameter (primary) 87,47 km – duration 5,51 s
Diameter (secondary) 5,8 km – duration 0,37 s
Semimajor axis 3336 km

S/2003 (379) 1, comb. 10,2 mag / 0,38 s / drop 3,9 mag

2023 Mar 23, 01:15
UT

379 S2003-379-1 #1 occults TYC 4940-00408-1 on 2023 Mar 23 from 1h 12m to 1h 21m UT

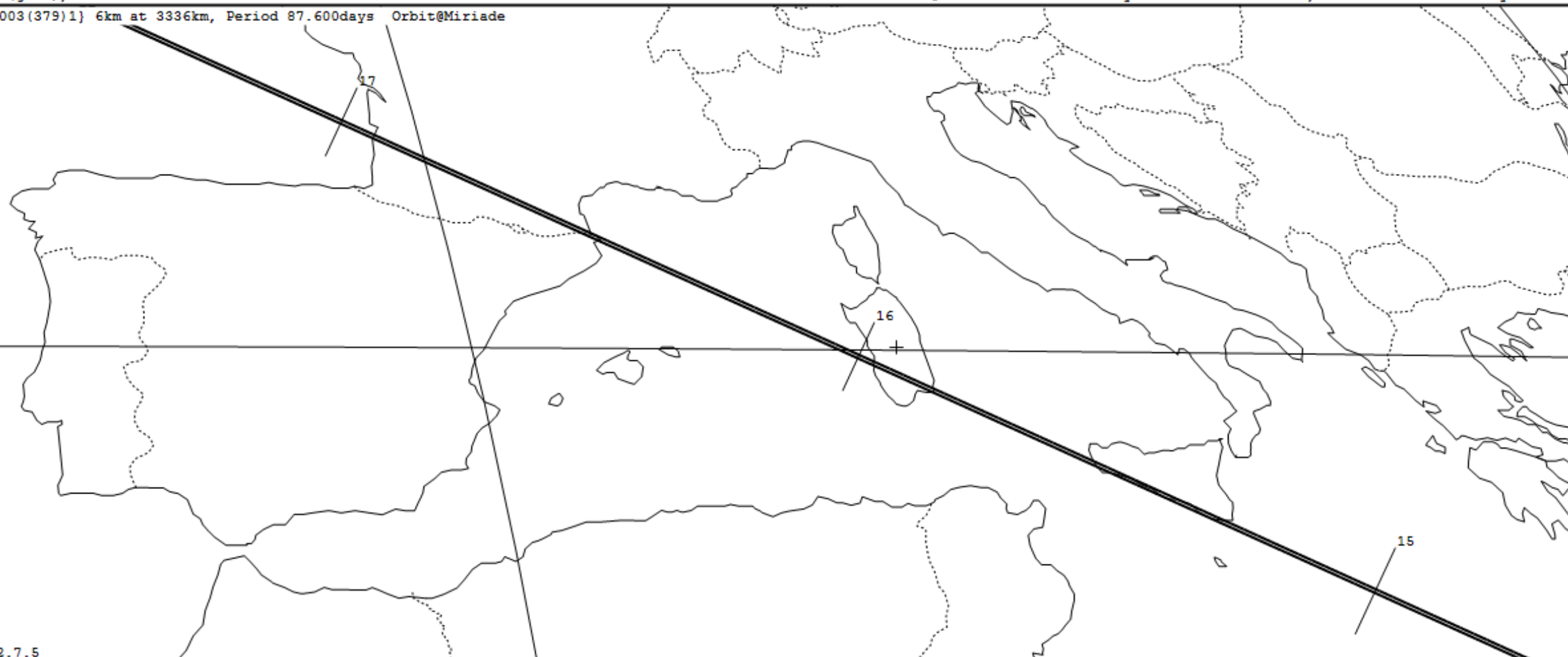
Star: (Dia < 0.1 mas)
Mv 10.3; Mb 10.5; Mr 9.9
RA = 12 12 57.4705 (astrometric)
Dec = - 0 55 32.089
[of Date: 12 14 10, - 1 3 21]
Prediction of 2022 Jul 14.9
Reliable 1.0 (good),

Durations: Max = 0.38 secs
1km = 0.064 secs, 1mas = 0.13 secs
Mag Drop: 3.9 [97%]v, 3.8 [97%]r
Sun : Dist = 179°
Moon: Dist = 164°, illum = 2%
Error 19.0 x 1.1 mas in PA 112°

Asteroid:
Mag = 14.1
Dia = 6.0 ±2.0km, 3 mas
Parallax = 3.258"
Hourly dRA = -1.760s
dDec = 12.25"

JPL#127:2022-Jun-06 Binary solution 1 : NumInt, Known errors + binary orbit

1 moon. {S/2003(379)1} 6km at 3336km, Period 87.600days Orbit@Miriade



Occult 4.2022.7.5

121 Hermione #1 occults TYC 1887-01582-1 on 2023 May 6 from 22h 43m to 22h 47m UT

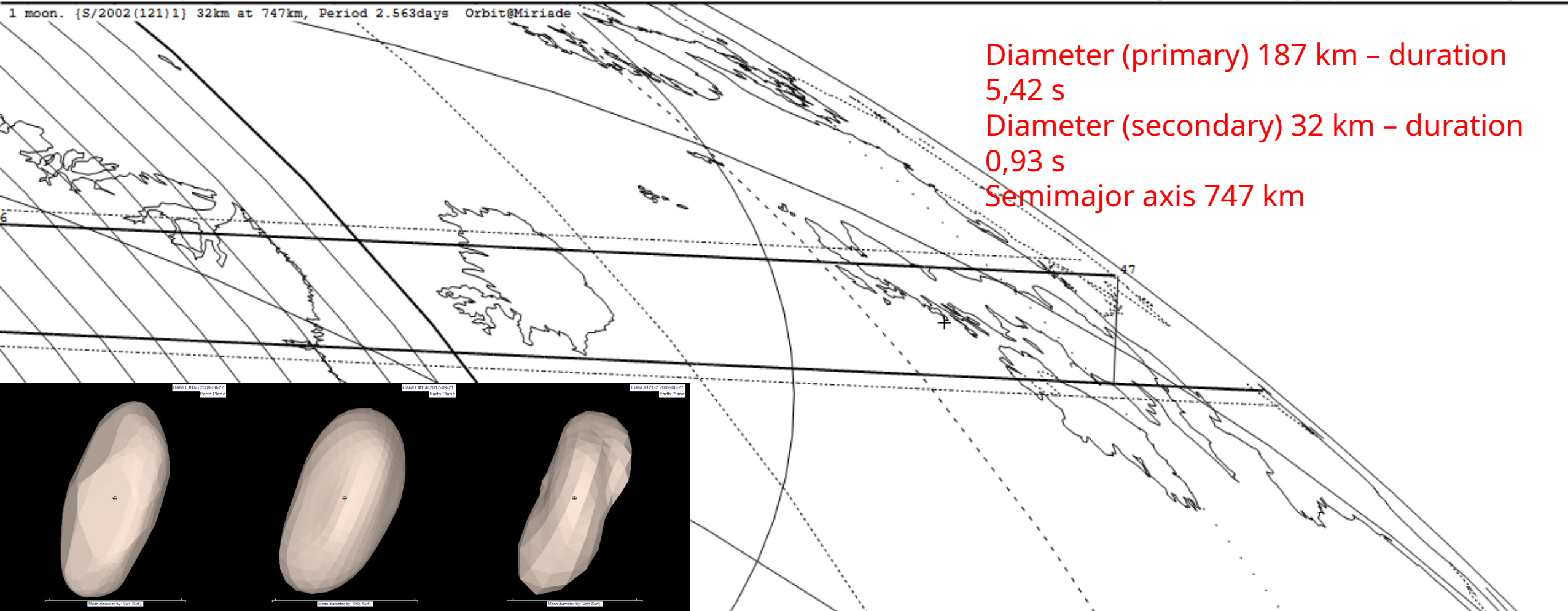
Star: (Dia < 0.1 mas)
Mv 9.2; Mb 9.2; Mr 9.2
RA = 6 28 46.9949 (astrometric)
Dec = 27 10 51.952
[of Date: 6 30 13, 27 10 2]
Prediction of 2022 Jul 14.9
Reliable 2.9 (beware),

Durations: Max = 5.7 secs
1km = 0.029 secs, 1mas = 0.086 secs
Mag Drop: 4.7 [99%]v, 4.3 [98%]r
Sun : Dist = 50°
Moon: Dist = 145°, illum = 98%
Error 16.0 x 9.3 mas in PA 85°

Asteroid: (in DAMIT, ISAM)
Mag = 13.9
Dia = 196 ±15km, 67 mas
Parallax = 2.186"
Hourly dRA = 3.154s
dDec = -1.76"

JPL#125:2022-Jun-06 Binary solution 1 : Kepler, Known errors + binary orbit

1 moon. {S/2002(121)1} 32km at 747km, Period 2.563days Orbit@Miriade



S/2002 (121) 1, comb. 9,2 mag / 0,94 s / drop 4,7 mag

2023 May 06, 22:46
UT

121 s2002-121-1 #1 occults TYC 1887-01582-1 on 2023 May 6 from 22h 43m to 22h 47m UT

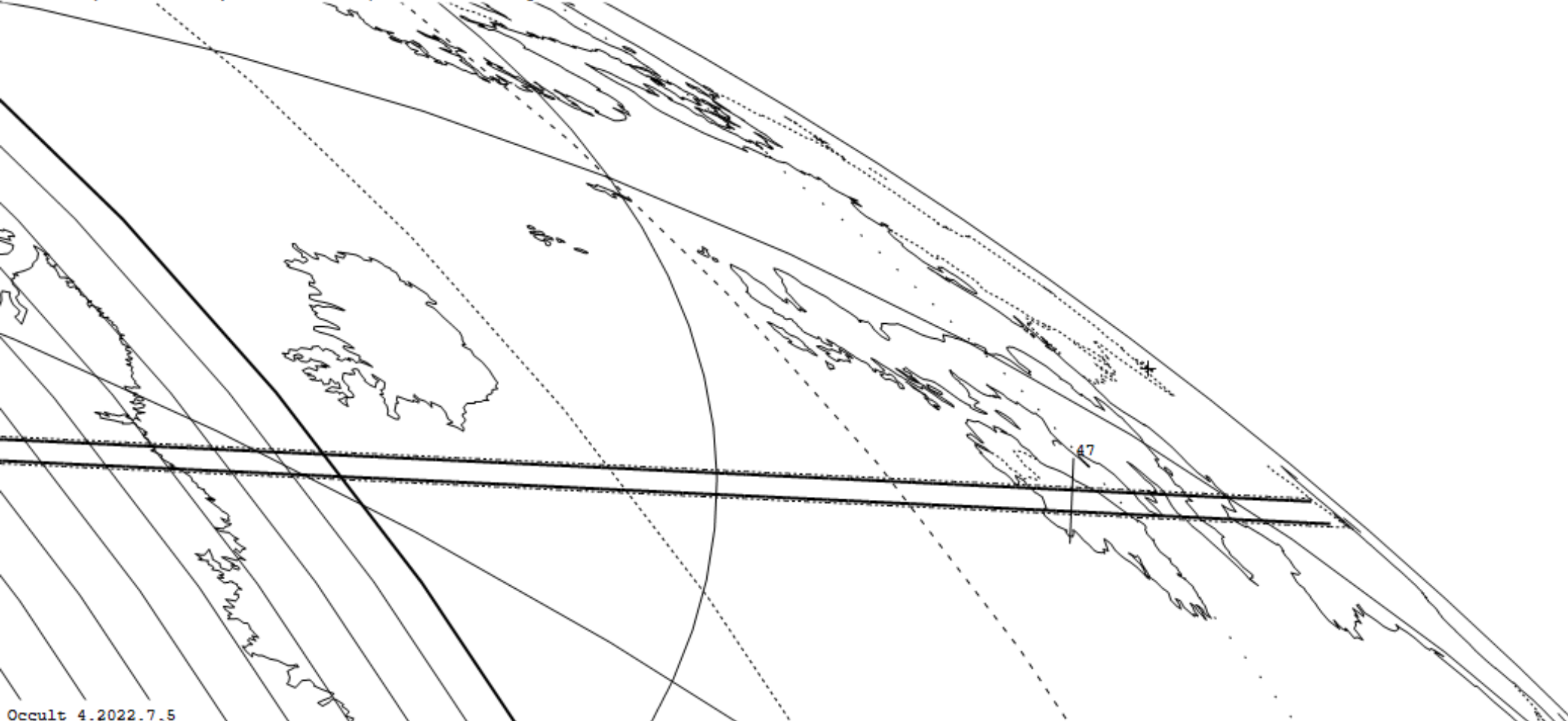
Star: (Dia < 0.1 mas)
Mv 9.2; Mb 9.2; Mr 9.2
RA = 6 28 46.9949 (astrometric)
Dec = 27 10 51.952
[of Date: 6 30 13, 27 10 2]
Prediction of 2022 Jul 14.9
Reliable 2.9 (beware),

Durations: Max = 0.94 secs
1km = 0.029 secs, 1mas = 0.086 secs
Mag Drop: 4.7 [99%]v, 4.3 [98%]r
Sun : Dist = 50°
Moon: Dist = 145°, illum = 98%
Error 16.0 x 9.3 mas in PA 85°

Asteroid: (in DAMIT, ISAM)
Mag = 13.9
Dia = 32 ±6km, 11 mas
Parallax = 2.186"
Hourly dRA = 3.154s
dDec = -1.76"

JPL#125:2022-Jun-06 Binary solution 1 : Kepler, Known errors + binary orbit

1 moon. {S/2002(121)1} 32km at 747km, Period 2.563days Orbit@Miriade



Occult 4.2022.7.5

(624) Hektor (Jupiter Trojan, L4), comb. 11,7 mag / 27,0 s / drop 3,5 mag

2023 Nov 09, 02:46 UT

624 Hektor #1 occults TYC 2486-00375-1 on 2023 Nov 9 from 2h 38m to 3h 9m UT

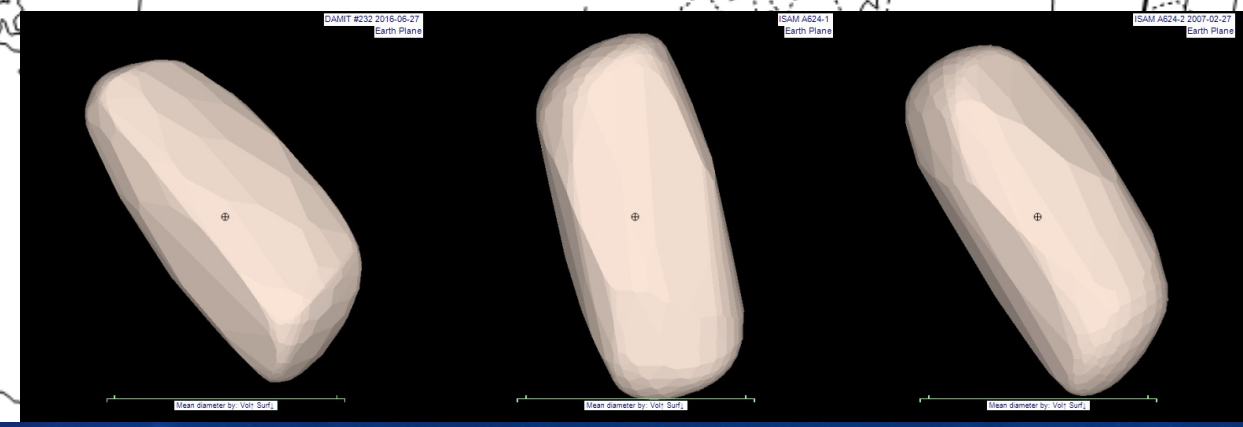
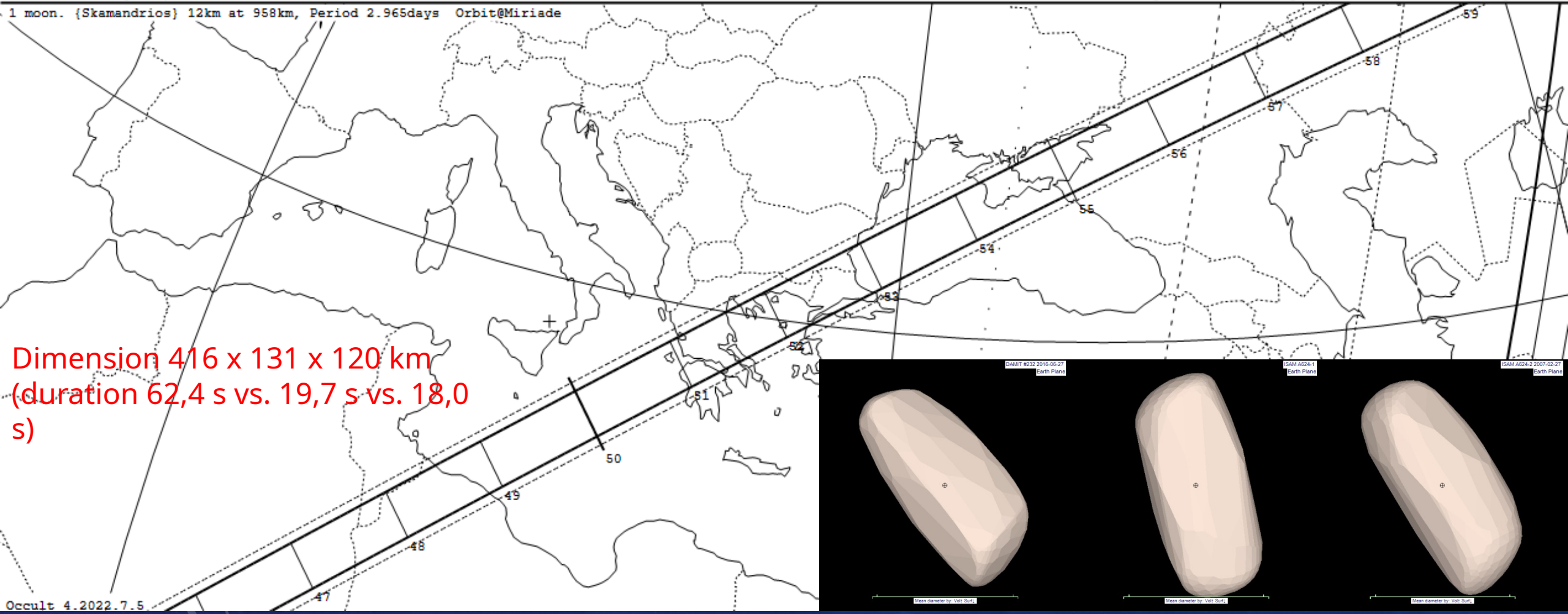
Star: (Dia < 0.1 mas)
Mv 11.7; Mb 12.0; Mr 11.3
RA = 8 35 53.0288 (astrometric)
Dec = 34 26 39.374
[of Date: 8 37 23, 34 21 40]
Prediction of 2022 Jul 15.0
Reliable 1.2 (good),

Durations: Max = 27.0 secs
1km = 0.15 secs, 1mas = 0.52 secs
Mag Drop: 3.5 [96%]v, 3.4 [96%]r
Sun : Dist = 103°
Moon: Dist = 55°, illum = 17%
Error 16.7 x 1.7 mas in PA 106°

Asteroid: (in DAMIT, ISAM)
Mag = 15.2
Dia = 184 ±12km, 52 mas
Parallax = 1.802"
Hourly dRA = 0.504s
dDec = 3.03"

JPL#117:2022-Jun-06 Binary solution 1 : Kepler, Known errors + binary orbit

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



Occult 4.2022.7.5

(624) Hektor I = Skamandrios, comb. 11,7 mag / 1,77 s / drop
3,5 mag

2023 Nov 09, 02:46
UT

624 Skamandrios #1 occults TYC 2486-00375-1 on 2023 Nov 9 from 2h 38m to 3h 9m UT

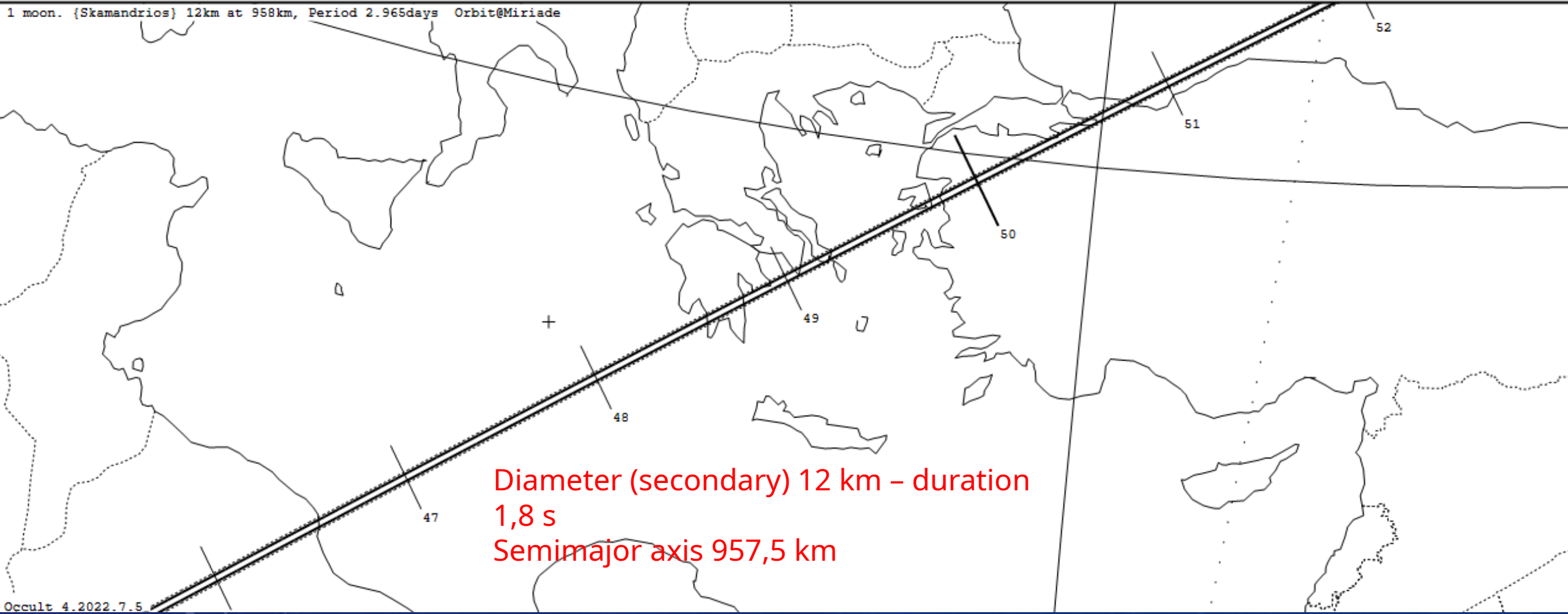
Star: (Dia < 0.1 mas)
Mv 11.7; Mb 12.0; Mr 11.3
RA = 8 35 53.0288 (astrometric)
Dec = 34 26 39.374
[of Date: 8 37 23, 34 21 40]
Prediction of 2022 Jul 15.0
Reliable 1.2 (good),

Durations: Max = 1.77 secs
1km = 0.15 secs, 1mas = 0.52 secs
Mag Drop: 3.5 [96%]v, 3.4 [96%]r
Sun : Dist = 103°
Moon: Dist = 55°, illum = 17%
Error 16.7 x 1.7 mas in PA 106°

Asteroid: (in DAMIT, ISAM)
Mag = 15.2
Dia = 12 ±4km, 3 mas
Parallax = 1.802"
Hourly dRA = 0.504s
dDec = 3.03"

JPL#117:2022-Jun-06 Binary solution 1 : Kepler, Known errors + binary orbit

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



Diameter (secondary) 12 km – duration
1,8 s
Semimajor axis 957,5 km

Occult 4.2022.7.5

(4337) Arecibo, comb. 13,2 mag / 1,46 s / drop 4,6 mag

2023 Nov 22, 18:34
UT

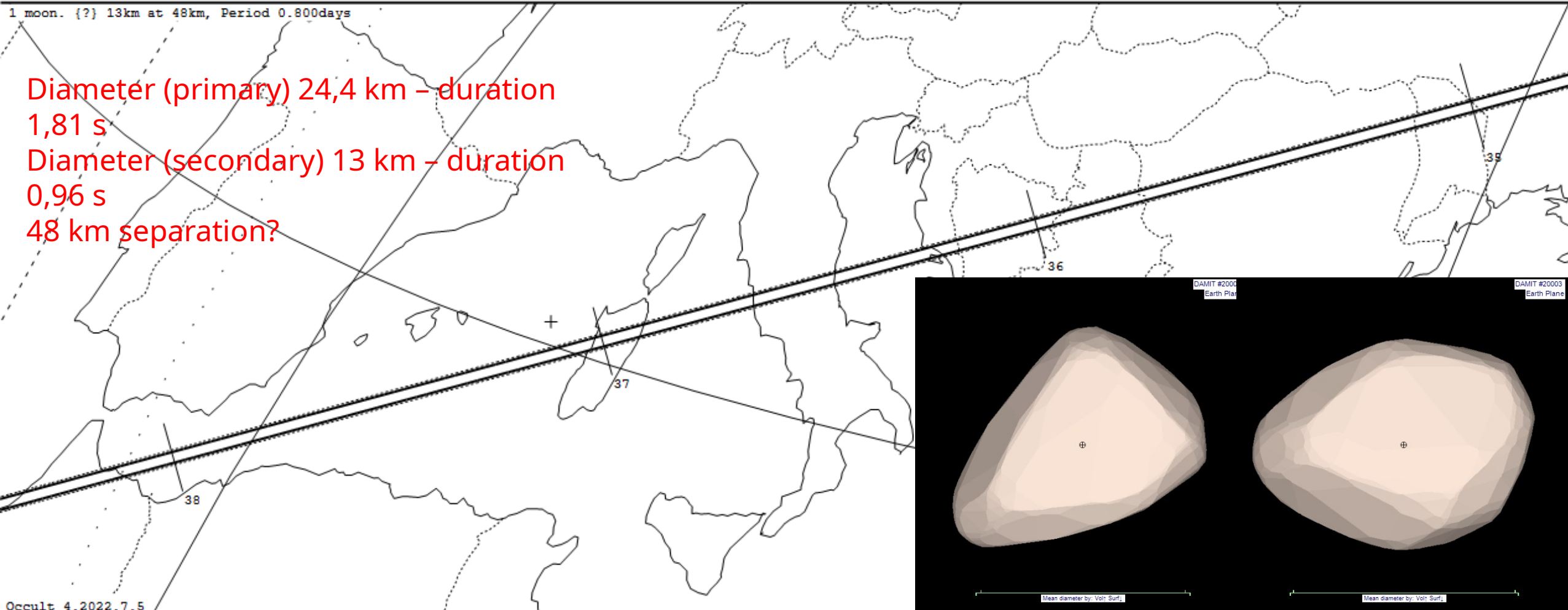
4337 Arecibo occults UCAC4 528-004534 on 2023 Nov 22 from 18h 27m to 18h 40m UT

Star: (Dia < 0.1 mas)
Mv 13.2; Mb 13.6; Mr 12.6
RA = 2 35 29.4410 (astrometric)
Dec = 15 30 24.860
[of Date: 2 36 49, 15 36 46]
Prediction of 2022 Jul 15.8
Reliable 1.0 (good),

Durations: Max = 1.46 secs
1km = 0.074 secs, 1mas = 0.14 secs
Mag Drop: 4.6 [99%]v, 4.8 [99%]r
Sun : Dist = 161°
Moon: Dist = 41°, illum = 75%
Error 24.3 x 1.0 mas in PA 71°

Asteroid: (in DAMIT)
Mag = 17.8
Dia = 20 ±2km, 10 mas
Parallax = 3.353"
Hourly dRA = -1.706s
dDec = -6.92"
JPL#45:2022-Jun-07, Known errors

1 moon. {?} 13km at 48km, Period 0.800days



Diameter (primary) 24,4 km – duration
1,81 s
Diameter (secondary) 13 km – duration
0,96 s
48 km separation?

Occult 4.2022.7.5

45 Eugenia #1 occults TYC 6274-01613-1 on 2023 Nov 26 from 17h 6m to 17h 9m UT

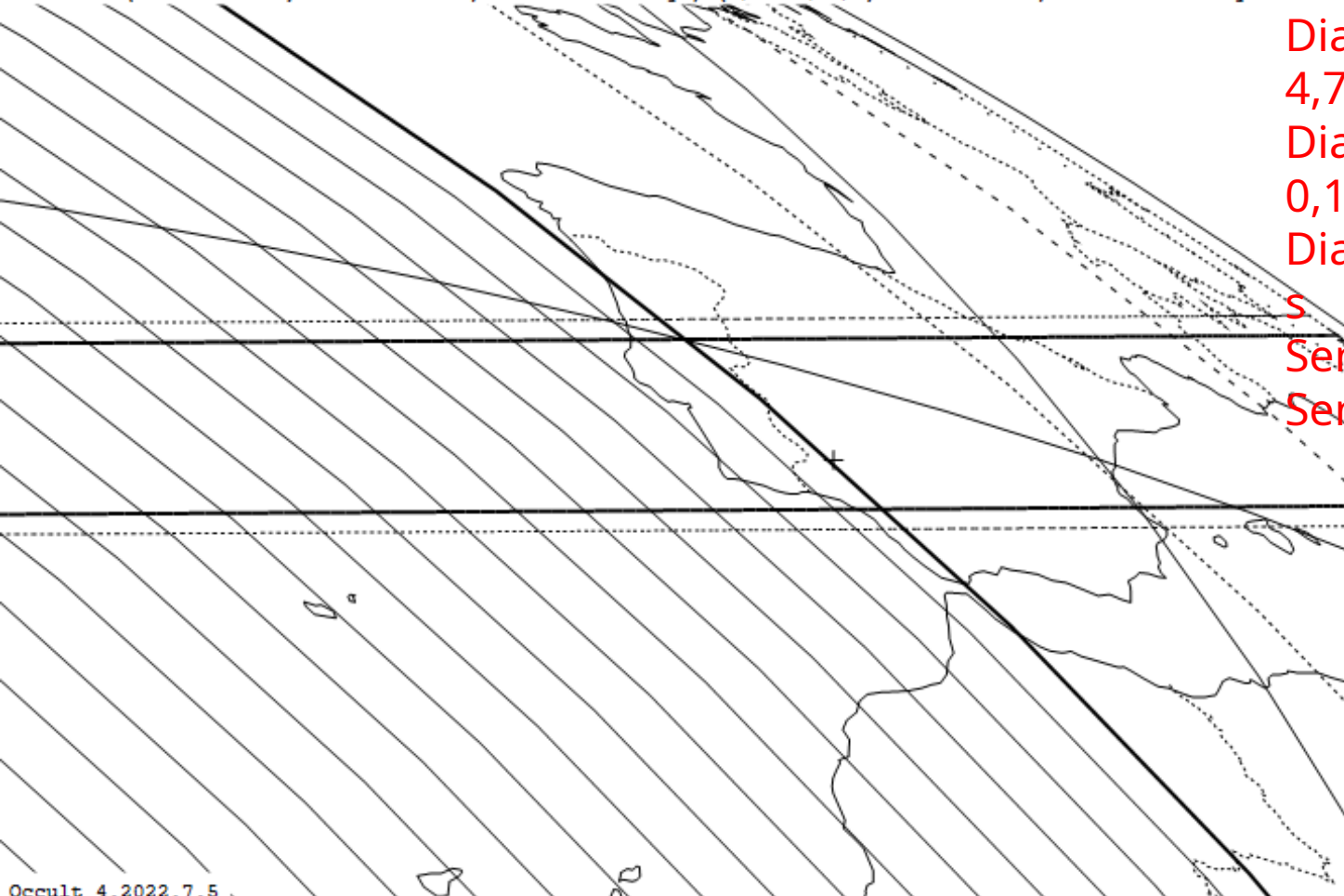
Star: (Dia = 0.1 mas)
Mv 9.9; Mb 10.6; Mr 9.1
RA = 18 31 34.3011 (astrometric)
Dec = -20 5 47.611
[of Date: 18 32 58, -20 4 49]
Prediction of 2022 Jul 14.8
Reliable 0.9 (good), DupSrc,

Durations: Max = 4.7 secs
1km = 0.023 secs, lmas = 0.055 secs
Mag Drop: 3.3 [95%]v, 3.7 [97%]r
Sun : Dist = 33°
Moon: Dist = 138°, illum = 99%
Error 18.7 x 9.7 mas in PA 95°

Asteroid: (in DAMIT, ISAM)
Mag = 13.2
Dia = 206 ±6km, 85 mas
Parallax = 2.634"
Hourly dRA = 4.658s
dDec = 0.22"

JPL#124:2022-Jun-06 Binary solution 1 : Kepler, Known errors + binary orbit

2 moons. {Petit-Prince} 7km at 1164km, Period 4.716days, {S/2004(45)1} 5km at 611km, Period 1.793days Orbit@Miriade



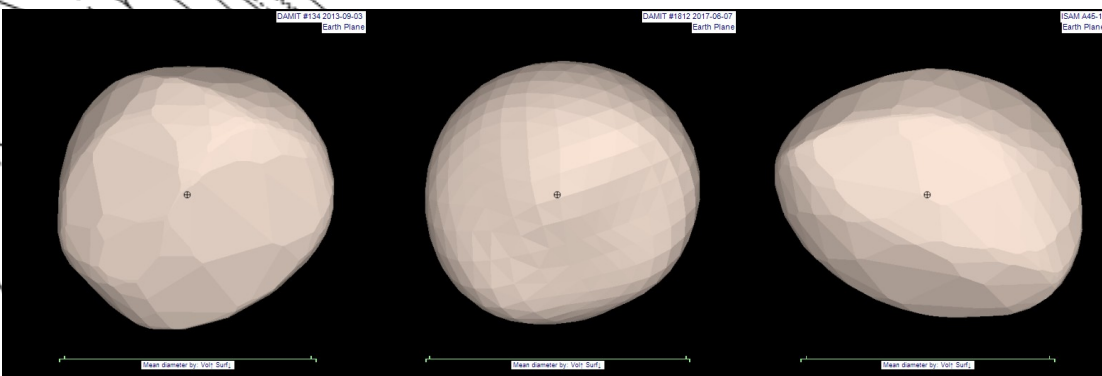
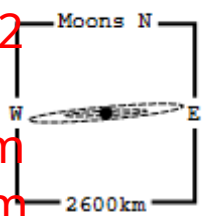
Diameter (Eugenia) 206,14 km – duration 4,74 s

Diameter (Petit-Prince) 7 km – duration 0,16 s

Diameter (S/2004 (45) 1) 5 km – durat. 0,12 s

Semimajor axis (Petit-Prince) = 1164,42 km

Semimajor axis (S/2004 (45) 1) = 610,59 km



Occult 4.2022.7.5

(45) Eugenia I = Petit-Prince, comb. 9,9 mag / 0,16 s / drop 3,3 mag

2023 Nov 26, 17:09 UT

45 Petit-Prince #1 occults TYC 6274-01613-1 on 2023 Nov 26 from 17h 6m to 17h 9m UT

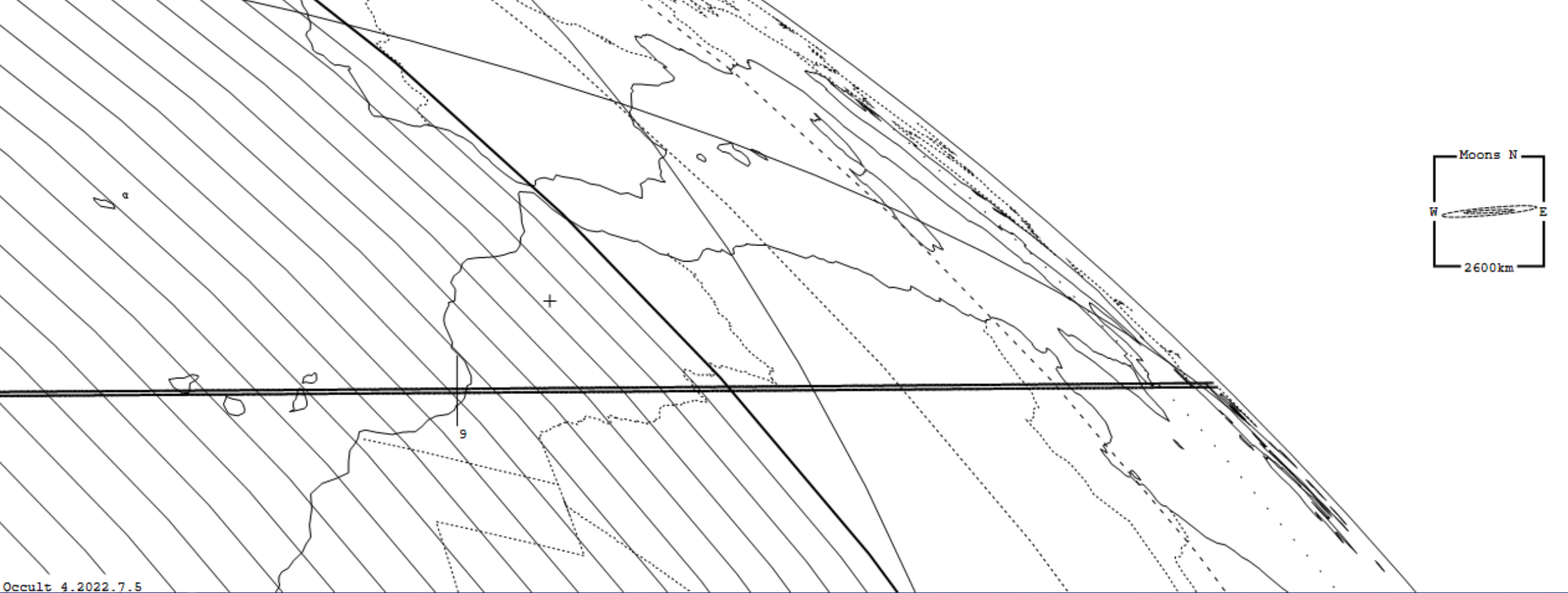
Star: (Dia = 0.1 mas)
Mv 9.9; Mb 10.6; Mr 9.1
RA = 18 31 34.3011 (astrometric)
Dec = -20 5 47.611
[of Date: 18 32 58, -20 4 49]
Prediction of 2022 Jul 14.8
Reliable 0.9 (good), DupSrc,

Durations: Max = 0.16 secs
1km = 0.024 secs, 1mas = 0.057 secs
Mag Drop: 3.3 [95%]v, 3.7 [97%]r
Sun : Dist = 33°
Moon: Dist = 138°, illum = 99%
Error 18.7 x 9.7 mas in PA 95°

Asteroid: (in DAMIT, ISAM)
Mag = 13.2
Dia = 7.0 ±2.0km, 3 mas
Parallax = 2.634"
Hourly dRA = 4.658s
dDec = 0.22"

JPL#124:2022-Jun-06 Binary solution 1 : Kepler, Known errors + binary orbit

2 moons. {Petit-Prince} 7km at 1164km, Period 4.716days, {S/2004(45)1} 5km at 611km, Period 1.793days Orbit@Miriade



Occult 4.2022.7.5

45 Petite-Princesse #1 occults TYC 6274-01613-1 on 2023 Nov 26 from 17h 6m to 17h 9m UT

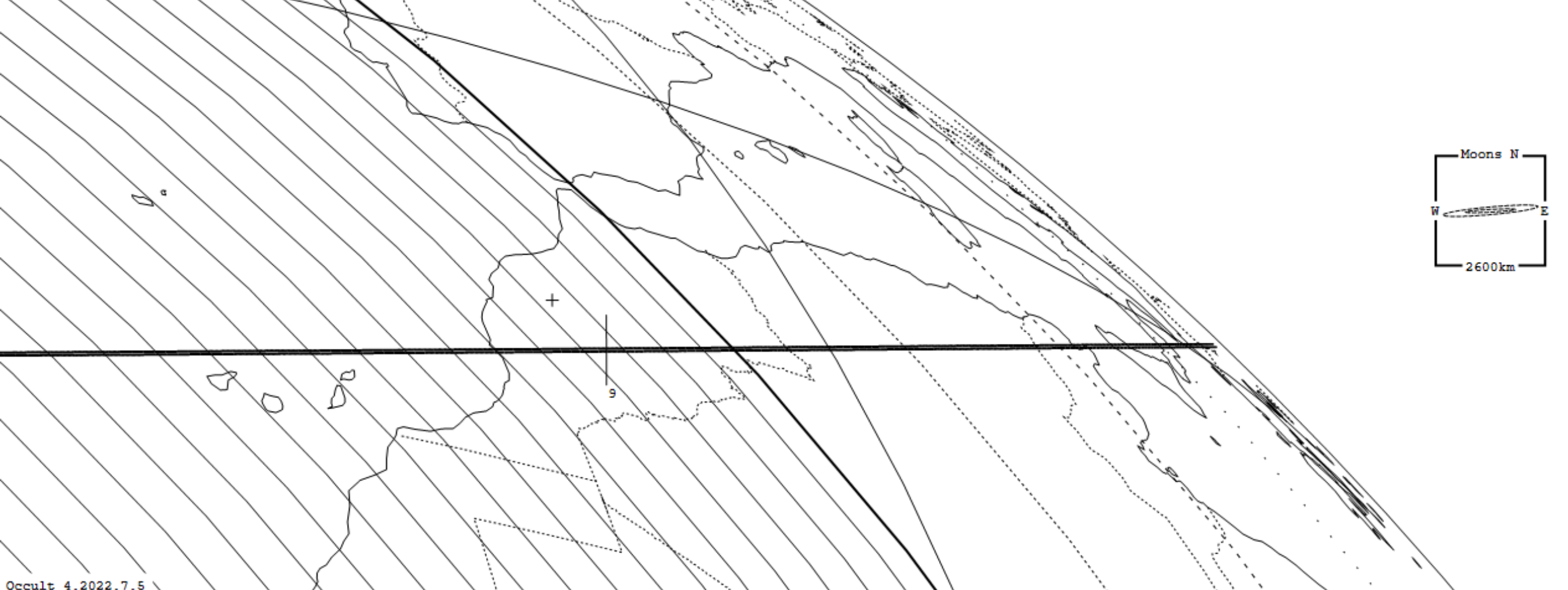
Star: (Dia = 0.1 mas)
Mv 9.9; Mb 10.6; Mr 9.1
RA = 18 31 34.3011 (astrometric)
Dec = -20 5 47.611
[of Date: 18 32 58, -20 4 49]
Prediction of 2022 Jul 14.8
Reliable 0.9 (good), DupSrc,

Durations: Max = 0.12 secs
1km = 0.024 secs, 1mas = 0.058 secs
Mag Drop: 3.3 [95%]v, 3.7 [97%]r
Sun : Dist = 33°
Moon: Dist = 138°, illum = 99%
Error 18.7 x 9.7 mas in PA 95°

Asteroid: (in DAMIT, ISAM)
Mag = 13.2
Dia = 5.0 ±2.0km, 2 mas
Parallax = 2.634"
Hourly dRA = 4.658s
dDec = 0.22"

JPL#124:2022-Jun-06 Binary solution 1 : Kepler, Known errors + binary orbit

2 moons. {Petit-Prince} 7km at 1164km, Period 4.716days, {S/2004(45)1} 5km at 611km, Period 1.793days Orbit@Miriade



Occult 4.2022.7.5

(317) Roxane, comb. 11,6 mag / 1,76 s / drop 0,8 mag

2023 Dec 05, 03:37
UT

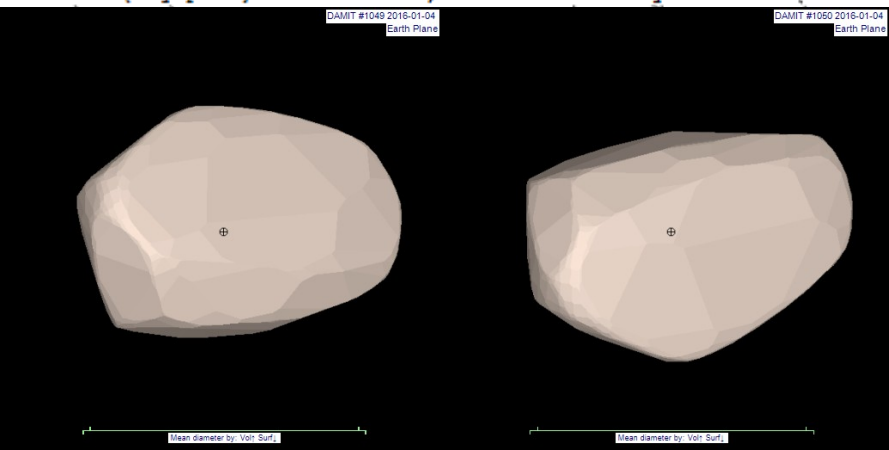
317 Roxane occults UCAC4 547-010590 on 2023 Dec 5 from 3h 37m to 3h 54m UT

Star: (Dia < 0.1 mas)
Mv 12.3; Mb 12.7; Mr 11.7
RA = 4 44 11.4404 (astrometric)
Dec = 19 13 16.917
[of Date: 4 45 36, 19 16 1]
Prediction of 2022 Jul 8.9
Reliable 1.4 (good),

Durations: Max = 1.76 secs
1km = 0.095 secs, 1mas = 0.089 secs
Mag Drop: 0.8 [53%]v, 0.9 [56%]r
Sun : Dist = 177°
Moon: Dist = 89°, illum = 51%
Error 32.7 x 1.9 mas in PA 82°

Asteroid: (in DAMIT, ISAM)
Mag = 12.4
Dia = 19 ±1km, 20 mas
Parallax = 6.773"
Hourly dRA = -2.833s
dDec = -4.48"
JPL#57:2022-Jun-06, Known errors

1 moon. {Olympias} 5km at 247km, Period 11.540days



Diameter (Roxane) 19,86 km – dur. 1,89 s
Diameter (Olympias) 5,2 km – dur. 0,49 s
Semimajor axis 245 km

Occult 4.2022.7.5

3. Other asteroids

A: Jupiter Trojans

3 events chosen

1 event of (624) Hektor was in part of Asteroids with satellites

(1583) Antilochus (Jupiter Trojan, L4), comb. 11,1 mag / 10,9 s / drop
4,8 mag

2023 Feb 05, 18:55
UT

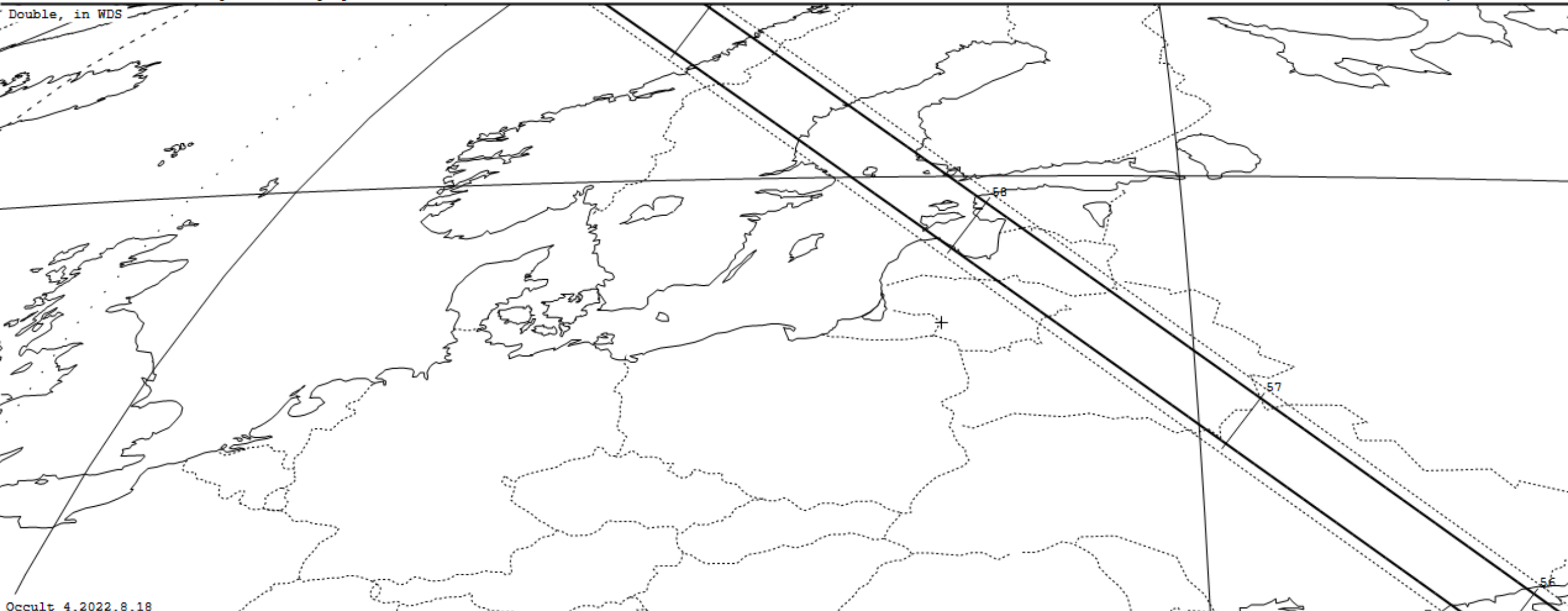
1583 Antilochus occults G055530.3-045445 on 2023 Feb 5 from 18h 44m to 19h 0m UT

Star: (Dia < 0.1 mas)
Mv 11.1; Mb 10.8; Mr 9.9
RA = 5 55 30.3476 (astrometric)
Dec = - 4 54 45.043
[of Date: 5 56 39, - 4 54 37]
Prediction of 2022 Aug 23.9
Reliable not set in Gaia (problem)Bad proper motion

Durations: Max = 10.9 secs
1km = 0.10 secs, 1mas = 0.32 secs
Mag Drop: 4.8 [99%]v, 5.5 [99%]r
Sun : Dist = 126°
Moon: Dist = 57°, illum =100%
Error 21.2 x 3.7 mas in PA 113°

Asteroid:
Mag = 15.9
Dia = 107 ±7km, 34 mas
Parallax = 2.037"
Hourly dRA =-0.600s
dDec = 6.83"
JPL#60:2022-Jun-06, Known errors

Double, in WDS



Occult 4.2022.8.18

mag

IIT

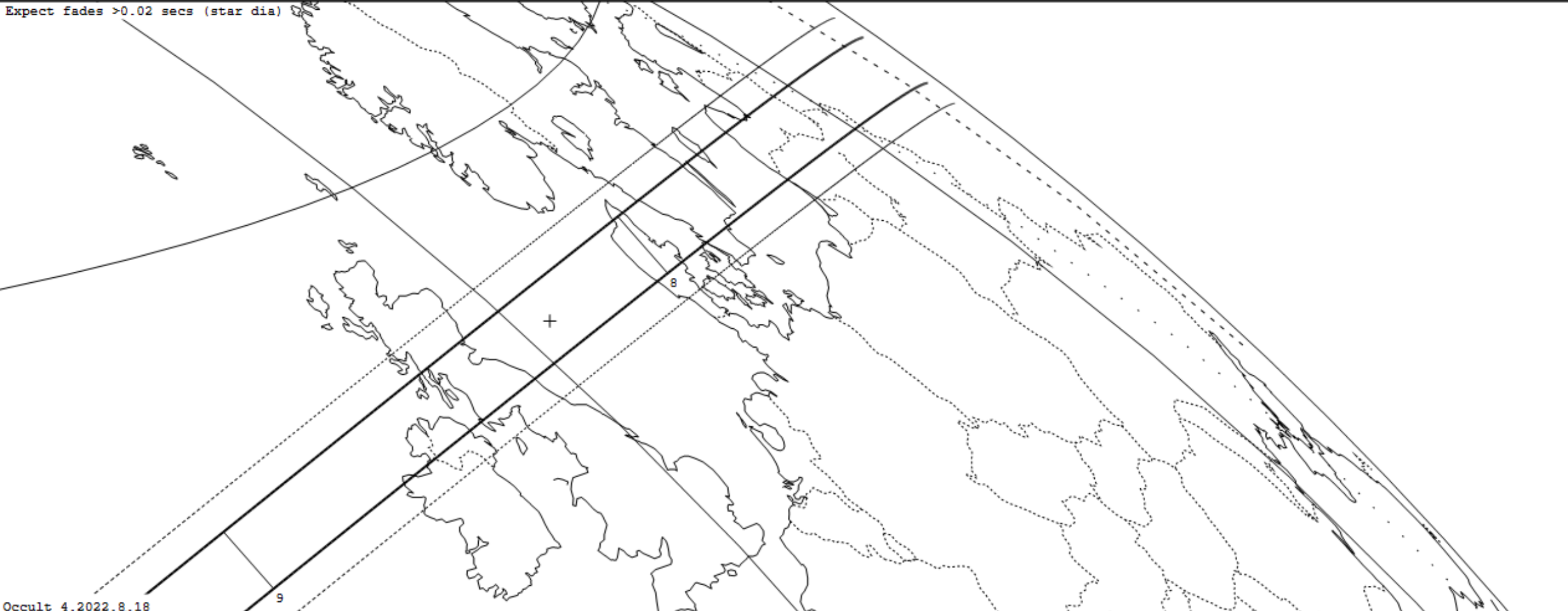
1172 Aneas occults TYC 1159-01132-1 on 2023 Oct 3 from 2h 7m to 2h 22m UT

Star: (Dia = 0.1 mas)
Mv 9.3; Mb 9.9; Mr 8.5
RA = 22 50 51.5355 (astrometric)
Dec = 14 8 52.100
[of Date: 22 52 3, 14 16 31]
Prediction of 2022 Aug 23.9
Reliable 1.2 (good),

Durations: Max = 9.5 secs
1km = 0.069 secs, 1mas = 0.20 secs
Mag Drop: 5.9 [100%]v, 6.2 [100%]r
Sun : Dist = 152°
Moon: Dist = 69°, illum = 83%
Error 37.3 x 17.7 mas in PA 69°

Asteroid:
Mag = 15.2
Dia = 139 ±6km, 48 mas
Parallax = 2.221"
Hourly dRA = -0.946s
dDec = -12.11"
JPL#103:2022-Aug-01, Known errors

Expect fades >0.02 secs (star dia)



Occult 4.2022.8.18

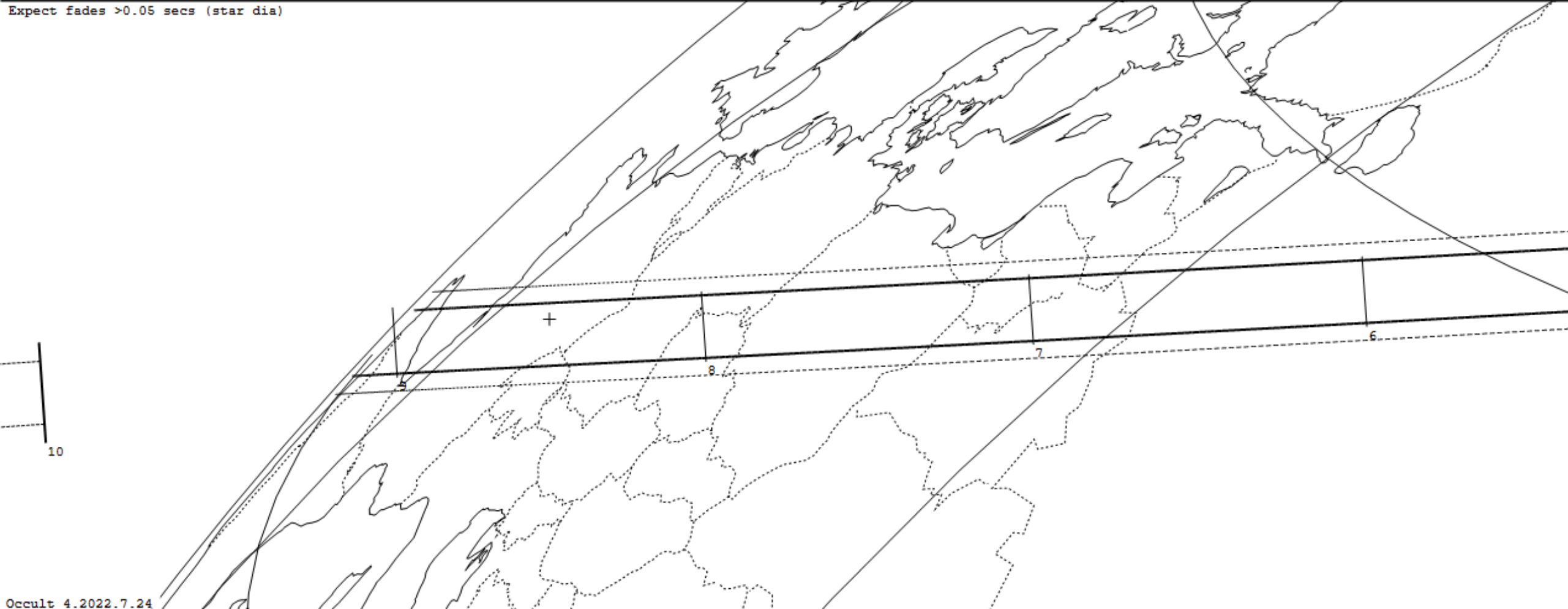
1143 Odysseus occults TYC 1337-01481-1 on 2023 Nov 23 from 19h 55m to 20h 9m UT

Star: (Dia = 0.2 mas)
Mv 10.5; Mb 11.7; Mr 9.4
RA = 6 33 23.7247 (astrometric)
Dec = 20 19 21.880
[of Date: 6 34 50, 20 18 19]
Prediction of 2022 Jul 28.9
Reliable 1.0 (good),

Durations: Max = 11.2 secs
1km = 0.098 secs, 1mas = 0.28 secs
Mag Drop: 4.8 [99%]v, 5.4 [99%]r
Sun : Dist = 143"
Moon: Dist = 82", illum = 85%
Error 33.0 x 9.0 mas in PA 97°

Asteroid:
Mag = 15.3
Dia = 115 ±8km, 40 mas
Parallax = 2.235"
Hourly dRA = -0.916s
dDec = -0.89"
JPL#92:2022-Jun-06, Known errors

Expect fades >0.05 secs (star dia)



Occult 4.2022.7.24

3. Other asteroids

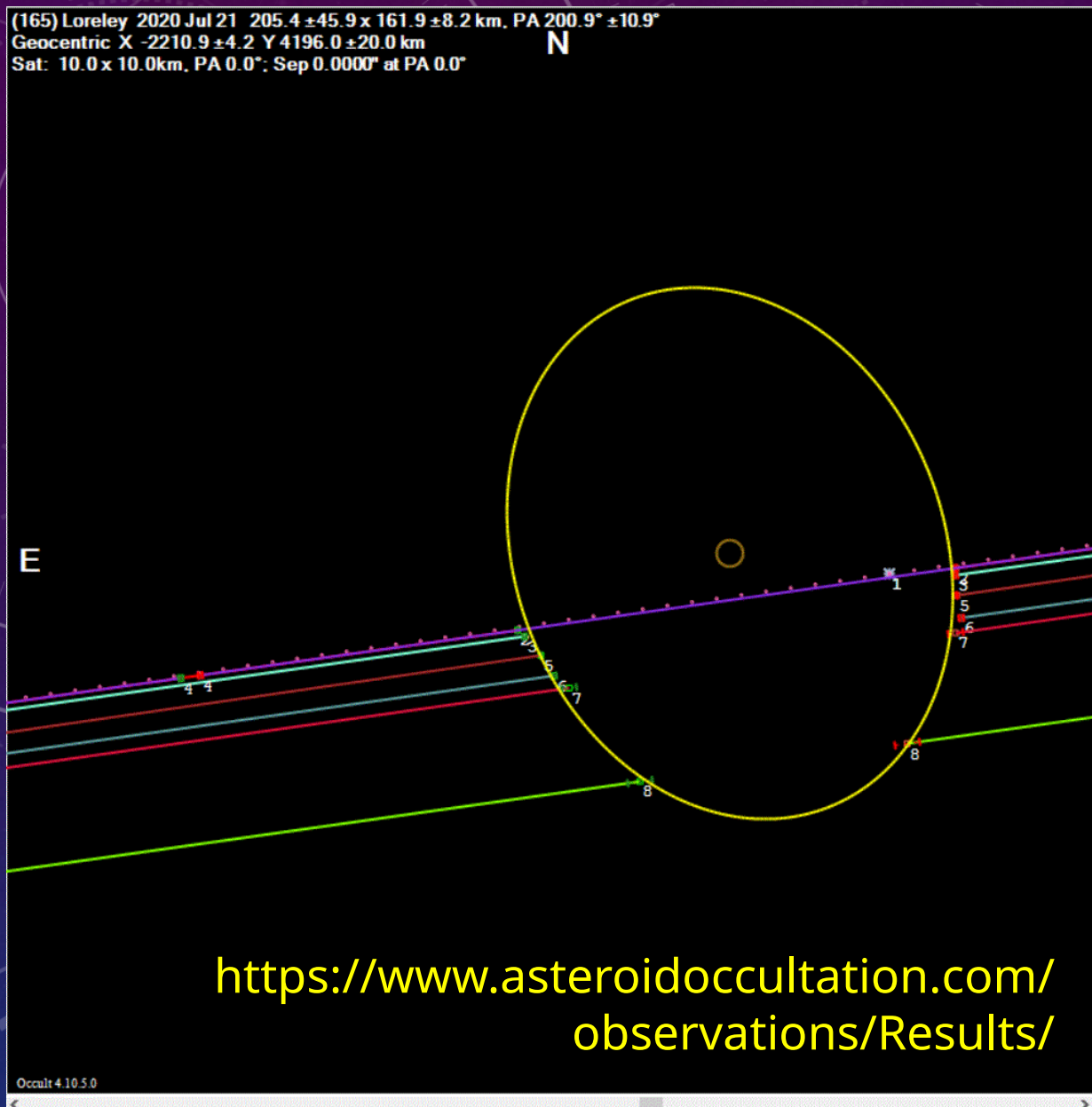
B: Interesting asteroids from past observations

Asteroids from view of an observer of the occultations; suspicion for a satellite, concave shape or other.

7 events chosen and 6 supplementary.

(165) Loreley, comb. 11,3 mag / 19,7 s / drop 0,8 mag

2020 Jul 21, 08:15
UT, North America



Find best fit

Center X: -3.6 -4.5 Centered on Shape model

Center Y: 45.8 22.2

Major axis (km): 205.4 48.0 a/b=1.27

Minor axis (km): 161.9 11.2 dMag=-0.26

Orientation: 200.9 -5.8 Motion: 3km/s, X

Circular Use assumed diameter Include Miss events

Show: Both Primary Secondary

Plot scale: normal x 2 x 5

Plot scale: [Slider]

Quality of the fit: No reliable position or size

Form opacity: [Slider]

RMS fit 1.1 ± 2.1 km

1 (P)	Predicted
2	R Jones
3	P Maley
4	R Jones
5	R Venable
6	G Lyzenga
7	C McPartlin
8	K Voeller

Satellite details

Satellite # 1 of 0

IAU designation: [Input field]

Seprn (mas)	Uncert	PA to satellite	Uncert
0.0	0.0	0.00	0.0

Major axis	Minor axis	PA of Major
10.0	10.0	0.0

Satellite fit: None # chords 1

Possible Satellite

Robert Jones in CA
observed a secondary event.

<https://www.asteroidoccultation.com/observations/Results/>

(165) Loreley, comb. 12,4 mag / 13,2 s / drop 0,5 mag

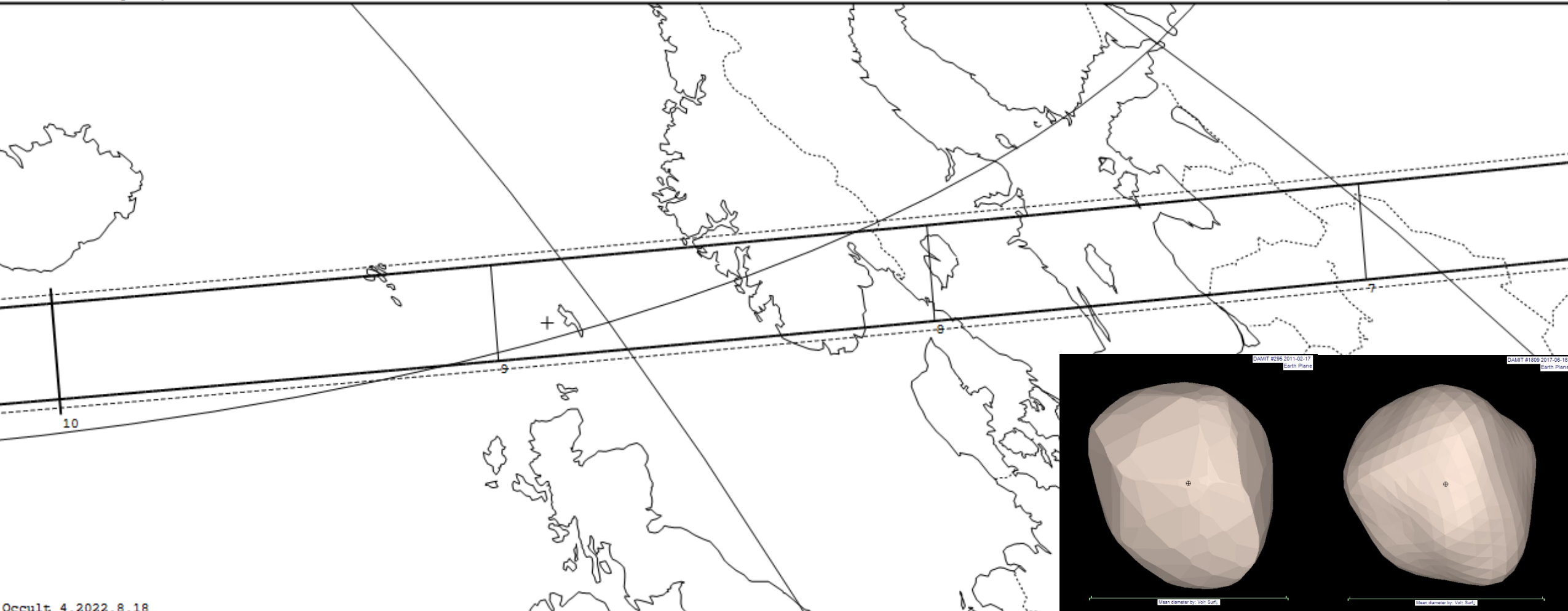
2023 Feb 04, 01:07
UT

165 Loreley occults UCAC4 564-040113 on 2023 Feb 4 from 1h 5m to 1h 18m UT

Star: (Dia < 0.1 mas)
Mv 13.4; Mb 13.8; Mr 12.9
RA = 7 35 3.1463 (astrometric)
Dec = 22 47 41.870
[of Date: 7 36 27, 22 44 39]
Prediction of 2022 Aug 23.9
Reliable 1.1 (good),

Durations: Max = 13.2 secs
1km = 0.076 secs, 1mas = 0.13 secs
Mag Drop: 0.5 [39%]v, 0.6 [40%]r
Sun : Dist = 157°
Moon: Dist = 6°, illum = 97%
Error 19.7 x 2.1 mas in PA 111°

Asteroid: (in DAMIT, ISAM)
Mag = 12.9
Dia = 175 ±9km, 98 mas
Parallax = 3.587"
Hourly dRA = -1.930s
dDec = -2.18"
JPL#65:2022-Jun-10, Known errors



Occult 4.2022.8.18

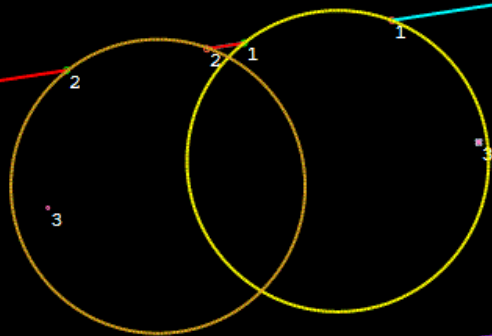
(814) Tauris, comb. 9,1 mag / 8,1 s / drop 5,3 mag

2018 Mar 19, 07:19
UT, North America

(814) Tauris 2018 Mar 19 77.8 x 77.8 km, PA 0.0°
Geocentric X 253.7 Y 1008.9 km
Sat: 75.9 x 75.9 km, PA 0.0°; Sep 0.0230" at PA 98.0°

N

E



50 km

Occult4.5.5.3

<https://www.asteroidoccultation.com/observations/Results/>

Find best fit

Center X 28.0 0.0
Center Y 6.9 0.0

Major axis (km) 77.8 0.0
Minor axis (km) 77.8 0.0
Orientation 0.0 0.0

a/b=1.00
dM=0.00
Motion 13.73km/s, X

Asteroid satellite
Sepn (masec) 23.0 0.0
PA of 2nd 98.0 0.0

Show: Both Primary Secondary

A= 75.9 B= 75.9 PA= 0.0

Circular Include Miss events

Plot scale Quality of the fit Not fitted
RMS fit 0.0 ±0.0 km Opacity

1	J Garlitz, Elgin, OR
2	J Garlitz, Elgin, OR
3 (P)	Predicted Centerline
4 (M)	A Morton, Rexburg, ID

„Lobed“ asteroid.

Joe Garlitz in OR
observed 2xD and
2xR.

(814) Tauris, comb. 12,7 mag / 11,4 s / drop 0,7 mag

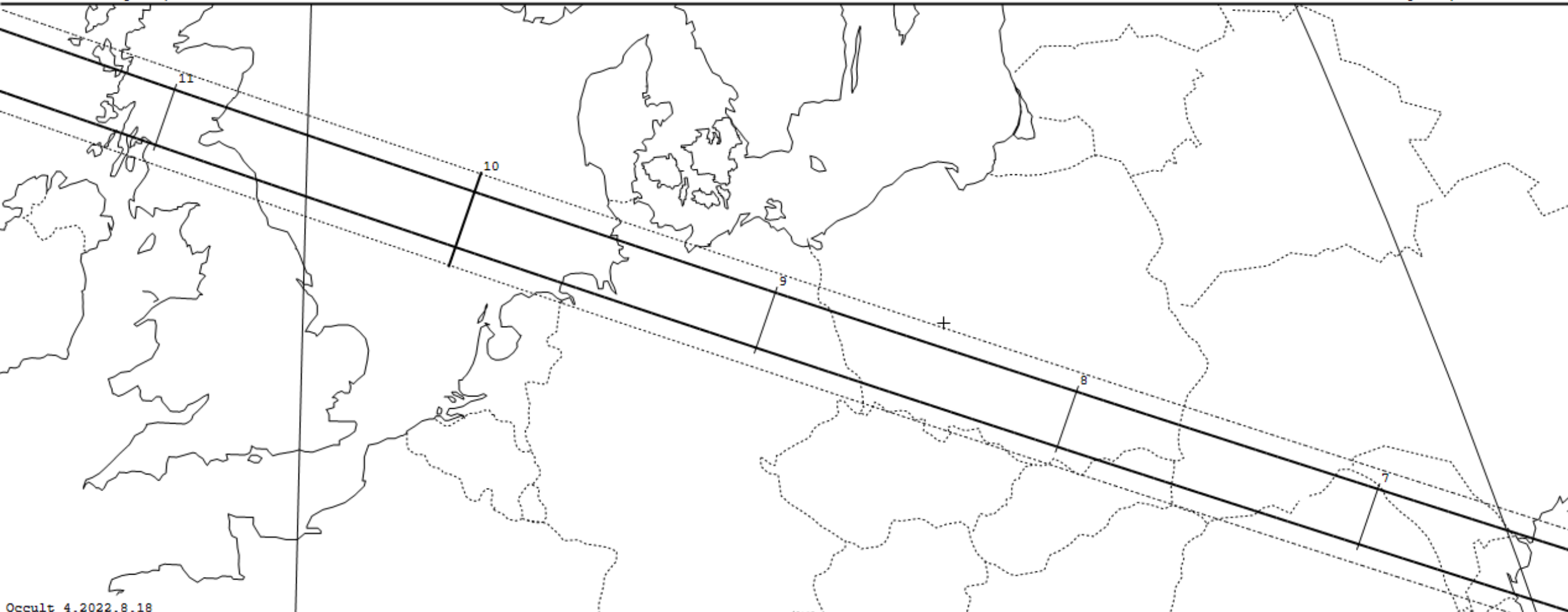
2023 Feb 08, 22:06
UT

814 Tauris occults UCAC4 641-041764 on 2023 Feb 8 from 21h 58m to 22h 20m UT

Star: (Dia < 0.1 mas)
Mv 13.4; Mb 14.0; Mr 12.8
RA = 7 29 46.9466 (astrometric)
Dec = 38 0 12.206
[of Date: 7 31 21, 37 57 22]
Prediction of 2022 Aug 23.9
Reliable 1.0 (good),

Durations: Max = 11.4 secs
1km = 0.11 secs, 1mas = 0.16 secs
Mag Drop: 0.7 [50%]v, 0.9 [55%]r
Sun : Dist = 145°
Moon: Dist = 66°, illum = 91%
Error 31.7 x 19.0 mas in PA 79°

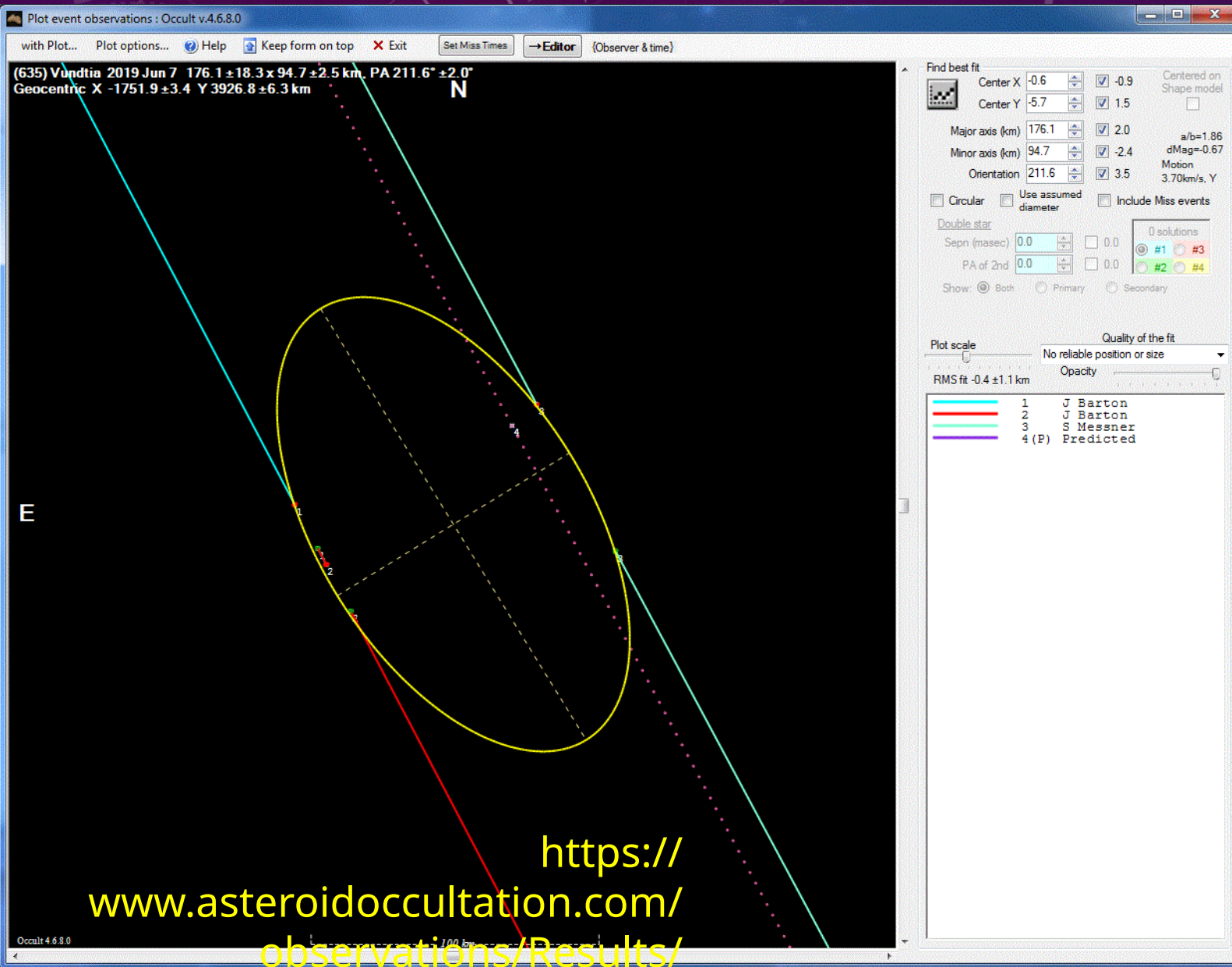
Asteroid:
Mag = 13.4
Dia = 107 ±7km, 71 mas
Parallax = 4.224"
Hourly dRA = -1.790s
dDec = 7.34"
JPL#88:2022-Apr-14, Known errors



Occult 4.2022.8.18

(635) Vundtia, comb. 11,7 mag / 23,2 s / drop 2,8 mag

2019 Jun 19, 09:20
UT, North America



Possible concavity

Johnny Barton in TX
observed 2xD and
2xR.

[https://
www.asteroidoccultation.com/
observations/Results/](https://www.asteroidoccultation.com/observations/Results/)

(635) Vundtia, comb. 12,8 mag / 8,3 s / drop 1,5 mag

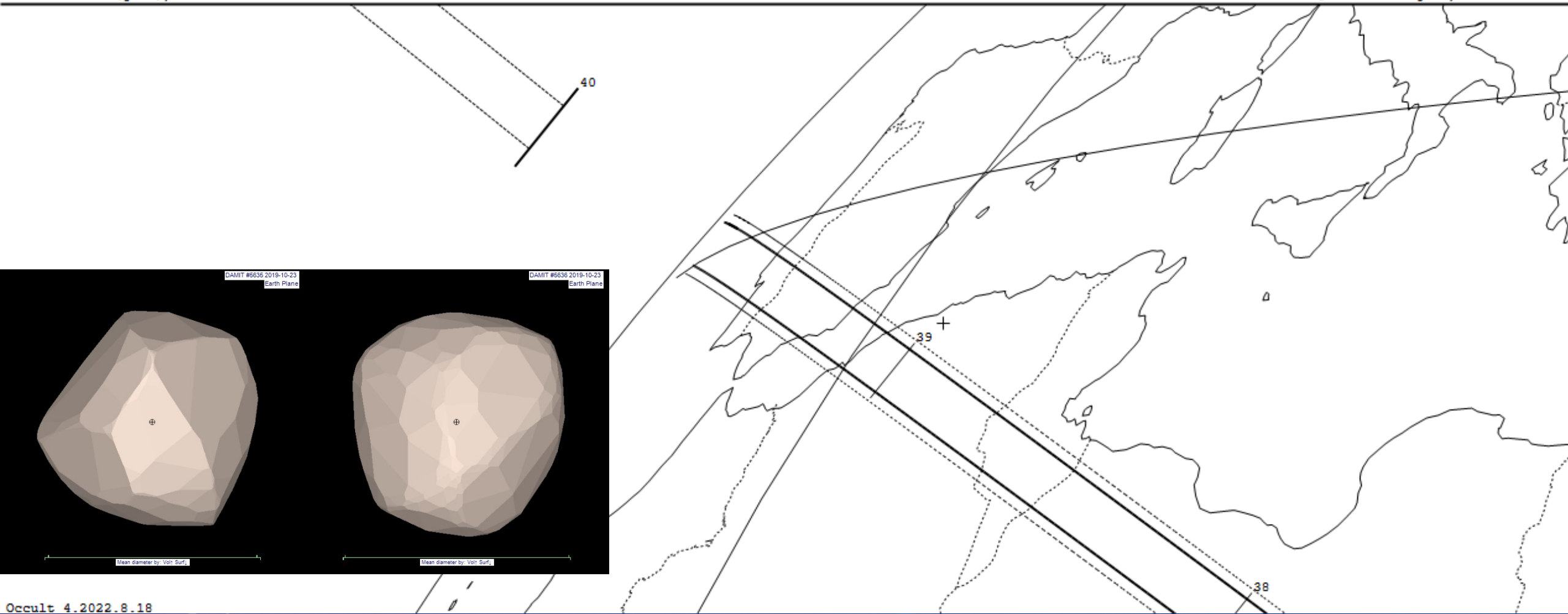
2023 Mar 23, 21:38
UT

635 Vundtia occults UCAC4 418-058484 on 2023 Mar 23 from 21h 22m to 21h 40m UT

Star: (Dia < 0.1 mas)
Mv 13.1; Mb 13.5; Mr 12.6
RA = 13 53 6.3447 (astrometric)
Dec = - 6 28 13.326
[of Date: 13 54 20, - 6 35 10]
Prediction of 2022 Aug 23.9
Reliable 1.0 (good),

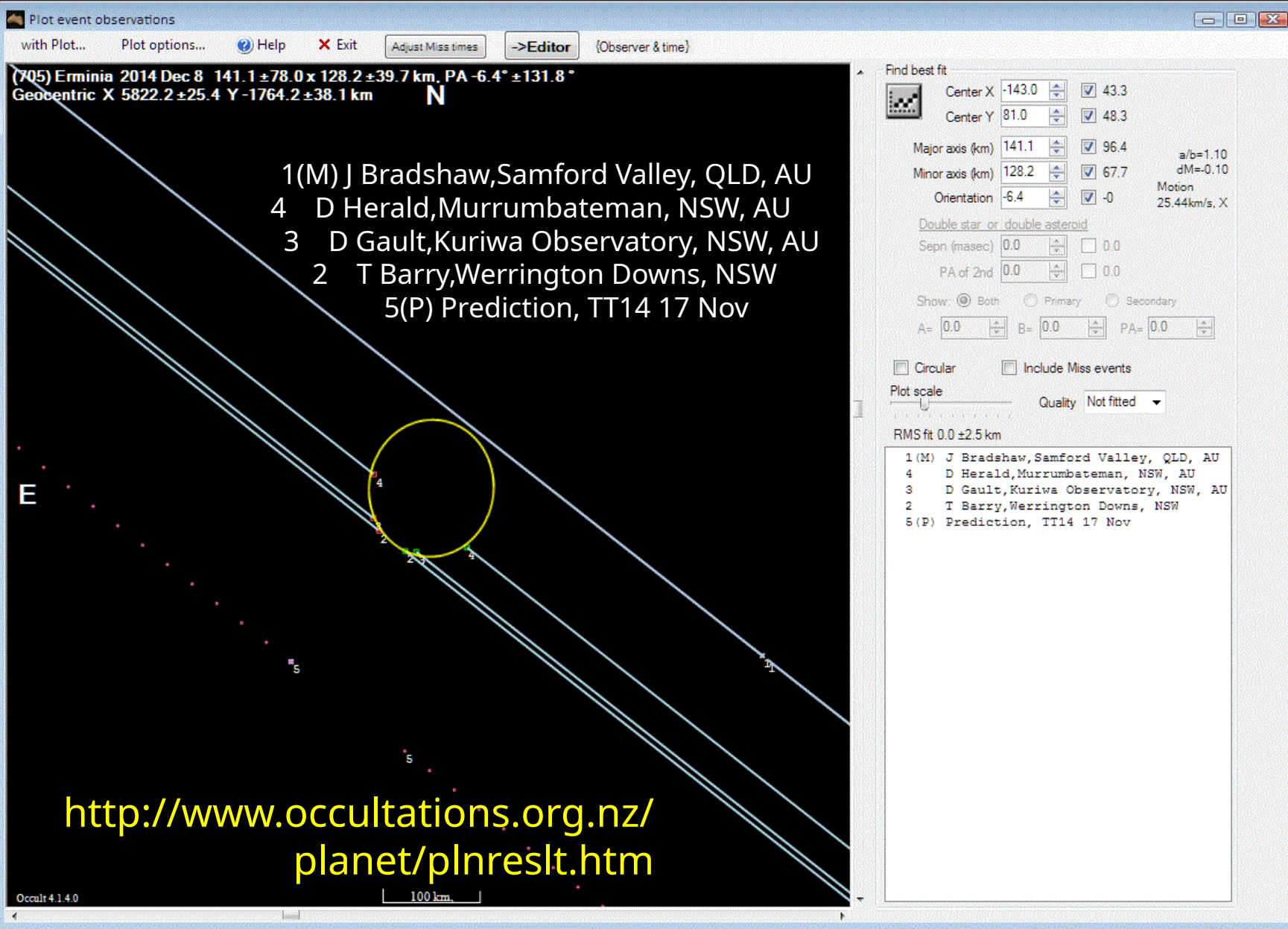
Durations: Max = 8.3 secs
1km = 0.083 secs, 1mas = 0.15 secs
Mag Drop: 1.5 [74%]v, 1.5 [75%]r
Sun : Dist = 154°
Moon: Dist = 175°, illum = 6%
Error 23.7 x 2.0 mas in PA 101°

Asteroid: (in DAMIT)
Mag = 14.3
Dia = 100 ±5km, 57 mas
Parallax = 3.619"
Hourly dRA = -1.285s
dDec = 15.44"
JPL#107:2022-Aug-03, Known errors



(705) Erminia, comb. 12,8 mag / 4,6 s / drop 1,5 mag

2014 Dec 08, 11:11
UT, Australia



Possible Satellite

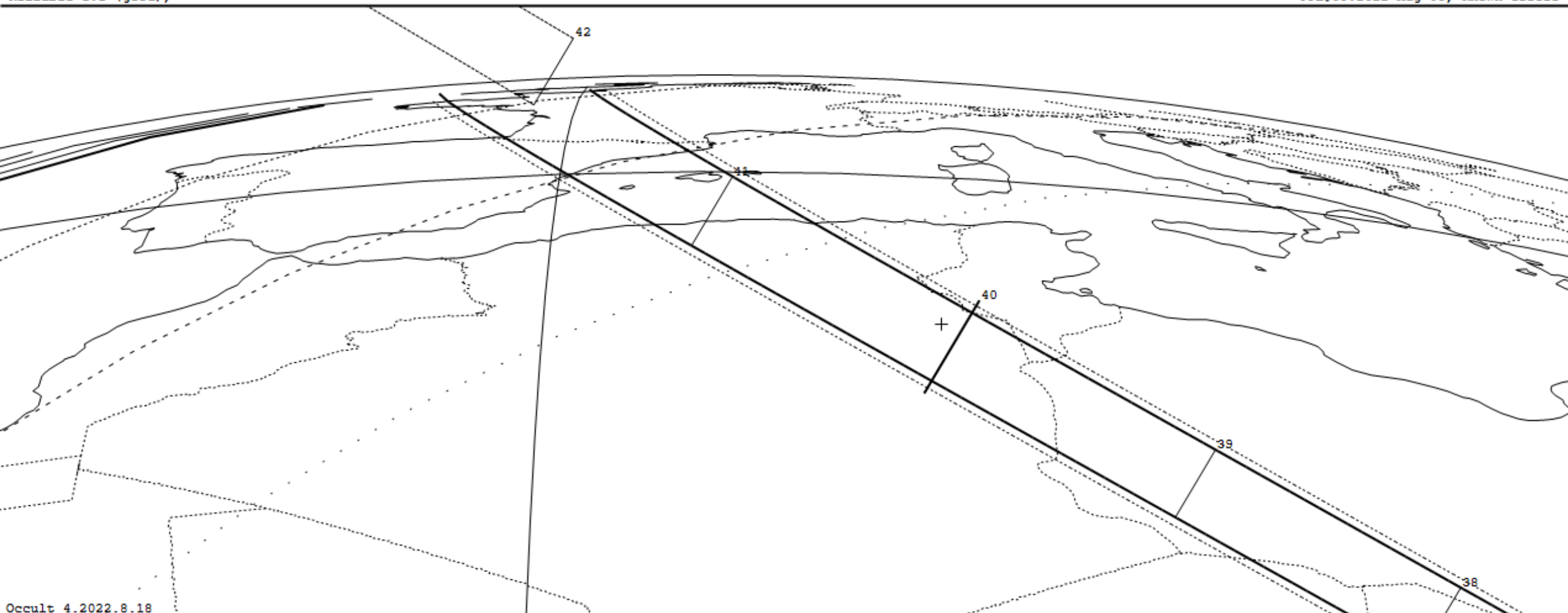
Jonathan Bradshaw in QLD
observed a positive out of
main body.
Minimum size of a possible
satellite is about 6 to 10 km.

705 Erminia occults UCAC4 266-069146 on 2023 Jun 2 from 20h 28m to 20h 42m UT

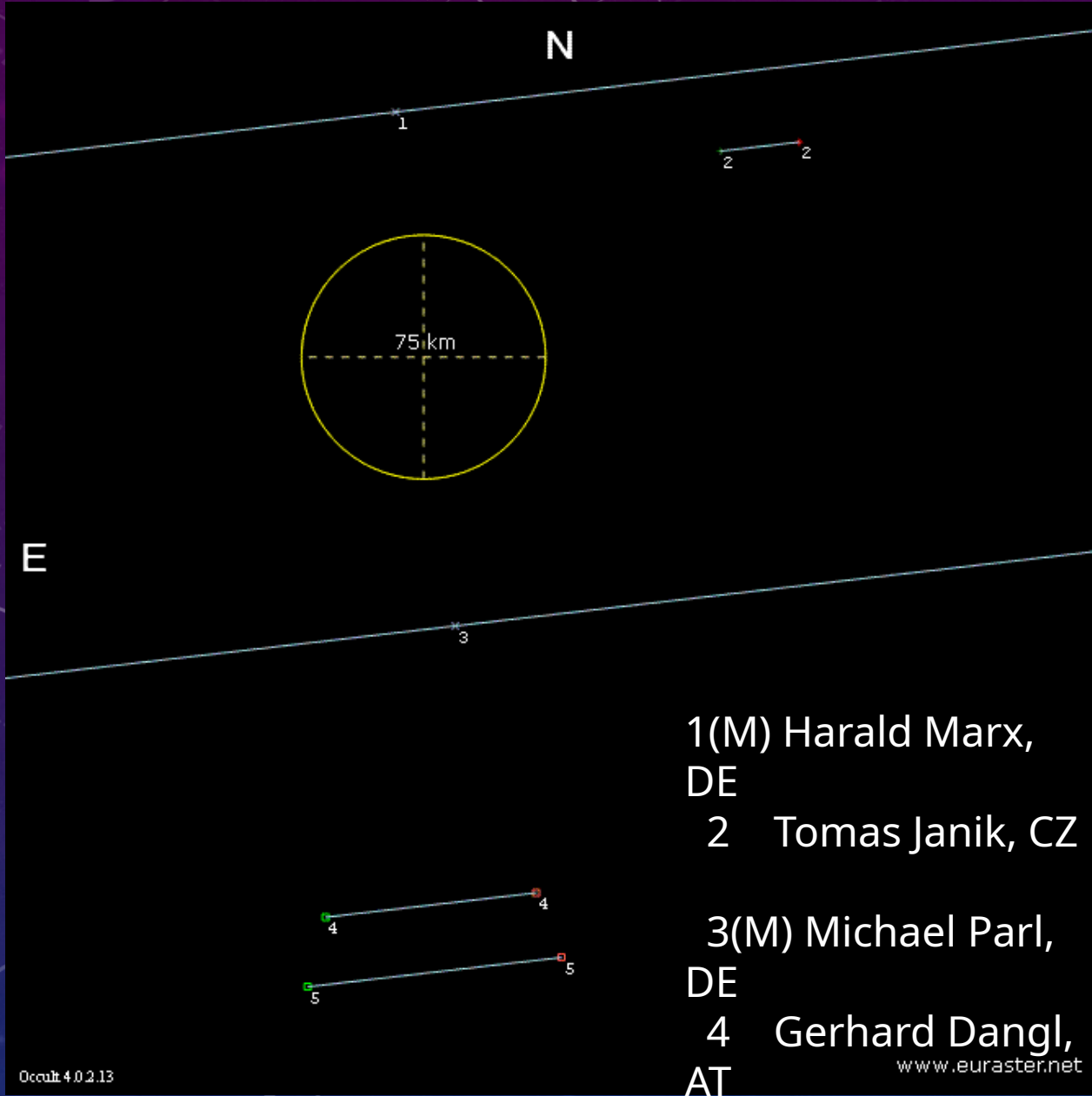
Star: (Dia < 0.1 mas)
Mv 13.1; Mb 13.5; Mr 12.6 [+2 near]
RA = 13 31 0.7964 (astrometric)
Dec = -36 59 18.640
[of Date: 13 32 22, -37 6 41]
Prediction of 2022 Aug 23.9
Reliable 1.1 (good),

Durations: Max = 17.2 secs
1km = 0.12 secs, 1mas = 0.19 secs
Mag Drop: 0.8 [54%]v, 0.9 [57%]r
Sun : Dist = 136°
Moon: Dist = 30°, illum = 98%
Error 26.7 x 5.0 mas in PA 136°

Asteroid:
Mag = 13.3
Dia = 142 ±8km, 89 mas
Parallax = 4.024"
Hourly dRA = -1.345s
dDec = 9.56"
JPL#59:2022-Aug-03, Known errors



Occult 4.2022.8.18



- 1(M) Harald Marx, DE
- 2 Tomas Janik, CZ
- 3(M) Michael Parl, DE
- 4 Gerhard Dangl, AT
- 5 Herbert Raab,

2008/02/03 | 595 | Polyxena | TYC 2989-01266-1
 potential stations W, E (O. Kloes)
[chords](#), [observer list](#)
 asteroid measurement: at least 78 km

0-	Harald Marx	18:53:40	19:04:43	M350	VIS	DE	E	09 11 51.0
0-	Michael Parl	18:53:00	19:03:00	M203	VID	DE	E	11 39 30.5
0?	Tomas Janik	18:57:59	19:00:49	M200	VIS	CZ	E	14 00 09
		1.67 18:58:31.97 0.2	18:58:33.64 0.5	RAD++				0.5 0.7 A
<i>Observer surprised by D in the 3 sigma zone. Technical interruption 18:59:22/32. Not consistent with the other observations.;</i>								
O+	Herbert Raab	18:56:40	19:00:40	M200	VID	AT	E	14 13 41.8
		5.40 18:58:49.92 0.12	18:58:55.32 0.12	GPS++				;
O+	Gerhard Dangl	18:55:04	19:02:02	M254	VID	AT	E	15 14 07.7
		4.48 18:58:44.57 0.08	18:58:49.05 0.08	GPS++				;

<http://www.euraster.net/results/>

Possible Satelliete

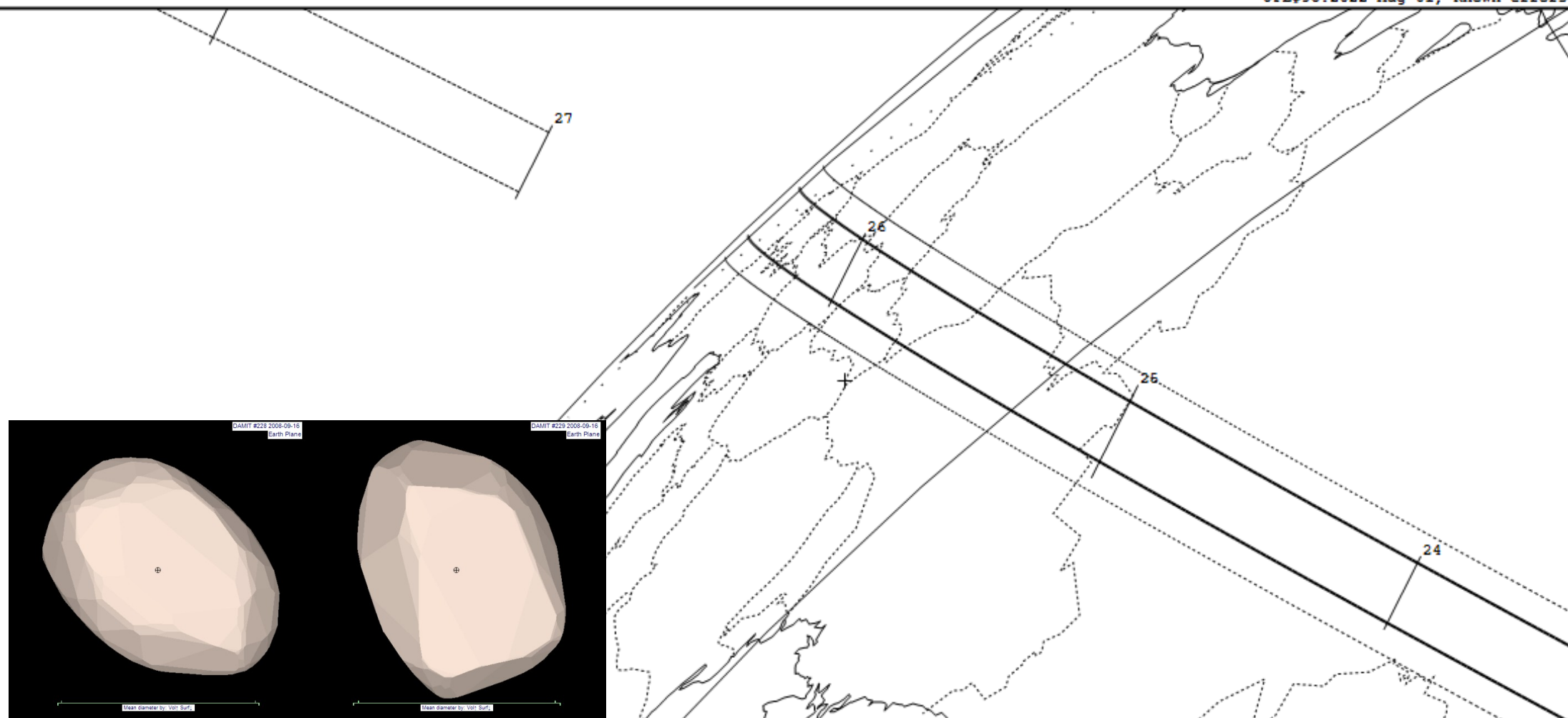
Tomáš Janík in CZ
was a positive out of
main body.

595 Polyxena occults UCAC4 553-005449 on 2023 Sep 25 from 19h 4m to 19h 27m UT

Star: (Dia < 0.1 mas)
Mv 12.3; Mb 12.6; Mr 11.7
RA = 2 48 51.4421 (astrometric)
Dec = 20 29 3.700
[of Date: 2 50 13, 20 35 2]
Prediction of 2022 Aug 23.9
Reliable 1.2 (good),

Durations: Max = 11.7 secs
1km = 0.11 secs, 1mas = 0.19 secs
Mag Drop: 1.3 [69%]v, 1.3 [70%]r
Sun : Dist = 136°
Moon: Dist = 95°, illum = 82%
Error 30.3 x 4.7 mas in PA 55°

Asteroid: (in DAMIT, ISAM)
Mag = 13.1
Dia = 104 ±5km, 60 mas
Parallax = 3.667"
Hourly dRA = -1.177s
dDec = 8.35"
JPL#95:2022-Aug-01, Known errors

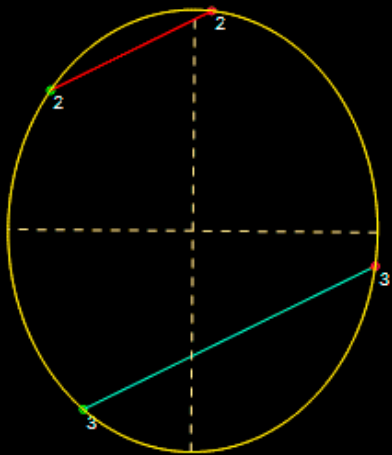


Occult 4.2022.8.18

(412) Elisabetha

(412) Elisabetha 2016 Mar 17 105.1 ±0.0 x 87.8 ±0.0 km, PA -0.5° ±0.0°
Geocentric X -3680.7 ±0.0 Y 3589.2 ±0.0 km
Sat: 2.0 x 2.0 km, PA 0.0°; Sep 0.2104" at PA -50.3°

E



<http://www.euraster.net/results/>

Occult 4.2.0.1

100 km

2016 Mar 17, 17:46
UT, Europe

Possible Satellite

Peter Delinčák in SK
was a positive out of
main body.

Find best fit

Center X	-84.7	<input checked="" type="checkbox"/>	0.0
Center Y	-63.0	<input checked="" type="checkbox"/>	0.0
Major axis (km)	105.1	<input checked="" type="checkbox"/>	0.0
Minor axis (km)	87.8	<input checked="" type="checkbox"/>	0.0
Orientation	-0.5	<input checked="" type="checkbox"/>	0.0

a/b=1.20
dM=-0.20
Motion 9.59km/s, X

Asteroid satellite

Seprn (masec)	210.4	<input checked="" type="checkbox"/>	0.0
PA of 2nd	-50.3	<input checked="" type="checkbox"/>	0.0

Show: Both Primary Secondary

A= 2.0 B= 2.0 PA= 0.0

Circular Include Miss events

Plot scale _____ Quality Not fitted

RMS fit 0.0 ±0.0 km

1	Peter Delincak, SK
2	Bernd Gaehrken, DE
3	Matej Korec, SK

(412) Elisabetha, comb. 12,3 mag / 12,4 s / drop 1,5 mag

2023 Oct 12, 00:26

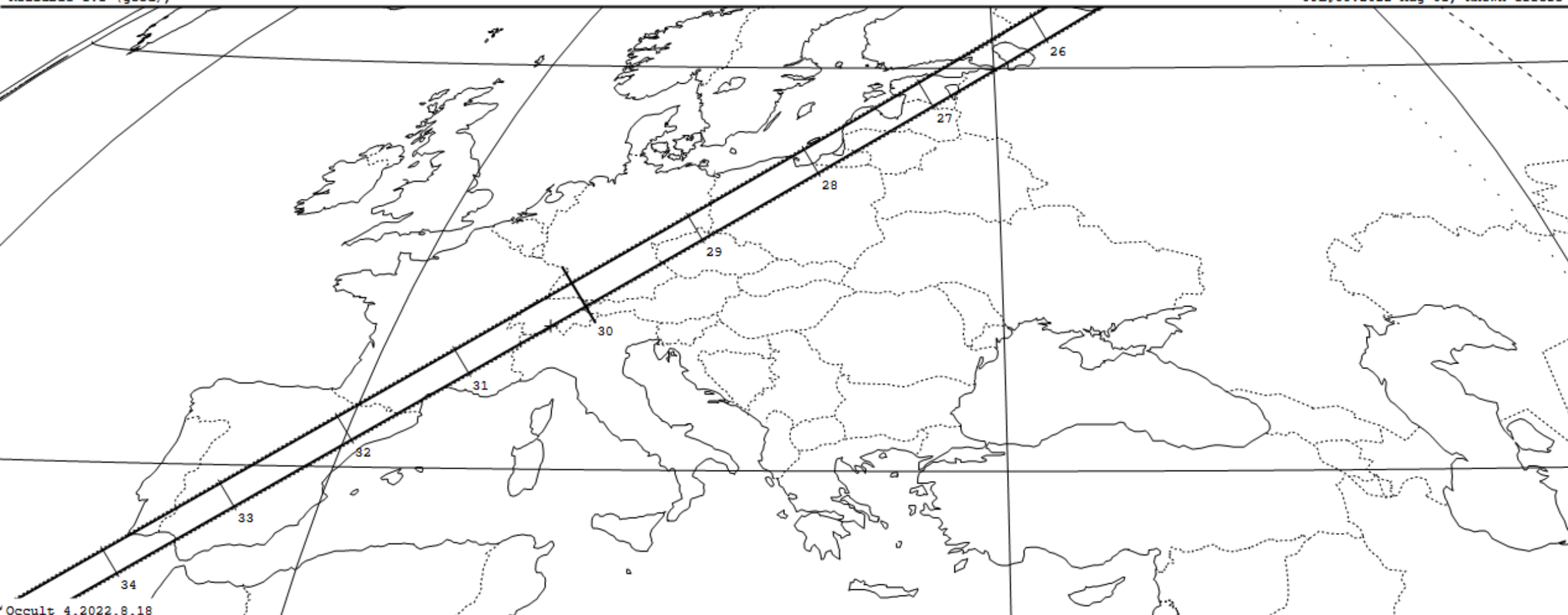
IIT

412 Elisabetha occults UCAC4 459-005219 on 2023 Oct 12 from 0h 23m to 0h 42m UT

Star: (Dia < 0.1 mas)
Mv 12.7; Mb 13.3; Mr 11.9
RA = 3 45 26.0402 (astrometric)
Dec = 1 42 19.603
[of Date: 3 46 40, 1 46 55]
Prediction of 2022 Aug 23.9
Reliable 1.1 (good),

Durations: Max = 12.4 secs
1km = 0.13 secs, 1mas = 0.19 secs
Mag Drop: 1.5 [74%]v, 1.7 [79%]r
Sun : Dist = 140°
Moon: Dist = 113°, illum = 7%
Error 16.7 x 3.2 mas in PA 66°

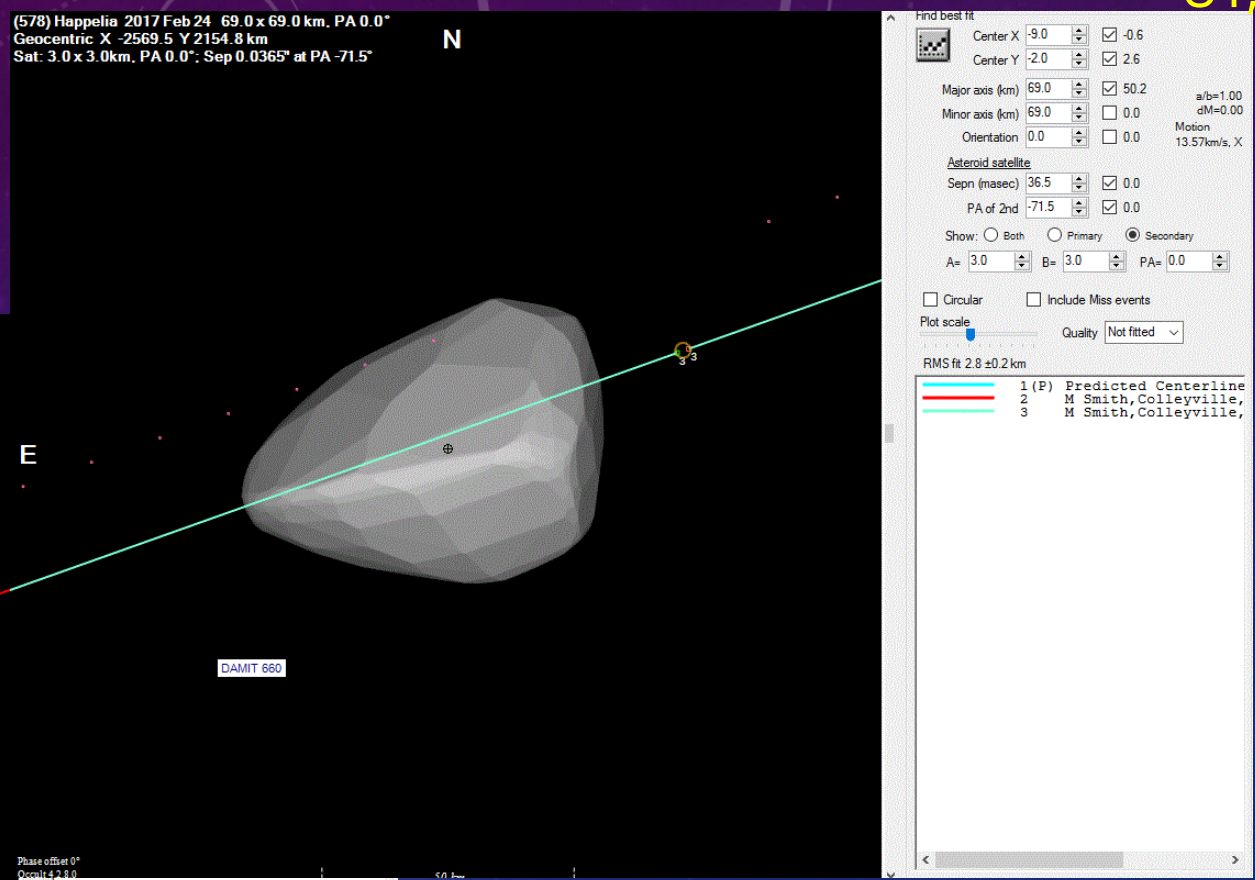
Asteroid:
Mag = 13.8
Dia = 99 ±5km, 67 mas
Parallax = 4.327"
Hourly dRA = -1.115s
dDec = -9.93"
JPL#59:2022-Aug-01, Known errors



Occult 4.2022.8.18

(578) Happelia, comb. 11,7 mag / 4,9 s / drop 2,0 mag

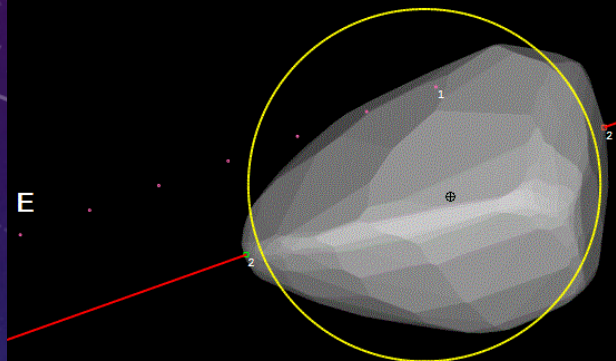
2017 Feb 24, 05:10
UT, North America



Possible
Satellite

Mark Smith
in TX
observed a
secondary
event.

(578) Happelia 2017 Feb 24 69.0 x 69.0 km, PA 0.0°
Geocentric X -2569.5 Y 2154.8 km
Sat: 3.0 x 3.0km, PA 0.0°; Sep 0.0360° at PA -71.0°



[https://
www.asteroidoccultation.com/
observations/Results/](https://www.asteroidoccultation.com/observations/Results/)

(578) Happelia, comb. 12,7 mag / 11,5 s / drop 0,5 mag

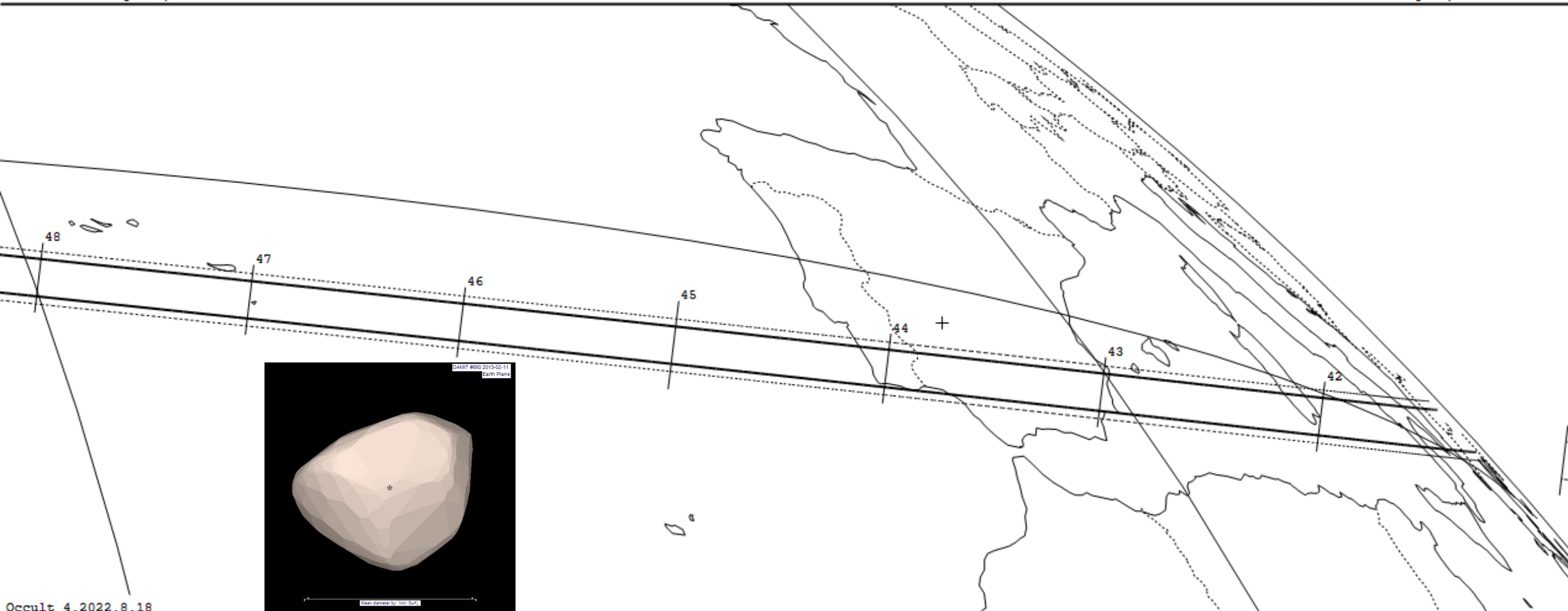
2023 Oct 12, 01:41
UT

578 Happelia occults UCAC4 400-138407 on 2023 Oct 12 from 1h 41m to 2h 5m UT

Star: (Dia < 0.1 mas)
Mv 13.7; Mb 14.1; Mr 13.1
RA = 23 15 45.5101 (astrometric)
Dec = -10 11 37.431
[of Date: 23 17 0, -10 3 48]
Prediction of 2022 Aug 23.9
Reliable 1.0 (good),

Durations: Max = 11.5 secs
1km = 0.17 secs, 1mas = 0.19 secs
Mag Drop: 0.5 [40%]v, 0.6 [42%]r
Sun : Dist = 147°
Moon: Dist = 177°, illum = 7%
Error 23.3 x 1.2 mas in PA 64°

Asteroid: (in DAMIT, ISAM)
Mag = 13.2
Dia = 68 ±4km, 60 mas
Parallax = 5.614"
Hourly dRA = -1.260s
dDec = 2.25"
JPL#128:2022-Aug-01, Known errors



Other events in 2023 of interesting asteroids from past observations

Date	Asteroid	Comb. Mag	Max. dur. (s)	Drop (mag)	Location (path and 1-sigma)	Past observation	Strange
7 January 03:05 UT	(885) Ulrike	14,3	3,5	2,0	DZ, MA, Lanzarote	2020, Pierre Le Cam in FR	Poss. bilobated shape
15 February 20:26 UT	(686) Gersuind	12,6	3,9	2,2	NO, SE, FI	2018, Andrea Manna in CH	Double body?
24 February 21:32 UT	(2494) Inge	14,3	5,1	2,2	PT, ES, DZ, TN	2016, Stefano Sposetti in CH	Close binary or elongated body?
15 March 00:26 UT	(934) Thuringia	13,5	3,5	1,2	La Gomera, Tenerife, Gran Canaria, EH, MR, DZ	2021, K. Halíč, T. Janík in CZ, 22 W. Stewart	Concave topographic features
30 October 20:11 UT	(57291) 2001 QQ172	10,8	0,77	7,7	UK, FR, ES, Madeira, Porto Santo (lower accuracy)	2022 Apr 17, Peter Nosál in SK	Close binary asteroid? Concave topographic feature on elongated body?
21	(776)	11,2	15,6	0,4	UA, MD, PL, SK, CZ,	2011, Peter	Poss. Satellite

3. Other asteroids

C: Occultations by (319) Leona
before the event with
Betelgeuse
We can get some profiles.

2 events chosen and 8 supplementary.

(319) Leona, comb. 11,9 mag / 2,8 s / drop 3,6 mag

2023 Sep 13, 03:43

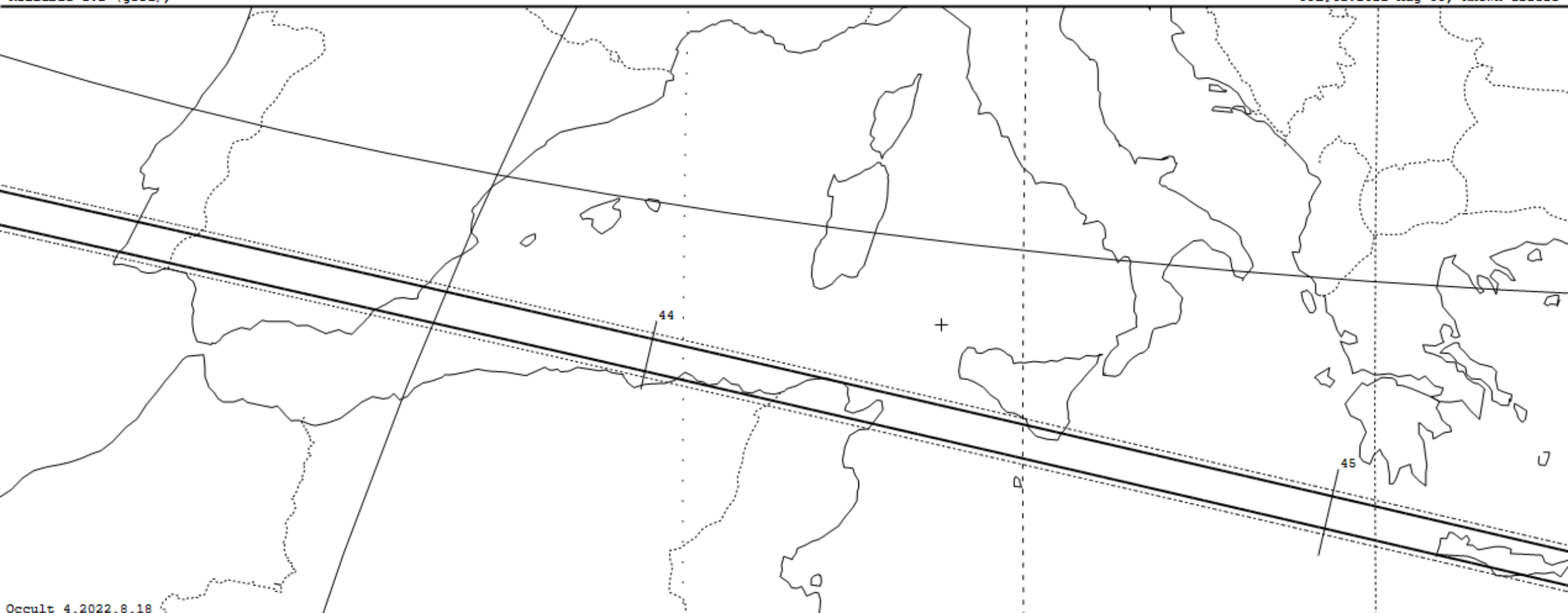
IIT

319 Leona occults UCAC4 521-014751 on 2023 Sep 13 from 3h 42m to 3h 51m UT

Star: (Dia < 0.1 mas)
Mv 11.9; Mb 12.3; Mr 11.3
RA = 5 42 12.5290 (astrometric)
Dec = 14 0 4.107
[of Date: 5 43 33, 14 0 51]
Prediction of 2022 Aug 22.9
Reliable 1.2 (good),

Durations: Max = 2.8 secs
1km = 0.046 secs, 1mas = 0.088 secs
Mag Drop: 3.6 [97%]v, 3.7 [97%]r
Sun : Dist = 85°
Moon: Dist = 65°, illum = 3%
Error 23.7 x 3.0 mas in PA 91°

Asteroid:
Mag = 15.5
Dia = 61 ±3km, 32 mas
Parallax = 3.388"
Hourly dRA = 2.756s
dDec = -9.34"
JPL#61:2022-Aug-03, Known errors



Occult 4.2022.8.18

Supplementary events of Leona in 2023 until December 12

Date	Time	Comb. Mag	Max. dur. (s)	Drop (mag)	Location (path and 1-sigma)
28 October 2023	20:33 UT	13.7	10.3	1.2	PL (low altitude)
29 October 2023	00:27 UT	14,1	10,3	0,8	IS, DK, UK, DE, PL, CZ, SK, HU, RO, BG, GR, TR
15 November 2023	05:10 UT	14,25	9,6	0,35	IT, FR, MC, ES, PT
19 November 2023	02:08 UT	14,41	8,6	0,19	IS
19 November 2023	02:08 UT	13,9	8,6	0,7	NO, FI, SE, UK

(319) Leona, comb. 12,1 mag / 6,0 s / drop 2,2 mag

2023 Dec 06, 01:08

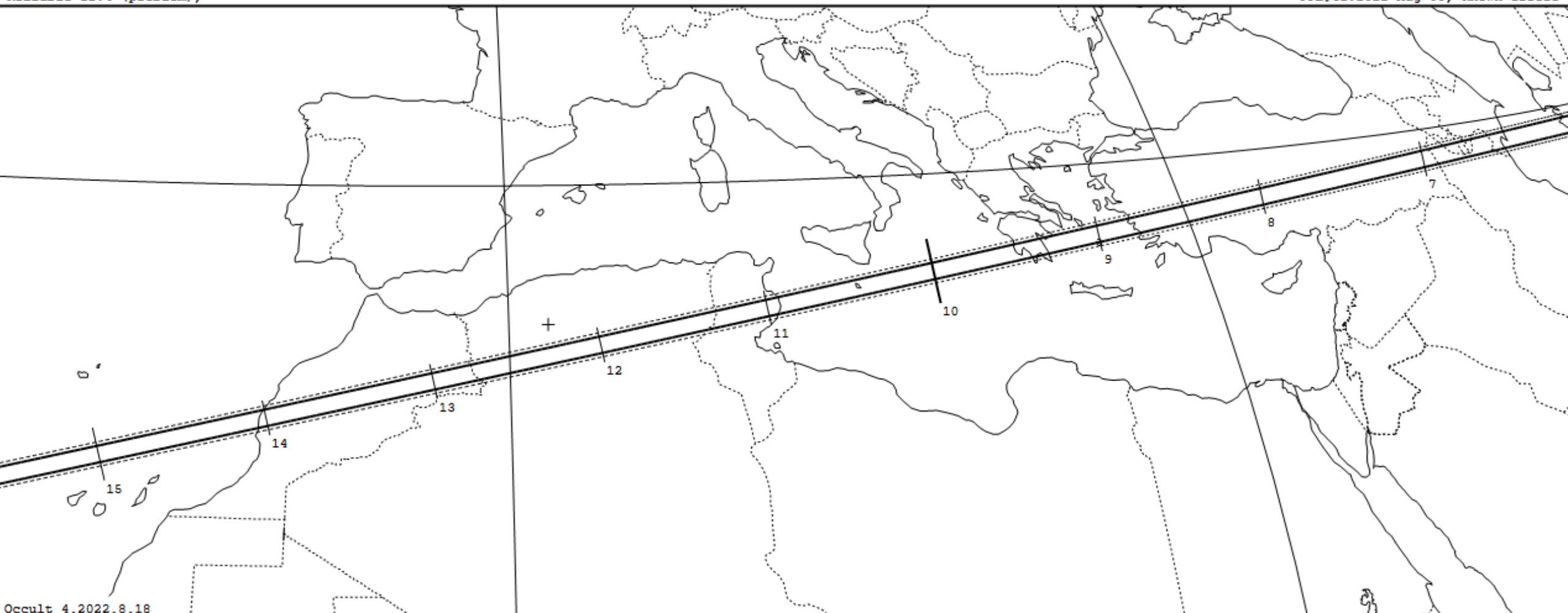
UT

319 Leona occults UCAC4 489-016418 on 2023 Dec 6 from 1h 4m to 1h 24m UT

Star: (Dia < 0.1 mas)
Mv 12.2; Mb 12.2; Mr 11.3
RA = 5 59 41.5298 (astrometric)
Dec = 7 36 41.083
[of Date: 6 1 0, 7 36 50]
Prediction of 2022 Aug 22.9
Reliable 12.4 (problem),

Durations: Max = 6.0 secs
1km = 0.099 secs, imas = 0.13 secs
Mag Drop: 2.2 [87%]v, 2.6 [91%]r
Sun : Dist = 157°
Moon: Dist = 83°, illum = 42%
Error 36.7 x 3.8 mas in PA 92°

Asteroid:
Mag = 14.3
Dia = 61 ±3km, 46 mas
Parallax = 4.838"
Hourly dRA = -1.803s
dDec = -6.06"
JPL#61:2022-Aug-03, Known errors



Occult 4.2022.8.18

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

2023 Dec 12, 01:08 UT

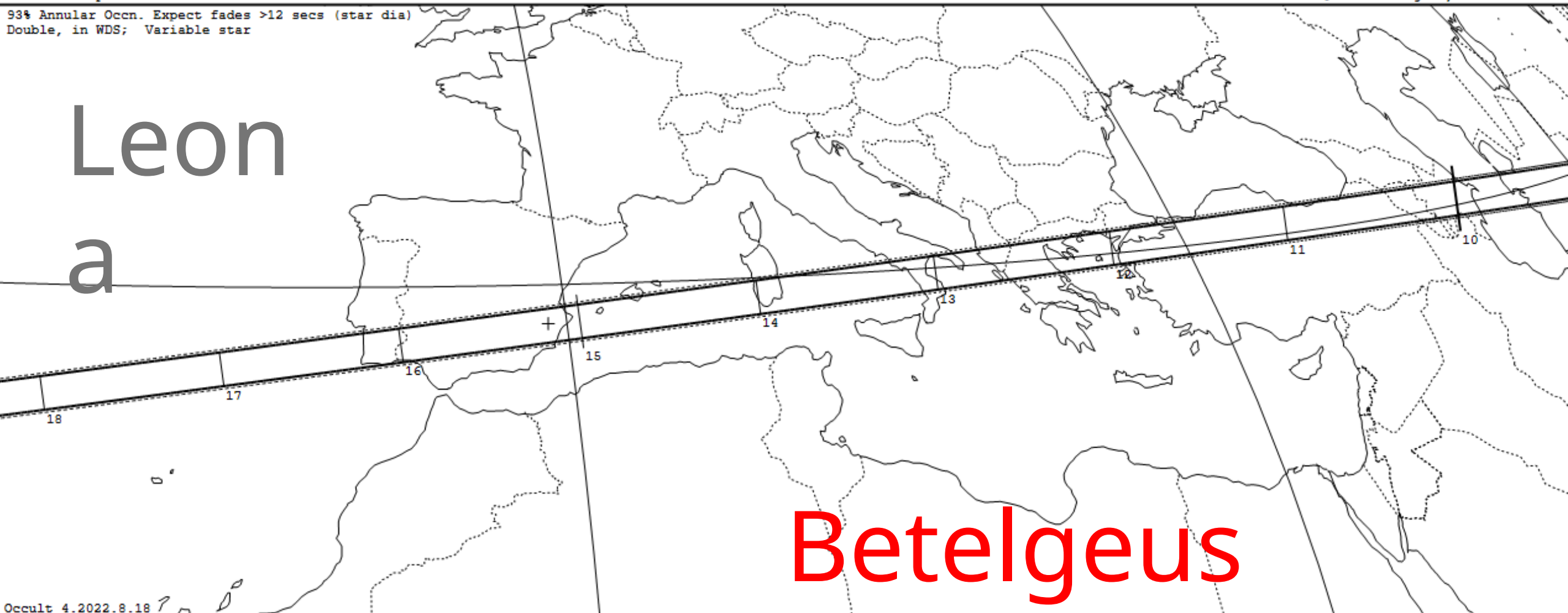
319 Leona occults HIP 27989 on 2023 Dec 12 from 1h 8m to 1h 26m UT

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

References, quotes and advice:

- 1) Program Occult, author Dave Herald, <http://www.lunar-occultations.com/iota/occult4.htm>
- 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/>
- 10) www.aavso.org
- 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 wsvětlen

References, quotes and advice:

- 16) All About Betelgeuse. How Big is it?, Michele Diodati,
<https://medium.com/amazing-science/all-about-betelgeuse-how-big-is-it-815d4e3c00e8>, 2020
Feb
- 17) The close circumstellar environment of Betelgeuse, M. Montargès, P. Kervella, G. Perrin, A. Chiavassa, J.-B. Le Bouquin, M. Aurière, A. López Ariste, Astronomy and Astrophysics, A&A 588, A130 (2016)
P. Mathias^{7,8}, S. T. Ridgway¹¹, S. Lacour², X. Haubois¹², and J.-P. Berger¹²
- 18) A SYSTEMATIC CHANGE WITH TIME IN THE SIZE OF BETELGEUSE, C. H. Townes¹, E. H. Wishnow, D. D. S. Hale, and B. Walp, The Astrophysical Journal, 697:L127–L128, 2009 June 1
- 19) Properties of the CO and H₂O MOLsphere of the red supergiant Betelgeuse from VLT/AMBER observations, M. Montargès, P. Kervella, G. Perrin, K. Ohnaka, A. Chiavassa, S. T. Ridgway, and S. Lacour, Astronomy and Astrophysics, A&A 572, A17 (2014)
- 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



*Thanks for your
attention!*

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