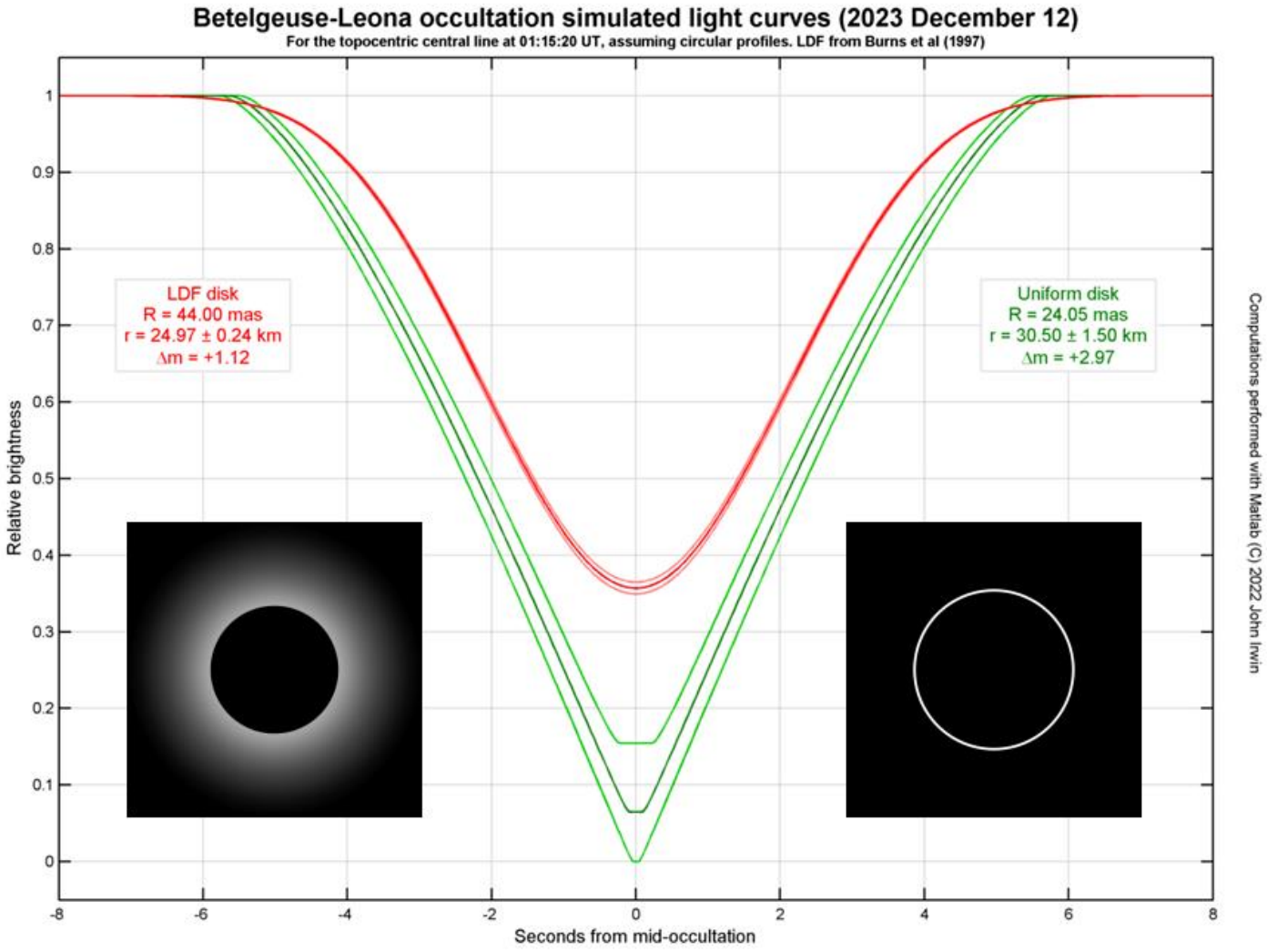
# OCCULTATION OF BETELGEUSE BY (319) LEONA ON 2023 DECEMBER 12 U.T.

**For the IOTA meeting by zoom, July 15, 2023**

**David W. Dunham, Dave Herald and Ted Blank**

# Important Question, what will be seen?




Possible occultation light curves

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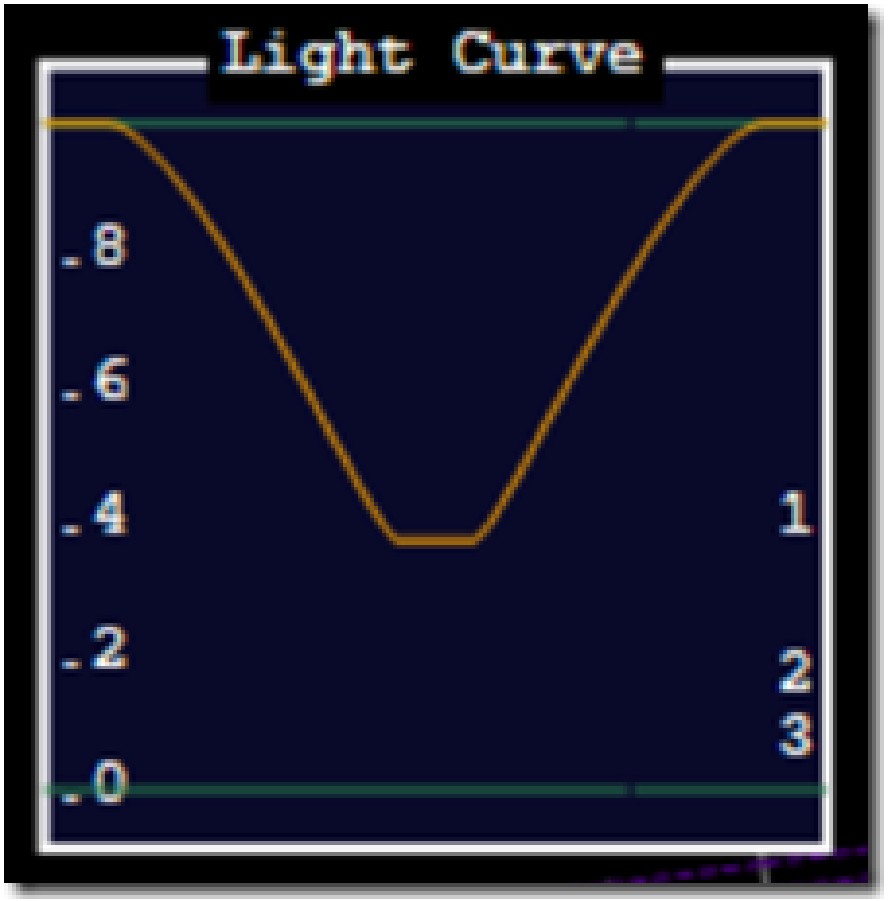
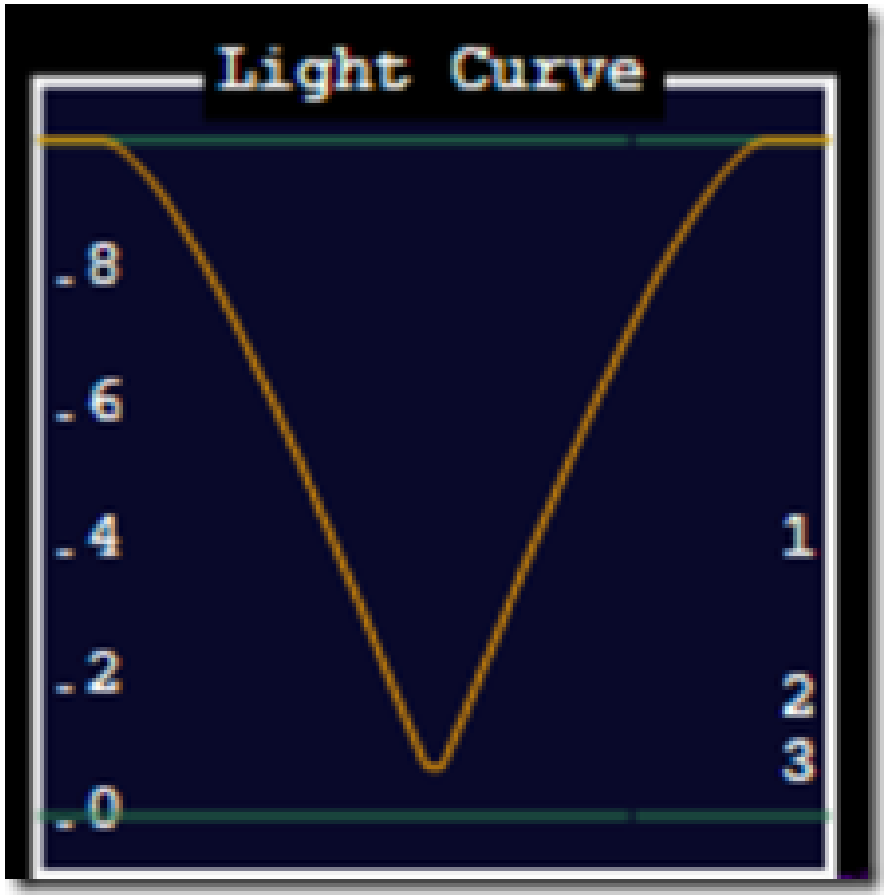


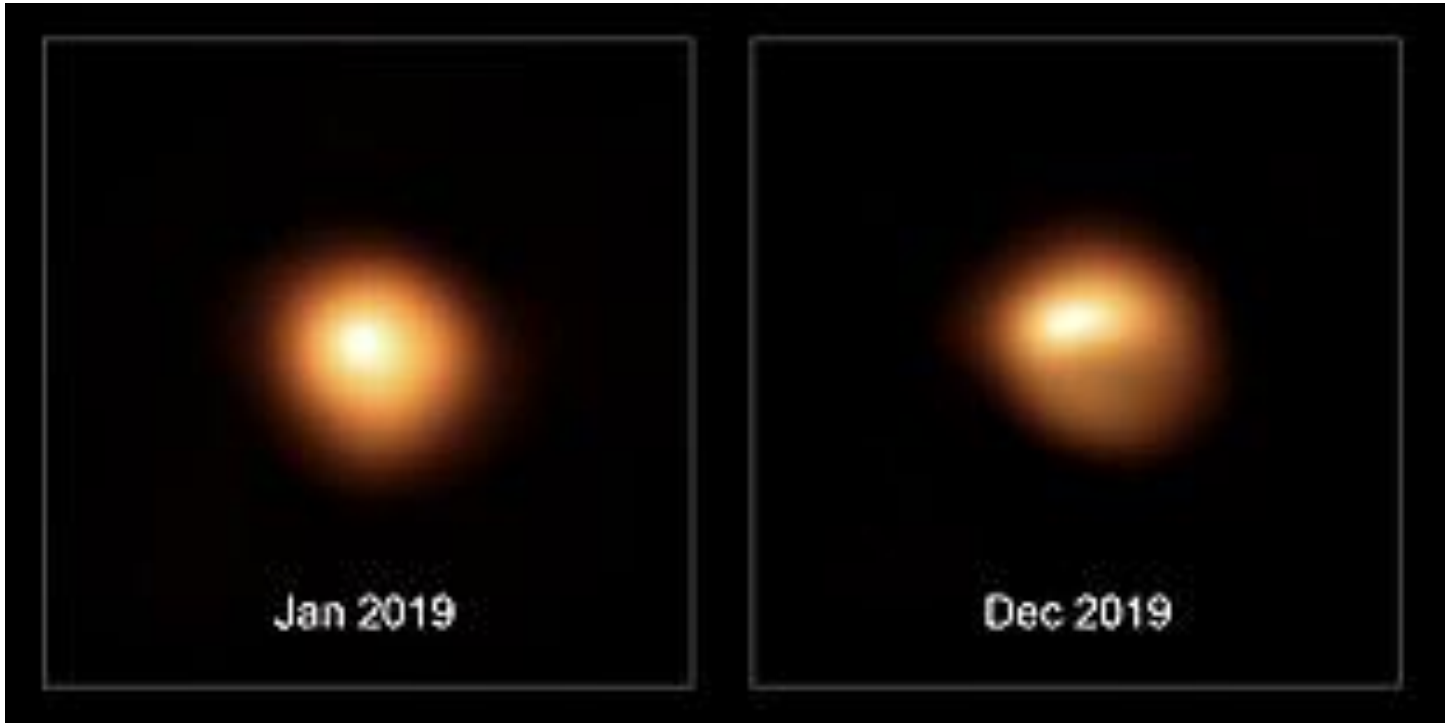




Leona diameter 50 km

Leona diameter 61 km

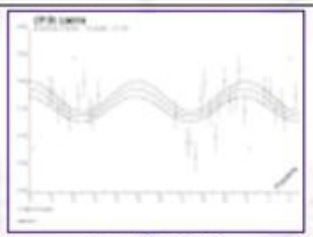
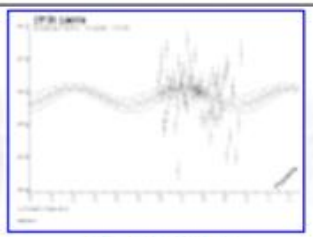
Possible occultation light curves

# The Size and Shape of both Betelgeuse (variable star) and Leona are uncertain

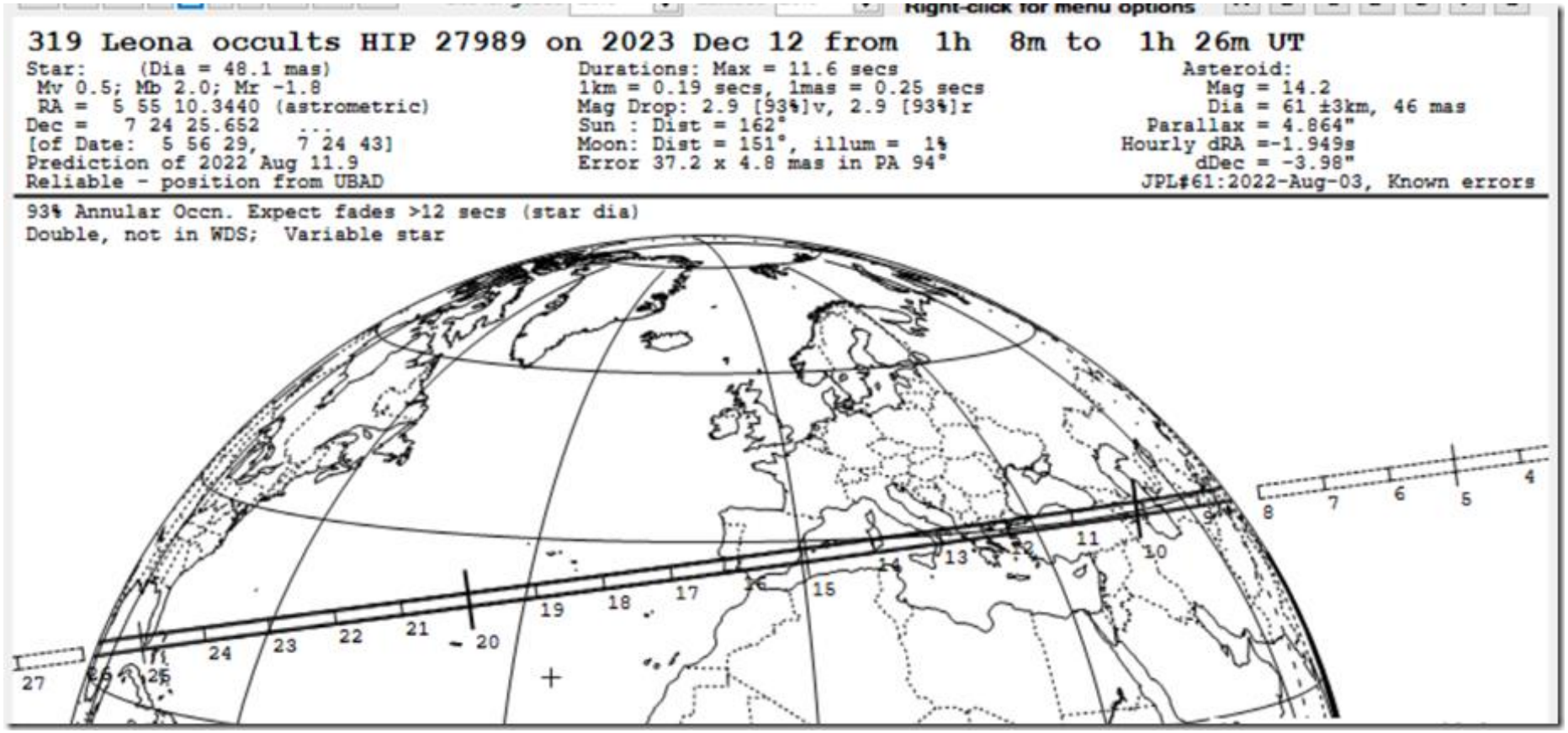



Above, SPHERE images of Betelgeuse (Wikipedia). Special observations of Betelgeuse with large telescopes and interferometers are planned to determine its size and possible irregularities or obscuring dust clouds in December.

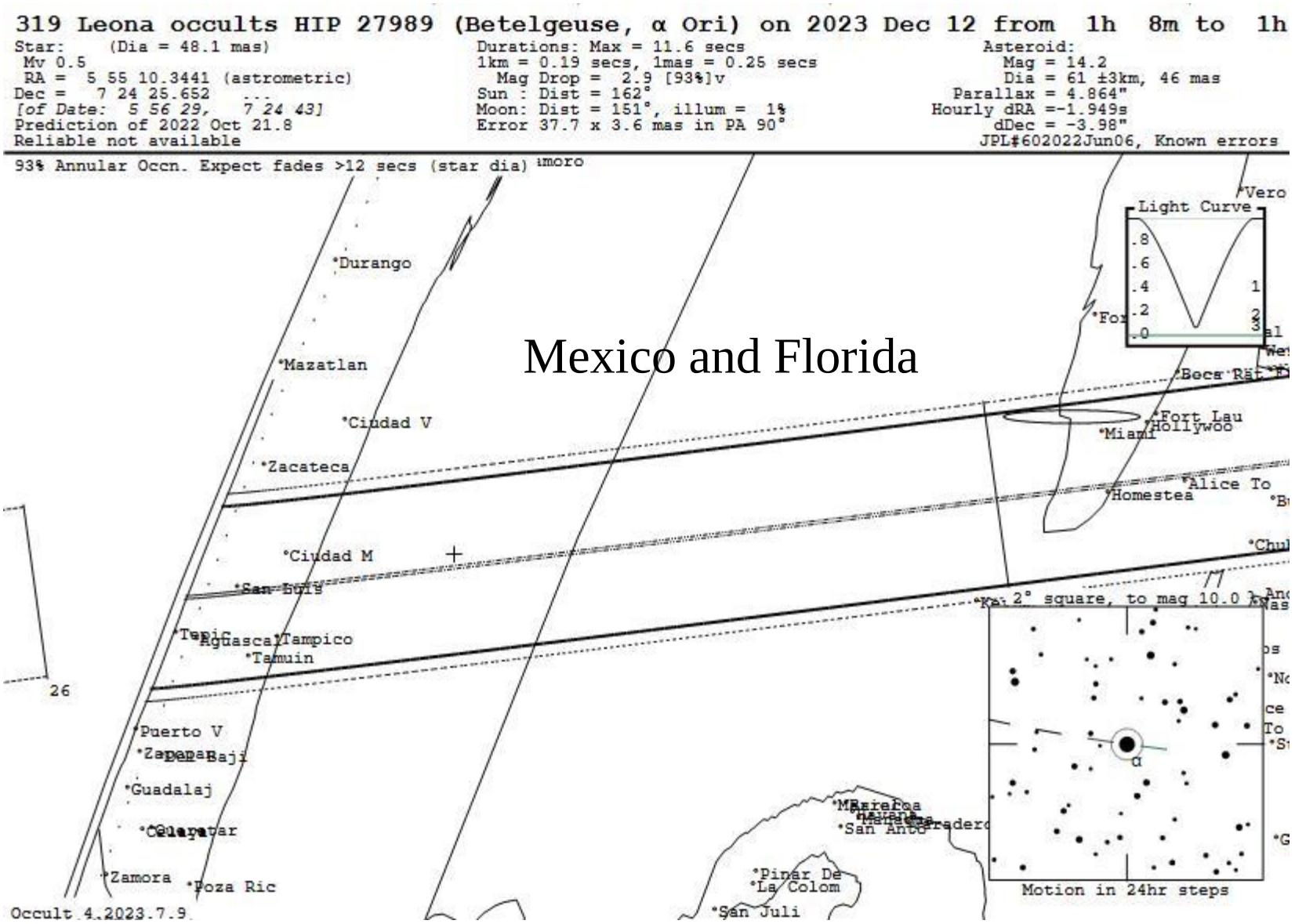
# Leona's Long Rotation Period (430h) complicates determination of its size and shape.

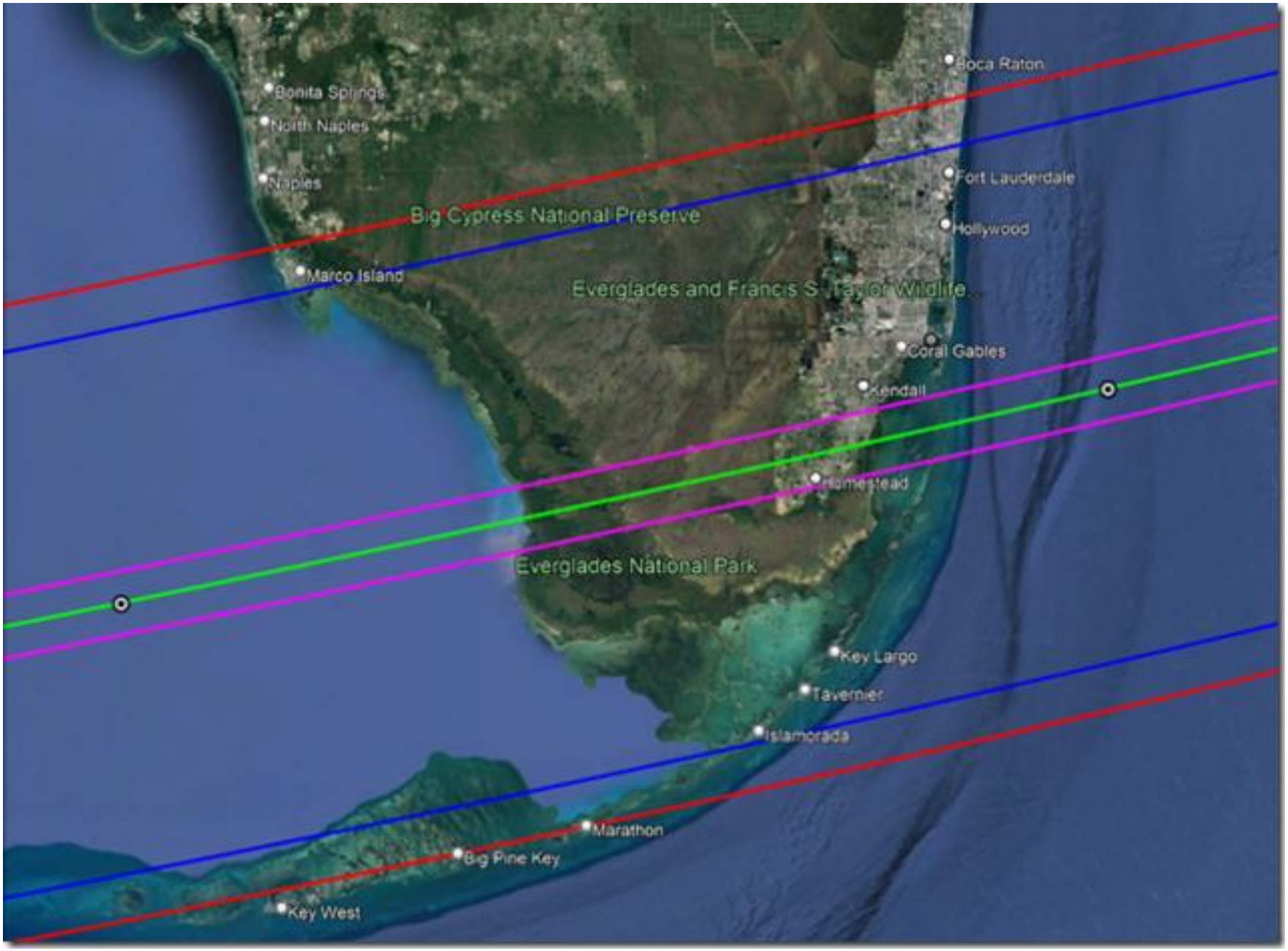
| | | | | |
|---|---|---|---|---|
| (319) Leona<br><br>E=2016-08-31 | Patrick Sogorb | Provisoire.<br>Trop faible rapport amplitude/incertitude.<br>Période sans signification |  <br>0,40000 |  <br>0,051±0,017 |
| (319) Leona<br><br>E=2006-04-02 | Roberto Crippa, Federico Manzini | Provisoire.<br>Trop faible rapport amplitude/incertitude.<br>Période sans signification |  <br>0,40000 |  <br>0,027±0,005 |

So it is VERY IMPORTANT that some OTHER occultations by Leona be observed from multiple stations BEFORE December 12, to take best advantage of this unique opportunity.




The best (currently used) path uses UBSC positional data for Betelgeuse and the latest (#60) Horizons orbit of Leona. This path shown assumes a point source for Betelgeuse.


319 Leona occults HIP 27989 (Betelgeuse, α Ori) on 2023 Dec 12 from 1h 8m to 1h
Star: (Dia = 48.1 mas)
Mv 0.5
RA = 5 55 10.3441 (astrometric)
Dec = 7 24 25.652 ...
[of Date: 5 56 29, 7 24 43]
Prediction of 2022 Oct 21.8
Reliable not available
Durations: Max = 11.6 secs
1km = 0.19 secs, 1mas = 0.25 secs
Mag Drop = 2.9 [93%]v
Sun : Dist = 162°
Moon: Dist = 151°, illum = 1%
Error 37.7 x 3.6 mas in PA 90°
Asteroid:
Mag = 14.2
Dia = 61 ±3km, 46 mas
Parallax = 4.864"
Hourly dRA =-1.949s
dDec = -3.98"
JPL#602022Jun06, Known errors
93% Annular Occn. Expect fades >12 secs (star dia)
Light Curve
Mexico and Florida
Durango
Mazatlan
Ciudad V
Zacateca
Ciudad M
San Luis
Tampico
Tamuin
Puerto V
Guadalaj
Zamora
Miami
Homestead
Fort Lau
Hollywoo
Boca Rat
Alice To
Chul
Pinar De
La Colom
San Juli
Motion in 24hr steps
Occult 4.2023.7.9


Boca Raton
Bonita Springs
North Naples
Naples
Fort Lauderdale
Big Cypress National Preserve
Hollywood
Marco Island
Everglades and Francis S. Taylor Wildlife
Coral Gables
Kendall
Homestead
Everglades National Park
Key Largo
Tavernier
Islamorada
Marathon
Big Pine Key
Key West

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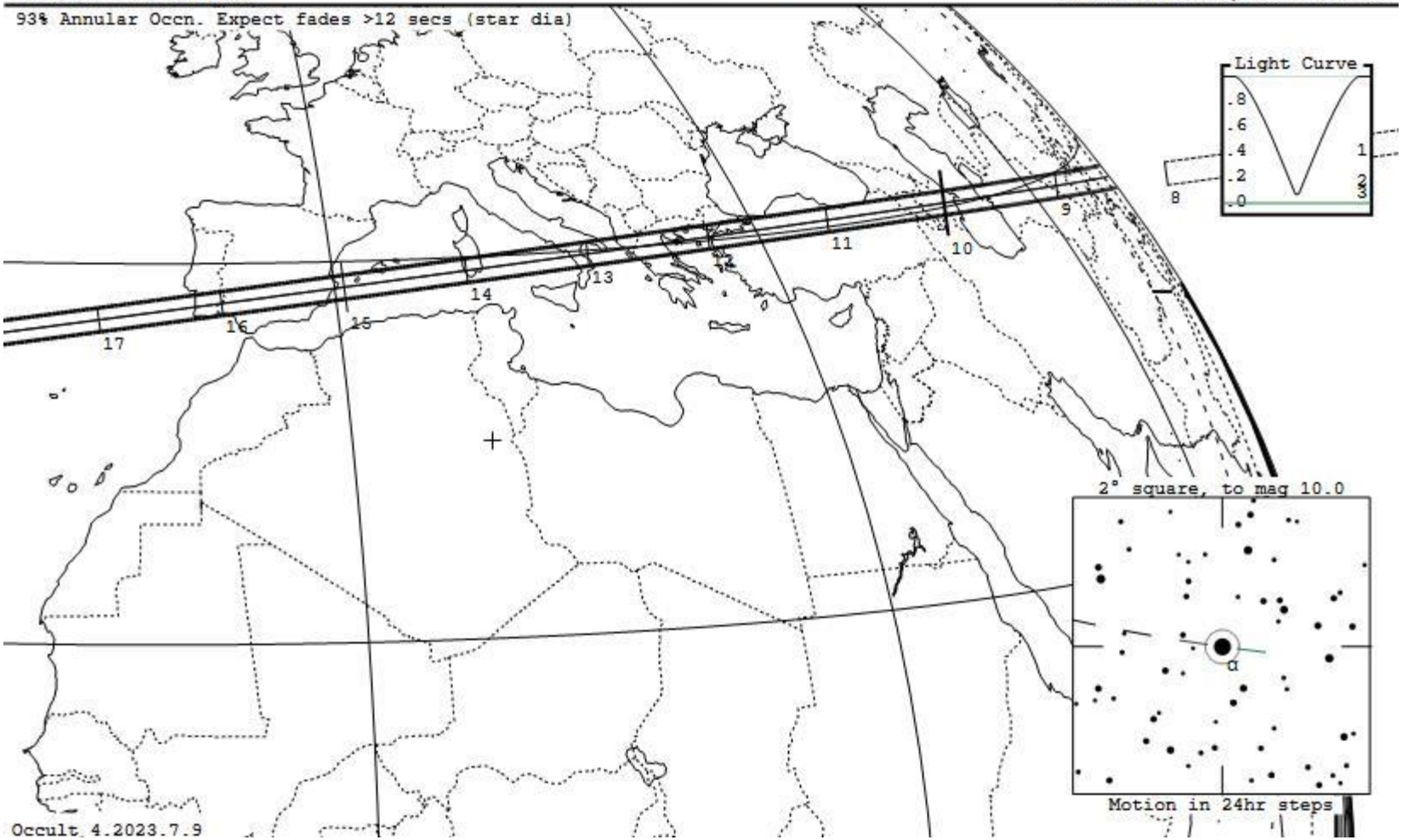
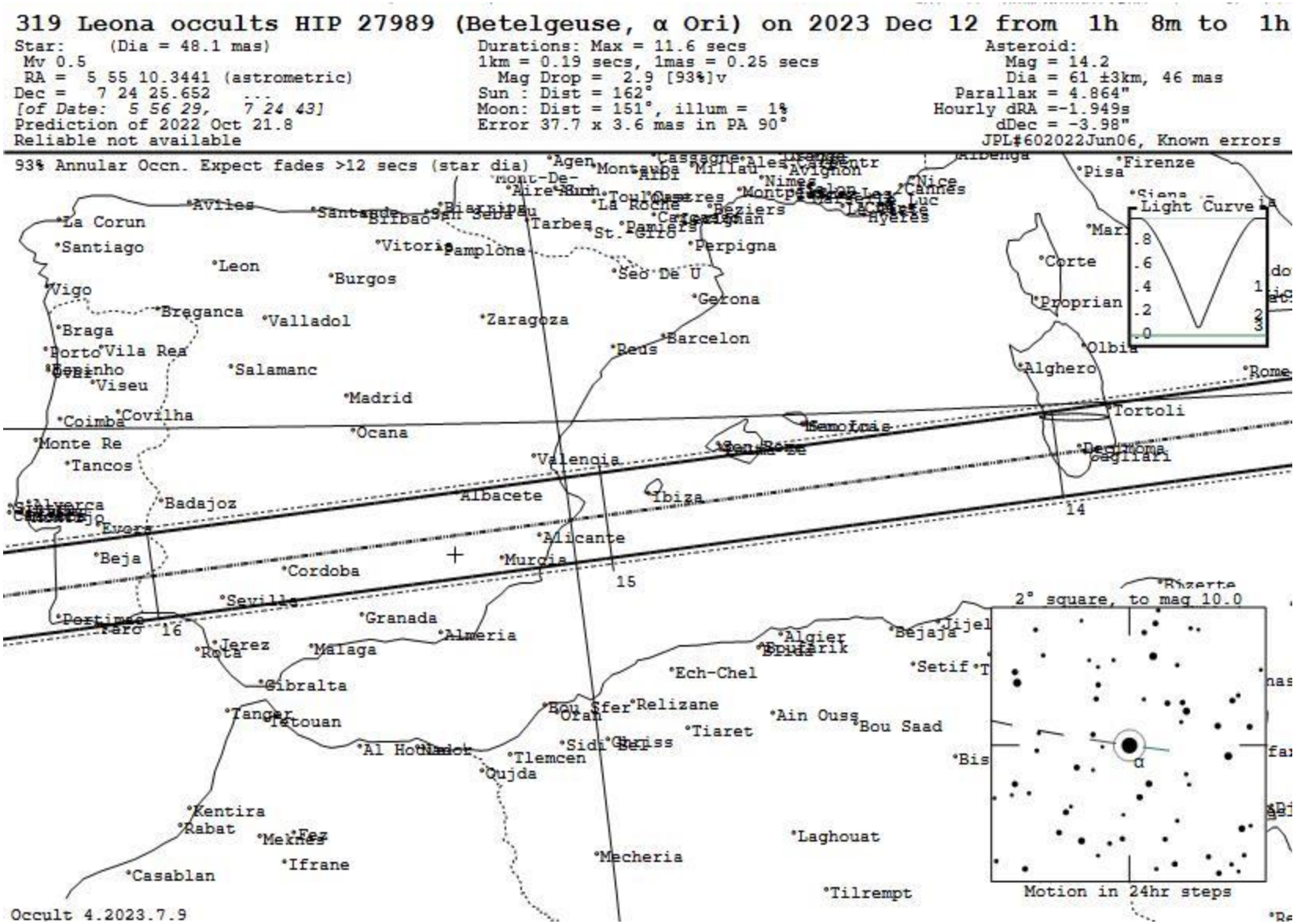
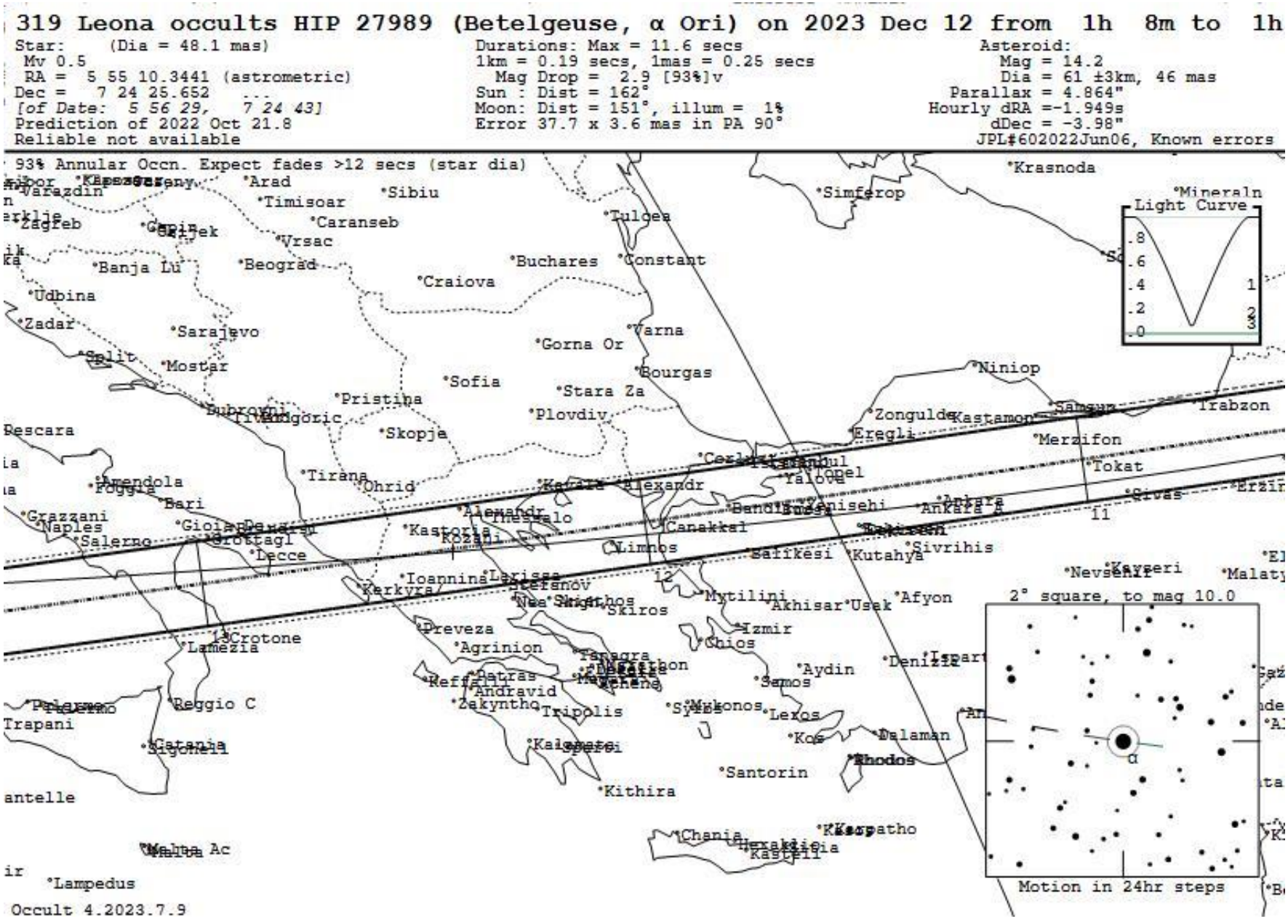


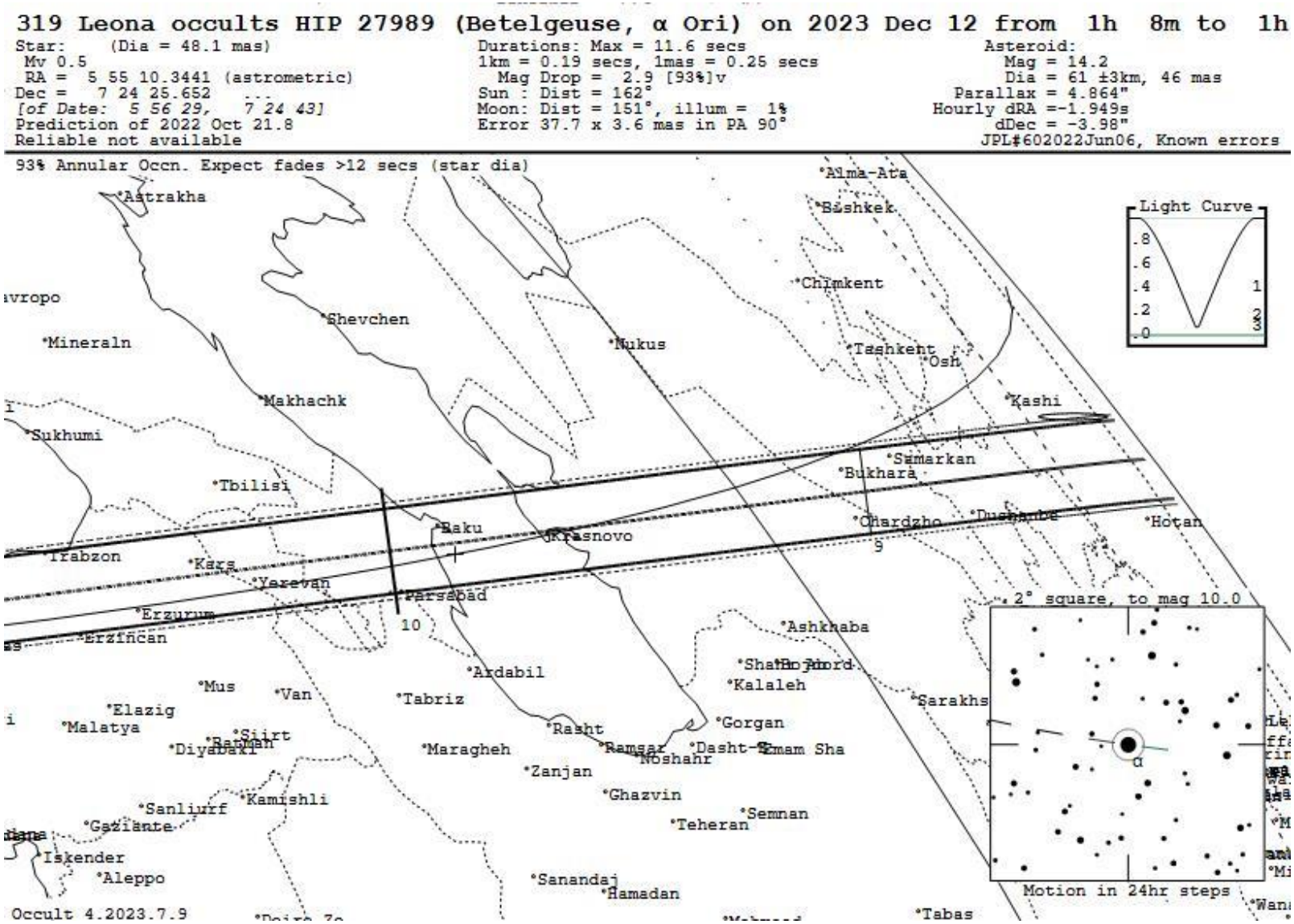
# Iberia and Sardinia



# Italy to Turkey

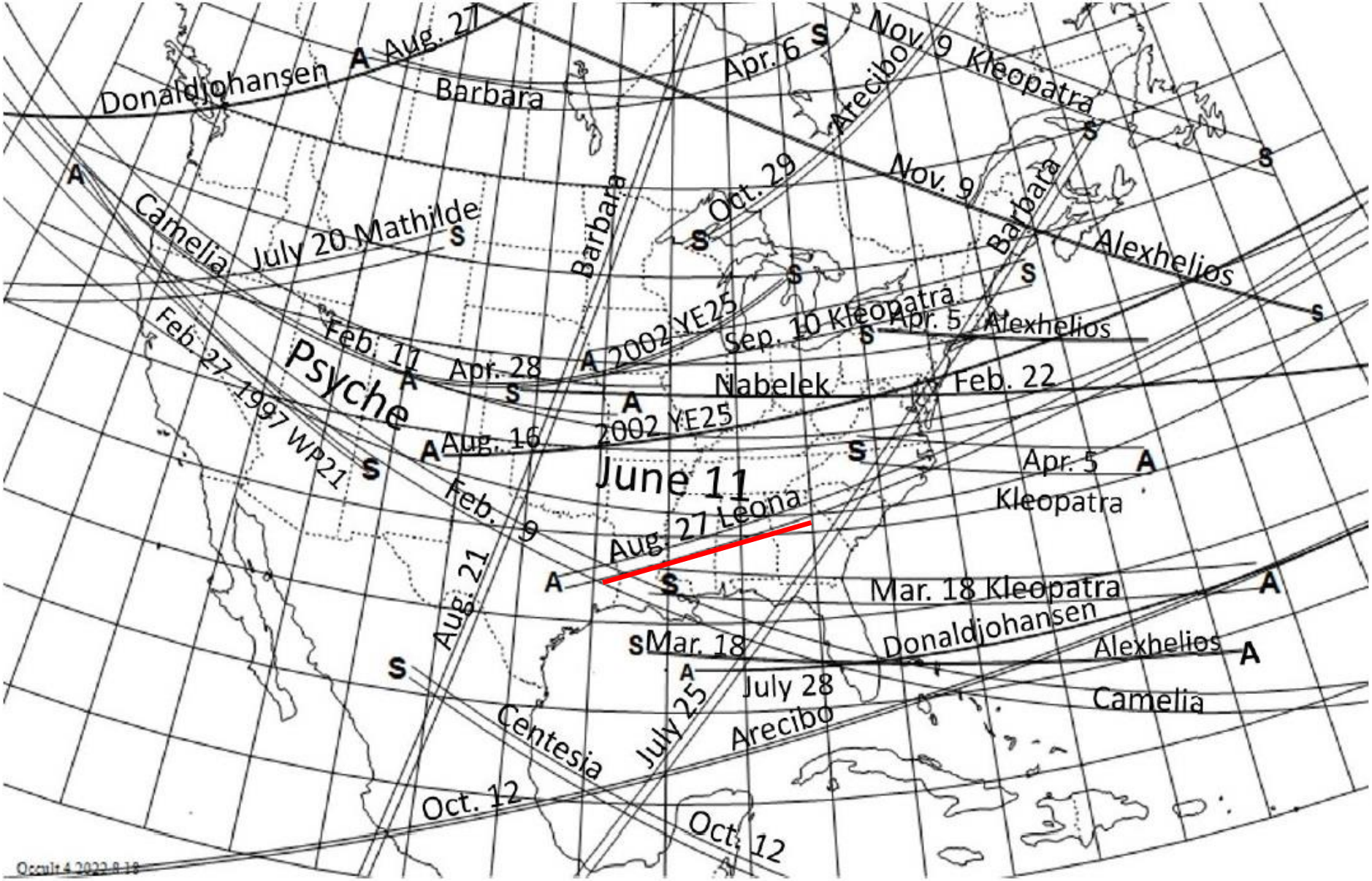


# Central Asia




The path is over Baku, Azerbaijan; the International Astronautical Society (large aerospace mtg.) will meet there 2023 Oct. 2-6

# 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

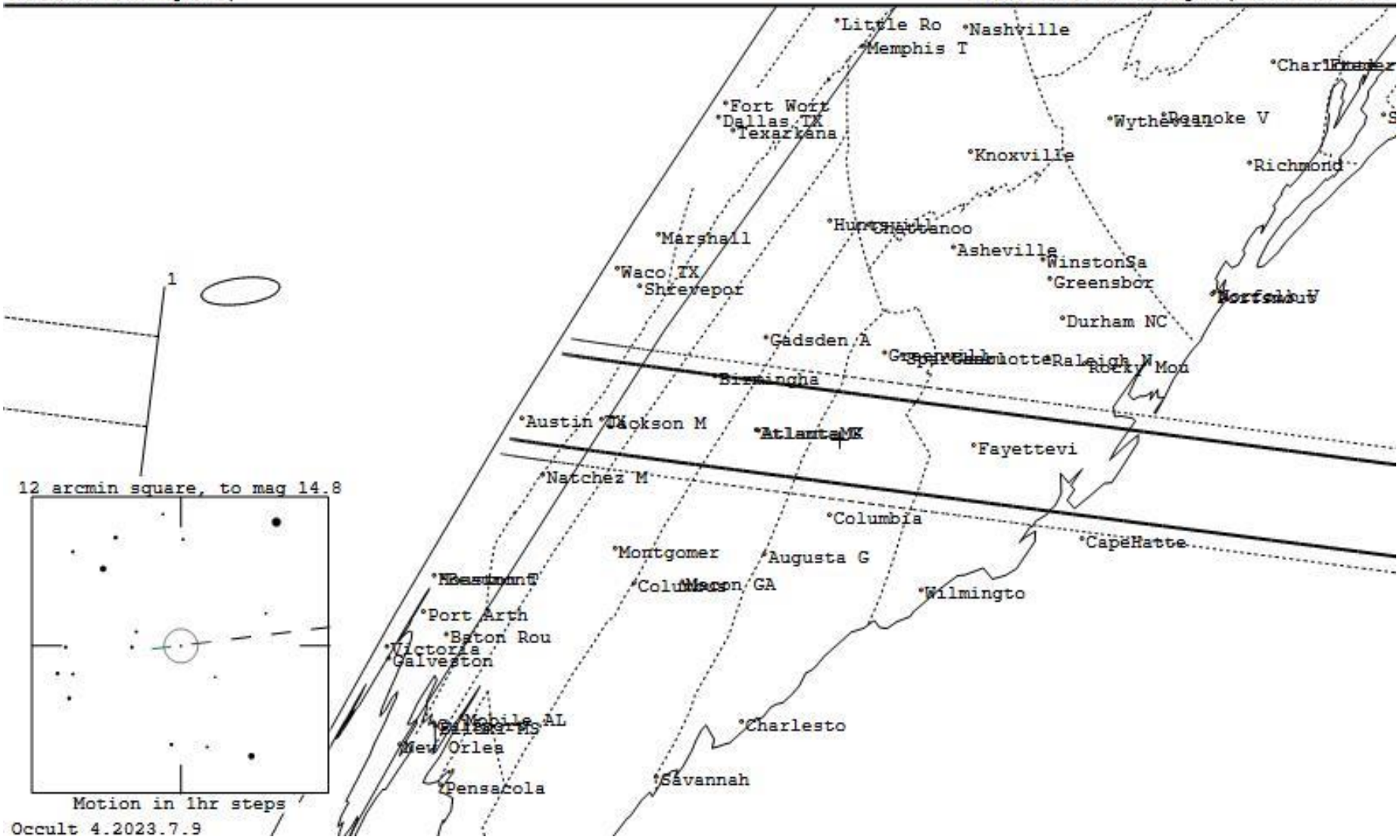
| Date | UT | Occulting Body | Star | Mag. | RA (2000) h m s | Dec ° ′ ″ | ΔMag. | Dur. s | Path |
|---|---|---|---|---|---|---|---|---|---|
| Feb. 9 | 06:08 | 957 Camelia | UCAC4 425-048350 | 13.3 | 08 39 41.6 | –05 05 33 | 1.2 | 6.5 | BS-CA |
| Feb. 11 | 10:40 | 957 Camelia | UCAC4 426-047968 | 13.7 | 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 |

# 319 Leona occults UCAC4 525-012493 on 2023 Aug 27 from 7h 1m to 7h 8m UT

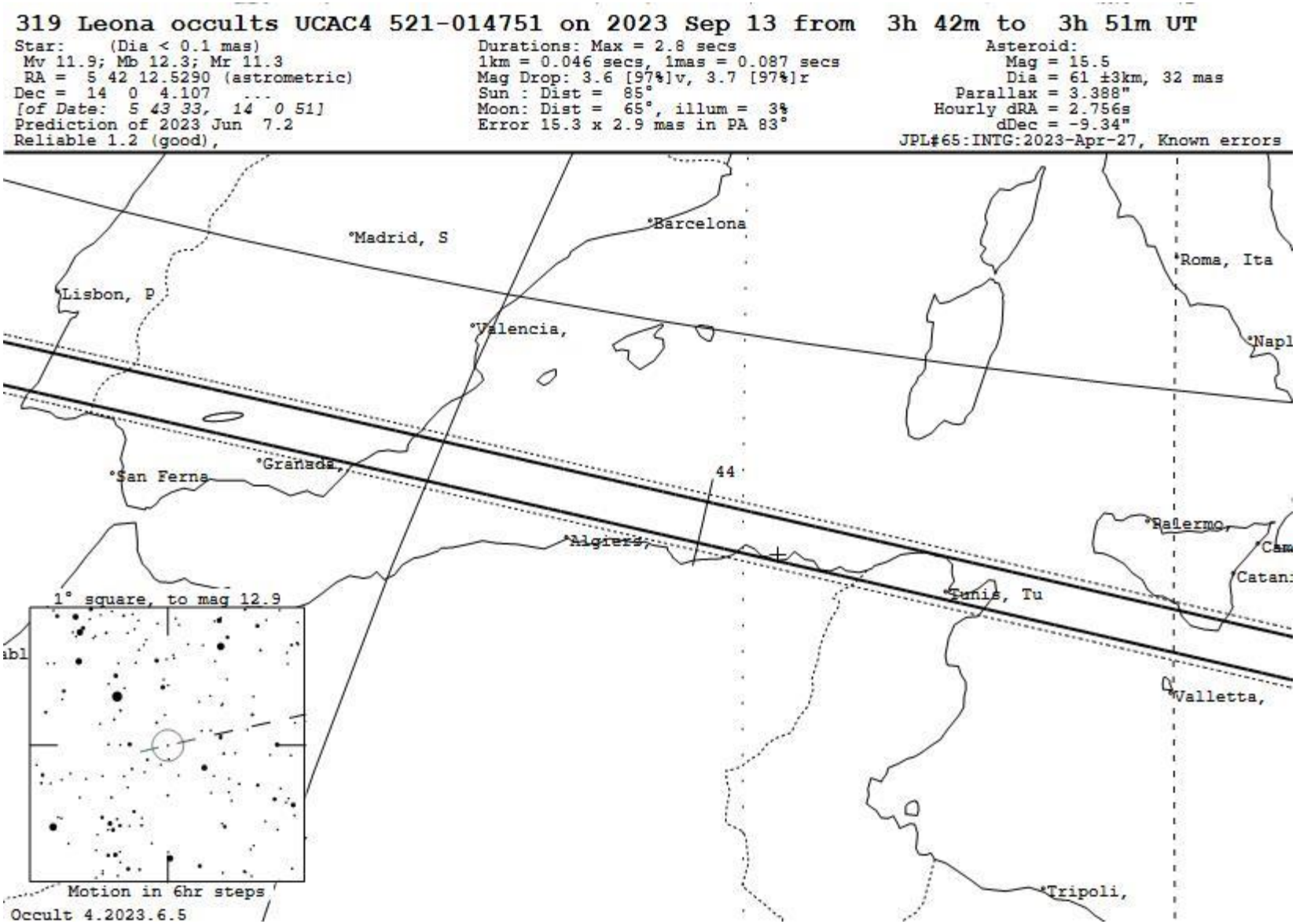
Star: (Dia < 0.1 mas)
Mv 13.8; Mb 14.5; Mr 12.9
RA = 5 21 37.5249 (astrometric)
Dec = 14 51 36.613 ...
*[of Date: 5 22 58, 14 53 4]*
Prediction of 2023 Apr 3.1
Reliable 1.0 (good),

Durations: Max = 2.2 secs
1km = 0.037 secs, 1mas = 0.074 secs
Mag Drop: 2.0 [85%]v, 2.4 [89%]r
Sun : Dist = 73°
Moon: Dist = 156°, illum = 80%
Error 13.0 x 4.3 mas in PA 83°

Asteroid:
Mag = 15.6
Dia = 61 ±3km, 30 mas
Parallax = 3.144"
Hourly dRA = 3.317s
dDec = -6.06"
JPL#61:INTG:2022-Aug-03, Known errors

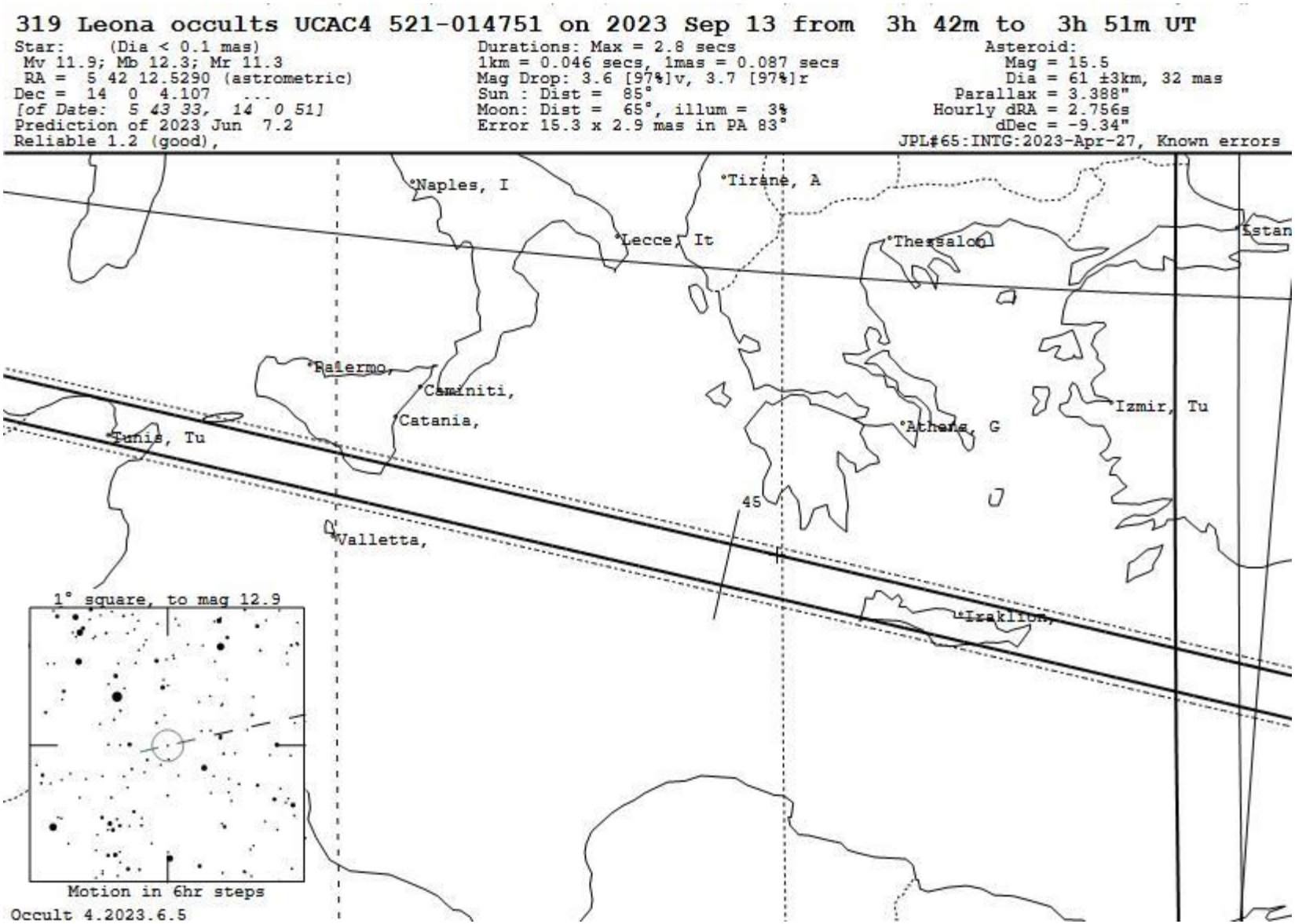


# Good opportunity in Europe - Iberia




Path over Iberia is similar to the Dec. 12th Betelgeuse event

# Good opportunity in Europe – farther east




Maybe Tunisia or s. Sicily, but twilight likely too strong in Crete

# Conclusions

- The occultation might be recorded with DSLR cameras (video mode), recording a smart phone timing app before and after for good time calibration; Ted Blank can say more about this.
- With gradual events, “on-off” timings like with Erigone – Regulus in 2014 won’t work, so not suitable for a large public campaign.
- But good for advanced high school and college students and astronomy clubs.
- You should visit https://occultations.org/publications/rasc/2023/nam23MBspecialoccs.htm and near the end, click on “Worldwide special main-belt events to mag. 14” to download the file 2023worldMBspecial.xml to use with Occult to calculate Leona occultation possibilities for YOUR
- observatory and region.
- Can discuss further at IOTA/ES-IOTA Round Table on
- Aug. 6 at 18h UT (2pm EDT in US); JOA 2023_3, p. 18-19

**Please visit https://occultations.org meetings section to get this presentation.**

**Contact: dunham@starpower.net; cell +1-301-526-5590**