Center of Research in Astronomy, Astrophysics
and Geophysics
(Algiers Observatory)

Observation campaign of several stellar occultation by asteroids with low probability in Algeria

Presented by :
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August 2018

Outline

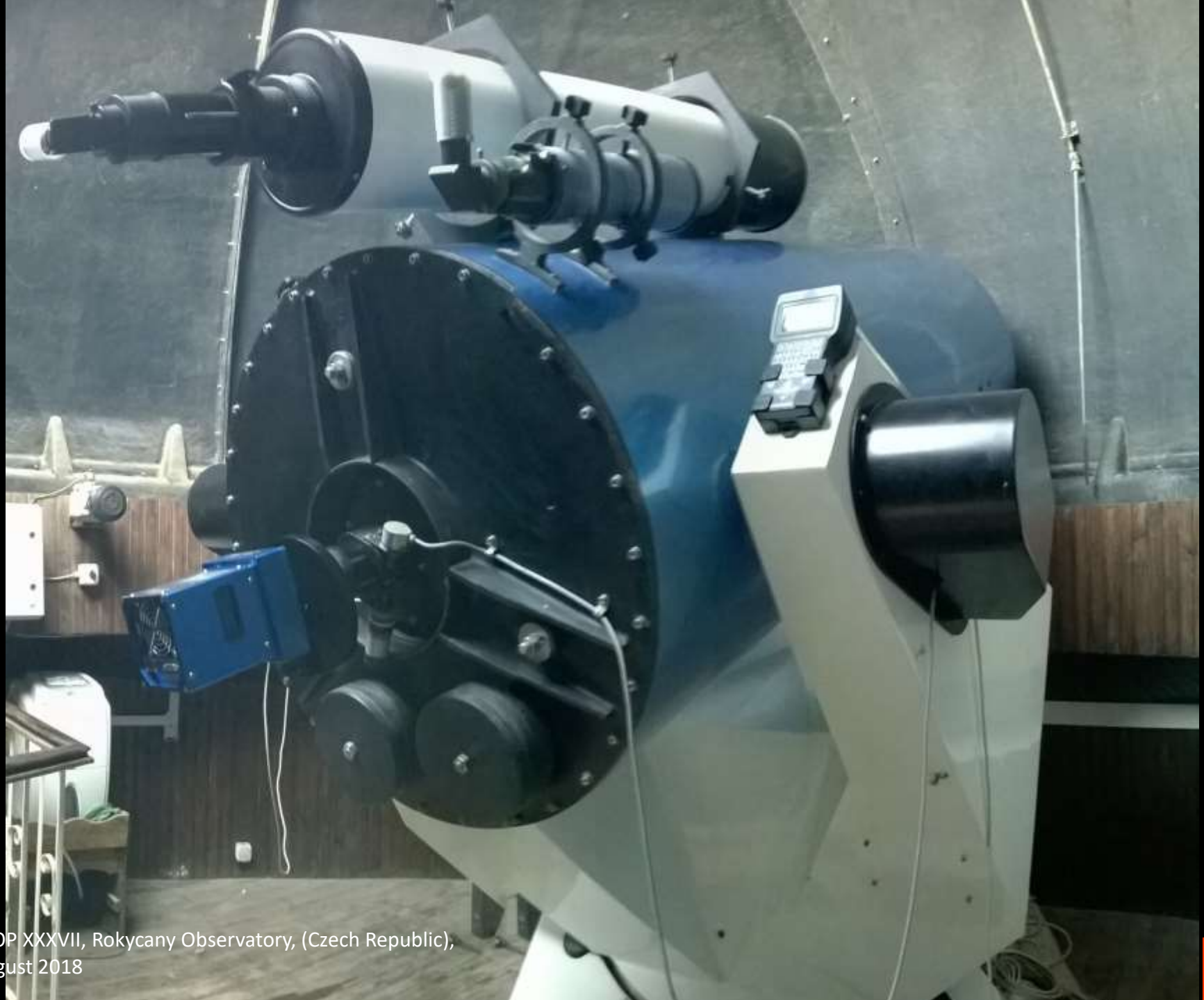
- Introduction
- Participative Astronomy occultation in Algeria
- Occultation of Triton
- Stellar occultation by Kuiper Object 2014 MU69
- Study of stellar occultation by Near Earth Asteroids
- Near Futur prospects
- Summary

Introduction

The Centre for Research in Astronomy Astrophysics and Geophysics (CRAAG) comes from the creation of the Algiers Observatory in 1890 and after from the Institute of Meteorology and Physics of the Globe in Algiers (IMPGA) in 1931.
The name of L'Observatoire d'Alger remained long after the independence of Algeria in 1962 until 1980.

In 1980, the Algerian ministry of high study and research created the National Center for Astronomy, Astrophysics and Geophysics (CNAAG) and in 1985, they change the establishment of the status of research center in Algeria, CRAAG was created.

64 asteroids were discovered including 858 El Djezair on May 26th 1916 and 859 Bouzareah on October 2nd 1916 by the french astronomer Frederic Sy. The first asteroid has the arabic name of the city of Algiers and the second has the arabic name of the village where the observatory built.



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Here the instruments that we used to observe occultation.

1 – Instruments that we can be moved throughout Algiers

- Celestron 8 with CGEM mount
- Celestron 11 with CGE Pro mount

2 – Fixed Instruments at Algiers Observatory

- A 200 mm Apochromatique Refractor guide F/D 9
- Richtey-Chretien Telescope 810 mm F=6400 mm from the italian society Dub Optika.

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Since 2012, we observed several positive stellar occultation by asteroid using visual method.

We obtained for the first time a positive occultation using the video method with IOTA VTI Inserter during the observation of the Triton occultation on October 5, 2017.

We also obtained a positive occultation using the video method with IOTA VTI Inserter during the observation of the occultation of the star TYC 1310-00528-1 by 464 Megaira on January 12, 2018.

We have also obtained several negative observations but very often the weather was against us.

The 4th of August 2018, we organized an expedition to observe the stellar occultation by the object of Kuiper 2014MU69 in the extreme south of Algeria but it's was cloudy.

Participative Astronomy occultation in Algeria

There are hundreds astronomical associations and clubs.

There are more than 2,300 youth institutions (youth centers and science centers) across the country, including more than 80 institutions in Algiers which depend on the Ministry of Youth.

There are also hundreds of cultural centers (which depend on the Ministry of Culture) throughout the national territory.

An exhaustive census of more than 300 telescopes.

So, I started to form a network to observe stellar occultation by asteroids since 2016.

First national meeting in asteroidal occultation for observing 861 Aïda and 444 Gyptis in December 2016.

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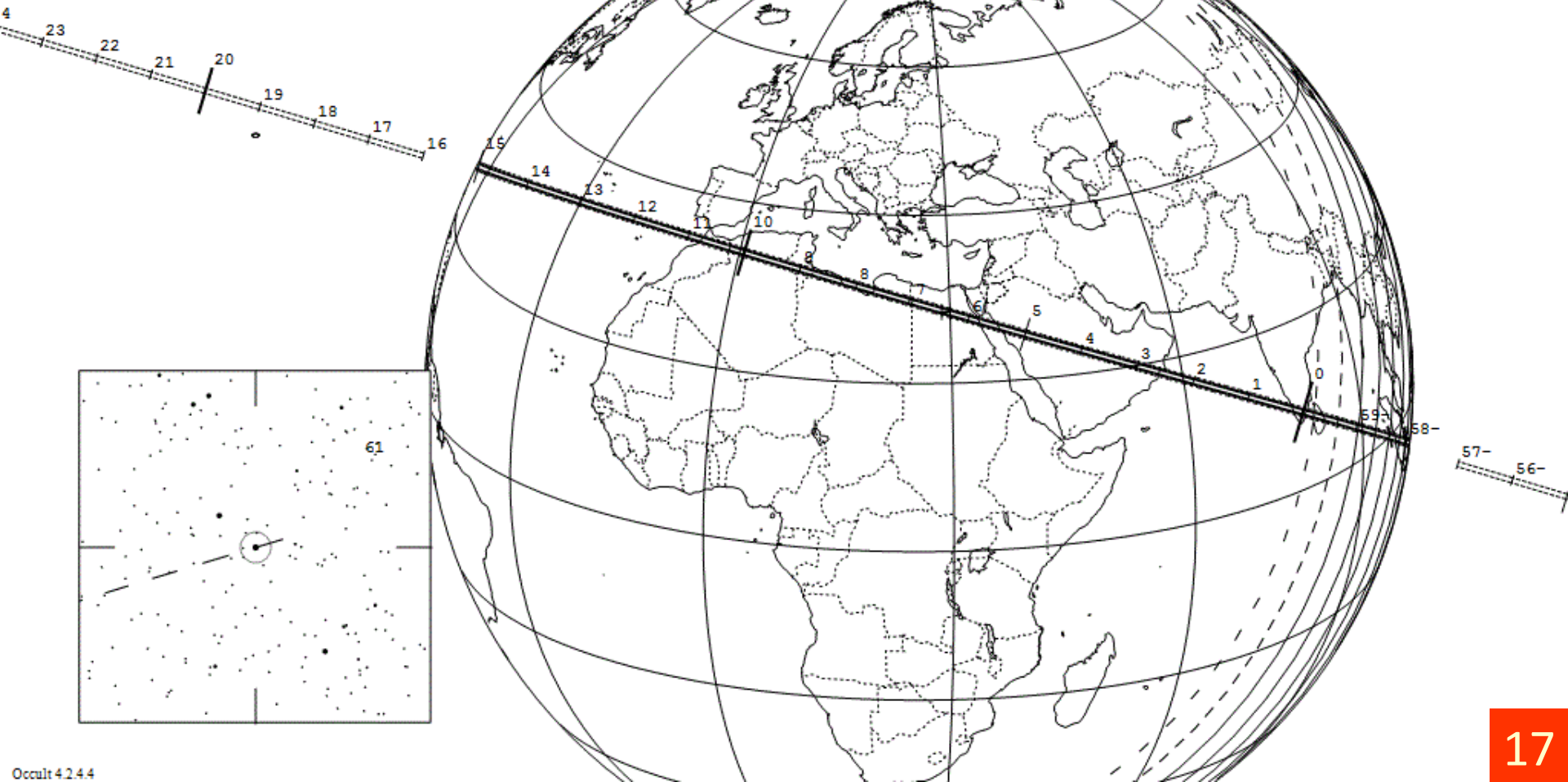
861 Aida occults HIP 36411 on 2016 Dec 15 from 23h 58m to 24h 15m UT

Star:
Mv = 6.7 Mp = 8.0 Mr = 6.0
RA = 7 29 30.7615 (J2000)
Dec = 19 37 59.392 ...
[of Date: 7 30 31, 19 35 39]
Prediction of 2016 Nov 1.0

Max Duration = 5.5 secs
Mag Drop = 8.2 (8.5r)
Sun : Dist = 153 deg
Moon: Dist = 2 deg
: illum = 94 %
E 0.024"x 0.013" in PA 89

Asteroid:
Mag =14.9
Dia = 67km, 0.037"
Parallax = 3.495"
Hourly dRA =-1.637s
dDec = 6.89"



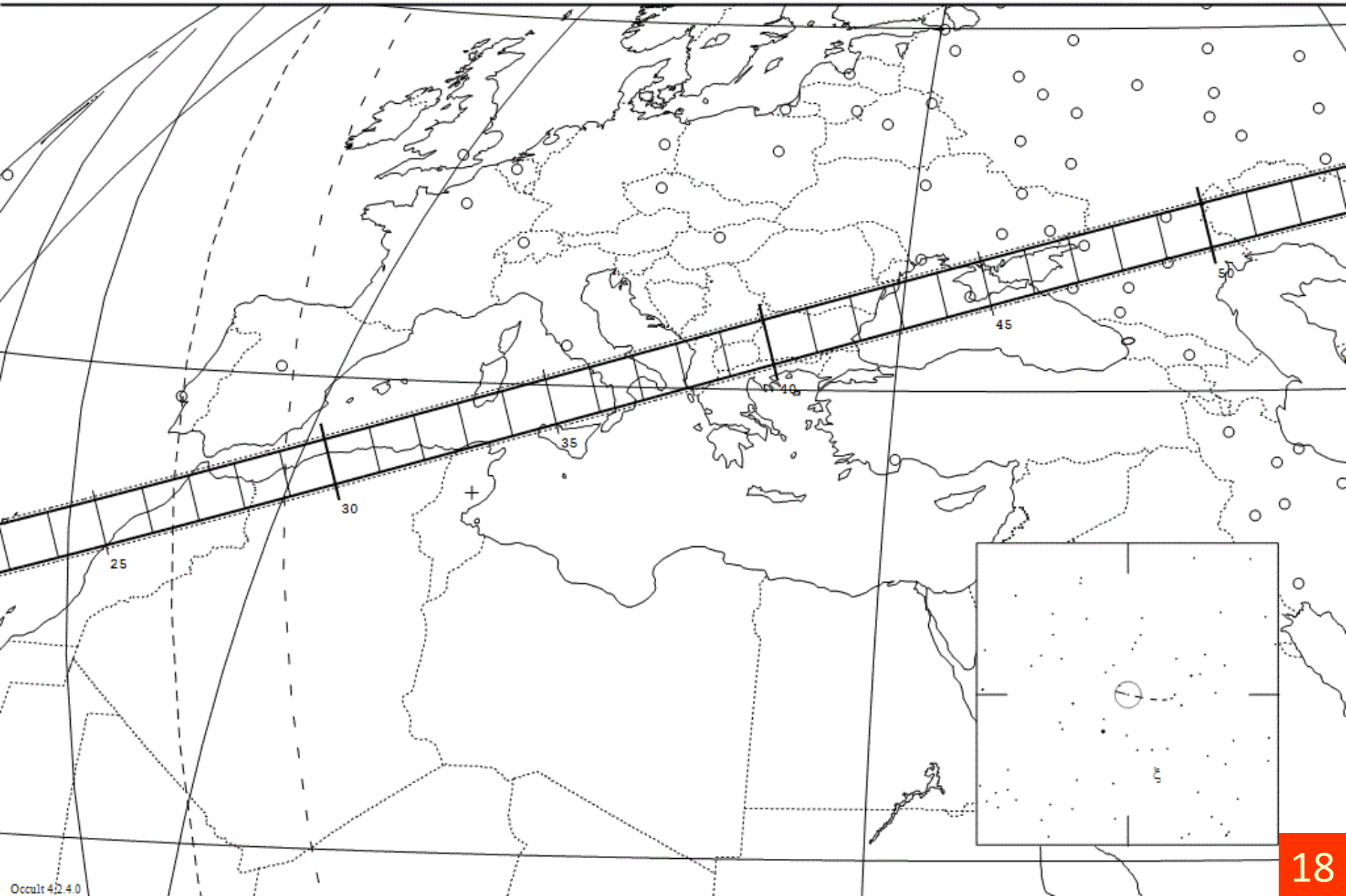
Occult 4.2.4.4

444 Gyptis occults TYC 0033-00648-1 on 2016 Dec 17 from 17h 17m to 18h 5m UT

Star:
Mv = 10.0 Mp = 10.6 Mr = 9.7
RA = 1 54 8.8279 (J2000)
Dec = 3 38 9.968 ...
[of Date: 1 55 2, 3 43 3]
Prediction of 2016 Sep 19.0

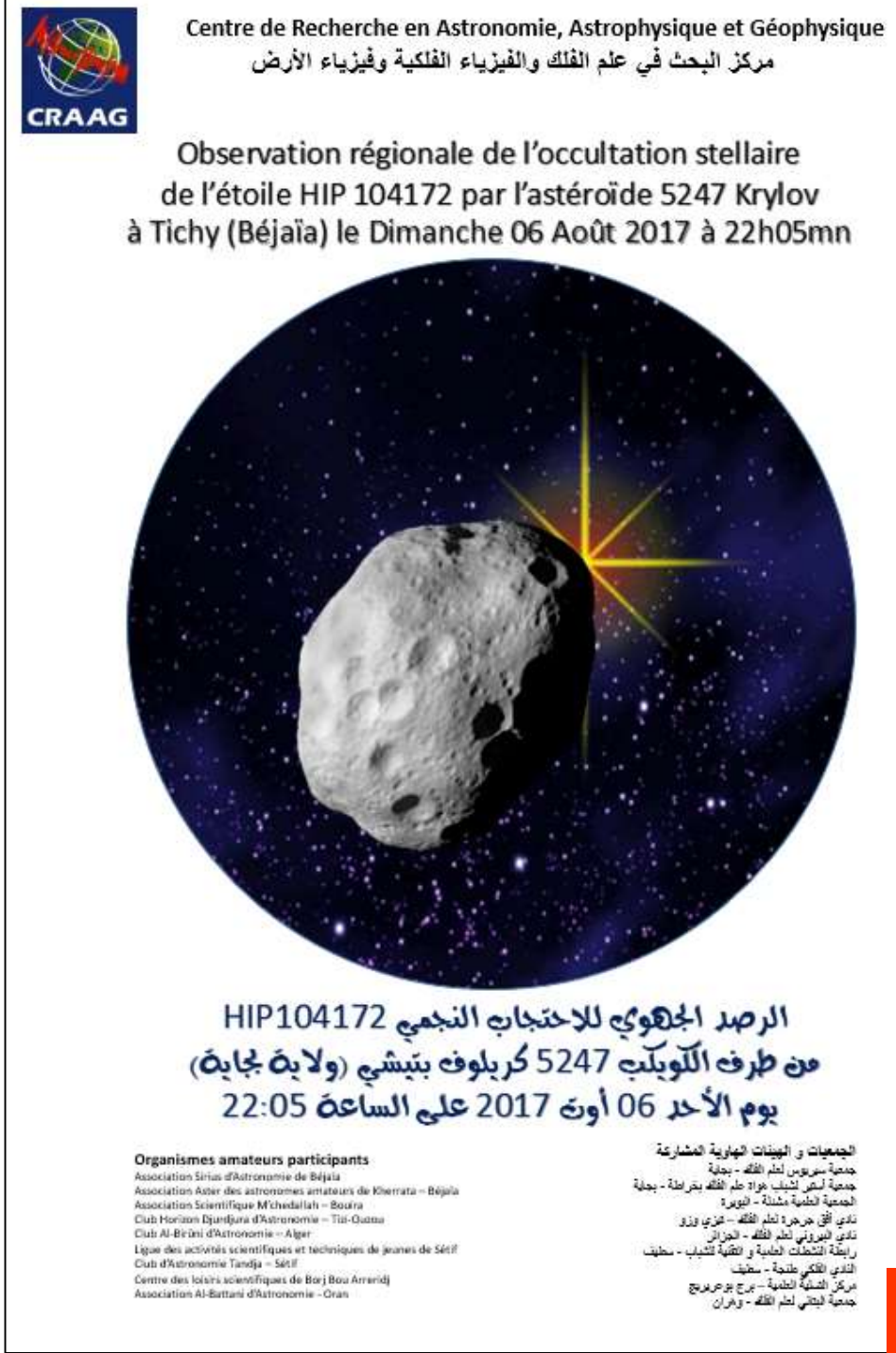
Max Duration = 55.5 secs
Mag Drop = 2.2 (2.1r)
Sun : Dist = 121 deg
Moon: Dist =108 deg
: illum = 82 %
E 0.021"x 0.010" in PA 81

Asteroid:
Mag =12.0
Dia = 193km, 0.149"
Parallax = 4.910"
Hourly dRA = 0.627s
dDec = 2.29"



Occult 4.2.4.0

Regional observation of the stellar occultation HIP 104172 by 5247 Krylov in Tichy (Bejaia) – Sunday 06th August 2017 at 21h05mn UT

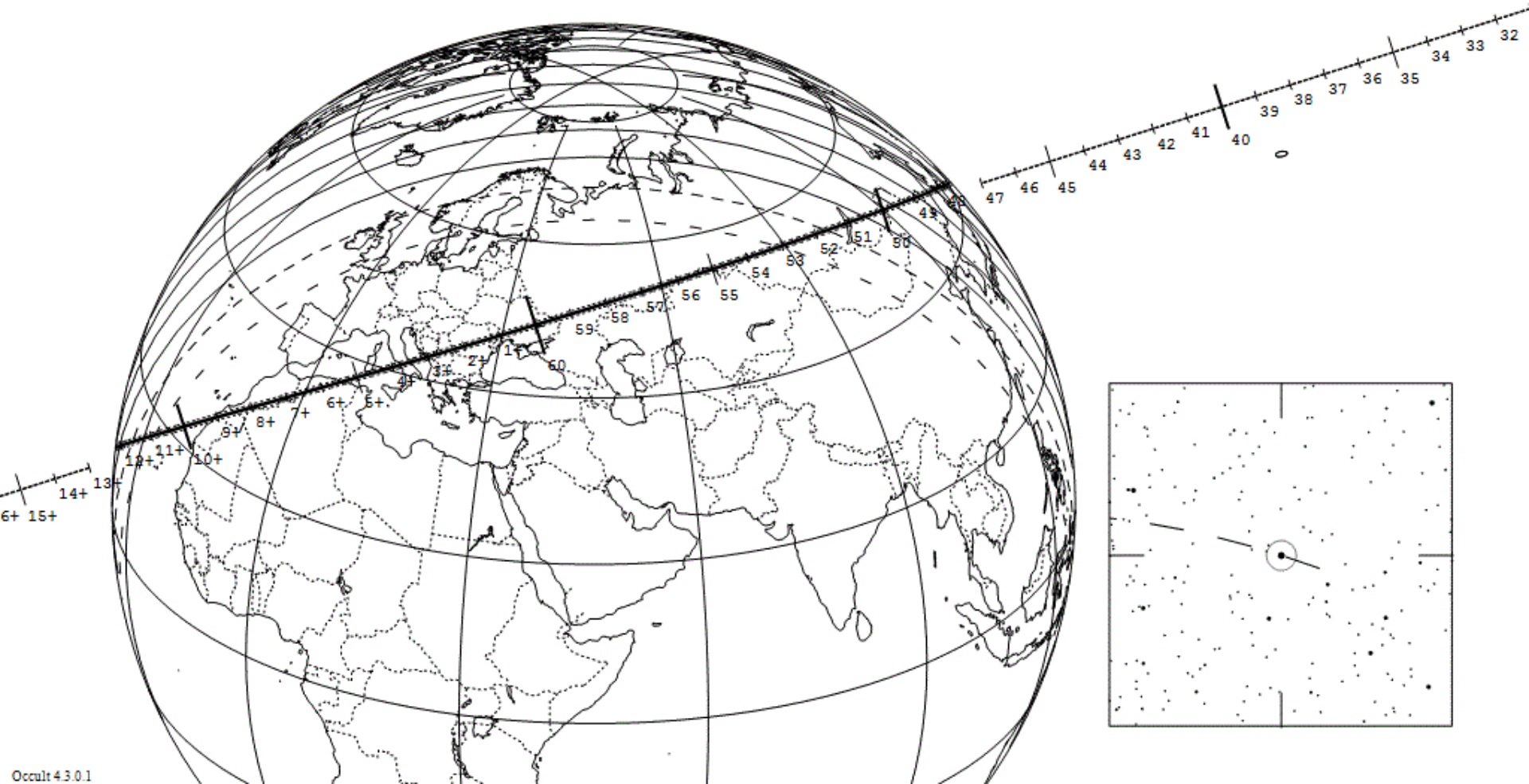


5247 Krylov occults HIP 104172 on 2017 Aug 6 from 20h 48m to 21h 12m UT

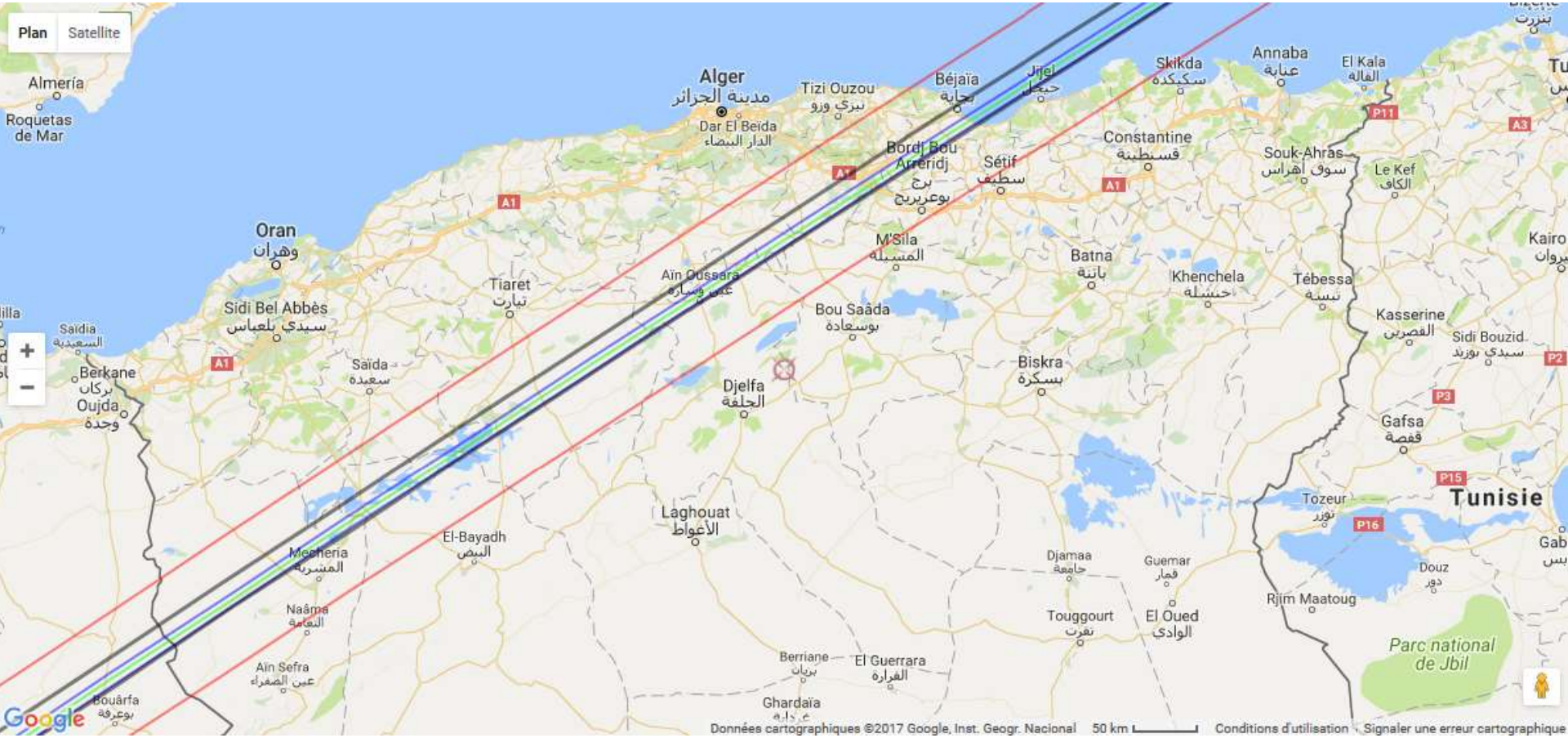
Star:
Mv = 6.1
RA = 21 6 23.5376 (J2000)
Dec = 26 55 27.364 ...
[of Date: 21 7 11, 26 59 51]
Prediction of 2017 Jun 28.0

Max Duration = 0.9 secs
Mag Drop = 9.2
Sun : Dist = 137 deg
Moon: Dist = 45 deg
: illum = 99 %
E 0.084"x 0.038" in PA 79

Asteroid:
Mag =15.3
Dia = 8km, 0.009"
Parallax = 6.946"
Hourly dRA =-2.220s
dDec = -9.49"



The path of the occultation band throughout algerian territory of the star HIP 104172
Of the constellation of Cygnus by 5247 Krylov.



Zoom on the occultation band around Béjaïa city

12 telescopes divided on 6 teams through the central center of the path occultation. Each team was composed by 2 or 3 personnes.

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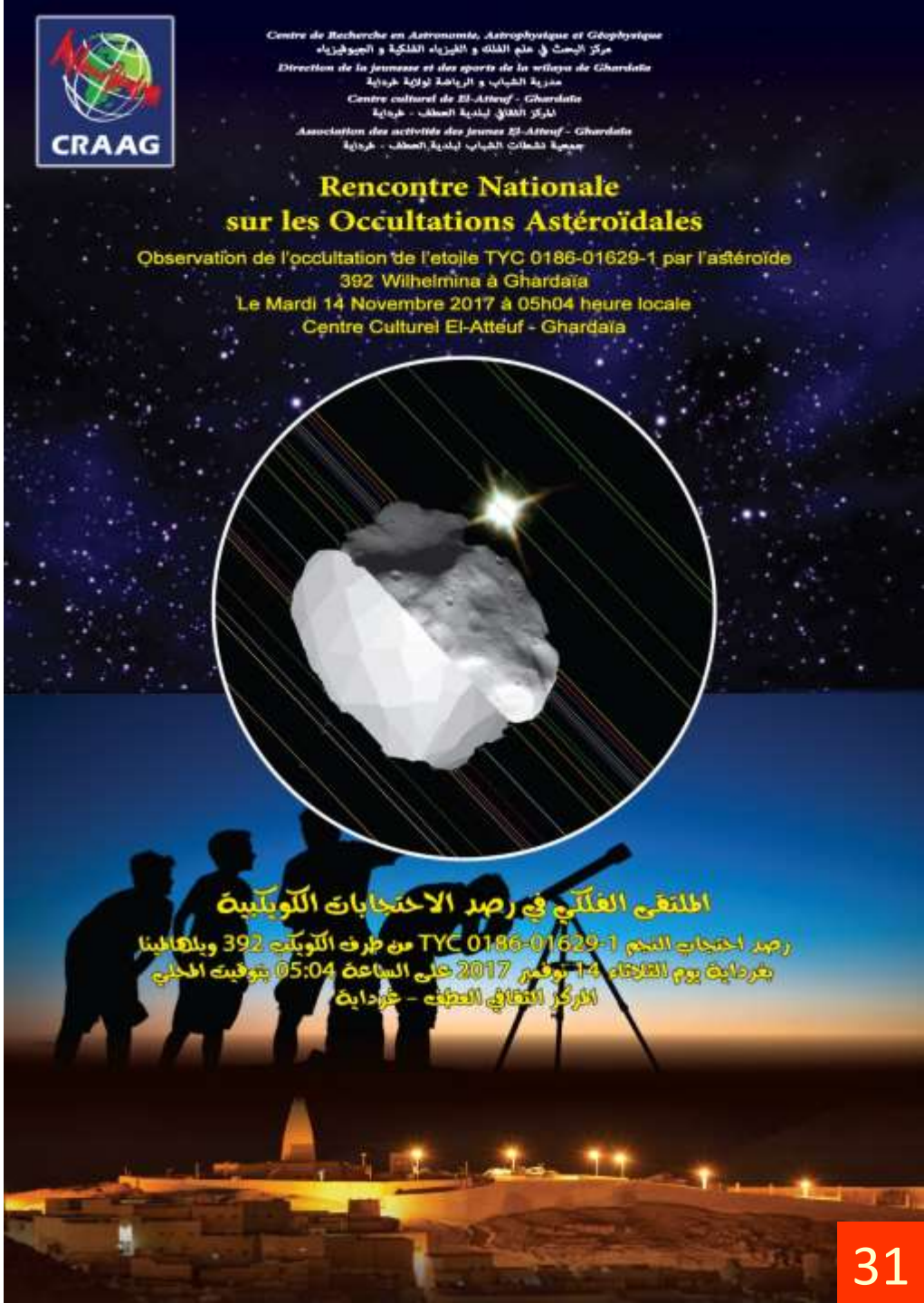
The second national meeting on stellar occultation by asteroids on November 14, 2017 in Ghardaia. More than 11 Algerian departments represented by their associations or clubs participated with more than 30 people who used 20 telescopes to observe the occultation of the star TYC 0186-01629-1 of Canis Major constellation by asteroid 392 Wilhelmina.



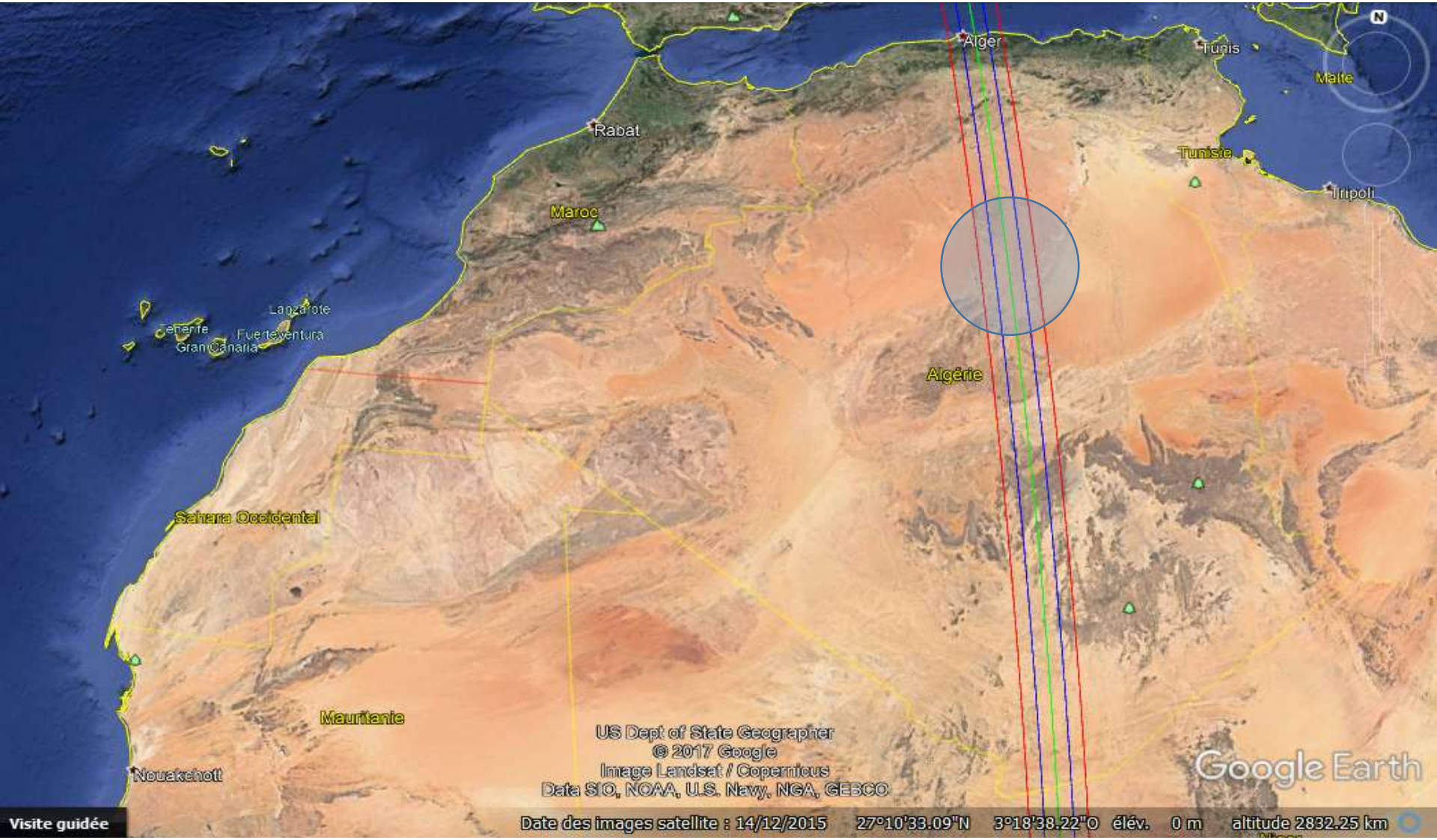
392 Wilhelmina occults TYC 0186-01629-1 on 2017 Nov 14 from 3h 57m to 4h 23m UT

Star:
Mv = 9.8
RA = 7 33 28.8933 (J2000)
Dec = 4 45 15.548 ...
[of Date: 7 34 26, 4 42 52]
Prediction of 2017 Jul 4.0

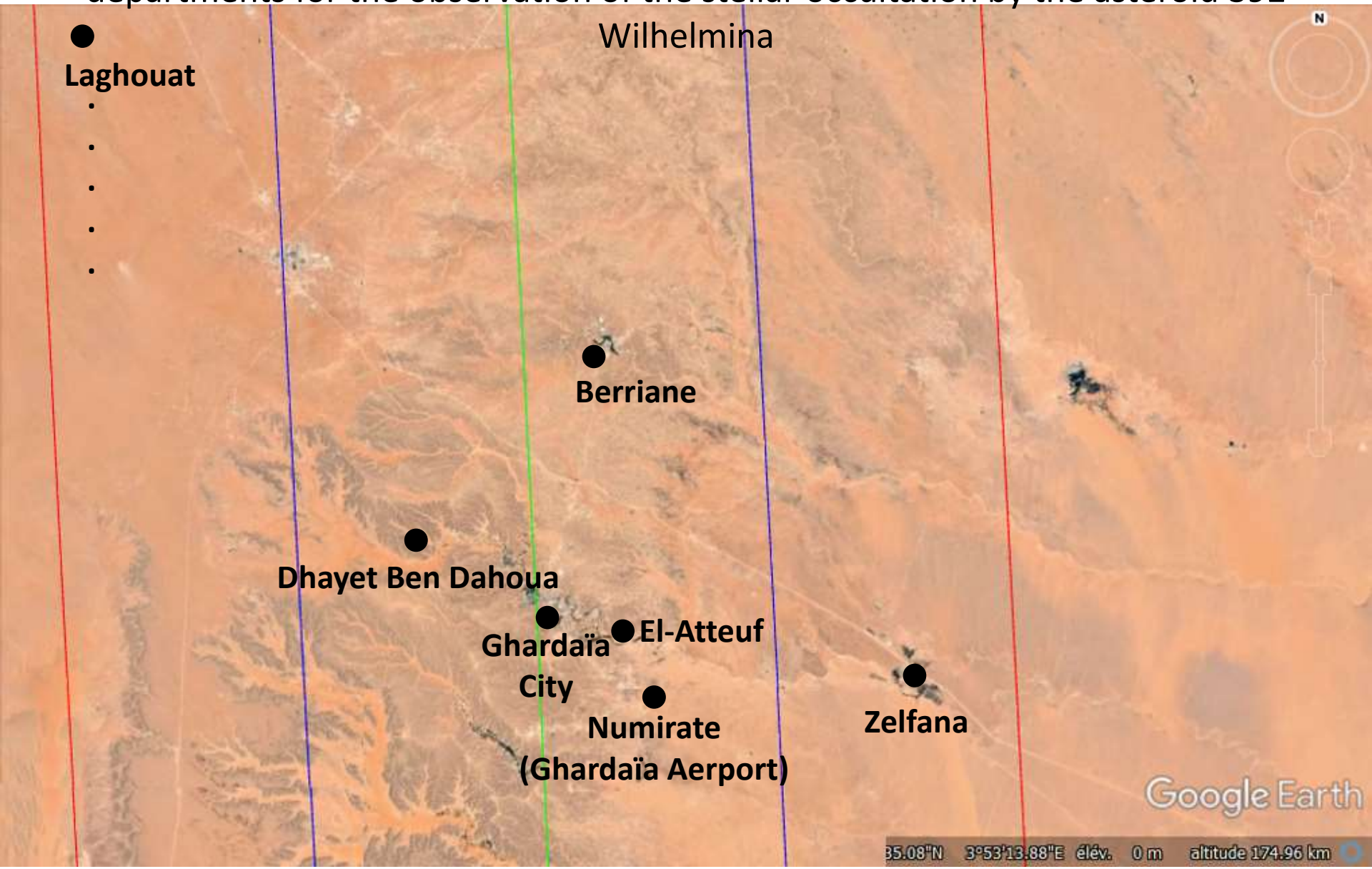
Max Duration = 8.5 secs
Mag Drop = 4.8
Sun : Dist = 116 deg
Moon: Dist = 70 deg
: illum = 18 %
E 0.019"x 0.011" in PA 82

Asteroid:
Mag =14.6
Dia = 69km, 0.045"
Parallax = 4.146"
Hourly dRA = 0.195s
dDec =-18.72"

Overall distribution of the teams on the 7 observation sites of Laghouat and Ghardaïa departments for the observation of the stellar occultation by the asteroid 392 Wilhelmina



Overall distribution of the teams on the 7 observation sites of Laghouat and Ghardaïa departments for the observation of the stellar occultation by the asteroid 392 Wilhelmina



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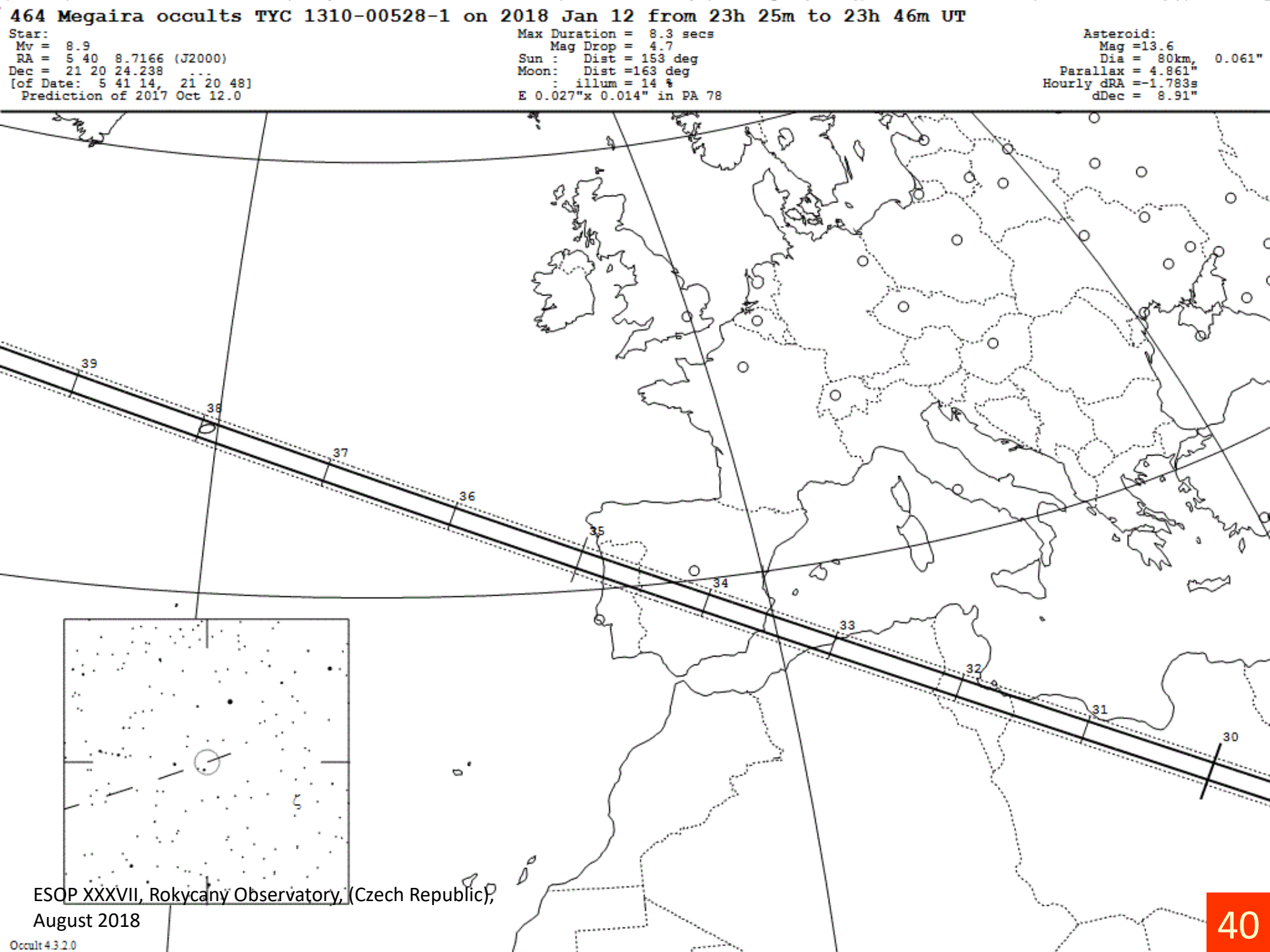
464 Megaira occults TYC 1310-00528-1 on 2018 Jan 12 from 23h 25m to 23h 46m UT
Star:
Mv = 8.9
RA = 5 40 8.7166 (J2000)
Dec = 21 20 24.238 ...
[of Date: 5 41 14, 21 20 48]
Prediction of 2017 Oct 12.0
Max Duration = 8.3 secs
Mag Drop = 4.7
Sun : Dist = 153 deg
Moon: Dist =163 deg
: illum = 14 %
E 0.027"x 0.014" in PA 78
Asteroid:
Mag =13.6
Dia = 80km, 0.061"
Parallax = 4.861"
Hourly dRA =-1.783s
dDec = 8.91"
39
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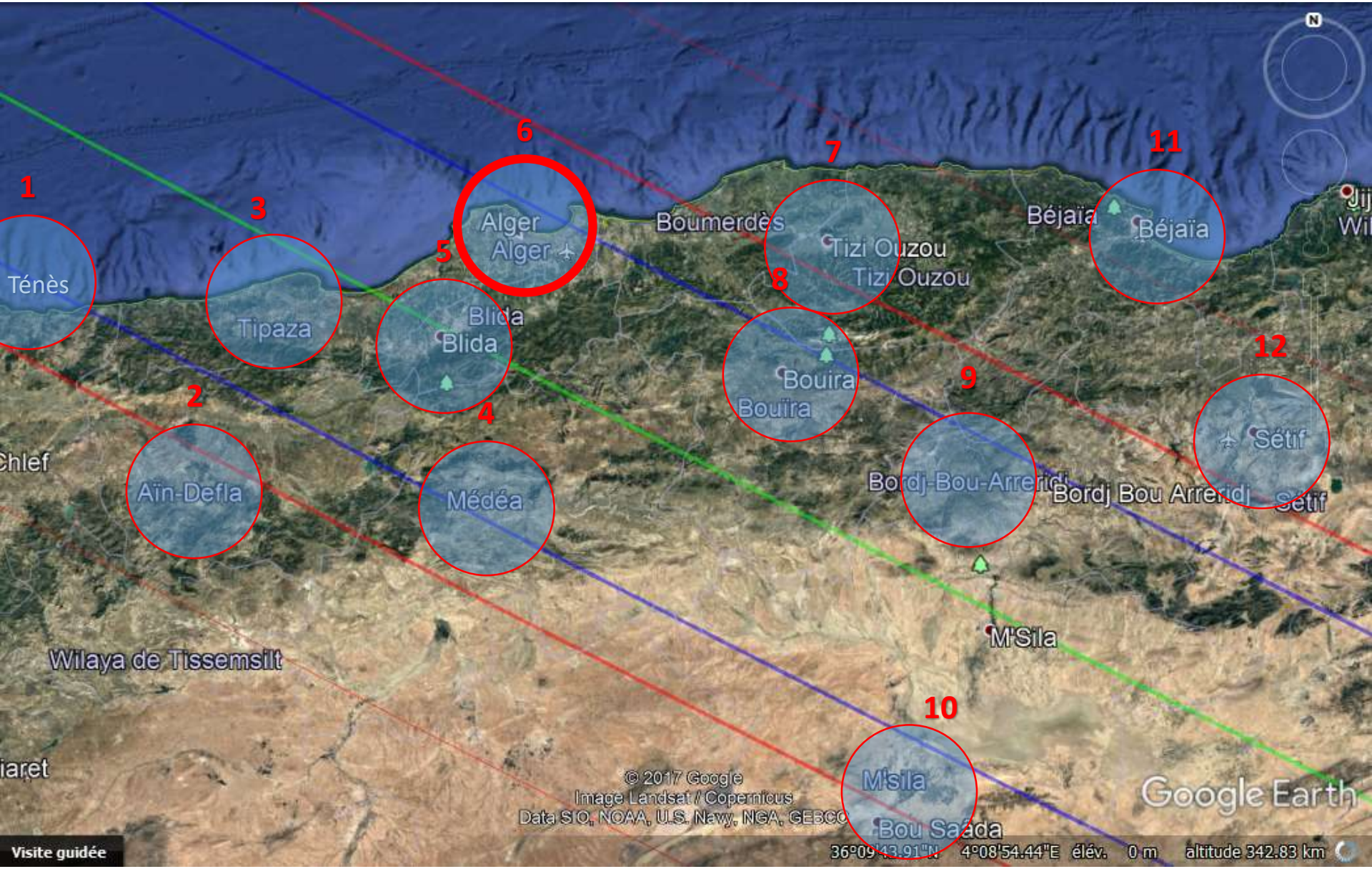
ζ
Occult 4.3.2.0

On Saturday January 13, 2018 at 00h33mn local time, the star TYC 1310-00528-1 of the constellation Taurus was occulted by the 464 Megaira.

On Saturday January 13, 2018 at 00h33mn local time, the star TYC 1310-00528-1 of the constellation Taurus was occulted by the 464 Megaira.

More than 30 persons of the algerian occultation network participed.

Global distribution on the Algerian territory of the observation sites of the stellar occultation by 464 Megaira



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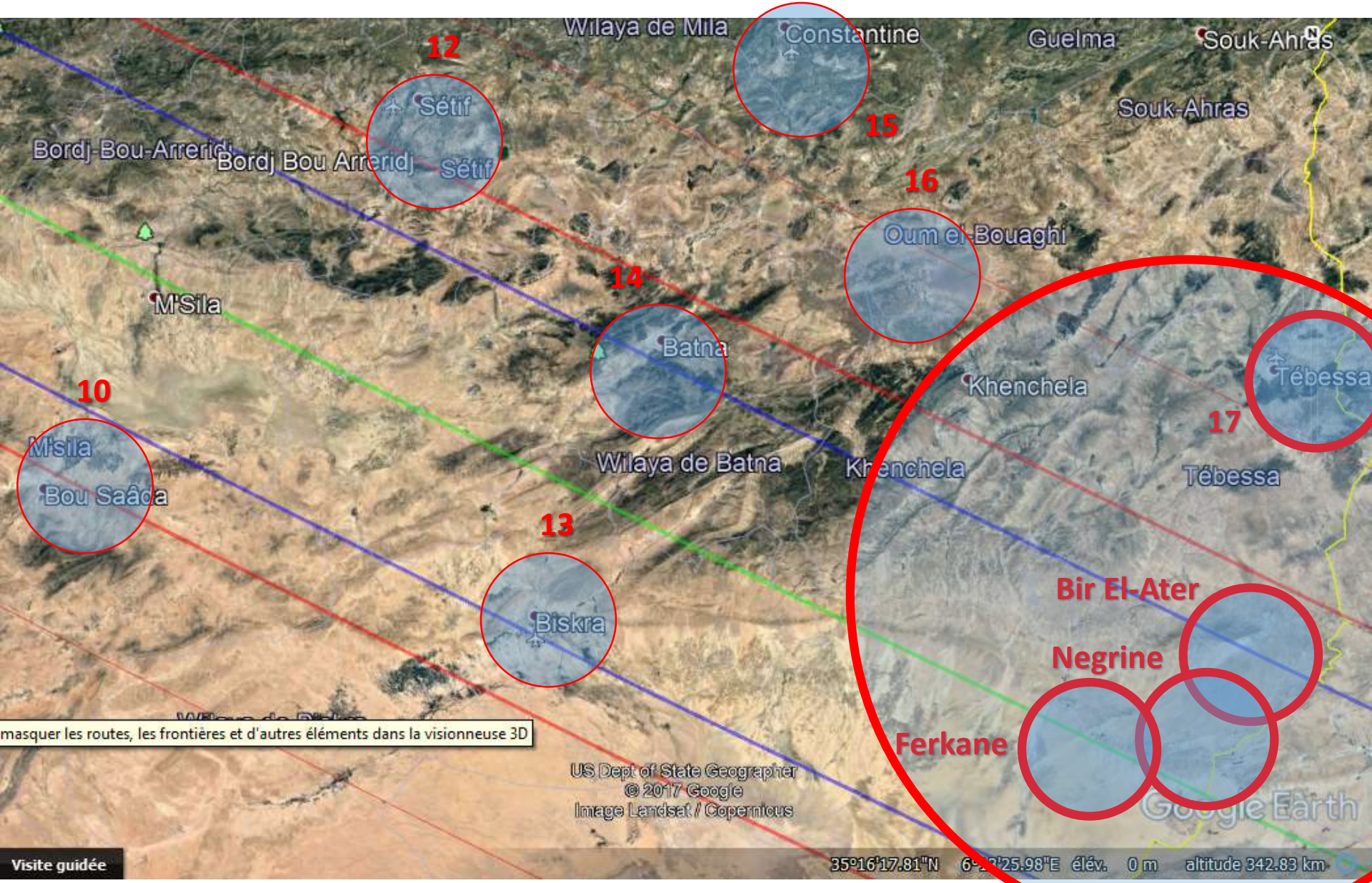
Global distribution on the Algerian territory of the observation sites of the stellar occultation by 464 Megaira



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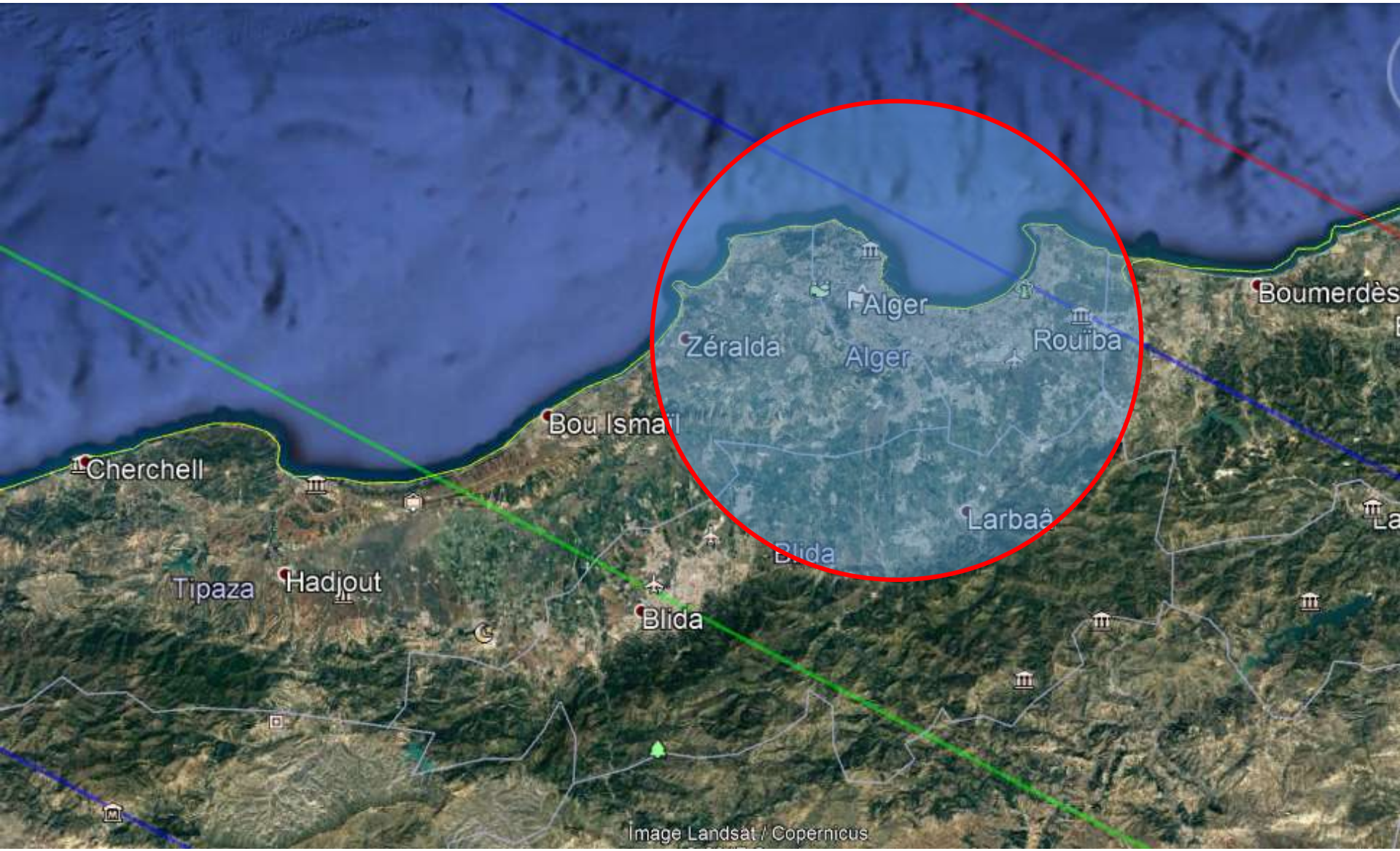
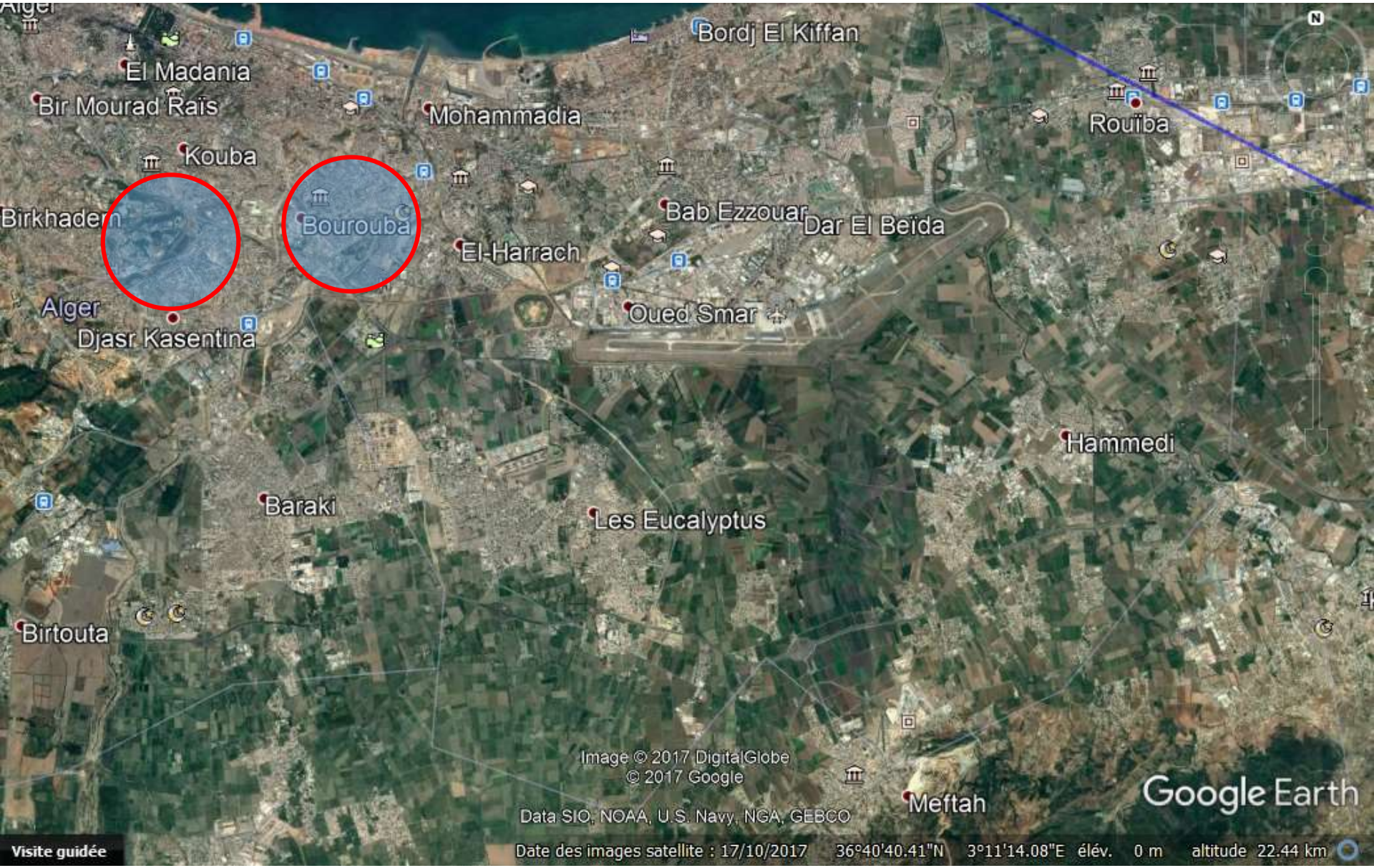
Global distribution on the City of Algiers of the observation sites of the stellar occultation by 464 Megaira

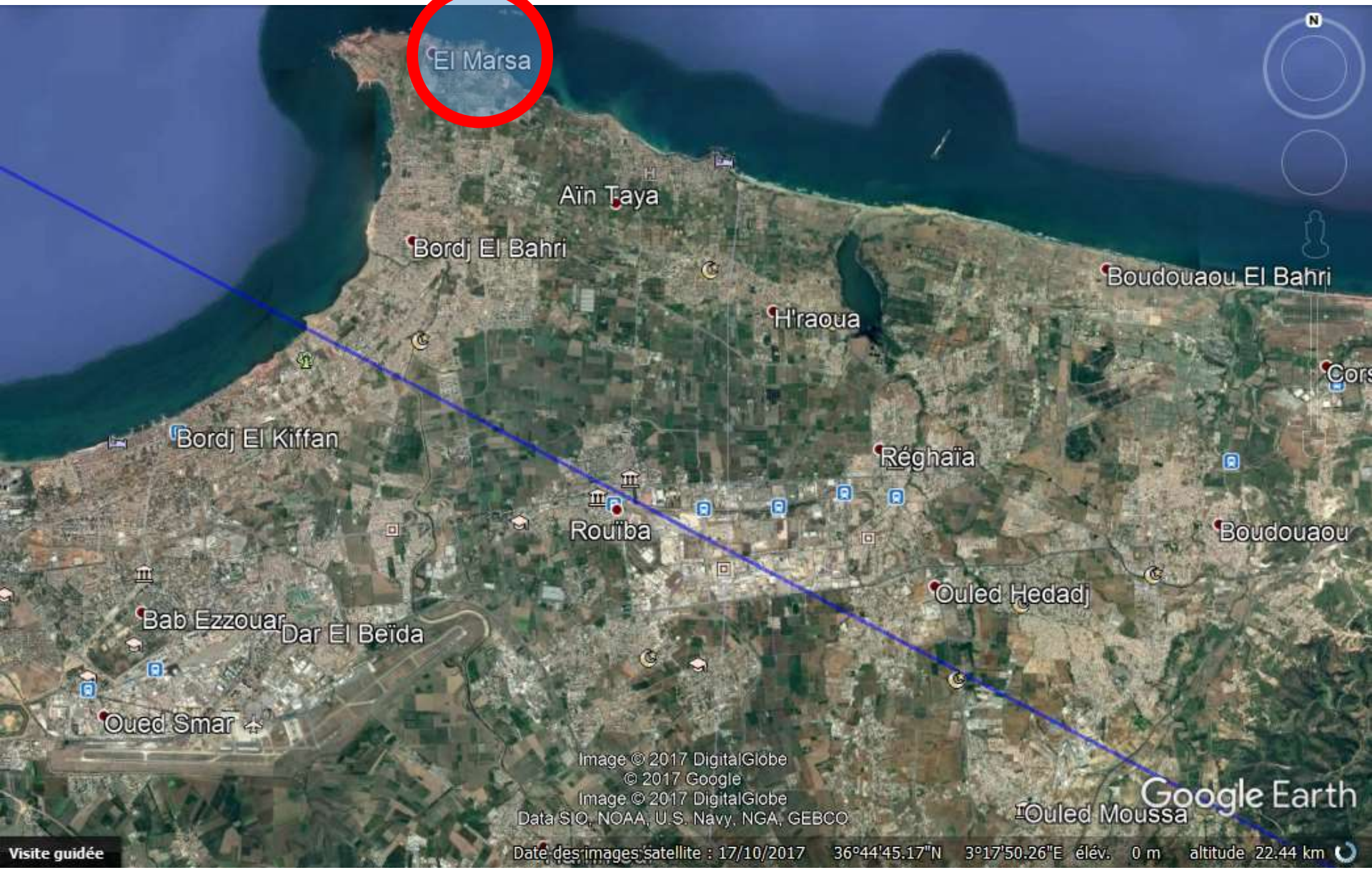


Global distribution on the City of Algiers of the observation sites of the stellar occultation by 464 Megaira

Global distribution on the City of Algiers of the observation sites of the stellar occultation by 464 Megaira



Global distribution on the City of Algiers of the observation sites of the stellar occultation by 464 Megaira



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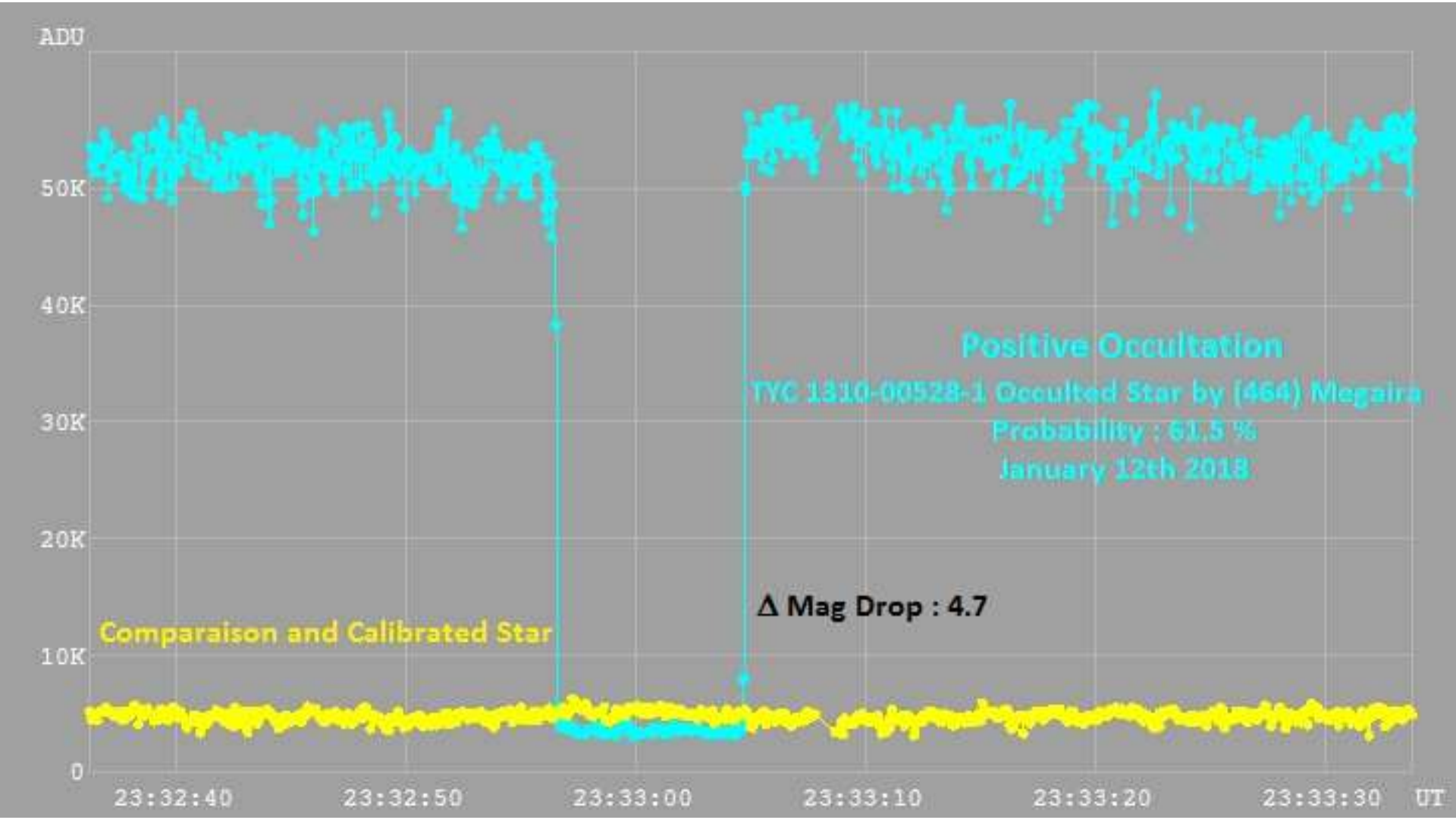
P9
23:31:09 6773 6973 16885


ADU
50K
40K
30K
20K
10K
0
Positive Occultation
TYC 1310-00528-1 Occulted Star by (464) Megaira
Probability : 61.5 %
January 12th 2018
Δ Mag Drop : 4.7
Comparaison and Calibrated Star
23:32:40
23:32:50
23:33:00
23:33:10
23:33:20
23:33:30
UT

2017/11/15 | 60036 | 1999 TD94 | TYC 1943-00758-1

```
O- | J.J. Castellani      | 00:29:24 | 00:31:35 | M203  | VID | FR | W  00 02 40.6 | N 43 37 15.2 |  180 | WS |;
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2017/11/14 | 392 | Wilhelmina | TYC 0186-01629-1

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O- | Jean-Louis Dumont    | 03:59:21 | 04:03:21 | M405  | CCD | FR | E  00 49 59.1 | N 47 13 23.9 |   91 | WS |;
O- | Joan Rovira          | 03:58:47 | 04:06:20 | M200  | VID | ES | E  02 05 45.1 | N 41 49 05.4 |  827 | WS |;
O- | H. Fahis/M. Yahiaoui |          |          | M115  | VIS | DZ | E  03 36 12.3 | N 32 31 56.2 |  534 | WS |;
O- | A. Ghadi/M. Lounes   |          |          | M130  | VIS | DZ | E  03 36 12.3 | N 32 31 56.2 |  534 | WS |;
O- | Djounai Baba Aissa   |          |          | M203  | VID | DZ | E  03 44 41.9 | N 32 28 50.5 |  456 | WS |;
O- | D. Bouzid/L. Bal     |          |          | L90   | VIS | DZ | E  03 46 29.4 | N 32 50 26.7 |  541 | WS |;
O- | M.L. Allik et al     |          |          | L90   | VIS | DZ | E  04 13 09.5 | N 32 23 55.2 |  350 | WS |
Observation with Z. Kebbab/Y. Berbar.|;
O- | E.H. Safar et al     |          |          | L90   | VIS | DZ | E  04 13 09.5 | N 32 23 55.4 |  350 | WS |
Observation with Y. Hocine.|;
O- | H. Addar/W. Belhadj  |          |          | M130  | VIS | DZ | E  04 13 09.8 | N 32 23 55.4 |  350 | WS |;
```

2017/11/14 | 2264 | Sabrina | 4UC565-015083

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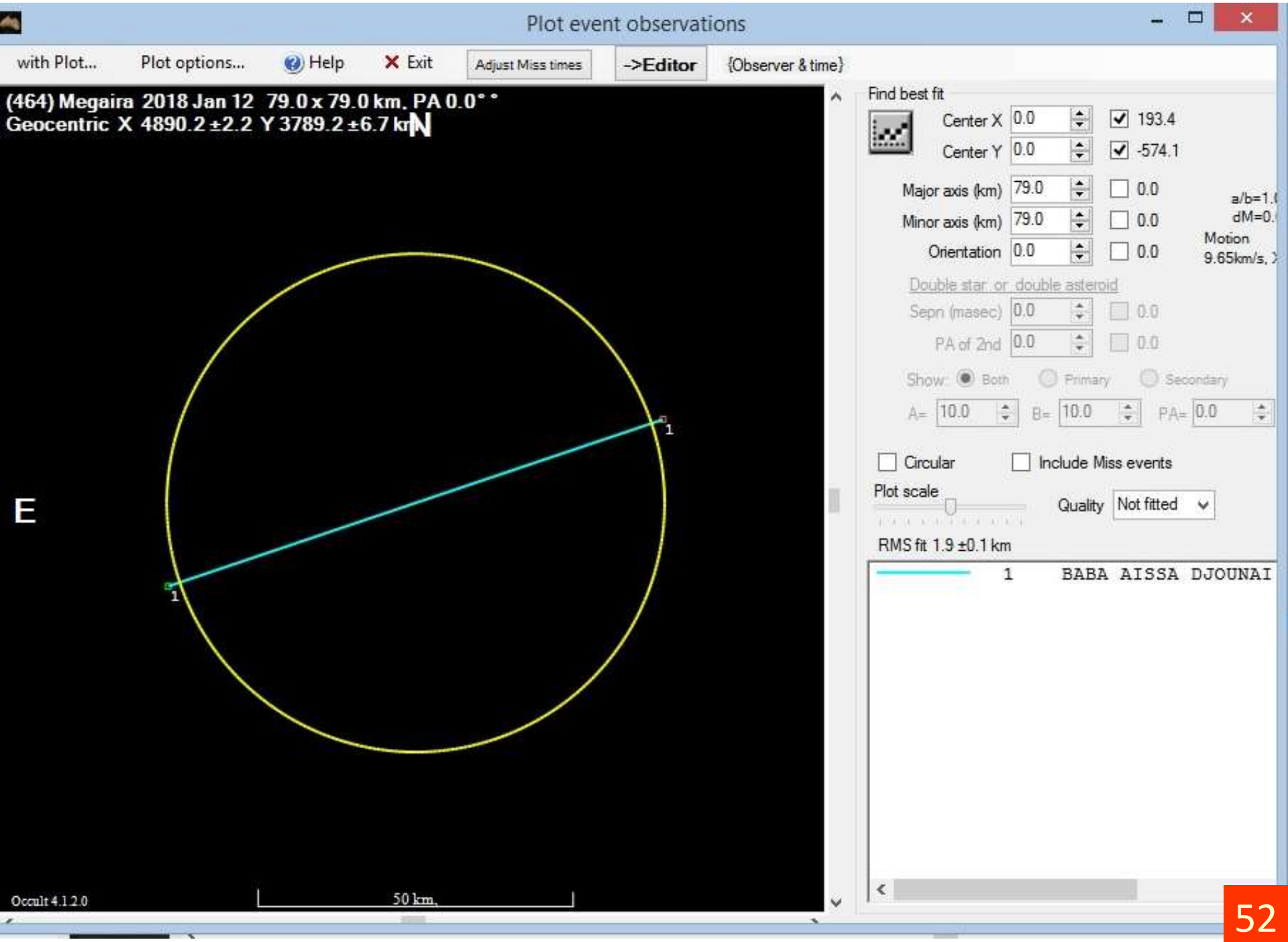
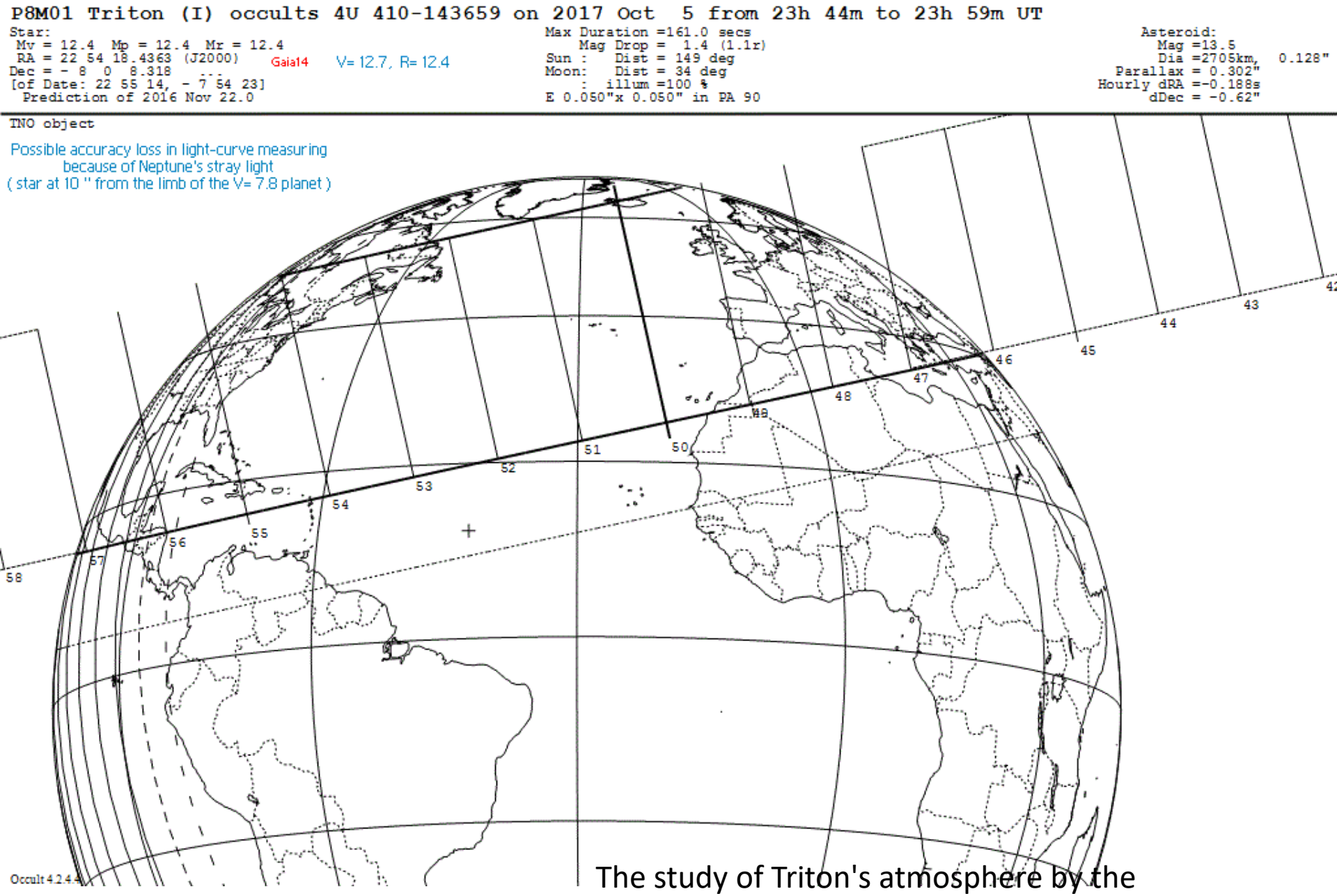
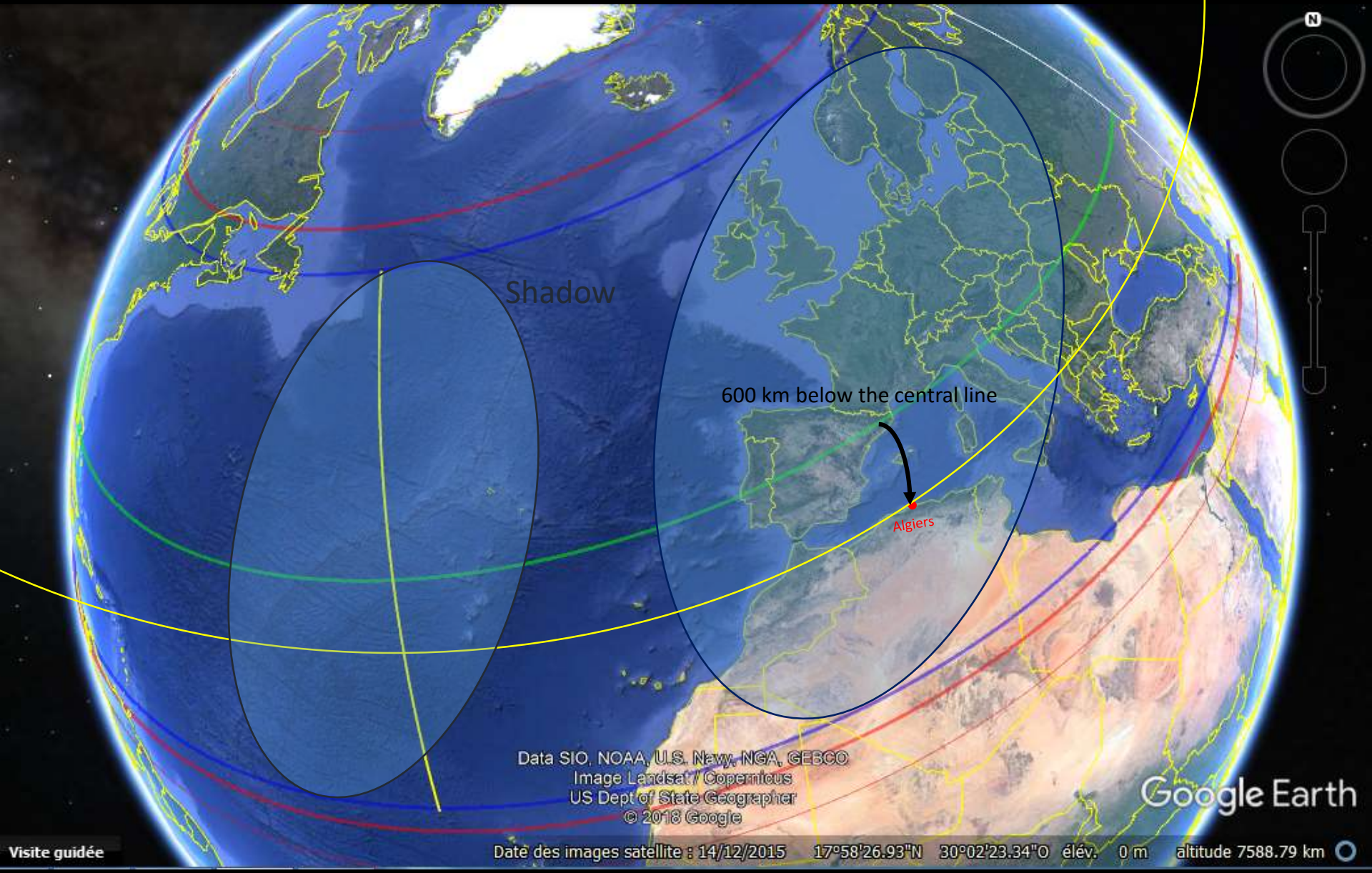
O- | Michal Rottenborn    | 02:27:07 | 02:31:07 | M303  | VID | CZ | E  13 19 55.8 | N 49 42 26.4 |  326 | WS |;
O- | Jiri Kubanek         | 02:27:02 | 02:31:13 | M203  | VID | CZ | E  13 52 30.9 | N 49 57 11.7 |  454 | WS |;
```


Plot event observations
with Plot...
Plot options...
Help
Exit
Adjust Miss times
->Editor
{Observer & time}
(464) Megaira 2018 Jan 12 79.0 x 79.0 km, PA 0.0° °
Geocentric X 4890.2 ±2.2 Y 3789.2 ±6.7 km
N
E
1
1
Occult 4.1.2.0
50 km.
Find best fit
Center X 0.0
193.4
Center Y 0.0
-574.1
Major axis (km) 79.0
0.0
Minor axis (km) 79.0
0.0
Orientation 0.0
0.0
a/b=1.
dM=0.
Motion
9.65km/s,
Double star or double asteroid
Sepn (masec) 0.0
0.0
PA of 2nd 0.0
0.0
Show: Both Primary Secondary
A= 10.0
B= 10.0
PA= 0.0
Circular
Include Miss events
Plot scale
Quality Not fitted
RMS fit 1.9 ±0.1 km
1 BABA AISSA DJOUNAI

Occultation of the star UCAC4 410-143659 by Triton on October 5th 2017



The study of Triton's atmosphere by the occultation method makes it possible to identify and understand its evolution in time.



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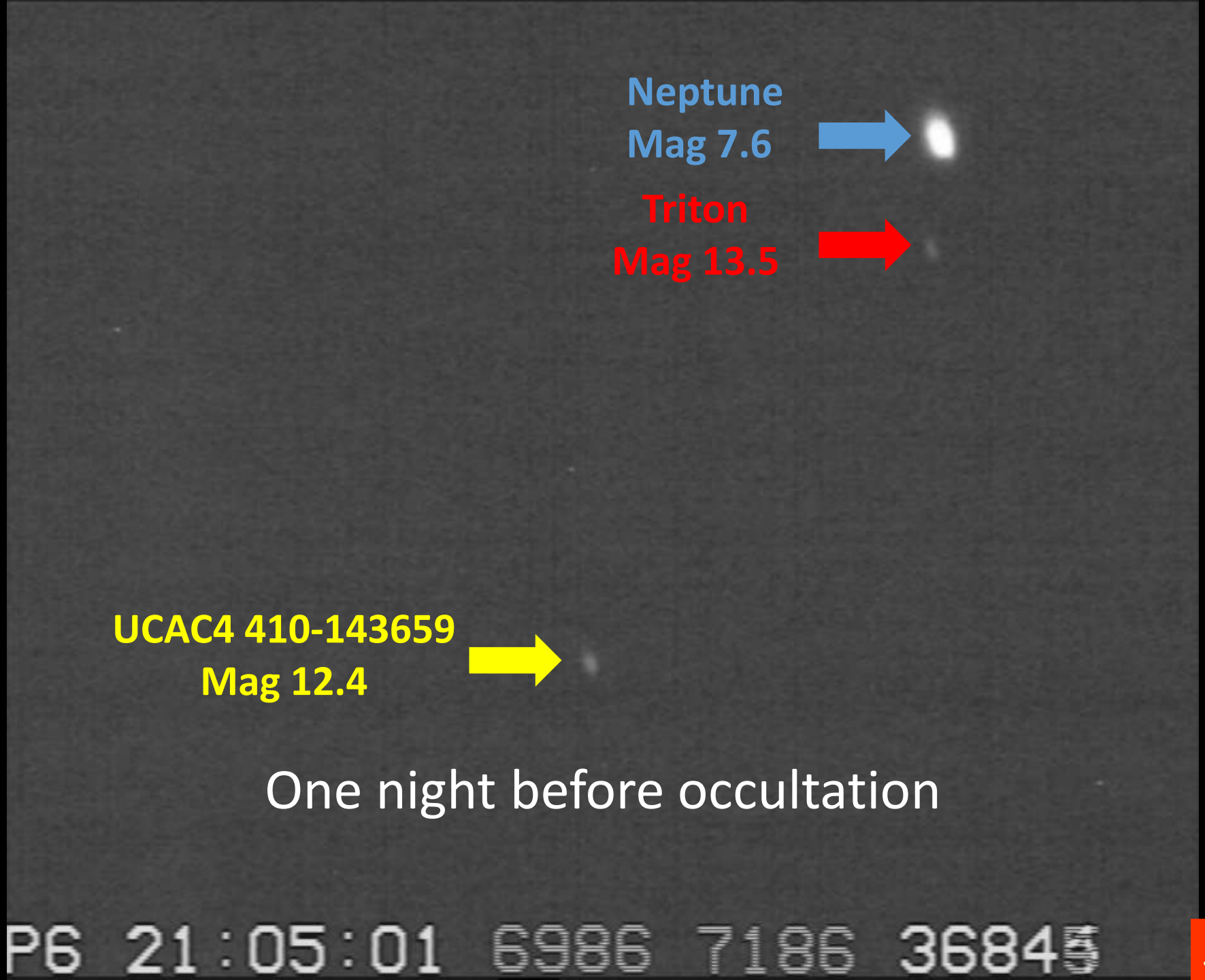
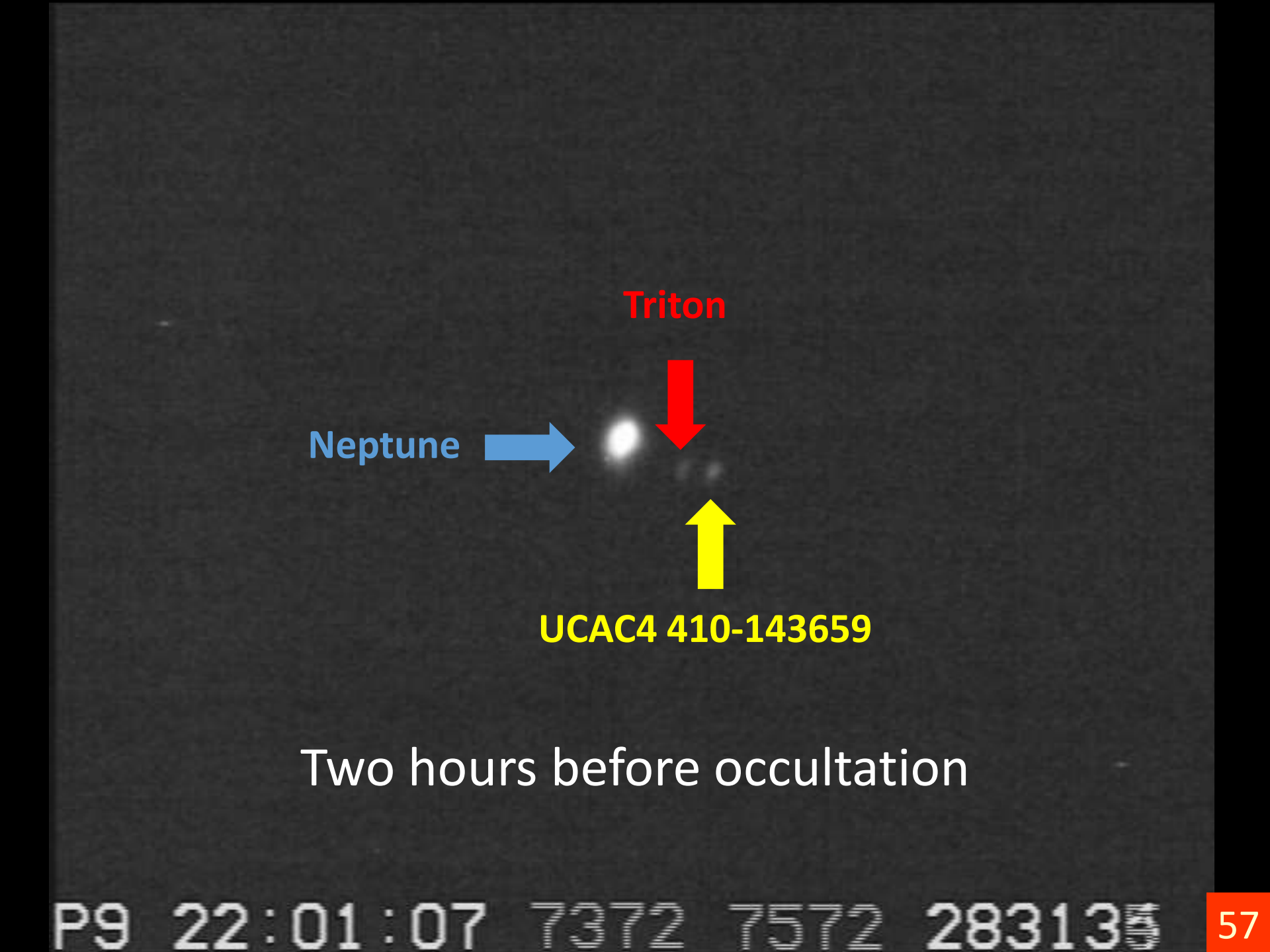
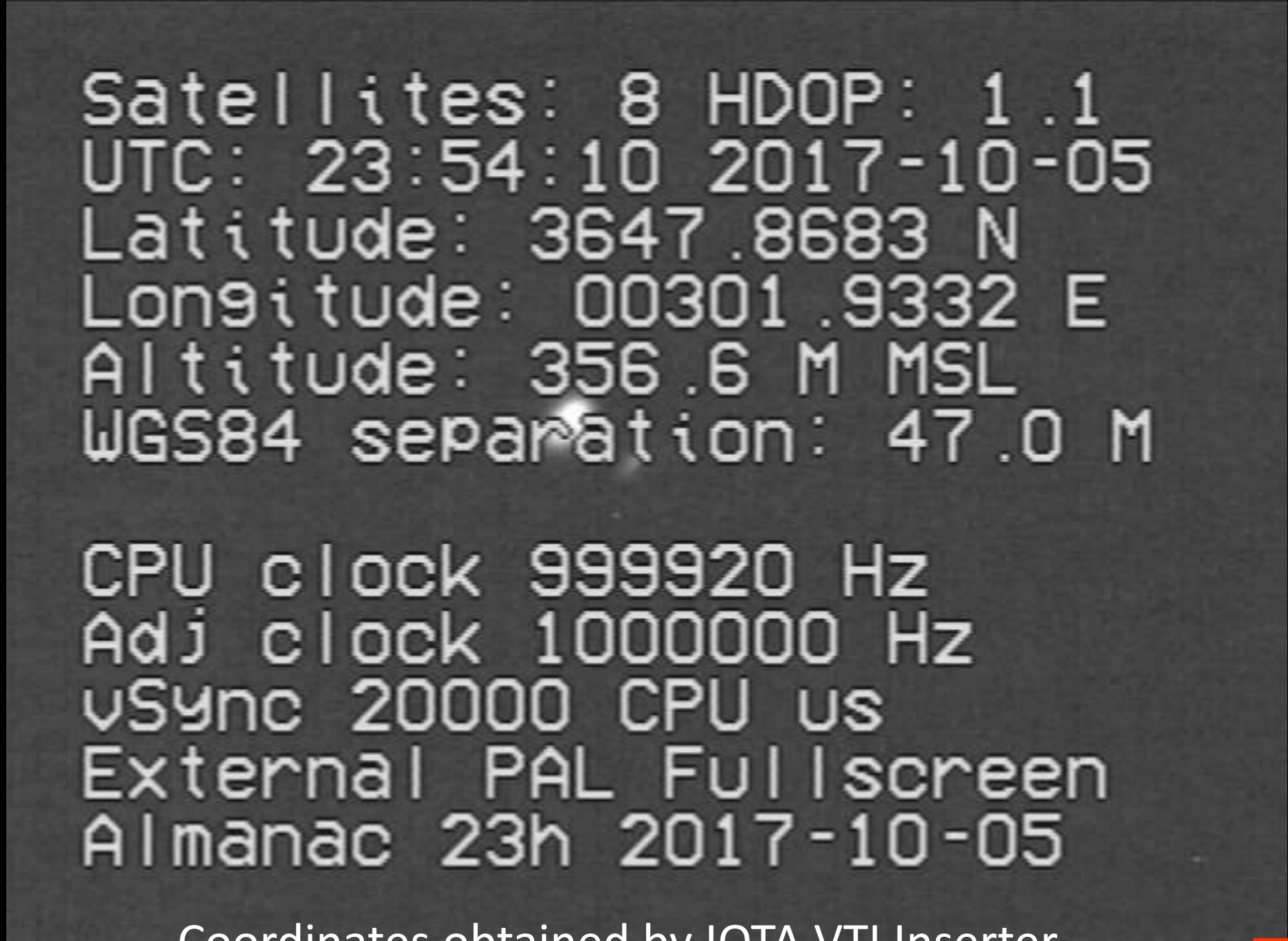
Occultation band of Triton


Neptune
Mag 7.6
Triton
Mag 13.5
UCAC4 410-143659
Mag 12.4
One night before occultation
P6 21:05:01 6986 7186 36845

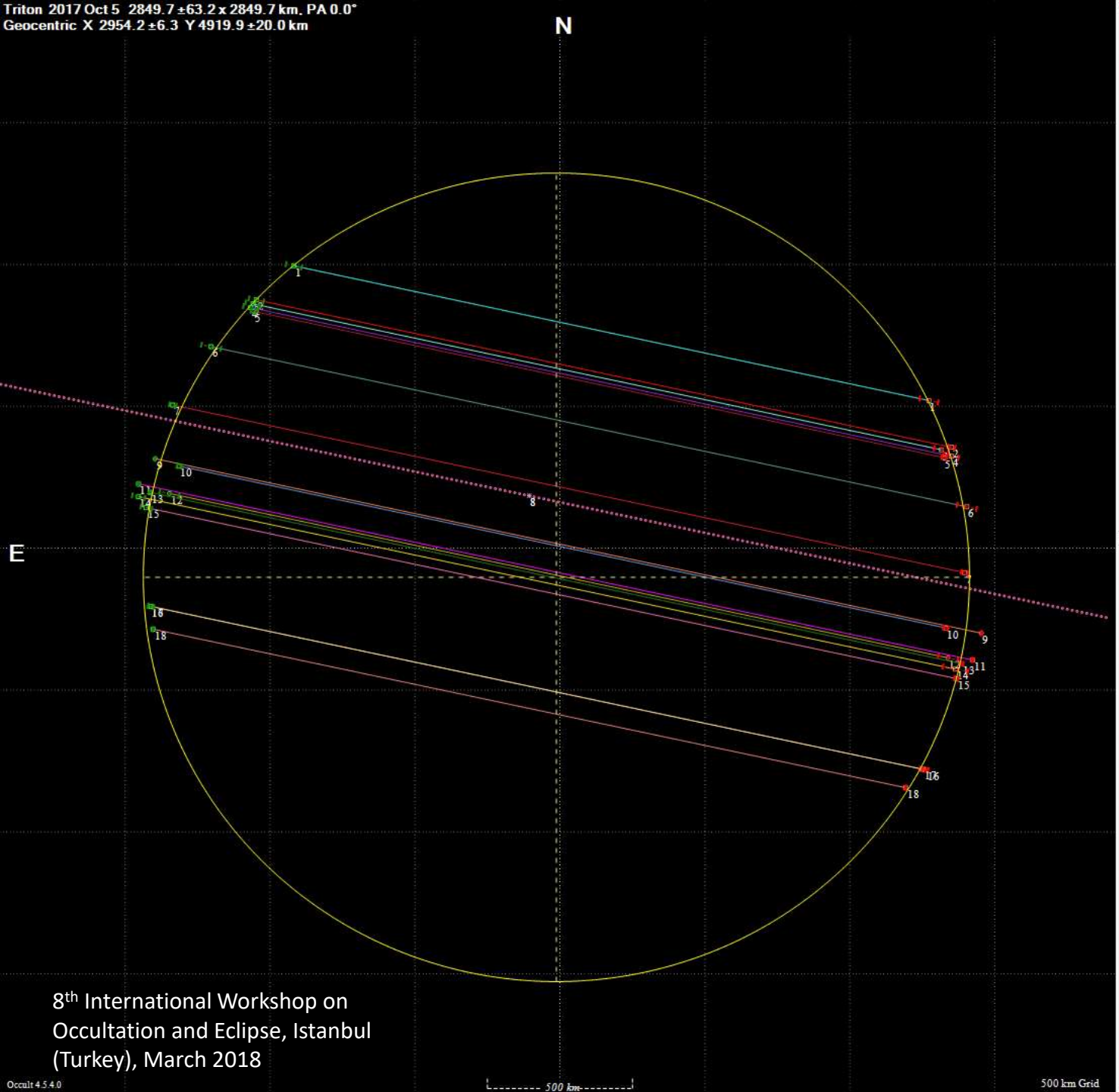


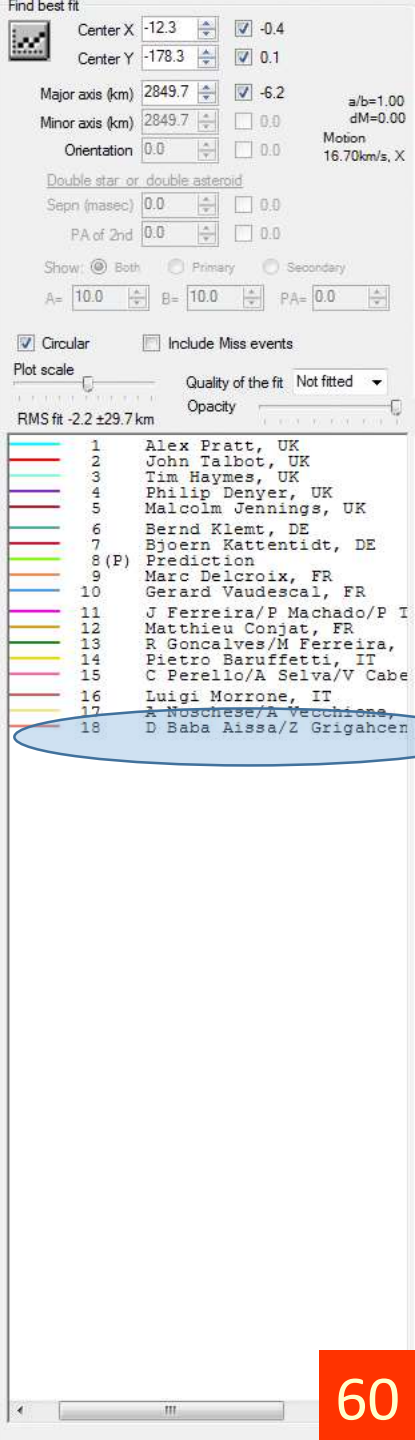
Two hours before occultation

During the occultation



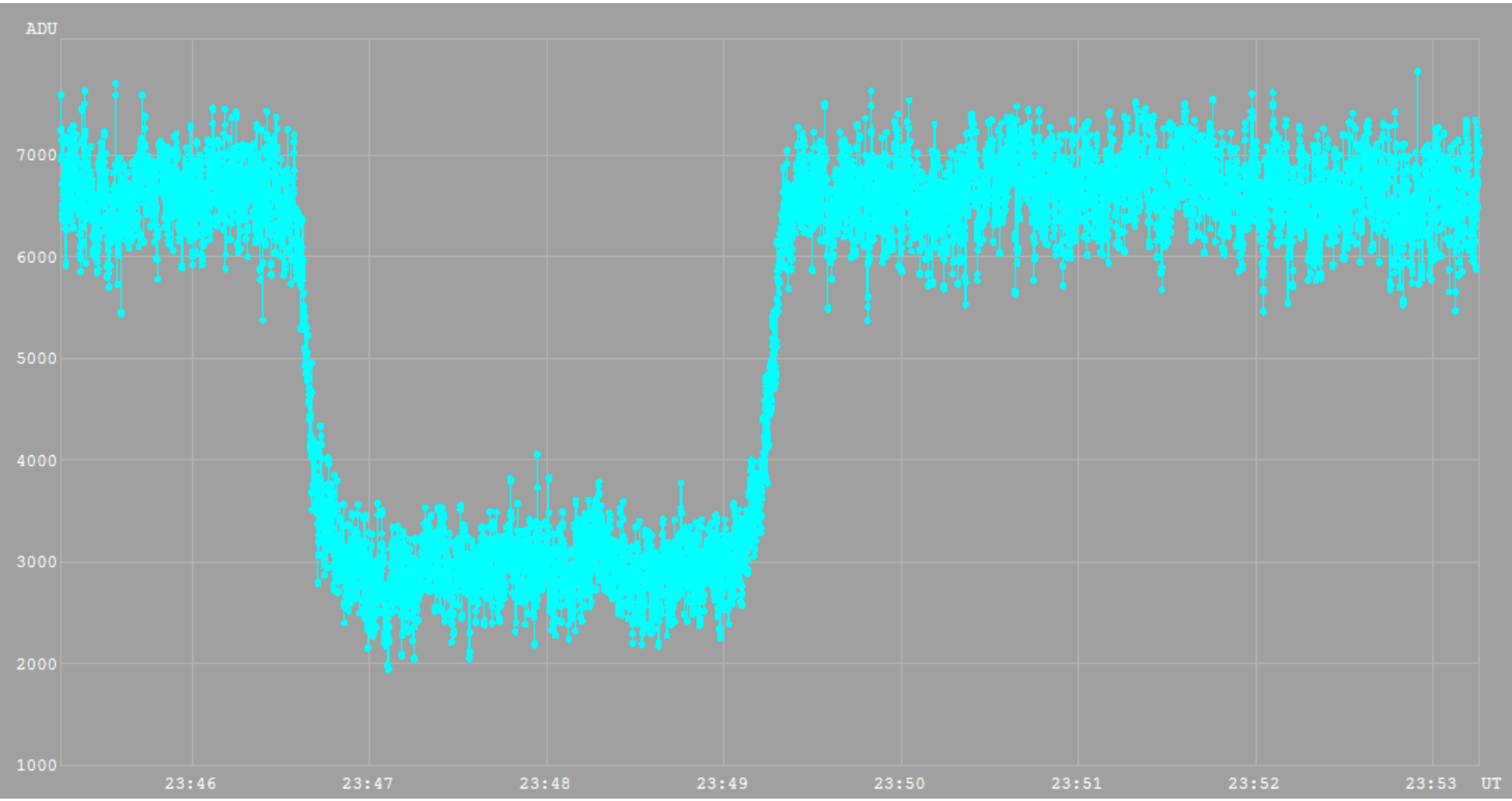
Coordinates obtained by IOTA VTI Inserter



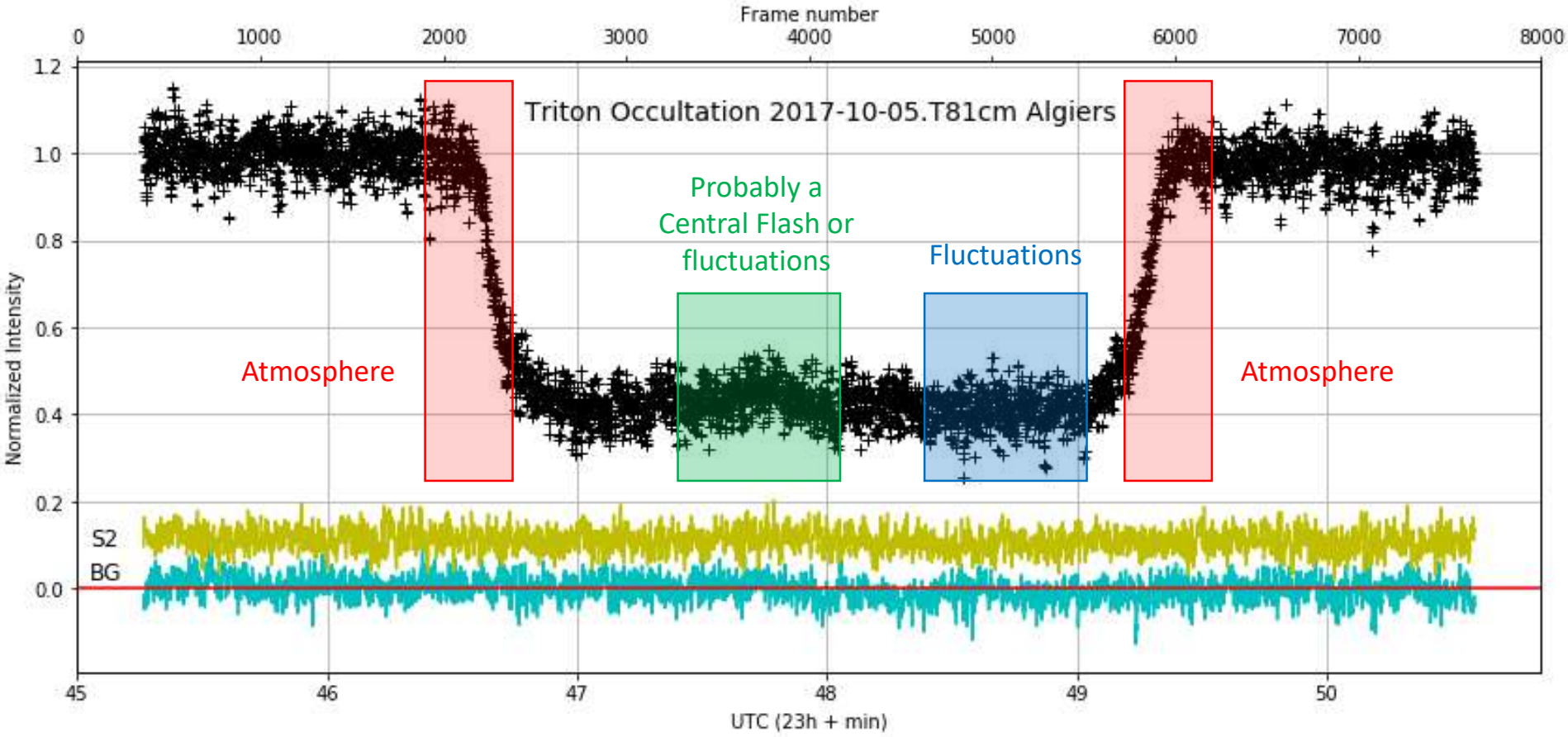


8th International Workshop on Occultation and Eclipse, Istanbul (Turkey), March 2018

Light Curve obtained by TANGRA software



After reduce data
light Curve processed and normalized



Special thanks for **Bruno Sicardy** and **Mike Kretlow**

Center of Research in Astronomy, Astrophysics and Geophysics

Expedition to Observe Stellar Occultation of Next New Horizons Spacecraft Flyby Target ULTIMA THULE 2014 MU69 at Tamanrasset (ALGERIA) on 4 August 2018

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New Horizons Probe

Goal : Flyby of Pluto system in 2015 and a Kuiper objet in 2019

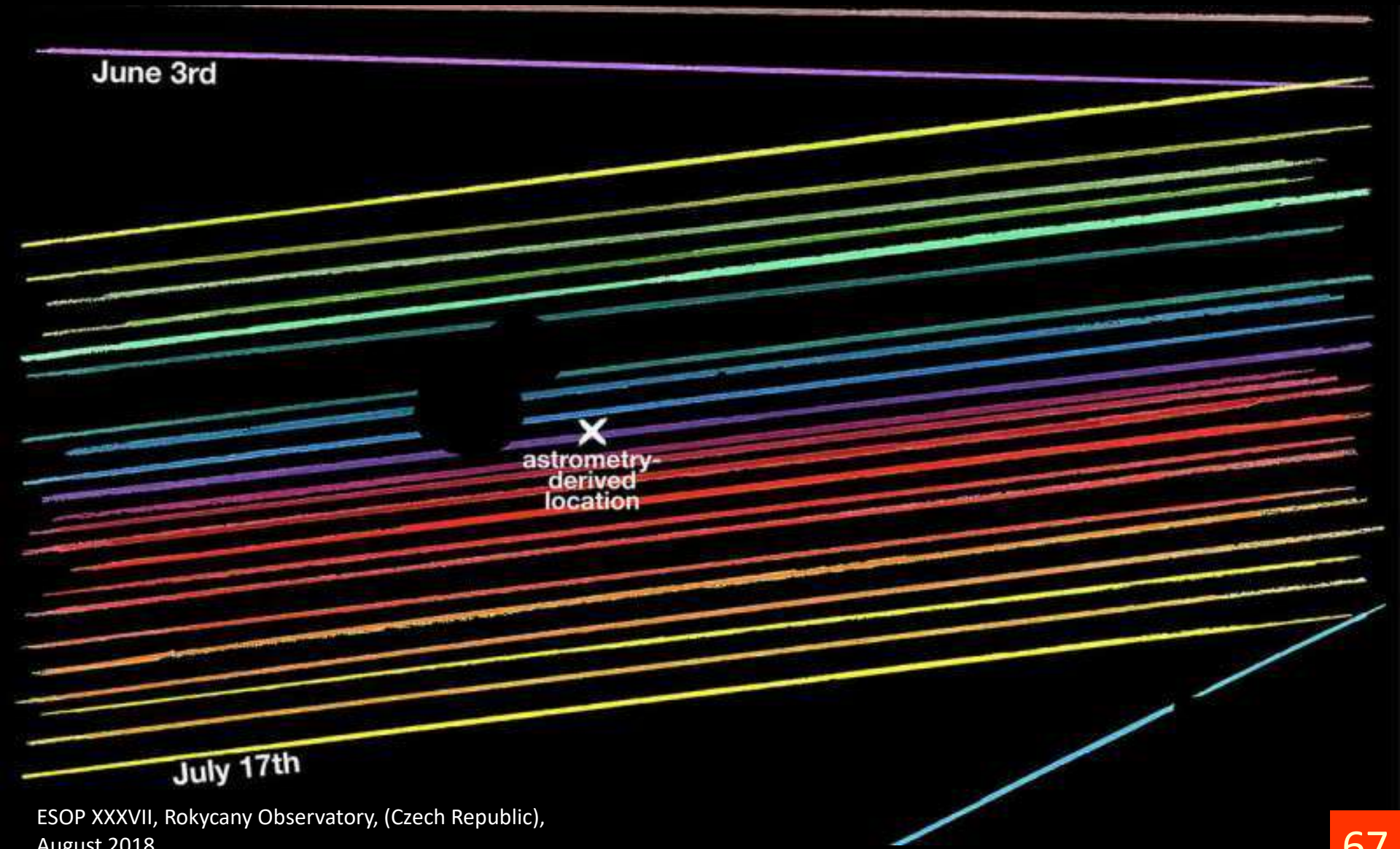
The Occultation of MU20180804 Star by the Kuiper Objet ULTIMA THULE 2014 MU 69 in August 4th 2018

The prediction is based on a Gaia DR2 pre-release position for the star and the orbit estimate for ULTIMA THULE 2014MU69. This orbit includes all data up through March 21th 2018. The event will be at 01:24 UT. The time at Senegal is 1:21:30 and Colombia is 1:26 UT. Star position is RA 19:04:21.5, Dec -20:35:37 (J2000).

TYC 6291-398-1 Star
Magnitude of the occulted Star : 13.3
Duration of the occultation : 1 to 2 seconds

Professor Marc BUIE
NASA supervisor of the occultation campaign of MU20180804 Star by the Kuiper Objet 2014 MU 69 in August 4th 2018

Chords obtained by the observation of the Stellar occultation of 2014 MU69 in July 17th 2017, Argentina



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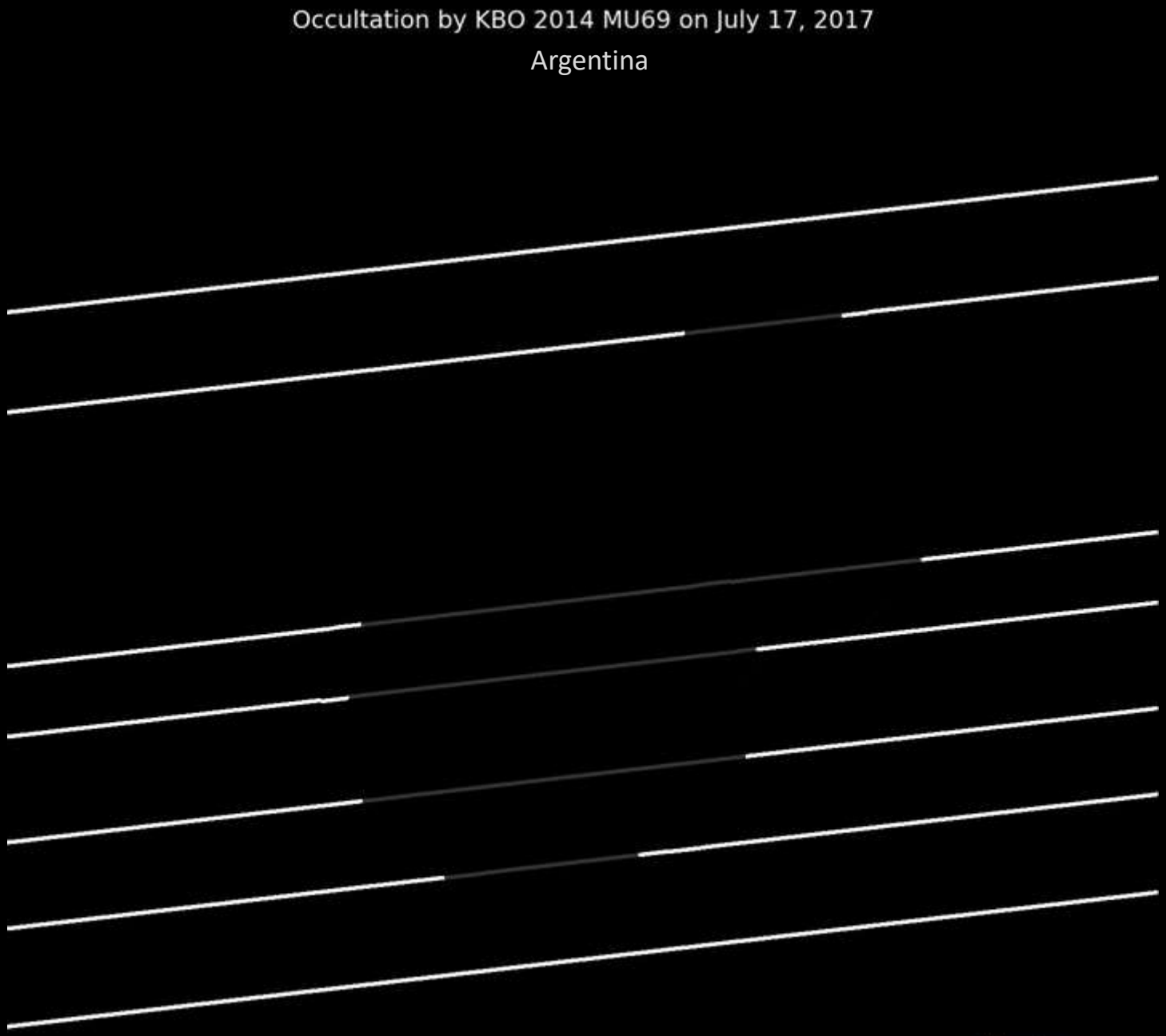

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The path of the occultation in the world Map

The path of the occultation in Senegal, Mauritania and Mali

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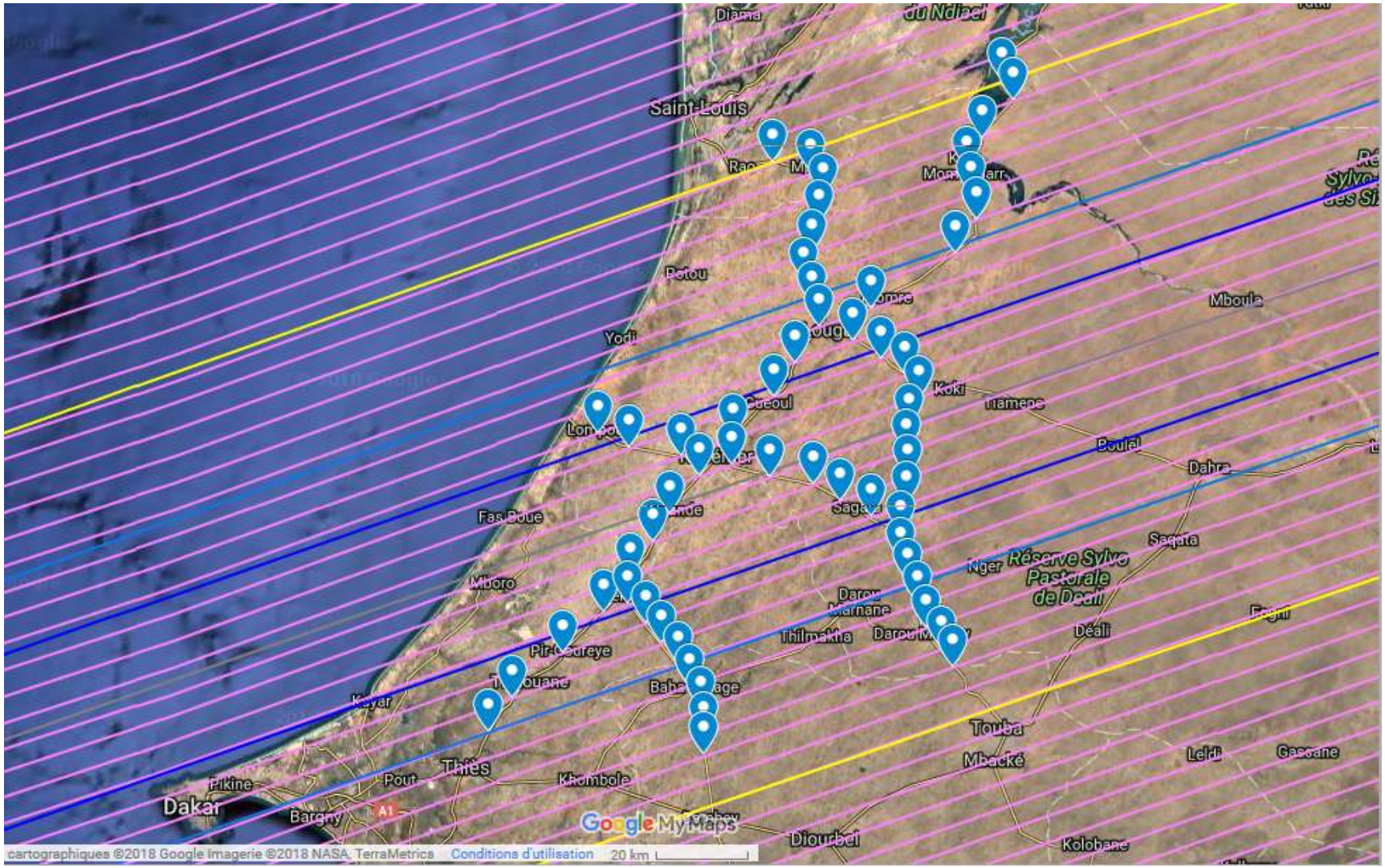
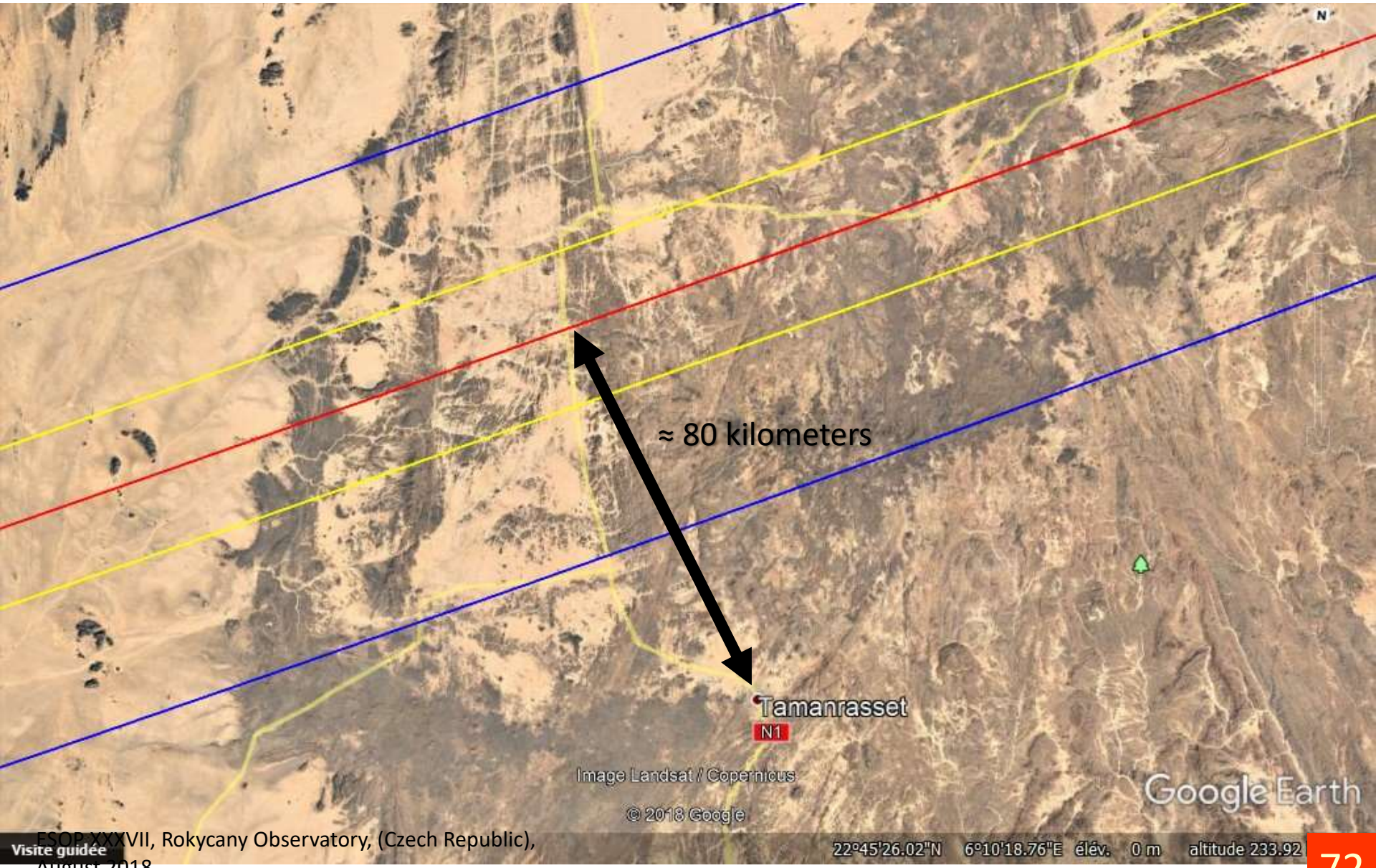
Distribution of the 23 NASA telescopes stations throughout the occultation band in Senegal



Zoom on the path prediction of the occultation in Tamanrasset



Zoom on the latest path prediction of the occultation in Tamanrasset

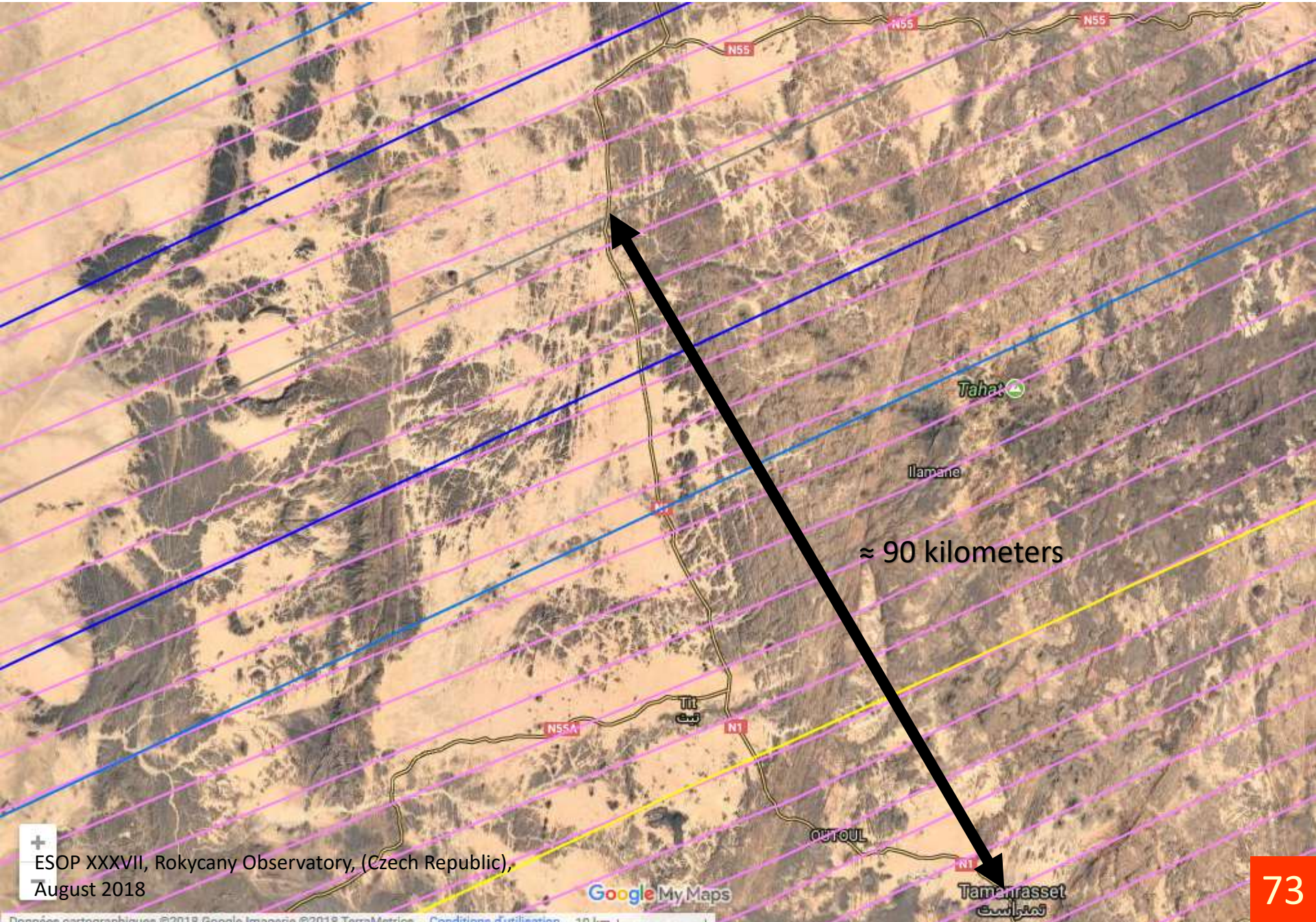
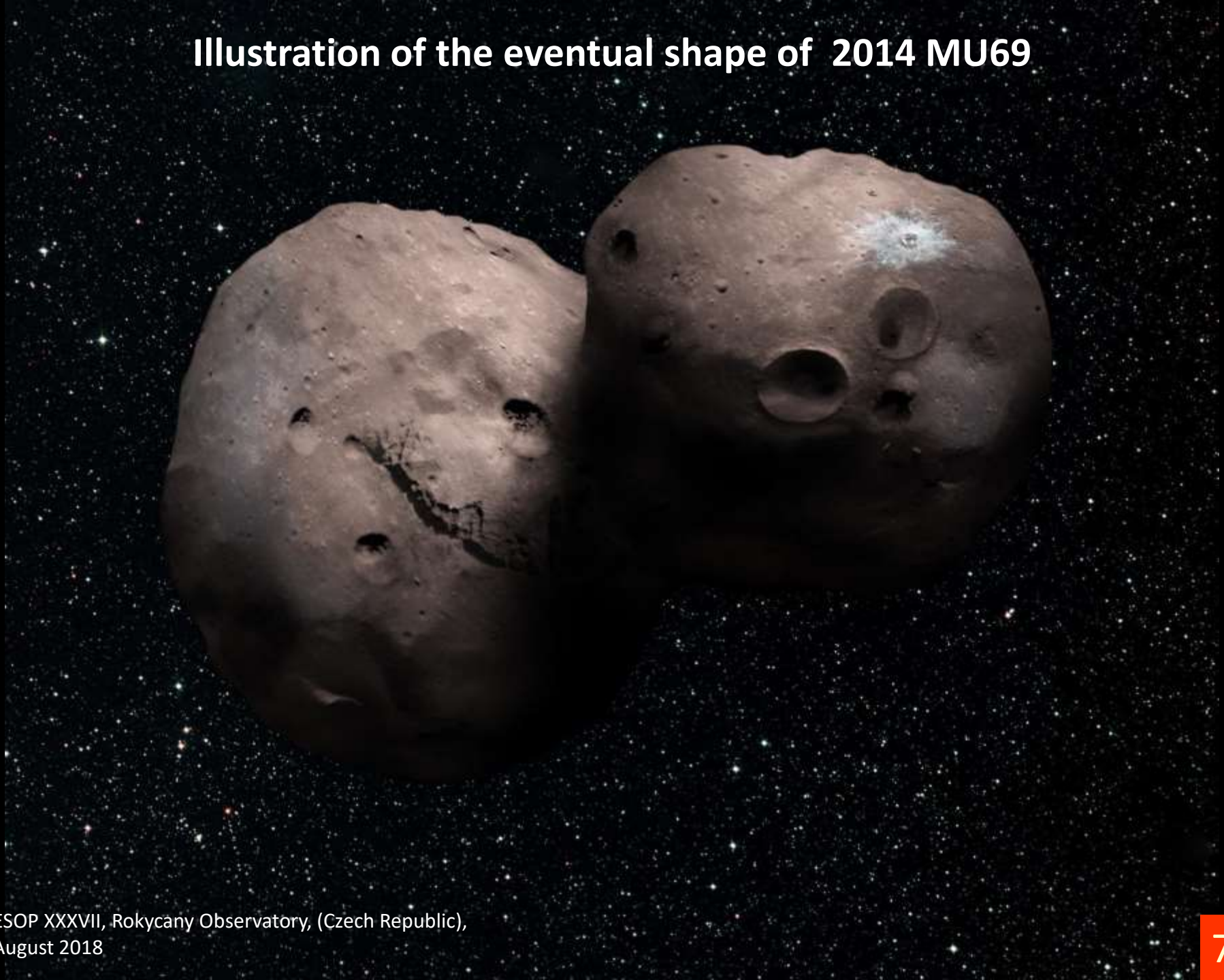


Illustration of the eventual shape of 2014 MU69



Flyby illustration of the eventual double Kuiper objet 2014 MU69 by New horizons in January 1st 2019

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GPSmap 60Csx
1018
GARMIN

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Study of stellar occultation by asteroids with low probability

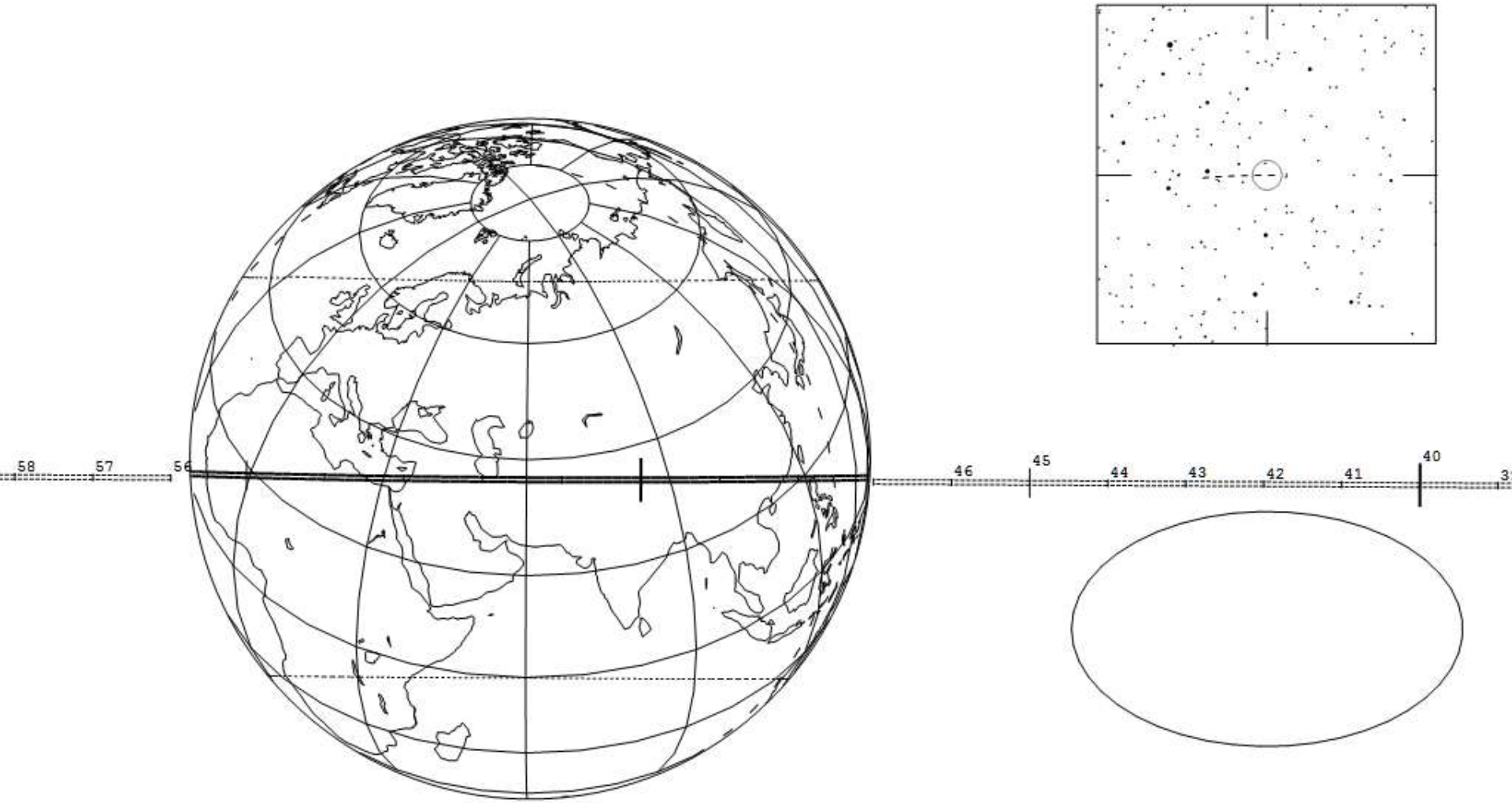
8405 Asbolus occults 4UC 650-023547 on 2017 Nov 20 from 20h 47m to 20h 56m UT

Star:
Mv = 14.5
RA = 4 52 5.9827 (J2000)
Dec = 39 59 3.252 ...
[of Date: 4 53 21, 40 0 39]
Prediction of 2017 Nov 15.5

Max Duration = 3.4 secs
Mag Drop = 7.9 (10.4r)
Sun : Dist = 155 deg
Moon: Dist =157 deg
: illum = 5 %
E 0.250"x 0.150" in PA 90

Asteroid:
Mag =22.4
Dia = 84km, 0.006"
Parallax = 0.435"
Hourly dRA =-0.521s
dDec = 0.03"

Prediction is from RIO_TNO feed. Contact RIO_TNO group with any observations
TNO object



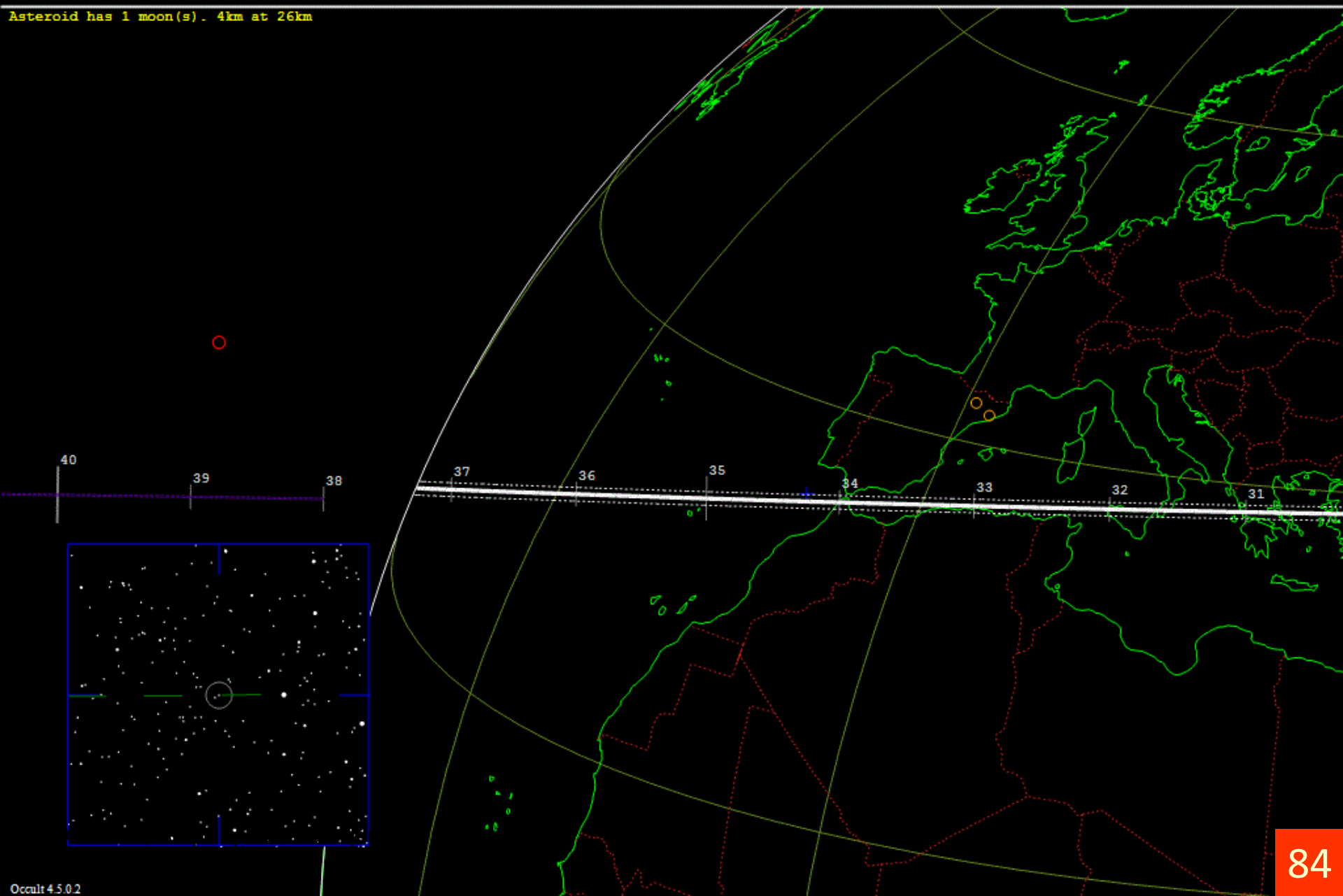
2121 Sevastopol occults TYC 1317-00116-1 on 2017 Dec 6 from 22h 20m to 22h 37m UT

Star:
Mv = 10.4 Mp = 10.4 Mr = 10.4
RA = 6 5 37.2448 (J2000)
Dec = 17 7 25.953 ...
[of Date: 6 6 40, 17 7 9]
Prediction of 2017 Nov 30.0

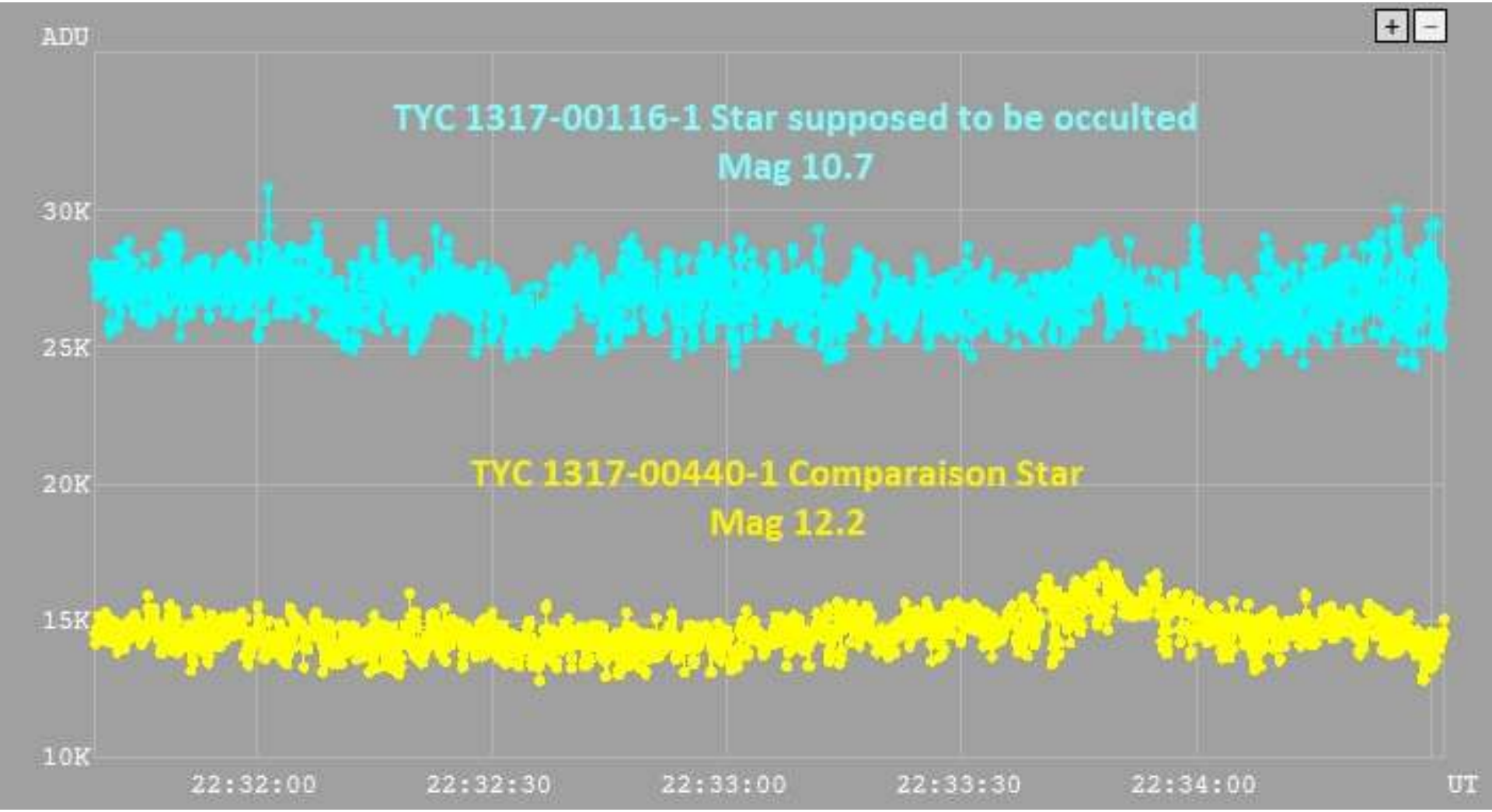
Max Duration = 0.8 secs
Mag Drop = 5.1 (4.7r)
Sun : Dist = 163 deg
Moon: Dist = 30 deg
: illum = 85 %
E 0.030"x 0.030" in PA 90

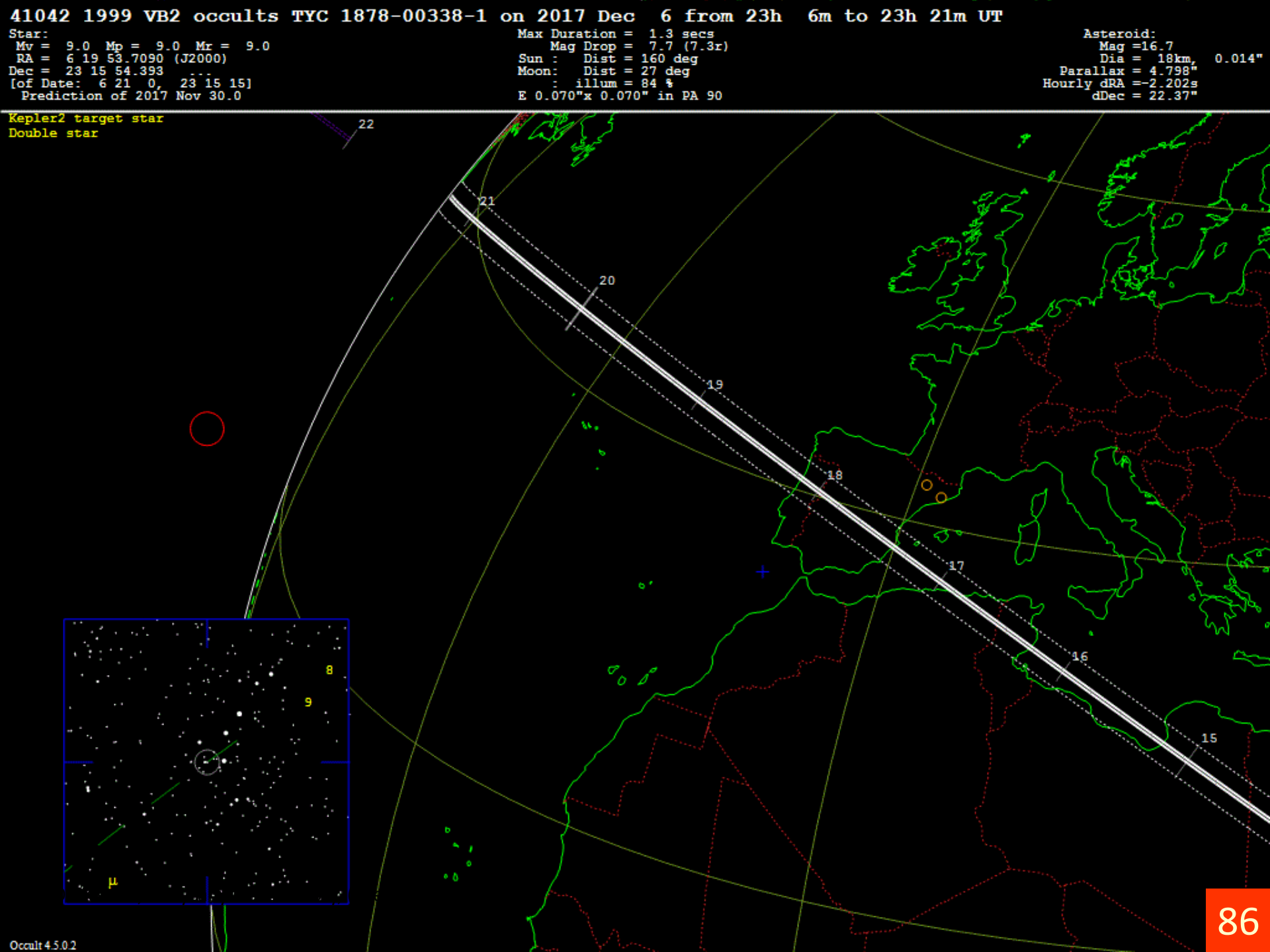
Asteroid:
Mag =15.5
Dia = 9km, 0.008"
Parallax = 5.930"
Hourly dRA =-2.730s
dDec = 0.59"

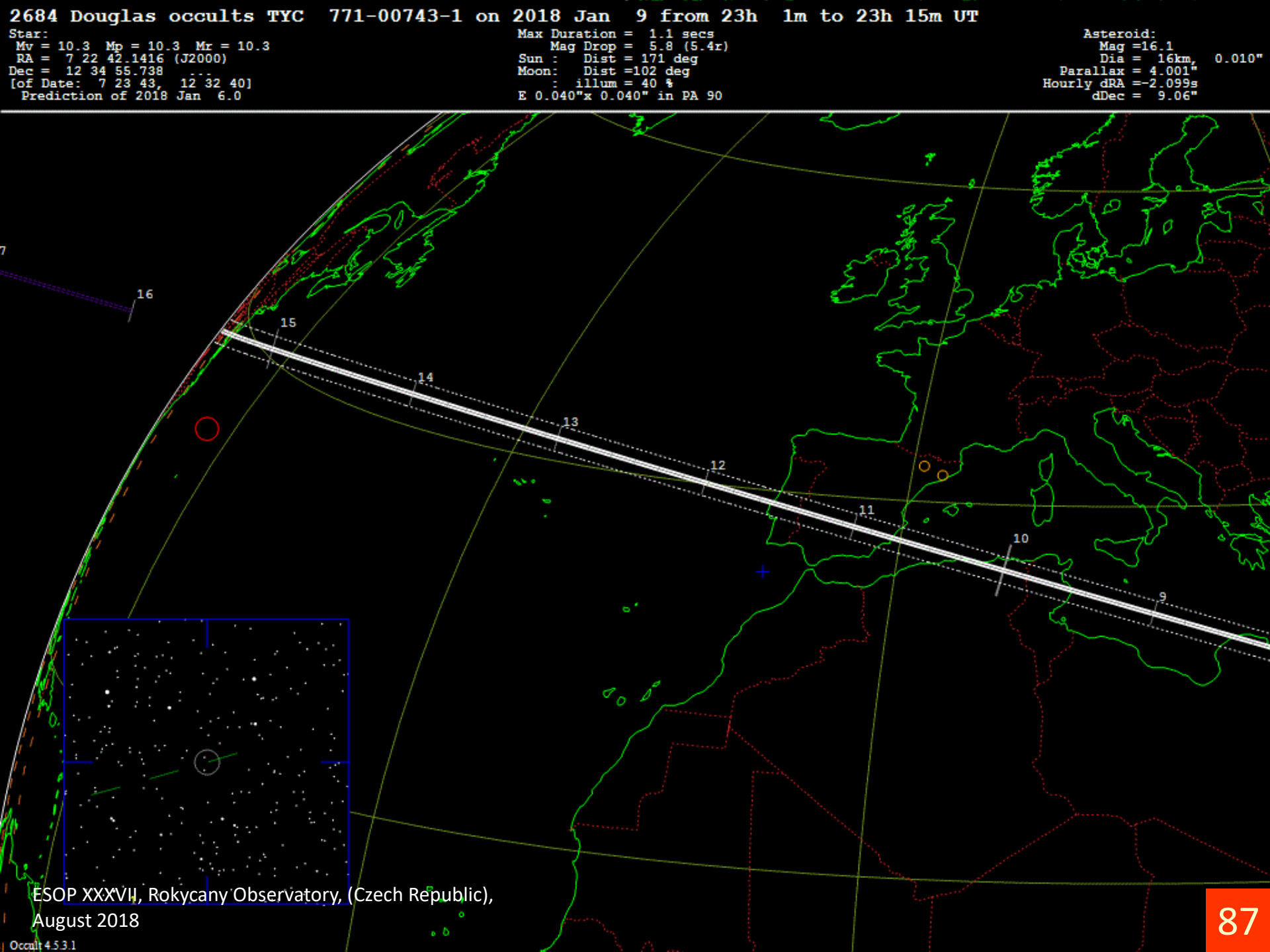
Asteroid has 1 moon(s). 4km at 26km



Occult 4.5.0.2


ADU
TYC 1317-00116-1 Star supposed to be occulted
Mag 10.7
30K
25K
TYC 1317-00440-1 Comparaison Star
Mag 12.2
20K
15K
10K
22:32:00
22:32:30
22:33:00
22:33:30
22:34:00
UT


41042 1999 VB2 occults TYC 1878-00338-1 on 2017 Dec 6 from 23h 6m to 23h 21m UT
Star:
Mv = 9.0 Mp = 9.0 Mr = 9.0
RA = 6 19 53.7090 (J2000)
Dec = 23 15 54.393 ...
[of Date: 6 21 0, 23 15 15]
Prediction of 2017 Nov 30.0
Max Duration = 1.3 secs
Mag Drop = 7.7 (7.3r)
Sun : Dist = 160 deg
Moon: Dist = 27 deg
: illum = 84 %
E 0.070"x 0.070" in PA 90
Asteroid:
Mag =16.7
Dia = 18km, 0.014"
Parallax = 4.798"
Hourly dRA =-2.202s
dDec = 22.37"
Kepler2 target star
Double star
22
21
20
19
18
17
16
15
8
9
μ
Occult 4.5.0.2



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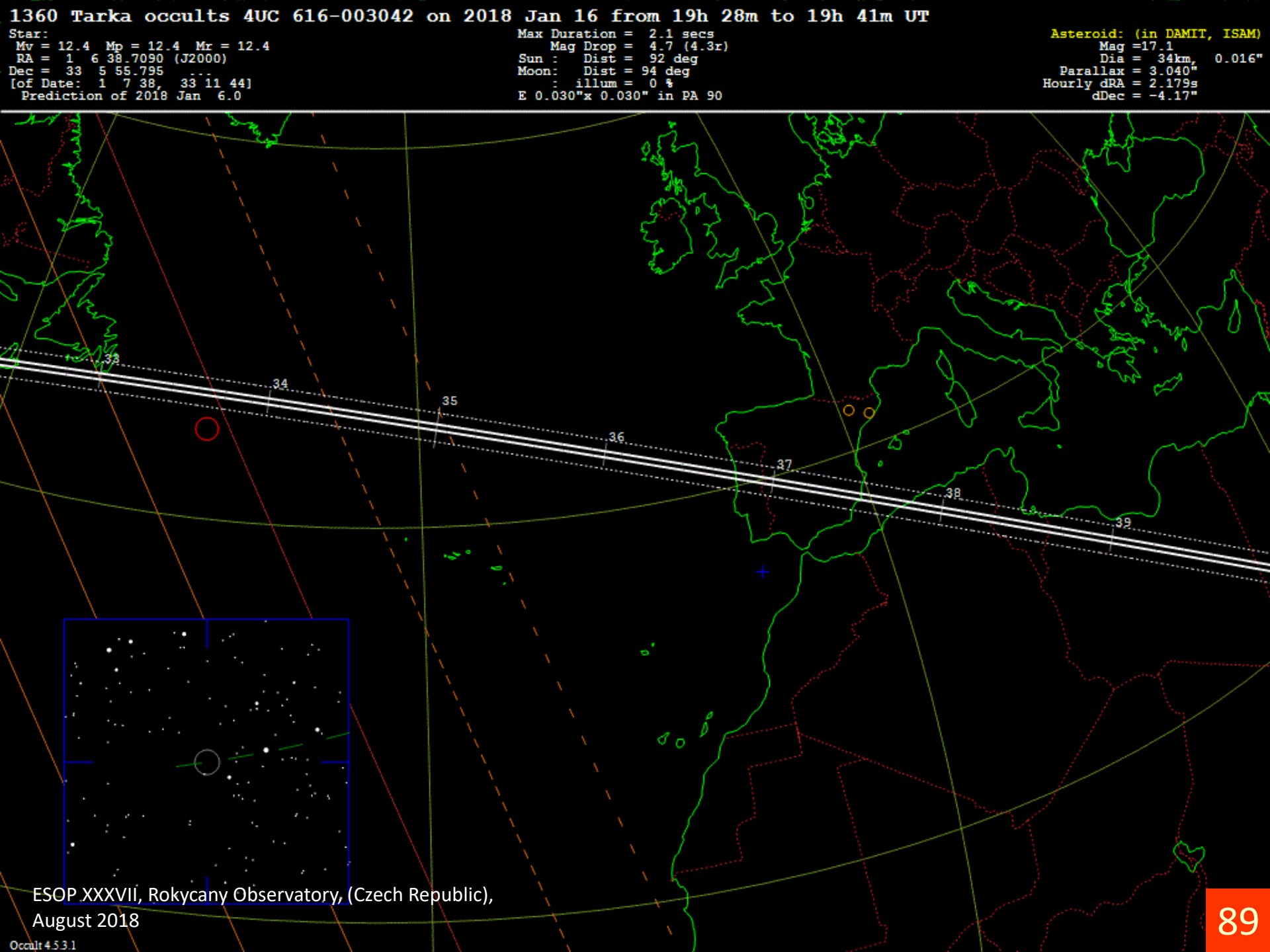
uvs180110-002.lc - Aperture Photometry, Average Background
File
Data
Customize
Add-ins
ADU
30K
25K
20K
15K
10K
5000
0
23:08:30
23:09:00
23:09:30
23:10:00
23:10:30
23:11:00
23:11:30
UT
Signal-minus-Background
No Normalisation
No Binning
Include Objects



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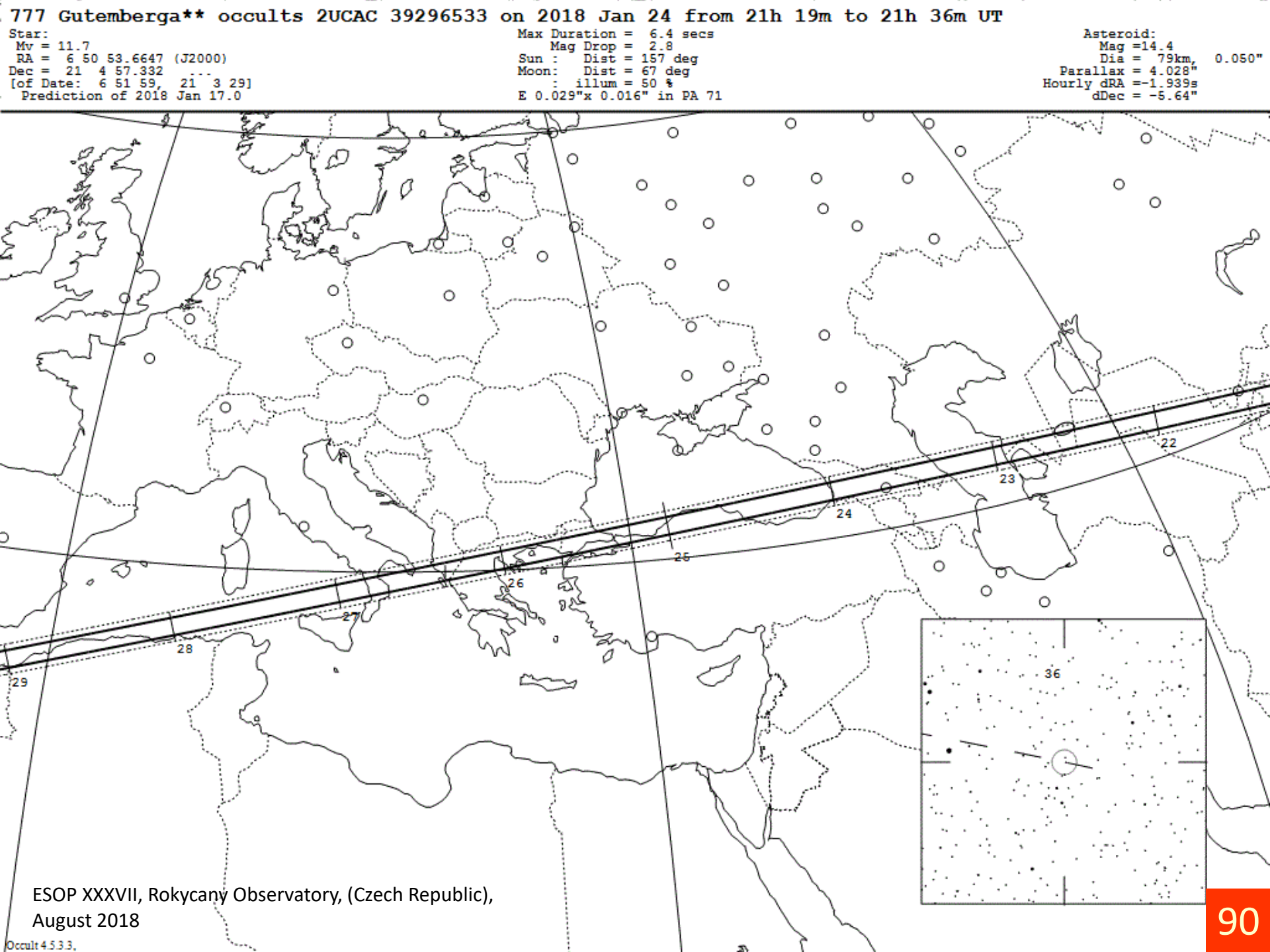

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I’m interesting to observe Near Earth Asteroids by occultation method.

There is 39 Near Earth Asteroids that have more than 4 kilometers of diameter.

6 of them are Potentially Hazardous Asteroids.

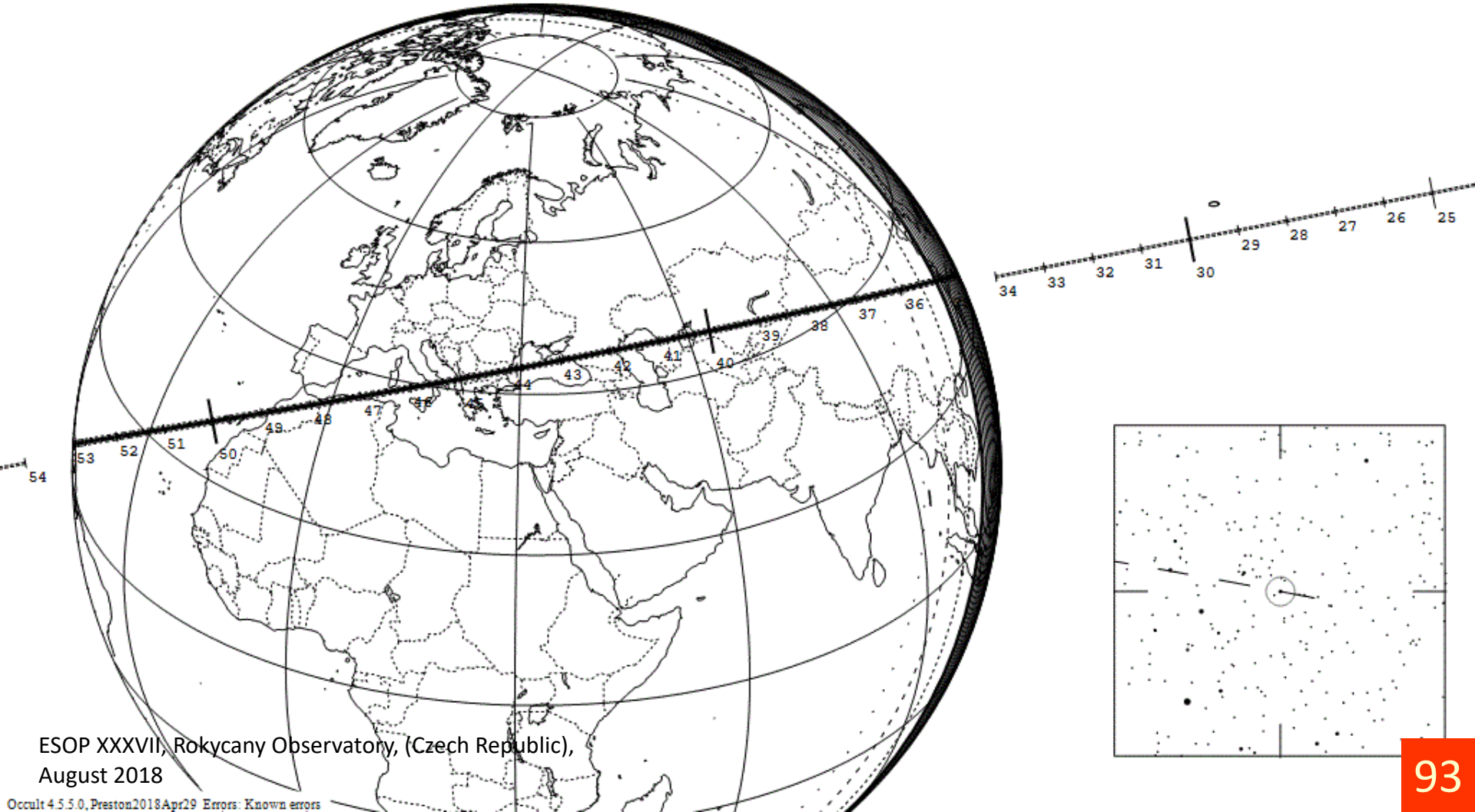
Next interesting occultation to observe in Algeria with the amateur network in Astronomy

1339 Desagneauxa occults TYC 2403-00937-1 on 2018 Nov 28 from 22h 35m to 22h 53m UT

Star:
Mv = 8.5
RA = 5 24 34.8930 (J2000)
Dec = 30 35 10.846 ...
[of Date: 5 25 48, 30 36 3]
Prediction of 2018 May 15.0

Max Duration = 2.3 secs
Mag Drop = 6.3 (0.0r)
Sun : Dist = 154 deg
Moon: Dist = 60 deg
: illum = 62 %
E 0.048"x 0.021" in PA 86

Asteroid: (in DAMIT, ISAM)
Mag =14.8
Dia = 26km, 0.019"
Parallax = 4.635"
Hourly dRA =-2.249s
dDec = -5.58"



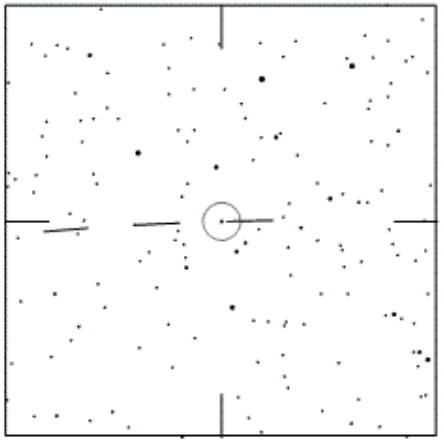
Occult 4.5.5.0, Preston2018Apr29 Errors: Known errors

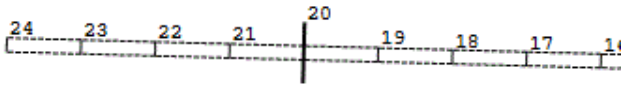
804 Hispania occults TYC 3360-00271-1 on 2018 Dec 8 from 21h 24m to 21h 41m UT

Star:
Mv = 9.1
RA = 5 40 57.9144 (J2000)
Dec = 46 6 20.599 ...
[of Date: 5 42 23, 46 6 45]
Prediction of 2018 May 15.0

Max Duration = 11.3 secs
Mag Drop = 3.2 (0.0r)
Sun : Dist = 156 deg
Moon: Dist =154 deg
: illum = 3 %
E 0.022"x 0.014" in PA 89

Asteroid:
Mag =12.2
Dia = 147km, 0.101"
Parallax = 4.391"
Hourly dRA =-3.111s
dDec = 0.86"





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Occult 4.5.5.0, Preston2018Apr29 Errors: Known errors

Summary

We are interesting by stellar occultation by asteroids with low probability observation like NEA (Near-Earth Asteroids) and TNO (TransNeptunian Objets).

I hope to characterize next year some of the 39 Near-Earth Asteroids that have more than 4 kilometers using 5 telescopes coupled with IOTA occultation kit.

We create an Algerian Amateurs Astronomers Network to observe stellar occultations by asteroids visually to develop participative astronomy in Algeria.

We wish to create a relationship with other partners around the world and especially from IOTA in order to develop this research in Algeria.

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August 2018