

Betelgeuse occultation in Spain

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ESOP XLII
Armagh

Occultation by Leona 13 Sept 2023. **GREAT SUCCESS**



Permanent stations participated and mobile stations were deployed to observe the event.

Permanent stations are the blue pins including the 3 largest observatories in Andalucia (Calar Alto, Sierra Nevada and La Sagra), Brown pins are the deployed stations from the IAA team, green pins are those by the ocultaas amateur deployment

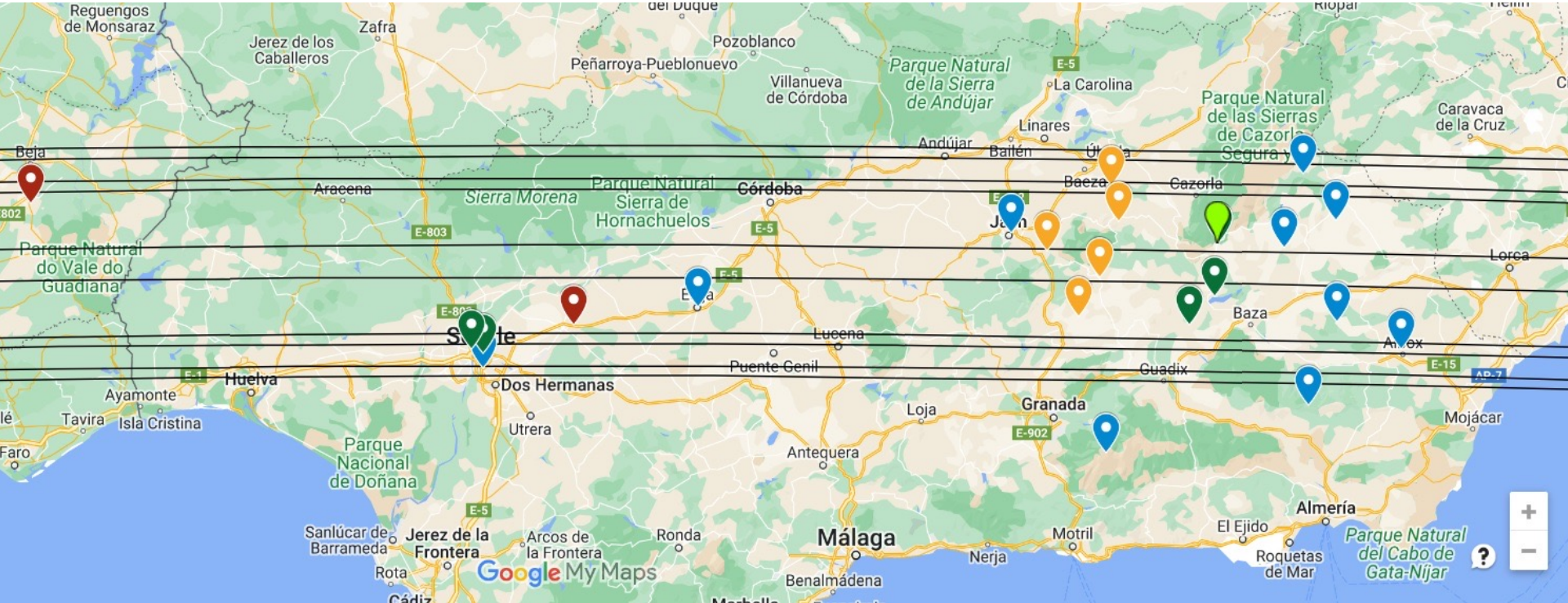


We had good weather in general as shown in the weather satellite at 3:45 UT

There are positive detections from 17 sites and 2 close negatives. At several sites there were multiple telescopes. For instance, at Calar Alto observatory we had 7 telescopes, so in total we have 26 positive recordings.

Occultation by Leona 13 Sept 2023

Close up view of the 25 participating stations, not including Murcia, outside the map.



The map shows two possible paths based on two different predictions, one using the JPL69 orbit and the other one taking into account an update using images of Leona on 3 nights taken with the 2m LT telescope at La Palma observatory. An assumed diameter of 61km was used.

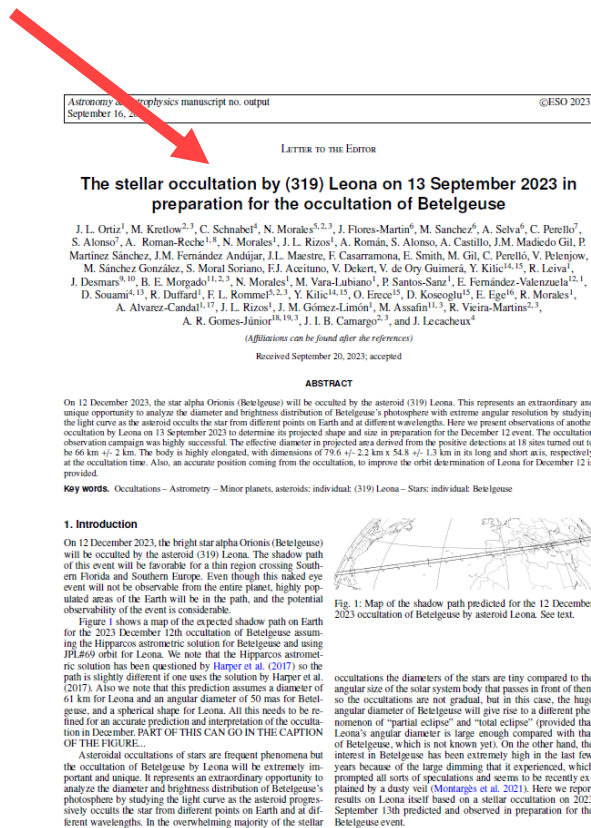
Occultation by Leona 13 Sept 2023

A paper on the preliminary occultation results is about to be submitted by **Ortiz, Kretlow, Schnabel et al. (2023)** to *Astronomy and Astrophysics letters* and simultaneously to Arxiv so that everybody can have a quick access to the preliminary results. **We expect to submit it by Monday or Tuesday.**

In the preliminary analysis Leona appears to be somewhat larger than most of the predictions and we have determined the long and short axis and the orientation. Stay tuned as results will soon be released, as well as a position to update the orbit.

Numerous resources and efforts have been made to achieve this in the professional and amateur field. **It is important that citations to the paper be made when referring to the results.**

We are still working on the rotational light curve to derive the rotational phase at the time of the occultation, which is also relevant for the 12 december 2023 Betelgeuse event.



(319) Leona occults UCAC4 521-014751 on 2023 Sep 13

OW Cloud

(319) Leona occults UCAC4 521-014751 on 2023-Sep-13 at 03:46 UT

Light Theme

Welcome, Carles Schnabel

Closest Approach	Rank	Asteroid	Star	Mag	Comb.	Drop	Max Dur
2023-Sep-13, 03:46 UT	100	(319) Leona (15.5 ^m)		11.9 ^m	11.9 ^m	3.6 ^m	2.32 sec

Predictions

Data Sources	Last Updated (UT)	Orbit Date	Error (PW*)	Error (time)	Path Diff**
Horizons/GaiaEDR3 <small>default</small>	25 Aug, 08:47 (by OWC)	23 Aug 2023 (JPL#69)	0.07	0.8 sec	-
Horizons/GaiaEDR3	06 Sep, 17:40 (by Carles Perelló)	23 Aug 2023 (JPL#69)	0.06	0.8 sec	-0.38 km
LuckyStar/GaiaEDR3	02 Sep, 01:35 (by DaveGault)	18 Jul 2023	0.36	2.3 sec	-5.7 km -2 sec
	16 Jul, 18:50 (by SteveP)	27 Apr 2023	12.14	34.3 sec	+3.4 km +3 sec

* PW = path widths; ** Across and along path difference between predictions. Across path shift is computed on the Fundamental Plane, where '-' indicates a left and '+' a right path shift.

Report observations to the LuckyStar group using the Occultation Portal <https://occultation.tug.tubitak.gov.tr/> to continue the collaborative work. Questions can be sent to ribas@on.br or josselin.desmars@obspm.fr

Countries in 1-σ Zone (19)

- Algeria
- Cambodia
- Greece
- India
- Iran
- Iraq
- Israel
- Italy
- Jordan
- Lebanon
- Myanmar
- Pakistan
- Philippines
- Portugal
- Spain
- Syria
- Thailand
- Tunisia
- Vietnam

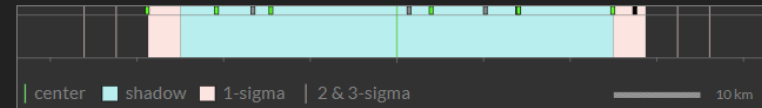
Tags (3)

- IBEROC
- IDTA
- LuckyStar

Tag Event



Shadow crossing the Earth for 9:24 min from 03:41:46 UT to 03:51:11 UT



Stations (13)

Chord	Observer	Note
-52.6 km	Carles Schnabel	Was clouded out or failed to observe
-29.0 km	Rui Goncalves	Observed a 1.5 sec occultation
-21.0 km	j. rovira	Observed a 1.8 sec occultation
-16.8 km	Carles Schnabel	No report
-14.8 km	Carles Schnabel	Observed a 24 sec occultation
1.2 km	Jose Maria Fernandez Andujar	No report
3.7 km	Antoni Selva	Observed a 2.8 sec occultation
10.0 km	Rafa Farfán	No report
13.7 km	Miguel Gil	No report
13.7 km	Miguel Gil	No report
13.8 km	F. Casarramona	Observed a 2.7 sec occultation
24.7 km	Jesus Delgado	Observed a 235 sec occultation
27.2 km	Carles Schnabel	No observation

Ferran Casarramona, Toni Selva, Carlos Perelló, Carles Schnabel



...with Eric Smith and Miguel Gil



Selva's station at Mirador del Negratín



Casarramona's station at Complejo Astronómico Los Coloraos



Results from IOTA observers



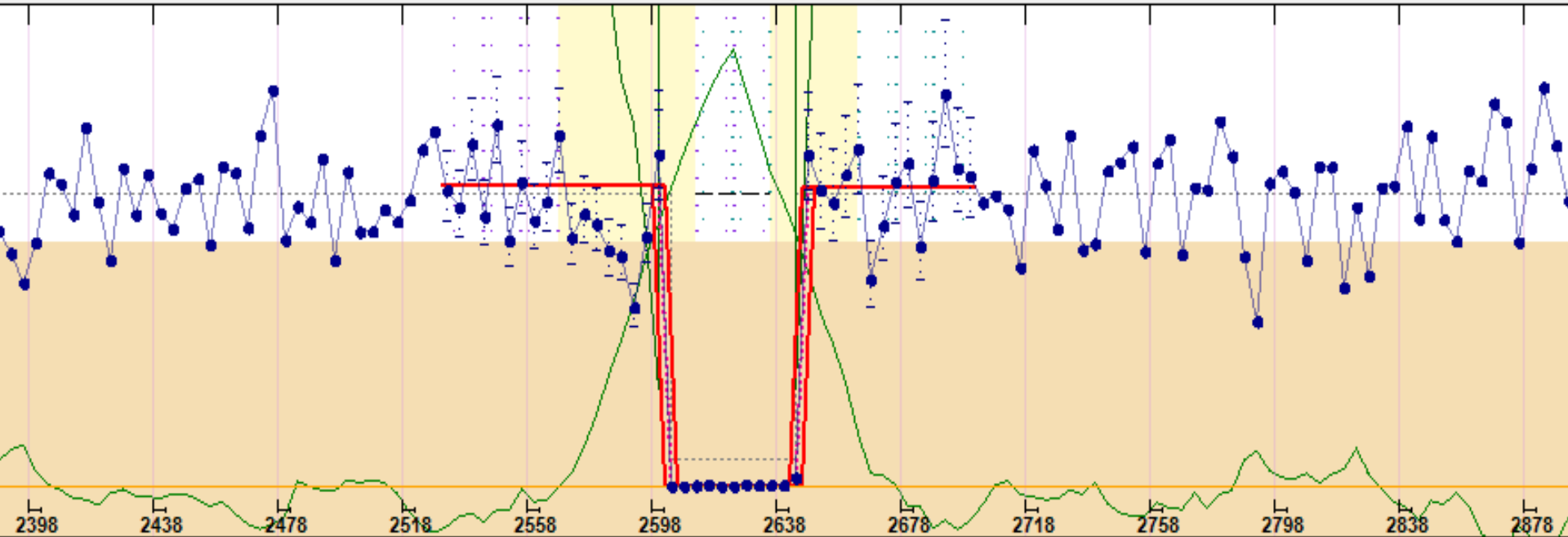
J. Rovira

1.8 s

2023.5.18 File being processed is F:\2023\ASTEROIDAL OCC\319_Leona\319_Leona_Master0001 05-41-46.avi, measured with Tangra

Edit... Star diameter analysis... Light curve report Help Hints and Tips Exit ... Right-click on plot to display frame in Tangra

CTRL + Right-click - to toggle validity of a data point



Objects

↑ 1.00 ↓

10 15

Point average

1. Read, Integrity, Set time, Bin & normalise
2. (info) Fourier plot
3. Find events
4. Select event to analyse
5. Analyse event #1
6. Camera corrections & final time

Camera corrections

Video camera

WAT-910HX

Video system

NTSC PAL Other Unknown

Final results ** Event #1

Time Source : Tangra

Verify

D at frame 2602.0 ±2.0/2.0

Save AOTA images

Save Tab 5 image

1 events to ana

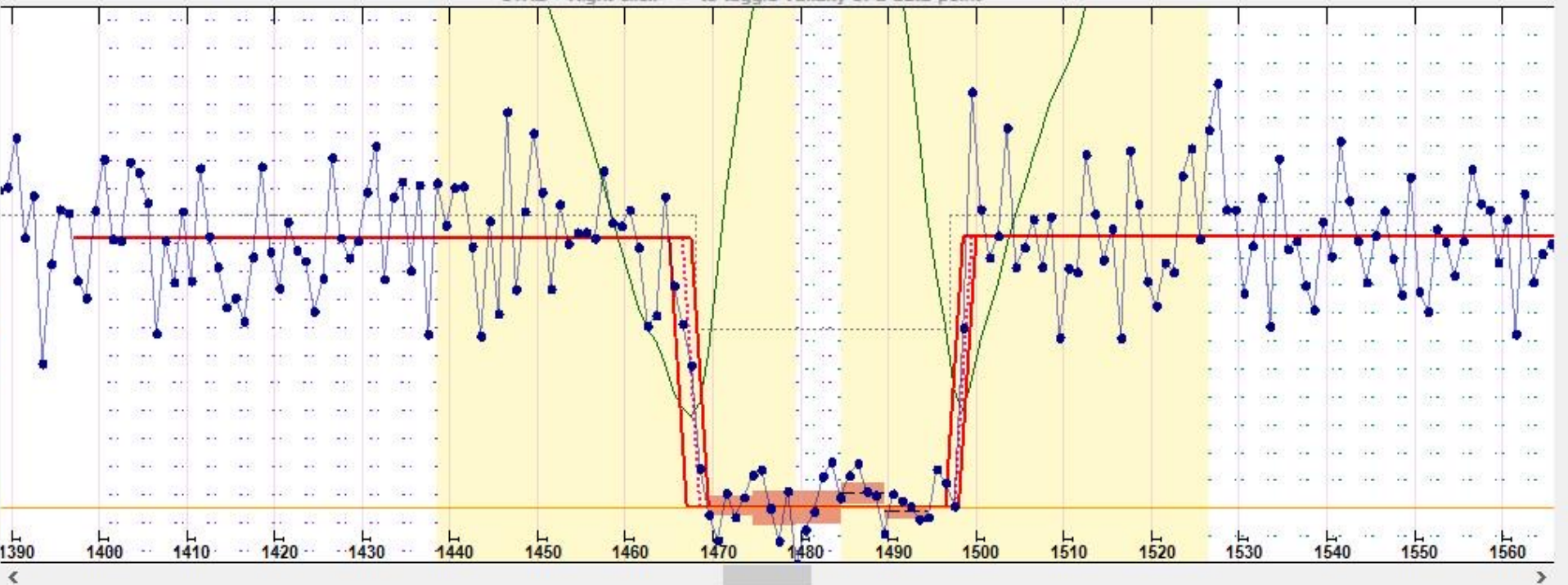
Set Event # as a non-eve

Perelló – Schnabel

2.4 s

AOTA v4.2023.8.18 File being processed is D:\Documents\Observaciones\Ocultaciones\Asteroidales\UCAC4 521-014751 x (319) Leona\20230913-05h41m32s_309_Leona_lag.lc, measured with .

File... Edit... Star diameter analysis... Light curve report ? Help ? Hints and Tips X Exit ... Right-click on plot to display frame in Tangra
CTRL + Right-click - to toggle validity of a data point



Scale, Objects
5.7 1.00
1 5 10 15
0 -point average

1. Read, Integrity, Set time, Bin & normalise 2. (info) Fourier plot 3. Find events 4. Select event to analyse 5. Analyse event #1 6. Camera corrections & final times Event #1

Camera corrections	Video system	Final results ** Event #1	Save AOTA images	1 events to analyse
Video camera WAT-910HX	NTSC PAL Other Unknown	Time Source : Tangra D at frame 1467.5 +1.0/-1.5	Verify Save Tab 5 image	Set Event # 1 as a non-event

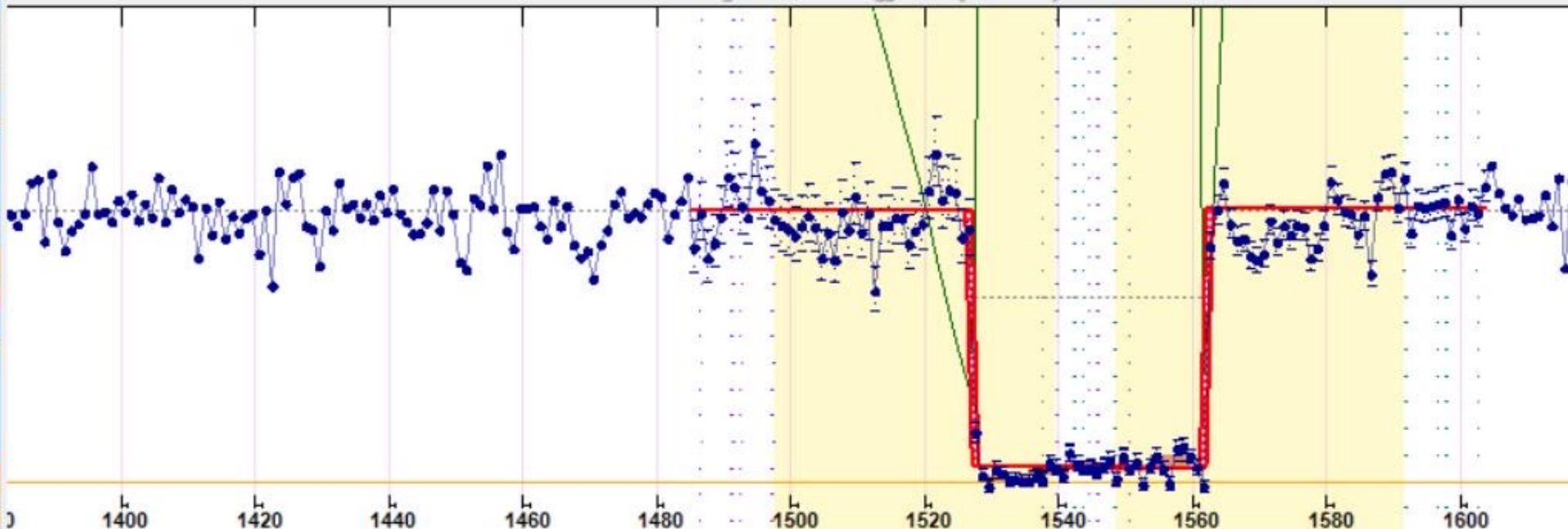
T. Selva

2.8 s

AOTA v4.2023.8.18 File being processed is C:\Observacions\20230912\20230913_319_aselva.lc, measured with Tangra

File... Edit... Star diameter analysis... Light curve report  Help  Hints and Tips  Exit ... Right-click on plot to

CTRL + Right-click - to toggle validity of a data point



Scale, Objects
↔ 3.5 ↓ 1.00
1 5 10 15

1. Read, Integrity, Set time, Bin & normalise 2. (info) Fourier plot 3. Find events 4. Select event to analyse 5. Analyse event #1 6. Car

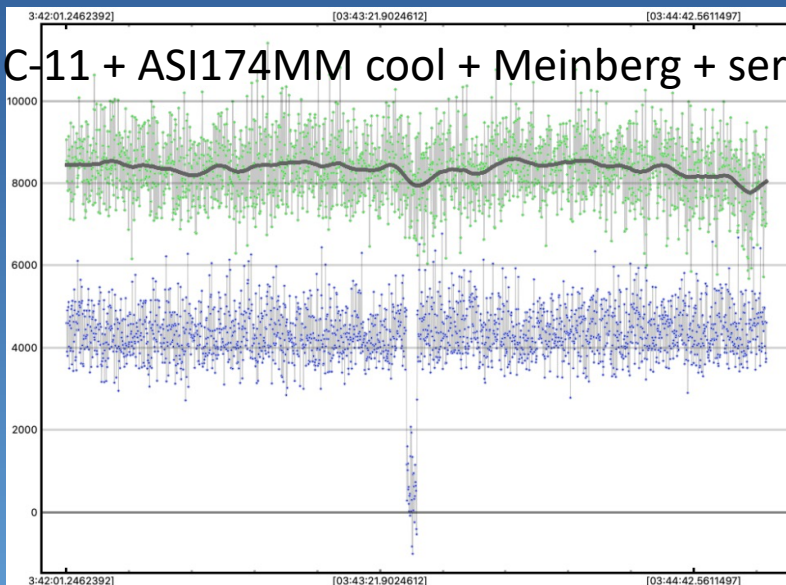
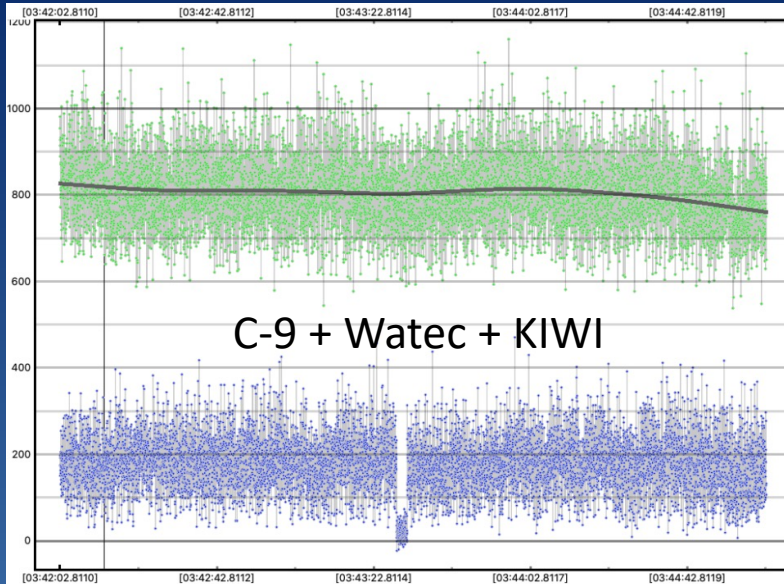
Camera corrections
Video camera: WAT-910HX
Video system:

Final results ** Event #1
Time Source: Tangra Verify

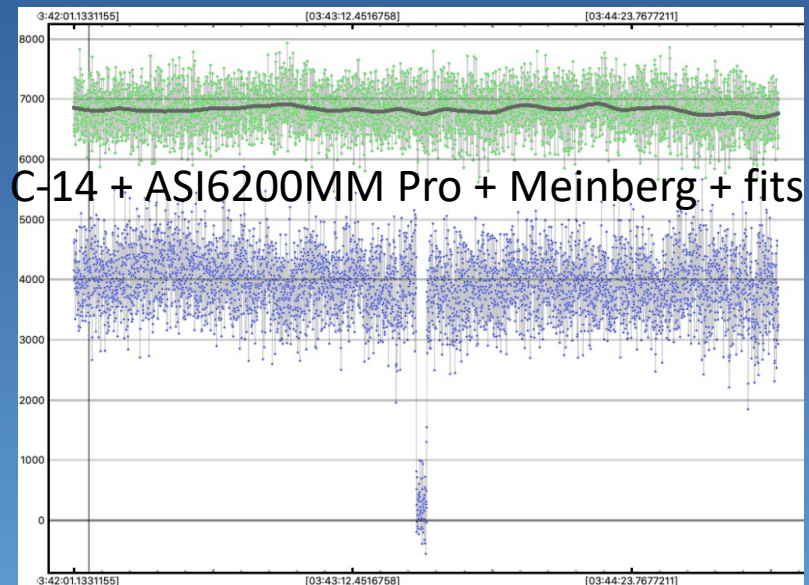
Save AOTA ima

F. Casarramona – M. Gil – E. Smith

2.7 s



Delay: 126 ms



Delay: 84 ms

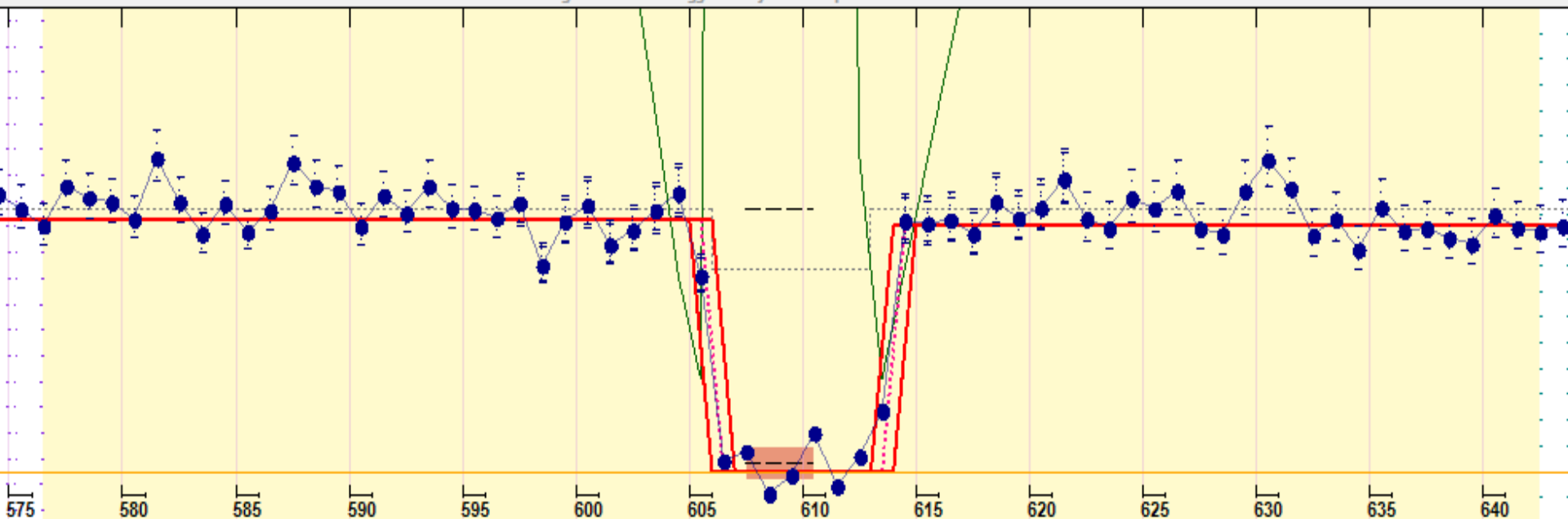
J. Delgado

2.35 s

A v4.2023.8.18 File being processed is C:\Users\Jesus\Desktop\319 Leona Ocultacion\03_40_21Z.lc, measured with Tangra

le... Edit... Star diameter analysis... Light curve report Help Hints and Tips Exit ... Right-click on plot to display frame in Tangra

CTRL + Right-click - to toggle validity of a data point



Scale, Objects

4.2 1.00

5 10 15

1. Read, Integrity, Set time, Bin & normalise
2. (info) Fourier plot
3. Find events
4. Select event to analyse
5. Analyse event #1
6. Camera corrections & final times Event #1

Camera corrections

Video camera

QUX17/CPS

Video system

Final results ** Event #1

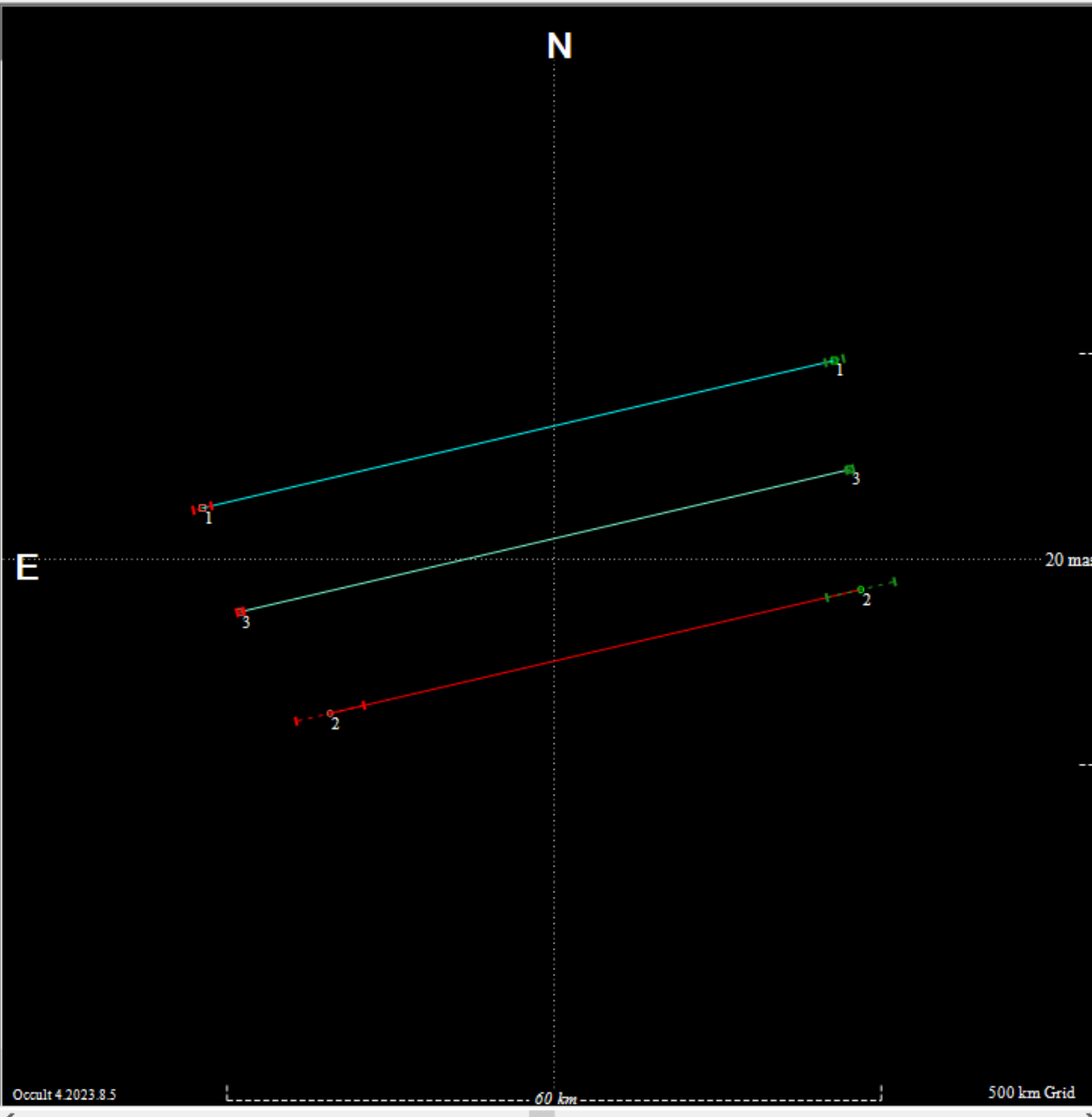
Time Source : Tangra

Verify

Save AOTA images

1 events to analyse

Set Event # 1 as a non-event



Find best fit

Center X: 2.6 -5.3 Mass X: 0.0

Center Y: -2.7 8.2 Mass Y: 0.0

Major axis (km): 78.0 -6.4 Shape model:

Minor axis (km): 53.2 6.3 a/b: 1.47, dMag: 0.42

Orientation: 57.3 -23.0 Motion: 21.26 km/s

Circular Use assumed diameter Include Miss events

Double stars - show: Both Primary Secondary

Quality of the fit: Astrometry only. No reliable size Flag for future review

Scale: [Slider]

Size: normal x 2 x 5 Form opacity: [Slider]

Scroll range x1.25

RMS fit -2.2 ±3.2 km

—	1	A. Selva, near Cuevas D
—	2	J. Delgado, near Camas
—	3	F. Casarramona, near Go

Betelgeuse occultation 2023, Dec 12

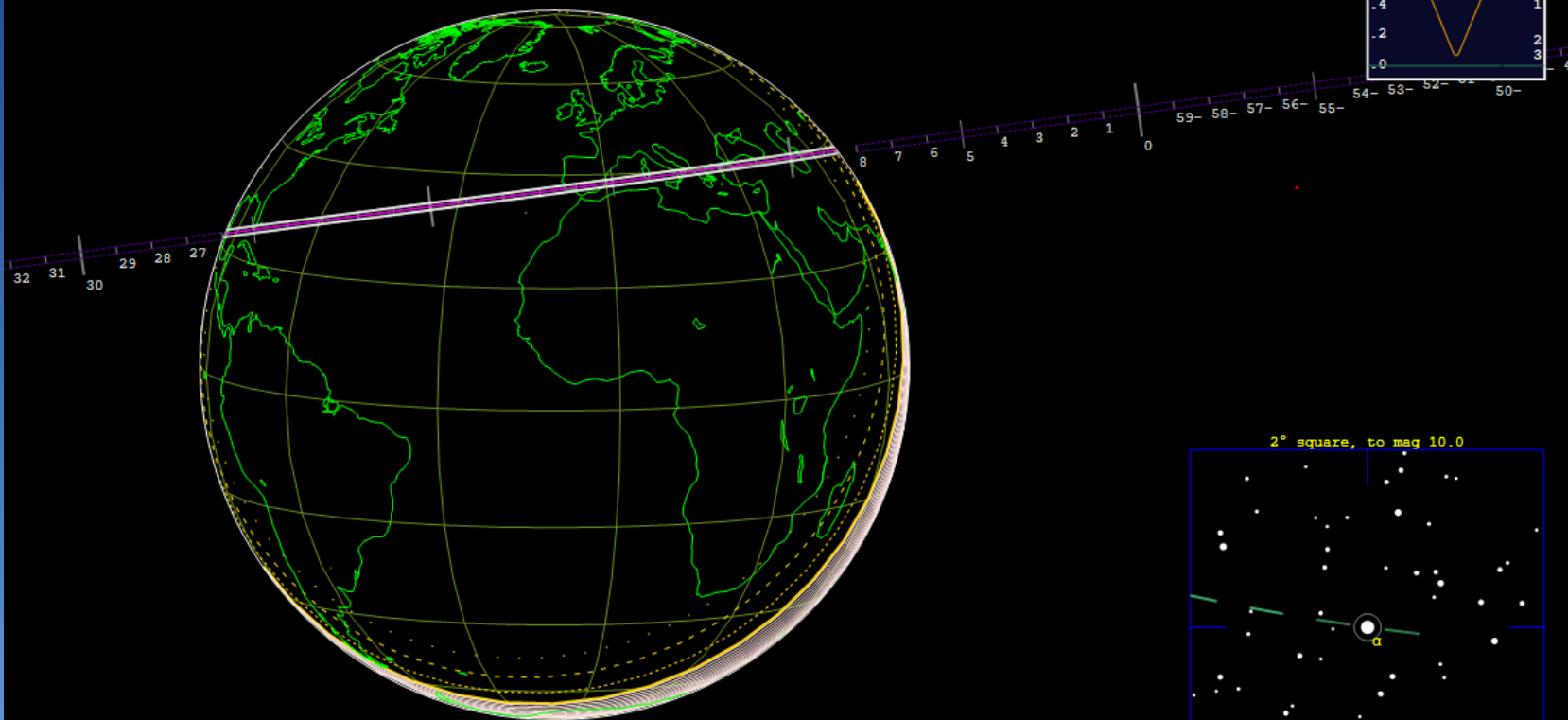
319 Leona occults HIP 27989 (Betelgeuse, α Ori) on 2023 Dec 12 from 1h 8m to 1h 26m UT

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 2023 Aug 9.3
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%
1 σ Err: $\pm(7.7 \times 2.2)$ mas in PA 79°

Asteroid:
Mag = 14.2
Dia = 61.43km, 46 mas
Parallax = 4.864"
Hourly dRA = -1.949s
dDec = -3.98"
JPL#68: INTG:2023-Aug-08, Known errors

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



Betelgeuse occultation 2023, Dec 12

Where to meet



Betelgeuse occultation 2023, Dec 12

At the moment, write to me
schnabelcarles@gmail.com

Interactive map:

<https://www.google.com/maps/d/u/2/edit?mid=1litFRSEU6DuXqaaUhVdMqb-AWJQBlyM&usp=sharing>





THANKS !

¡ MUCHAS GRACIAS !

Carles Schnabel & Jose Luis Ortiz
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Haumea artistic impression IAA-CSIC