The Betelgeuse/Leona ocultation 12th December 2023

Miguel Montargès

LESIA | l'Observatoire de Paris | PSL

Laboratoire d'Études Spatiales et d'Instrumentation en Astrophysique

Région îledeFrance

Derrick Lim
APOD 21 Mar, 2018

ESOP 42
17th September 2023

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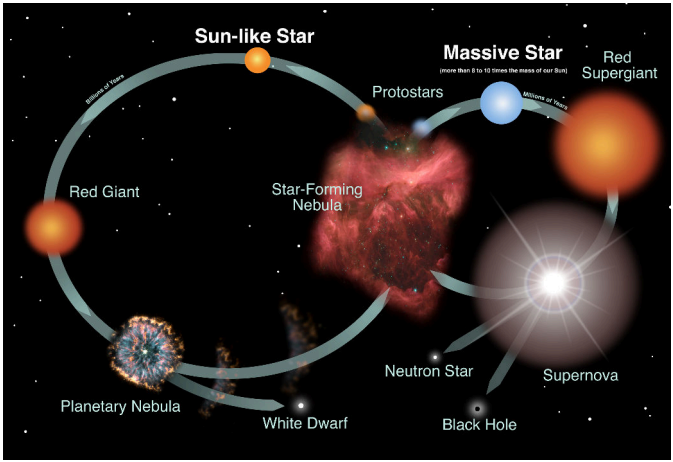
Stellar evolution cycle

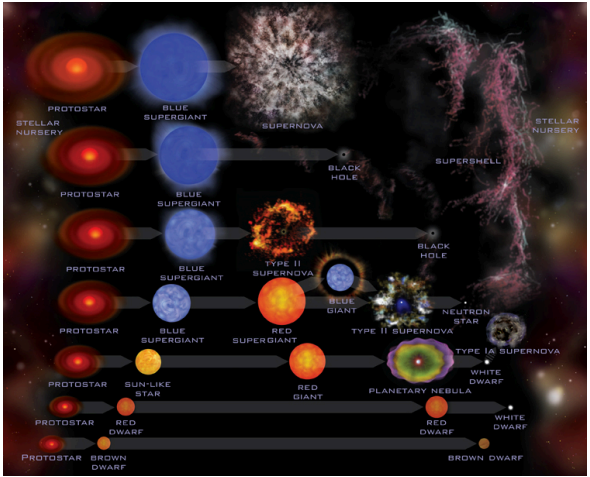
Asymptotic Giant Branch (AGB, $M_{init} \lesssim 8\ M_\odot$)



Credits: NASA and the Night Sky Network

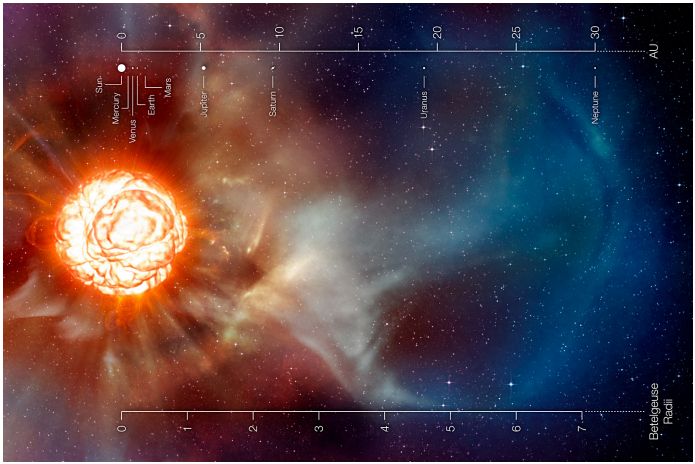
Red supergiant (RSG, $M_{init} \gtrsim 8\ M_\odot$)

Stellar evolution cycle



Credits: NASA/Chandra

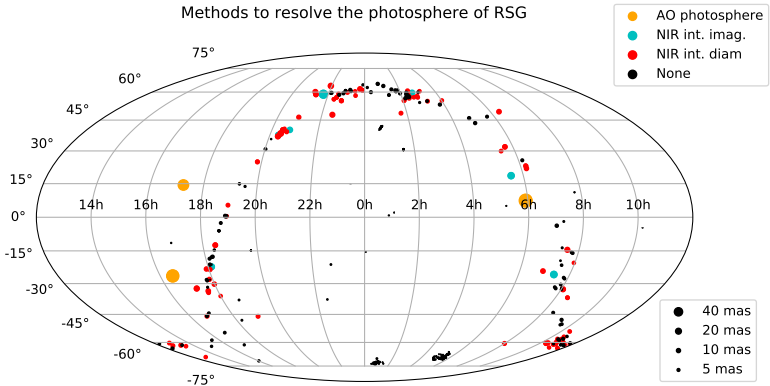
Mass loss of red supergiant stars



1 $M_\odot$ / 500 000 years

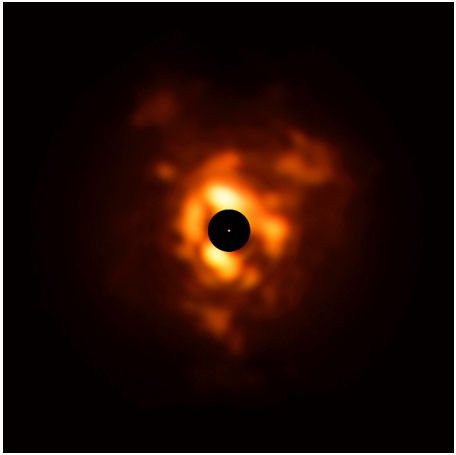
Credits: ESO/L. Calçada / Video st35gm04b0n002_l3brm_1

RSGs as seen from Earth



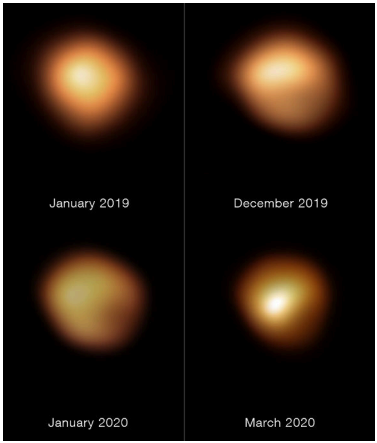
Credits: M. Montargès

Betelgeuse with high angular resolution



VLT/VISIR at 10μm - FoV : 5.63"

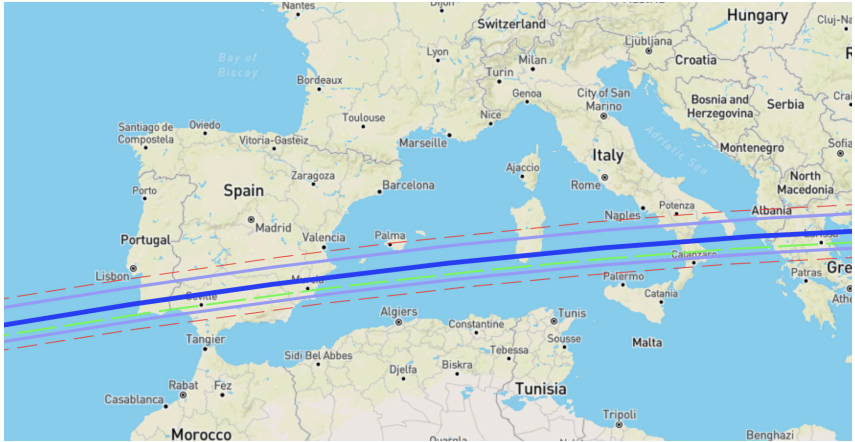
Credits: ESO/P. Kervella/M. Montargès et al., Ackn.: E. Pantin



VLT/SPHERE at 645nm - FoV : 0.100"

(Montargès et al. 2021, *Nature*)

The occultation path

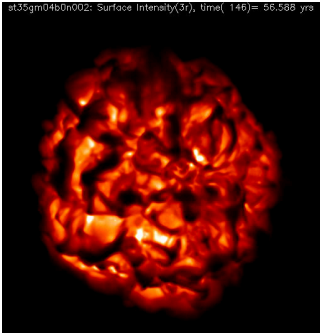


Last news on: `https://lesia.obspm.fr/lucky-star/occ.php?p=124370`

Not an occultation, but an annular eclipse

Artist impression of the asteroid Steins

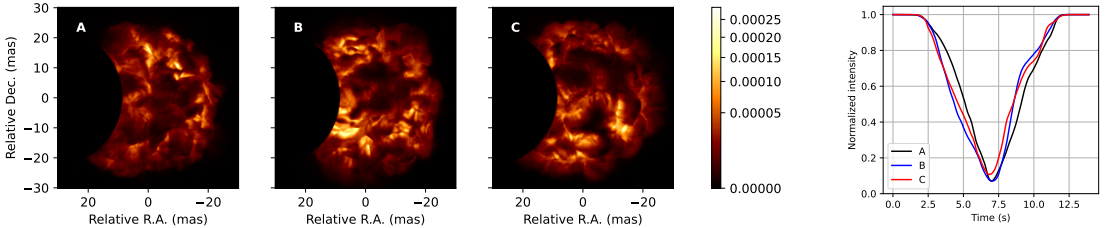
Estimated angular diameter of Leona ~ 45-50 mas



3D RHD simulation of the photosphere of Betelgeuse (Freytag/Chiavassa)

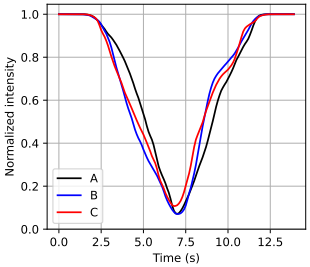
Angular diameter of Betelgeuse ~ 50-55 mas (visible)

The light curve



Credits: M. Montargès

Photometry



- Short integration time (∼ 10-50 ms) to get the ingress and the egress
- Time-box (accurate time) !
  - Priority 0: filters R and V
  - Priority 1: R and B
  - Priority 2: R and Hα
- Several cords to probe several regions of the star

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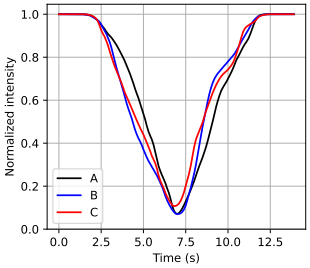

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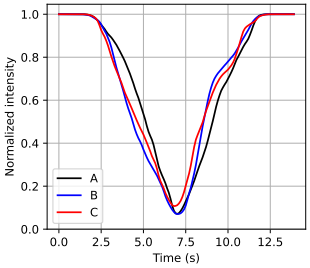

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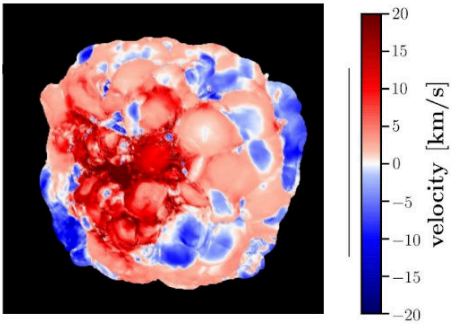
→ B filter → beginning of the chromosphere ?

→ Hα → larger atmosphere.

Spectroscopy



Kravchenko et al. 2019

- Getting the evolution of the width and position of metallic lines during the event (Fi, N, Ti ...)
- R ∼ 40 000 → Star'Ex HR (see with Christian Buil for details)

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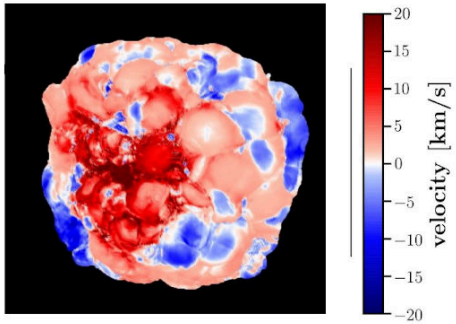

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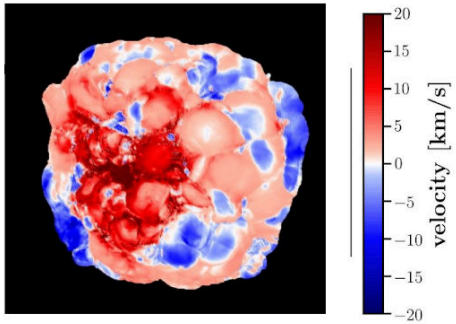

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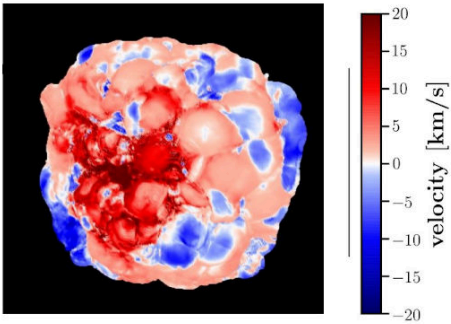

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⇒ Will probe the phospheric convection velocity field

We need the shape of Leona to analyze the data!

Other regular occultations predicted:

- 29th October
- 30th et 31th December 2023 (sorry)

Precise times and location to be checked.
No need for filters or spectroscopy here, just regular occultation observations.

Conclusion

- On December 12th : an annular eclipse, not an occultation
- Ingress and egress most interesting
- Shape of Leona needed from other regular events
- Photometry:
  - Short integration time (→ earlier training on other stars between magnitude 0 and 10)
- Spectroscopy:
  - R ∼ 40 000
  - Single shot with no tracking (R.A. || slit)
  - Practicing mandatory

Registration/Coordination

`http://betelgeuse.proam-gemini.fr/#EN`