Discovery of an extreme Red Supergiant in the LMC transitioning to a Blue Supergiant

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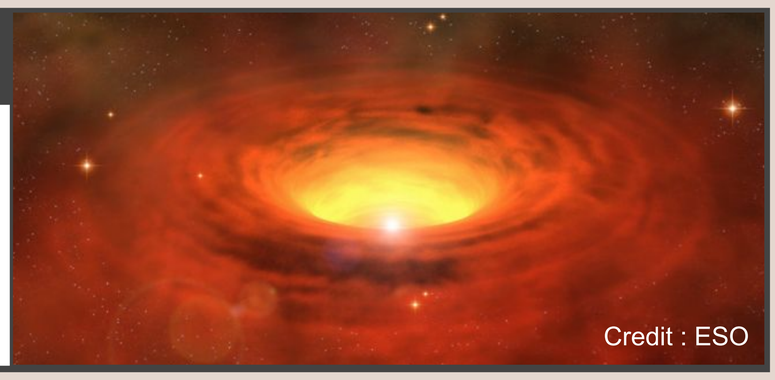
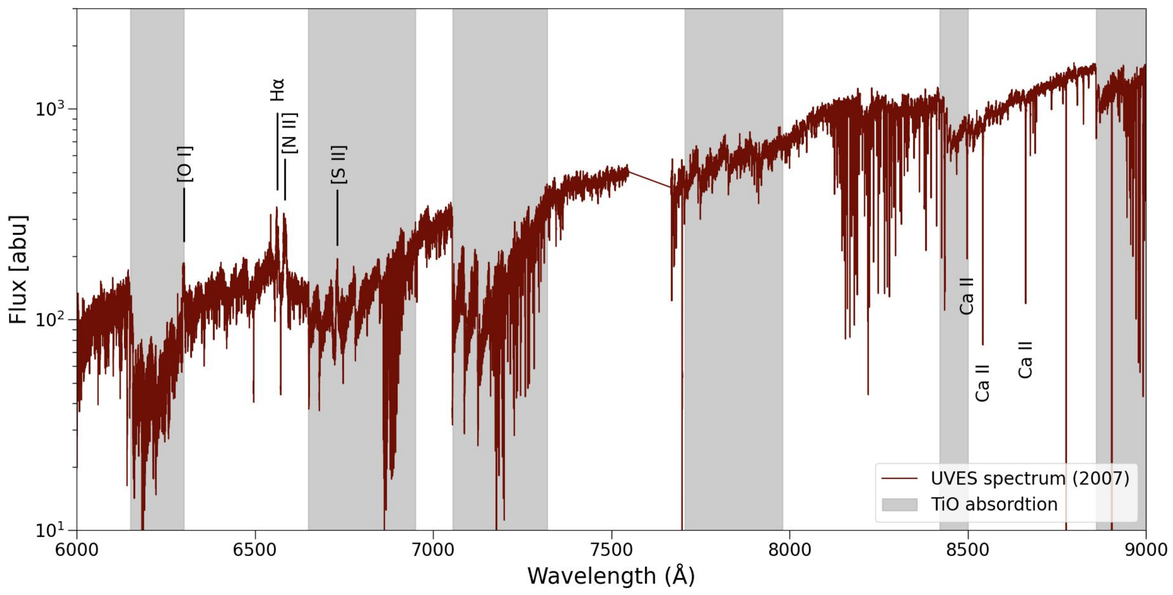
Why WOH G64?

WOH G64 is a very cool (*T*eff = 3400 K)[1], luminous (log *L*/L⊙= 5.45)[2] extreme RSG in the Large Magellanic Cloud. The star has the highest mass-loss rate (log $\dot{M}$/M⊙ yr^{-1} = -2.6)[3] recorded for a RSG in the LMC and is surrounded by dense circumstellar material. The star has an axisymmetric, optical thick dust torus, viewed close to pole on (*i* = 20°) that contains 3-9 M⊙[2]. **We obtained new spectroscopy of this extreme RSG, which revealed a dramatic transformation in its spectral appearance and motivated this study.**



Red supergiant for > 30 years

- **M7.5** spectral type (*Elias et al. 1986*[4])
- **M5/M7** spectral type (DFOSC 1995, *van Loon et al. 2005*[5])
- **M6** spectral type (UVES 2007, *our work*)
- **M5** spectral type (IMACS 2008, *Levesque et al. 2009*[1])

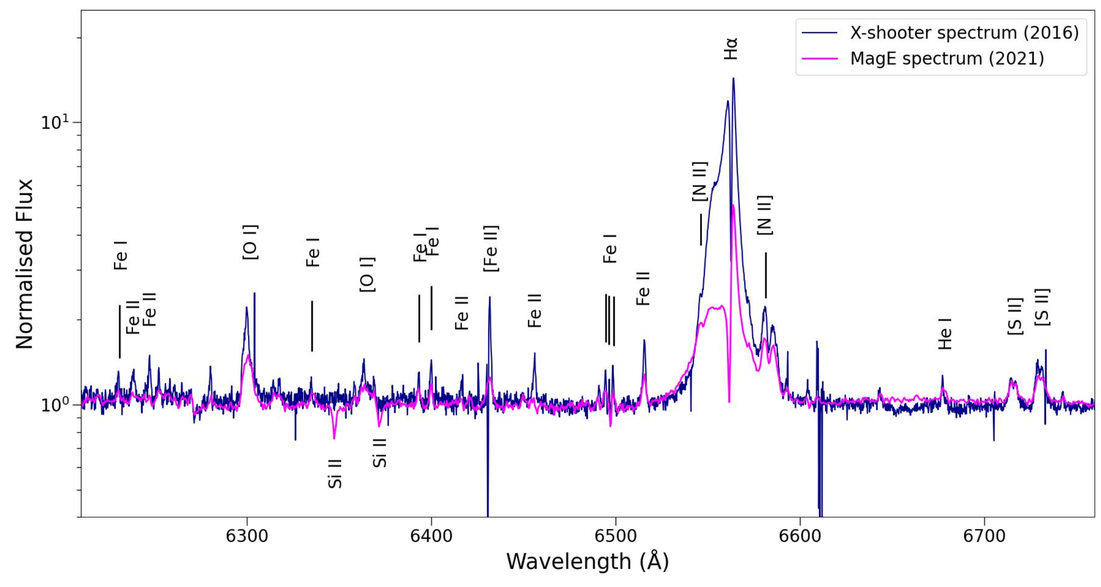


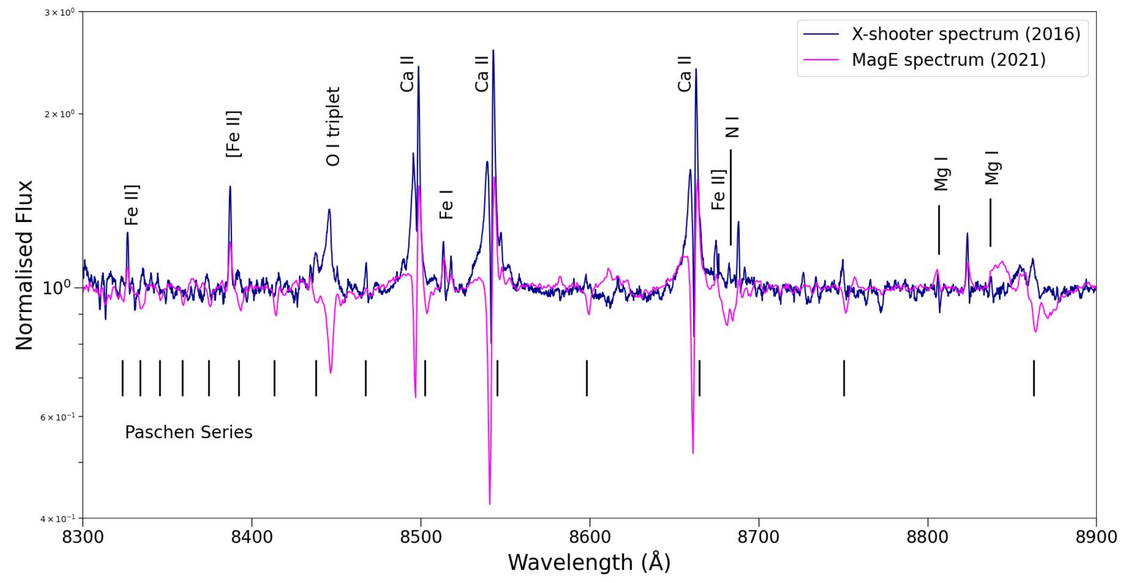
Transition to the blue in 2014 !

Spectroscopy from X-Shooter (2016) & MagE (2021):

- No TiO absorption
- Fe II and [Fe II] emission lines
- Double peaked Ca II and Balmer emission lines
- P Cygni profiles

→ **supergiant B[e] star**





Light Curve

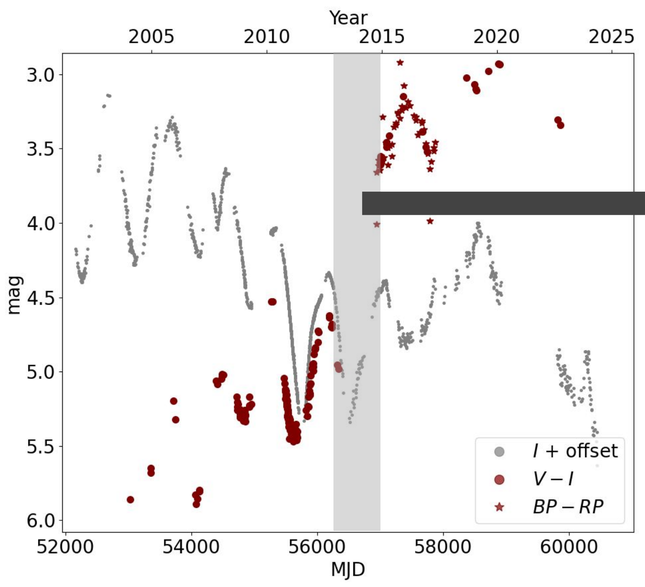
Before the transition (**RSG**):

- Mira variable
- ΔV ~ 2 mag

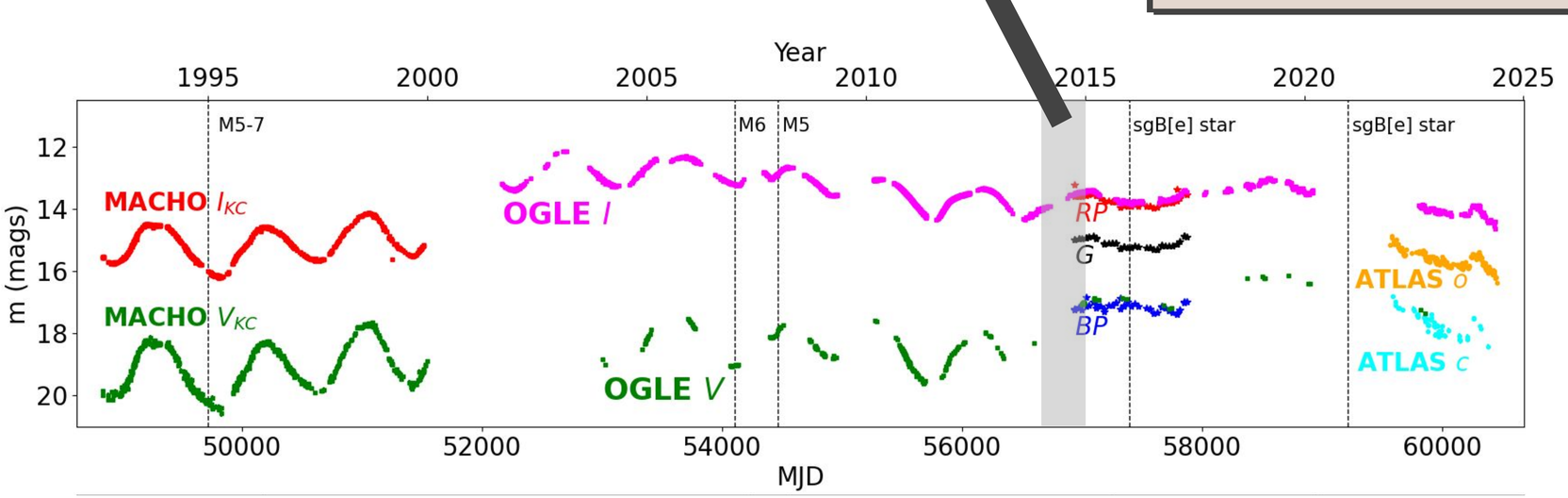
After the transition (**sgB[e]**):

- No periodicity
- ΔV < 1 mag

Color Change ! ! !



Dramatic Transition ! ? !

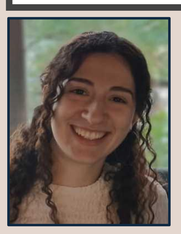


Interpretation

Some possible scenarios for explaining this remarkable transition of WOH G64 from a red to a blue supergiant are:

a) Loss of stellar atmosphere due to episodic mass loss
b) Loss of atmosphere due to LBV-like mass loss near the Humphreys-Davidson limit
c) Common envelope evolution due to unstable mass transfer onto a companion, which is obscured due to dust
d) Thorne–Żytkow object (TŻO)

These possible scenarios are still under investigation, however, studying RSGs as their atmospheres transition from H-rich to H-poor helps to understand Type II SNe progenitors and "the RSG problem".



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References:
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