

Unveiling the mysteries of WR stars at low metallicity

Insights from new spectroscopy from NGC 6822

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Trigg et al. (submitted)

Collaborators: Wolf-Rainer Hamann, Lida Oskinova, Helge Todt, Daniel Pauli, Tomer Shenar, Andreas Sander



Wolf-Rayet Stars – Cosmic Engines

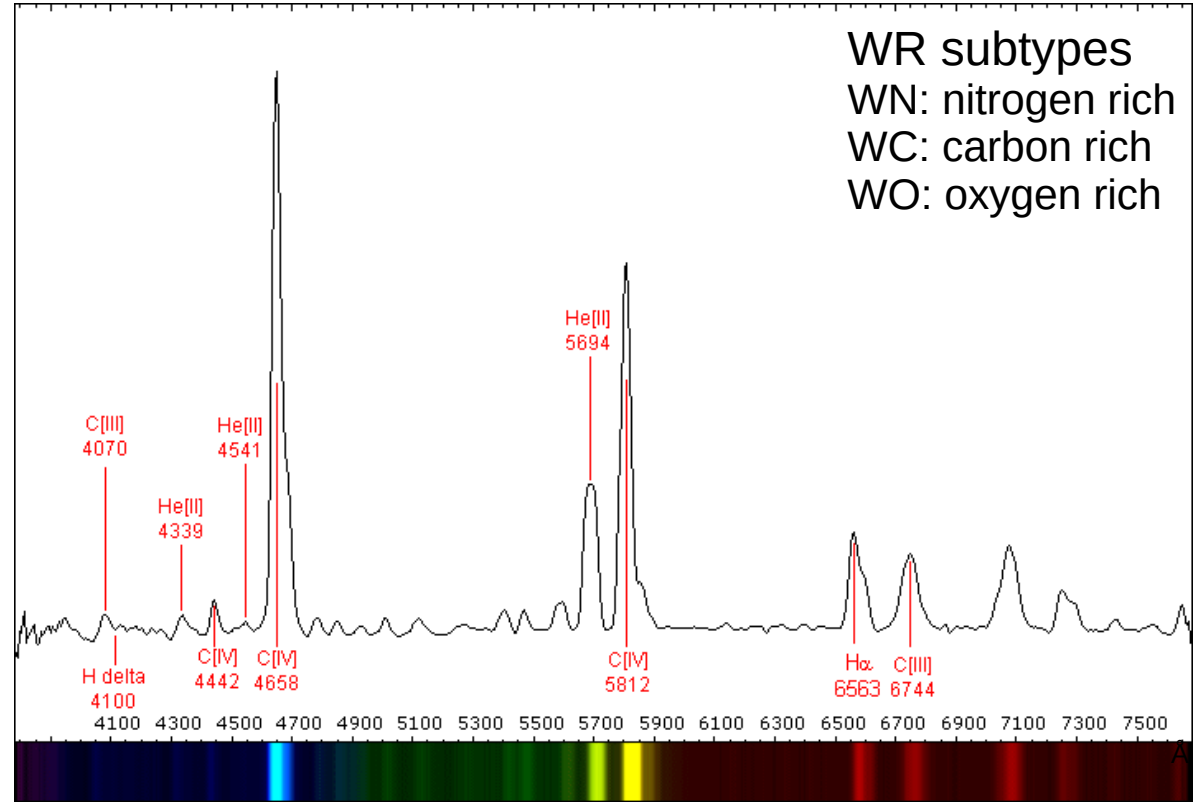
$M_i \gtrsim 20 M_{\odot}$

$T \sim 20 - 200 \text{ kK}$

$L \sim 10^5 - 10^{6.5} L_{\odot}$

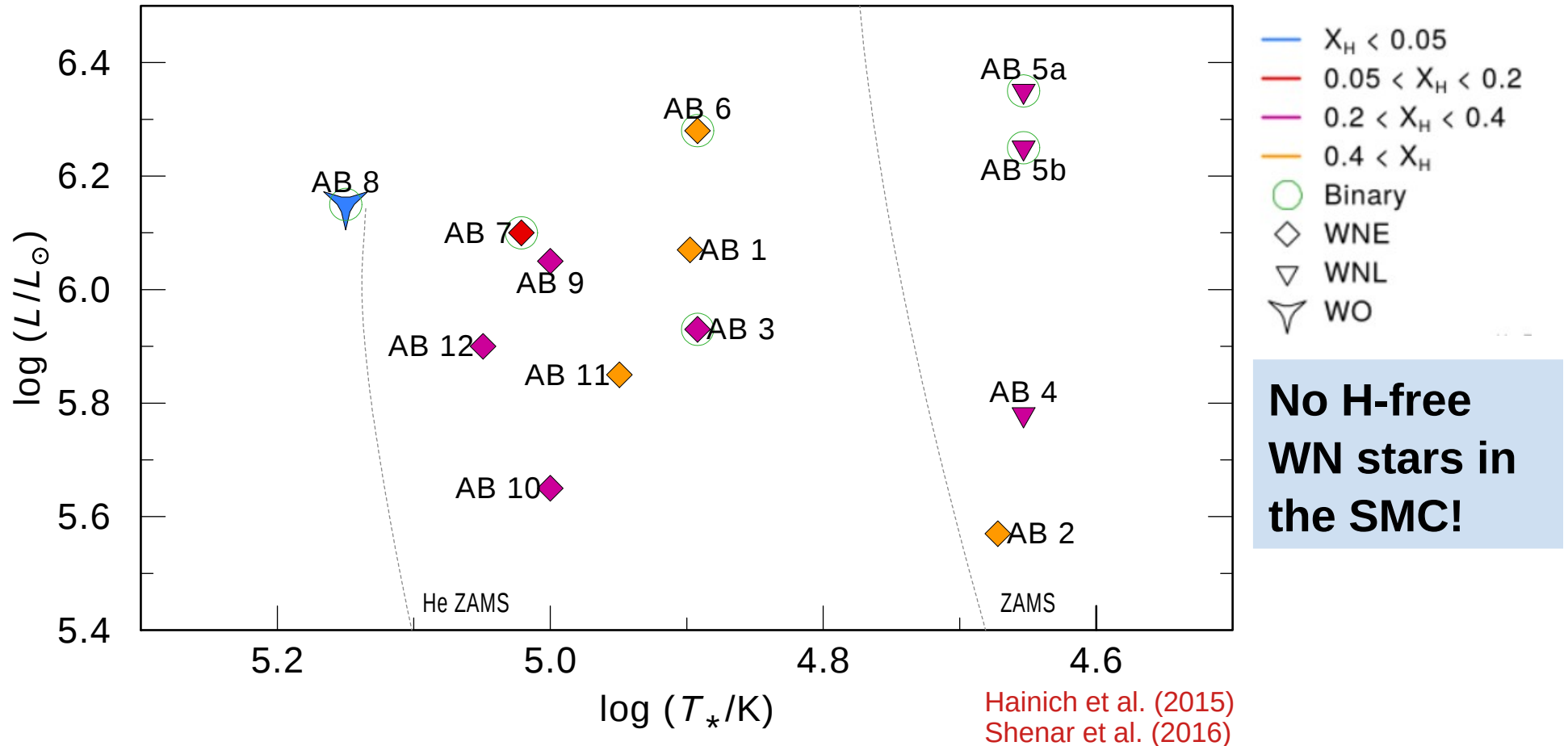


WR 124, NASA/JWST



WR 137

Wolf-Rayet Stars - SMC



NGC 6822 – A Low Metallicity Galaxy

NGC 6822

Distance: 500 kpc

Stellar Mass: $\sim 10^8 M_{\odot}$

Recent star formation

NGC 6822

[Fe/H] = -1.38

[O/H] = -0.6

SMC

[Fe/H] = -1.25

[O/H] = -0.95

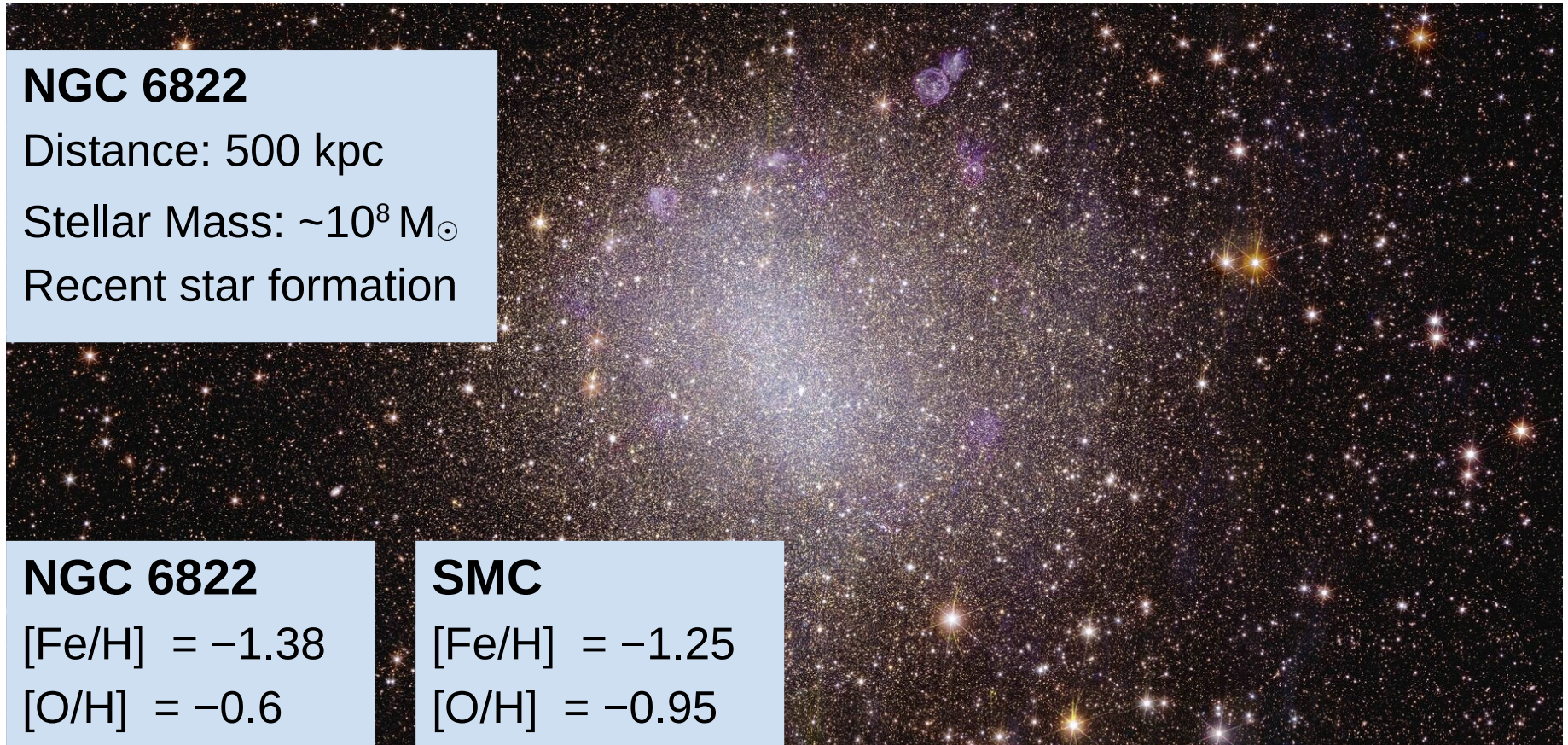
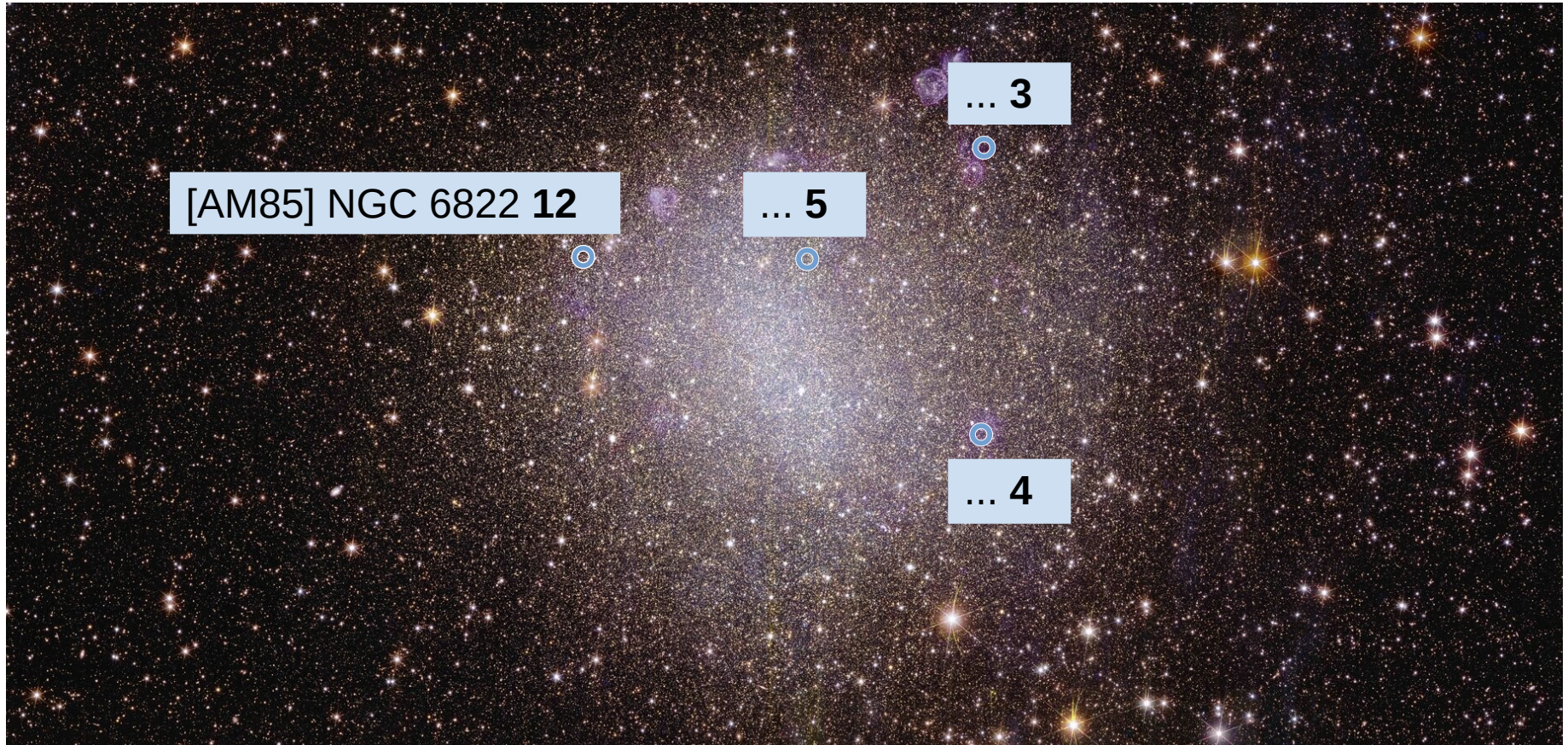


Image: ESA Euclid, optical

NGC 6822 – A Low Metallicity Galaxy



Armandroff & Massey (1985)

Image: ESA Euclid, optical

Observations and Modelling

New spectroscopic observations obtained:

- UV: HST, 2025
- Optical: ESO VLT, 2022

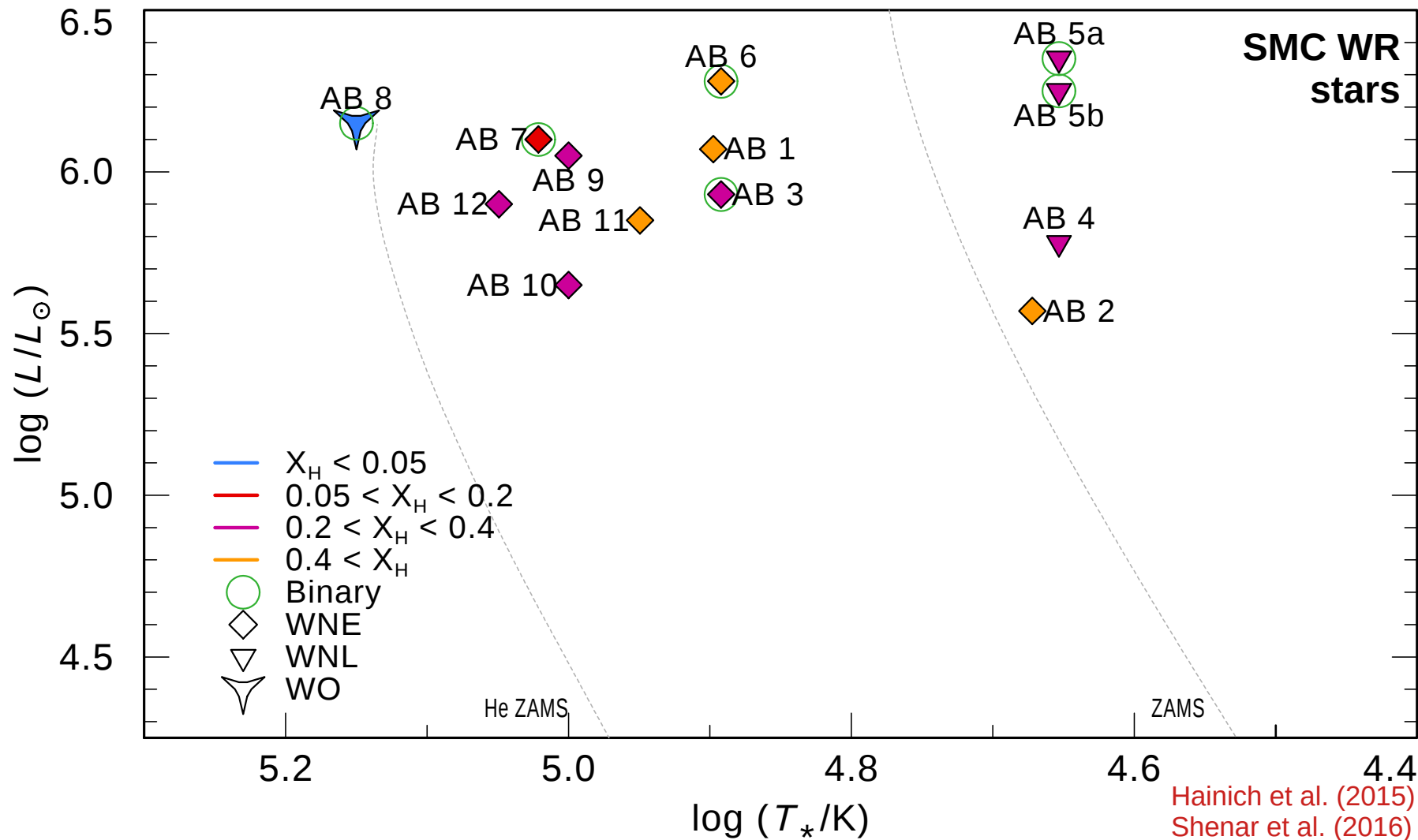
Detailed spectral analysis performed with the Potsdam Wolf Rayet (PoWR) model atmosphere code.

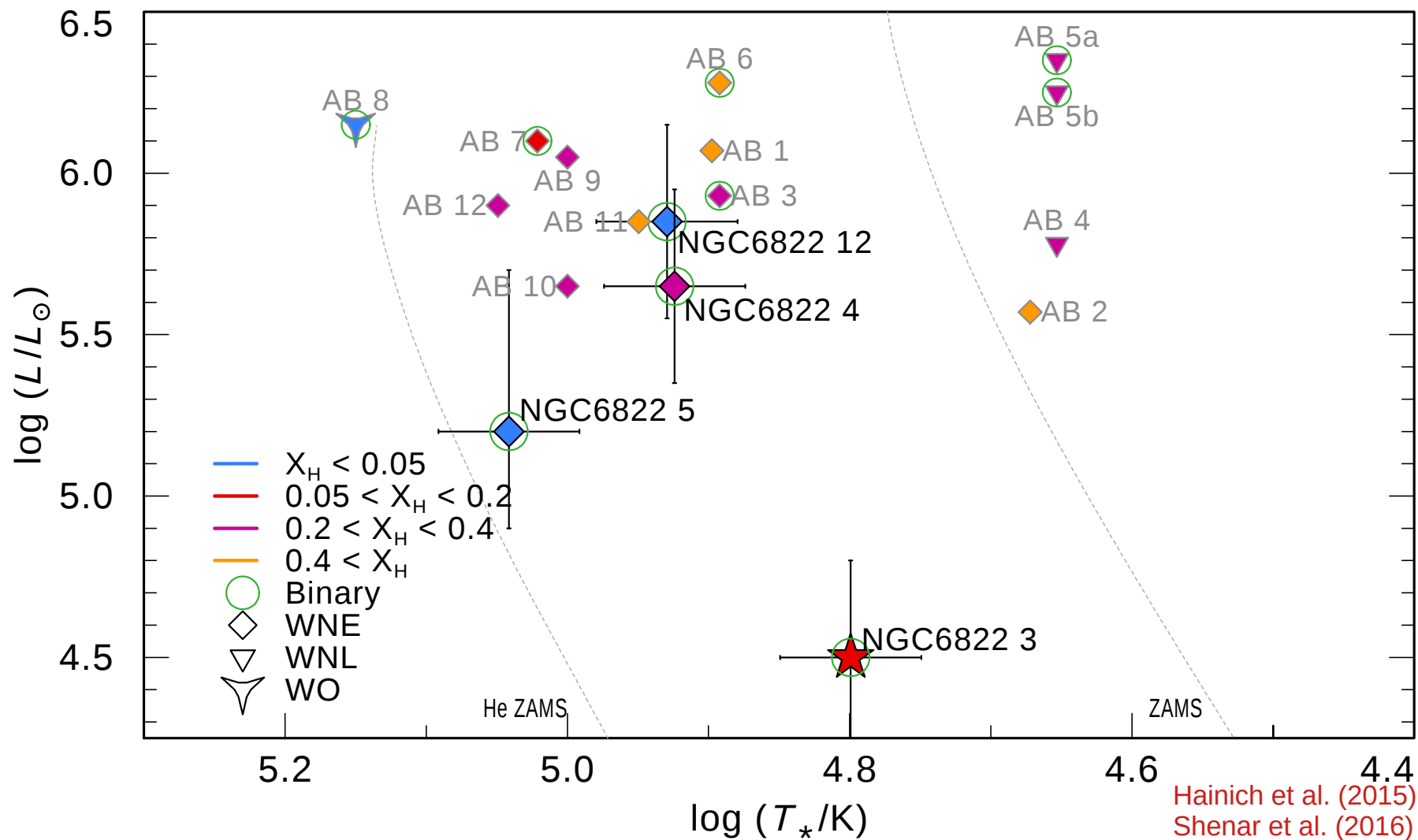
Trigg et al. (submitted)

Image: A. Tudorica/ESO

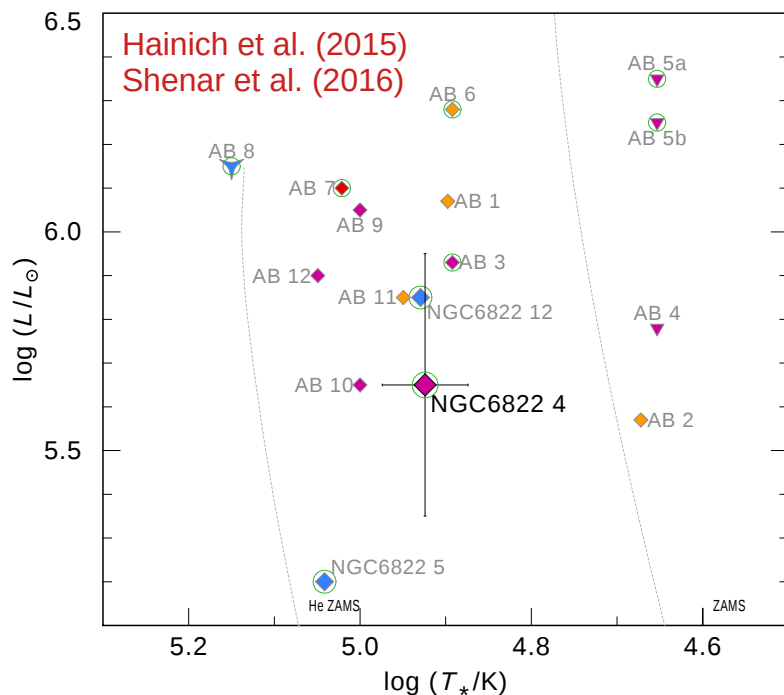


Image: ESA

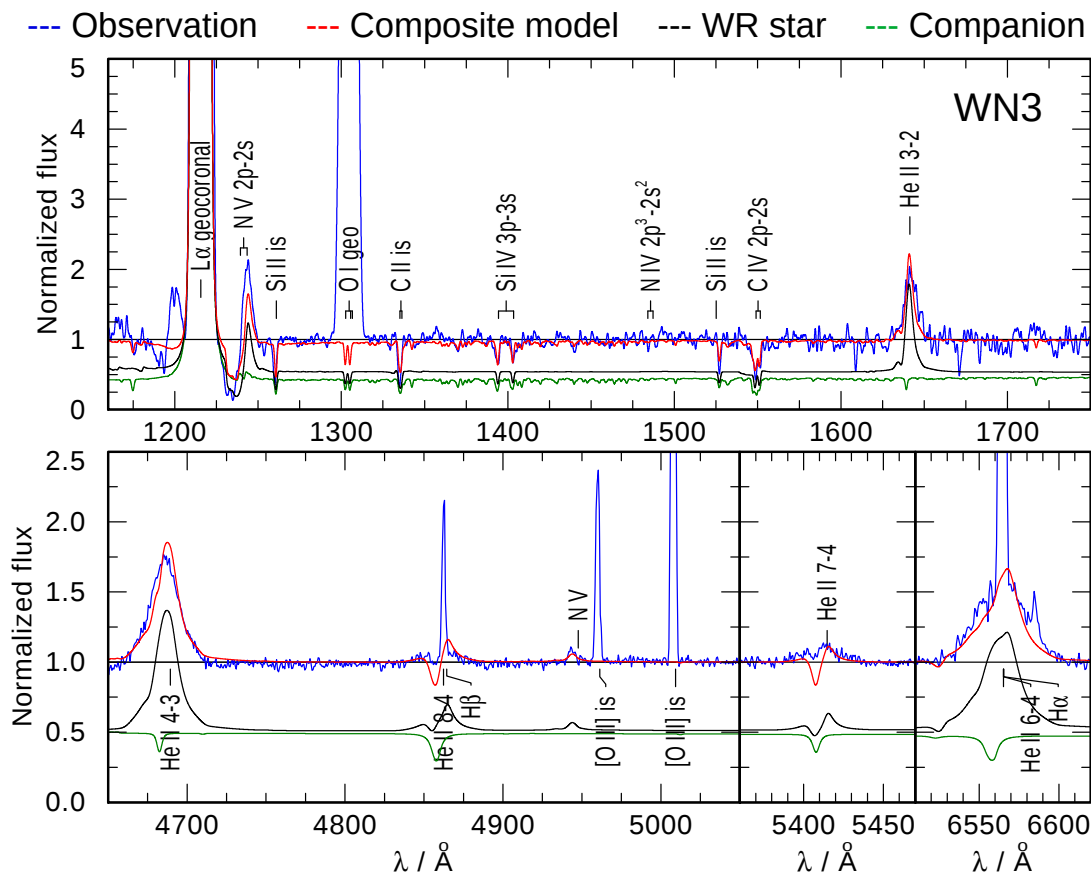




[AM85] NGC 6822 4

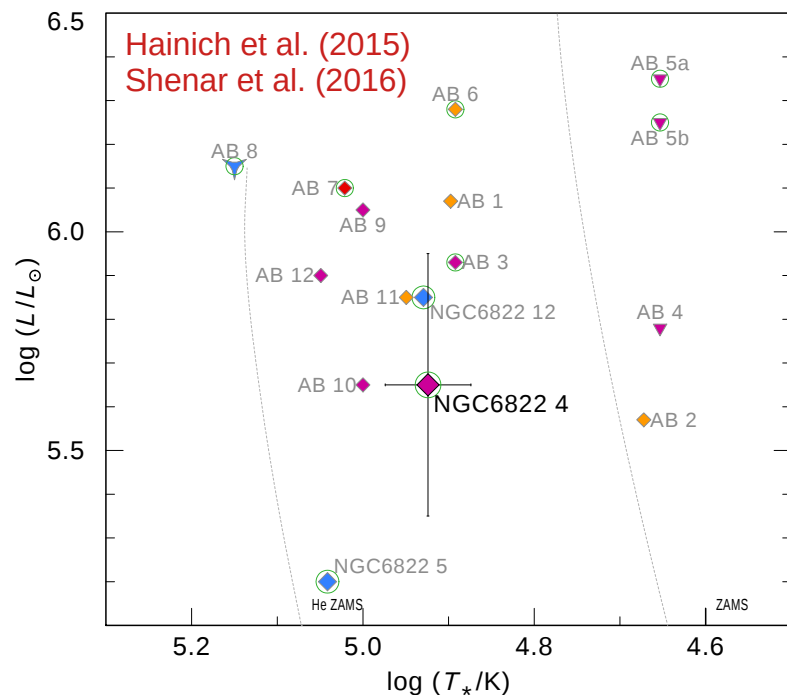


$T = 84 \pm 10 \text{ kK}$
 $\log(L/L_{\odot}) = 5.65 \pm 0.3$
 $\log(\dot{M}) = -5.55 \pm 0.3 \text{ [M}_{\odot}/\text{yr}]$
 $X_{\text{H}} = 0.4 \pm 0.05$

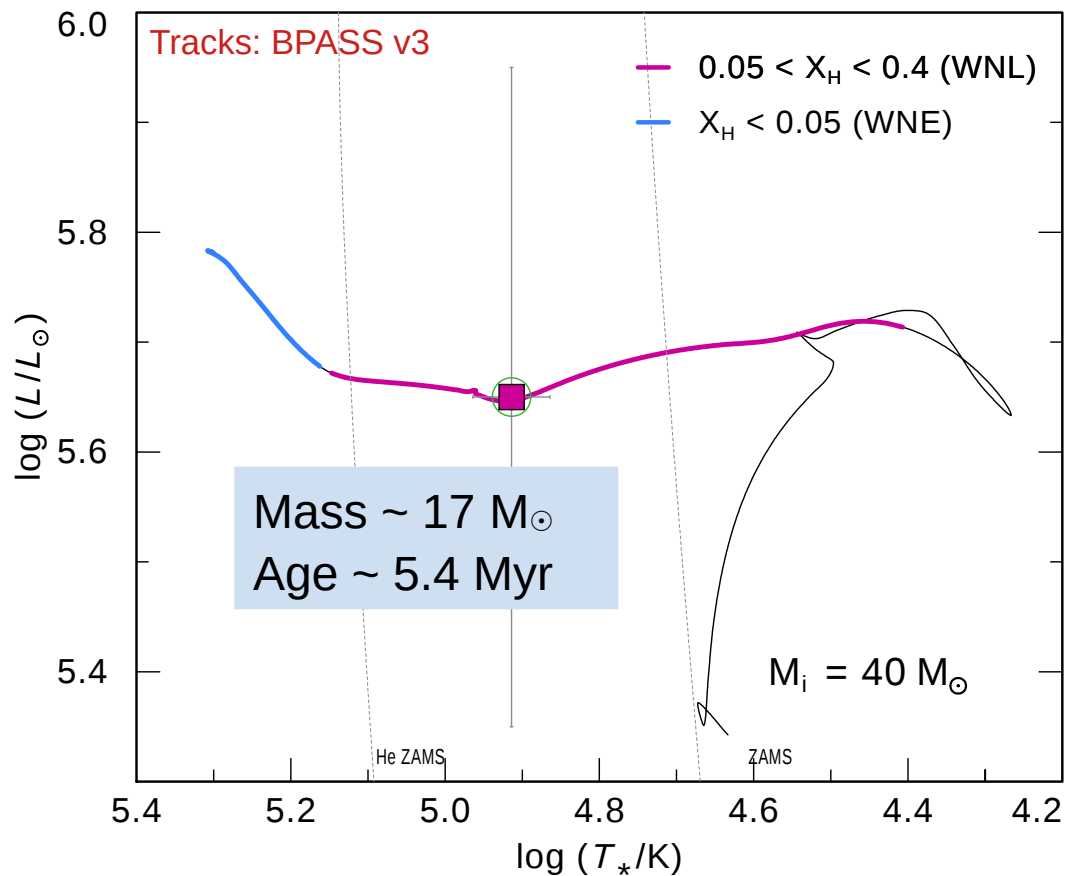


Trigg et al. (submitted)

[AM85] NGC 6822 4



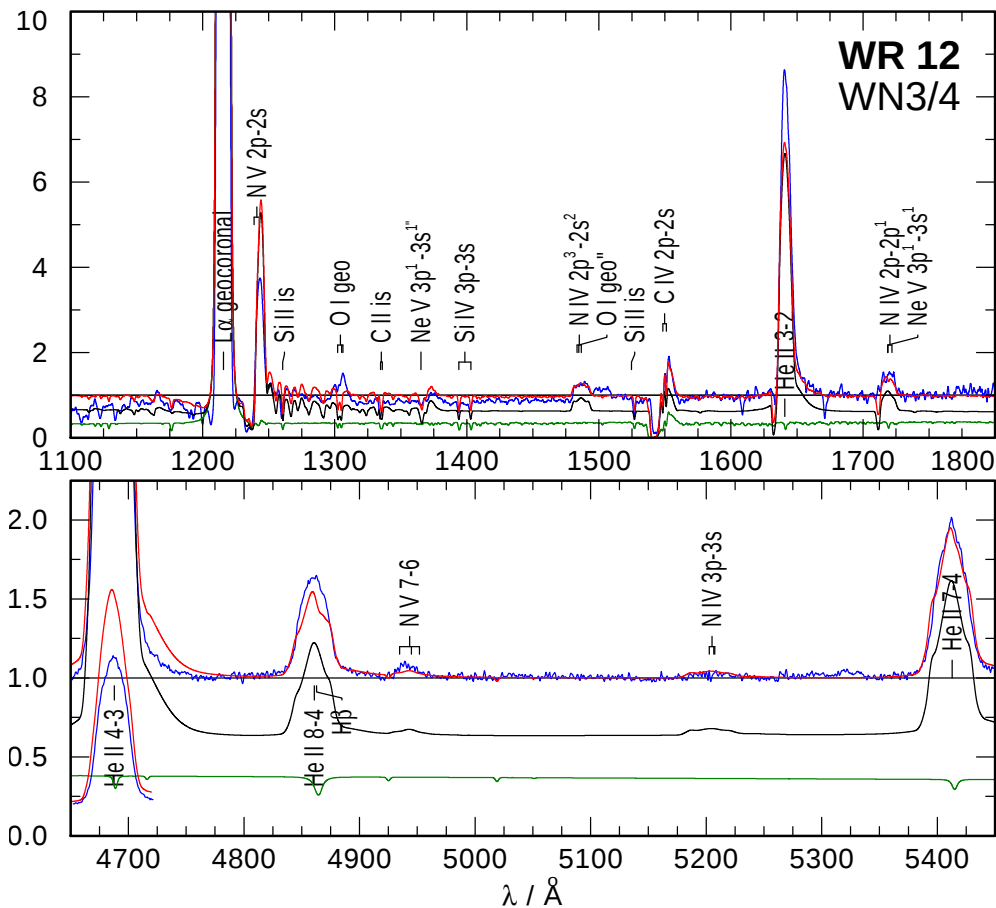
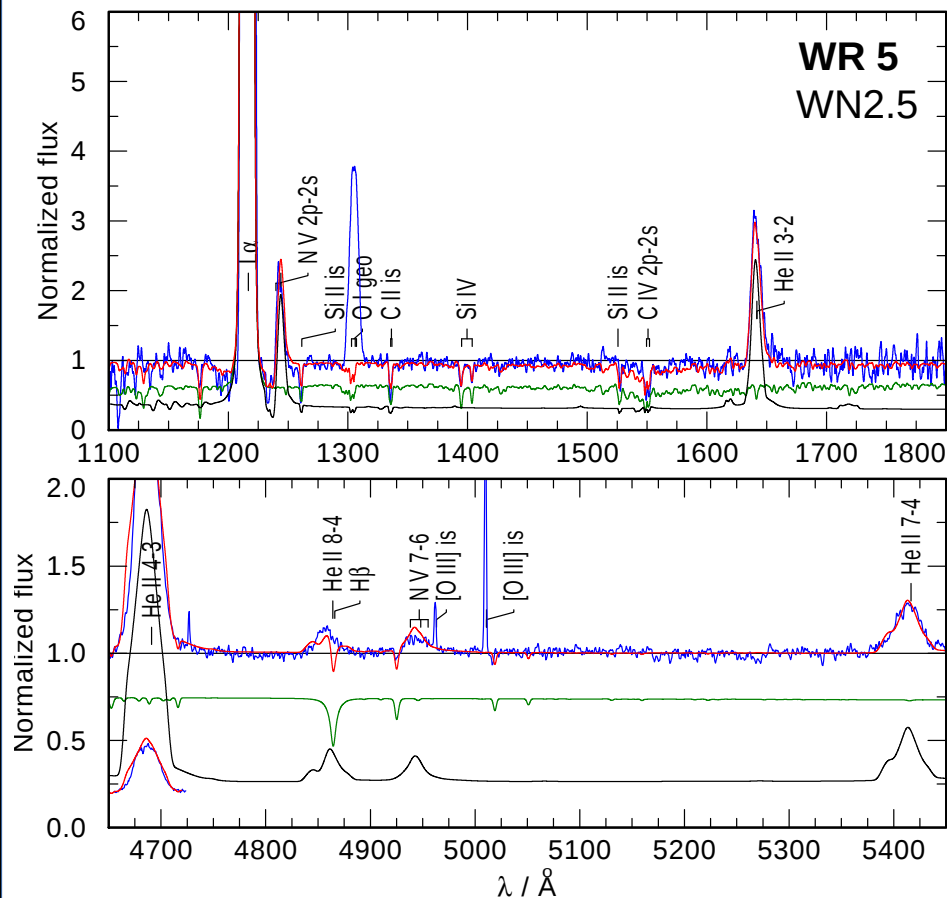
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[AM85] NGC 6822 5 & 12 – H-free stars

--- Observation --- Composite model --- WR star --- Companion

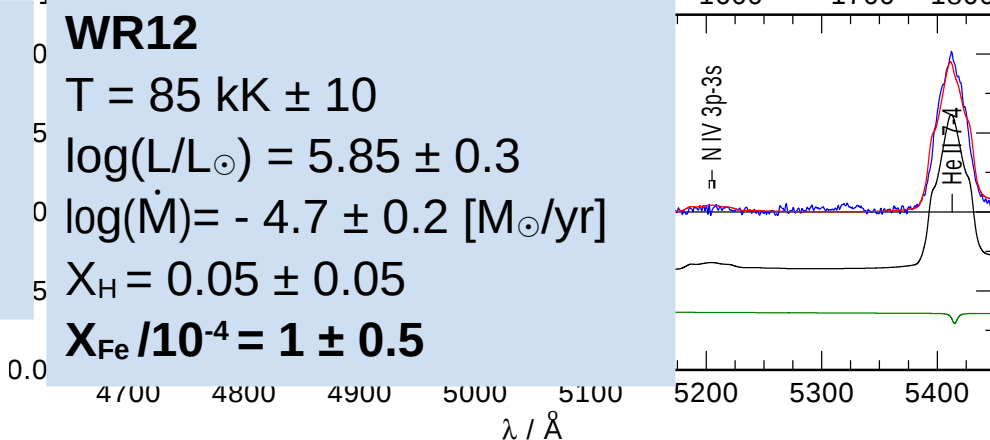
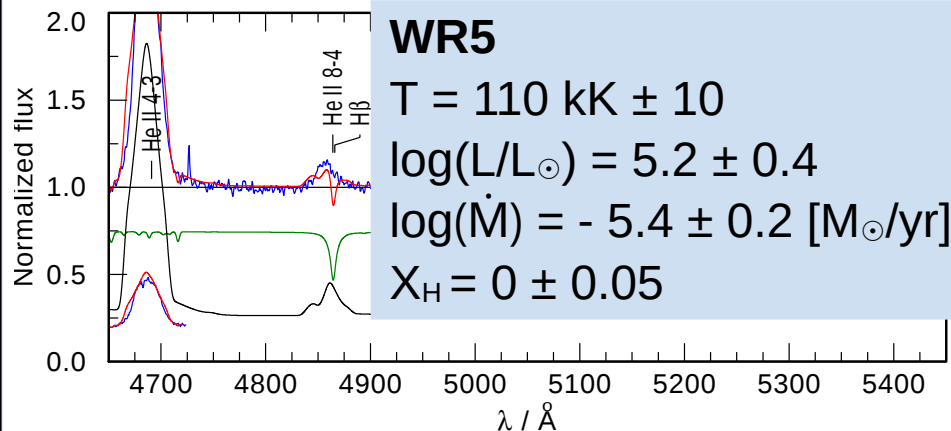
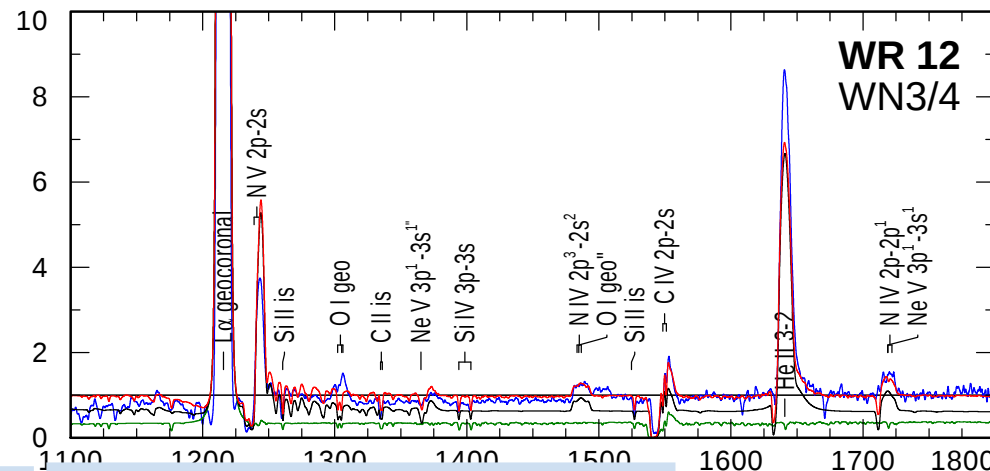
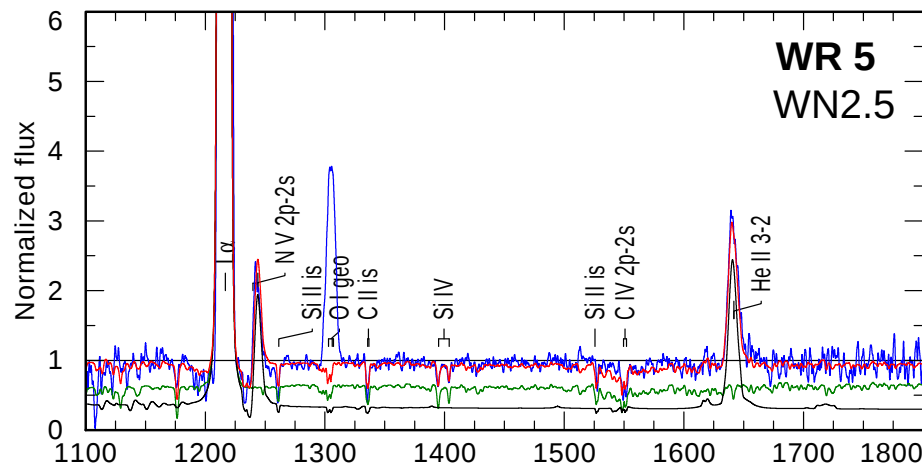
Trigg et al. (submitted)



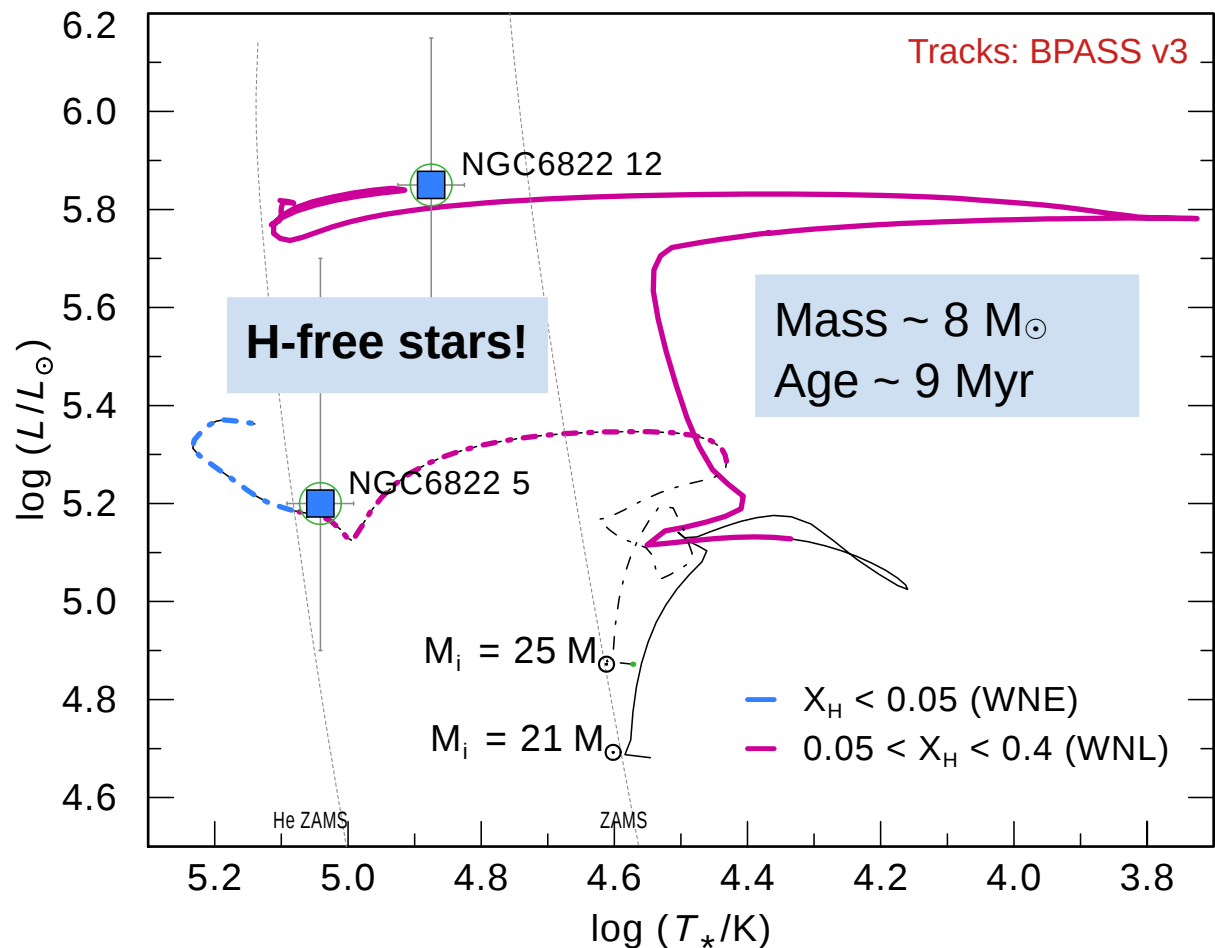
[AM85] NGC 6822 5 & 12 – H-free stars

--- Observation --- Composite model --- WR star --- Companion

Trigg et al. (submitted)



[AM85] NGC 6822 5 & 12 – H-free stars



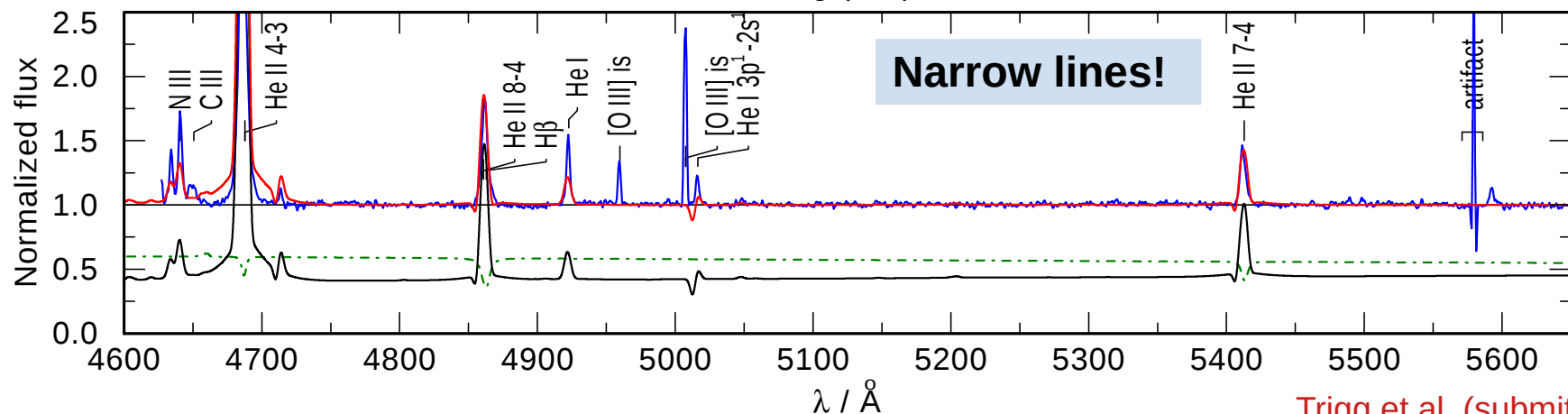
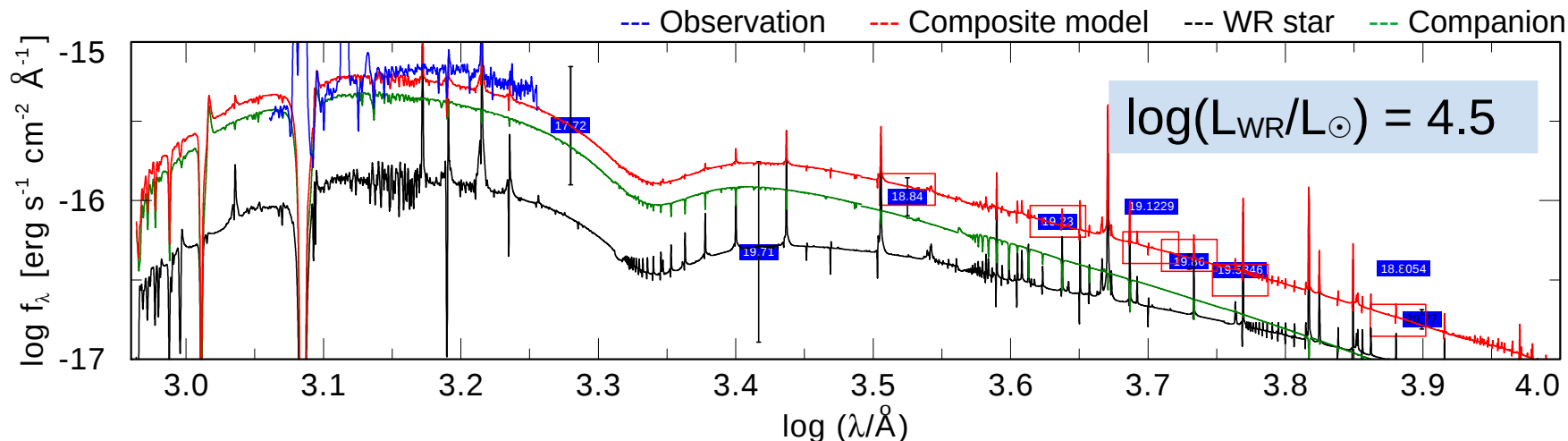
WR12

$T = 85 \text{ kK} \pm 10$
 $\log(L/L_{\odot}) = 5.85 \pm 0.3$
 $\log(\dot{M}) = -4.7 \pm 0.2 [M_{\odot}/\text{yr}]$
 $X_H = 0.05 \pm 0.05$
 $X_{\text{Fe}}/10^{-4} = 1 \pm 0.5$

WR5

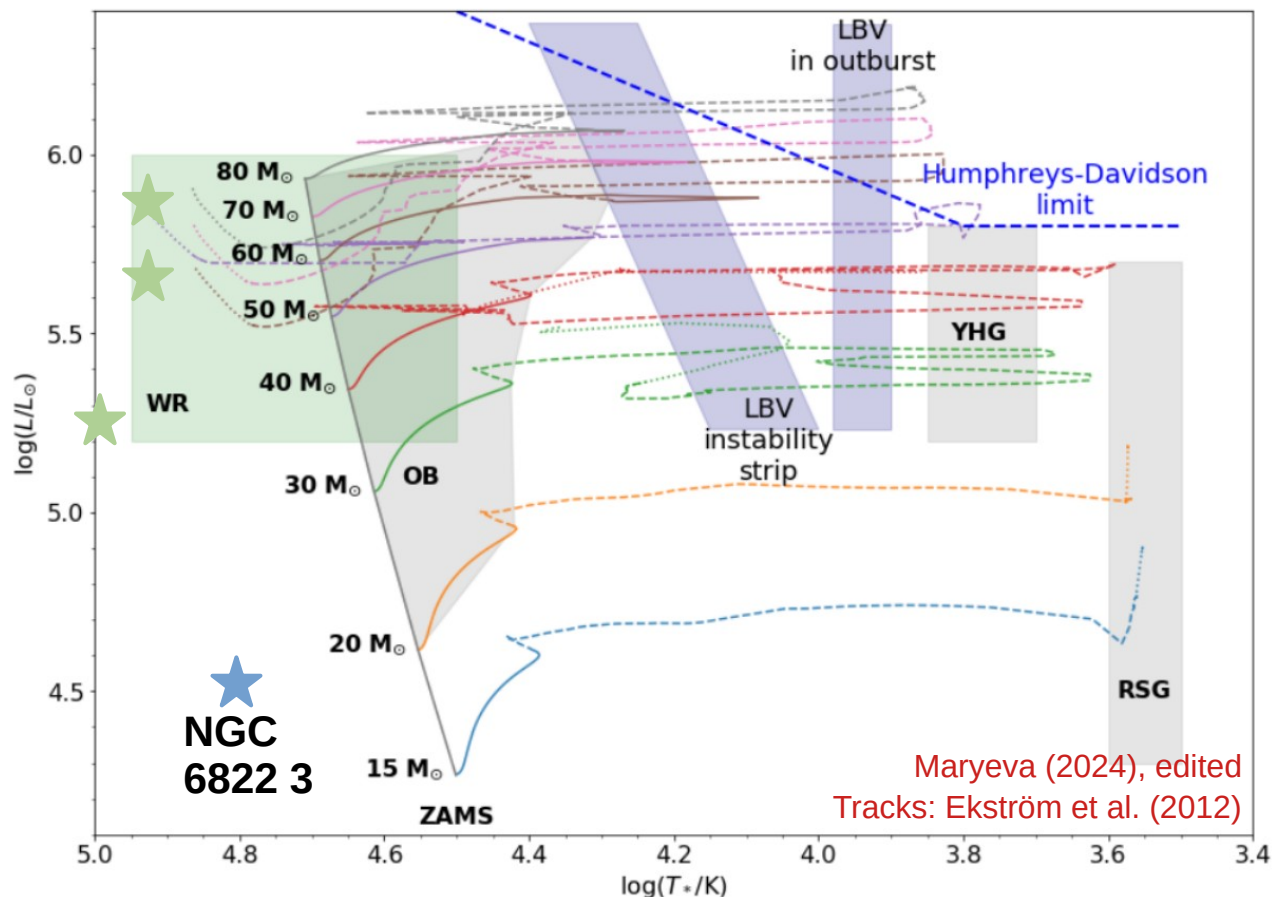
$T = 110 \text{ kK} \pm 10$
 $\log(L/L_{\odot}) = 5.2 \pm 0.4$
 $\log(\dot{M}) = -5.4 \pm 0.2 [M_{\odot}/\text{yr}]$
 $X_H = 0 \pm 0.05$

[AM85] NGC 6822 3 – qWR star with low L



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[AM85] NGC 6822 3 – qWR star with low L



WR3

$$T = 63 \text{ kK} \pm 10$$

$$\log(L/L_{\odot}) = 4.5 \pm 0.1$$

$$\log(\dot{M}) = -5.7 \pm 0.2 \text{ [} M_{\odot}/\text{yr} \text{]}$$

$$X_{\text{H}} = 0.15 \pm 0.05$$

WR star?

LBV?

Intermediate mass
stripped star?

Maryeva (2024), edited
Tracks: Ekström et al. (2012)

[AM85] NGC 6822 3 – qWR star with low L

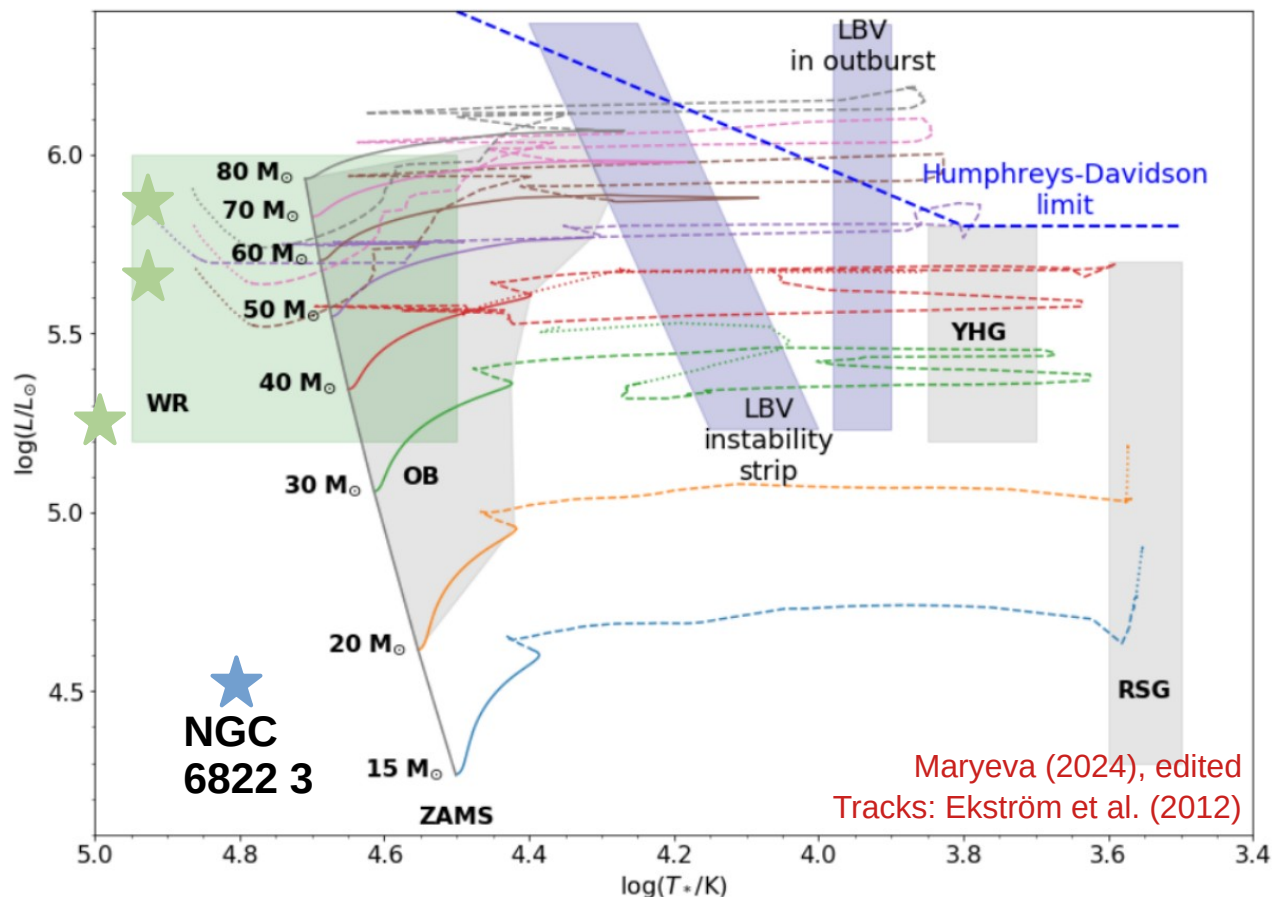
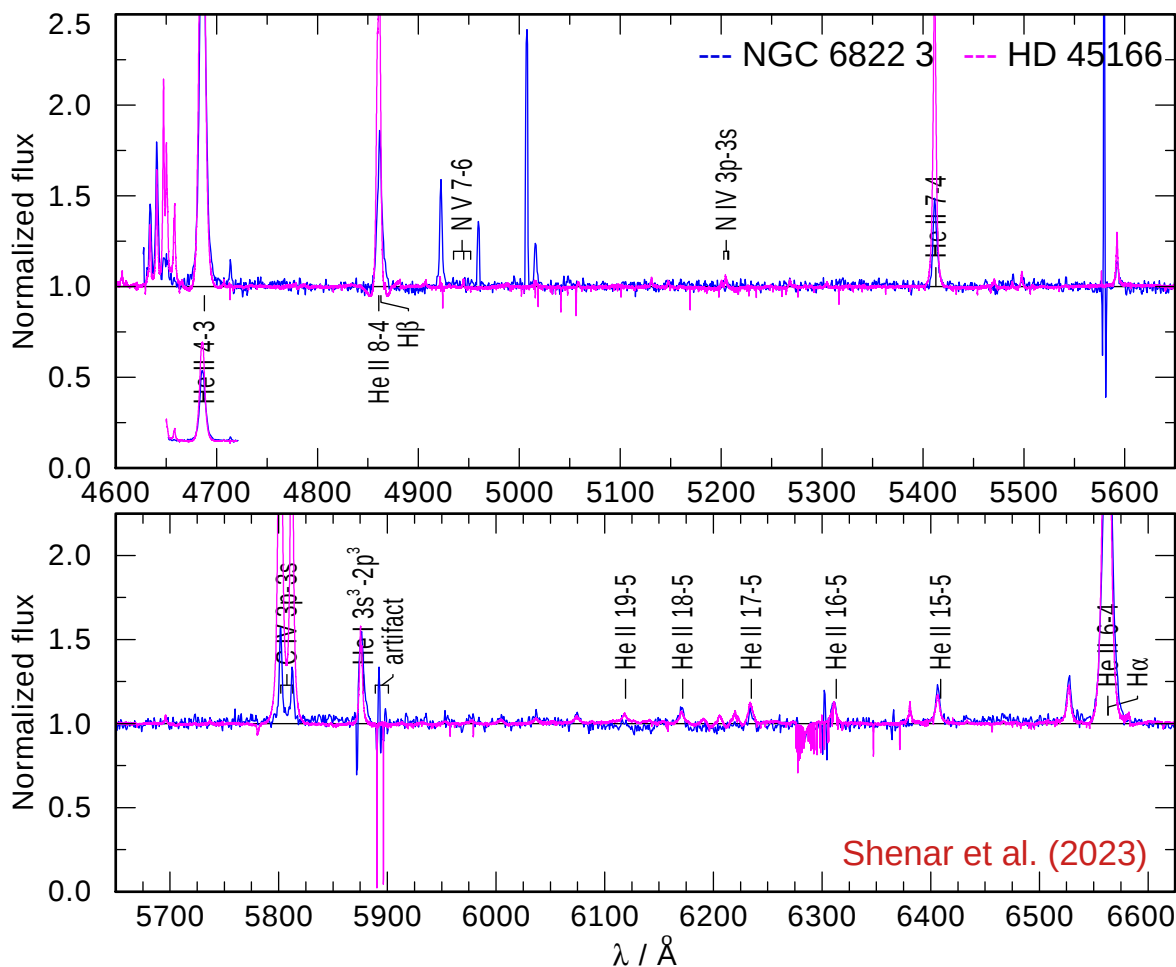


Image: NOIRLab/AURA/NSF/P. Marenfeld/M. Zamani



HD 45166 - Magnetic
stripped star
(Shenar et al. 2023)

[AM85] NGC 6822 3 and HD 45166



Low luminosity

Narrow emission lines

Of?p phenomenon

WR3 possibly a
magnetic stripped star?

Conclusions

The metallicity dependence of WR parameters remains an open question as the SMC population is highly enigmatic.

The WR population of NGC 6822 features interesting objects not present in the SMC.

- [AM85] NGC 6822 4 – Similar to SMC WR stars, hydrogen rich.
- [AM85] NGC 6822 5 & 12 – **Hydrogen free**, post-interaction binaries.
- [AM85] NGC 6822 3 – **Low luminosity qWR** star, possibly a merger and magnetic stripped star (more observations needed)