The Of/WN transition Region

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and the VLT/Flames Tarantula Survey Team

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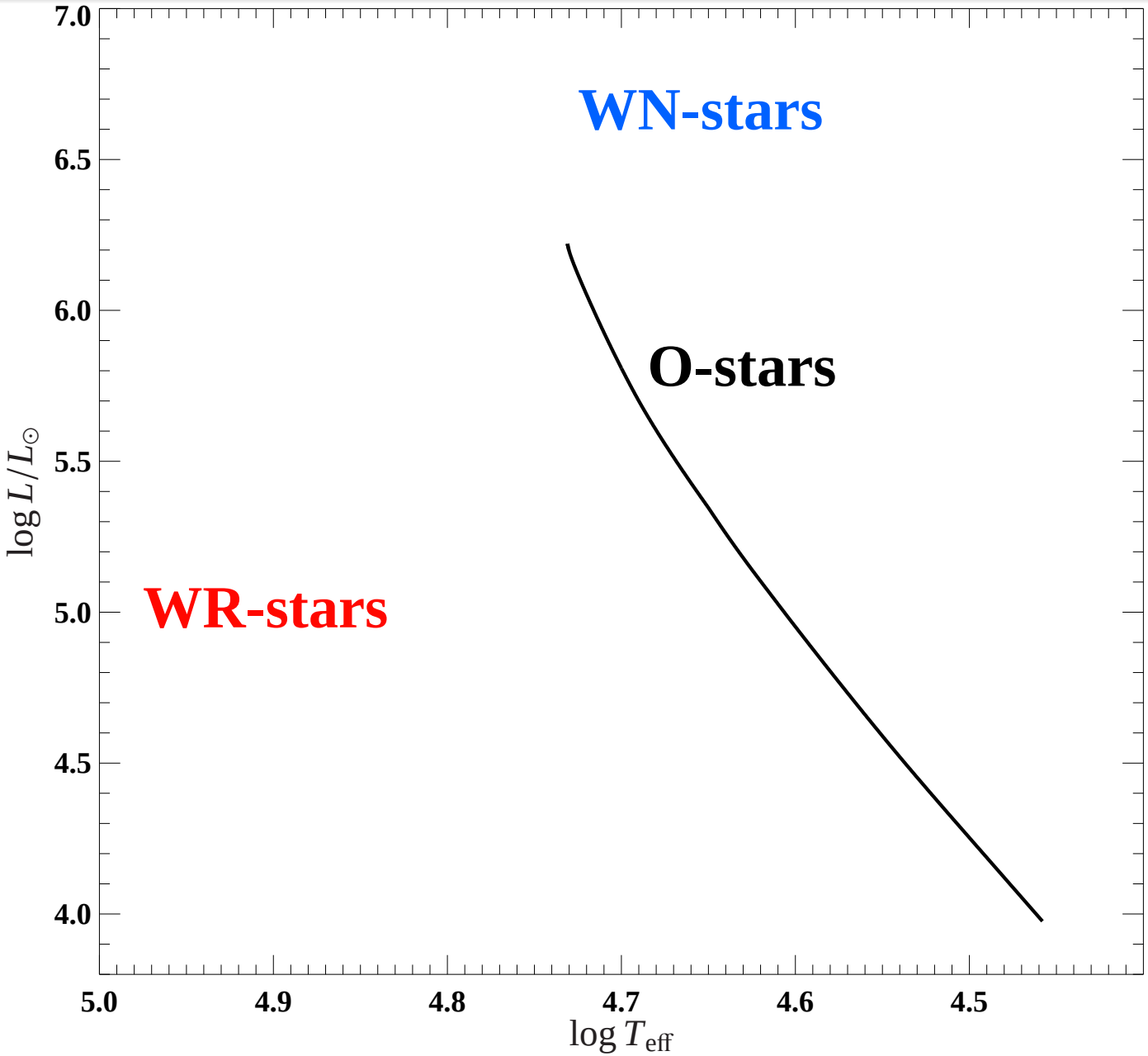
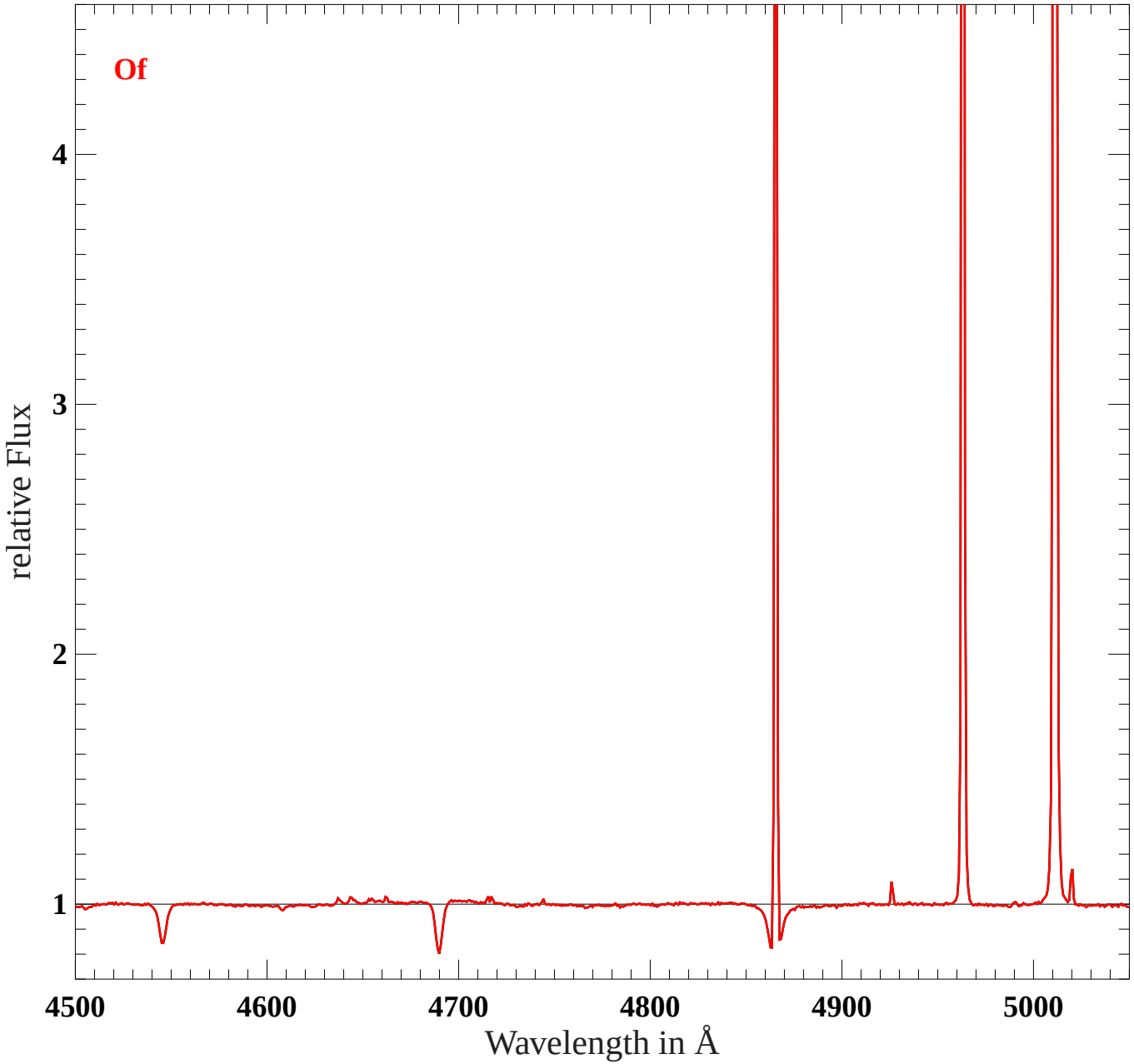
Outline

- What is the transition Region?
- Goals
- Spectral Analysis
- First Results

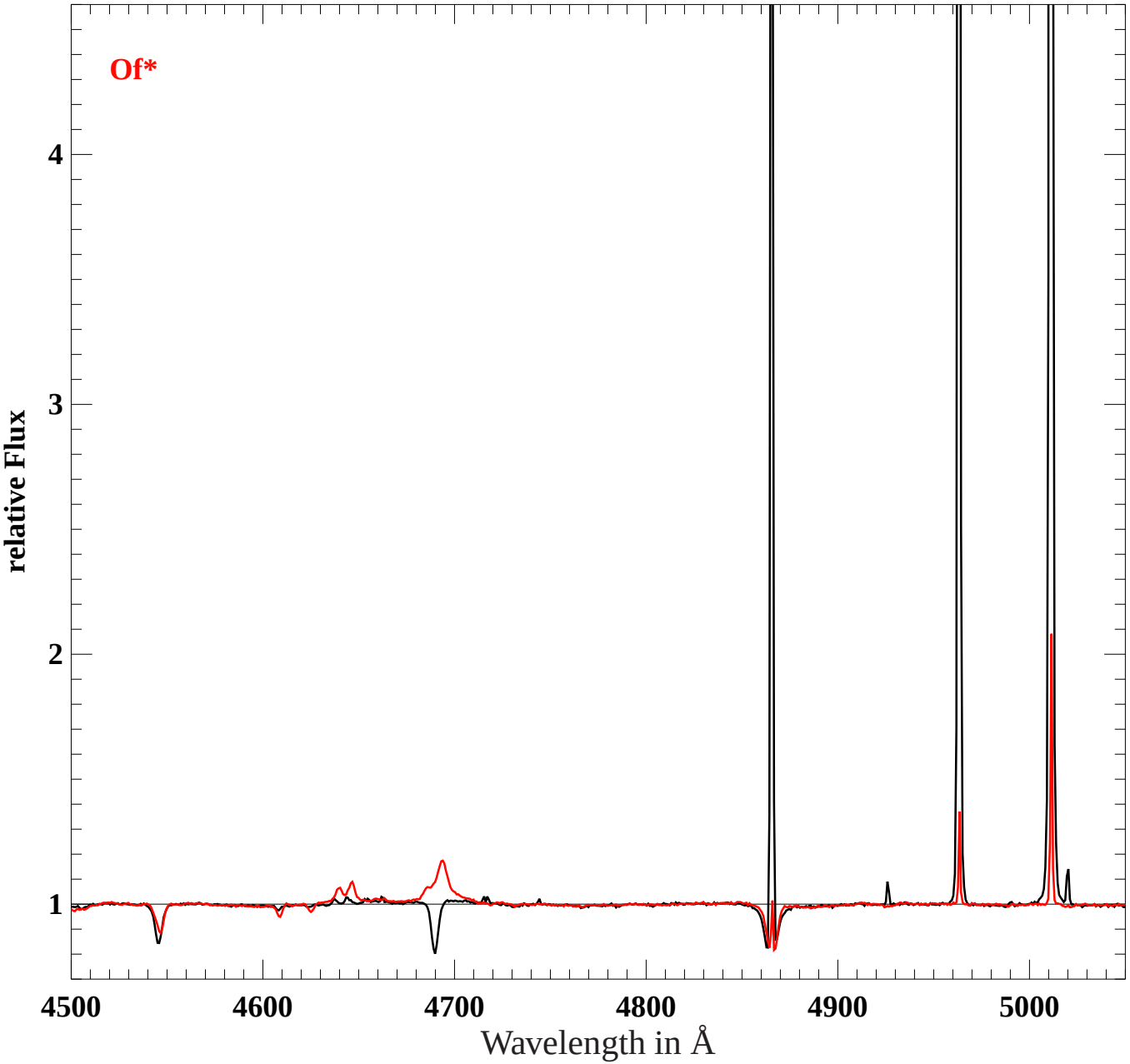
Of/WN transition region



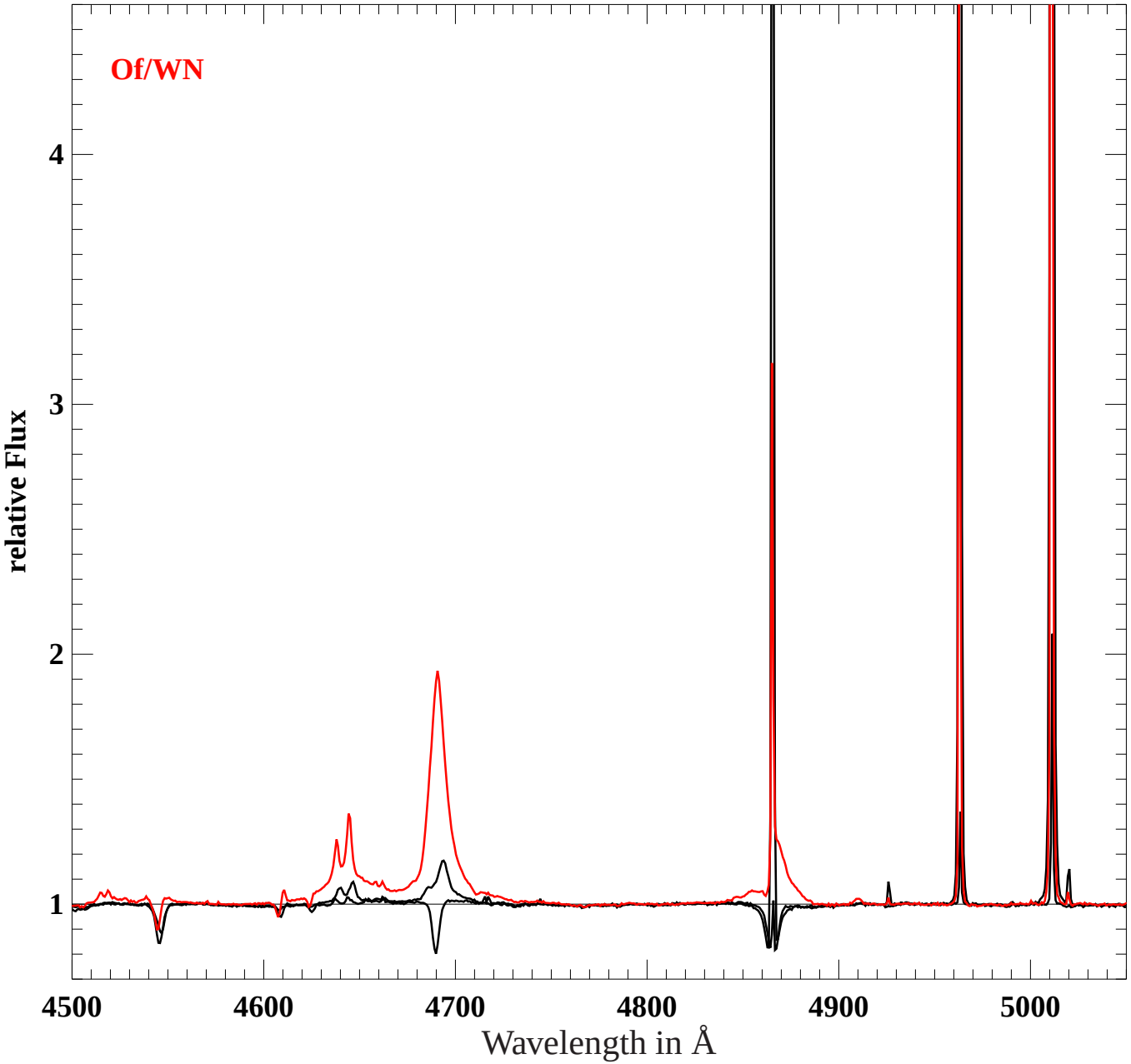
Of/WN transition region



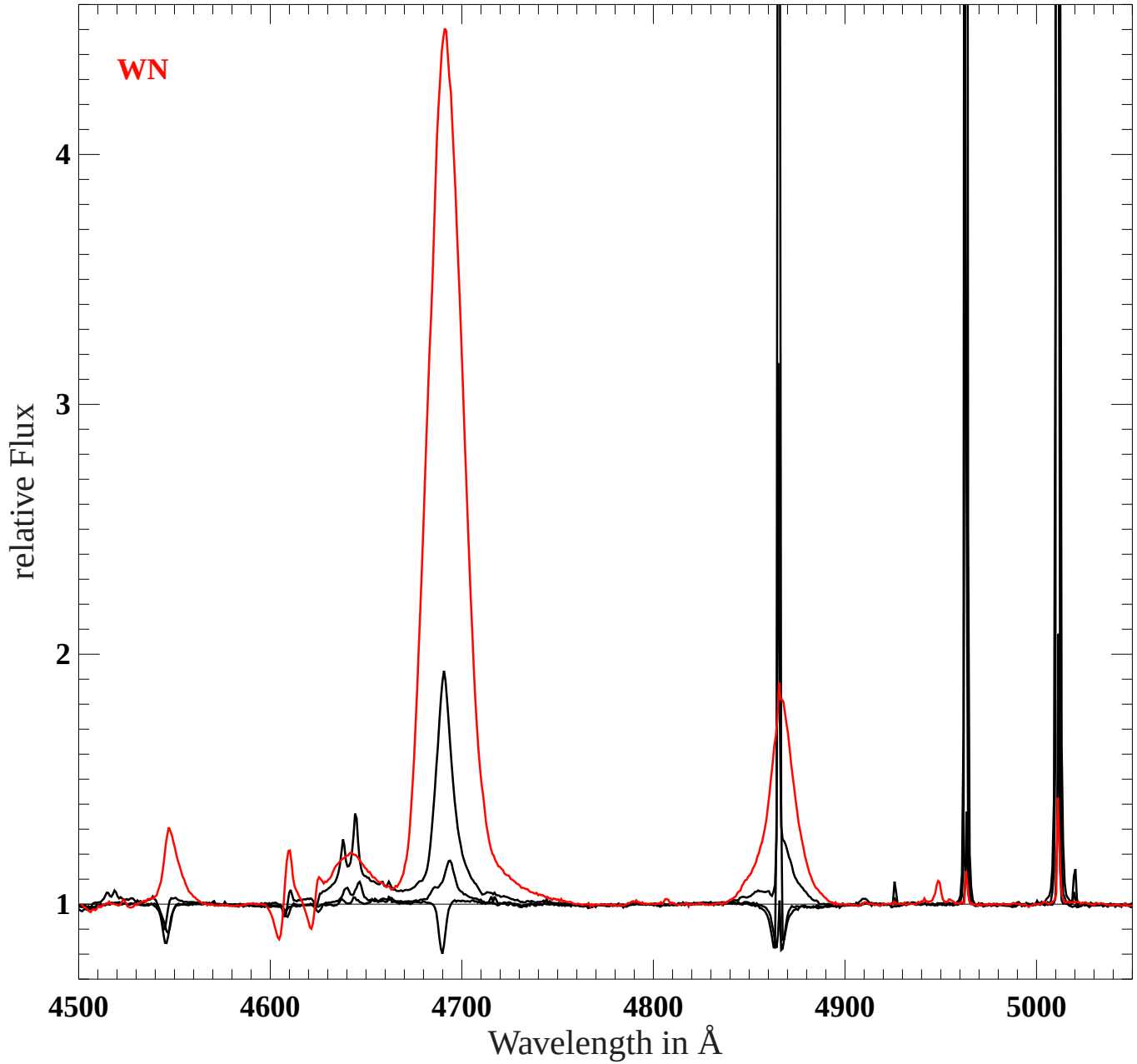
Of/WN transition region



Of/WN transition region



Of/WN transition region



Goals

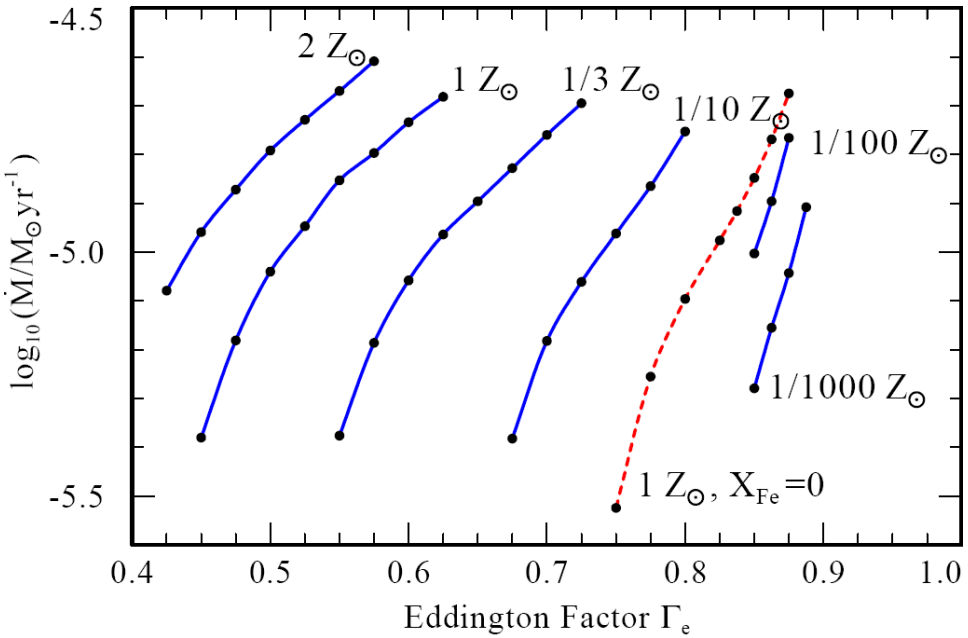
In the context of the VLT/FLAMES Tarantula Survey our Goals are:

- What is going on in the O-WN transition region?
- Which role has the mass-loss rate for the evolution?

Goals

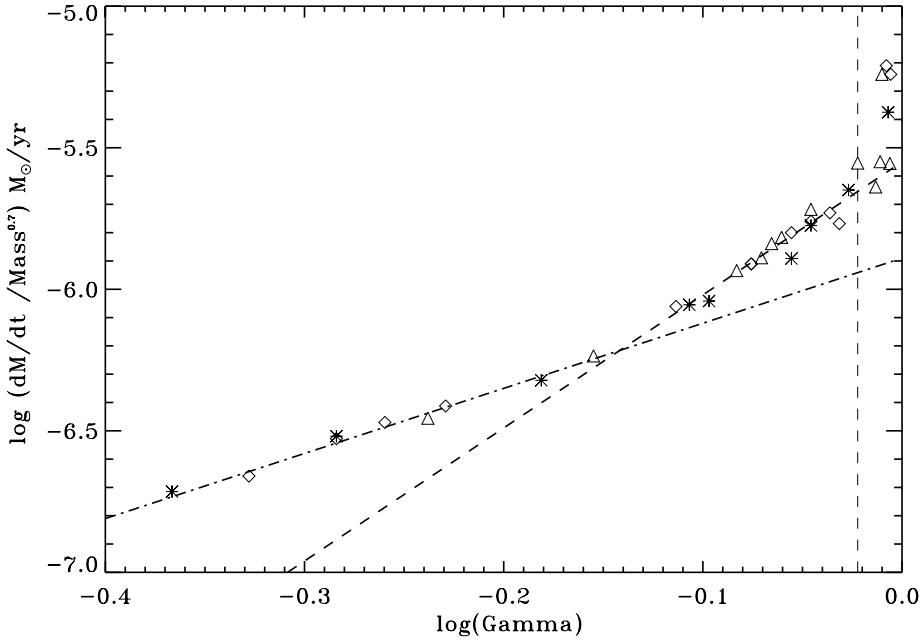
Mass loss close to the Eddington Limit:

WR-star wind models



Gräfener et al. 2008

Winds of super massive stars



Vink et al. 2011

Mass-loss dependency on Γ_e

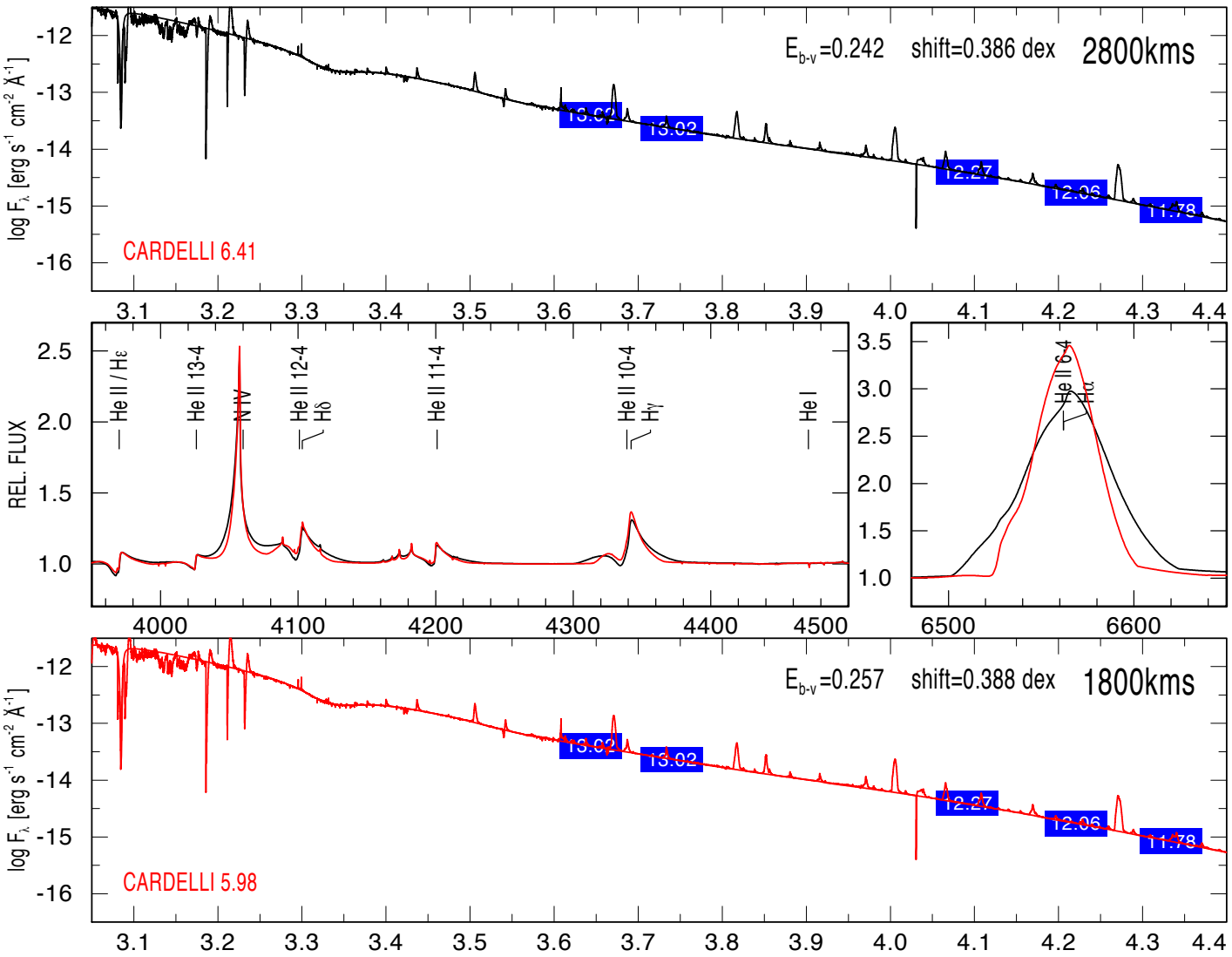
Spectral Analysis

Non-LTE code CMFGEN

- time intensive
- 3D grid of models (clumped and unclumped):
  - temperatures ($T_{\rm eff}$)
  - mass-loss rates ($\dot{M}$)
  - helium abundances (Y)
- fixed parameters:
  - luminosity (L)
  - terminal velocity (v_∞) and β
  - $\log g$
- $\approx$ 2000 models

Spectral Analysis: Luminosity

$L_\star$: match the observed SED with the model SED



higher wind density: $\Delta L = 0.002\,\mathrm{dex}$

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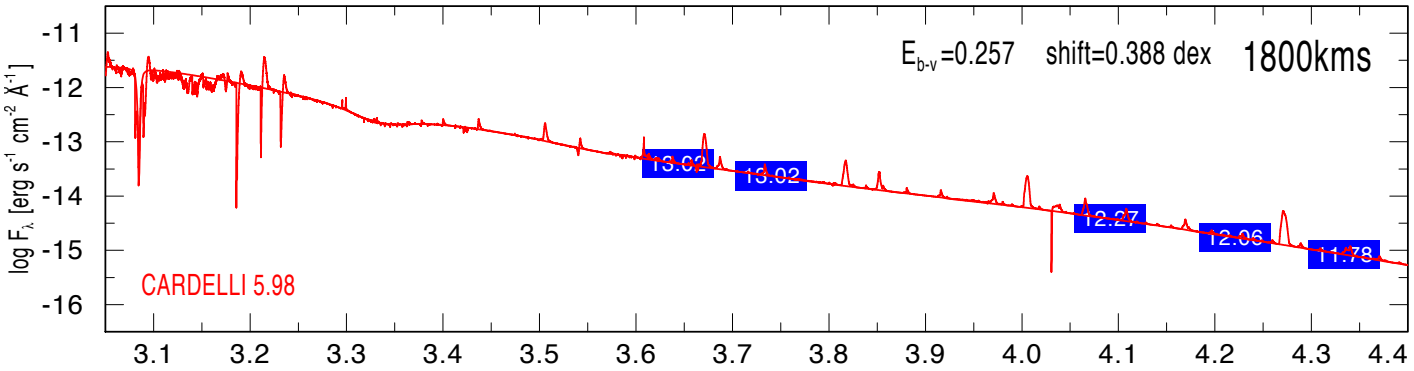
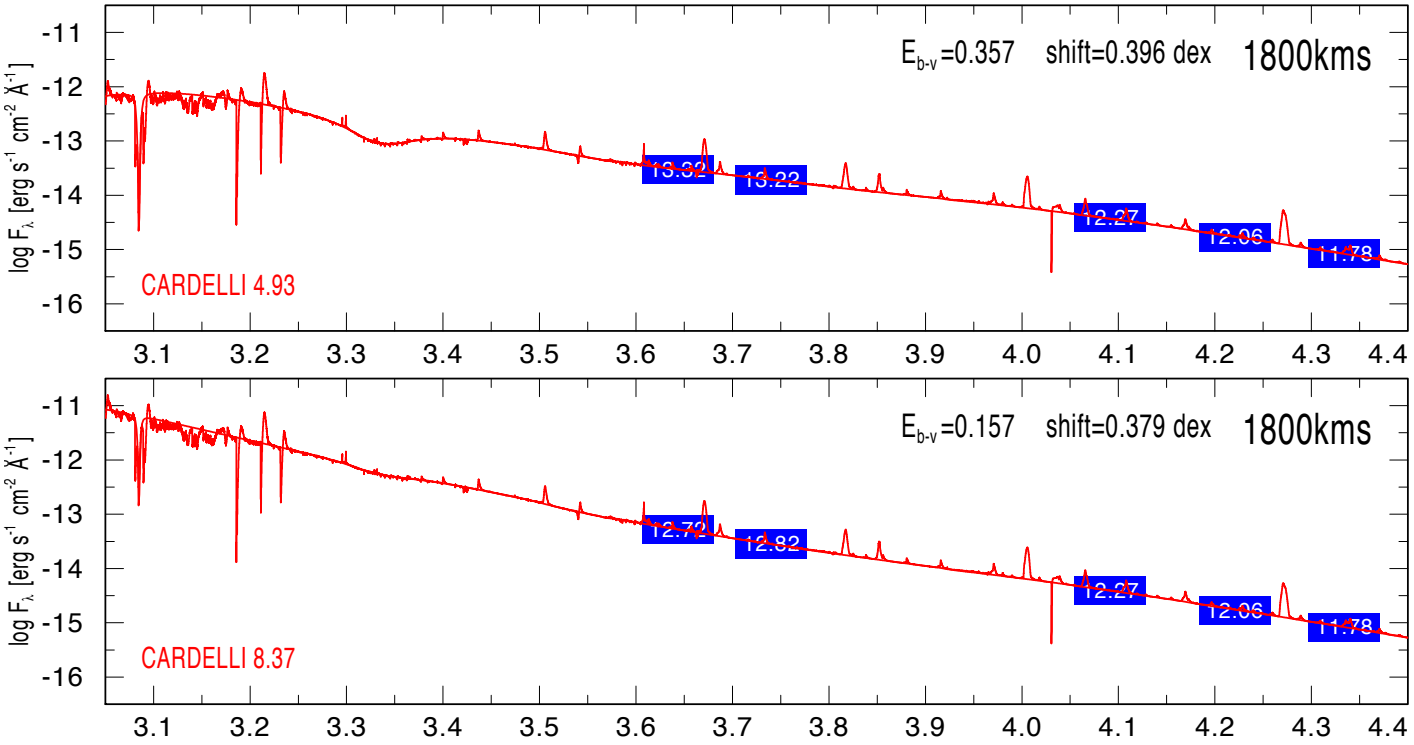
Spectral Analysis: Luminosity



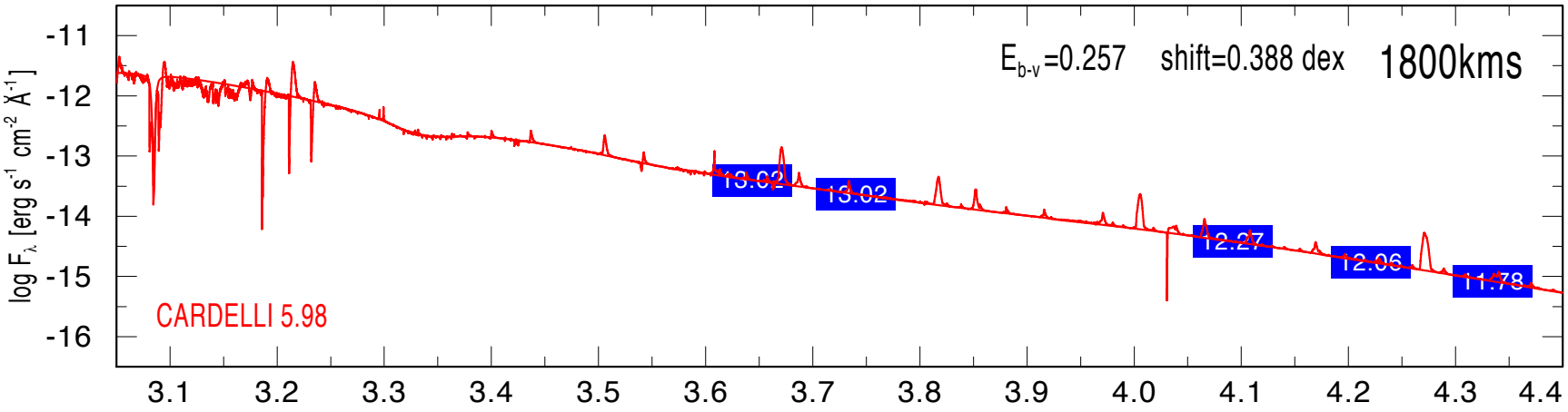
$\Delta B = \pm 0.3$ mag and $\Delta V = \pm 0.2$ mag



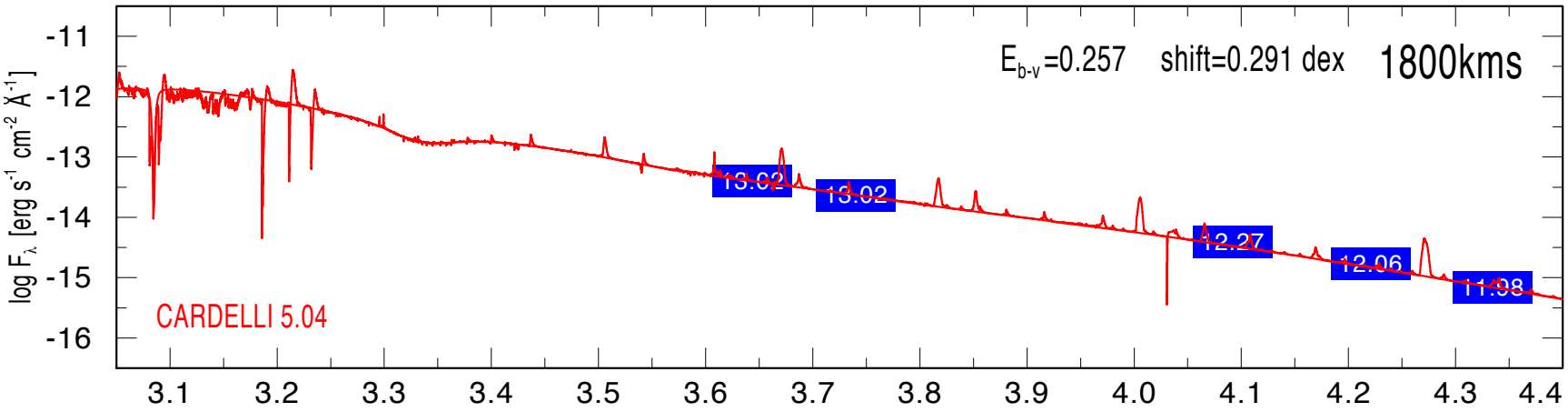
$\Delta L = \pm 0.01$ dex

Spectral Analysis: Luminosity

$K_s = 11.78$



$\Delta K_s = 0.2\,\mathrm{mag}$



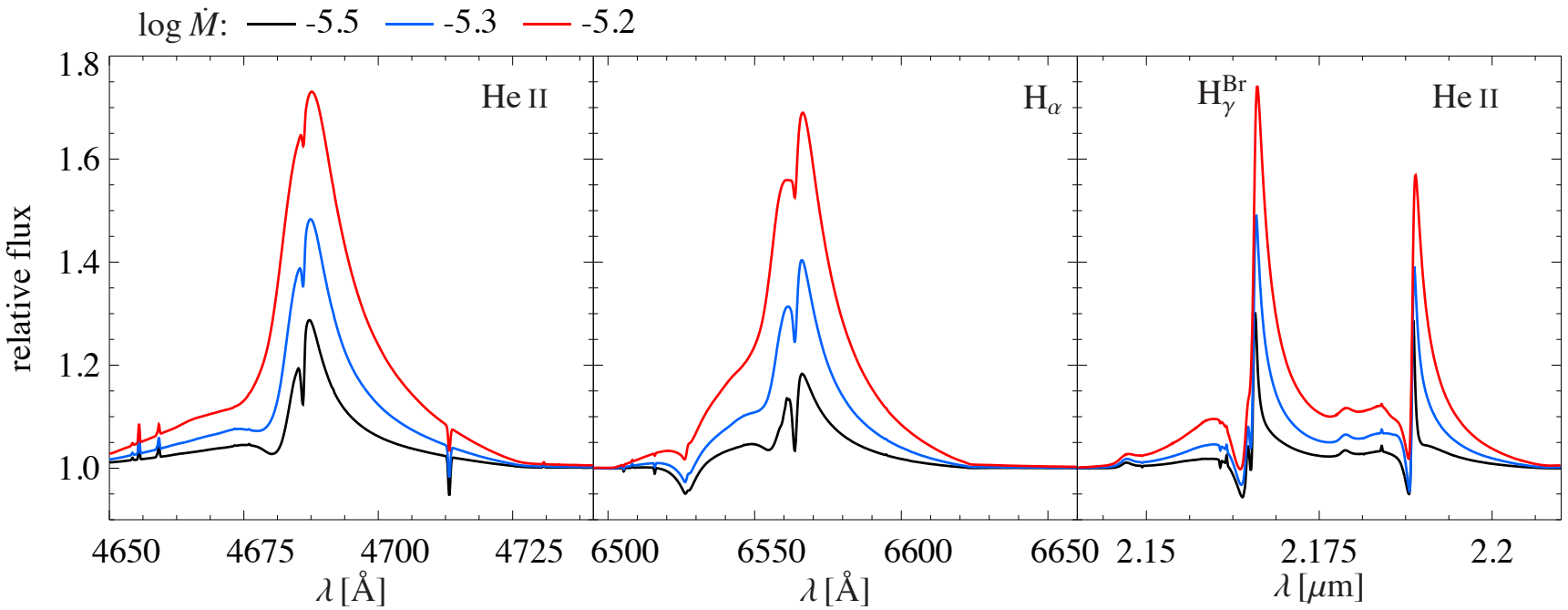
$\Delta L = 0.1\,\mathrm{dex}$

Spectral Analysis

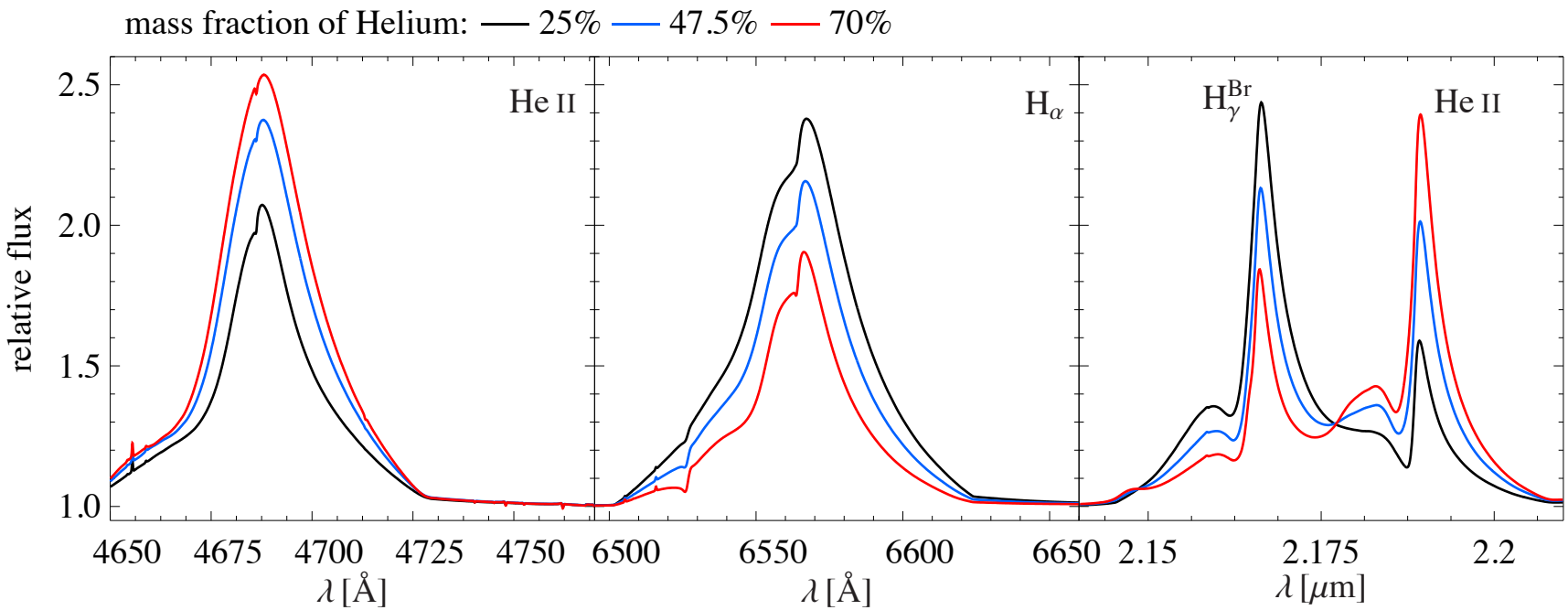
Fitting Non-LTE CMFGEN models to observations:

- optical (VLT/FLAMES) and near-IR (VLT/SINFONI)
- $T_{\rm eff}$ (optical diagnostics)
- $\dot{M}$ (near-IR and optical diagnostics)
- *He* (near-IR and optical diagnostics)

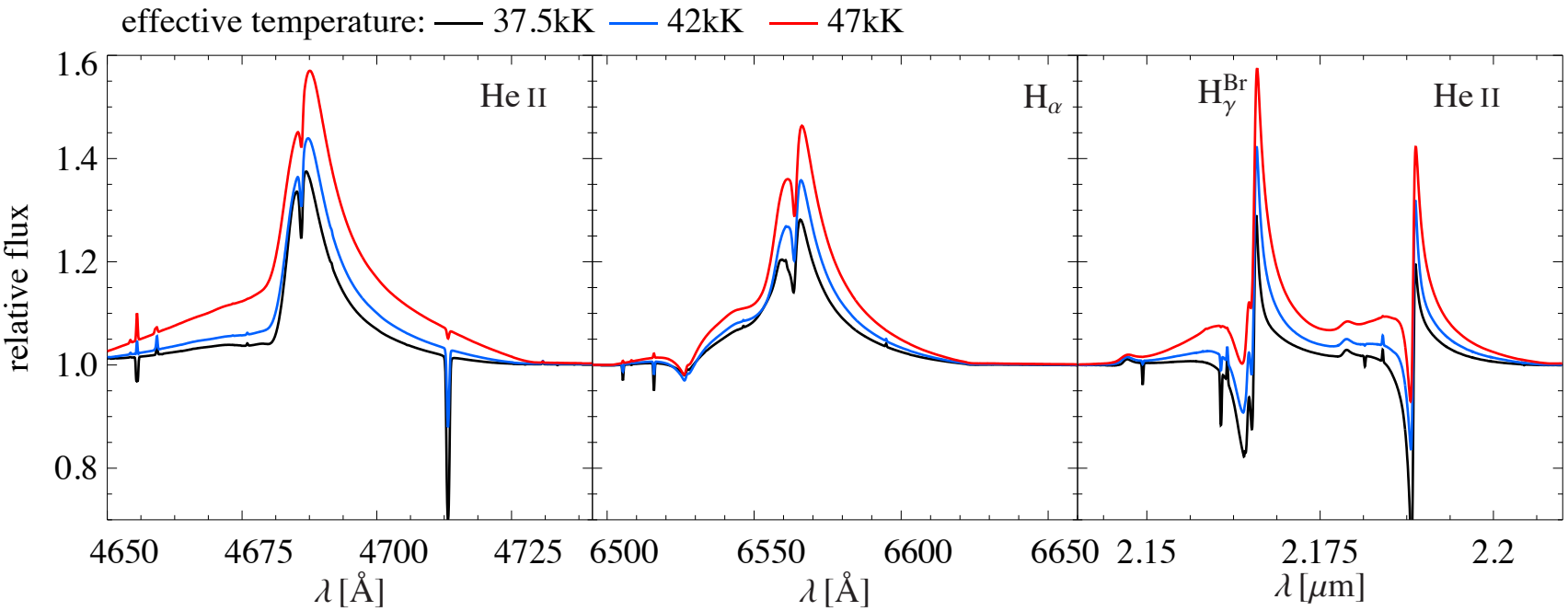
Spectral Analysis: mass-loss rate



Spectral Analysis: Helium abundance



Spectral Analysis: Temperature



He II (λ4686) has a temperature jump in the optical

$\Rightarrow$ may lead to wrong Y or/and $\dot{M}$

Upper mass limit of massive Stars

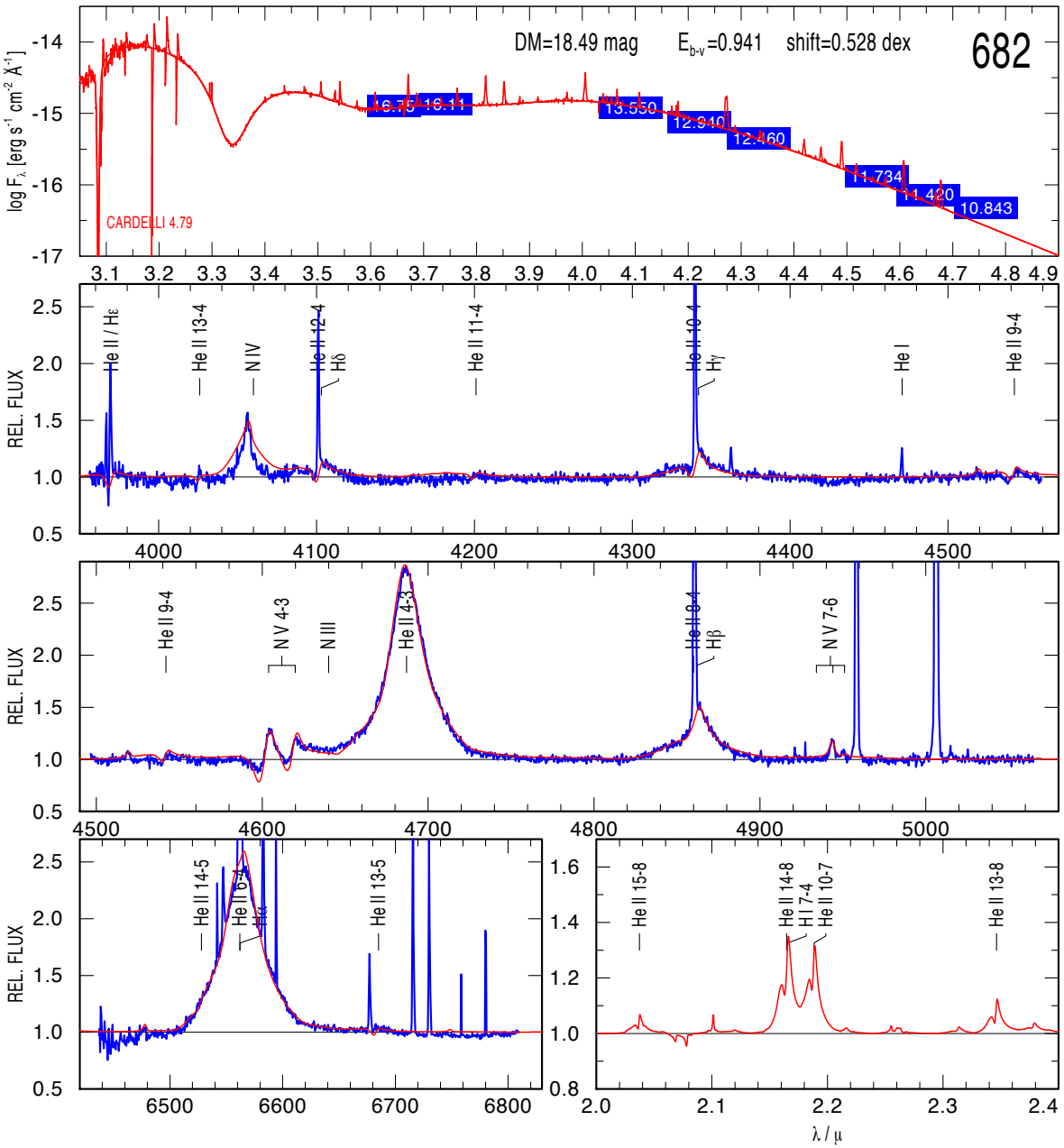
Crowther et al. 2010:

R136 contains several stars with $M_\star > 150 M_\odot$

Bestenlehner et al. 2011:

VFTS 682 $\sim 150 M_\odot$

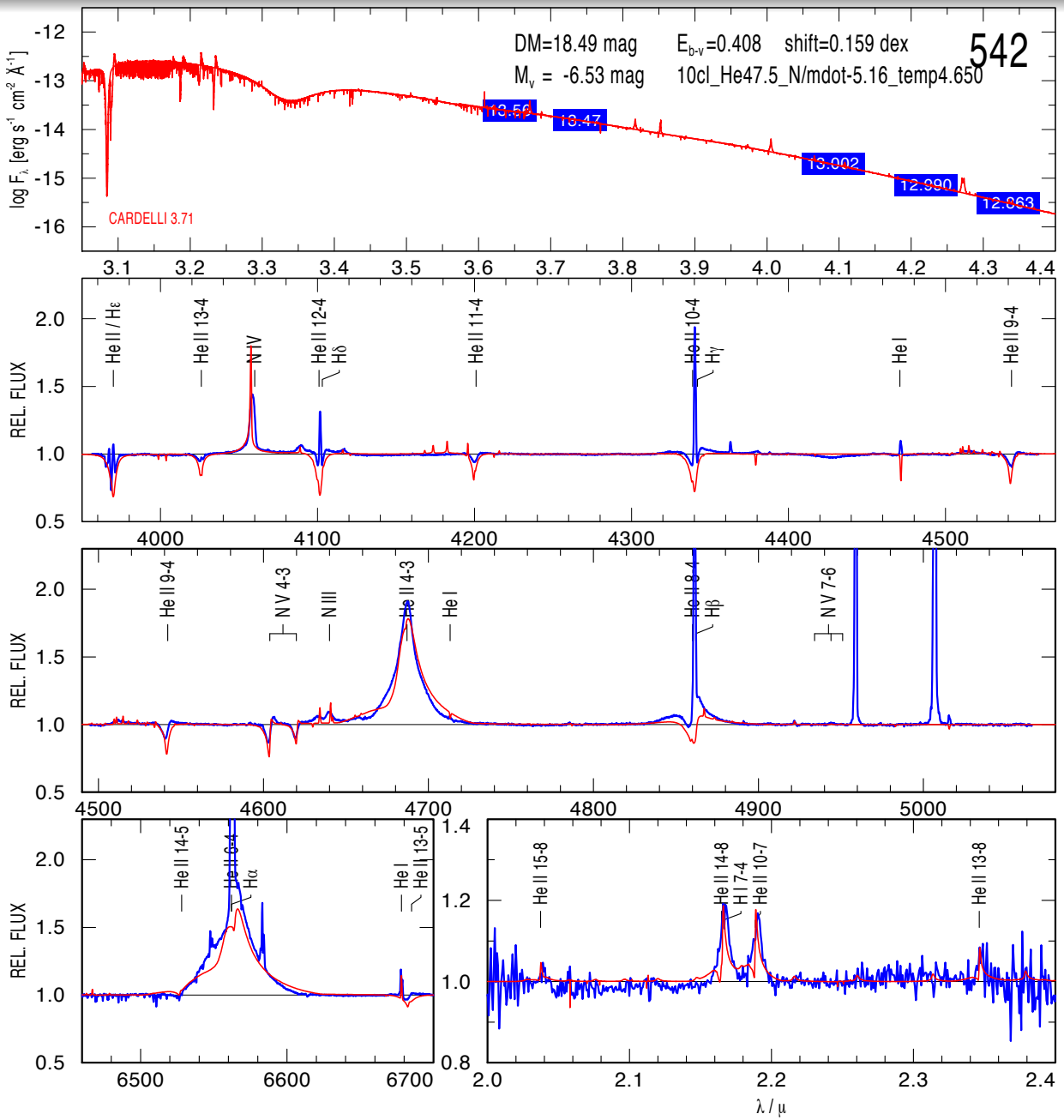
Results: Solitary Superstar VFTS 682



- $T_{eff} = 52.2 \pm 2.5 kK$
- $\log(\dot{M}/M_{\odot} yr^{-1}) = -4.13 \pm 0.2$
- $\log(L/L_{\odot}) = 6.5 \pm 0.2$
- Runaway?
- Formed at its current location?

Bestenlehner et al. 2011

VFTS 542 (O2 If*/WN5) preliminary result



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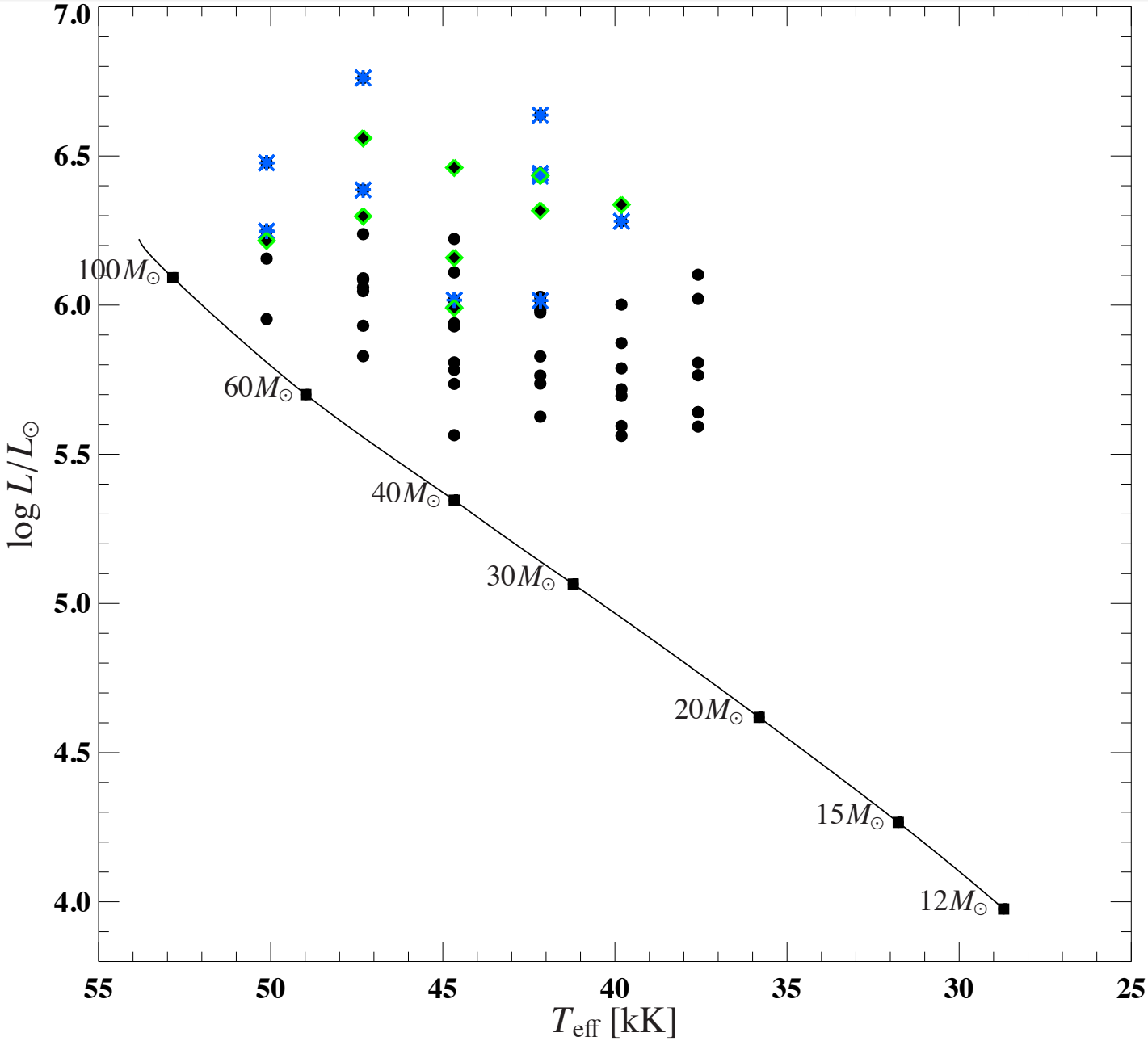
HR-Diagram preliminary result



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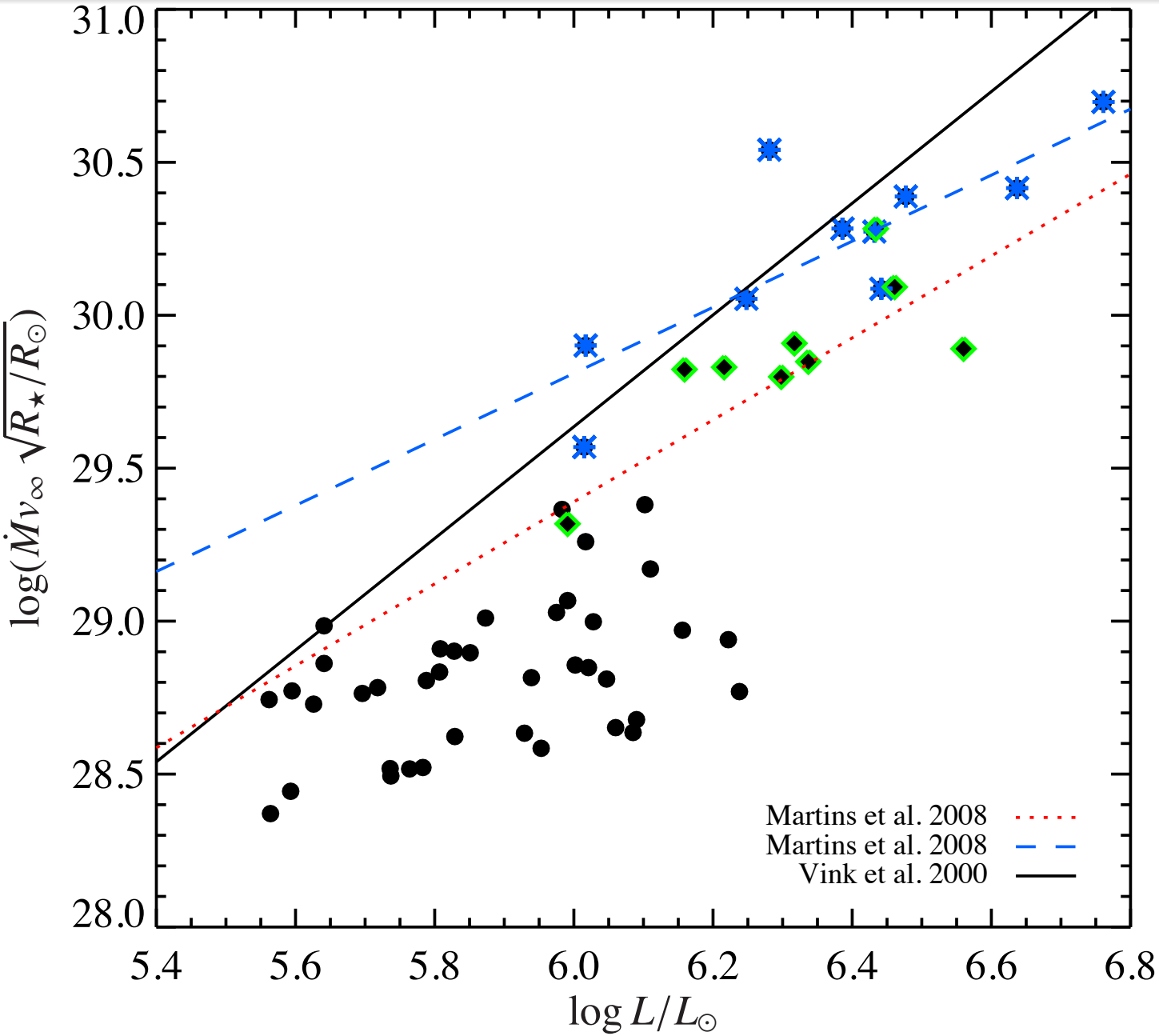
$\dot{M}v_\infty - \log L/L_\odot$ preliminary result comparison



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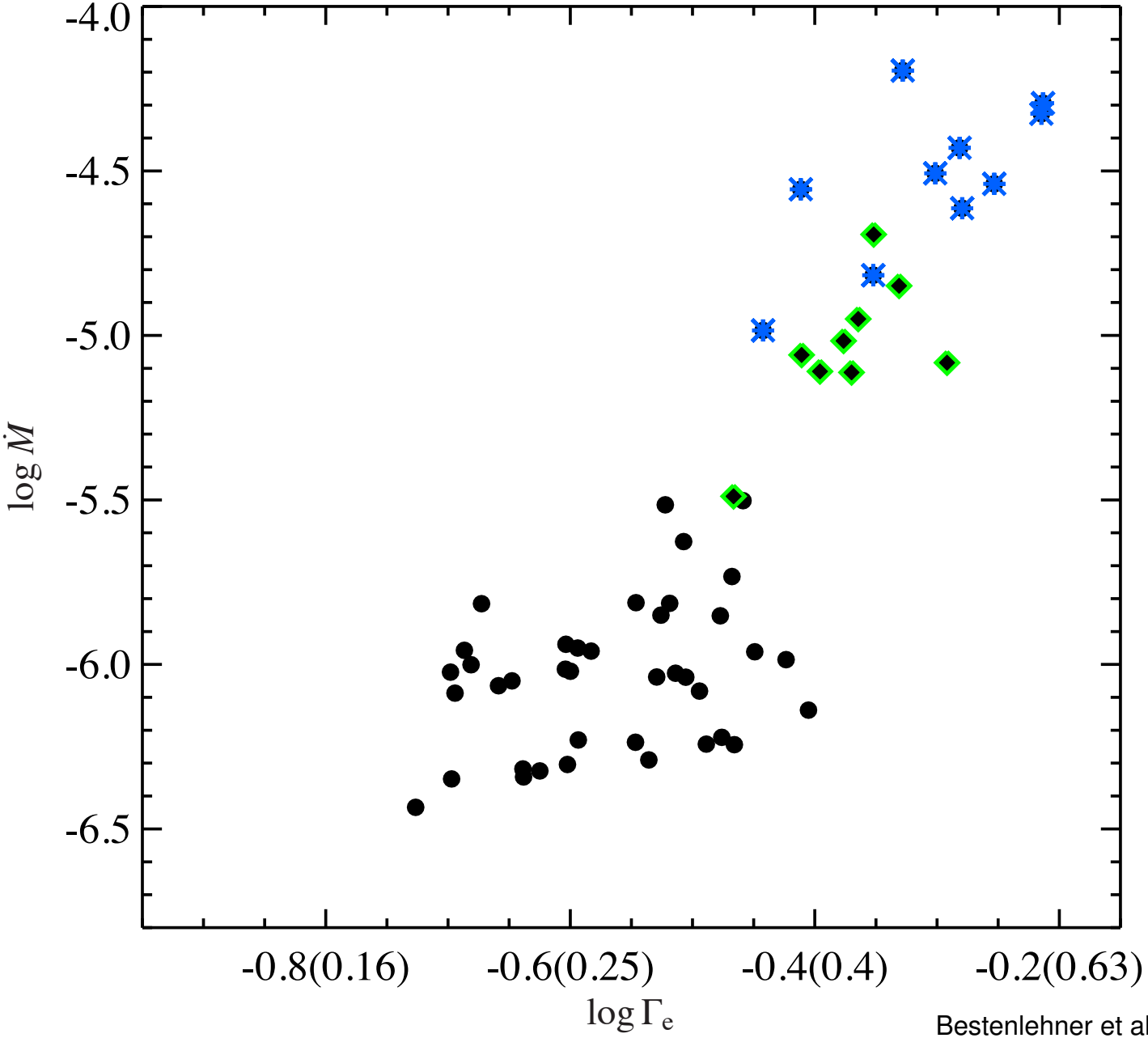
$\dot{M} - \Gamma_e$ preliminary result



Bestenlehner et al. in prep.

Summary

- Luminosity depends mainly on the near-IR photometry
- Near-IR spectroscopy solves contradictions in the optical
- $\dot{M} - \Gamma_e$ relation regarding to the theoretical predictions by Gräfener et al. 2008 and Vink et al. 2011
- Possible ”Kink” at the transition to Of/WN stars (Vink et al. 2011)
- Results are preliminary