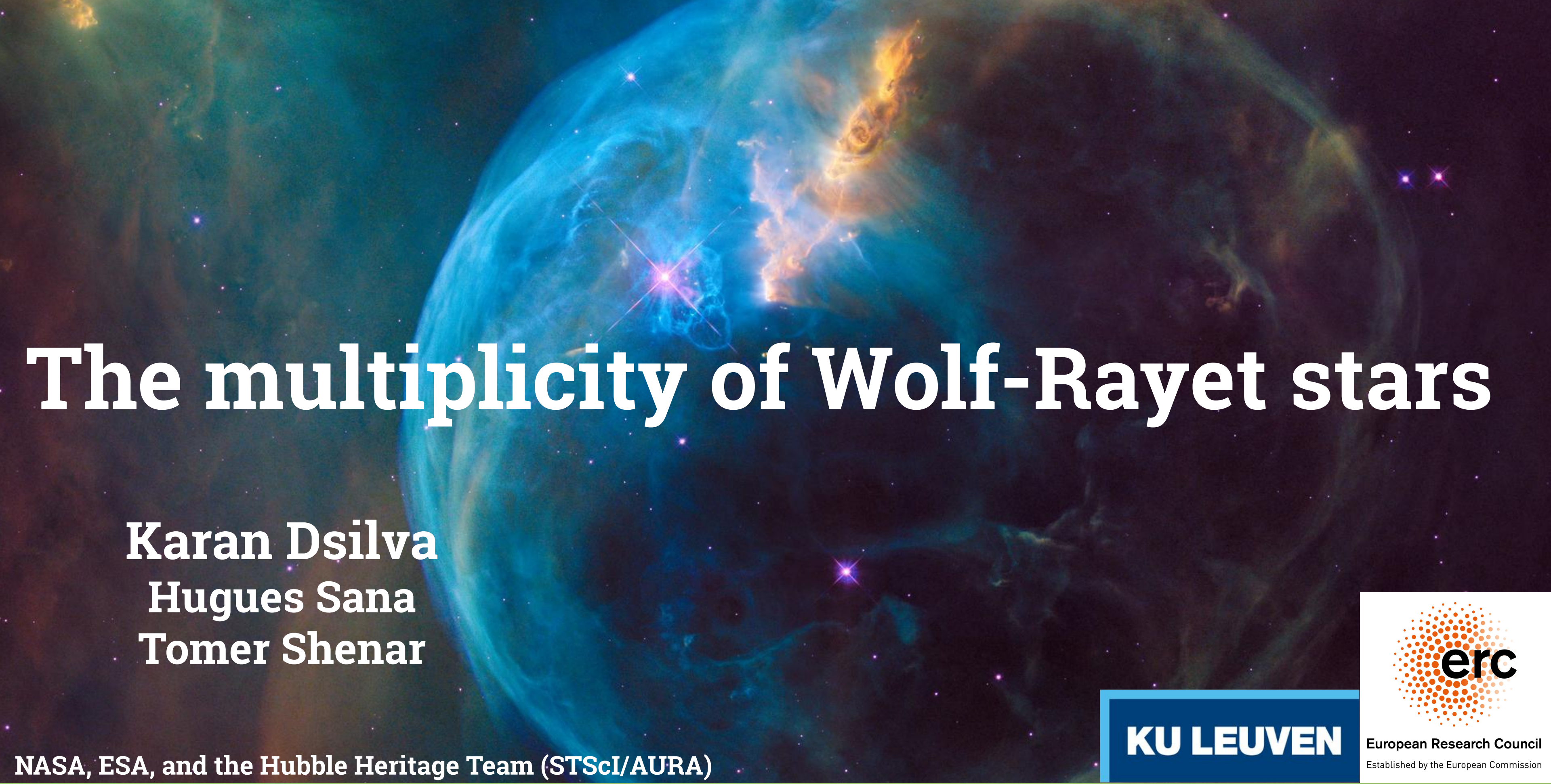

The multiplicity of Wolf-Rayet stars

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KU LEUVEN

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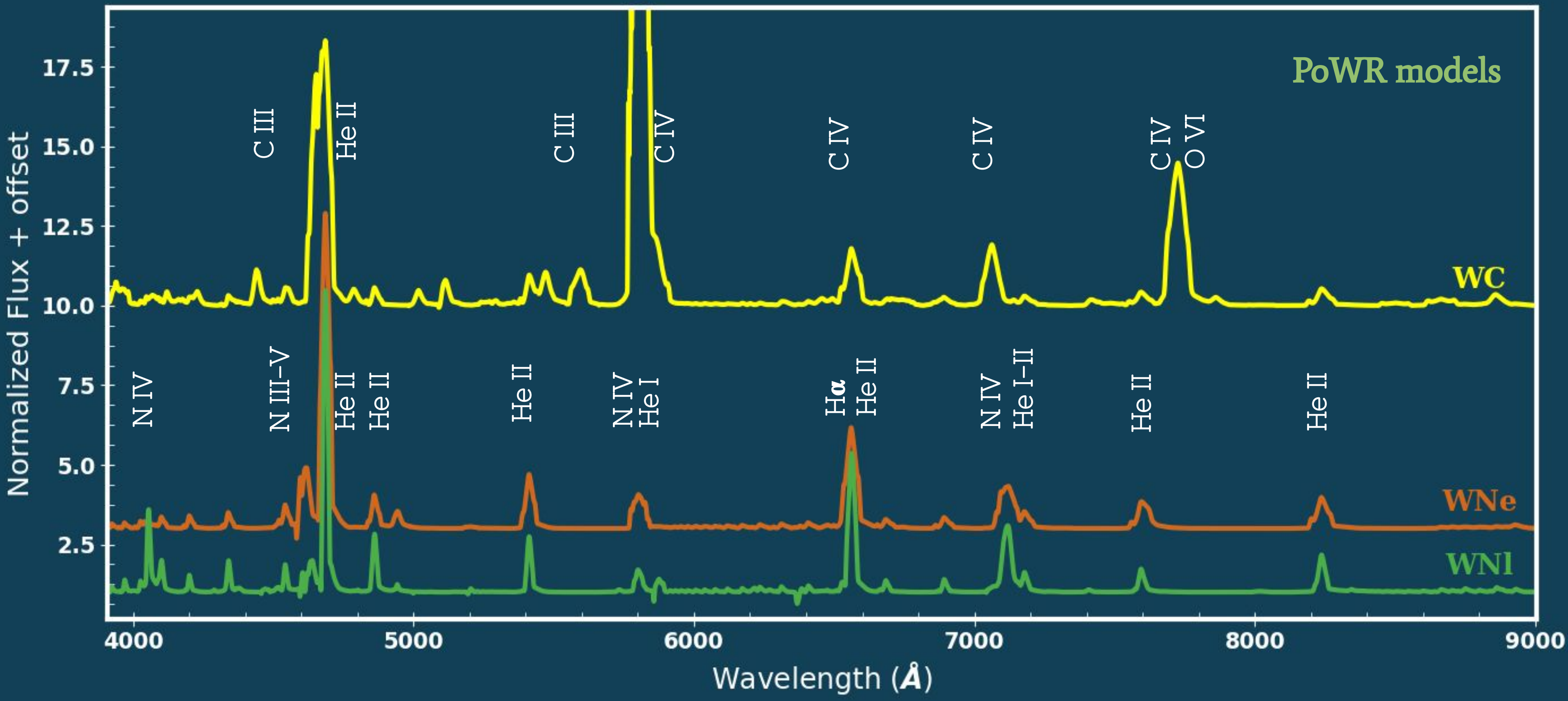
The importance of massive stars

- Drive galactic evolution with their highly energetic stellar radiation and winds

- Important feedback to the ISM through supernovae/stellar winds

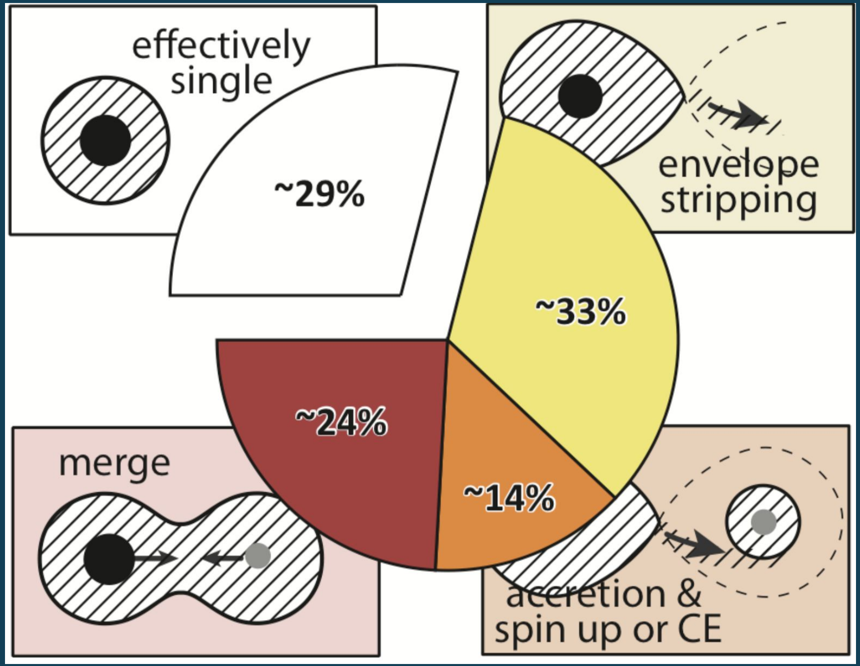
Composite image of WR124. Credit:ESO

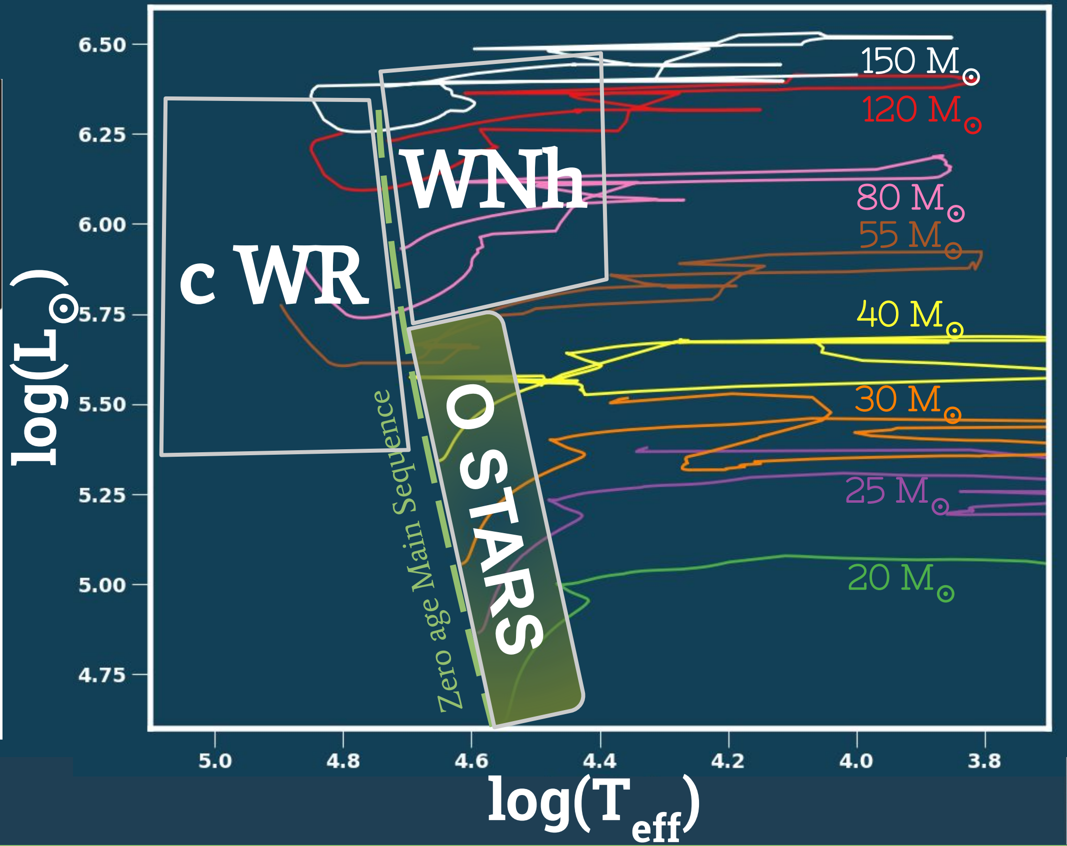
Wolf-Rayet stars: classes and subclasses



Hamann & Gräfener (2004), Todt+ (2015), Sander, Hamann, & Todt (2012)

The multiplicity of massive stars

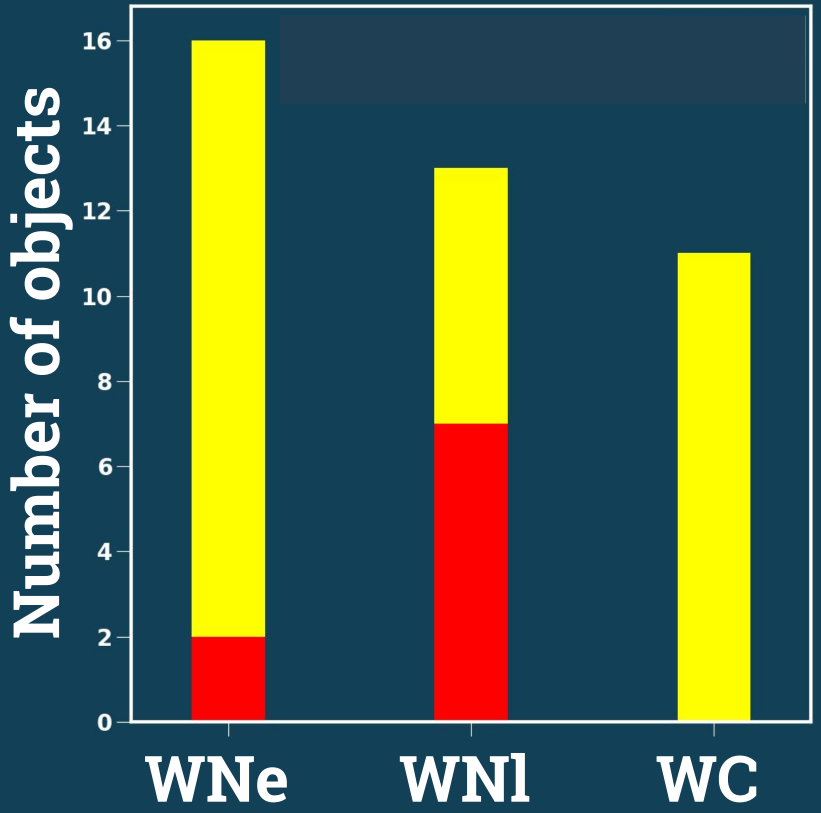


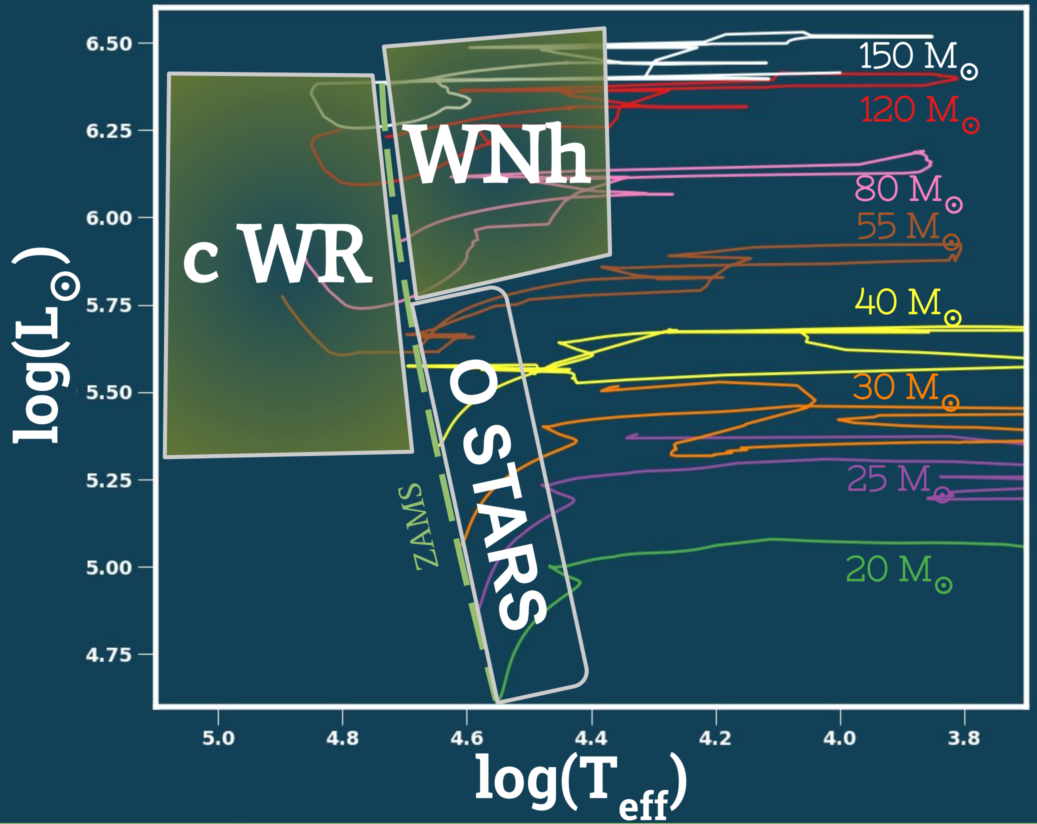


O Stars: Sana+ (2012), Ekström+ (2012), Yusof+ (2013), Sota+ (2014), Barba+ (2010), Simon-Diaz+ (2011ab, 2015)

WR: Van der Hucht (2000, 2001), Moffat (1995), Niemela+ (1999), Bartzakos+ (2001), Foellmi+ (2003a,b), Barba+ (2014)

The sample





Stars from the WR catalogue* that are observable with HERMES (R ~ 85000)

*http://pacrowther.staff.shef.ac.uk/WRcat/index.php

Raskin+ (2011), Ekström+(2012), Yusof+ (2013)

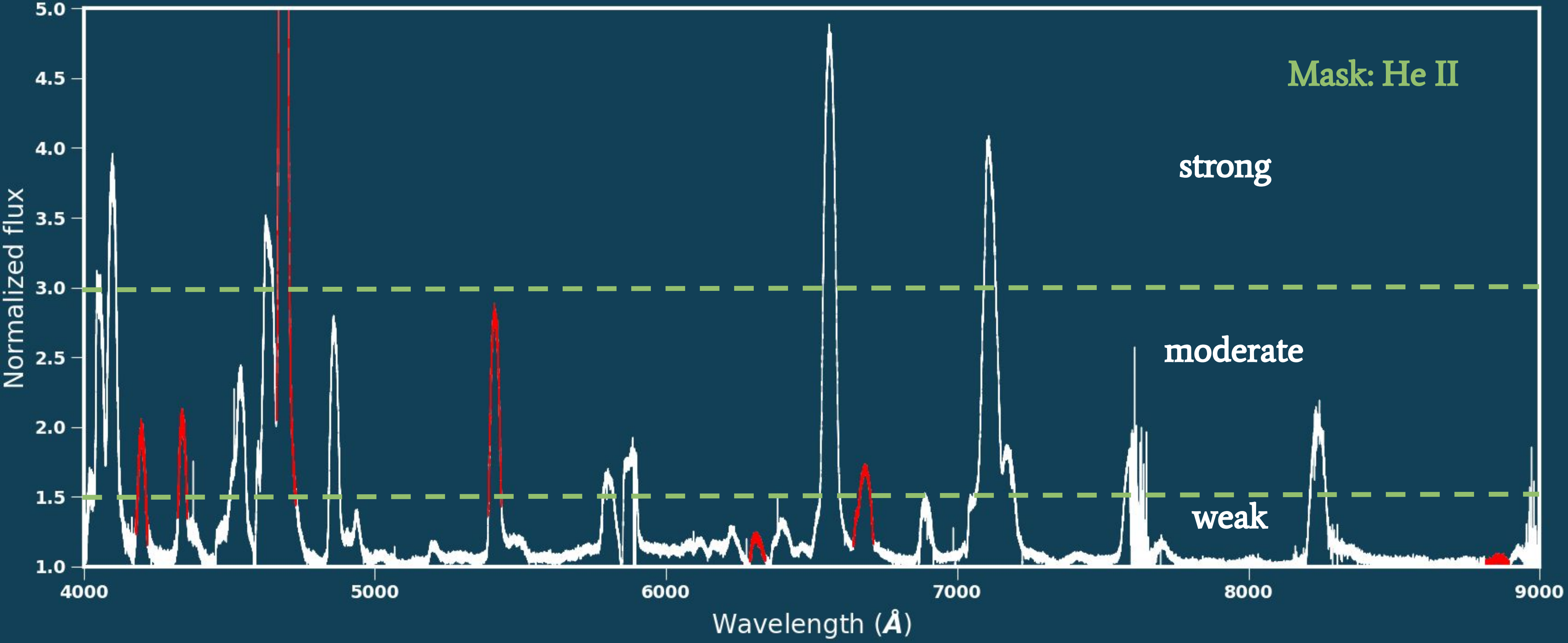
Radial Velocity measurements

For a statistically accurate, bias-corrected multiplicity analysis, we need:

- High-quality spectral time series
- Homogeneous radial velocity measurements
- Accurate errors

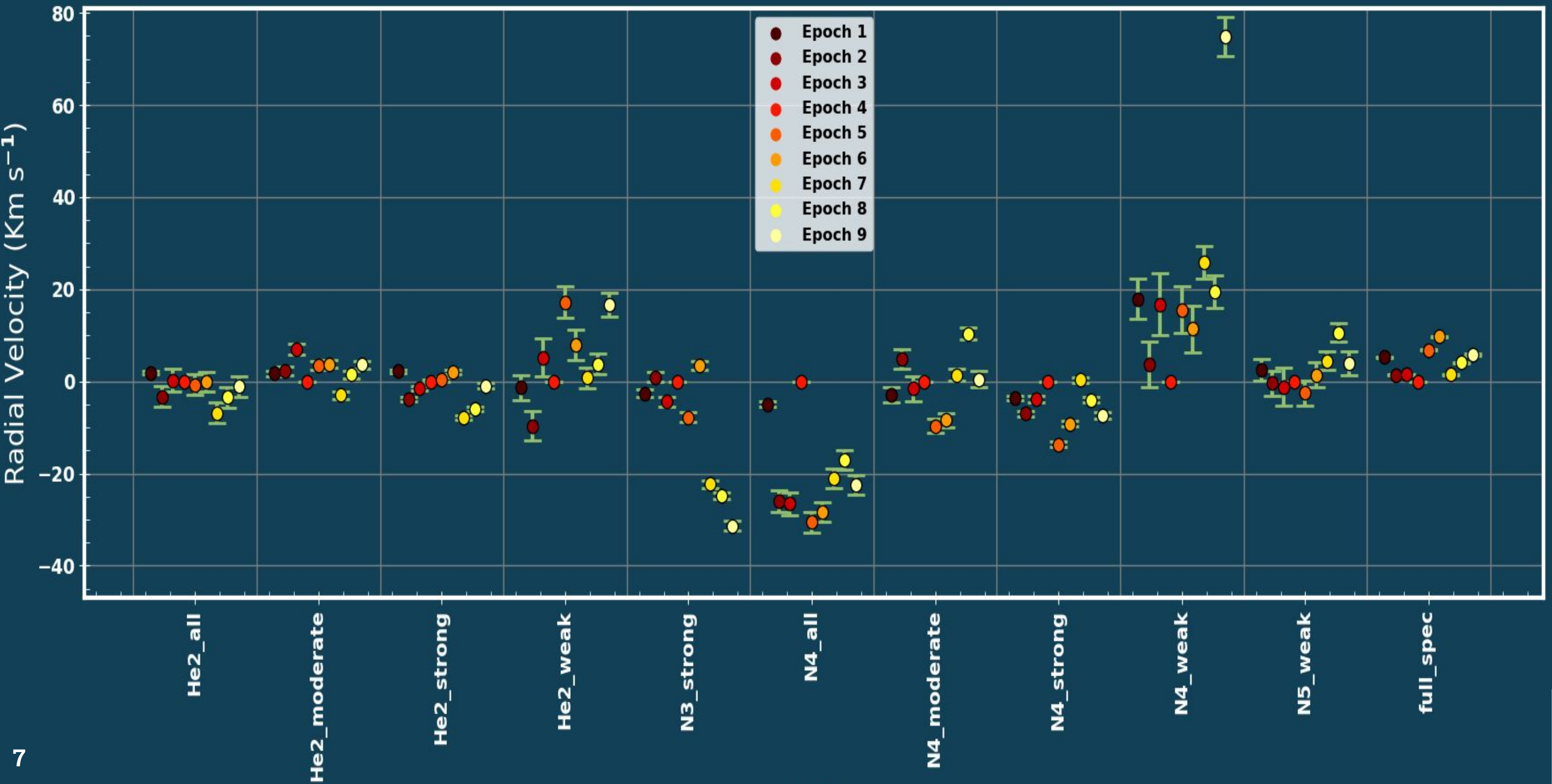
Radial Velocities: Cross-correlation

Compares a template to the data using convolution

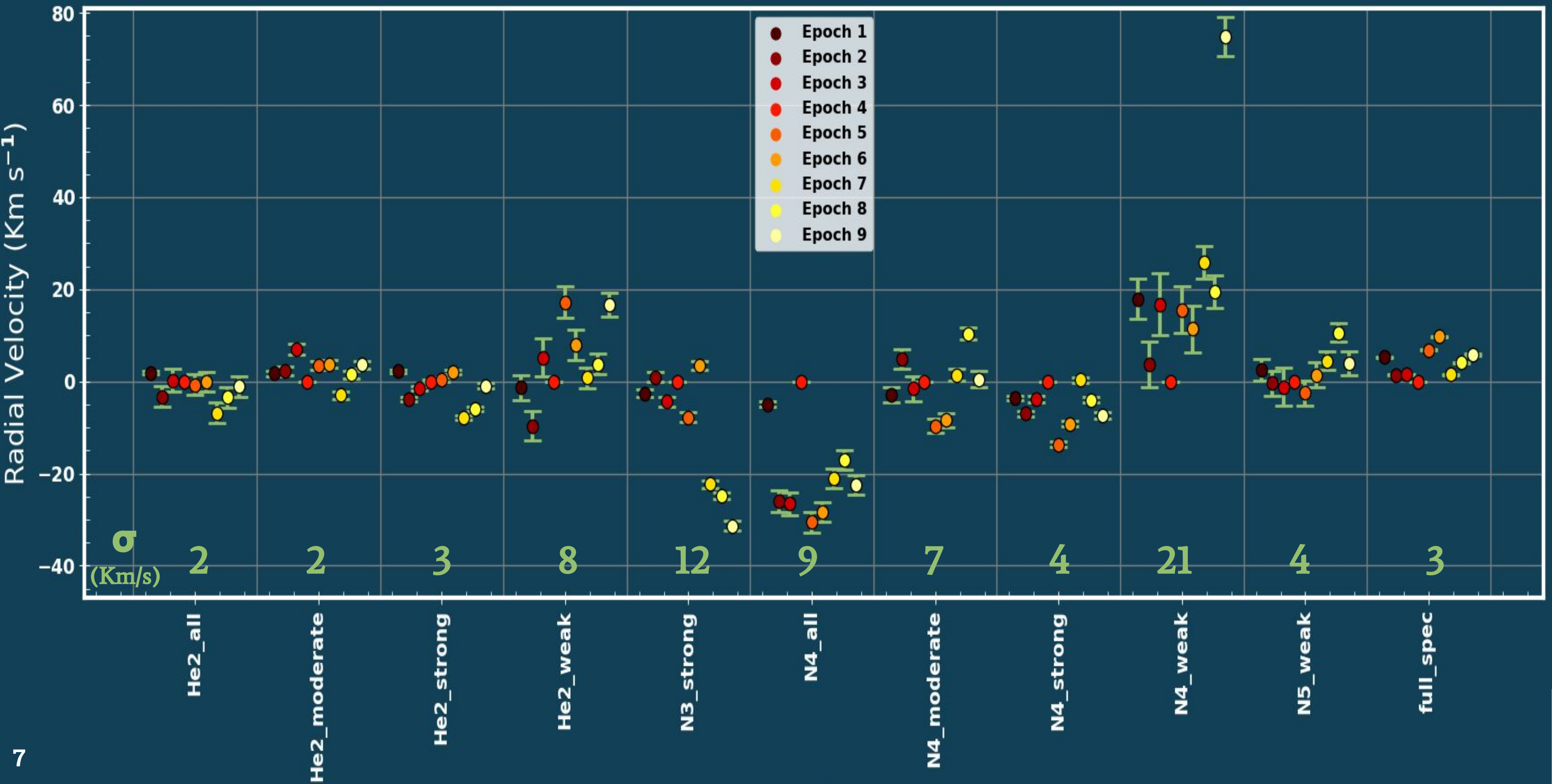


Errors from the theory of maximum log-likelihood (Zucker 2003)

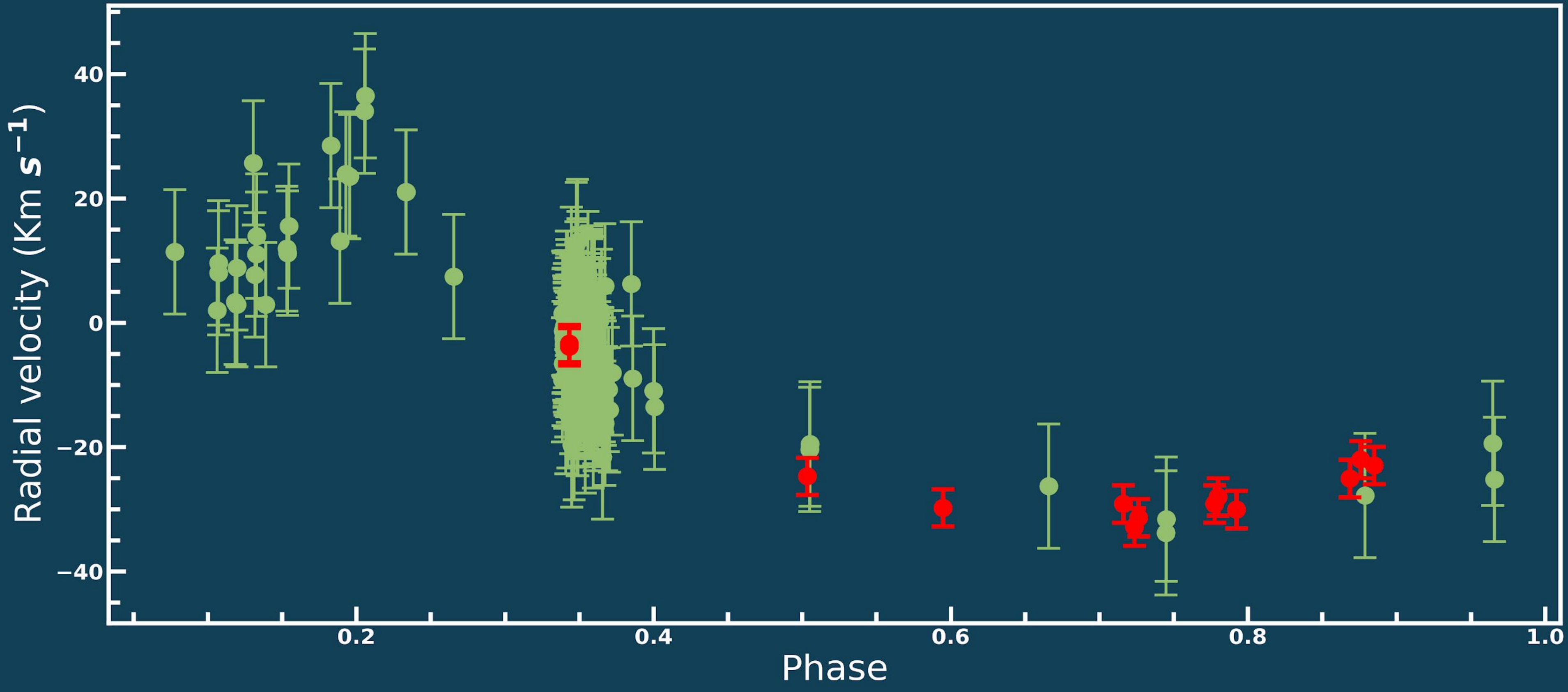
The Radial Velocity spread over ions (WR136)



The Radial Velocity spread over ions (WR136)



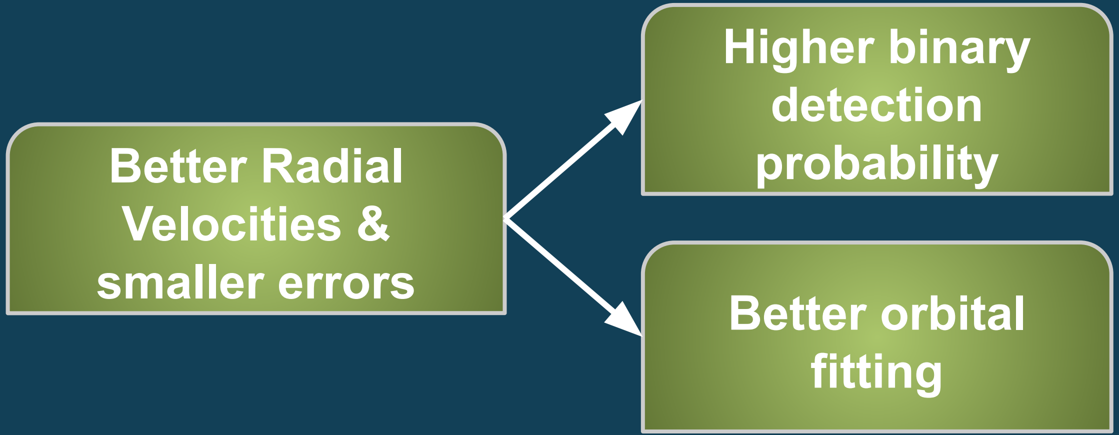
WR 137 (WC7pd + O9) - 13.6 year period



P = 4766 +/- 66 days from Lefevre+ 2005

Conclusions & next steps

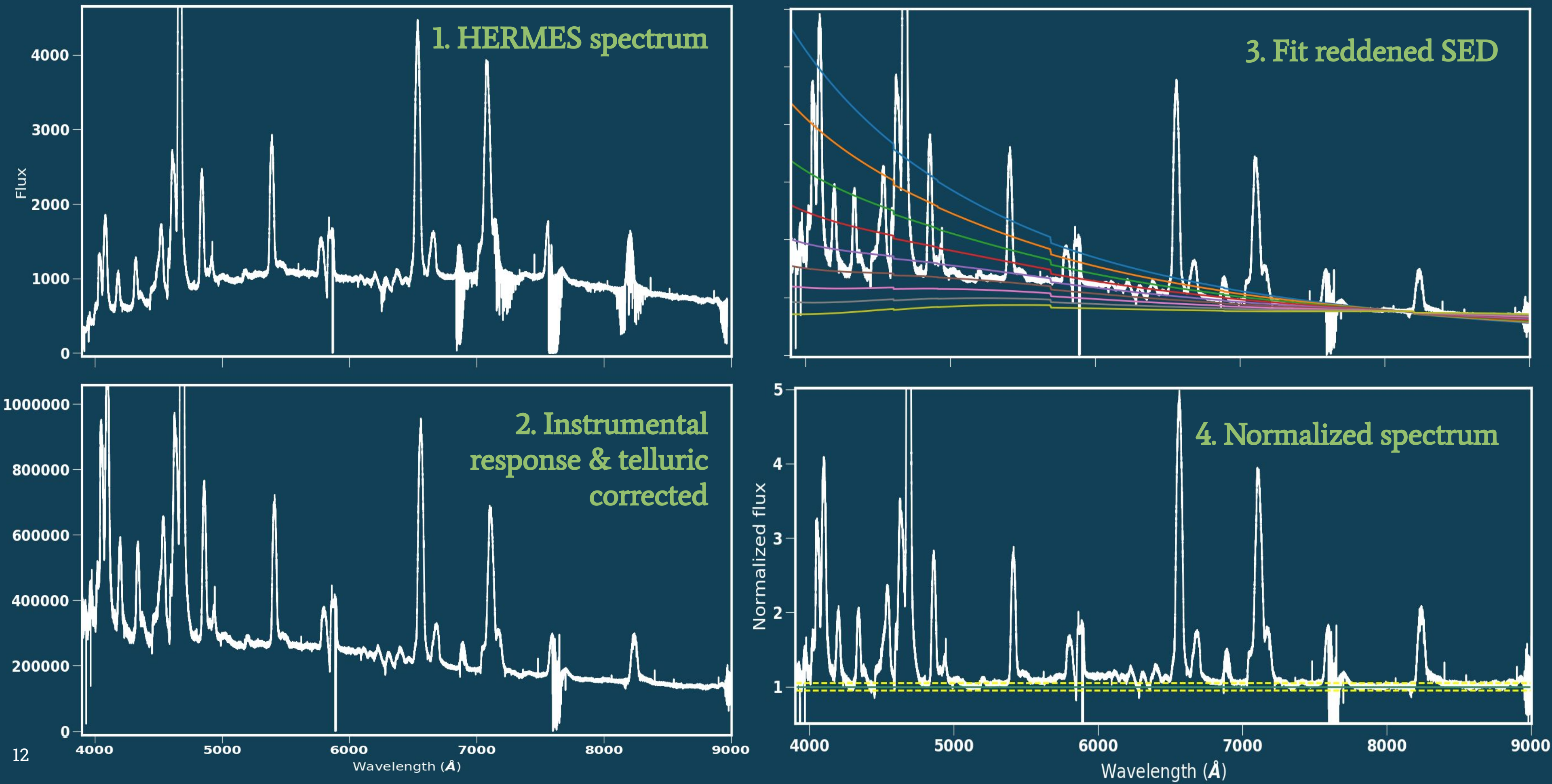
- Radial velocities accuracy of the order of 2-5 Km/s can be achieved
- Statistical errors are much smaller, wind variability dominates



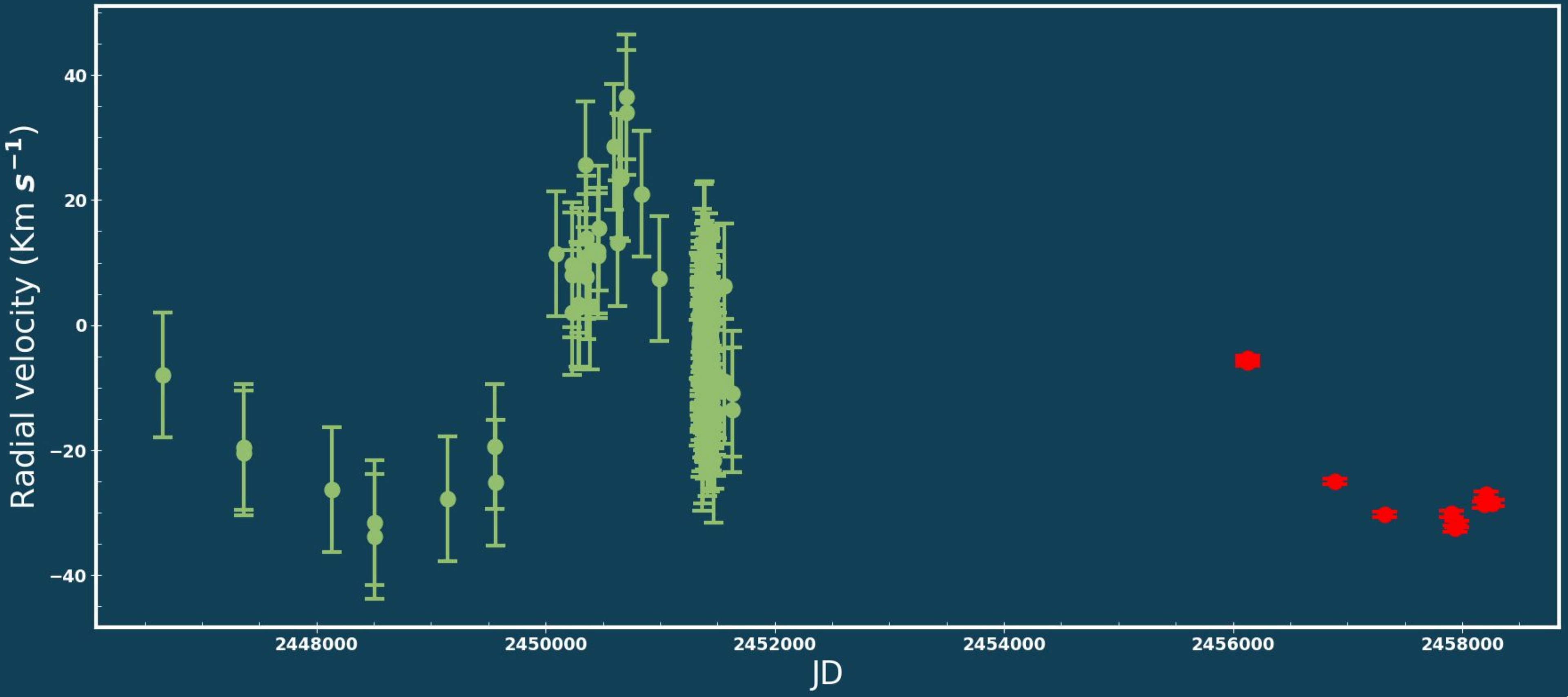
A. Extend the sample to include southern targets (archival data + ESO + SALT).

B. Determine orbits for the binary candidates.

Normalization

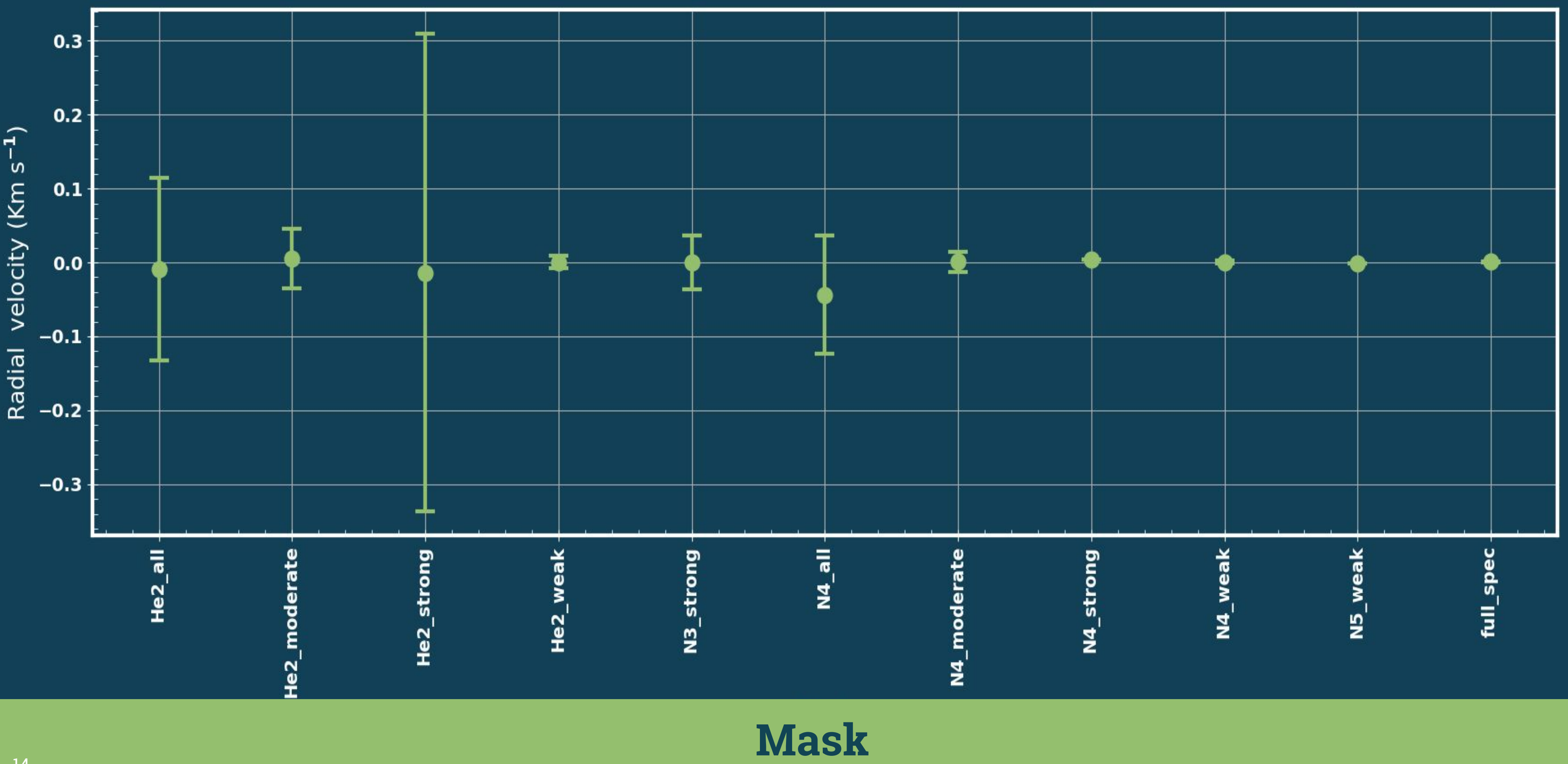


WR 137 - 13.6 year period

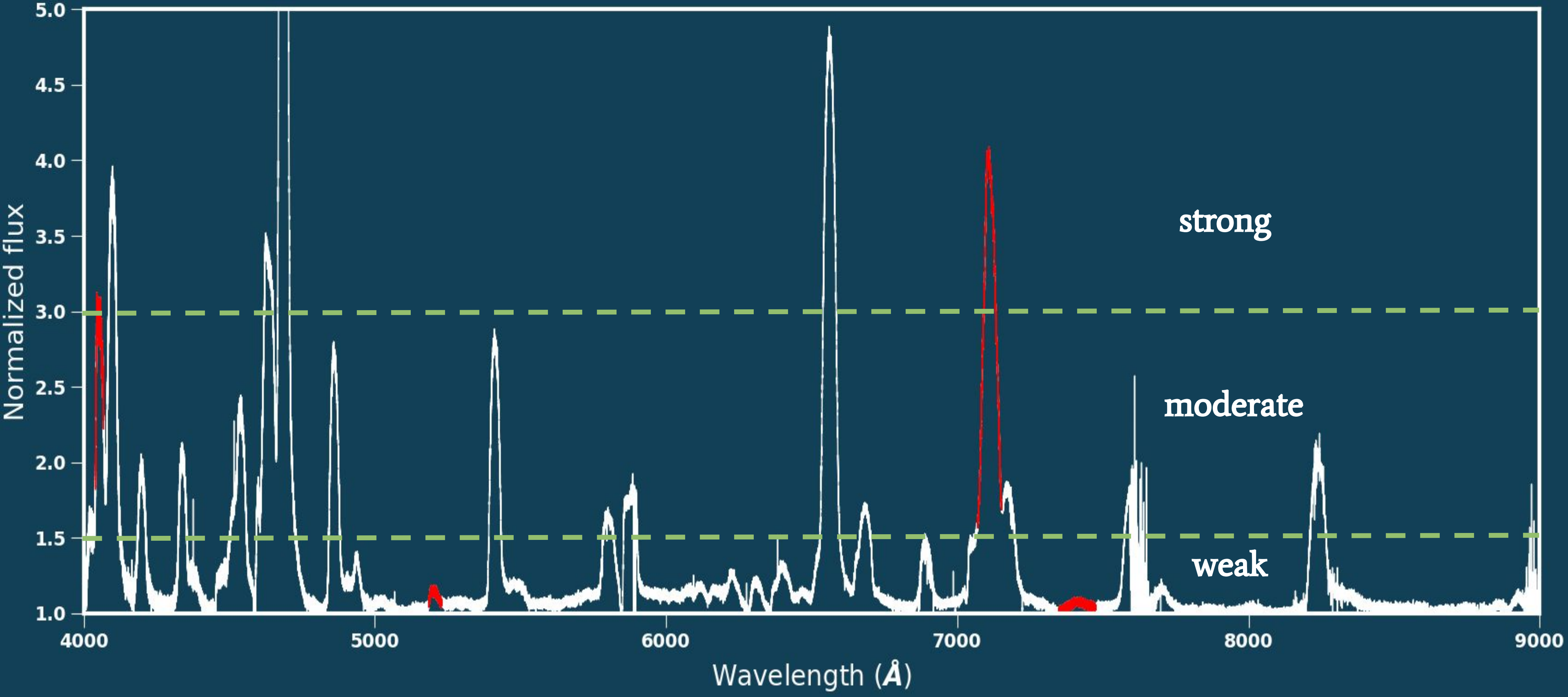


Lefevre+ 2015

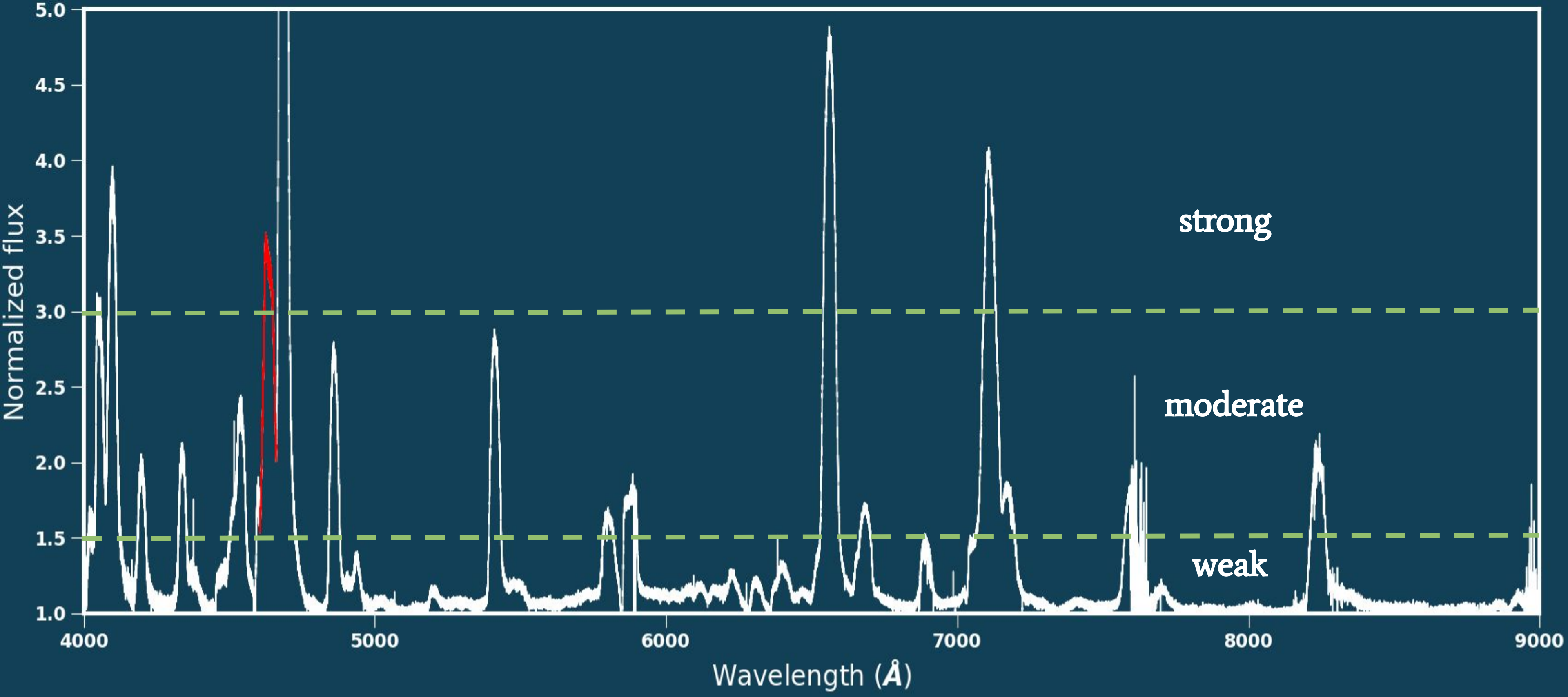
A test for reliable masks: autocorrelation (WR136)



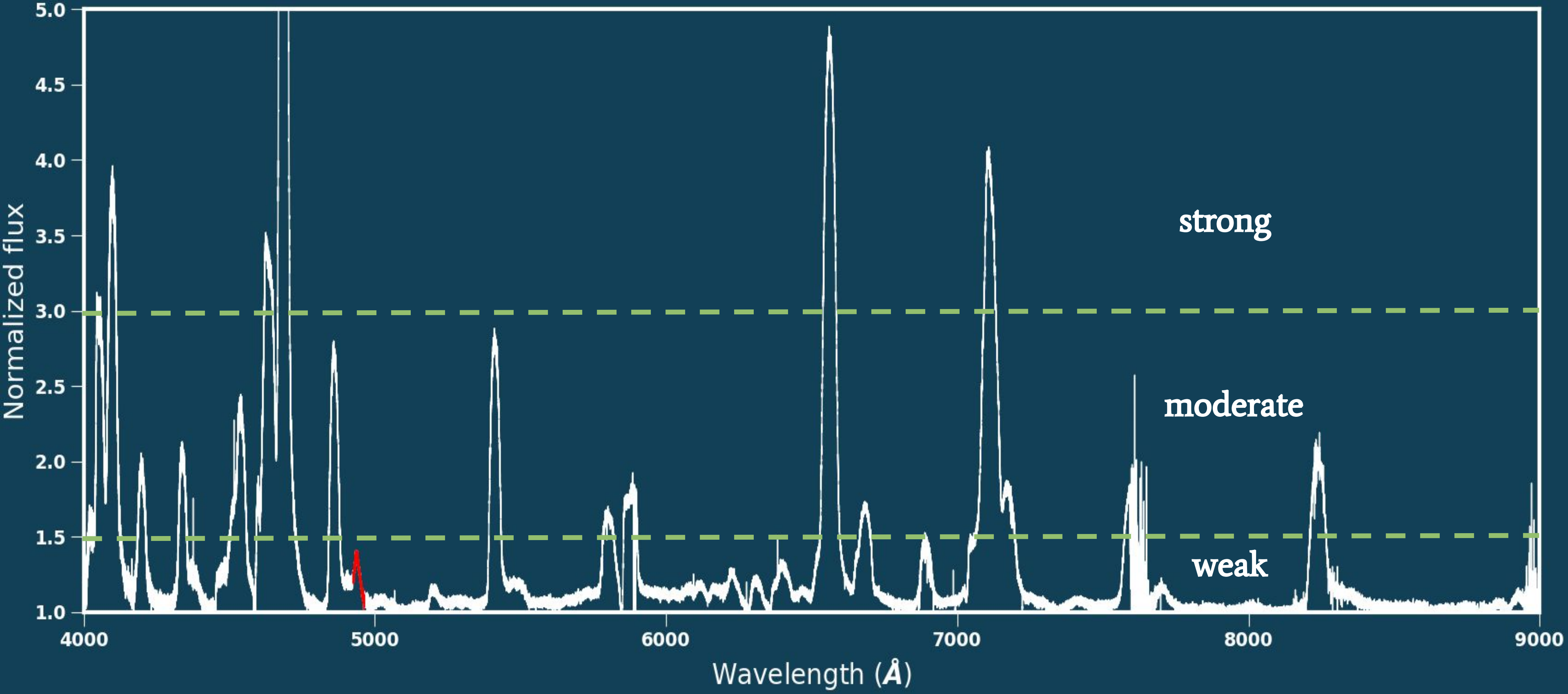
Cross-correlation masks: N IV



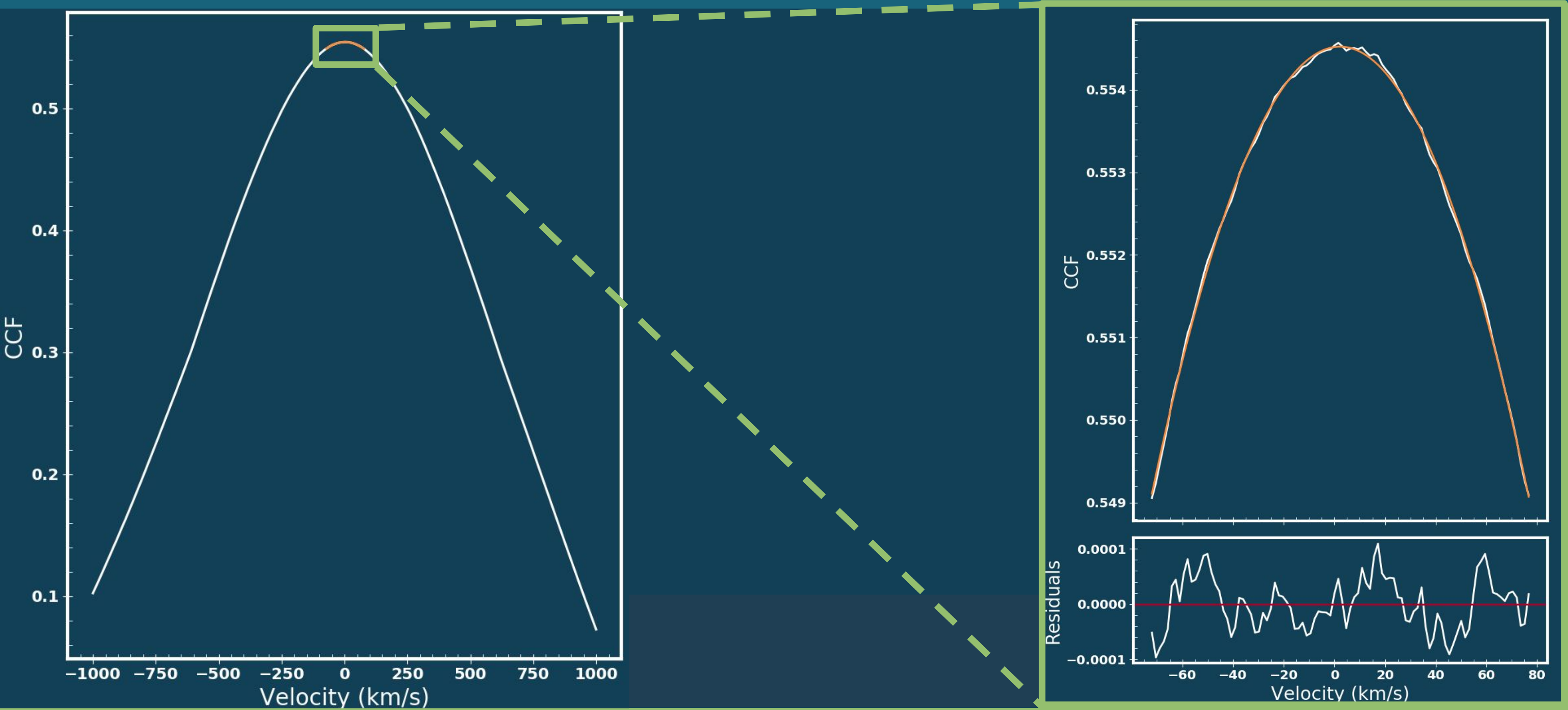
Cross-correlation masks: N III



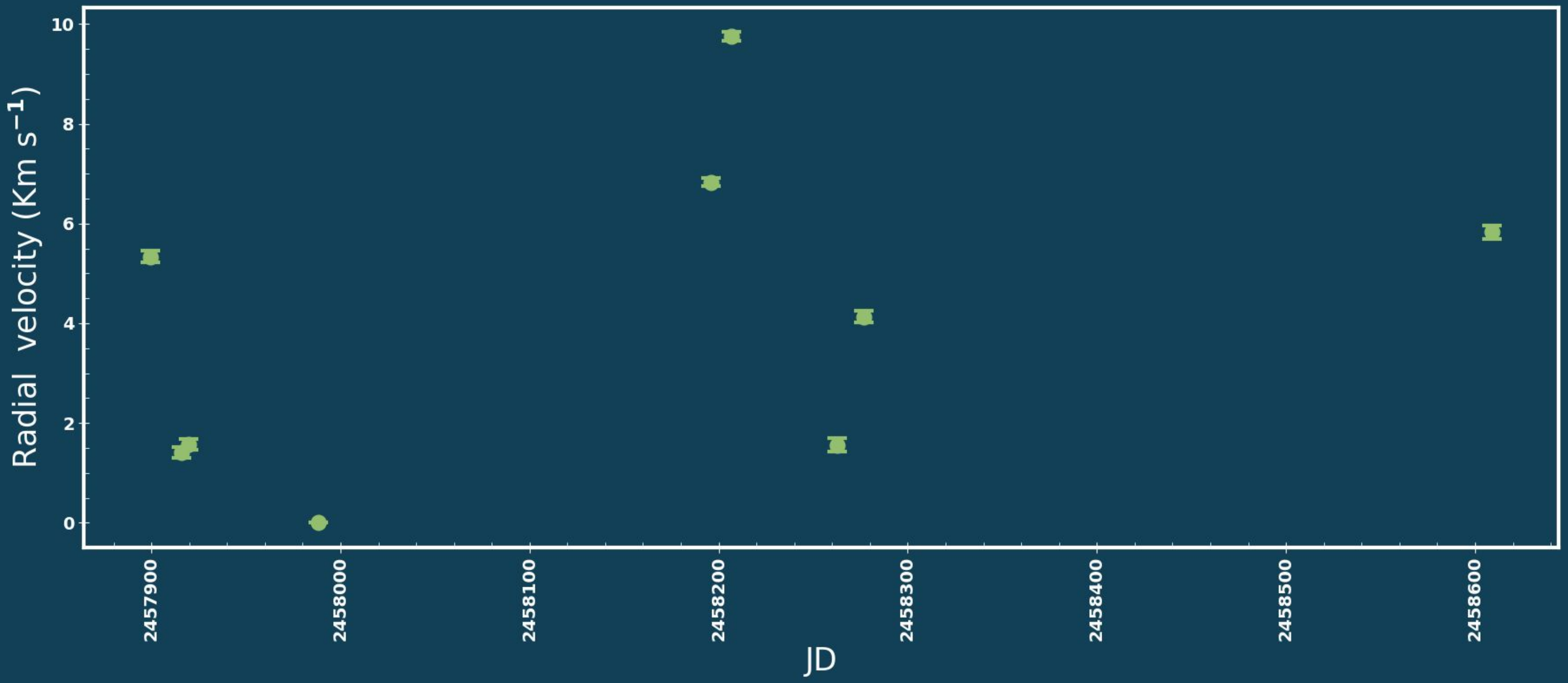
Cross-correlation masks: N V



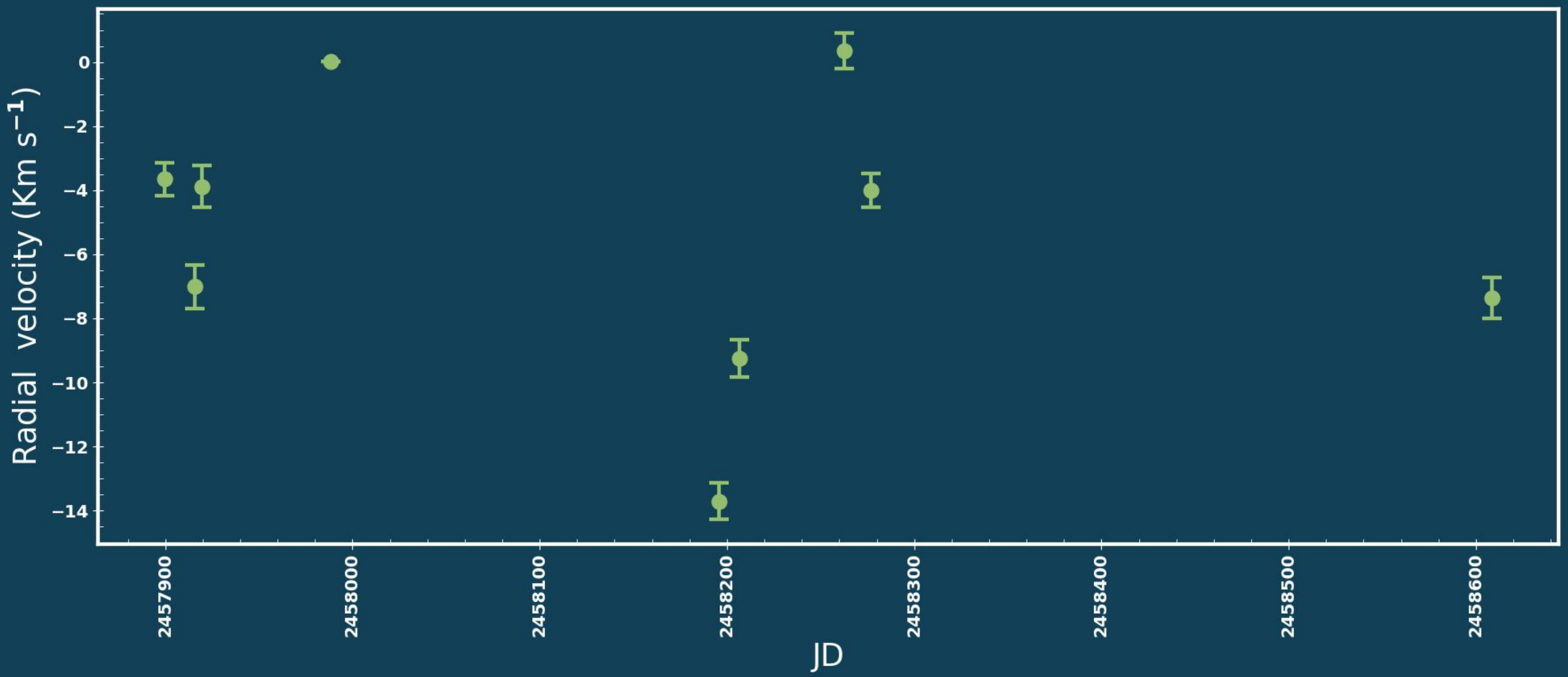
The cross-correlation function (CCF)



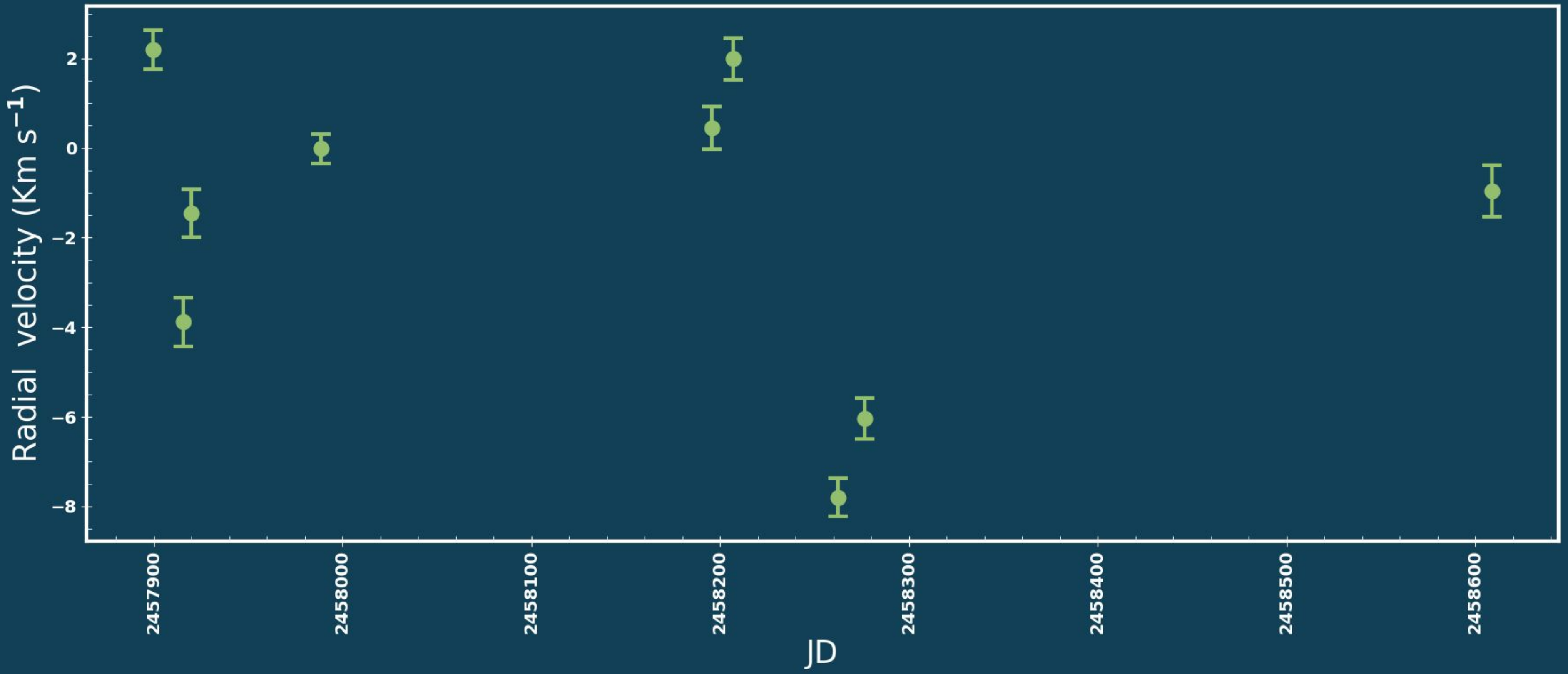
Radial velocity plot: Full spectrum



Radial velocity plot: N IV strong



Radial velocity plot: He II strong



Radial velocity plot: He II moderate