

Red Supergiants: New Perspectives on Dying Stars

UW Massive Stars group



Trevor Dorn-
Wallenstein (grad)



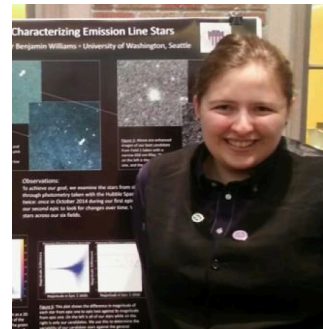
Kathryn Neugent
(grad)



Brooke Dizenzo
(undergrad)



Keyan Gootkin
(undergrad)



Aislynn Wallach
(undergrad)

Recent members...



Jamie Lomax
(faculty, USNA)



Locke Patton
(grad, Harvard/CfA)

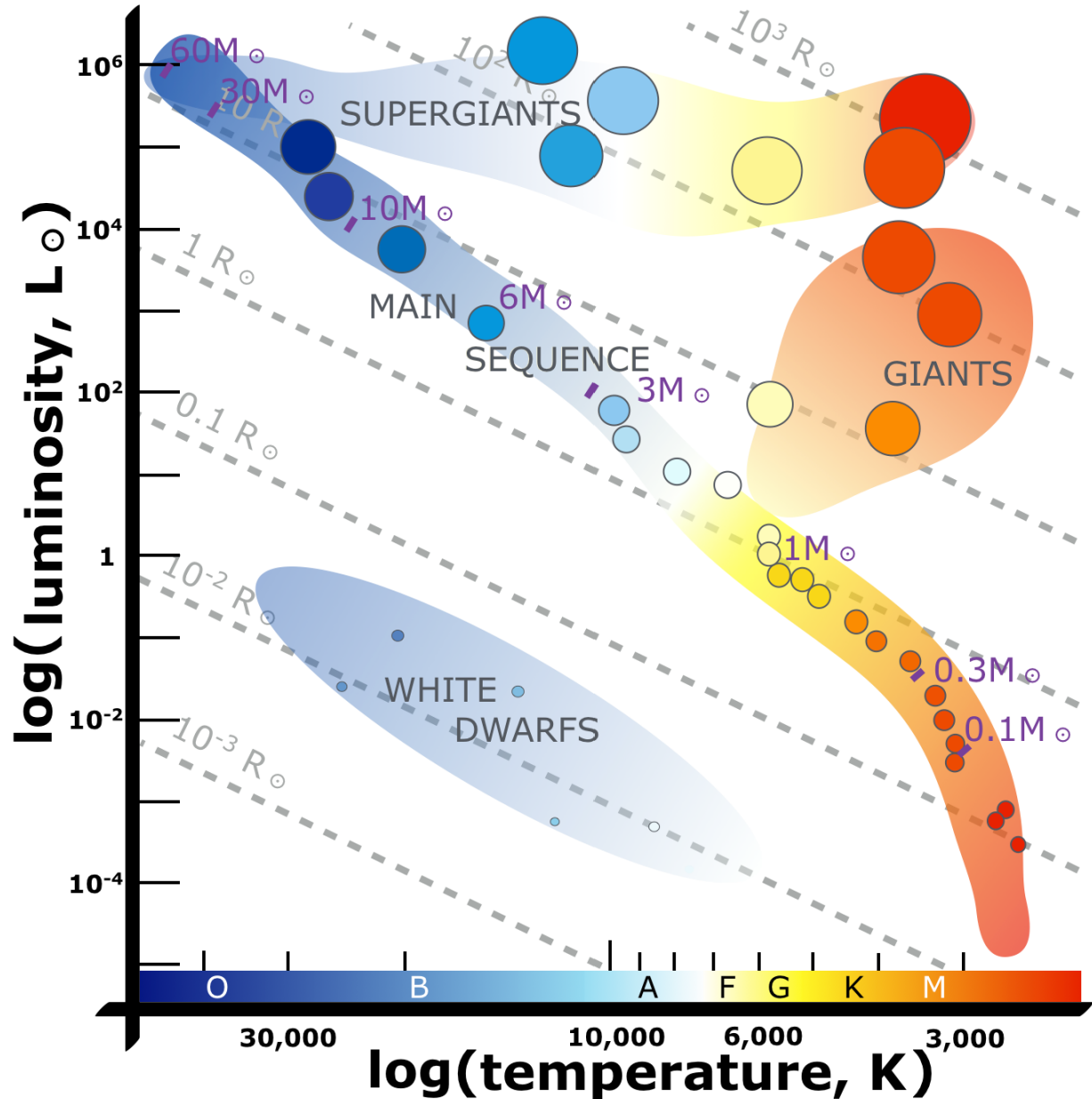
Massive stars and Supernovae

11.7.18

Emily Levesque
University of Washington

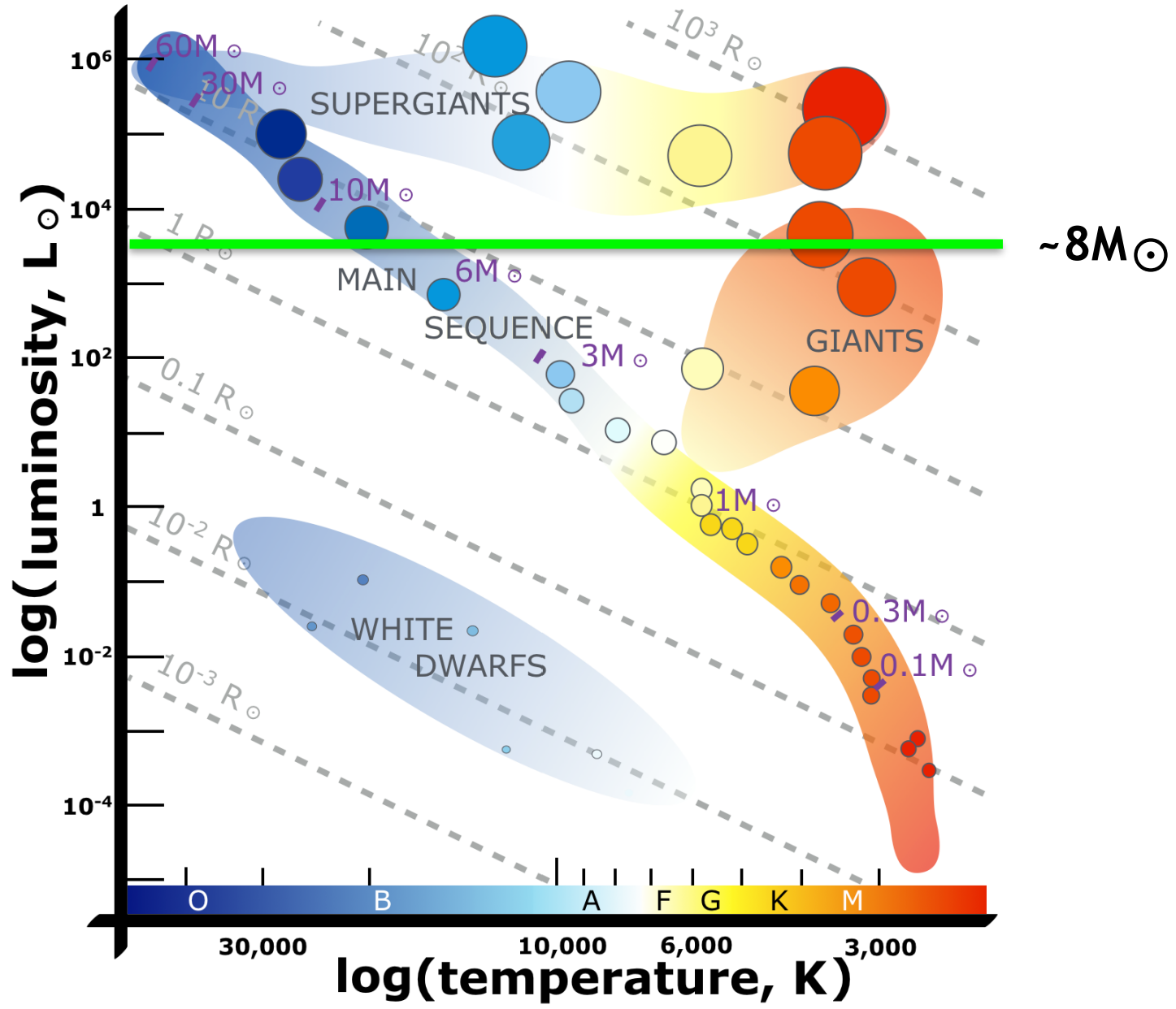
What are red supergiants?

RSGs are the helium-fusing evolved descendants of moderately massive (~8-30M_☉) main sequence stars.



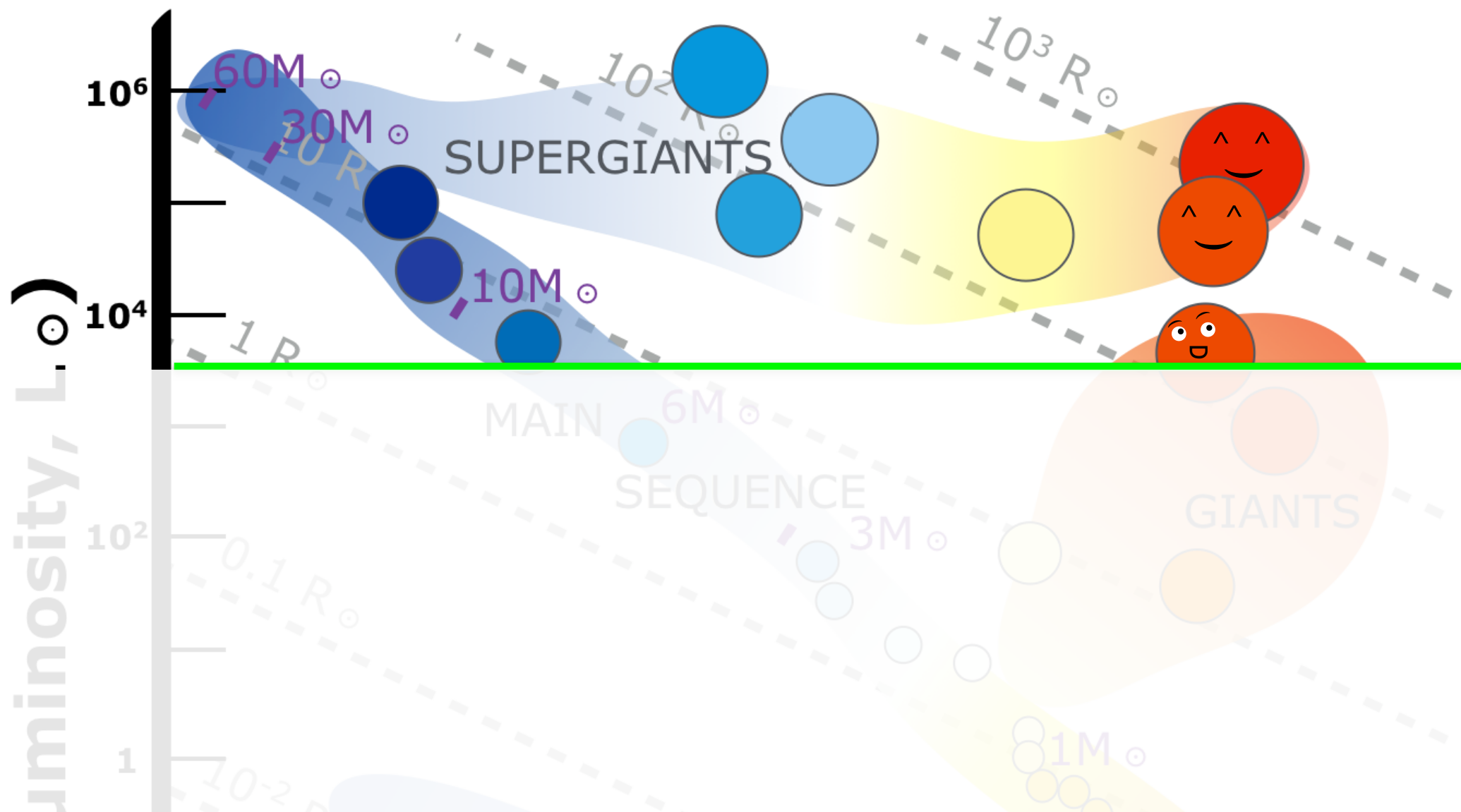
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Who *cares* about red supergiants?

massive star formation

dust production

early universe chemistry

mass loss in cool stars

massive binary fraction

gravitational waves

stellar magnetic fields

massive star evolution

mass loss in massive stars

stellar populations

YOU DO!

mass-transfer binaries

galaxy compositions

supernova progenitors

stellar rotation

strange and variable stars

stars in the early universe

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time-domain astronomy

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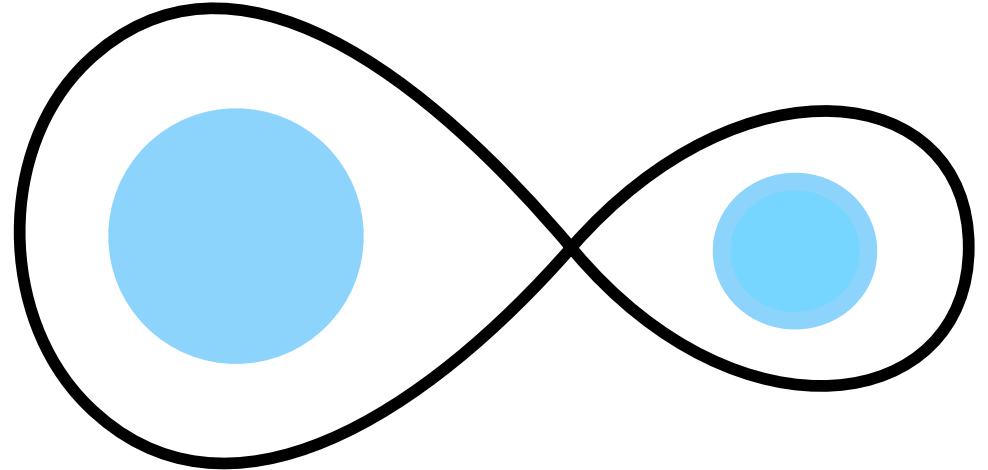
Applications of RSGs

massive binary fraction - RSGs impact the evolution & products of massive binaries
interacting binary fraction, core-collapse products, NS+NS and NS+BH binary fractions...

supernova progenitors

RSGs are a crucial evolutionary phase for determining the fate of massive stars in binaries.

- RLOF will kick off mass transfer, circularize orbit



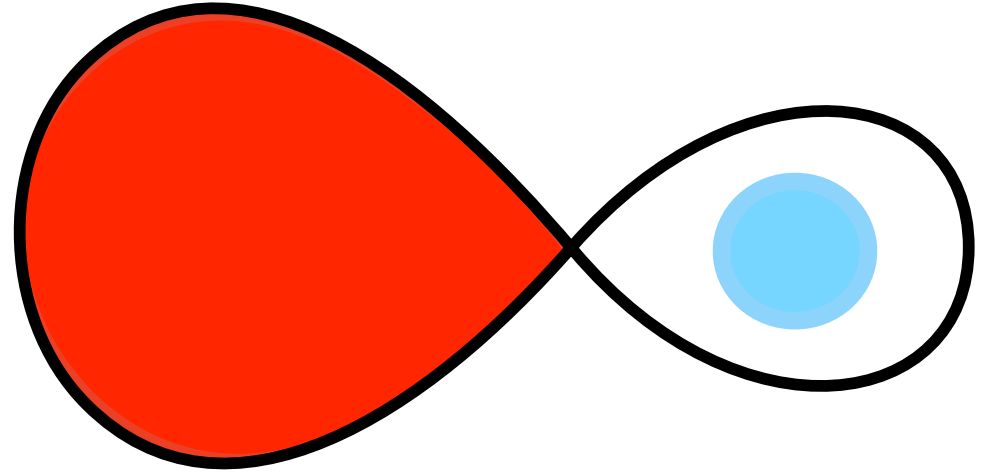
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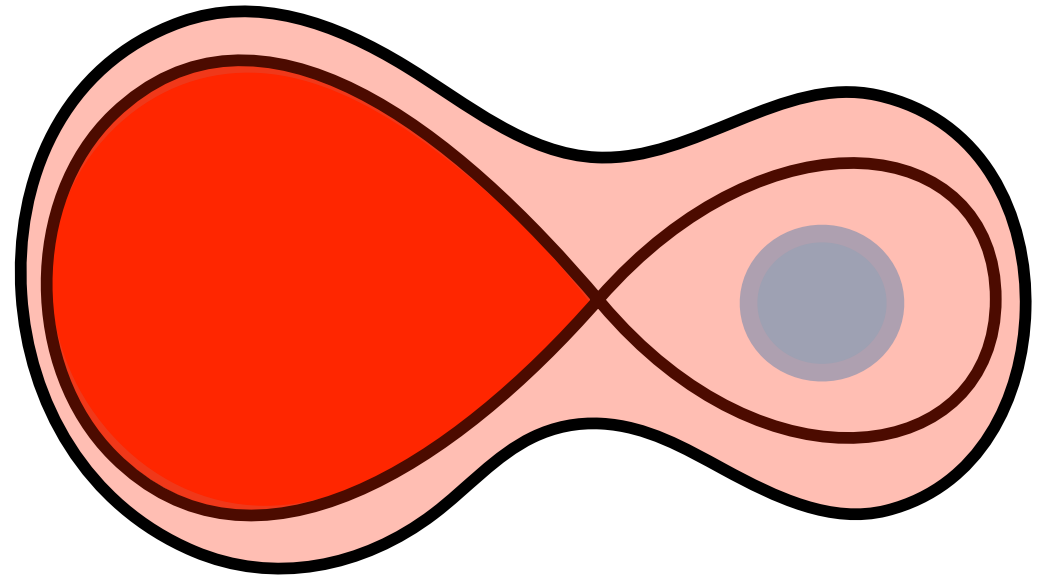
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Levesque, Massey, Zytzkow, & *Morrell* 2014

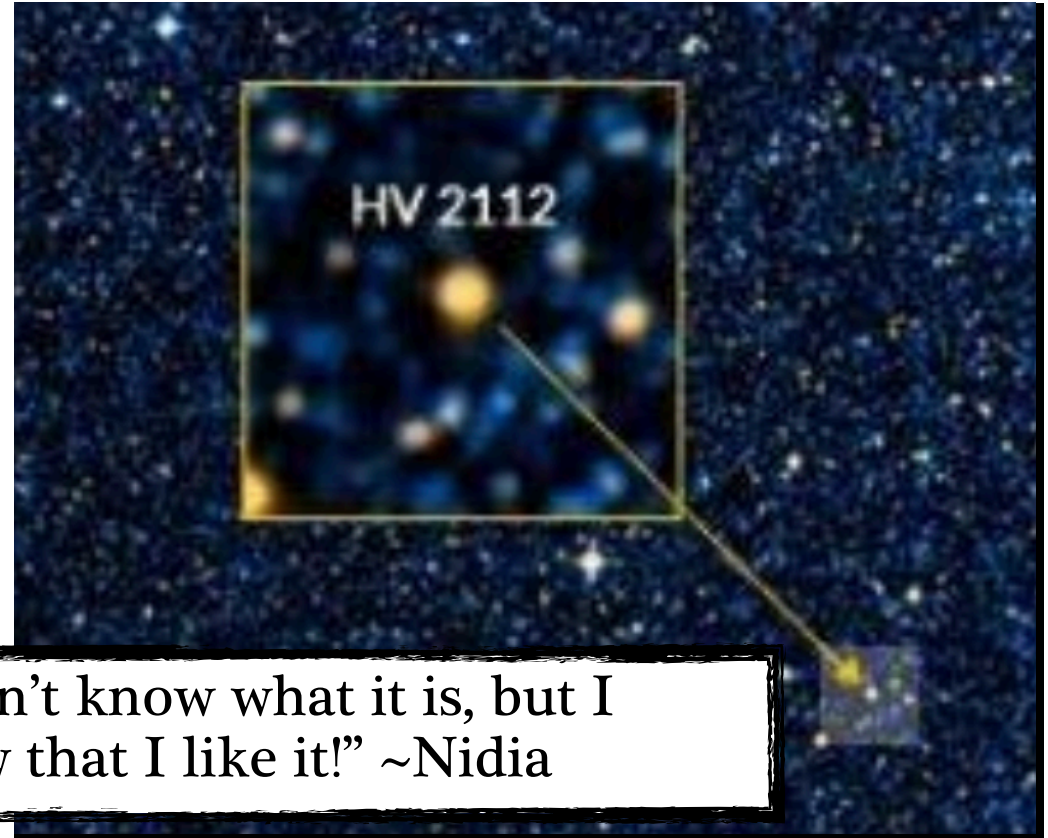
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“I don’t know what it is, but I know that I like it!” ~Nidia

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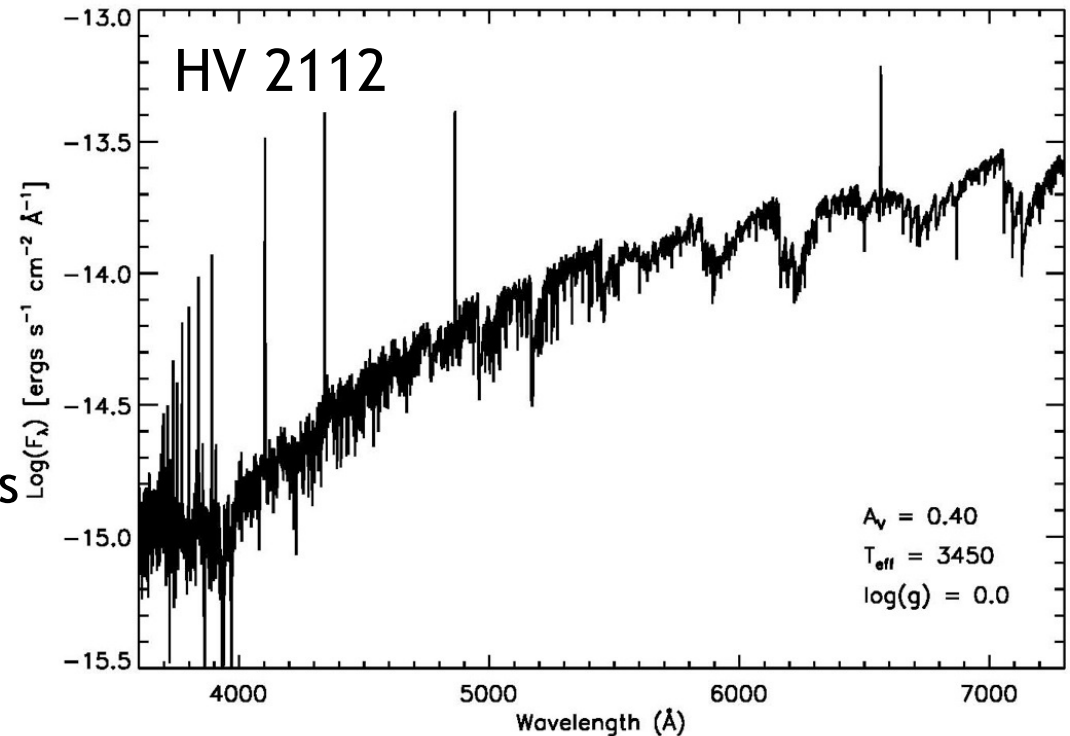
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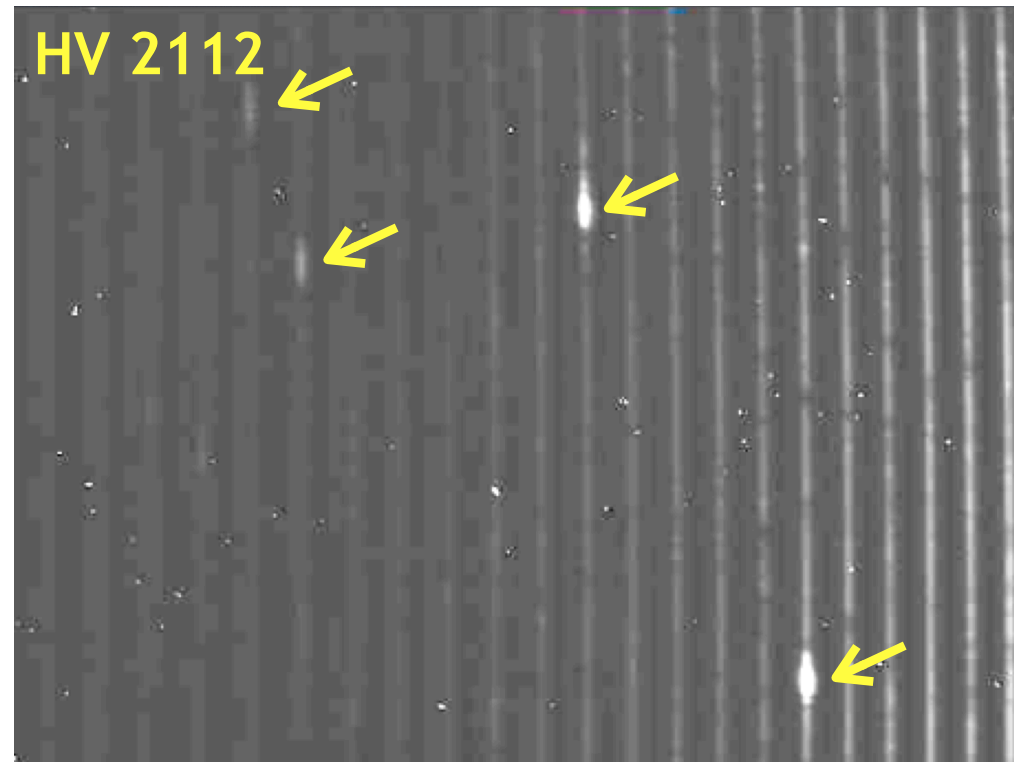
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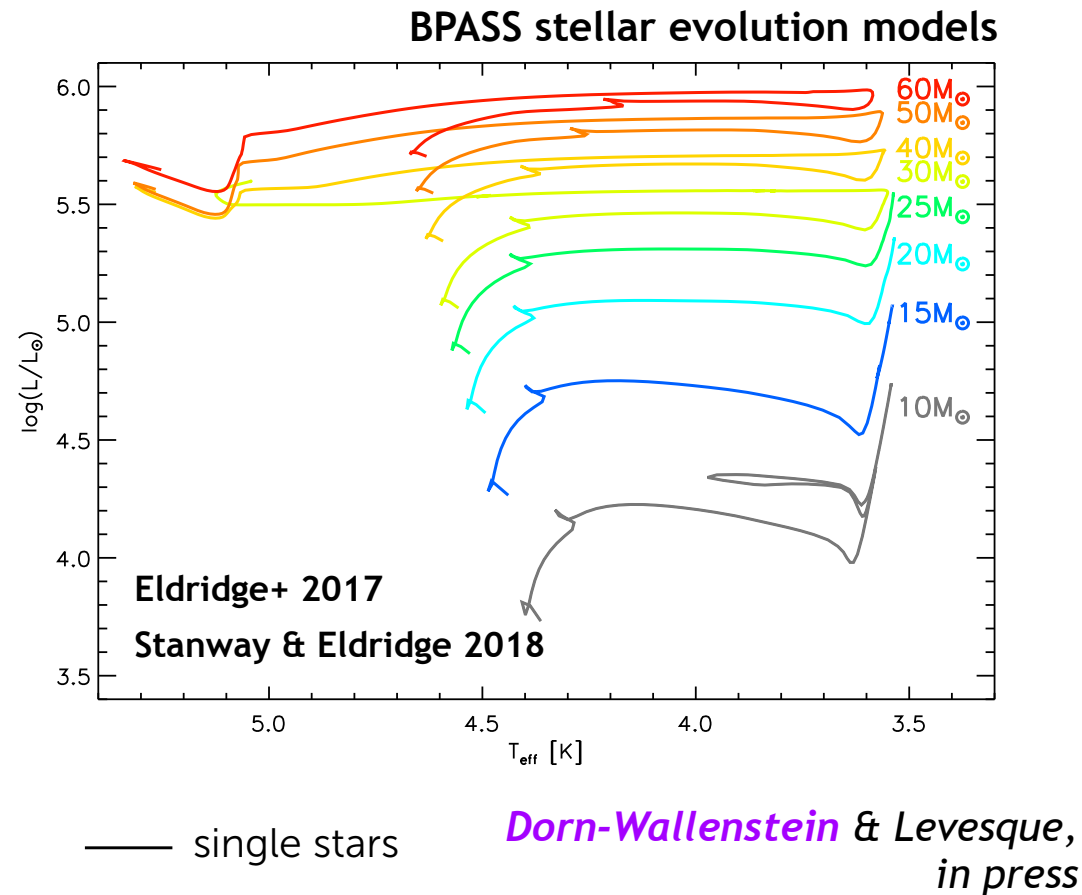
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Binary effects strongly impact the evolution and populations of massive stars.



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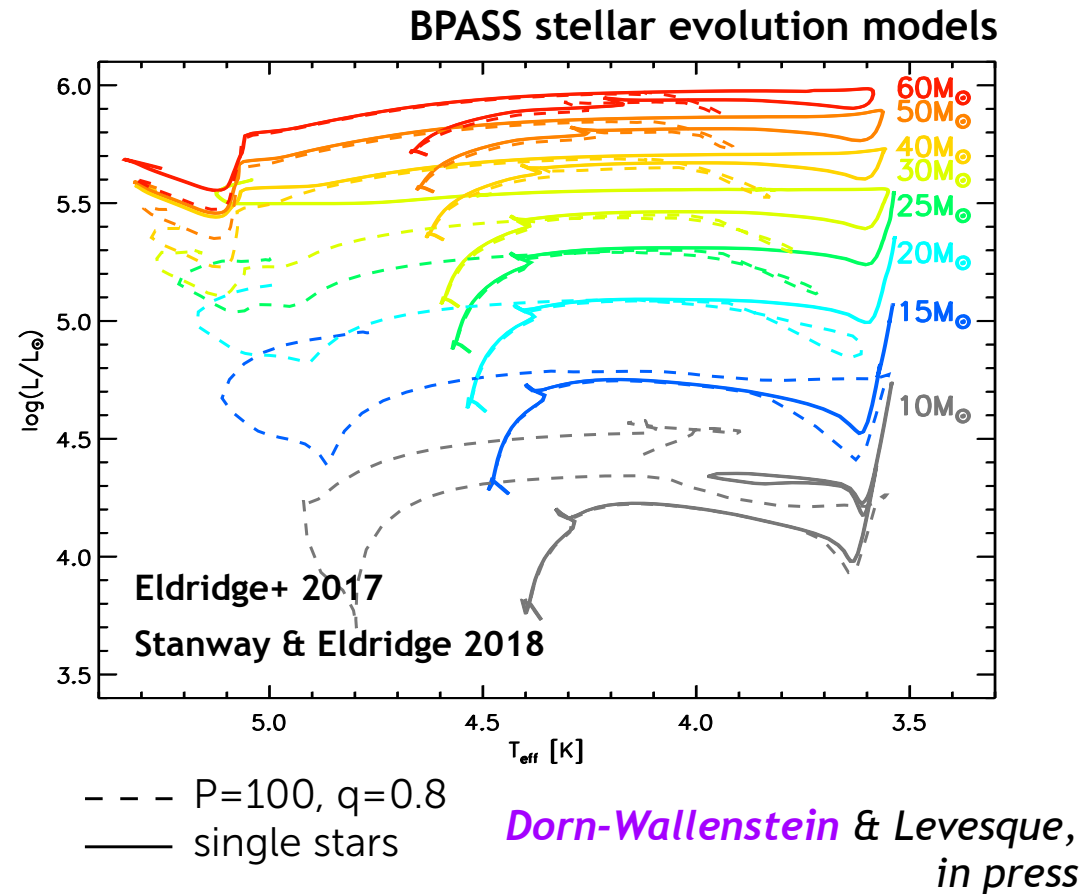
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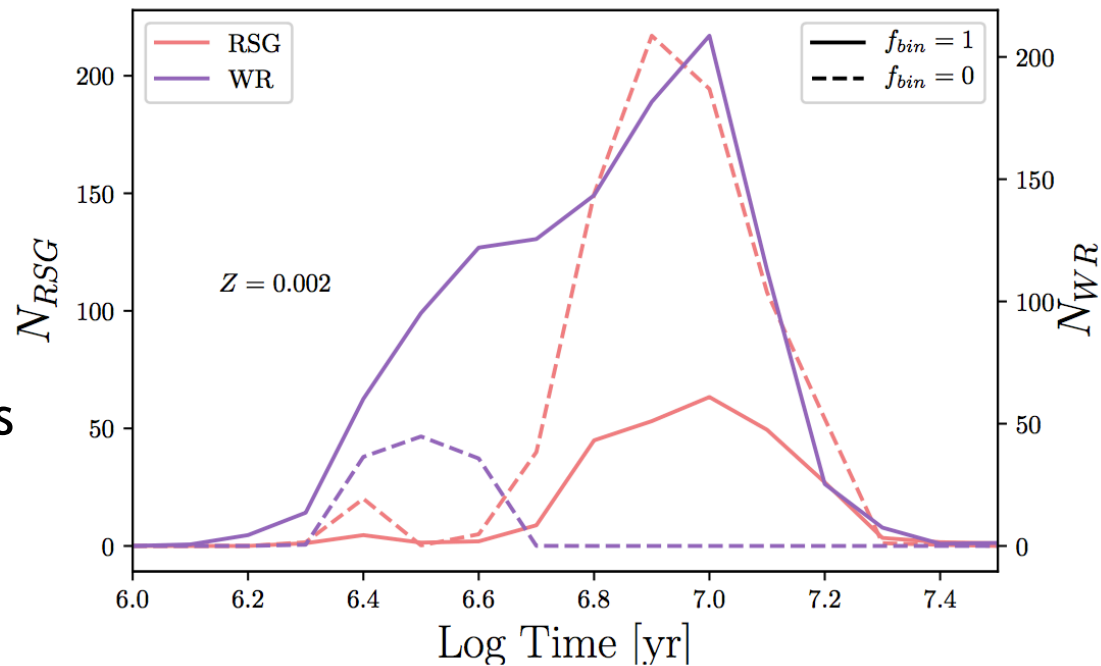
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Dorn-Wallenstein & Levesque, in press

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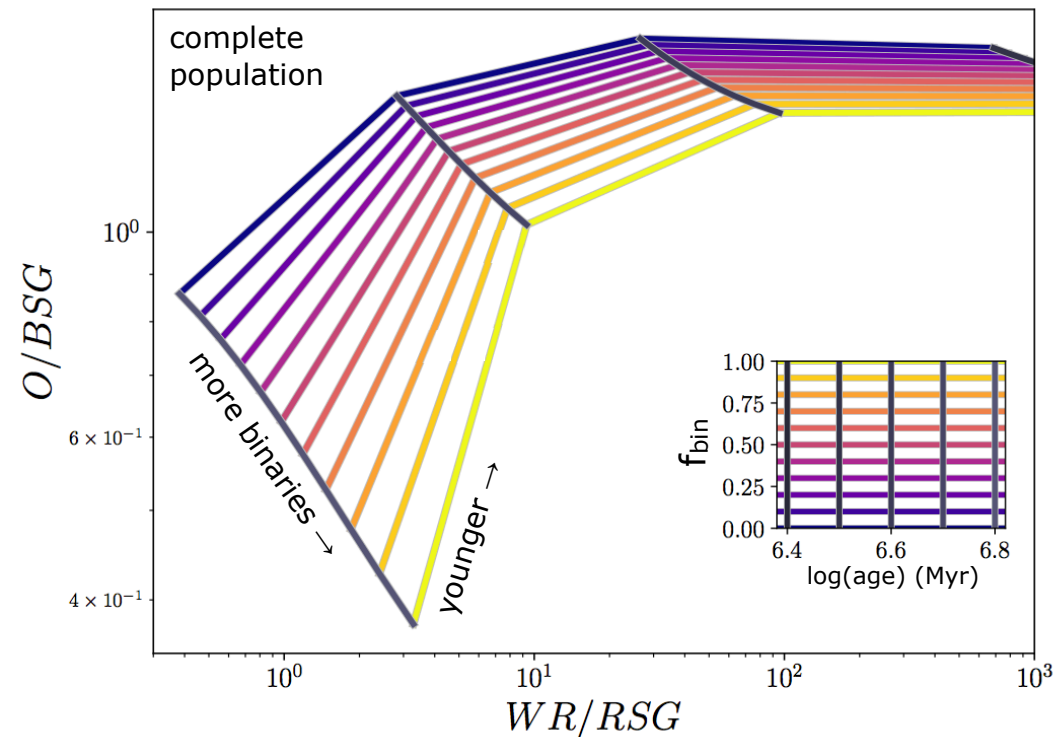
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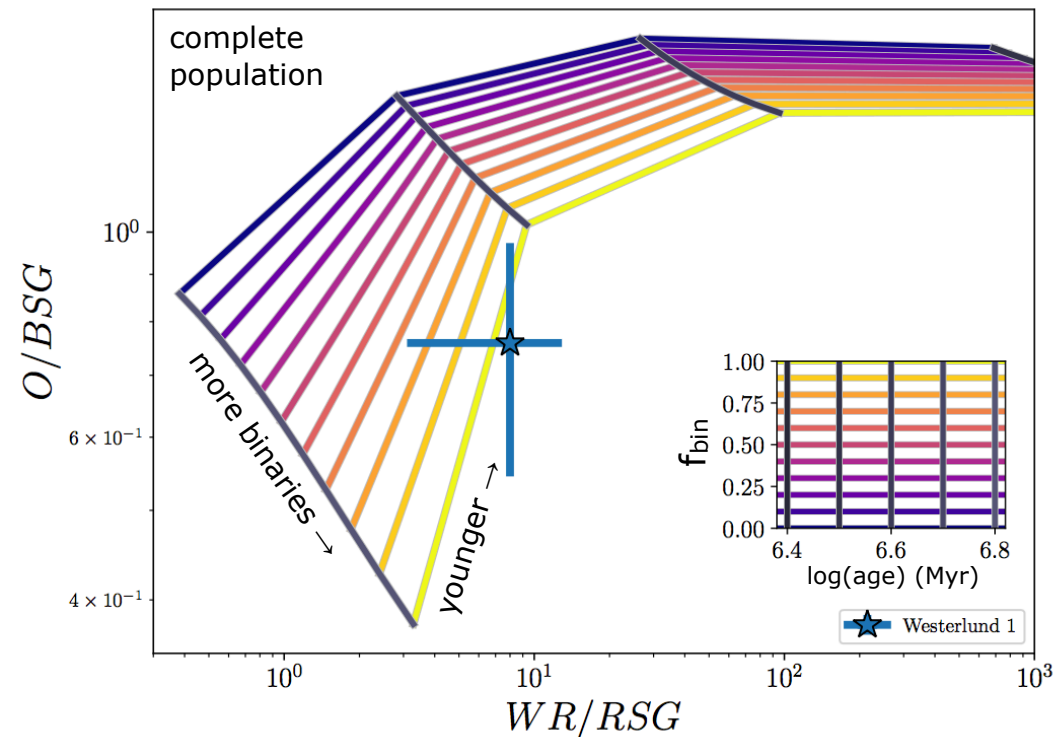
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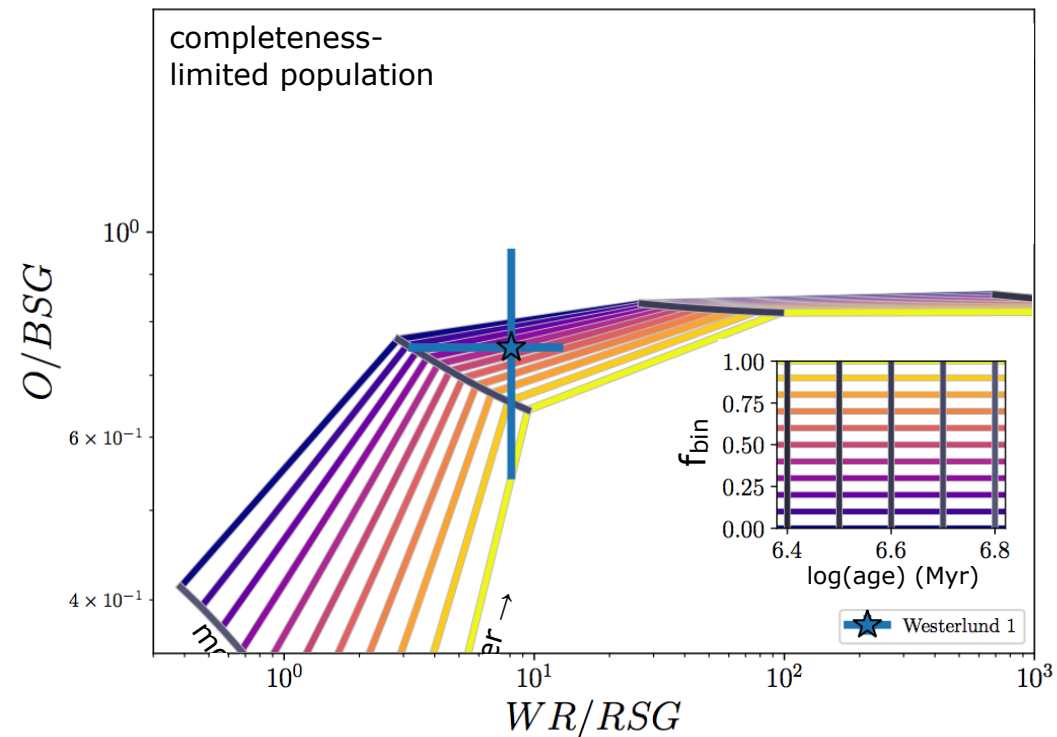
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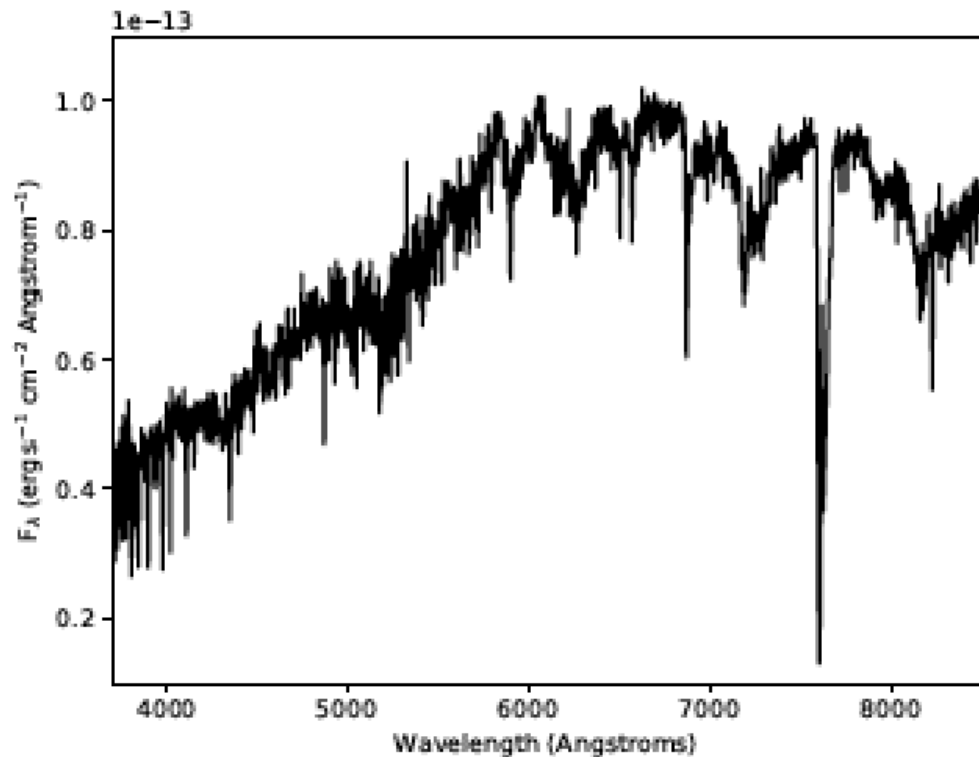
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We know almost nothing about binary RSGs!



Most RSGs appear to be single stars...

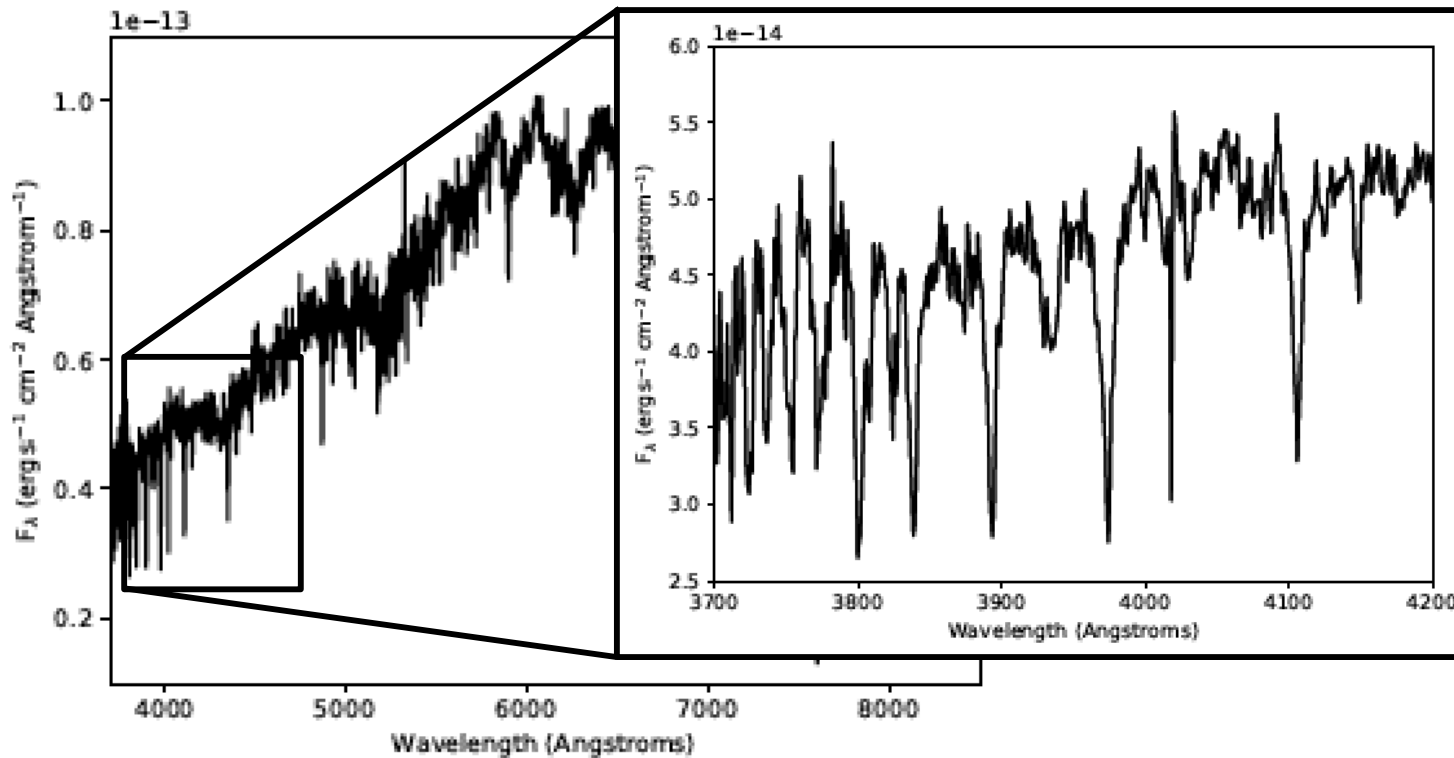
Neugent, Levesque, & Massey, 2018

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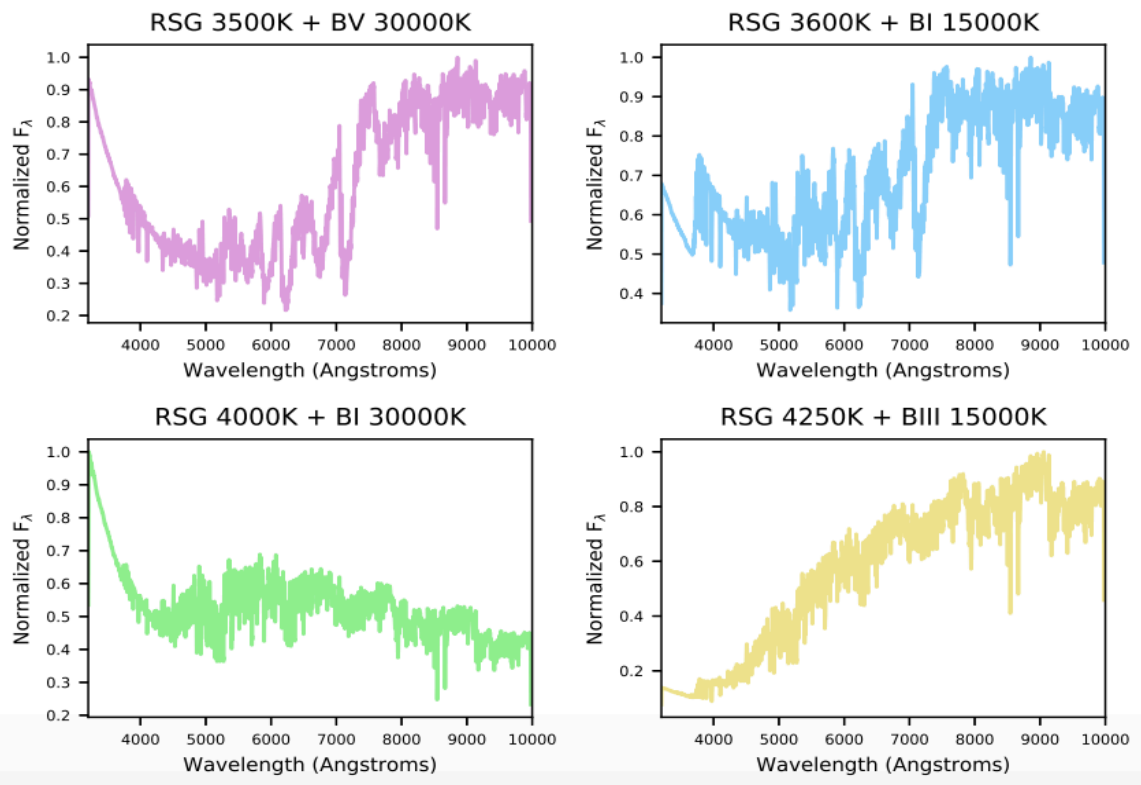
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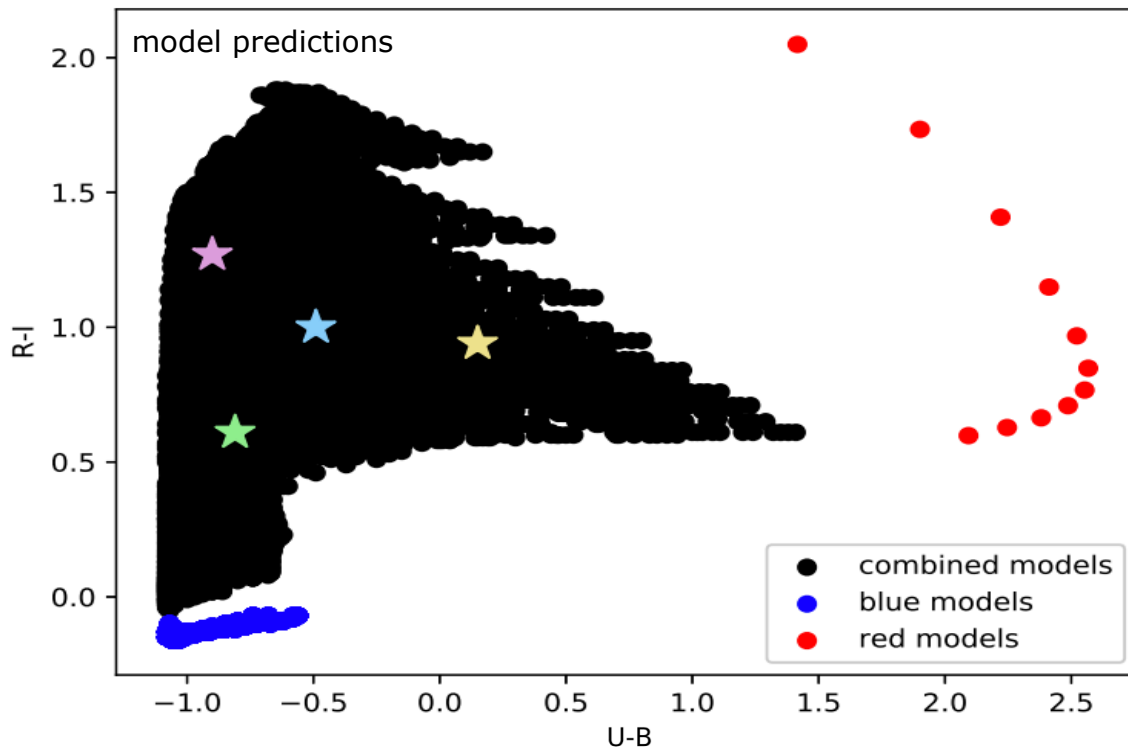
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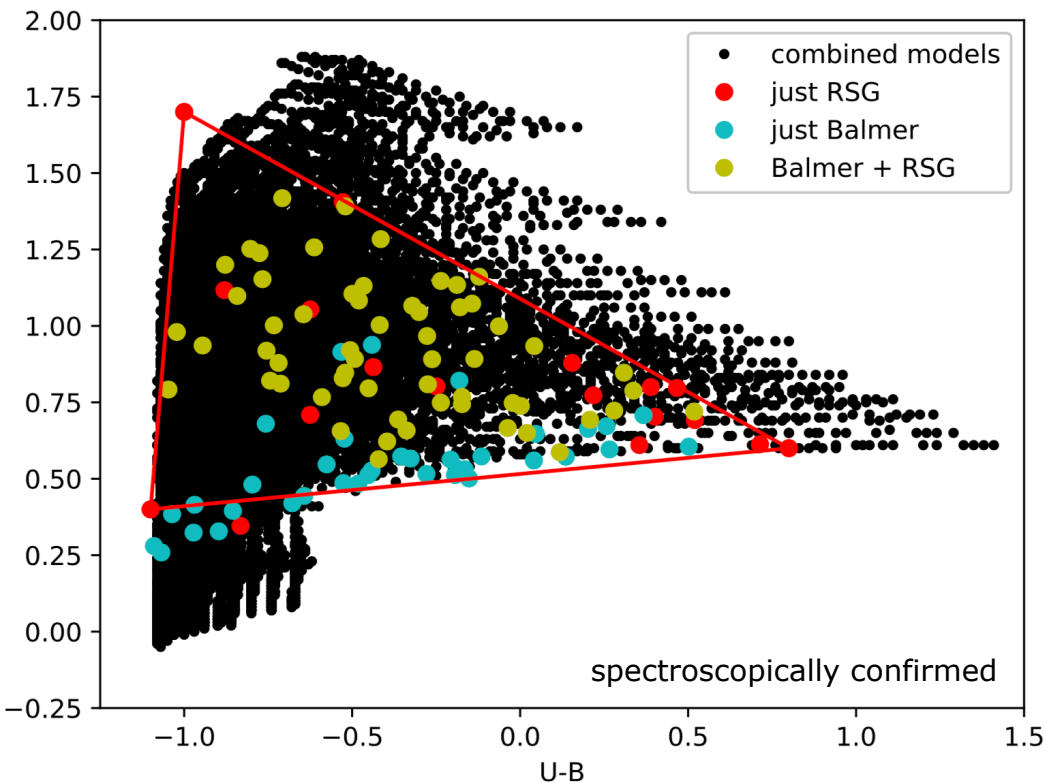
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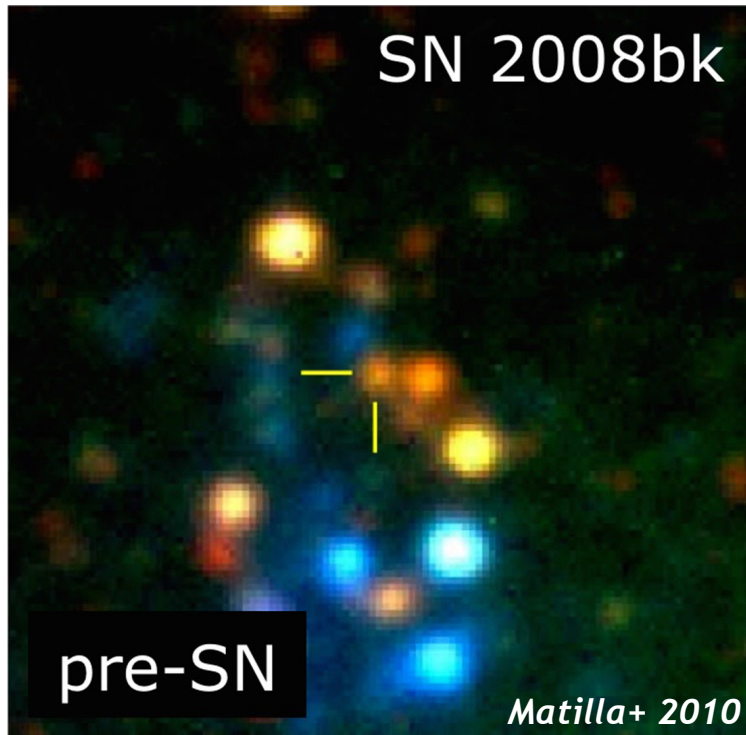
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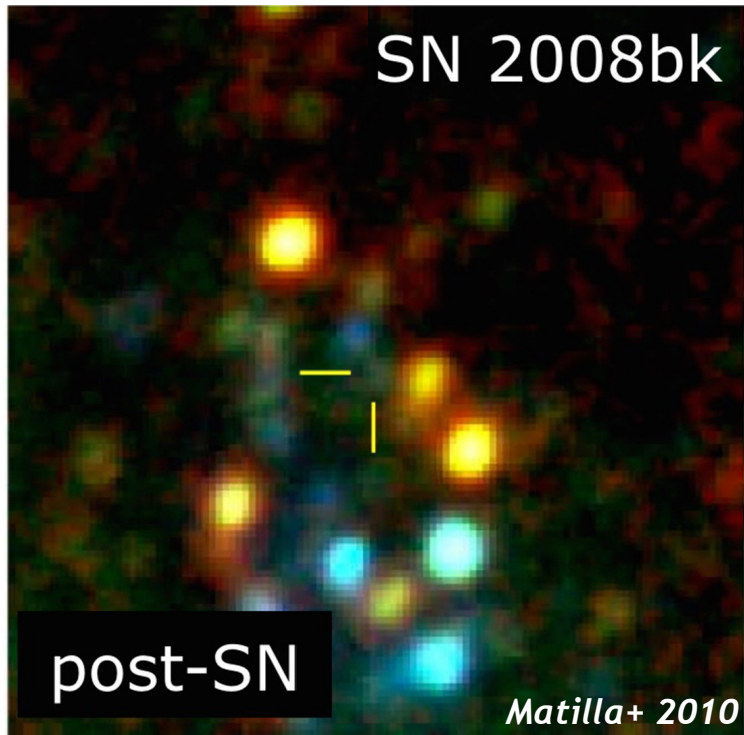
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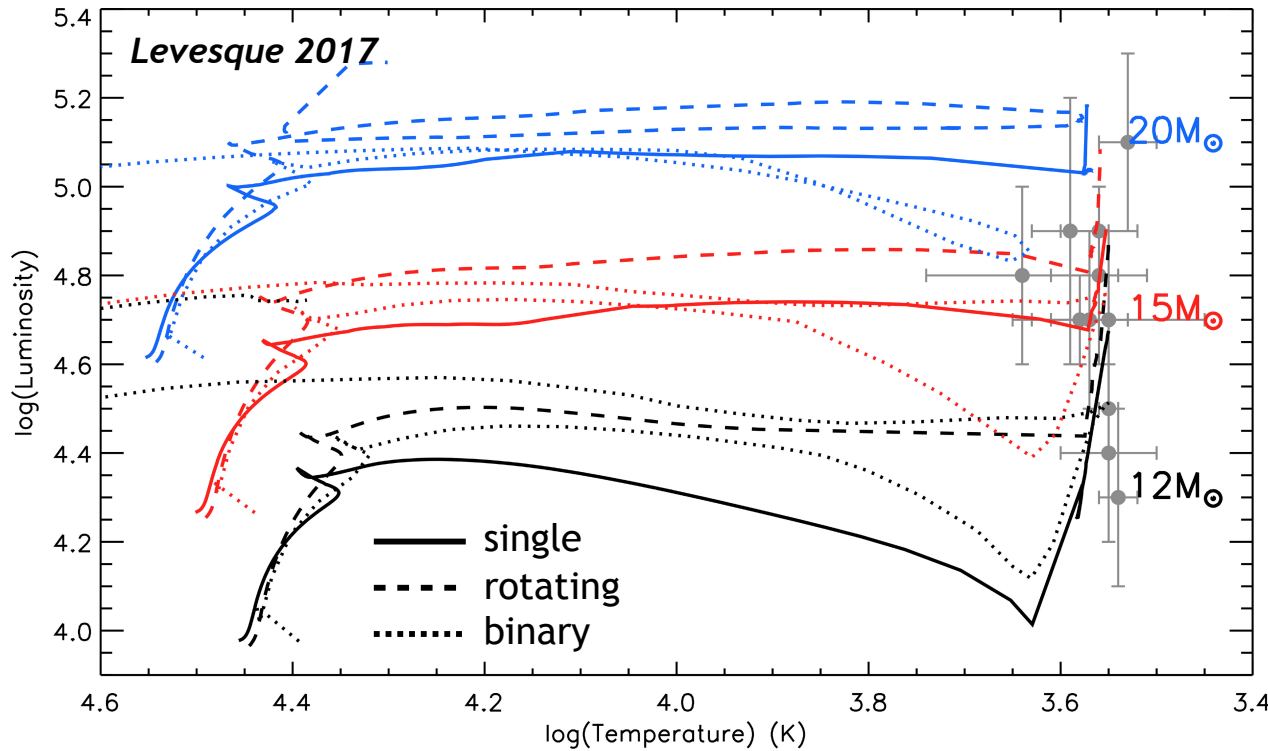
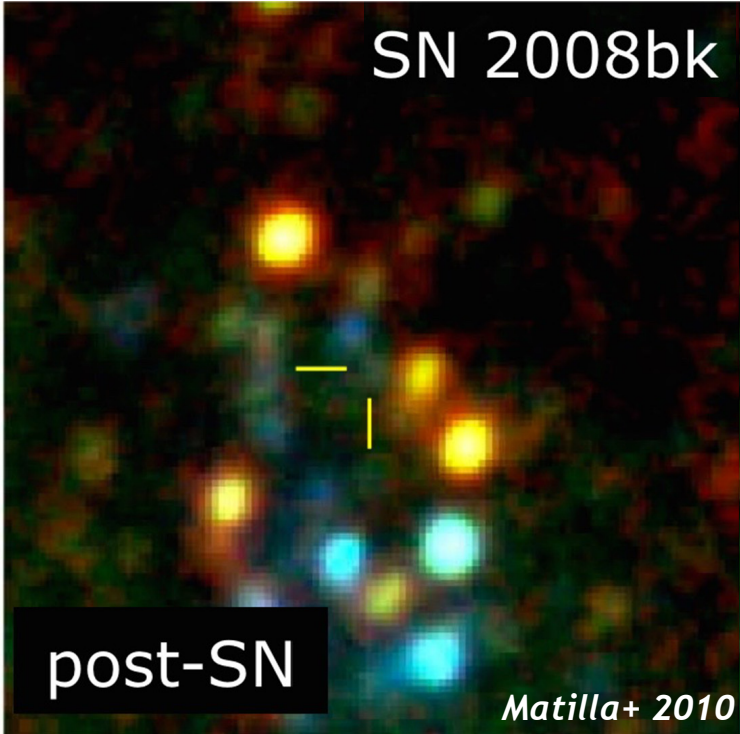


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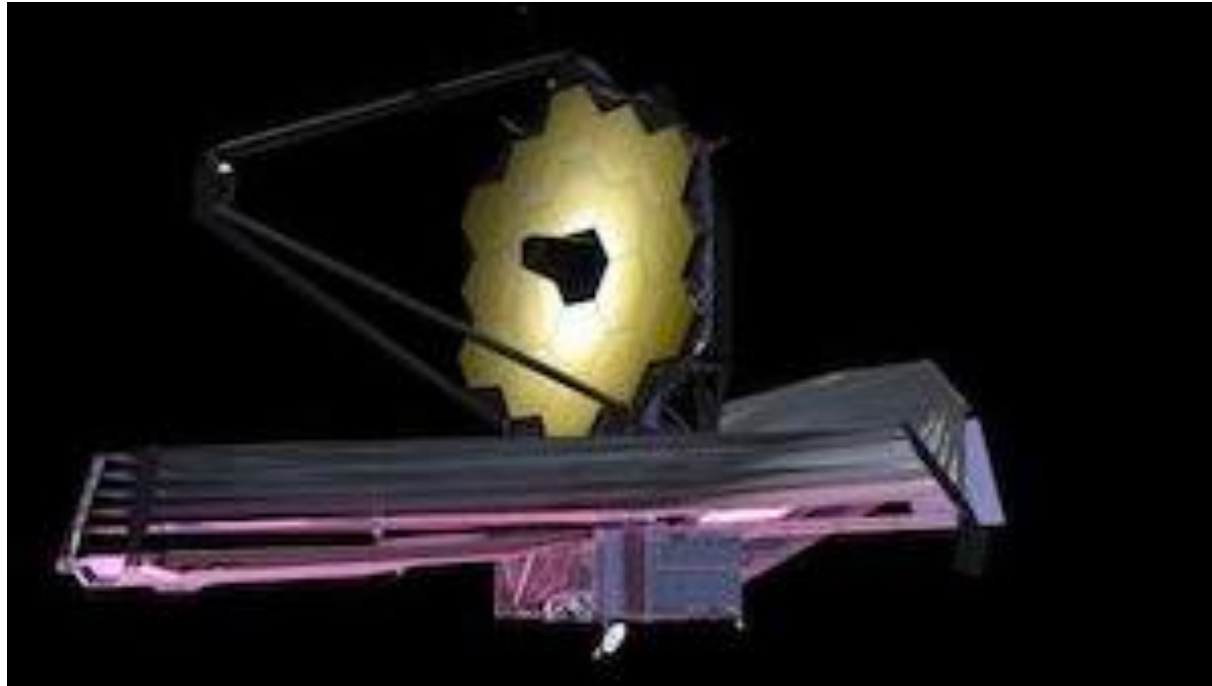
supernova progenitors - direct and intermediary progenitors

Understanding RSG evolution is critical for interpreting pre-explosion imaging and modeling SNe



Applications of RSGs

In ~~2018~~ ~~2019~~ 2021 JWST will launch and become a valuable new resource for pre-explosion detections of RSGs.



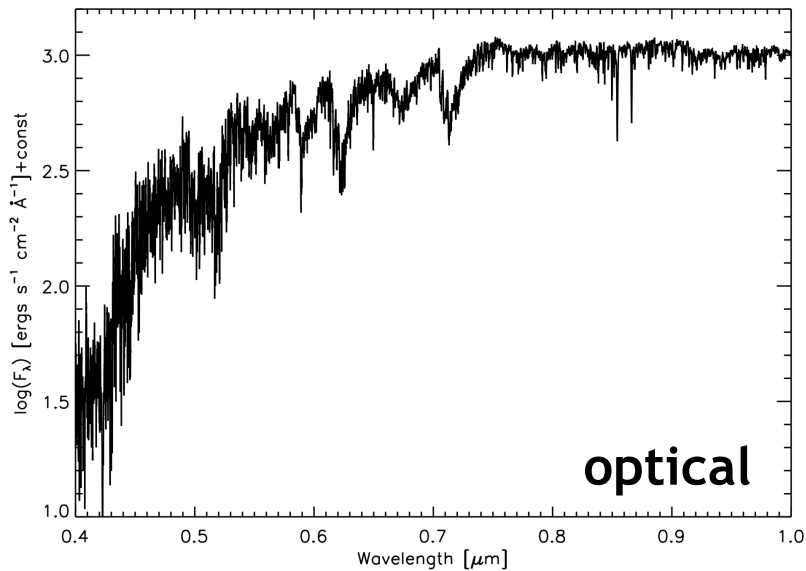
We can improve this work in the JWST era with surveys in bands optimized for pre-explosion RSG imaging...

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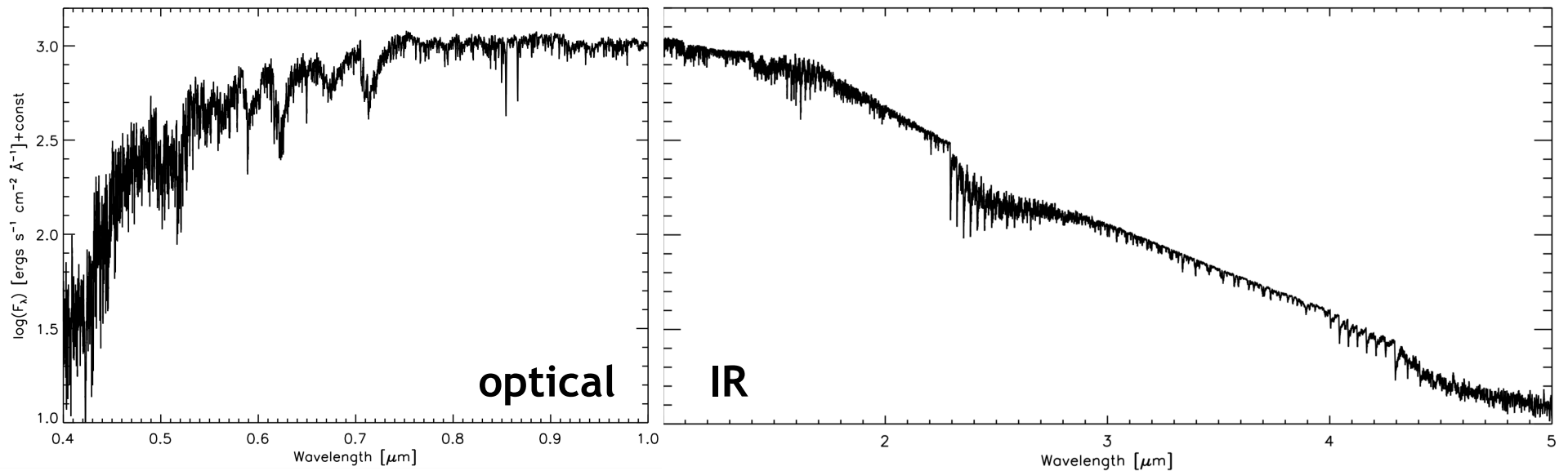
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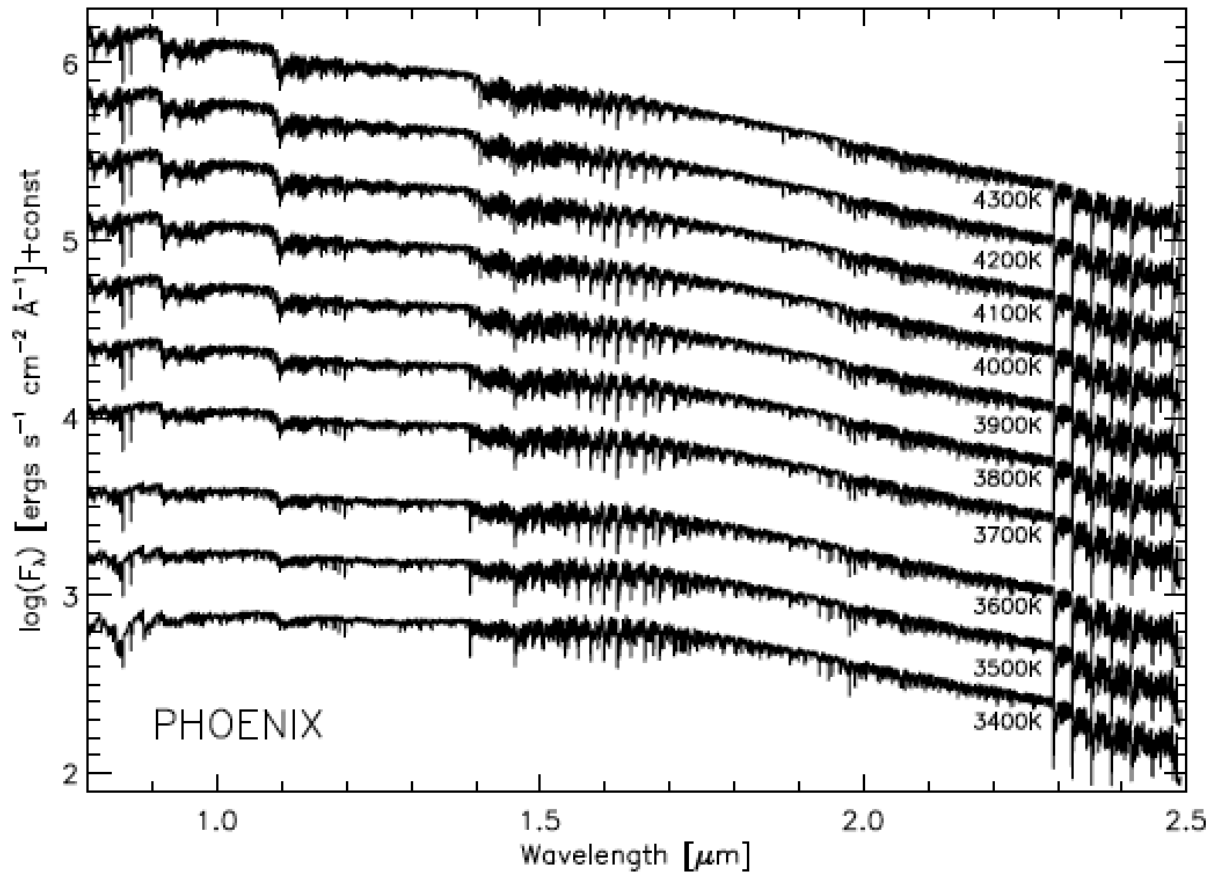
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Levesque 2018

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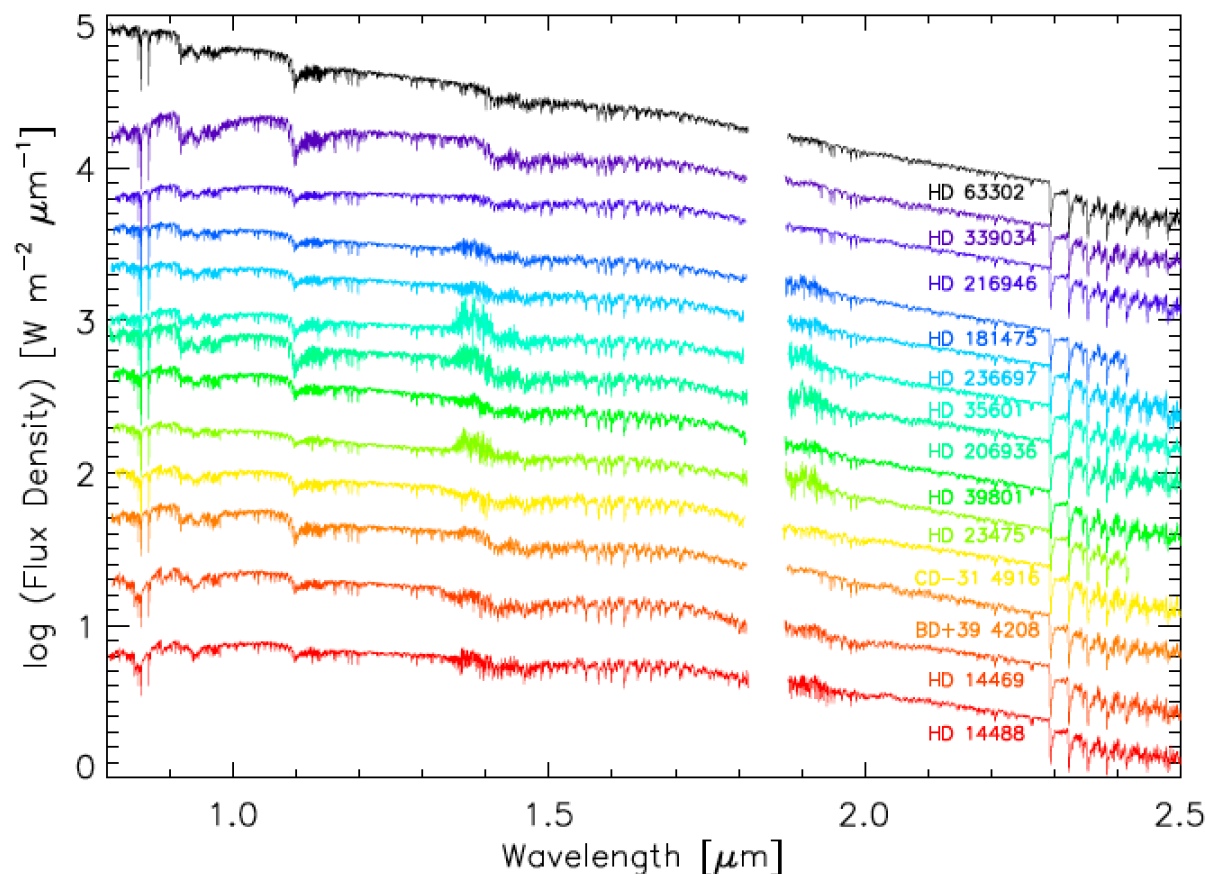
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Combining:
–theoretical RSG spectra

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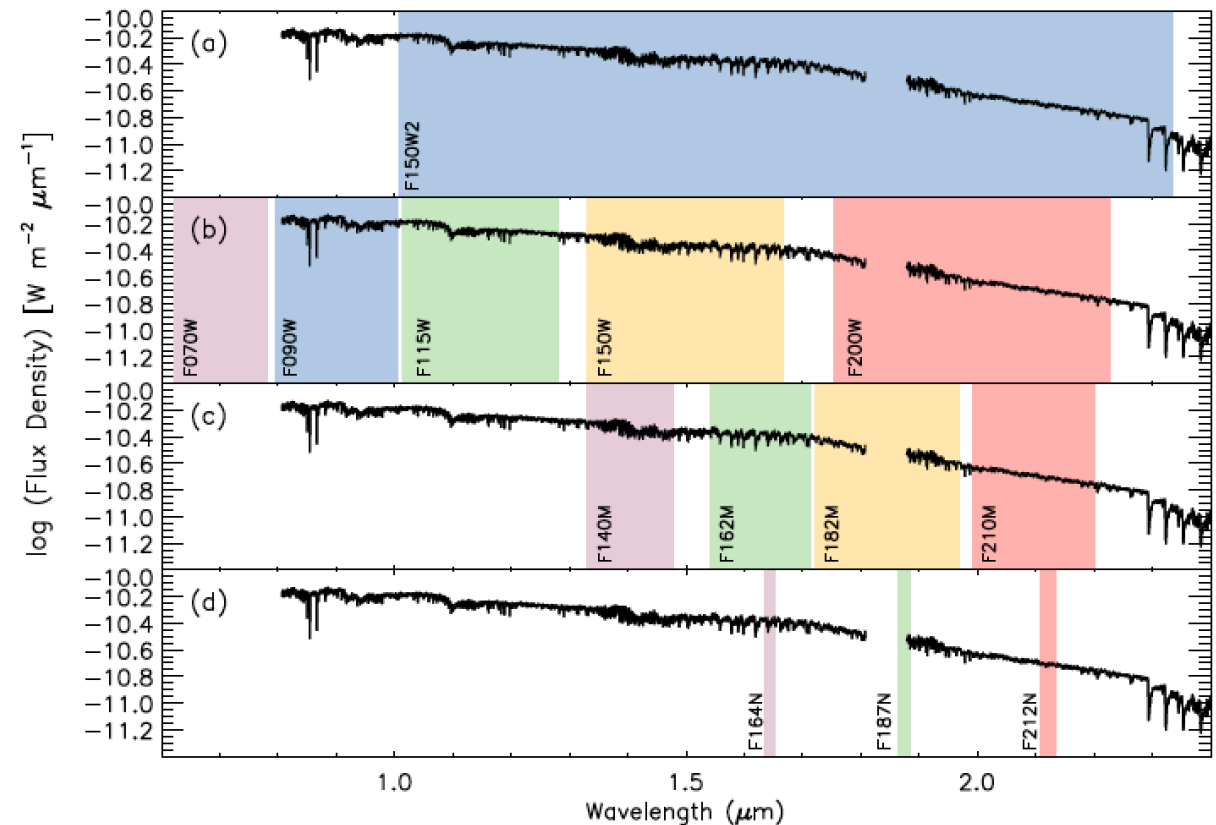


Combining:
–theoretical RSG spectra
–observed RSG spectra (IRTF)



Applications of RSGs

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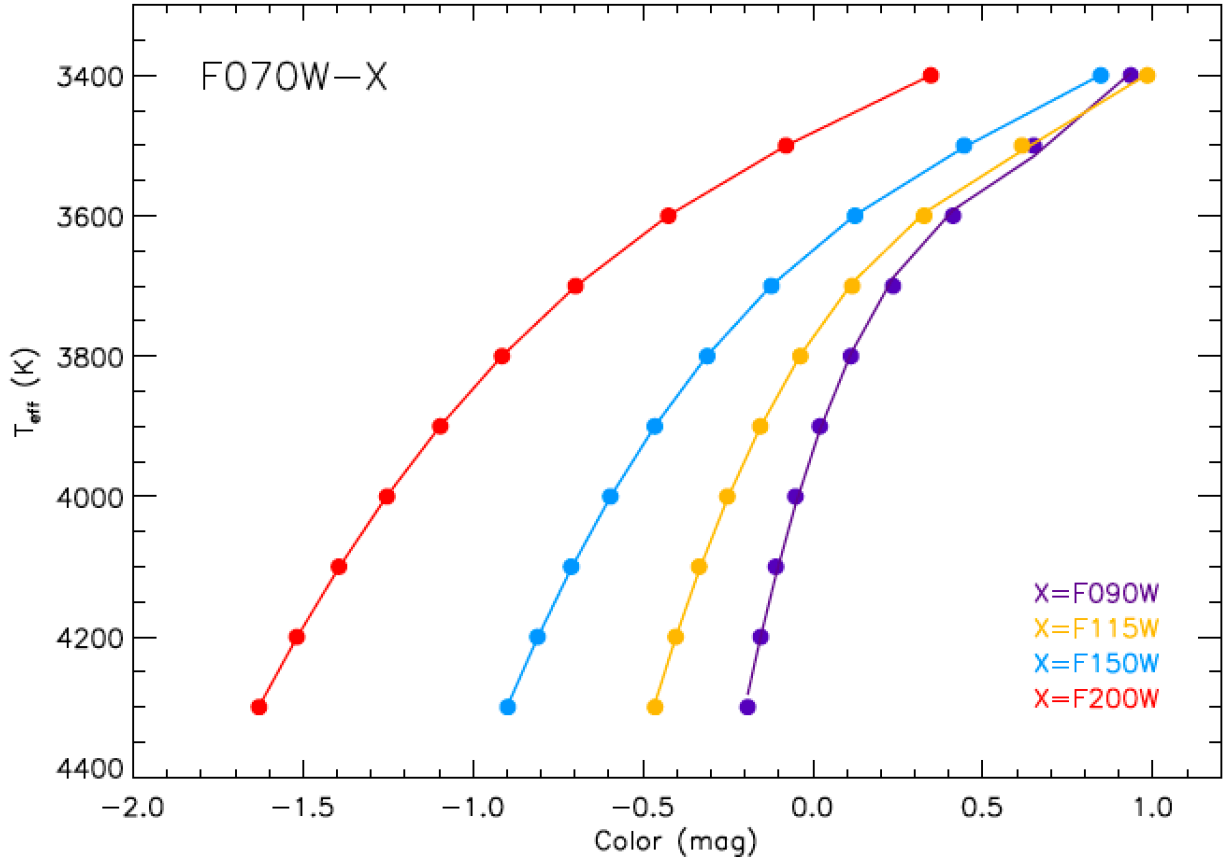
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–JWST/NIRCam filter transmission throughput curves

Applications of RSGs

We can improve this work in the JWST era with surveys in bands optimized for pre-explosion RSG imaging...

Near-IR (NIRCam):

F070W
F200W



Levesque 2018

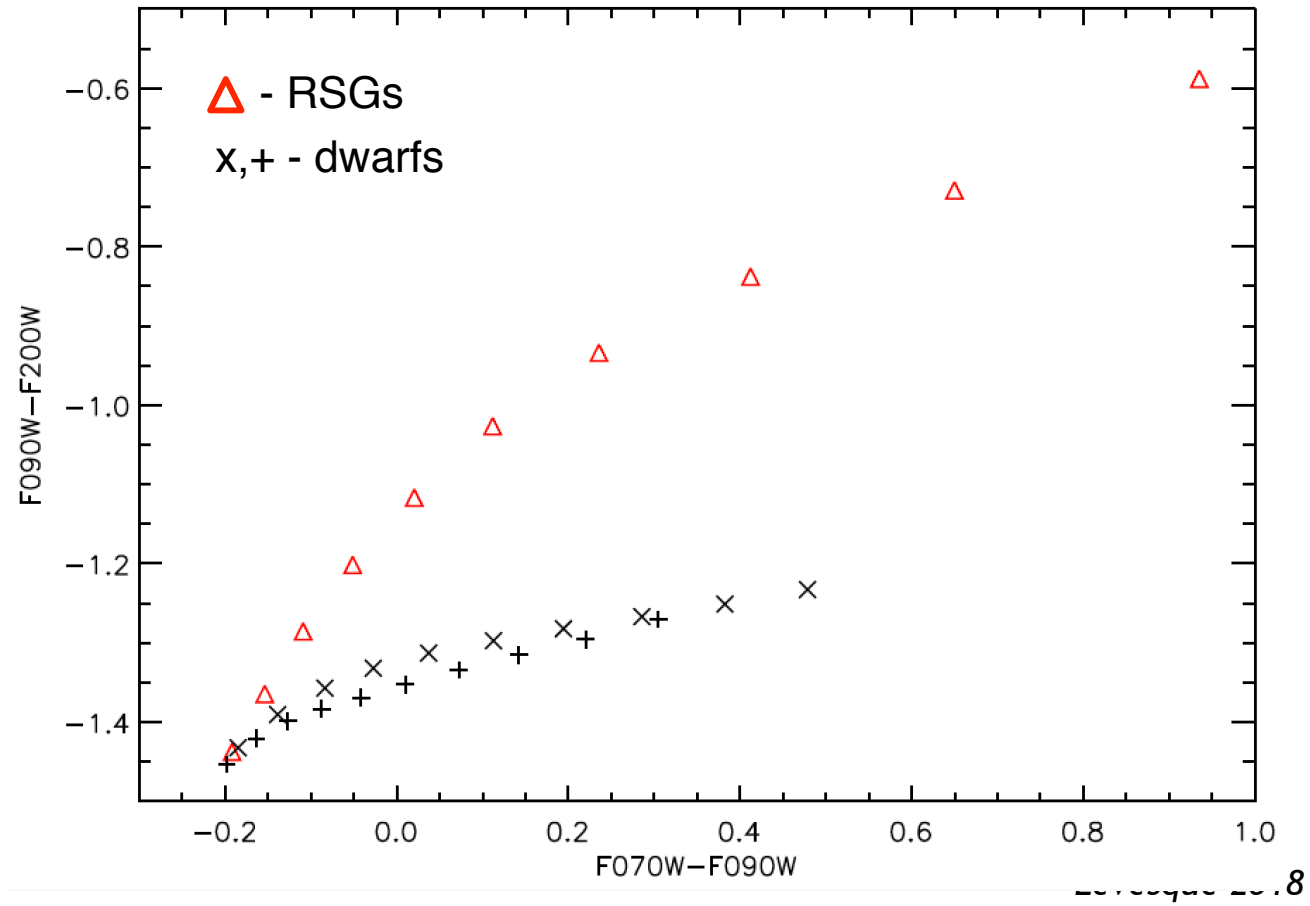
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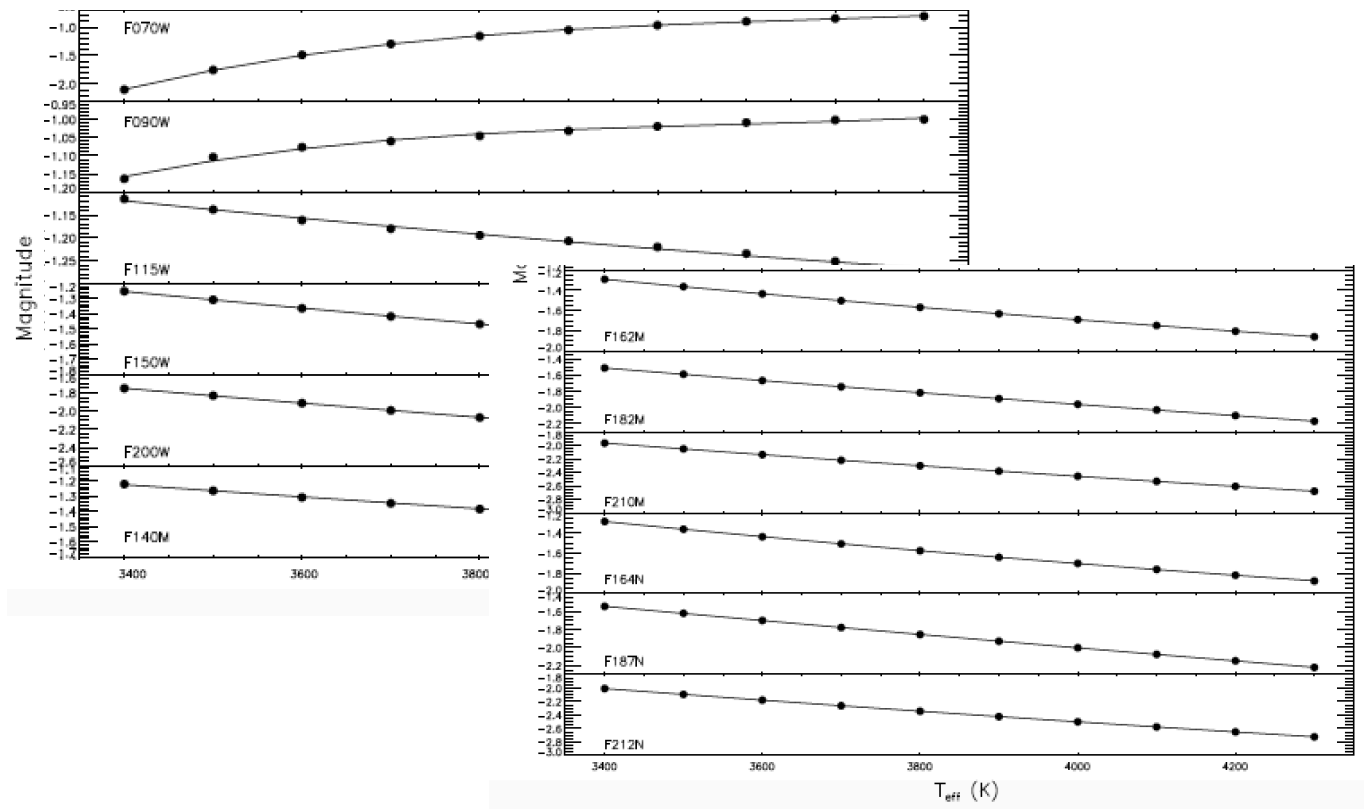


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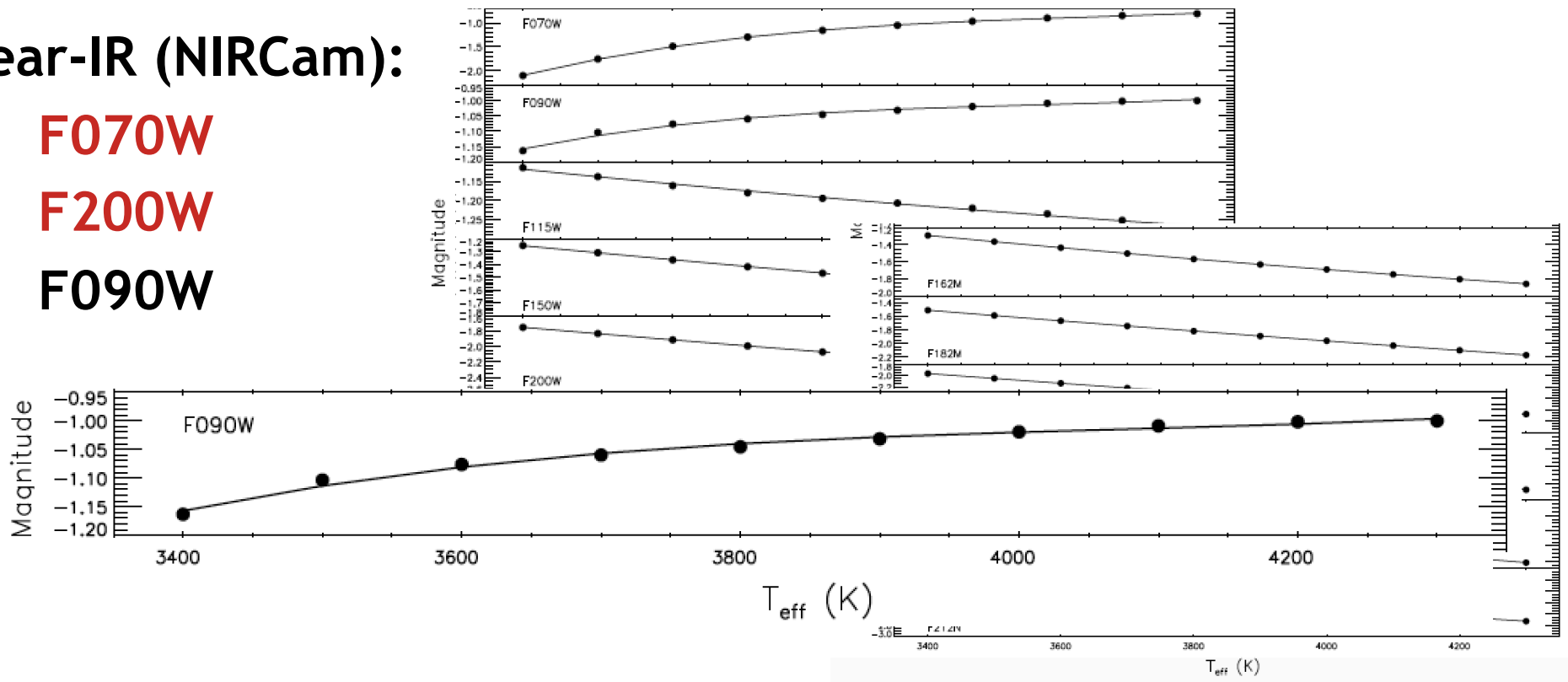
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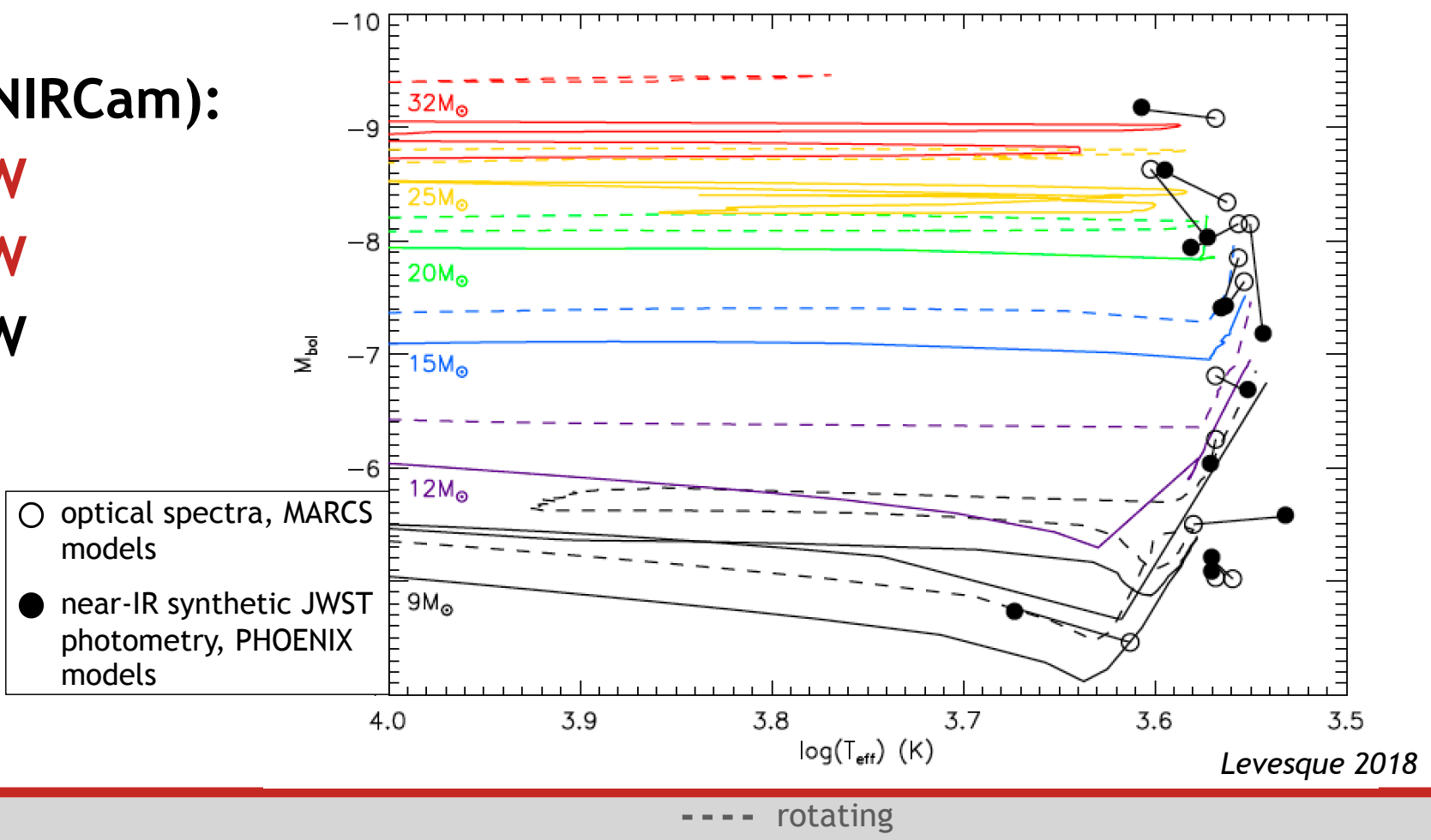
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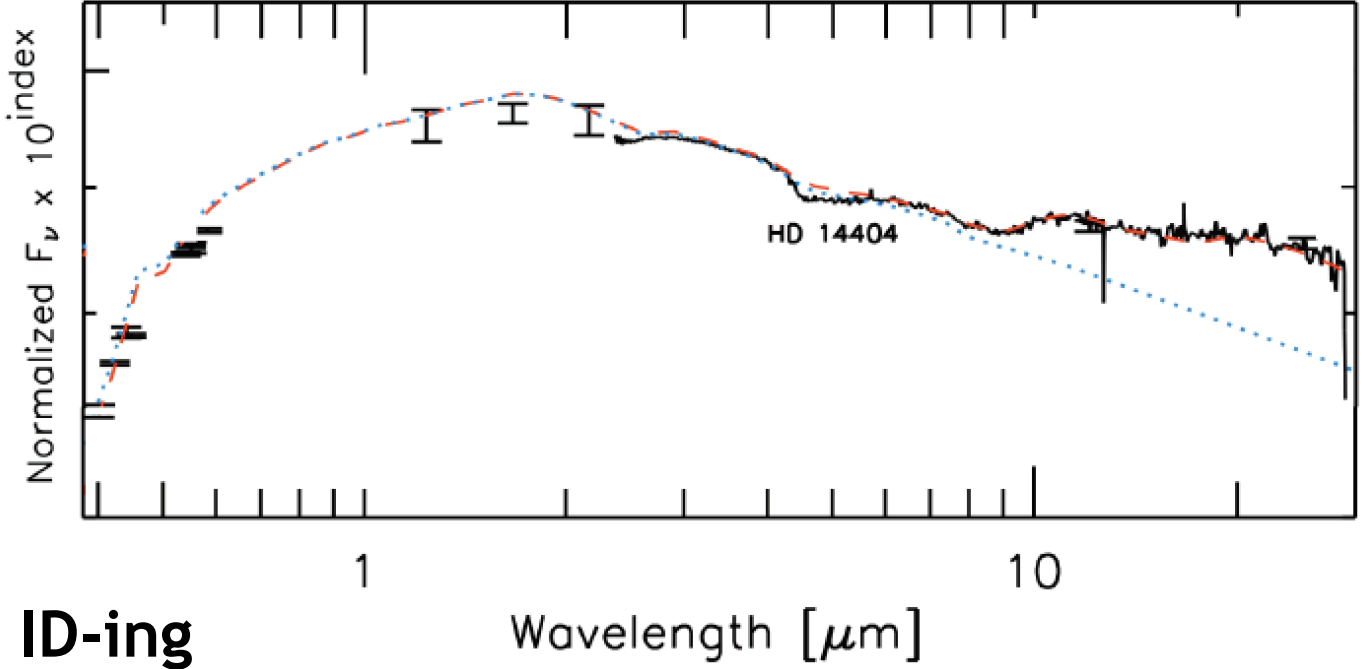
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Mid-IR!
coming soon...



(mid-IR is ideal for ID-ing RSGs and quantifying their mass loss, but sample spectra are challenging...)

Verhoelst+ 2009

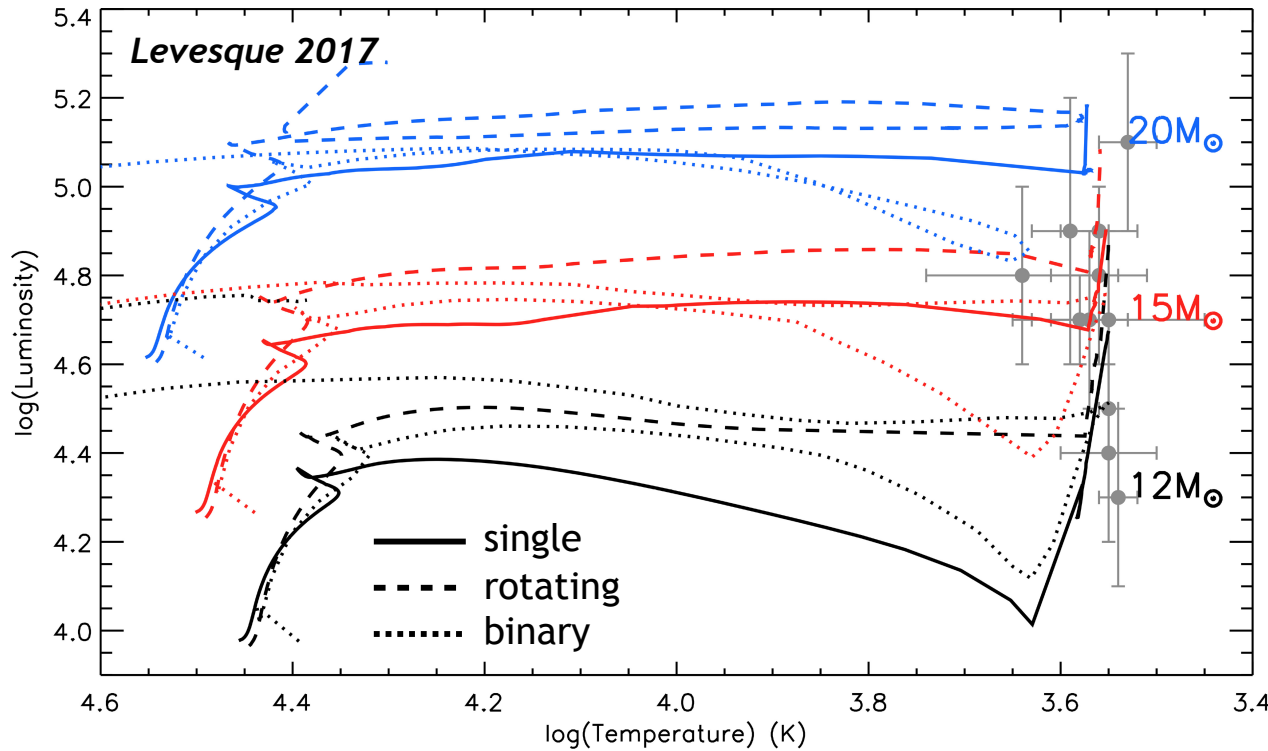
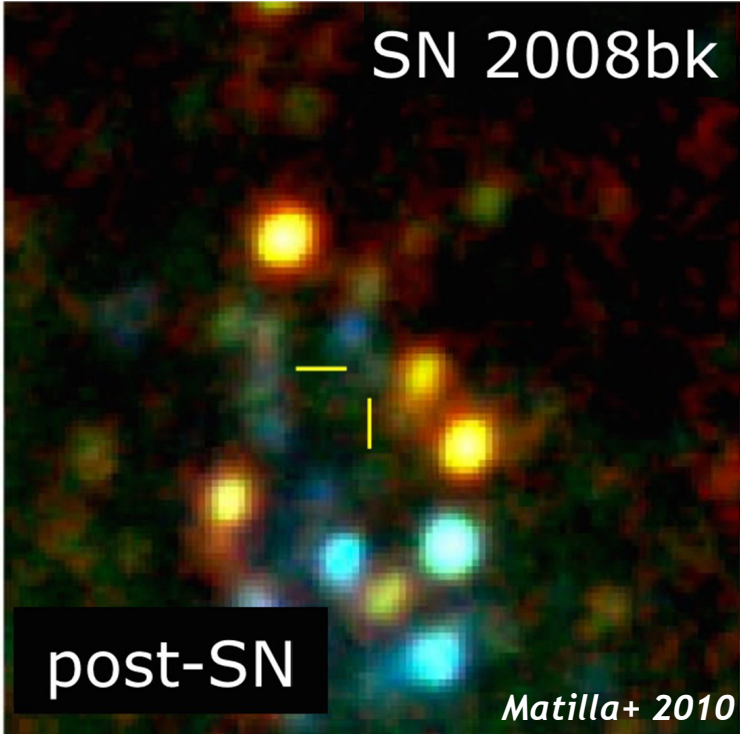
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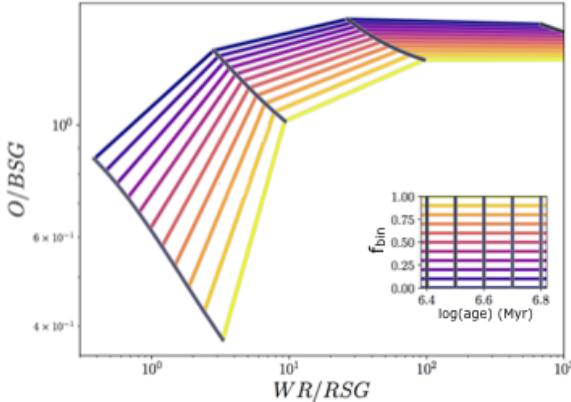
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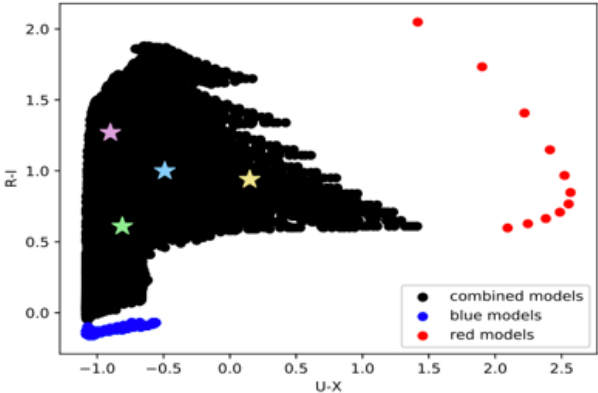
Stellar Population Diagnostics of the Massive Star Binary Fraction

Dorn-Wallenstein & Levesque 2018, ApJ



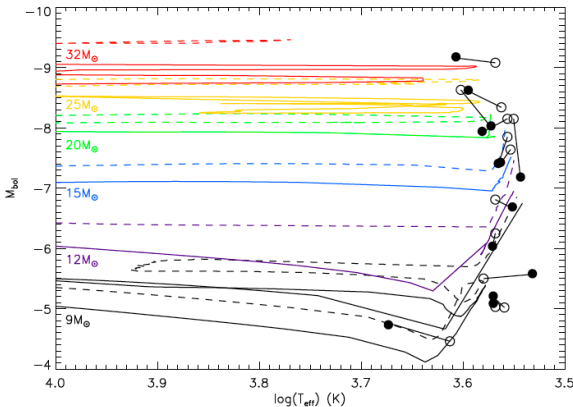
Binary RSGs: New Method for Detecting B-type Companions

Neugent, Levesque, & Massey 2018, AJ



RSGs in the JWST Era: Near-IR Photometric Diagnostics

Levesque 2018, ApJ



Book! Astrophysics of RSGs

Levesque 2017, IOP eBooks

- FREE with institute subscription
- succinct (~100 pages!)
- written at advanced grad student level
- reference for current state of RSG research

