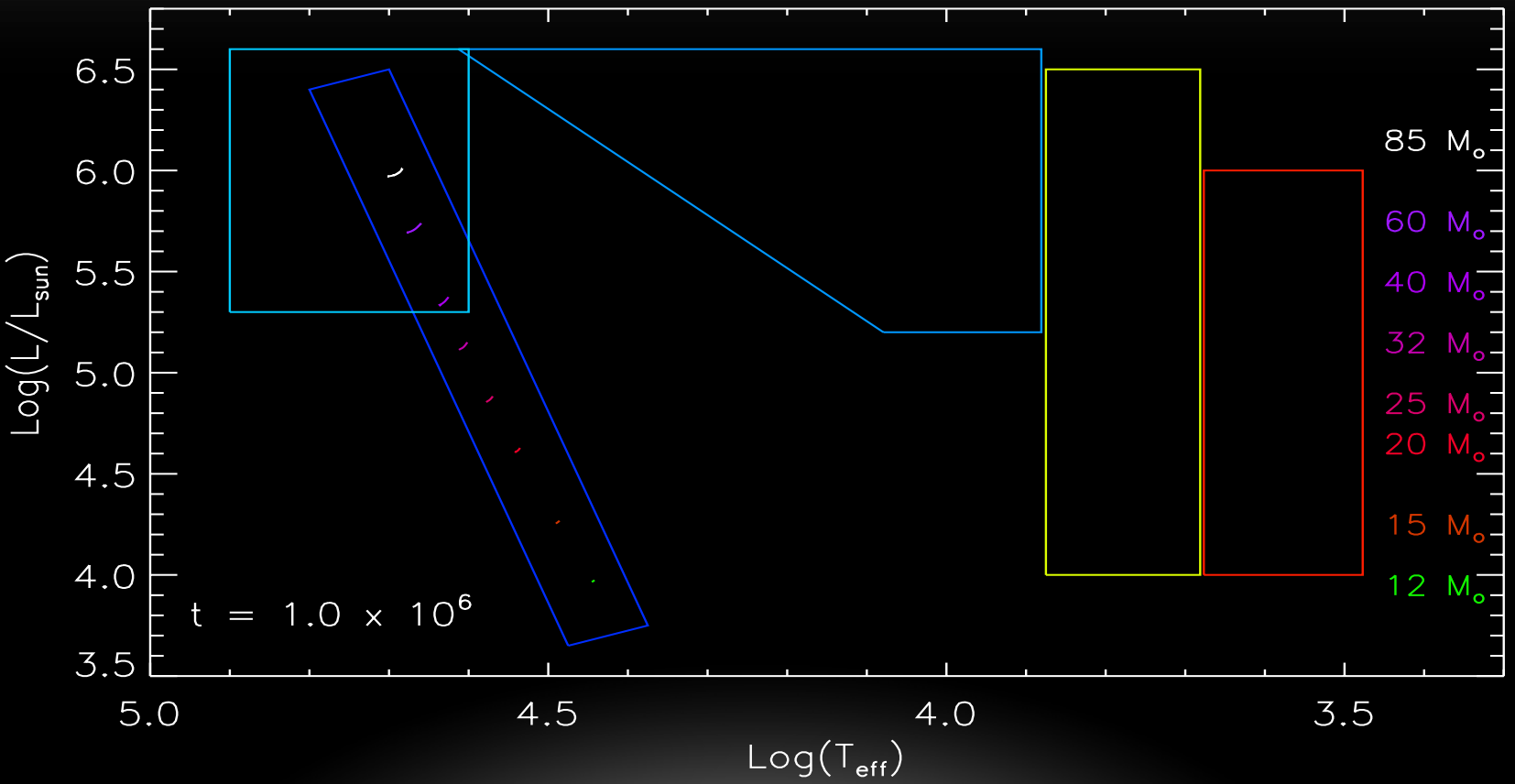
EVOLVED MASSIVE STARS IN THE LOCAL GROUP

Maria R. Drout (Harvard University)

CTIO 50th Anniversary (May 9th, 2013)

Collaborators: Philip Massey, Emily Levesque, Kathryn Neugent, Georges Meynet

MASSIVE STAR EVOLUTION: A REVIEW



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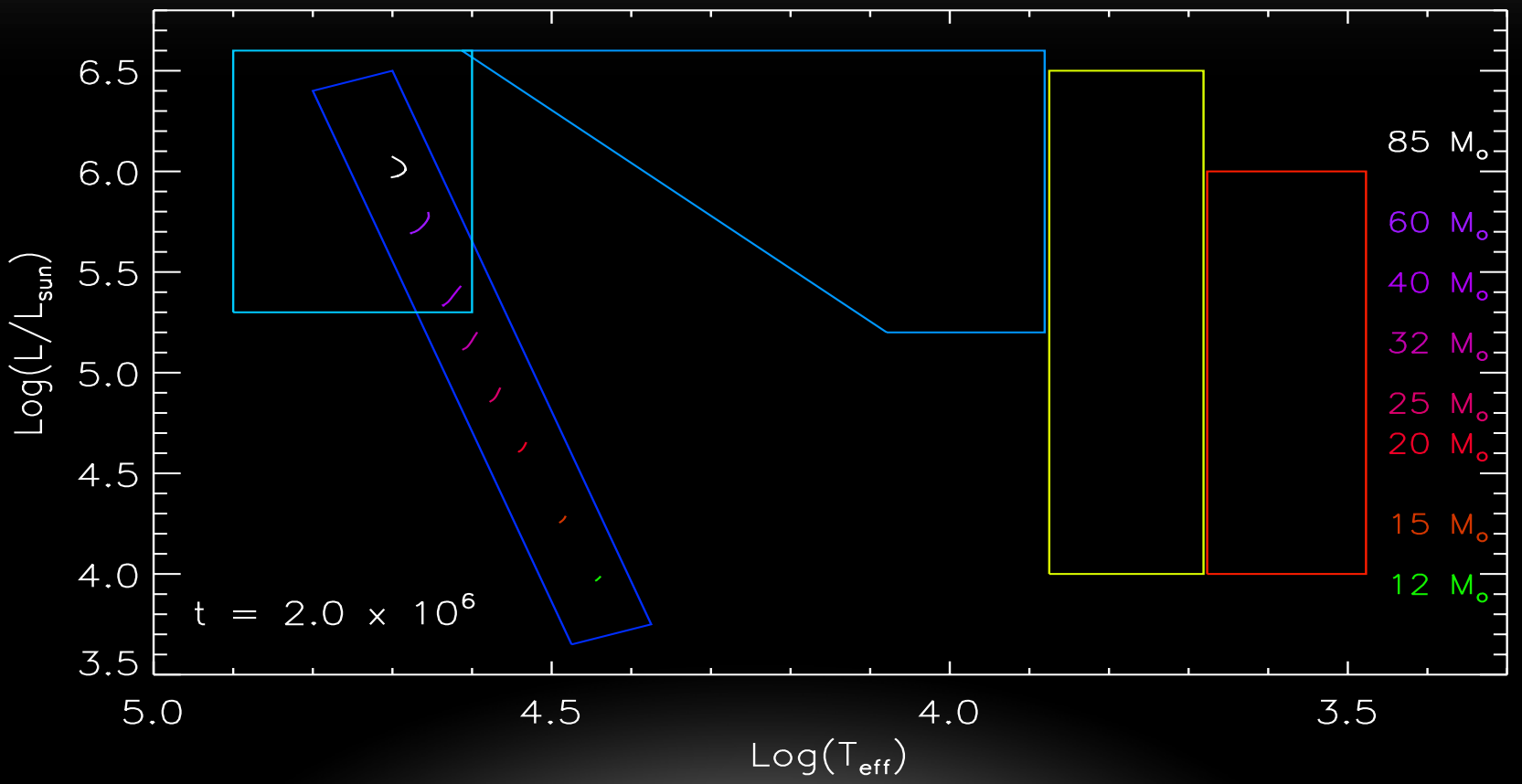

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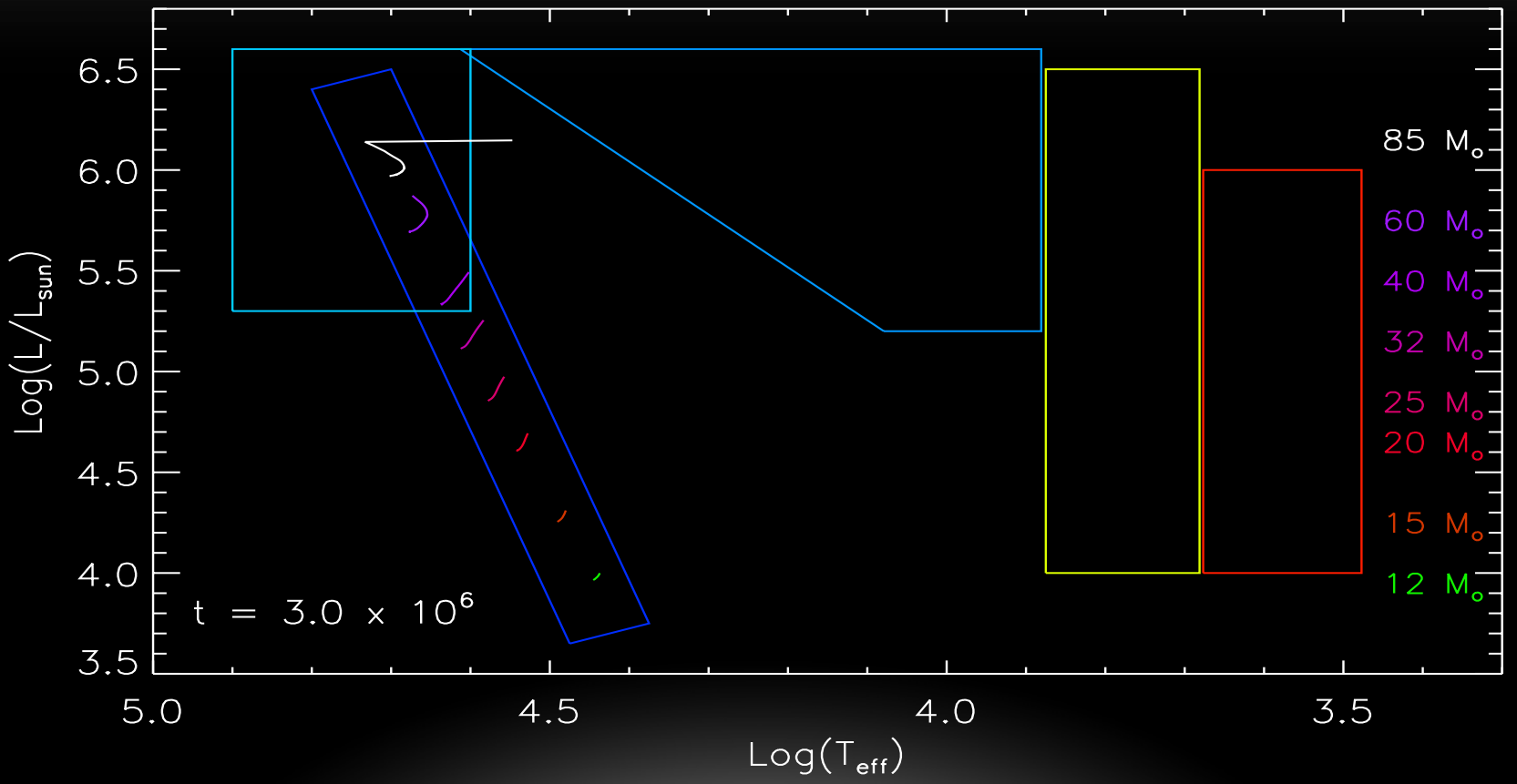

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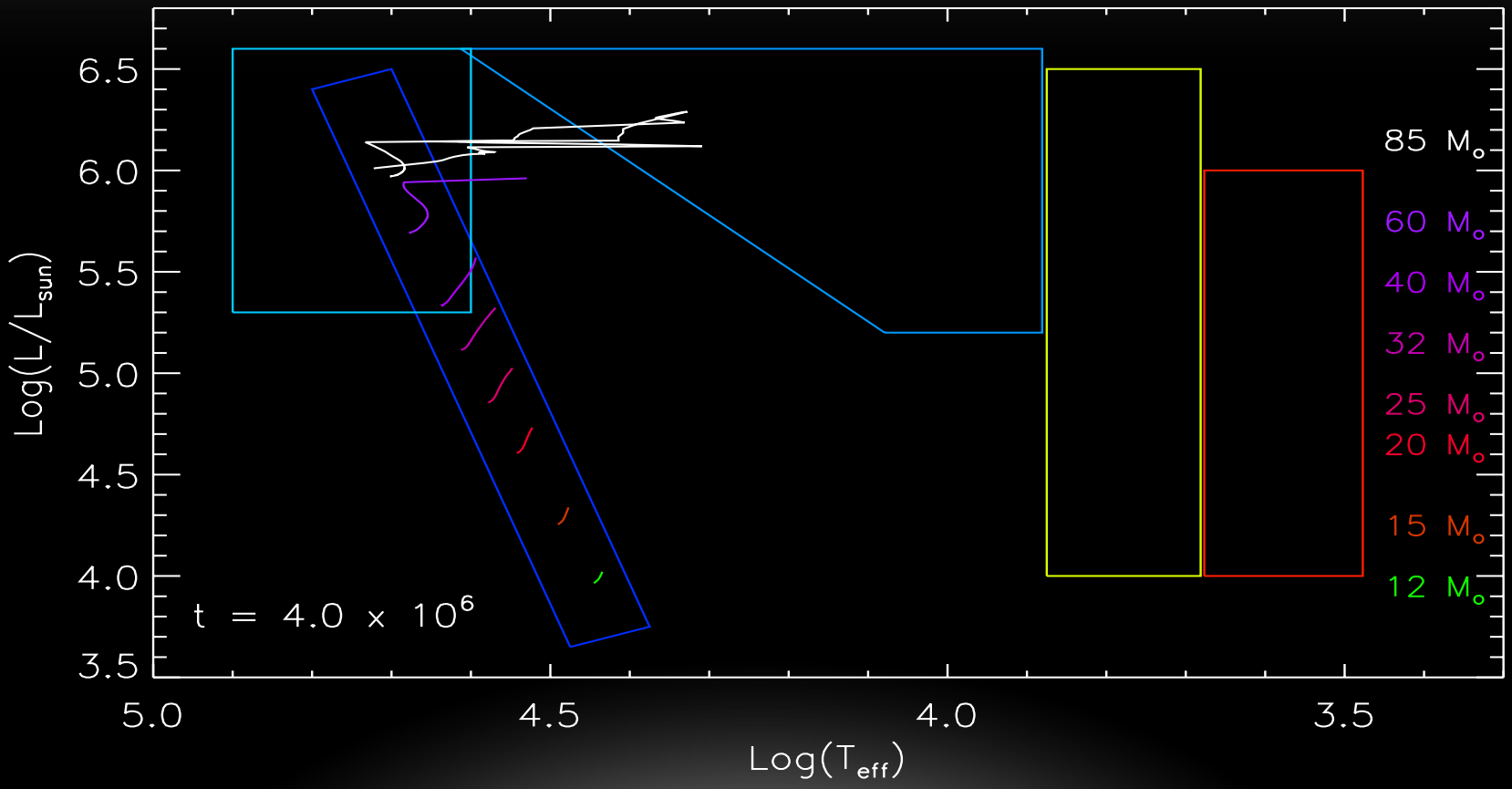

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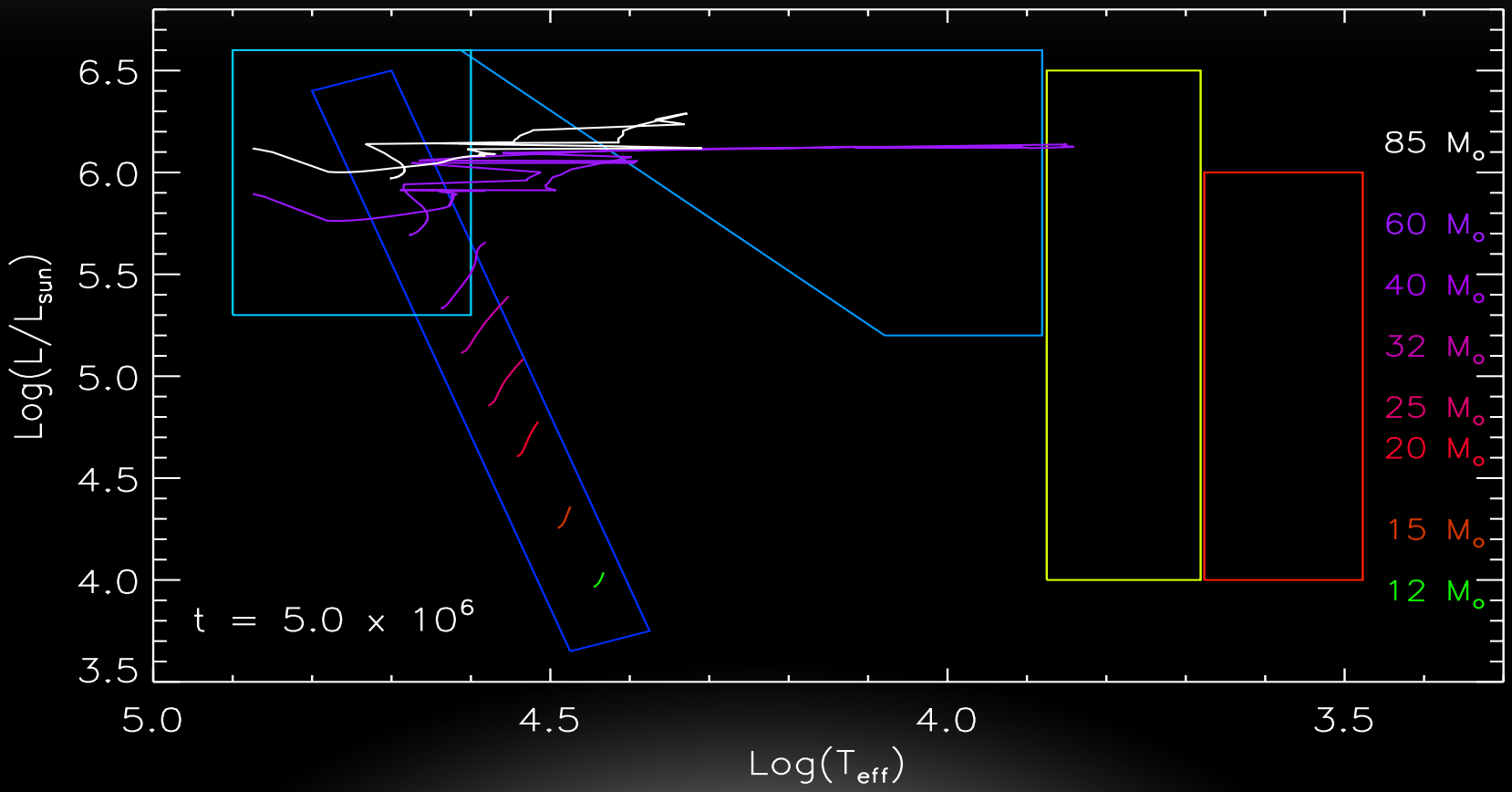

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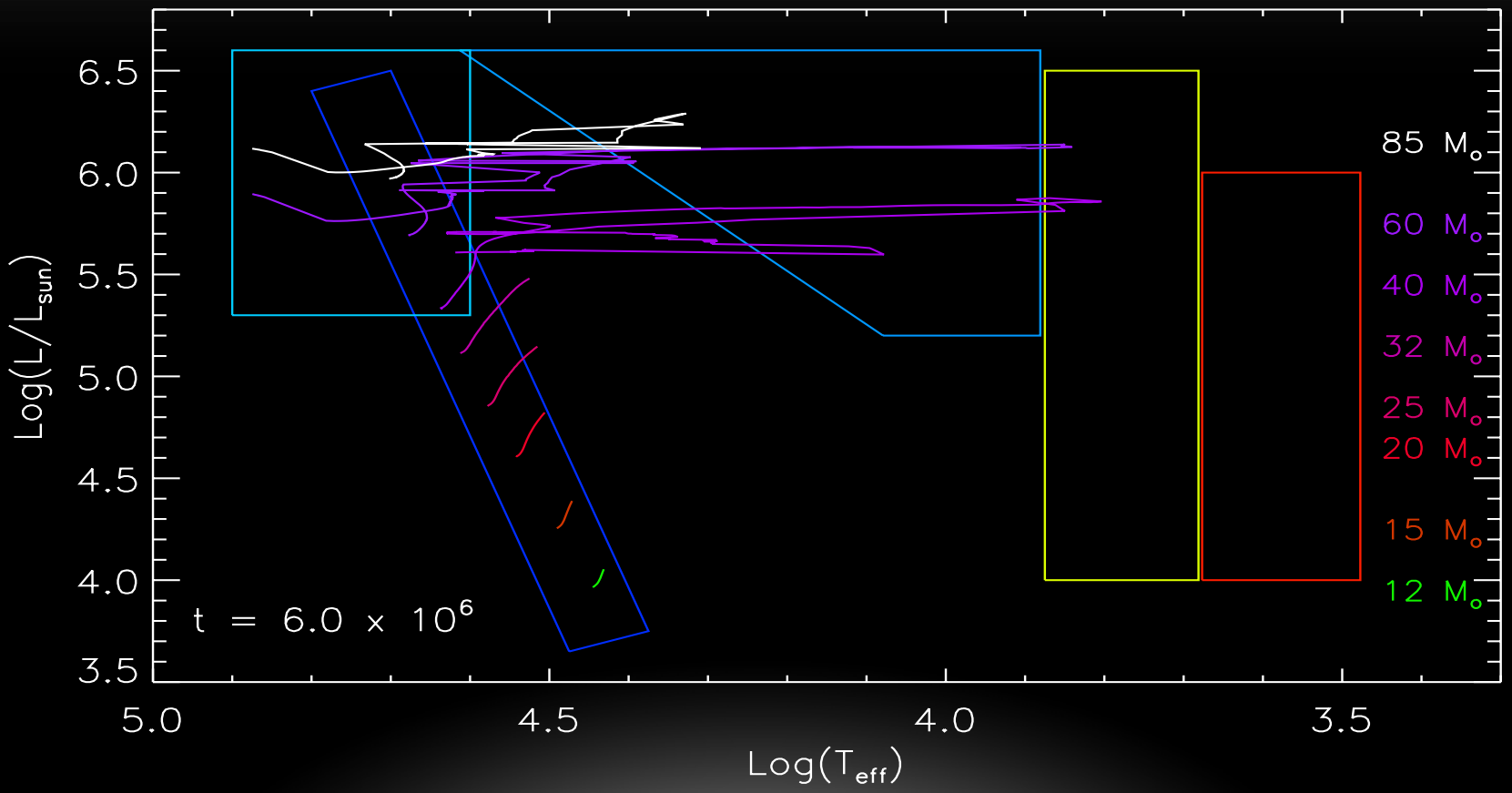

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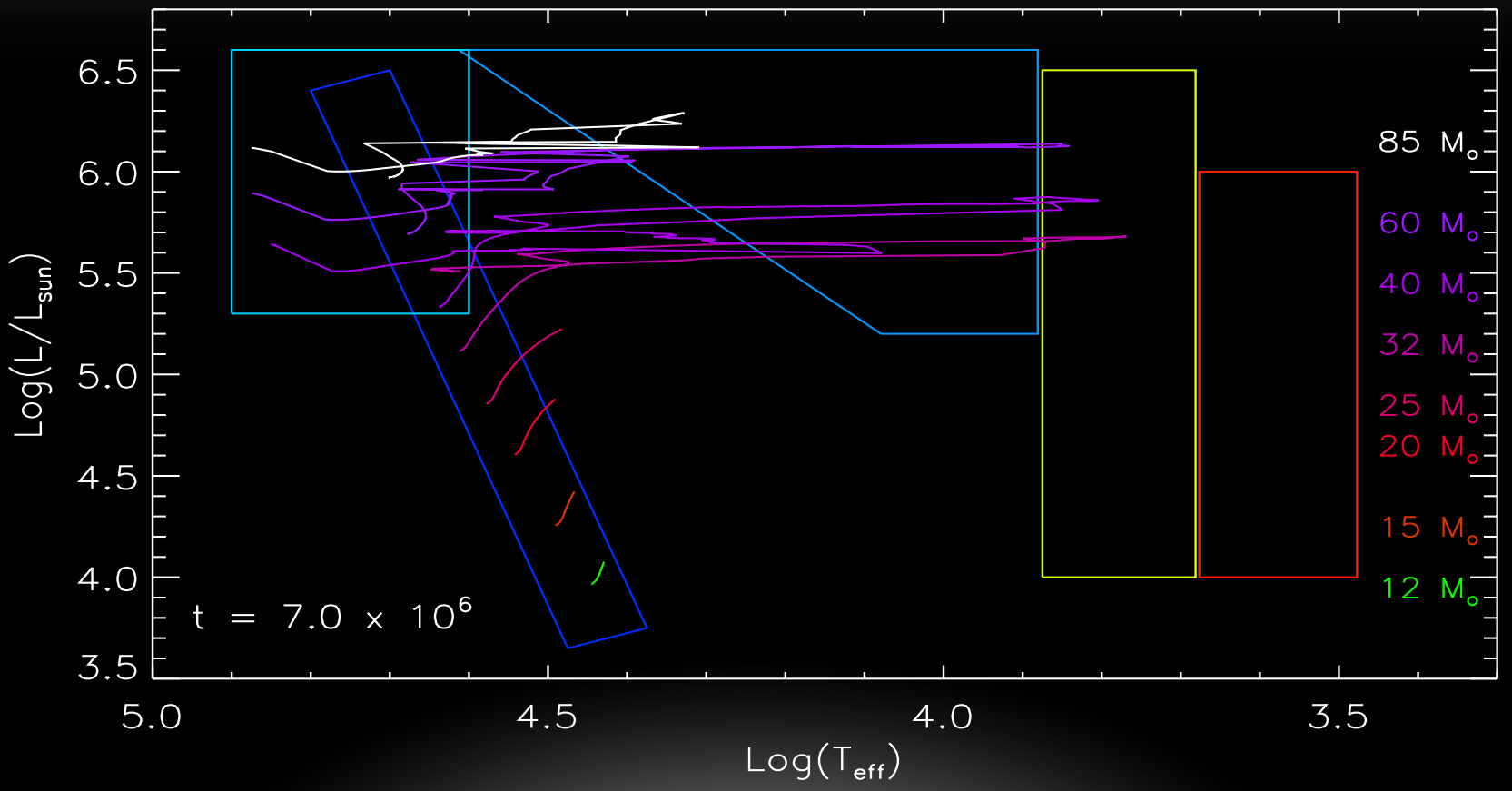

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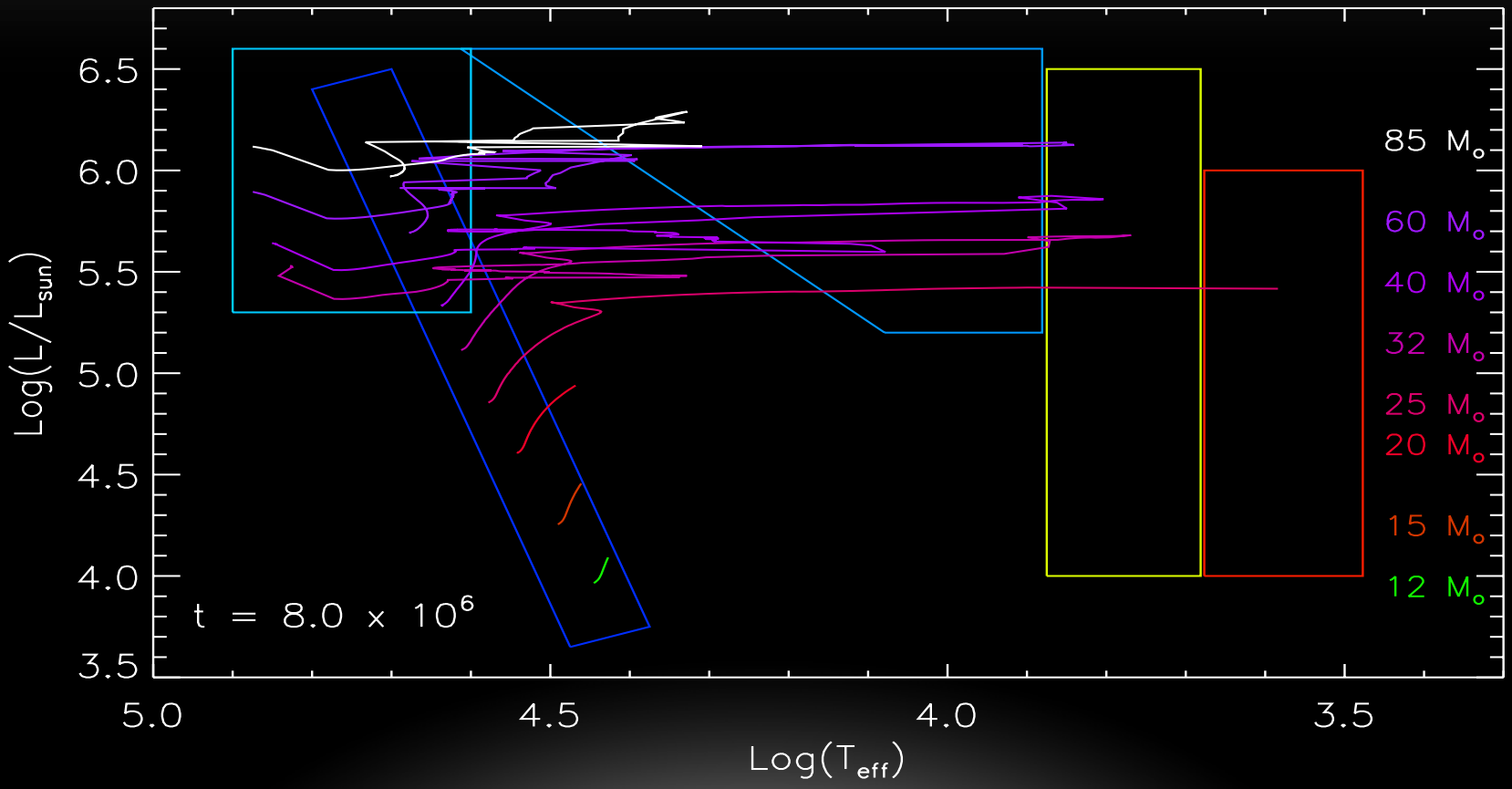

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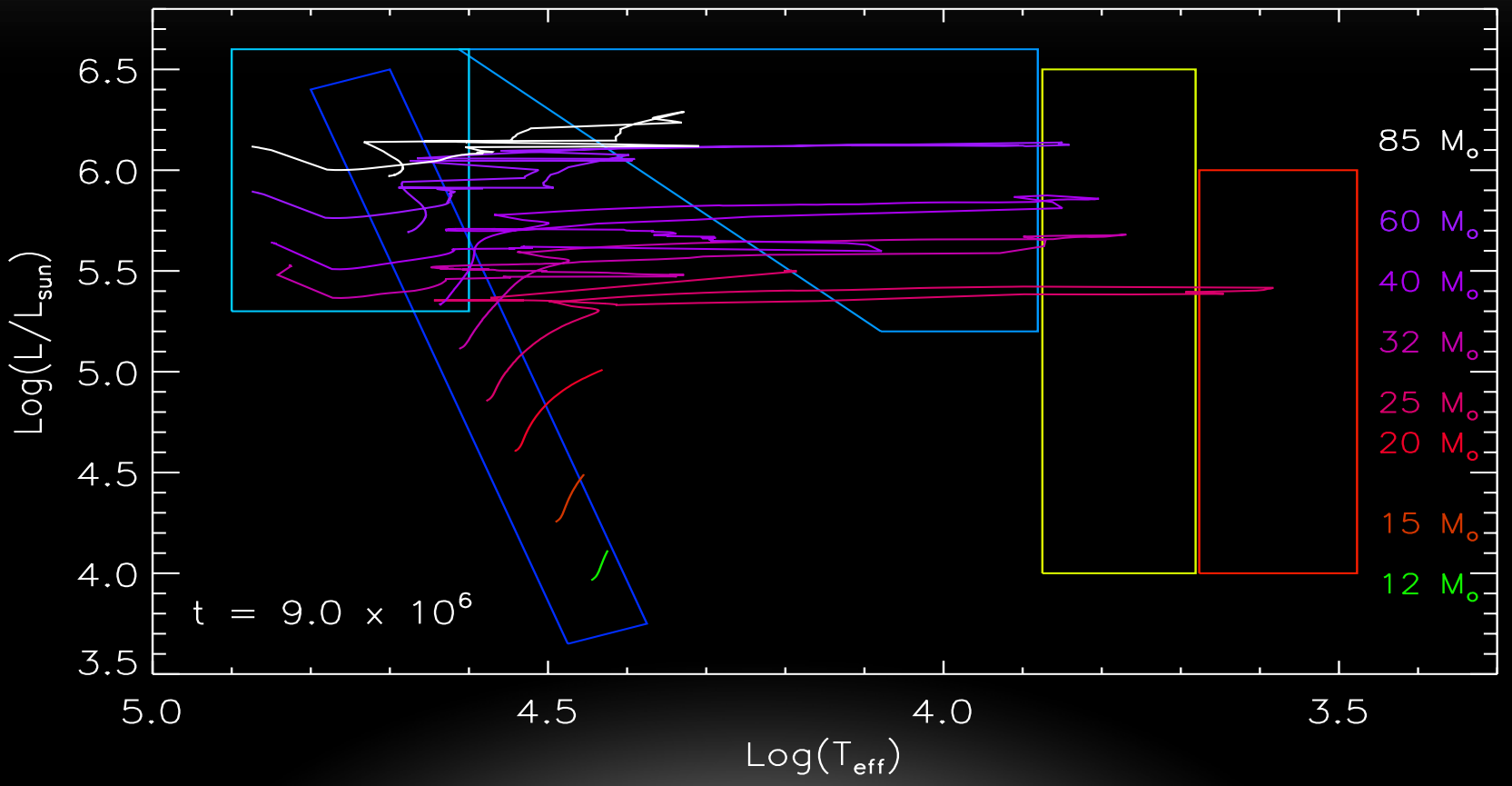

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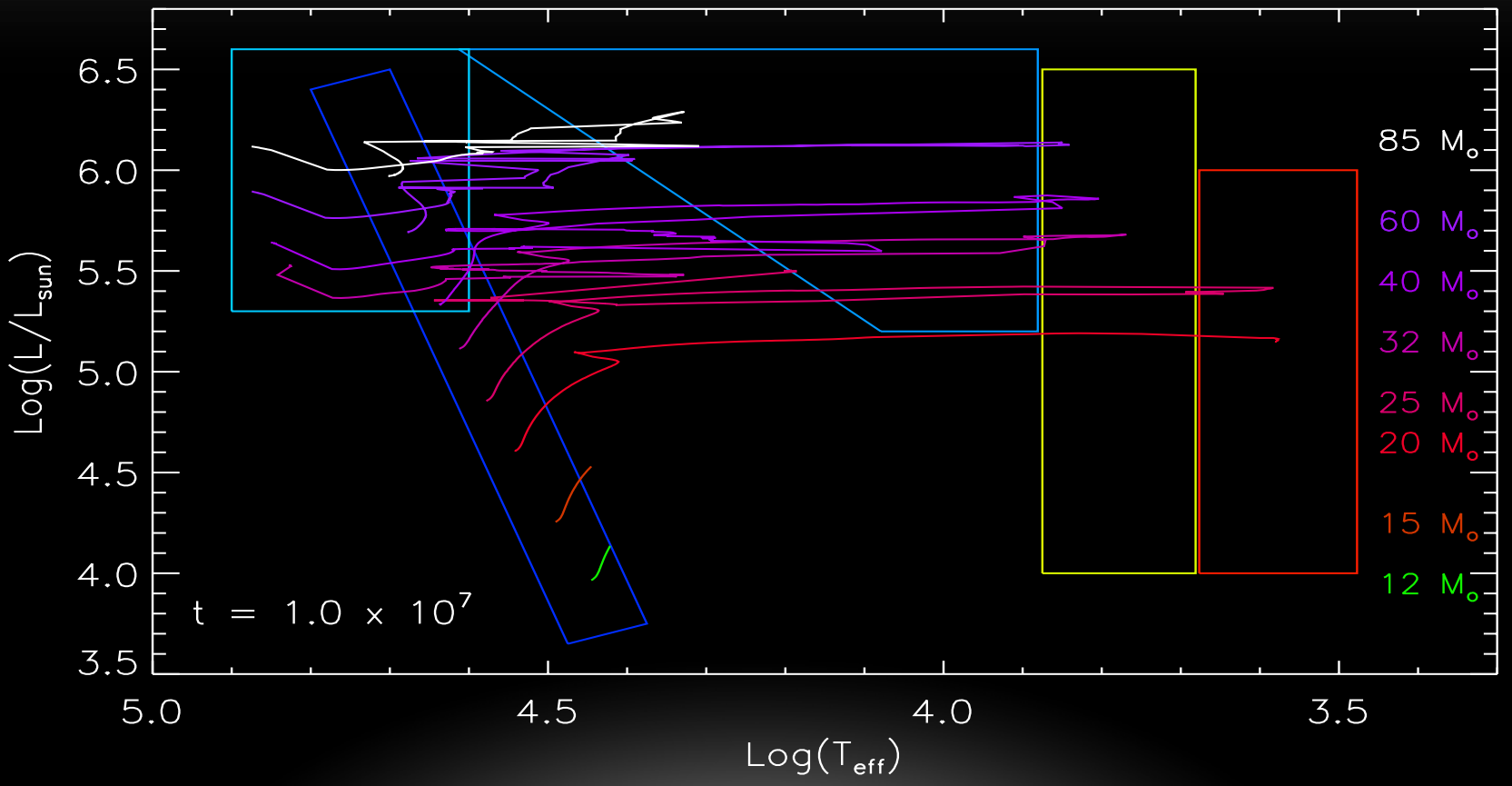

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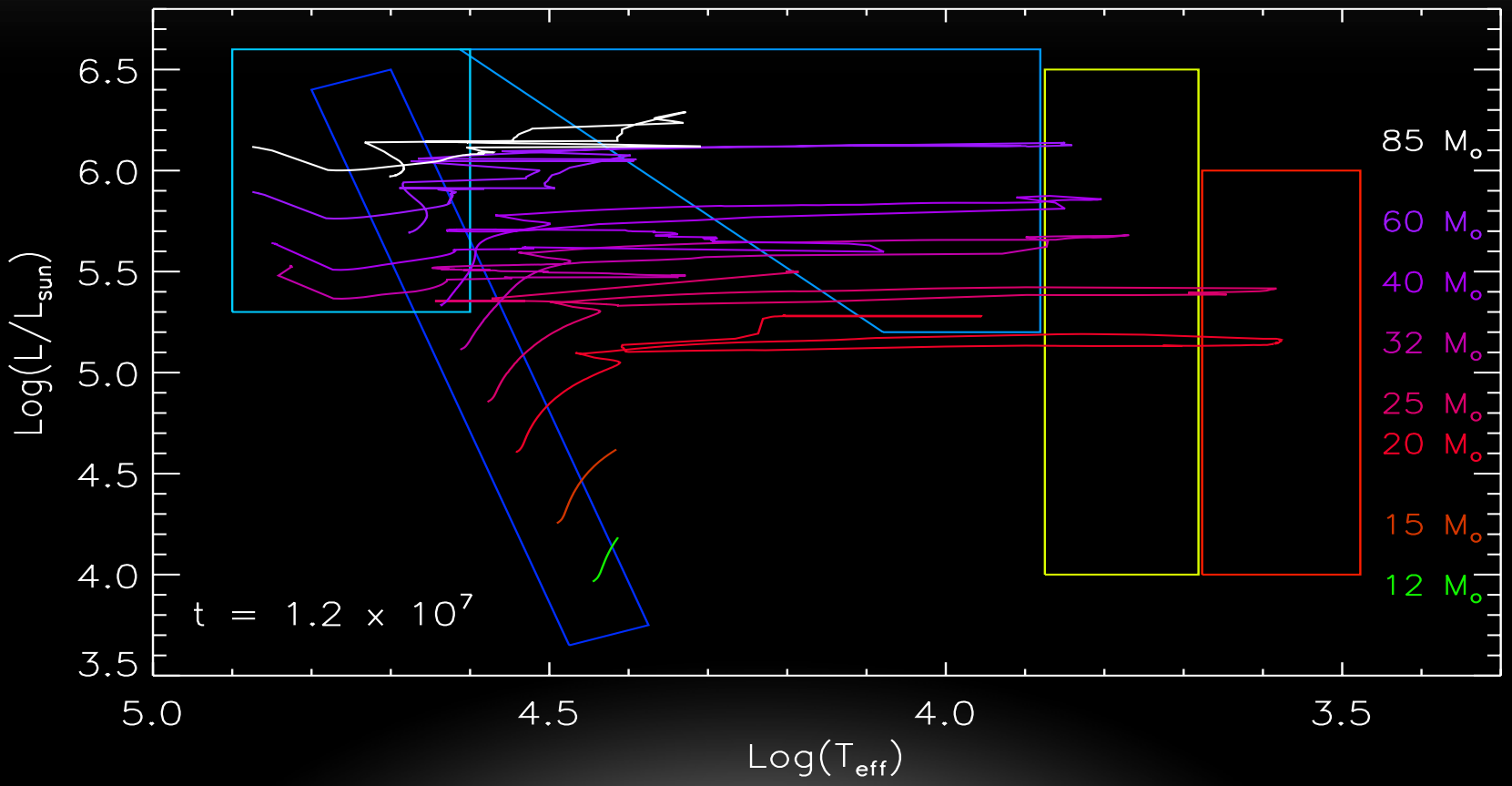

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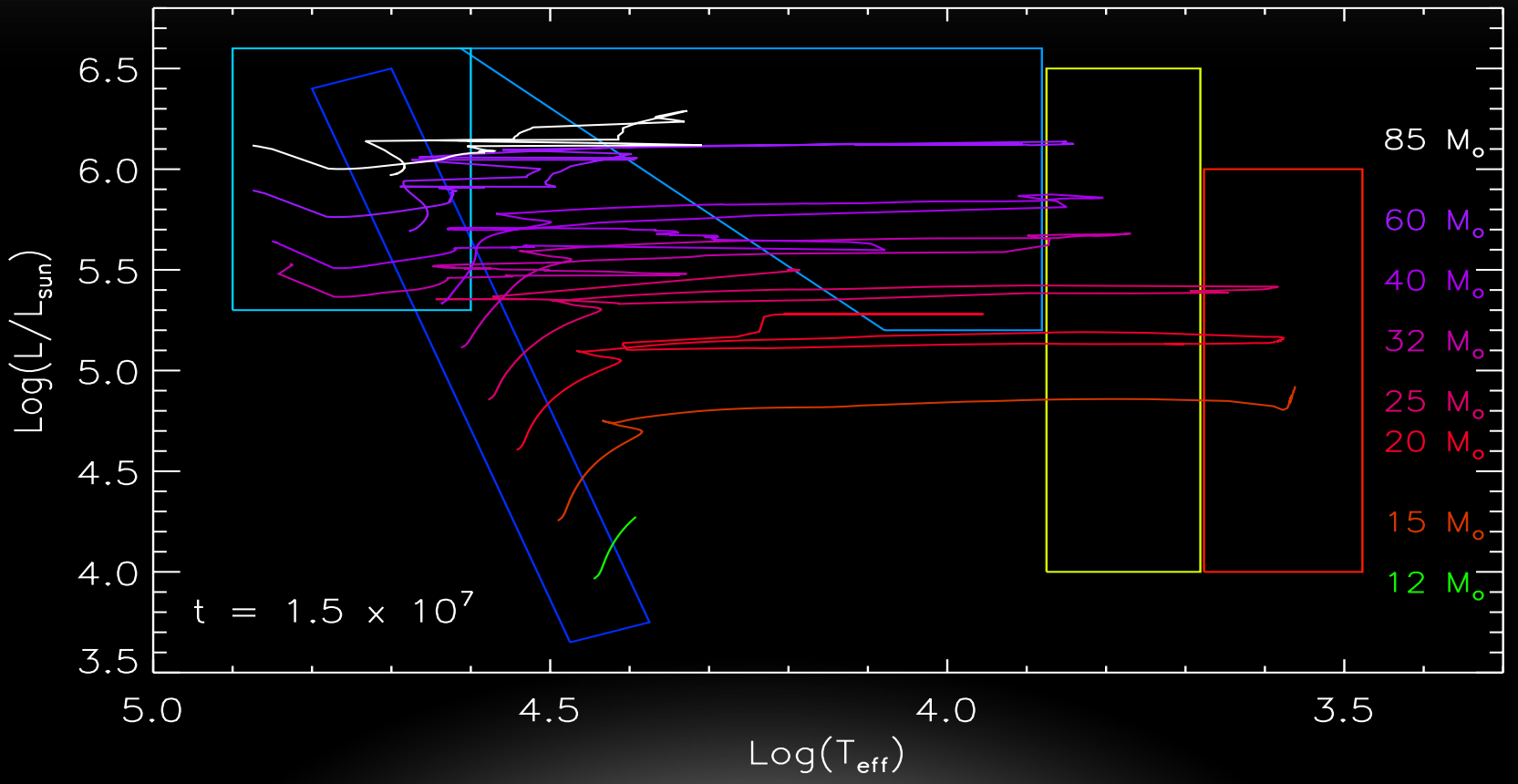

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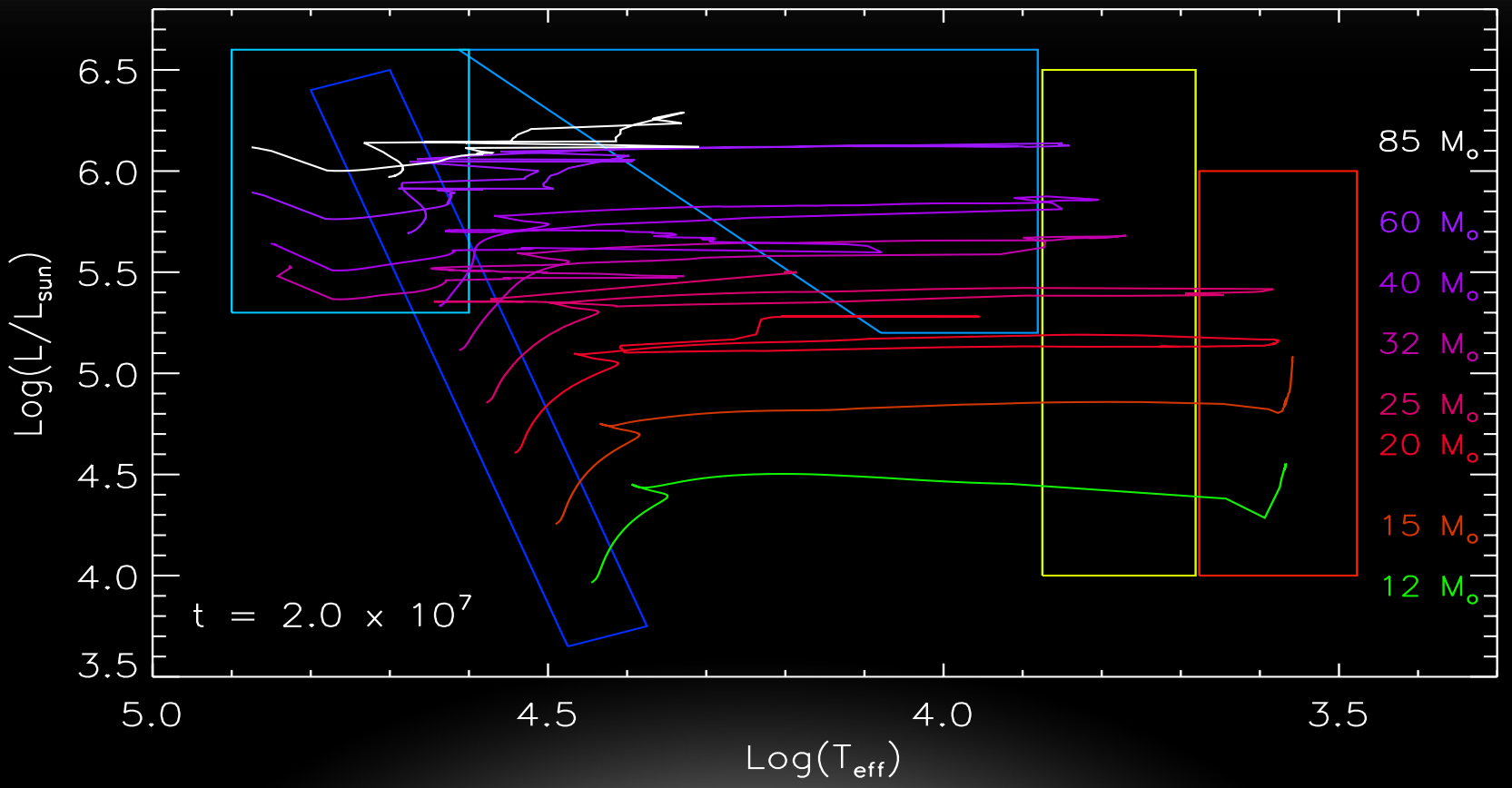

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ISSUES…

- Mass-Loss
- Rotation
- Opacities
- Convection
- Binarity
- …

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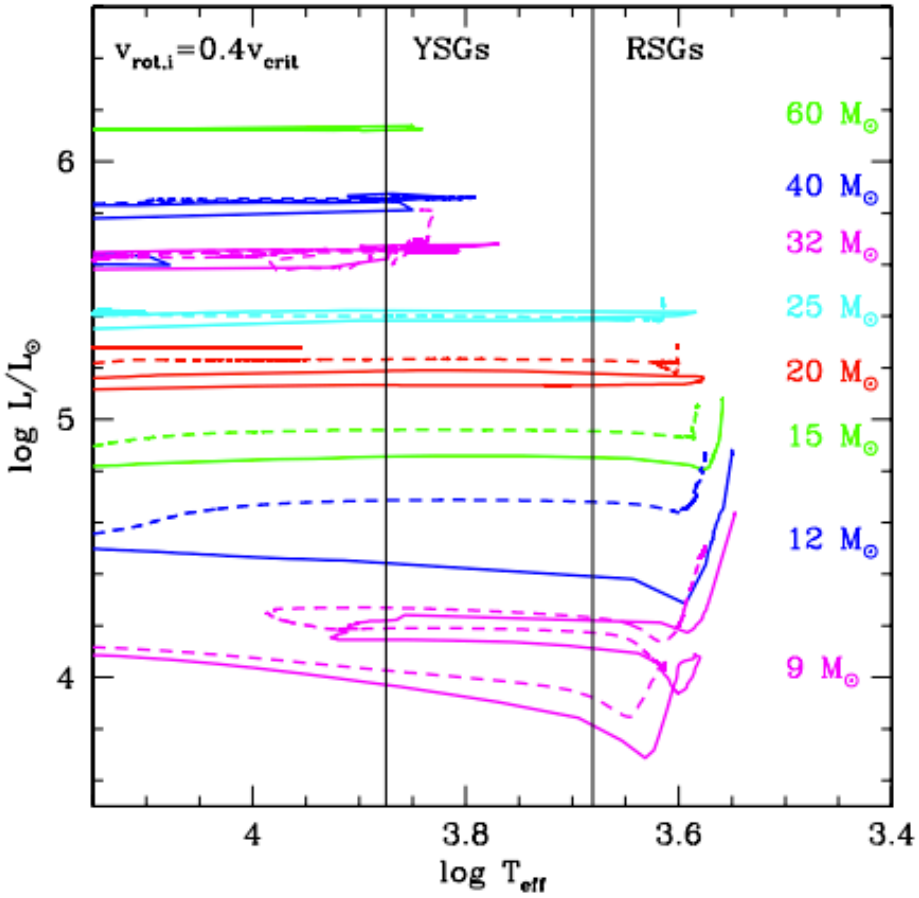
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YSGs
RSGs
60 $M_\odot$
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32 $M_\odot$
25 $M_\odot$
20 $M_\odot$
15 $M_\odot$
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4
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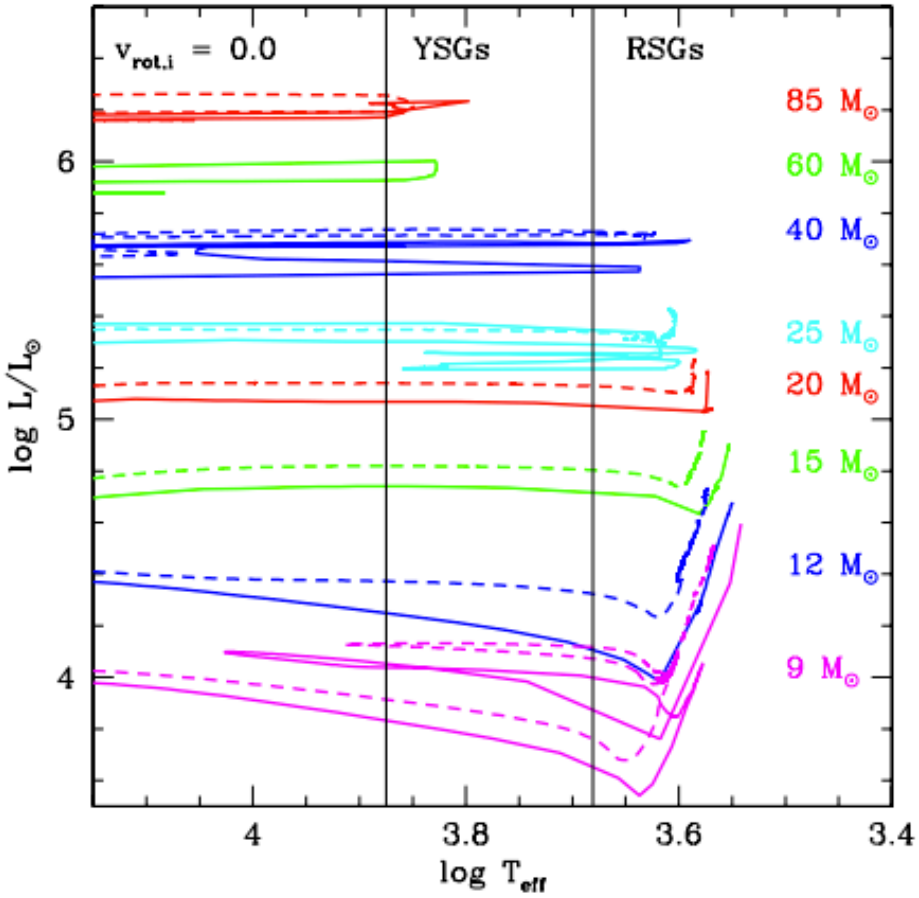
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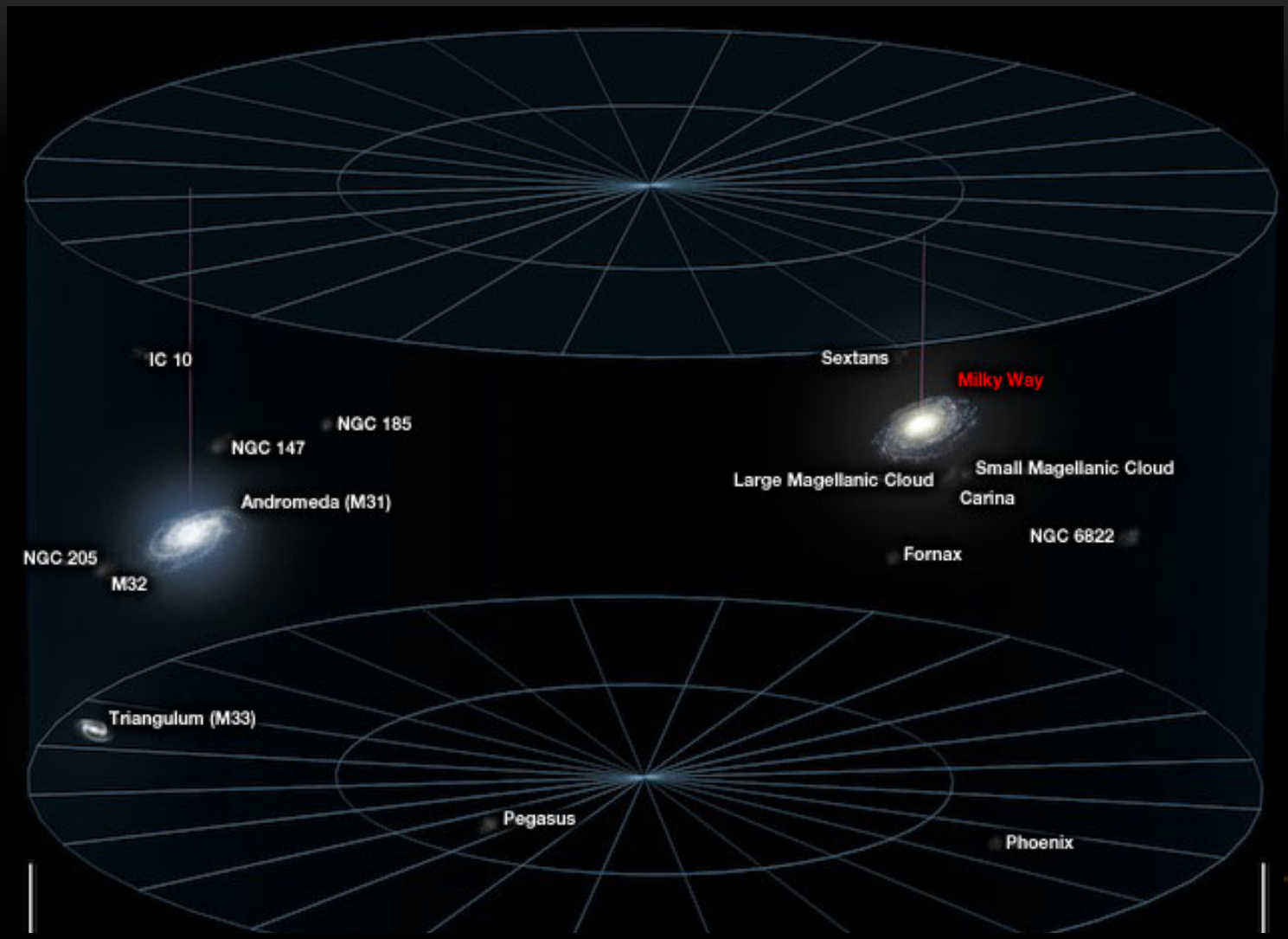
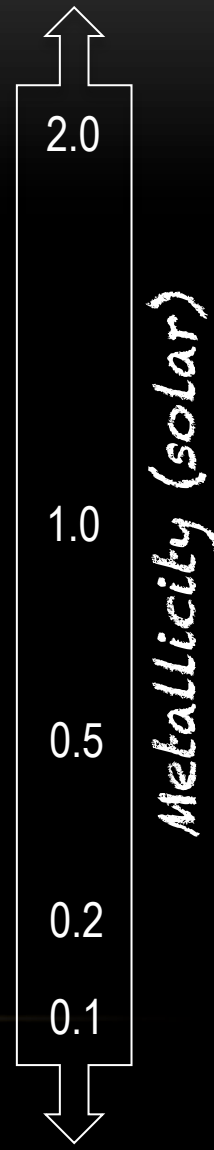
THE LOCAL GROUP AS A TESTING GROUND





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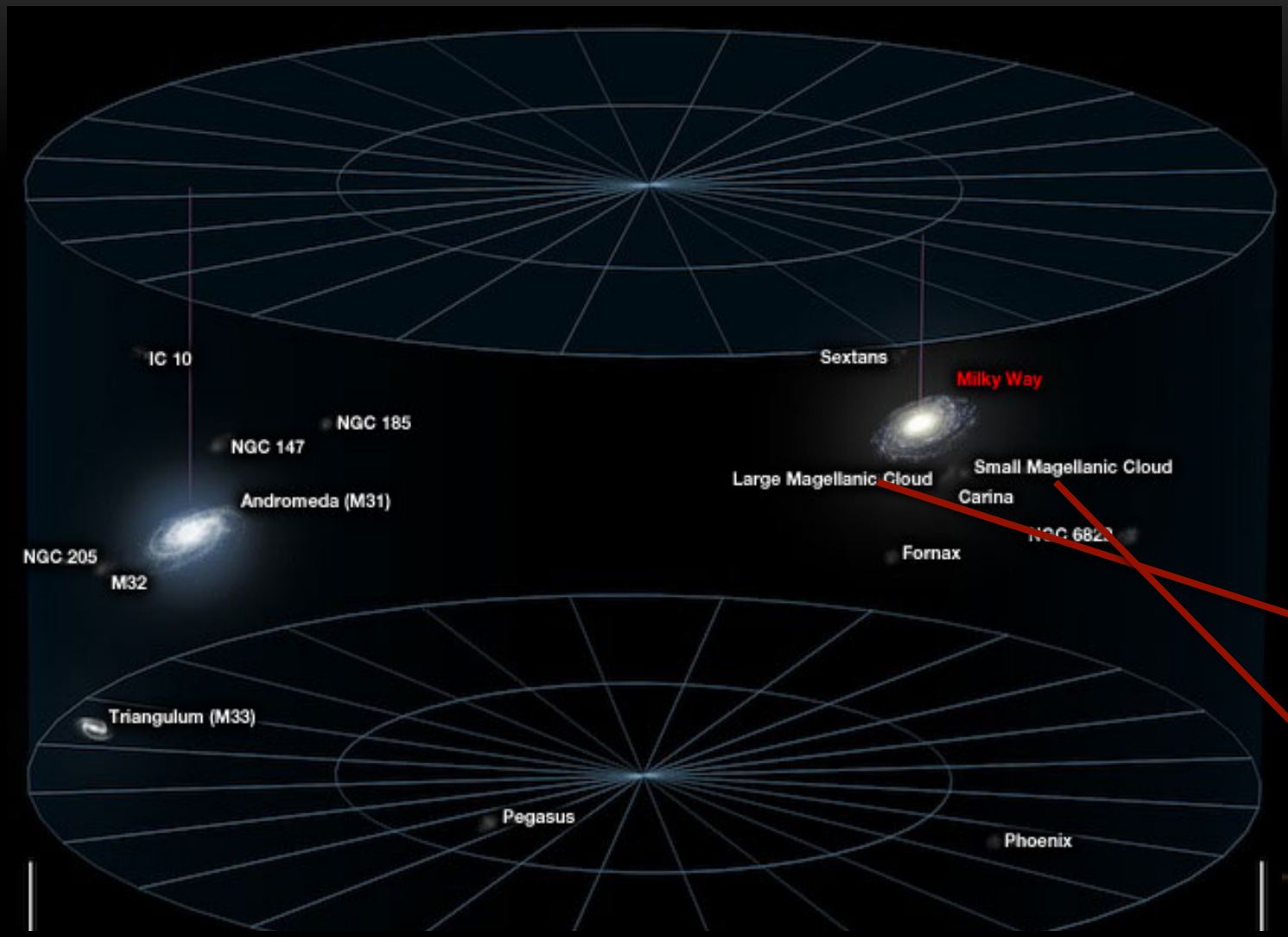

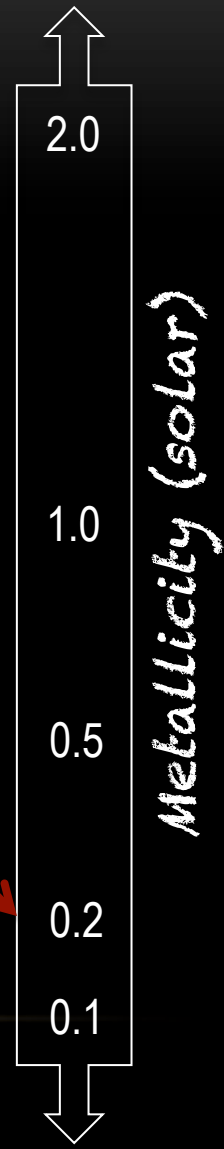

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Yellow Supergiants

Red Supergiants

Luminous Blue Variables

Wolf Rayets

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Past <-> Present <-> Future

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~~Past <-> Present <-> Future~~

What I need <-> Progress We've <-> How We're
You to know made Confused

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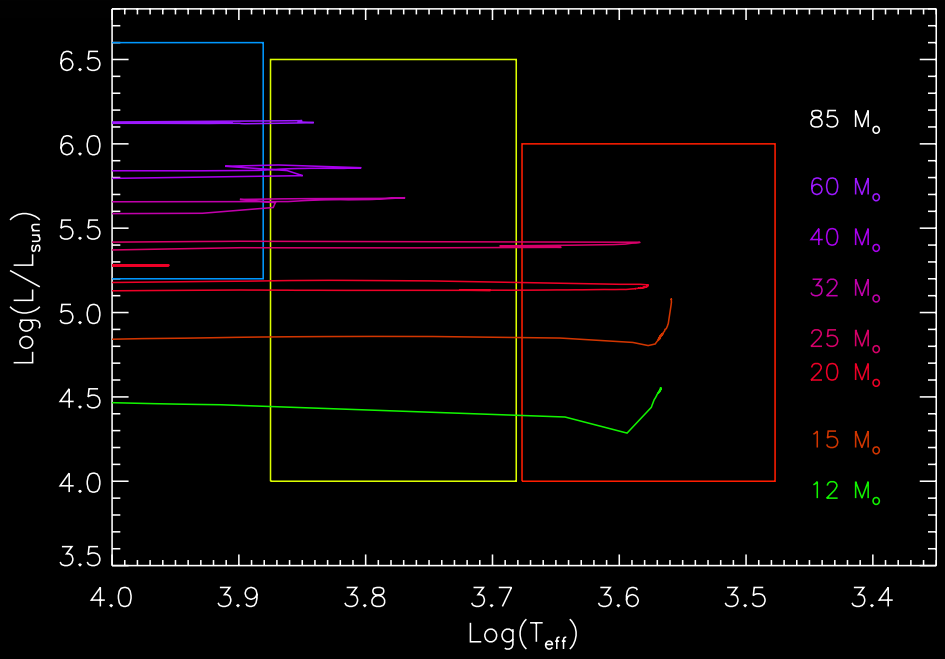
- Only handful of known objects.
- Some high luminosity variable members “Yellow Hypergiants”
- No comprehensive surveys conducted.



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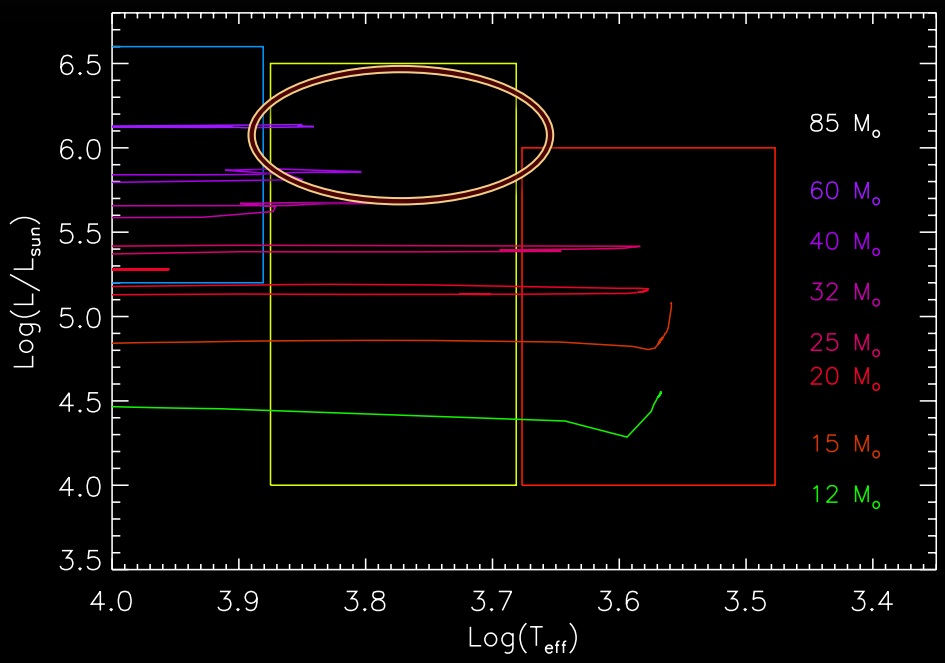

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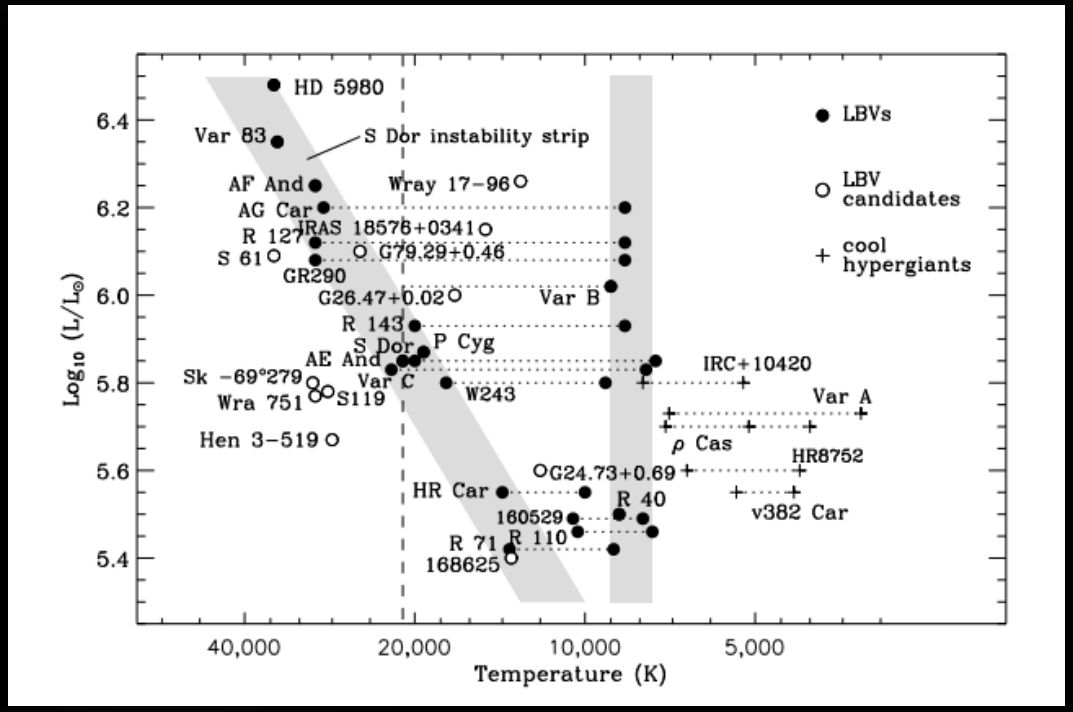

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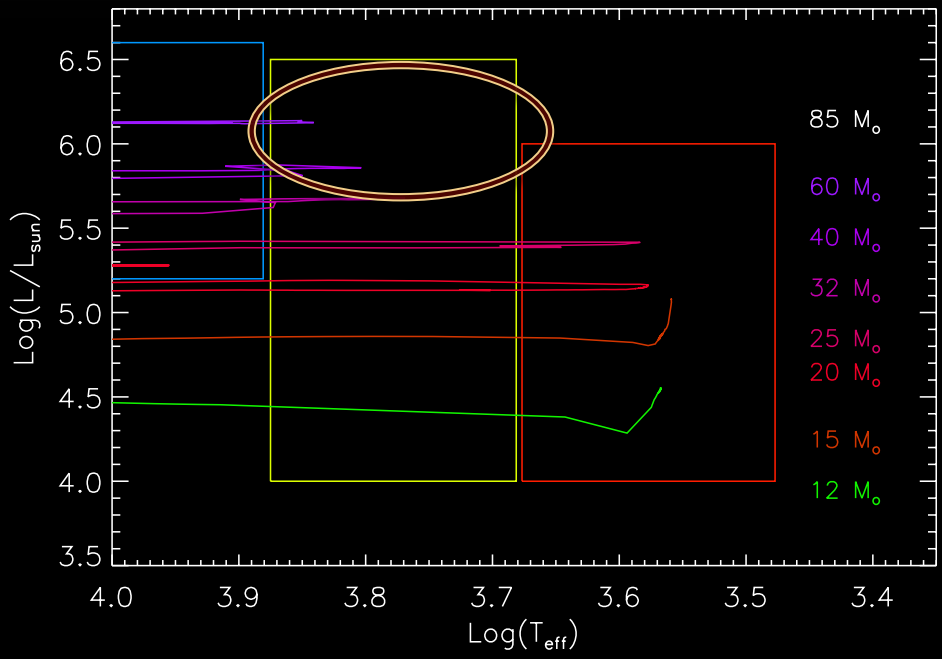

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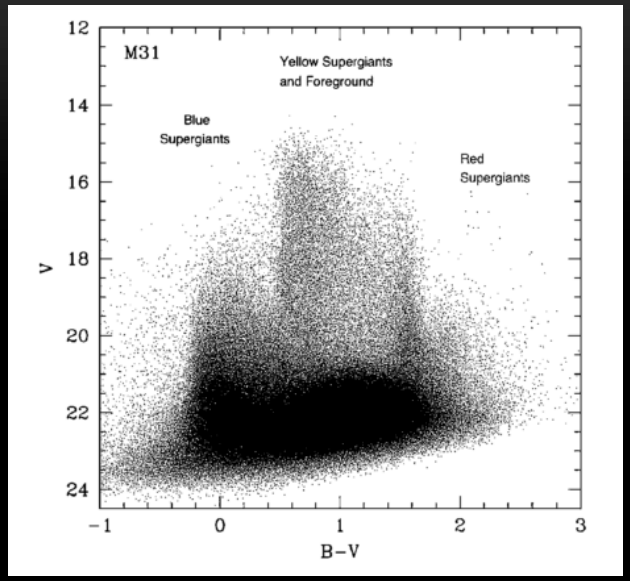

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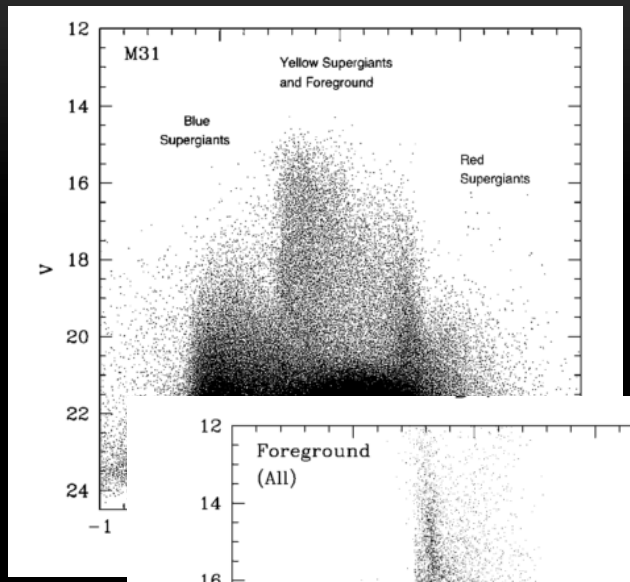

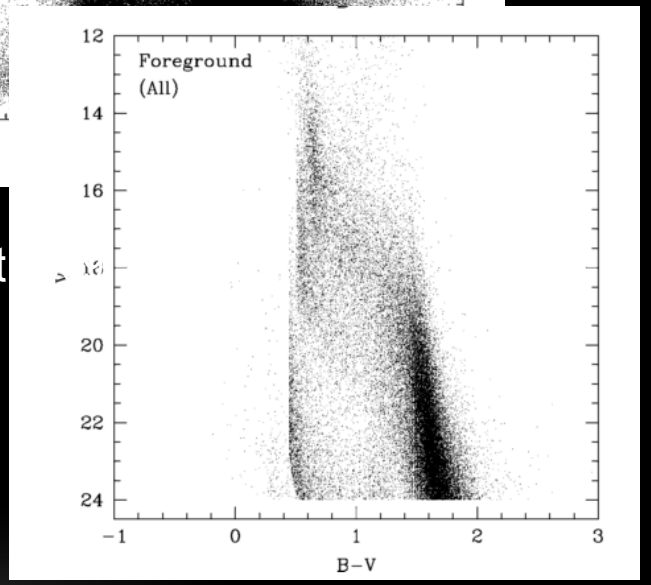

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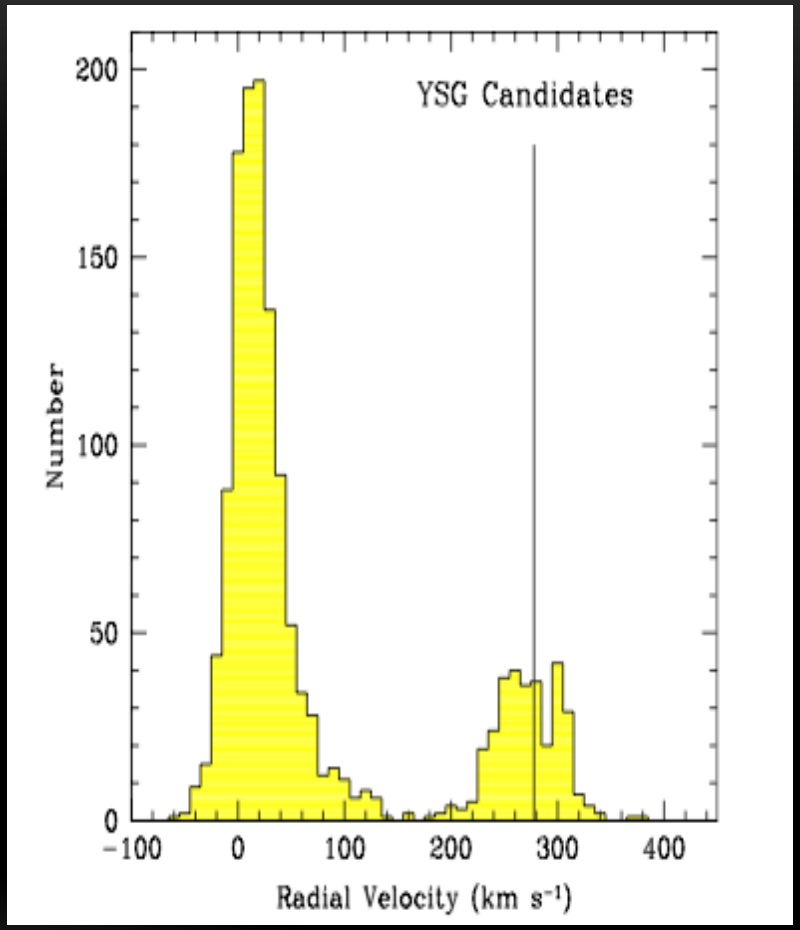

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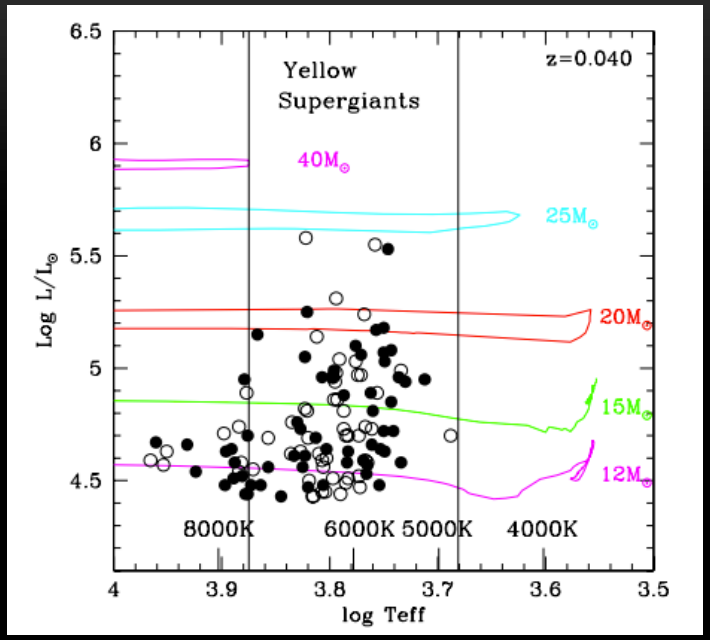

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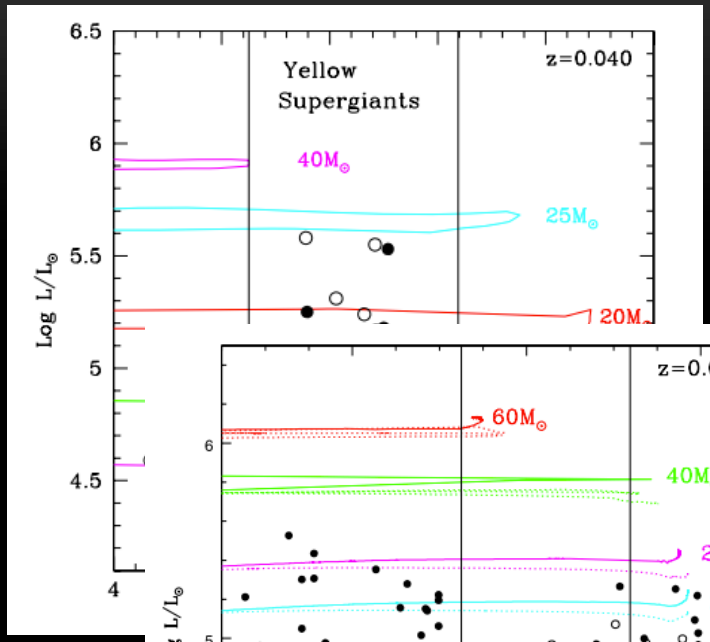

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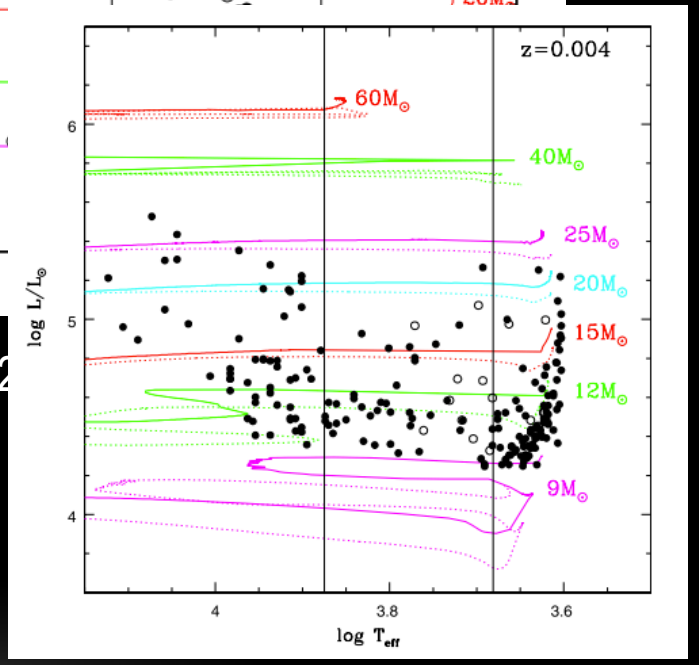

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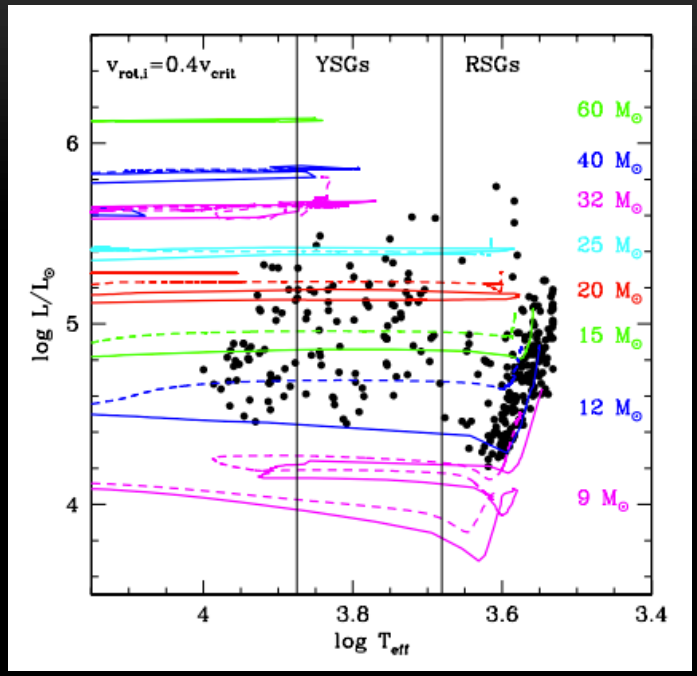

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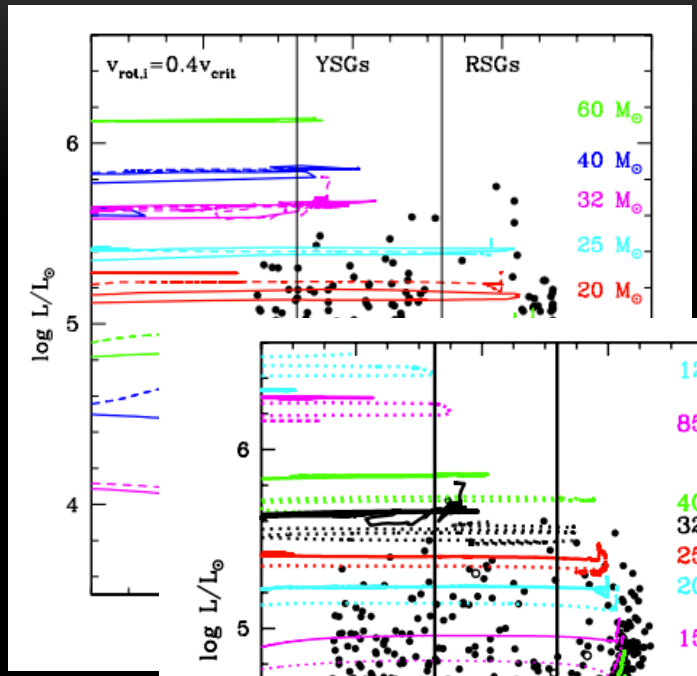

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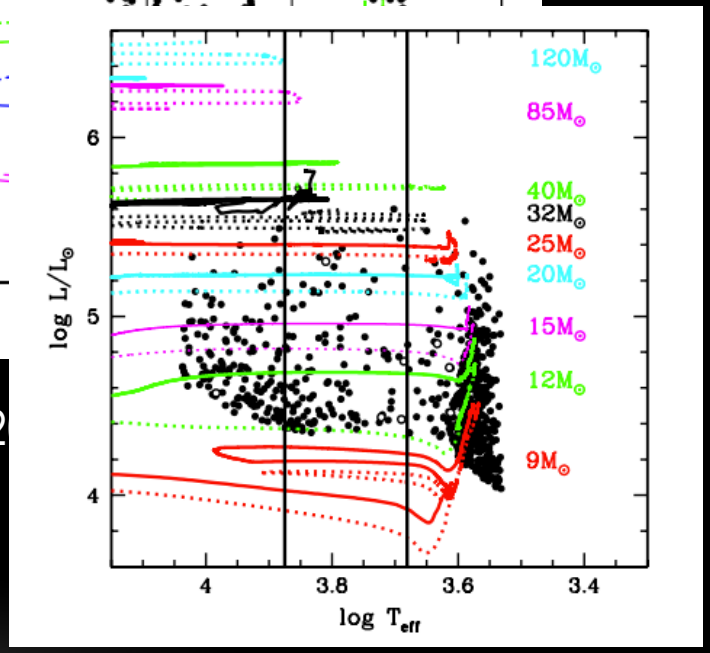

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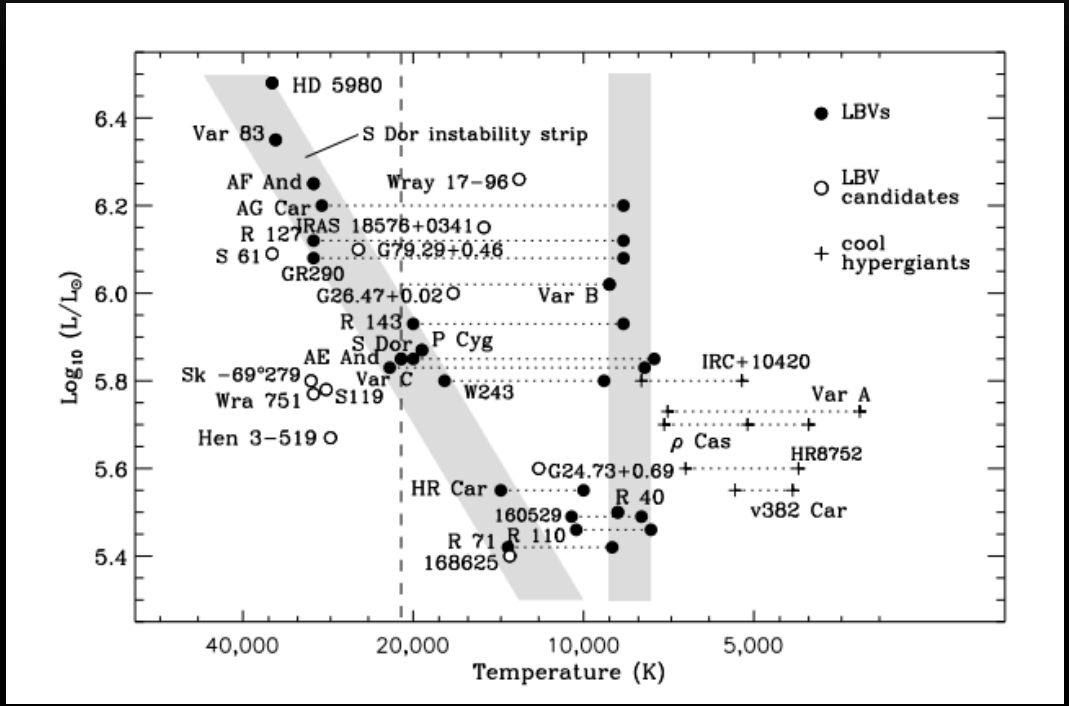
- Supernovae!



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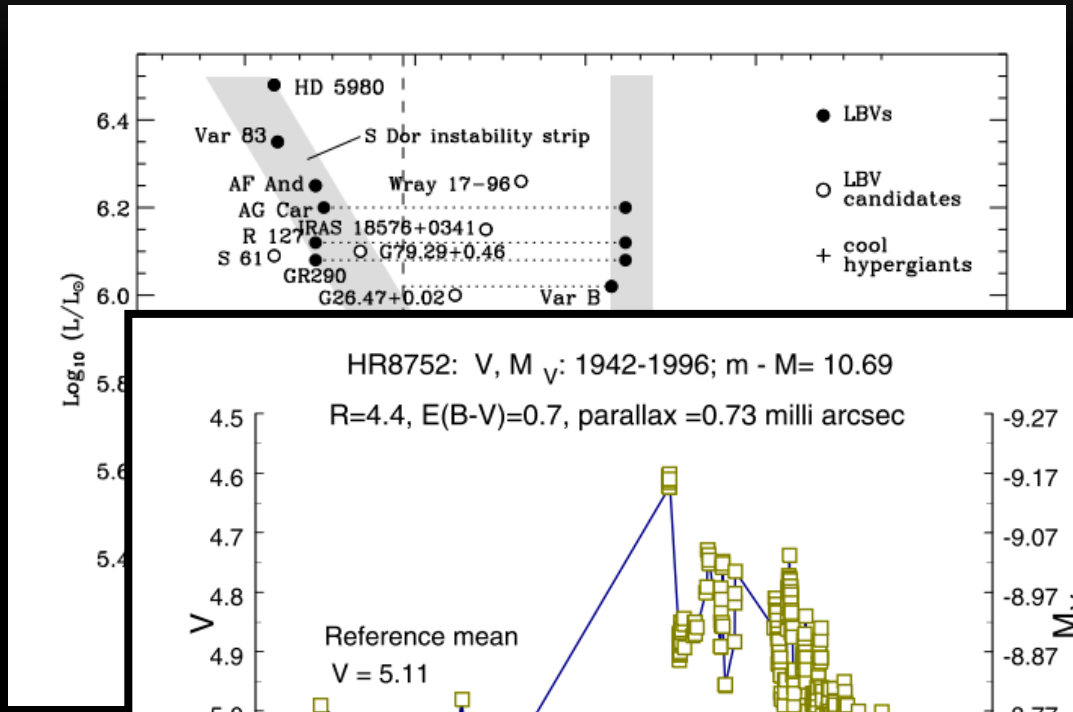

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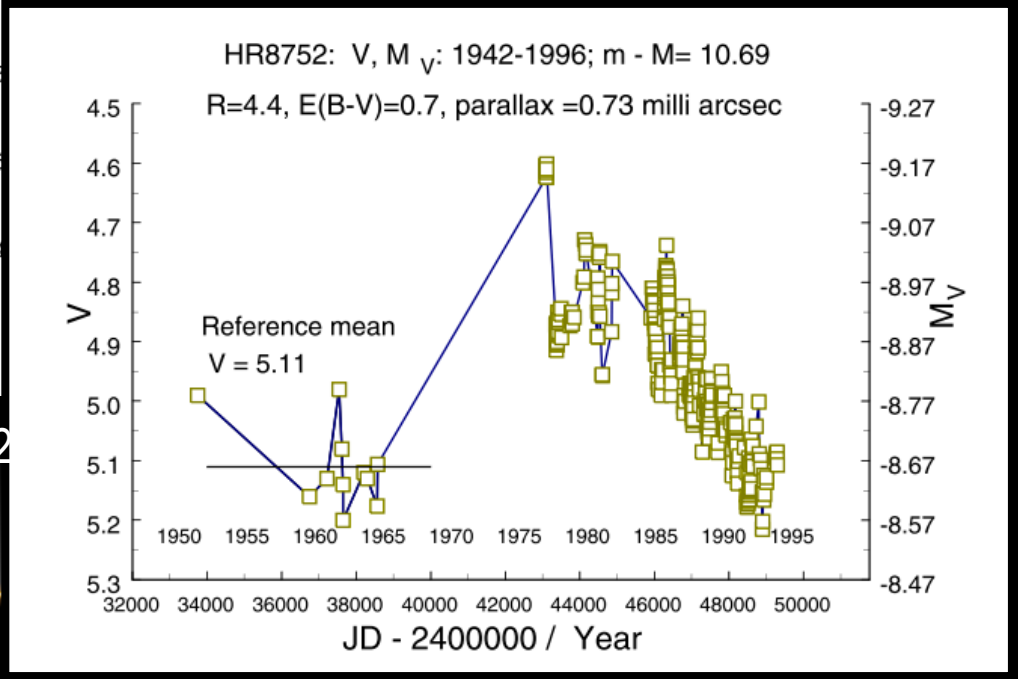

Nieuwenhuijzen et al 2012

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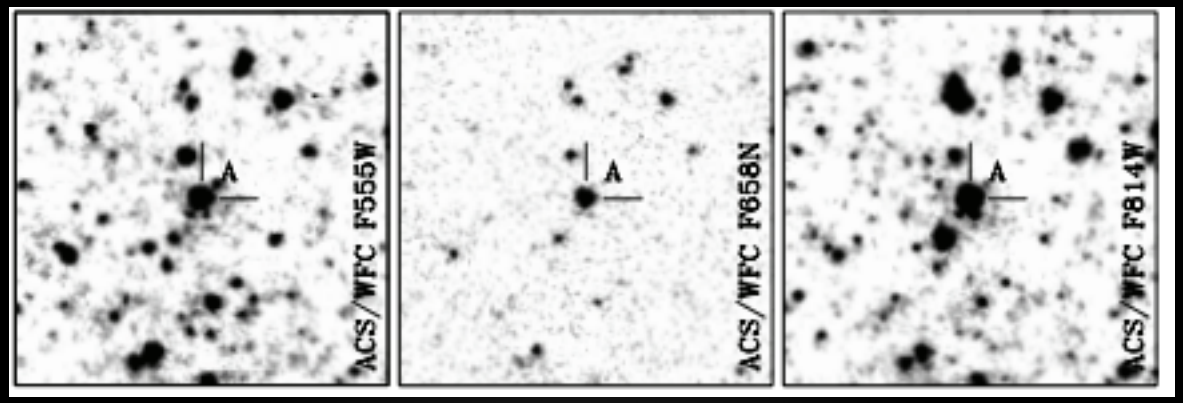

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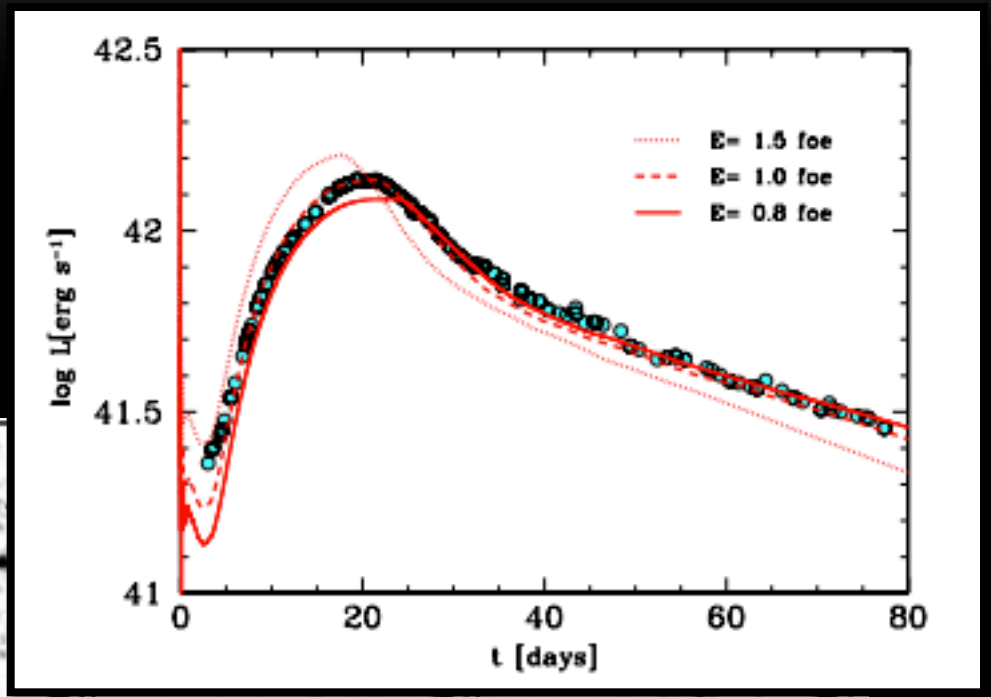

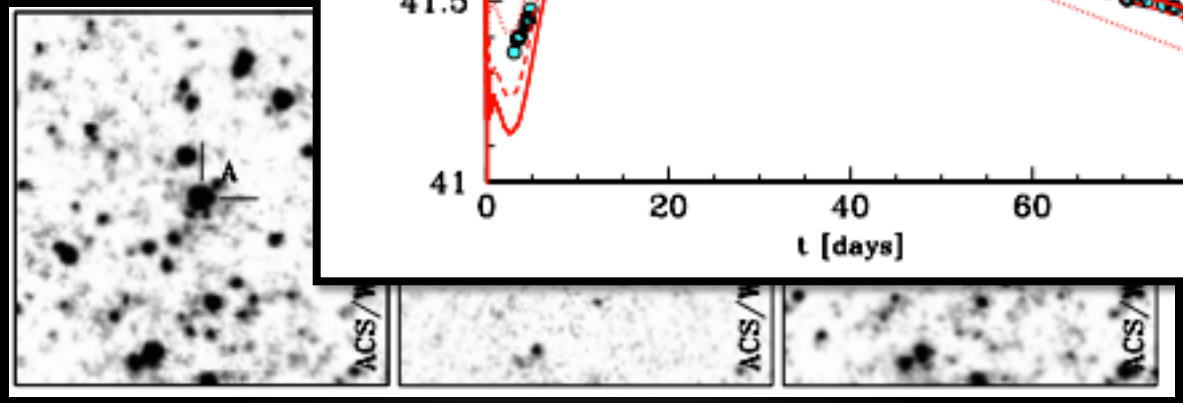

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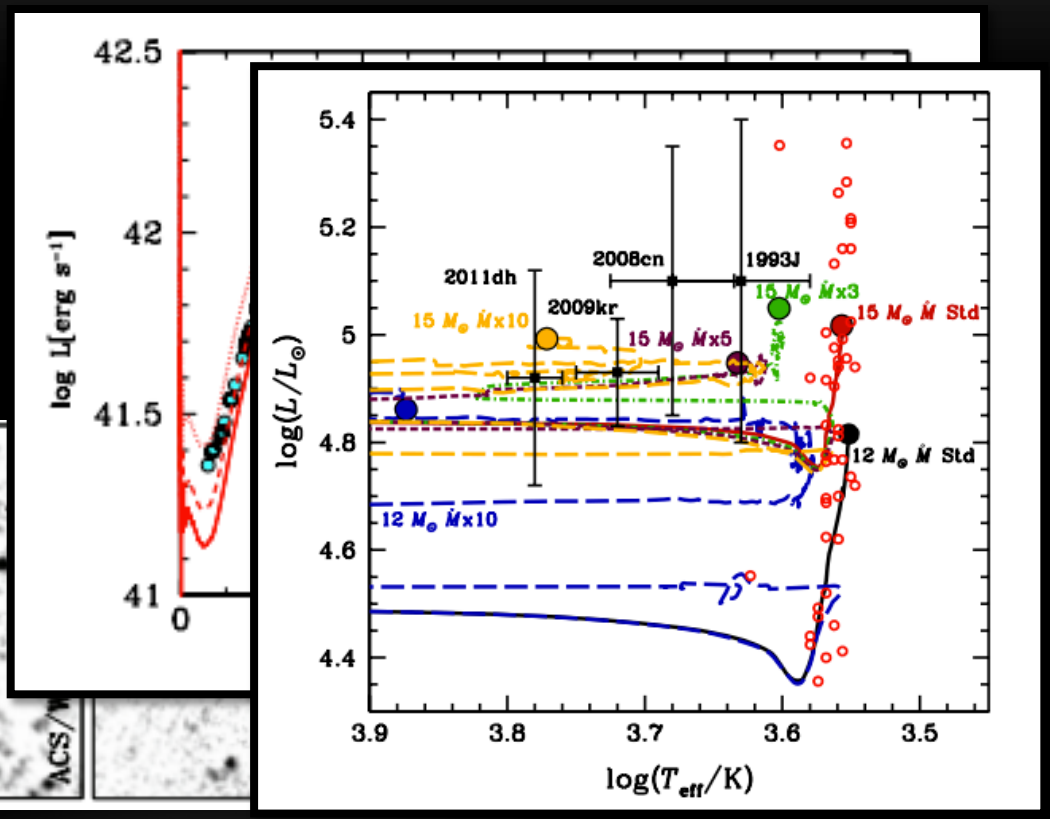

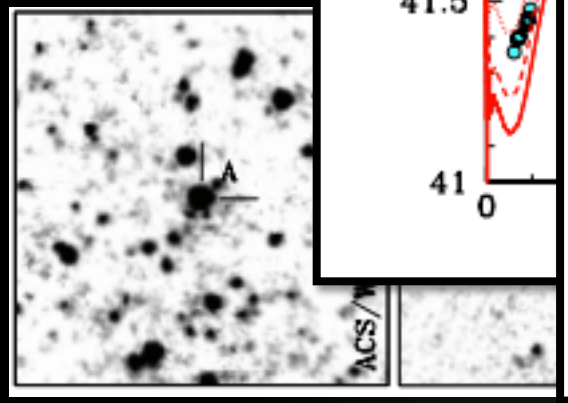

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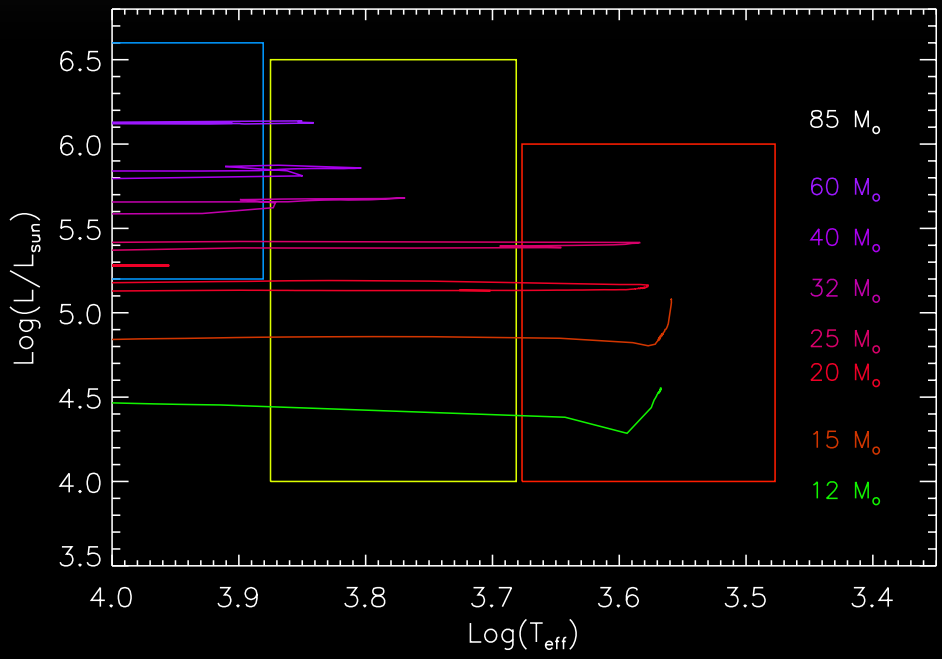

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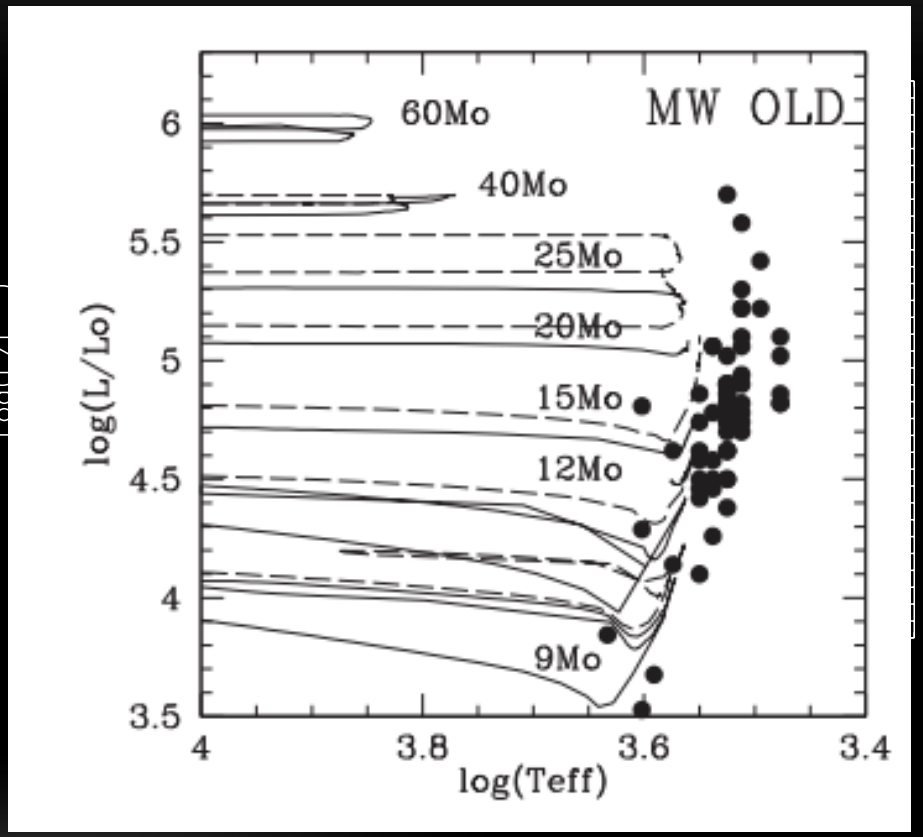

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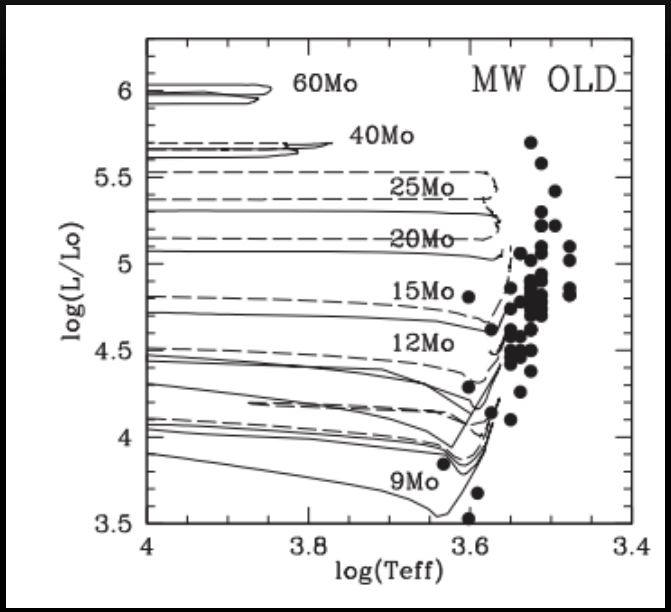

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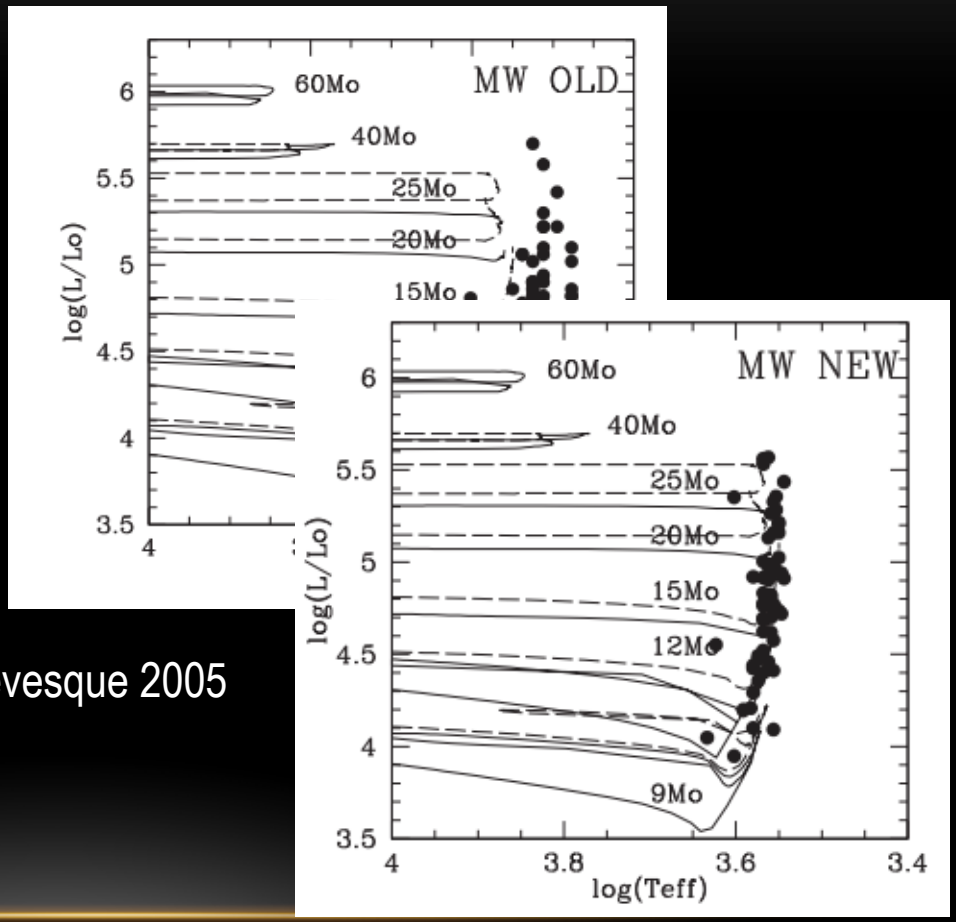
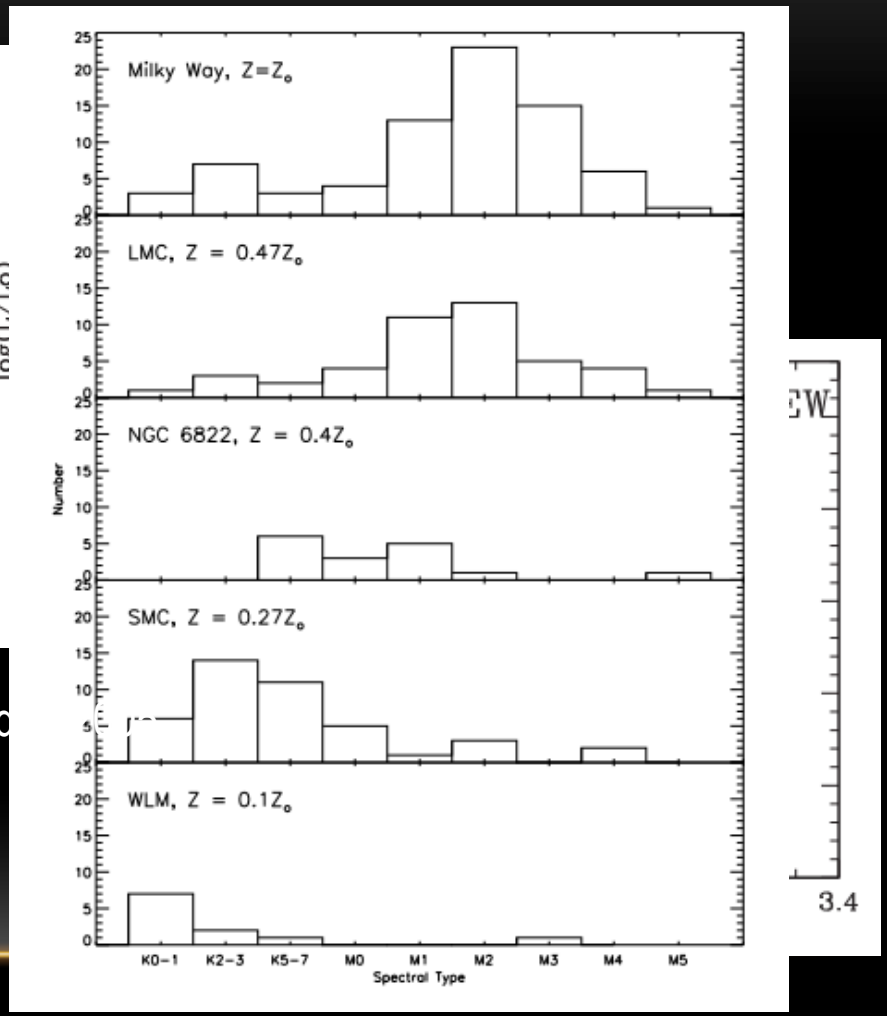


Levesque 2005

RED SUPERGIANTS: PRESENT

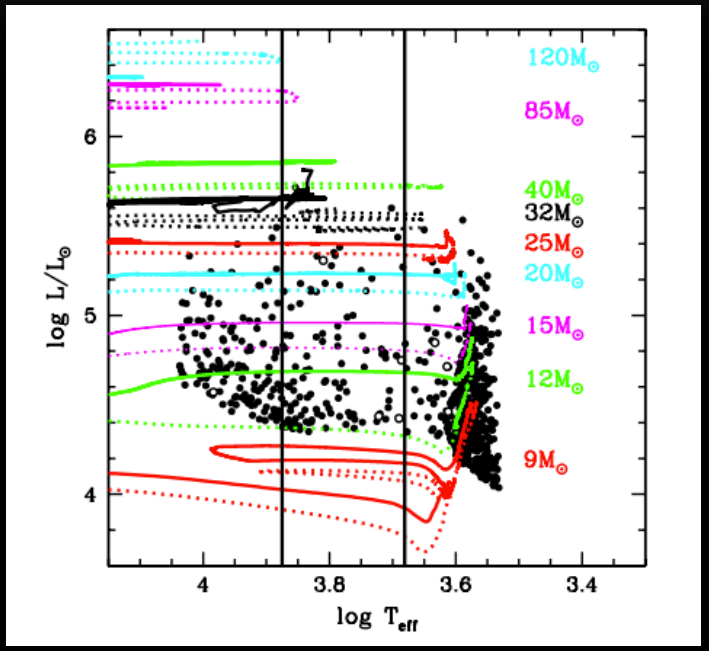
- Fault with observational transformation.
- Now have examined 6+ galaxies.
- Mean spectral type shifts with metallicity.
- Peak luminosity stays roughly constant (5.2-5.3)



Levesque 2013

RED SUPERGIANTS: FUTURE

- Complete Surveys
- Understanding Mass-Loss
- Unusual objects.
  - Dust Enshrouded (WO G64)
  - Variable (HV 11423)



Neugent 2012

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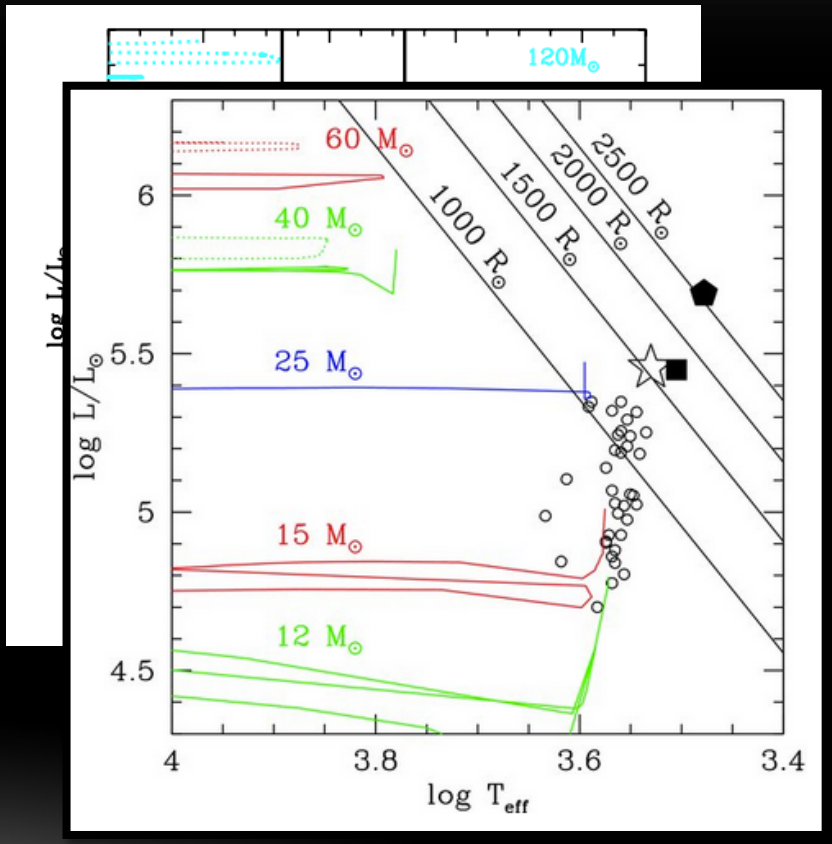
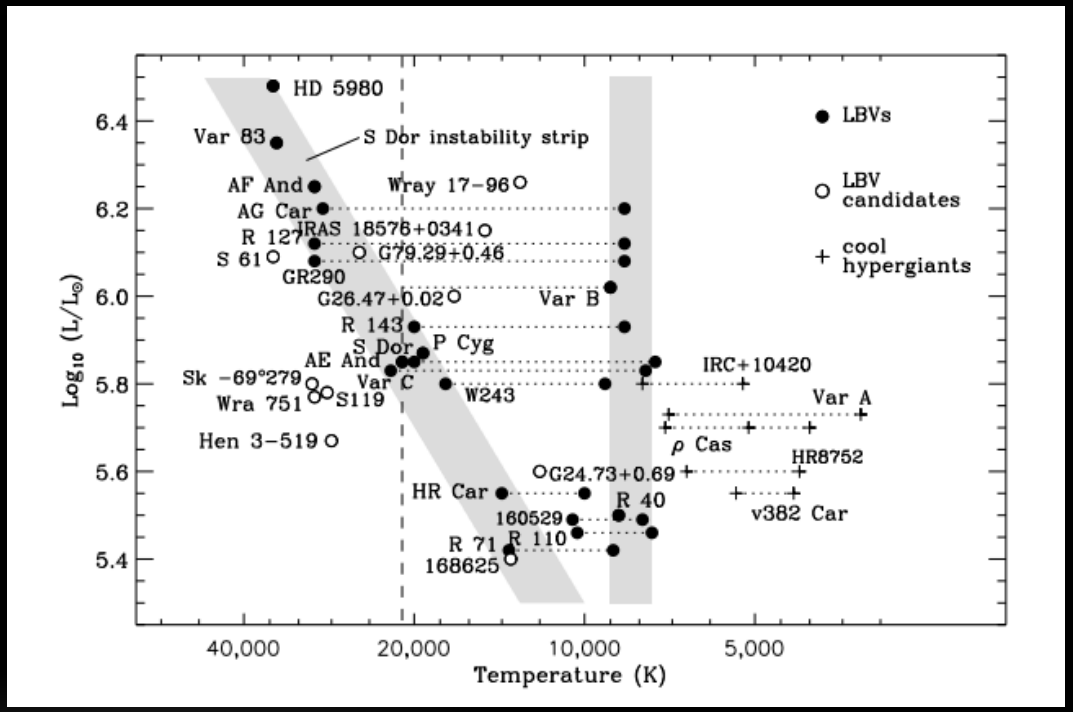


Levesque 2009

LUMINOUS BLUE VARIABLES: PAST

- "Hubble-Sandage" Variables
- Coined by Conti 1984
- Several dozen known in the local group
- Eta Car



Vink 2011

LUMINOUS BLUE VARIABLES: PRESENT/FUTURE

- Many candidates known
- “Quiescence” does not equal hot (Massey 2000)

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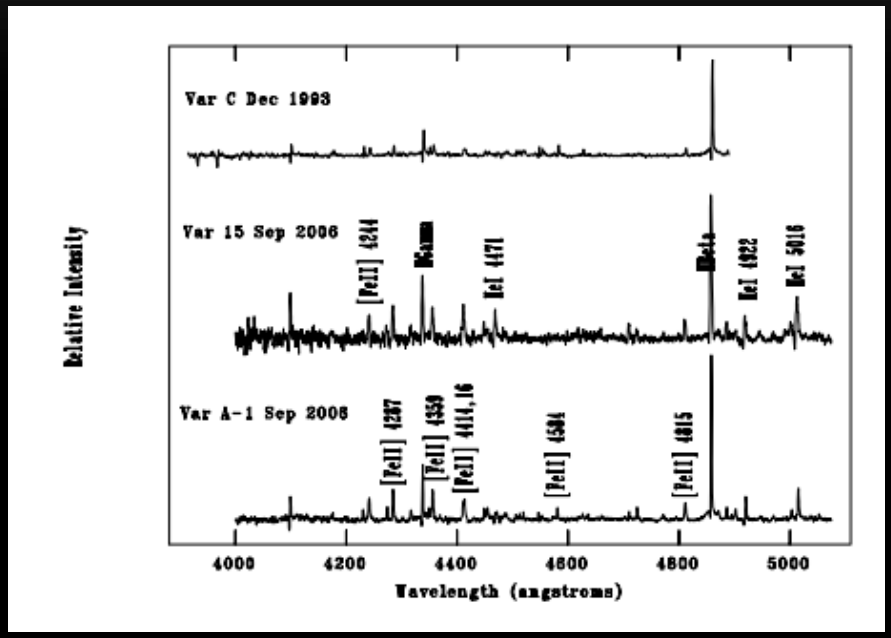

Massey et al. 2007

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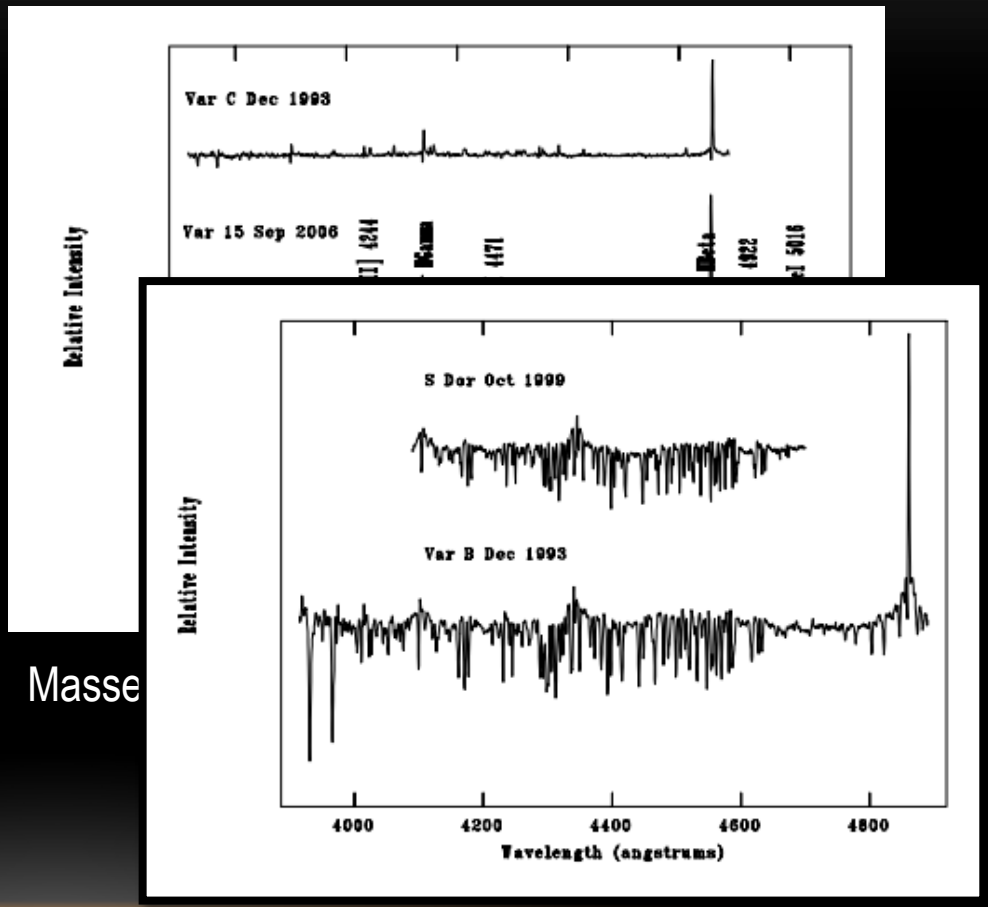

Masse

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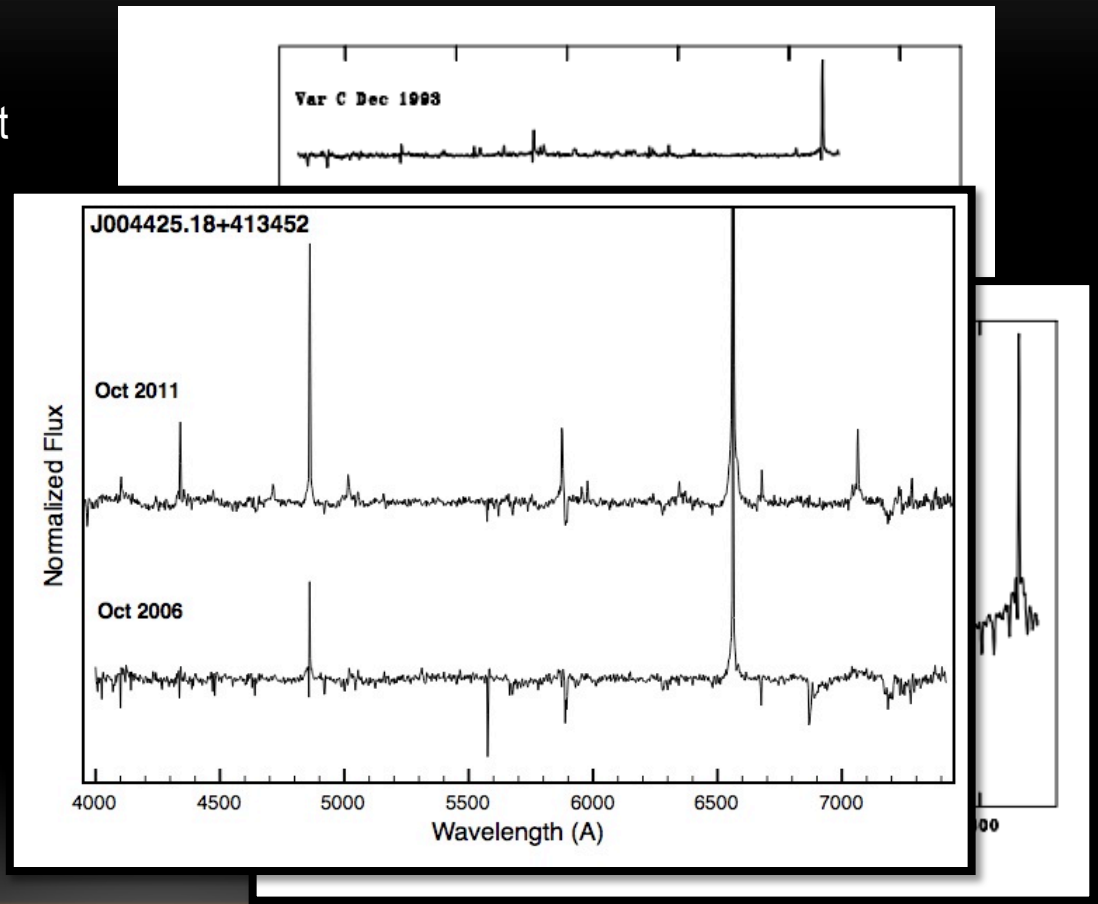
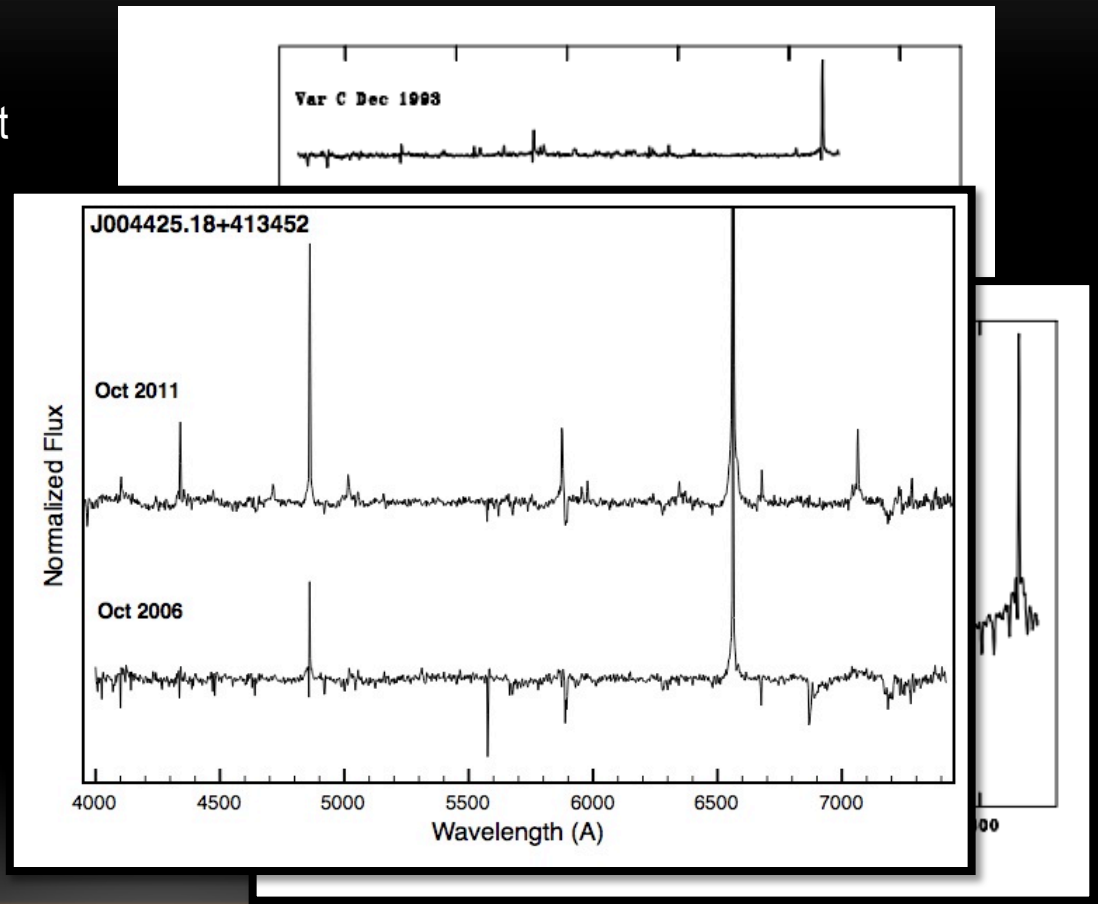


LUMINOUS BLUE VARIABLES: PRESENT/FUTURE

- Many candidates known
- “Quiescence” does not equal hot (Massey 2000)
- SN2009ip
- Binarity?



WOLF RAYETS: PAST

- Westerlund & Rodger 1959: 50 WR stars in LMC
- Ratio of WC/WN type should change with metallicity.
- WN are harder to find
- Discrepancy at large metallicities.

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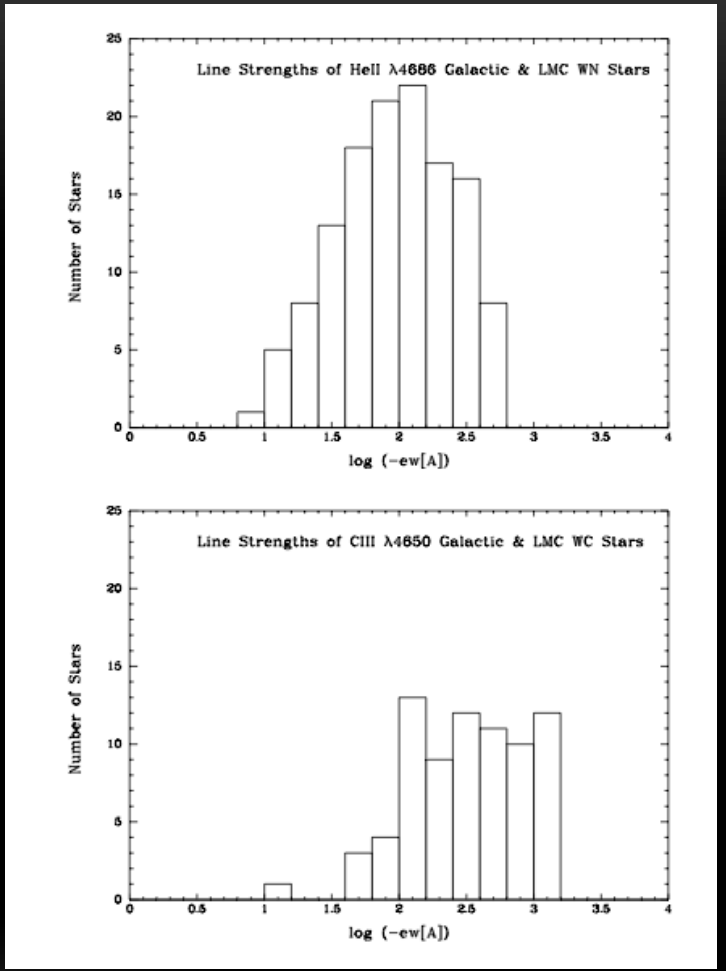

Massey & Johnson 1998

WOLF RAYETS: PRESENT/FUTURE

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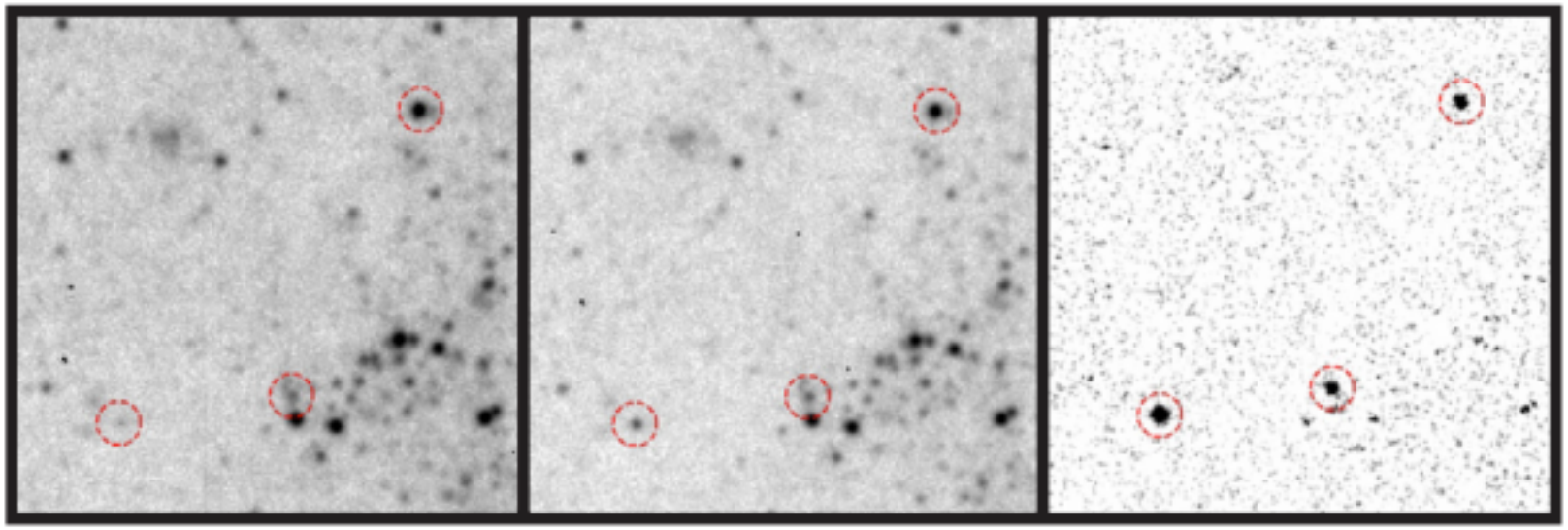

Neugent 2011

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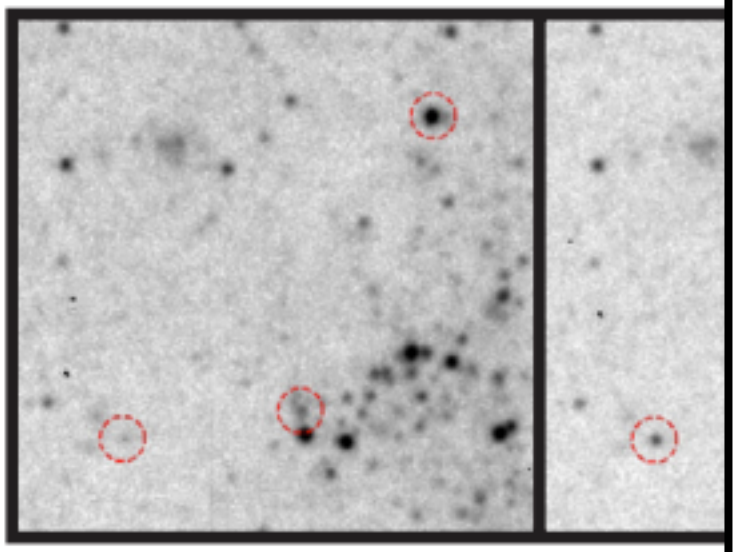
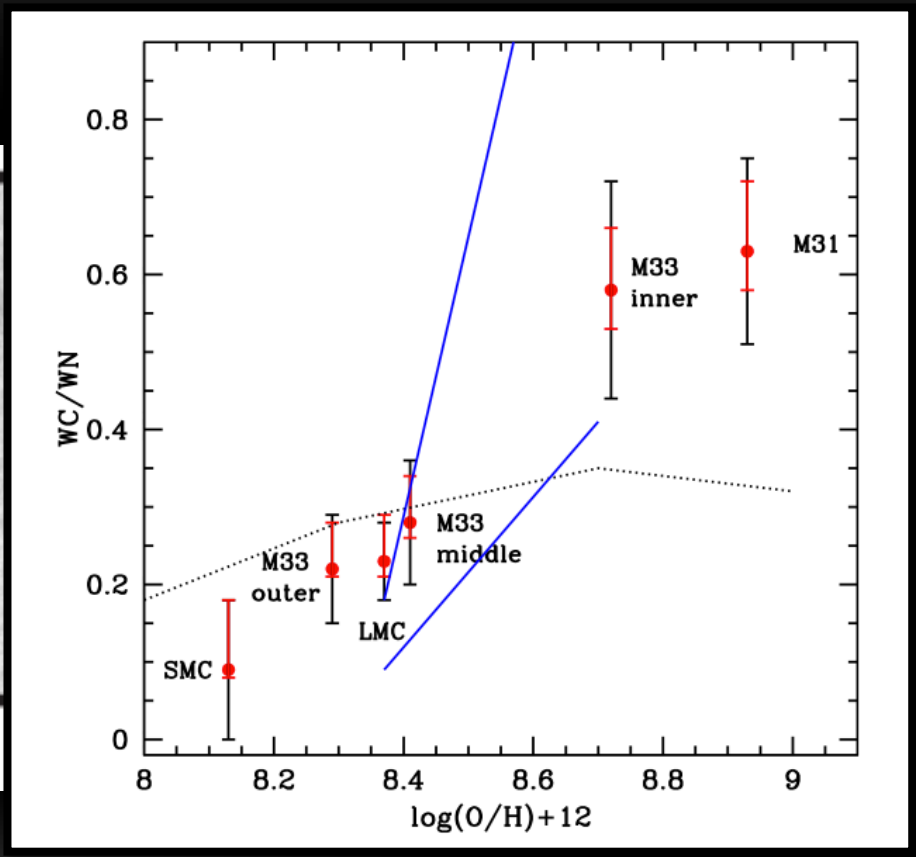


Neugent 2011



Neugent 2012

CONCLUSIONS

- Huge steps have been made in terms of characterizing the massive star populations across the local group galaxies.
- Still plenty of fun to be had.

THANK YOU