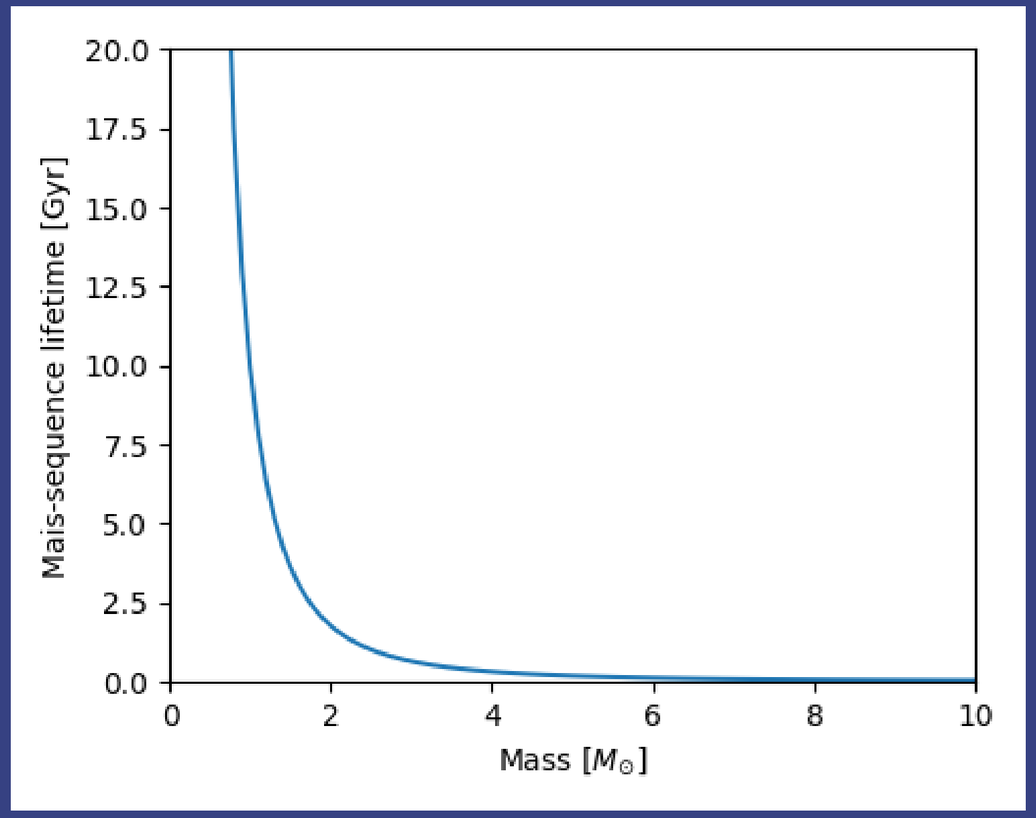
Investigating the origin of the lowest-mass white dwarfs

Gabriela Oliveira da Rosa
Supervisor: Dr Ingrid Pelisoli

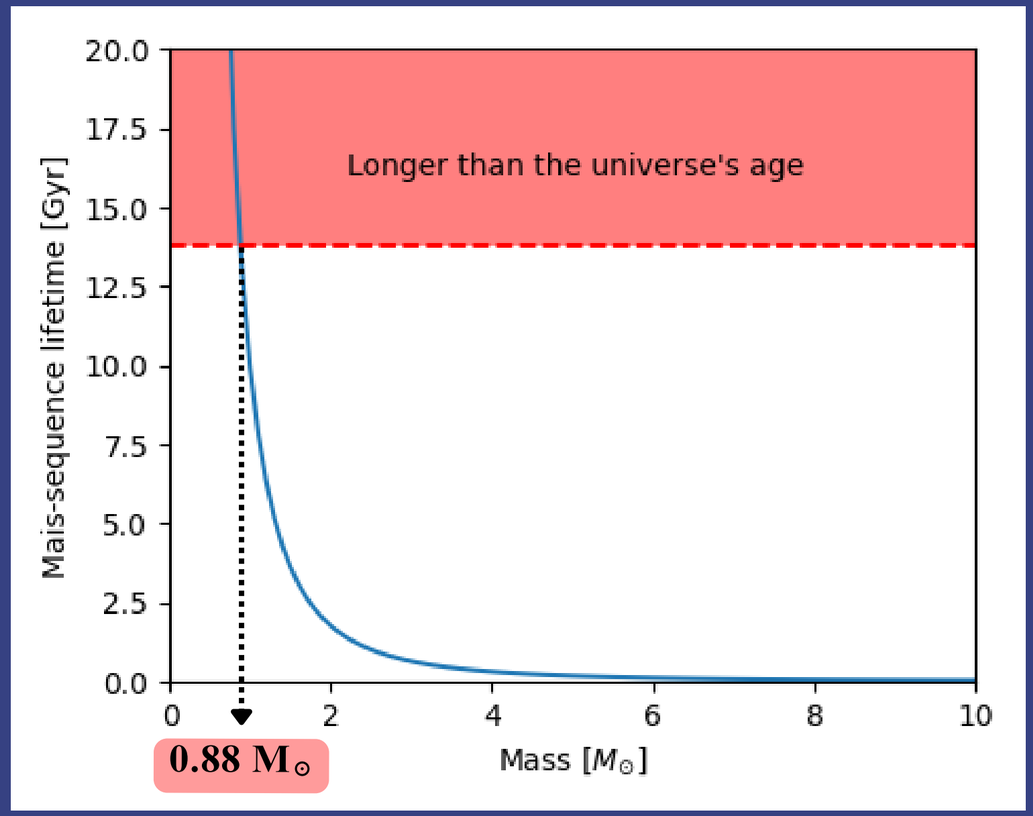
WARWICK
THE UNIVERSITY OF WARWICK

WDbin

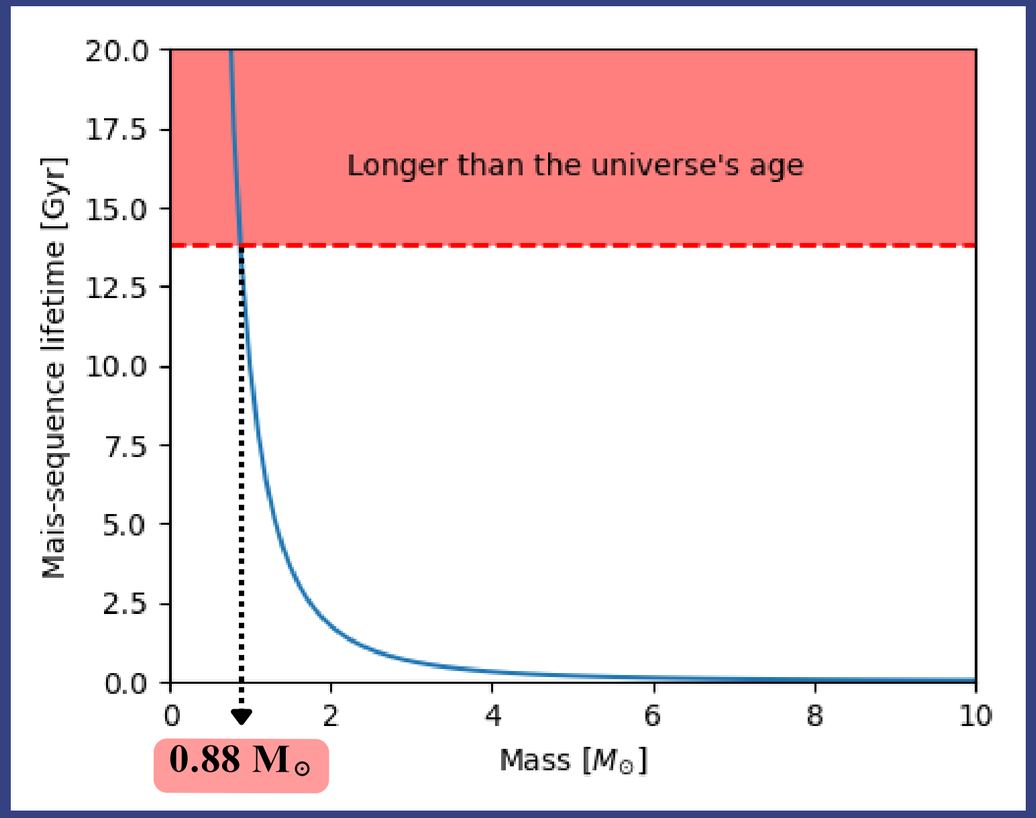
Single-evolution White dwarfs



Single-evolution White dwarfs

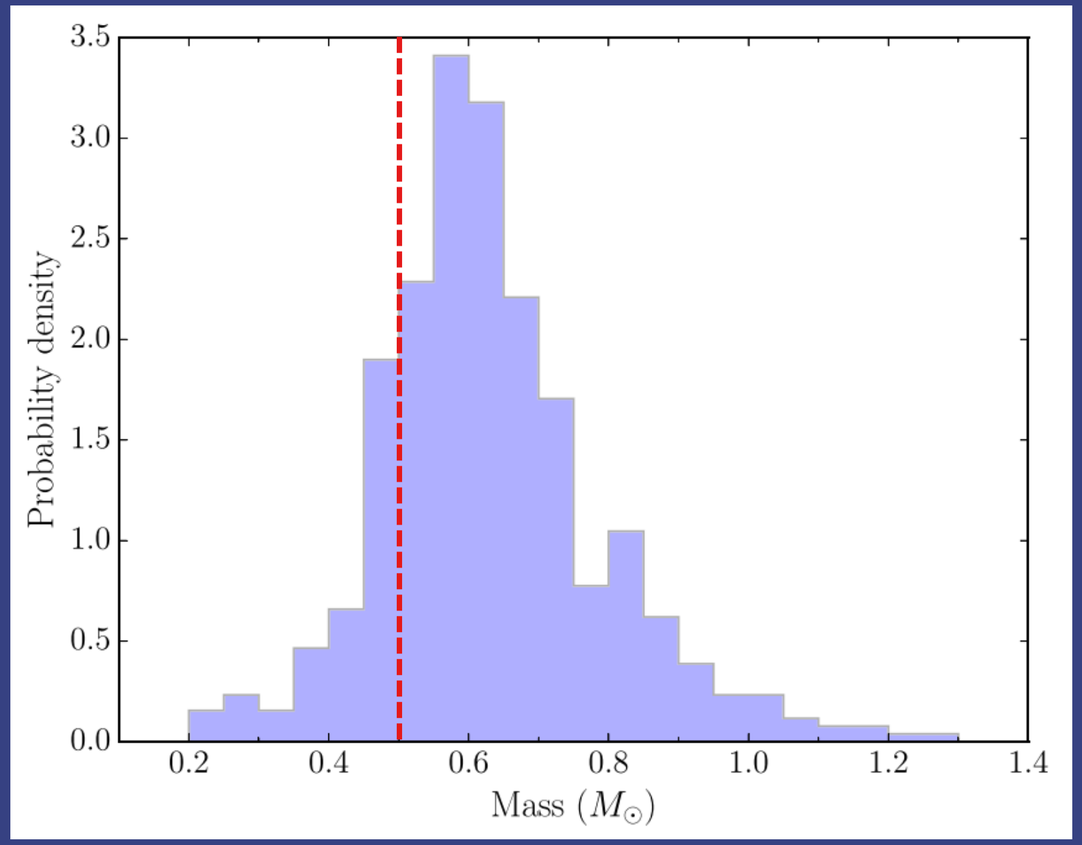


Single-evolution White dwarfs



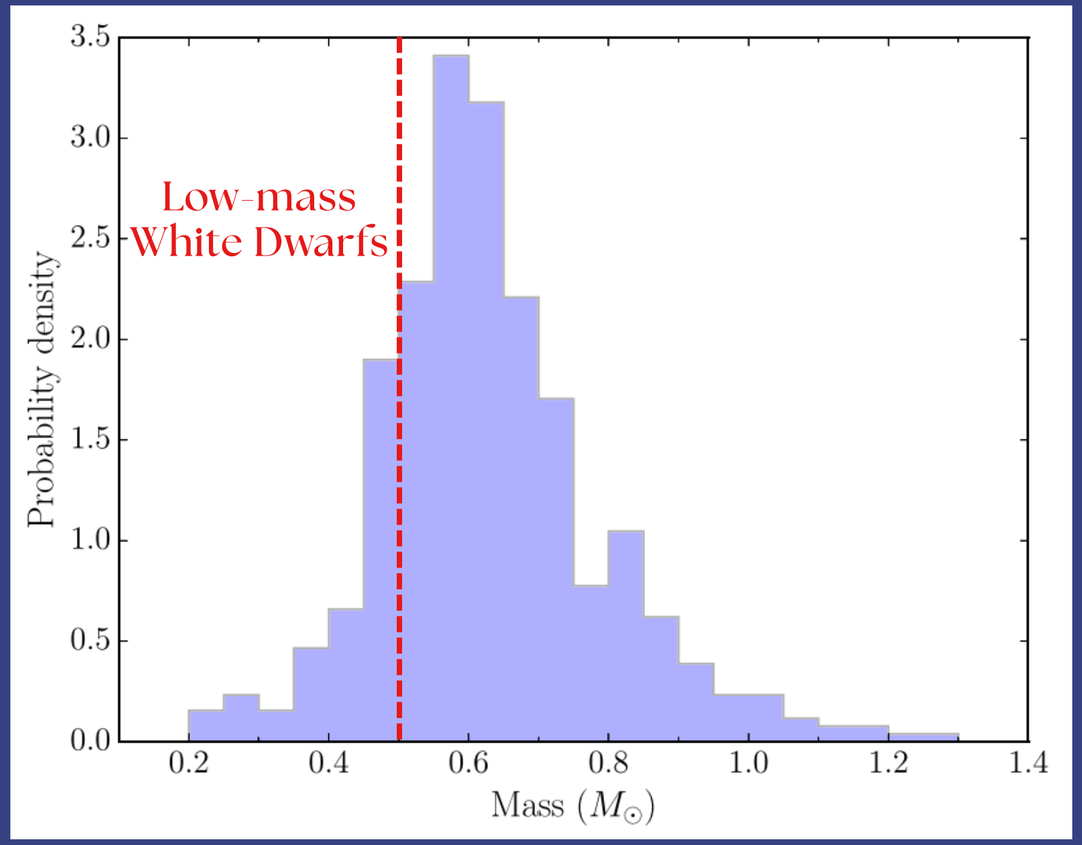
0.88 M⊙ ⇢ (Cummings et al., 2018) ⇢ **0.5 M⊙**

White Dwarf's mass distribution



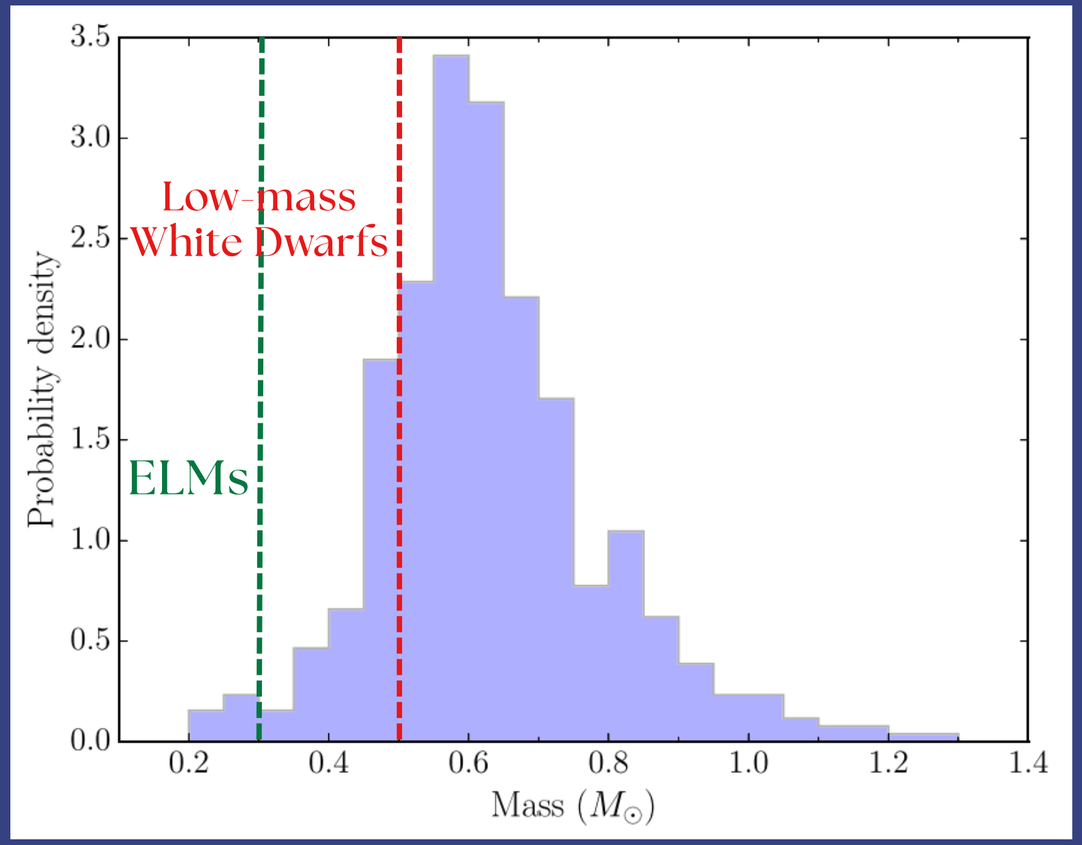
Didier Saumon et al. Current challenges in the physics of white dwarf stars. Physics Reports, 2022.

White Dwarf's mass distribution



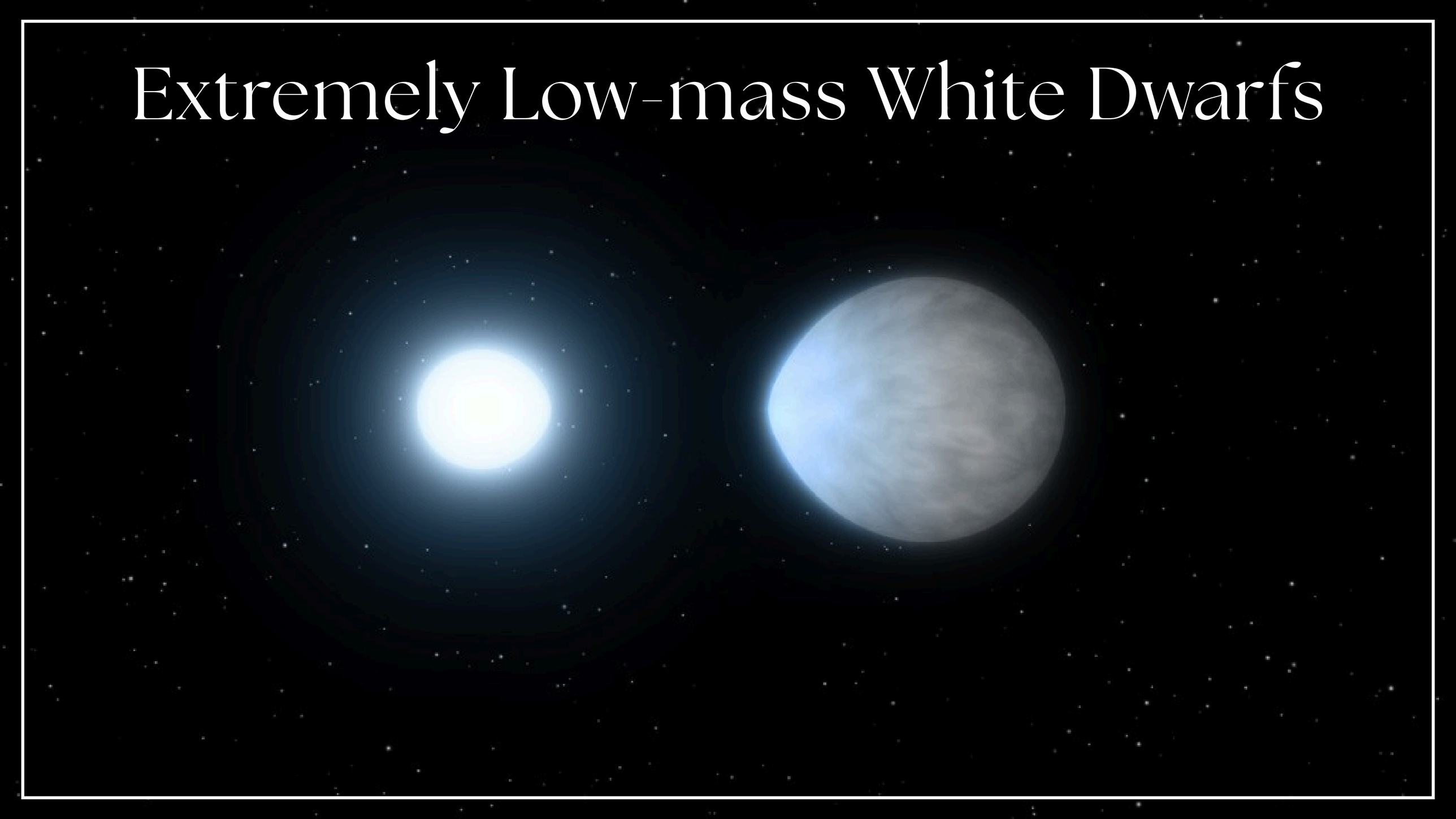
Didier Saumon et al. Current challenges in the physics of white dwarf stars. Physics Reports, 2022.

White Dwarf's mass distribution



Didier Saumon et al. Current challenges in the physics of white dwarf stars. Physics Reports, 2022.

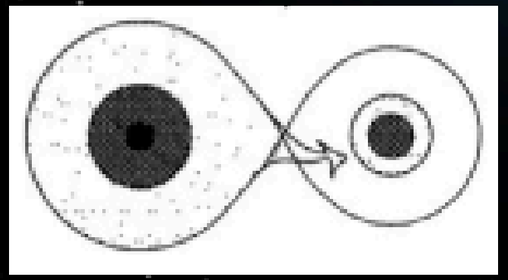
Extremely Low-mass White Dwarfs



Extremely Low-mass White Dwarfs

Extremely Low-mass White Dwarfs

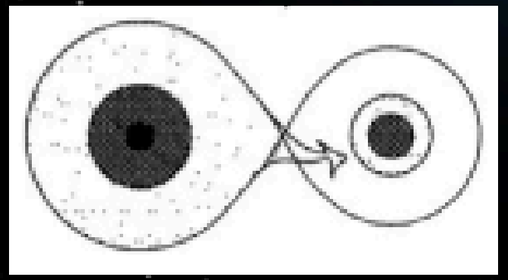
RL channel



Mass transfer

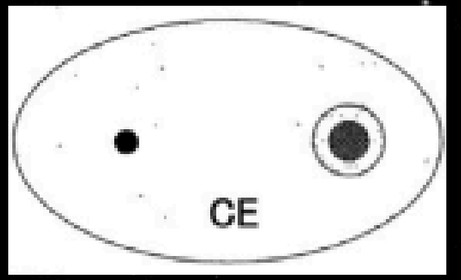
Extremely Low-mass White Dwarfs

RL channel

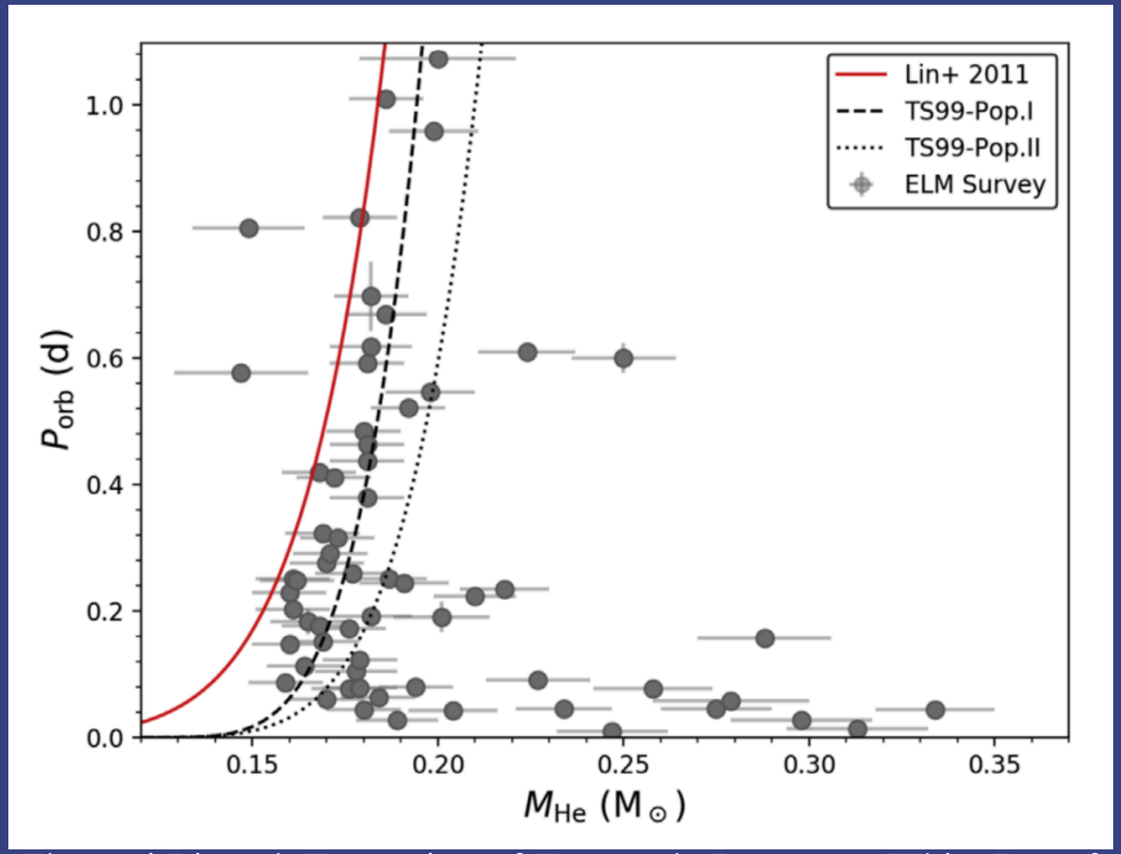


Mass transfer

CE channel



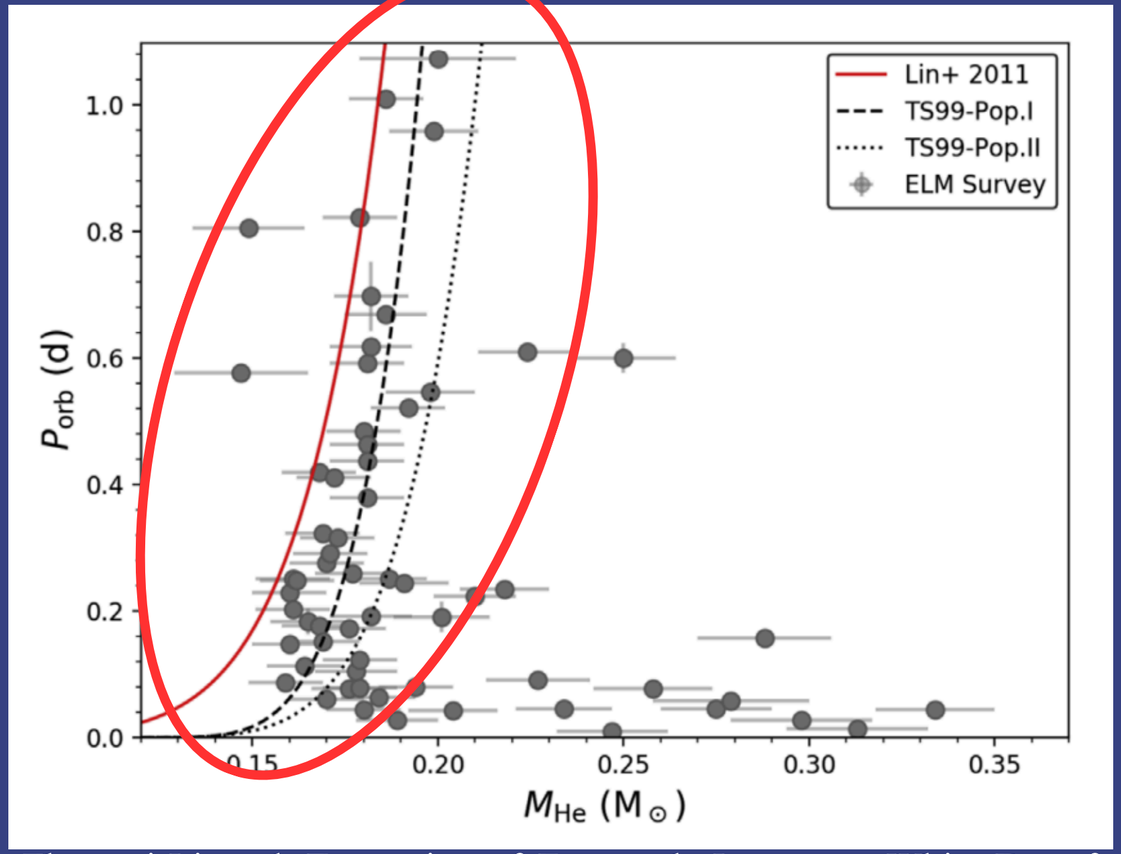
ELM's formation channels



Zhenwei Li et al. Formation of Extremely Low-mass White Dwarfs in Double Degenerates. Apj, 2019.

ELM's formation channels

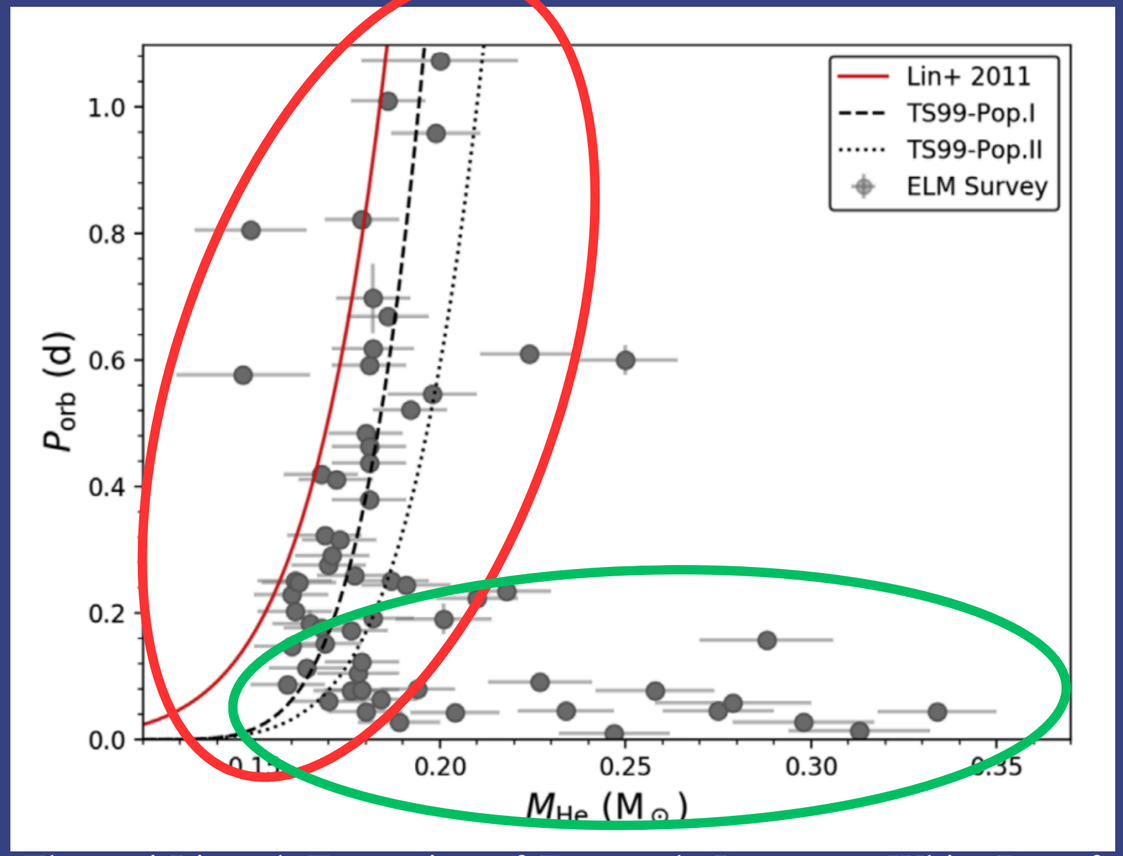
RL channel



Zhenwei Li et al. Formation of Extremely Low-mass White Dwarfs in Double Degenerates. Apj, 2019.

ELM's formation channels

RL channel

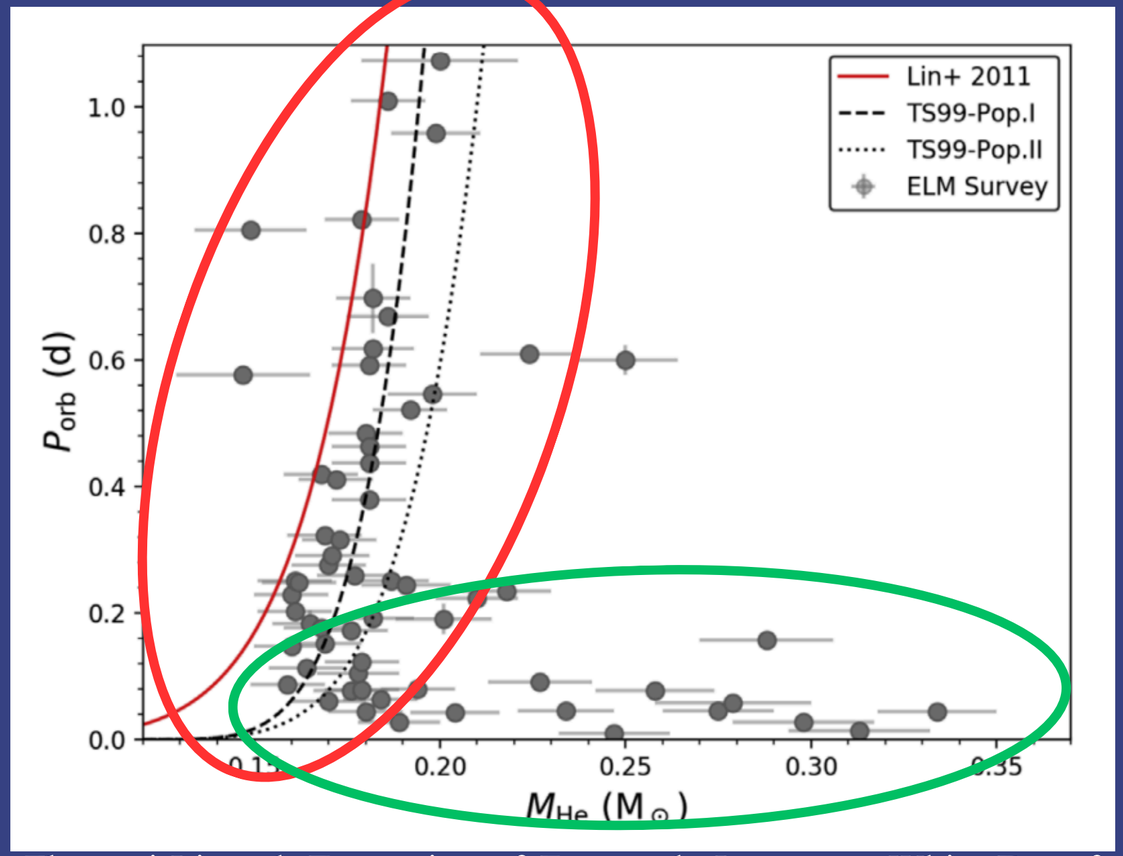


Zhenwei Li et al. Formation of Extremely Low-mass White Dwarfs in Double Degenerates. Apj, 2019.

CE channel

ELM's formation channels

RL channel



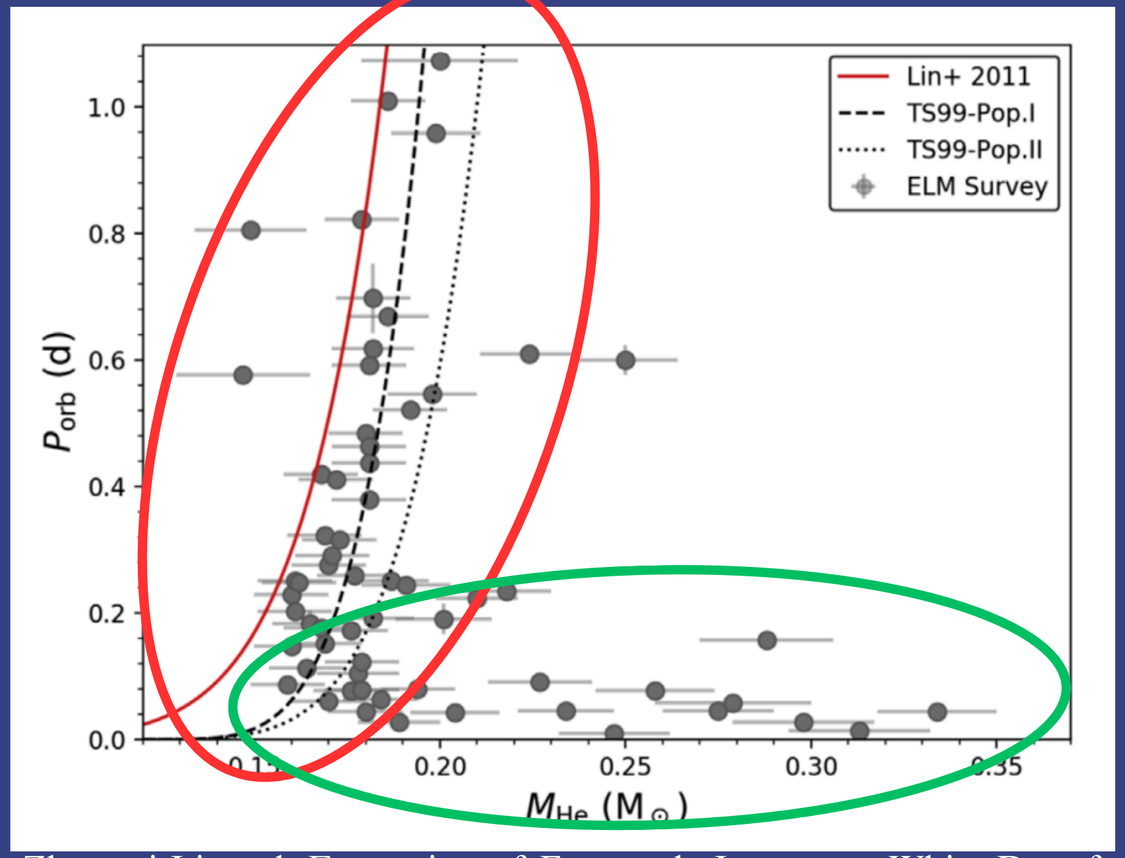
Zhenwei Li et al. Formation of Extremely Low-mass White Dwarfs in Double Degenerates. Apj, 2019.

CE channel

ELM survey

ELM's formation channels

RL channel



Zhenwei Li et al. Formation of Extremely Low-mass White Dwarfs in Double Degenerates. Apj, 2019.

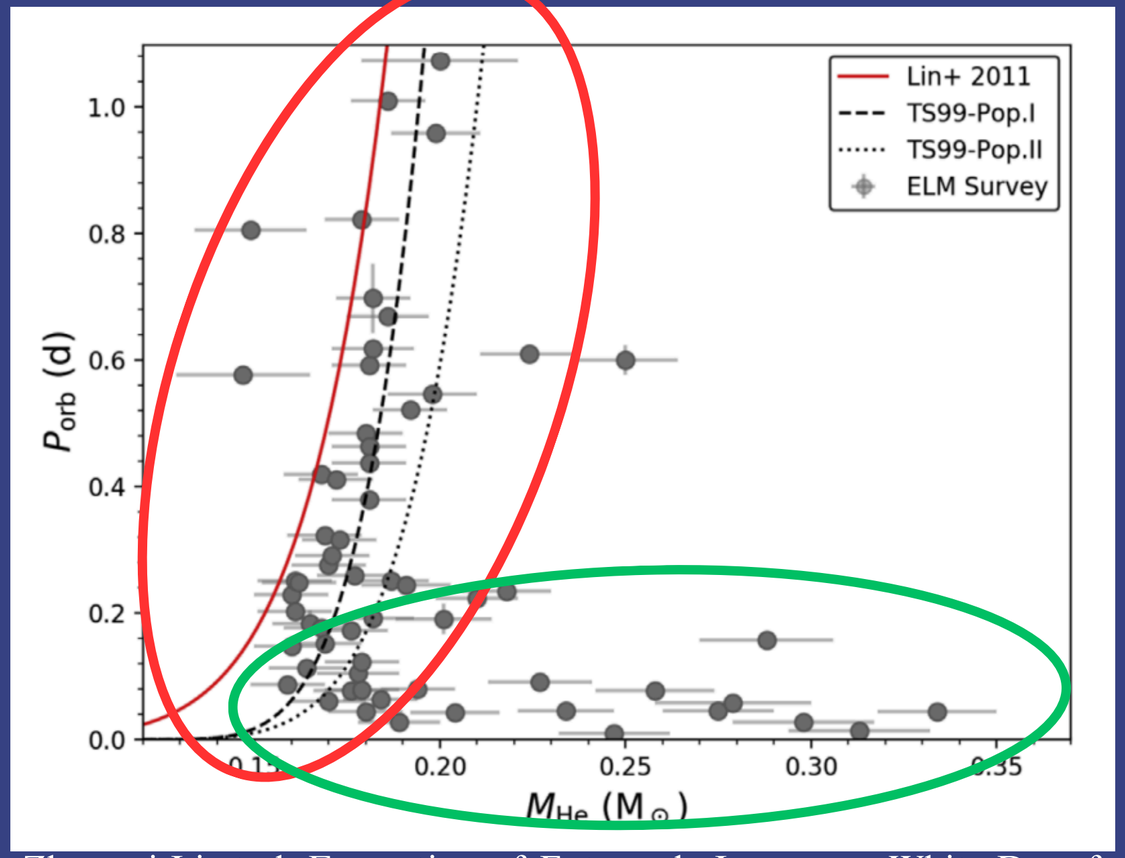
CE channel

ELM survey

- SDSS

ELM's formation channels

RL channel



Zhenwei Li et al. Formation of Extremely Low-mass White Dwarfs in Double Degenerates. Apj, 2019.

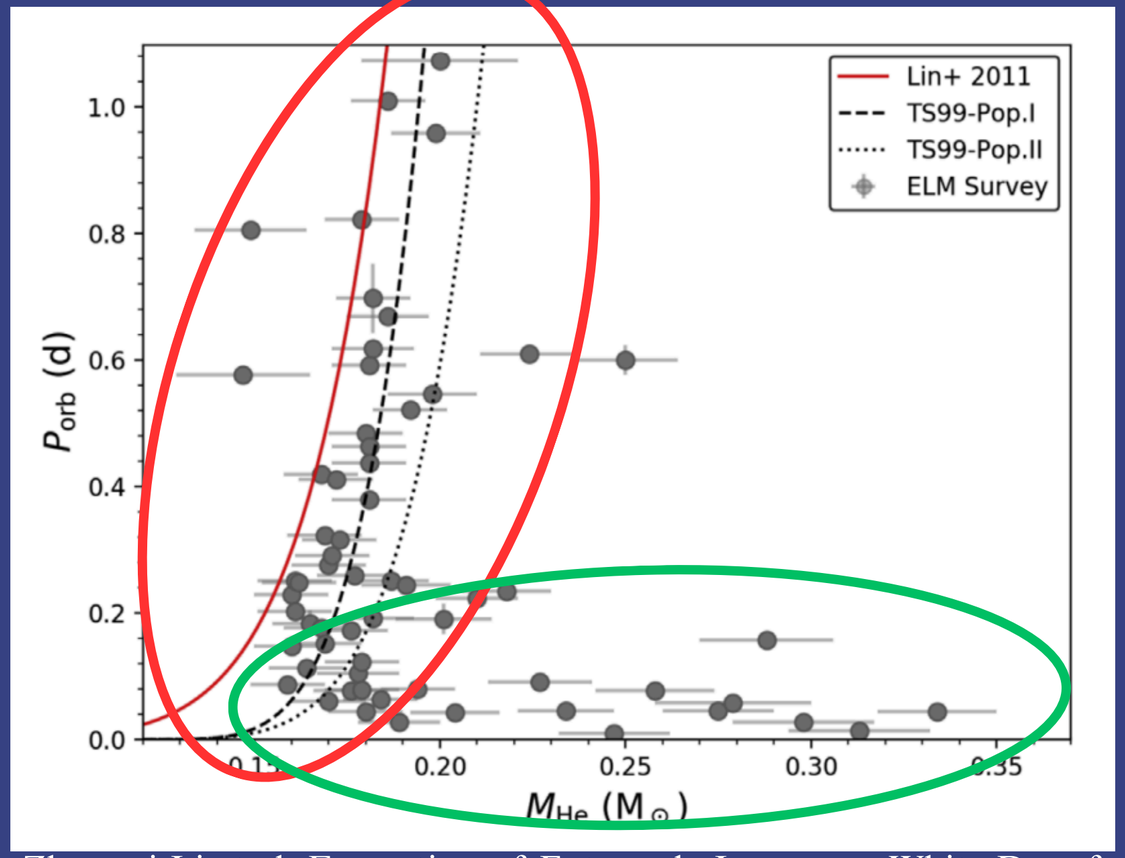
CE channel

ELM survey

- SDSS
- 139 ELMs

ELM's formation channels

RL channel



Zhenwei Li et al. Formation of Extremely Low-mass White Dwarfs in Double Degenerates. Apj, 2019.

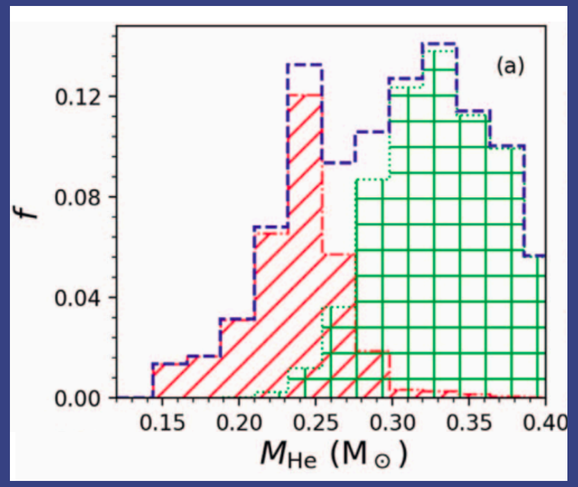
CE channel

ELM survey

- SDSS
- 139 ELMs
- biases.....

Formation of ELMs in Double Degenerates
Zhenwei Li et al.

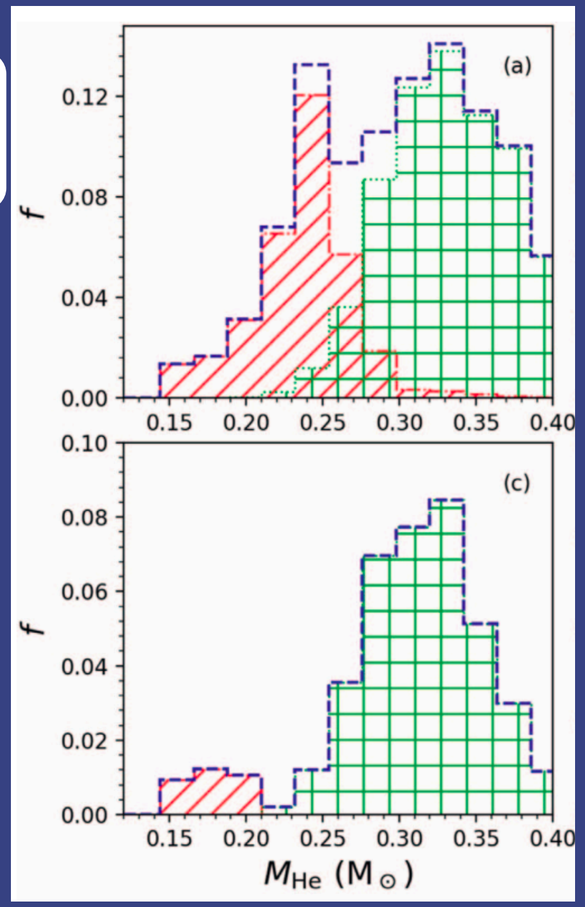
ELM survey



Zhenwei Li et al. Formation of Extremely Low-mass White Dwarfs in Double Degenerates. Apj, 2019.

ELM survey

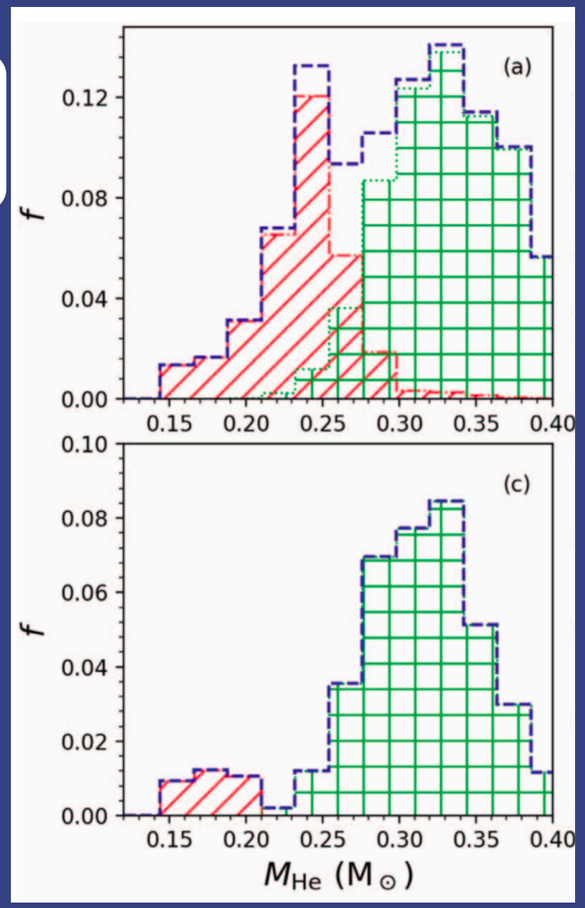
P_{orb} < 2 days
k > 75 km/s



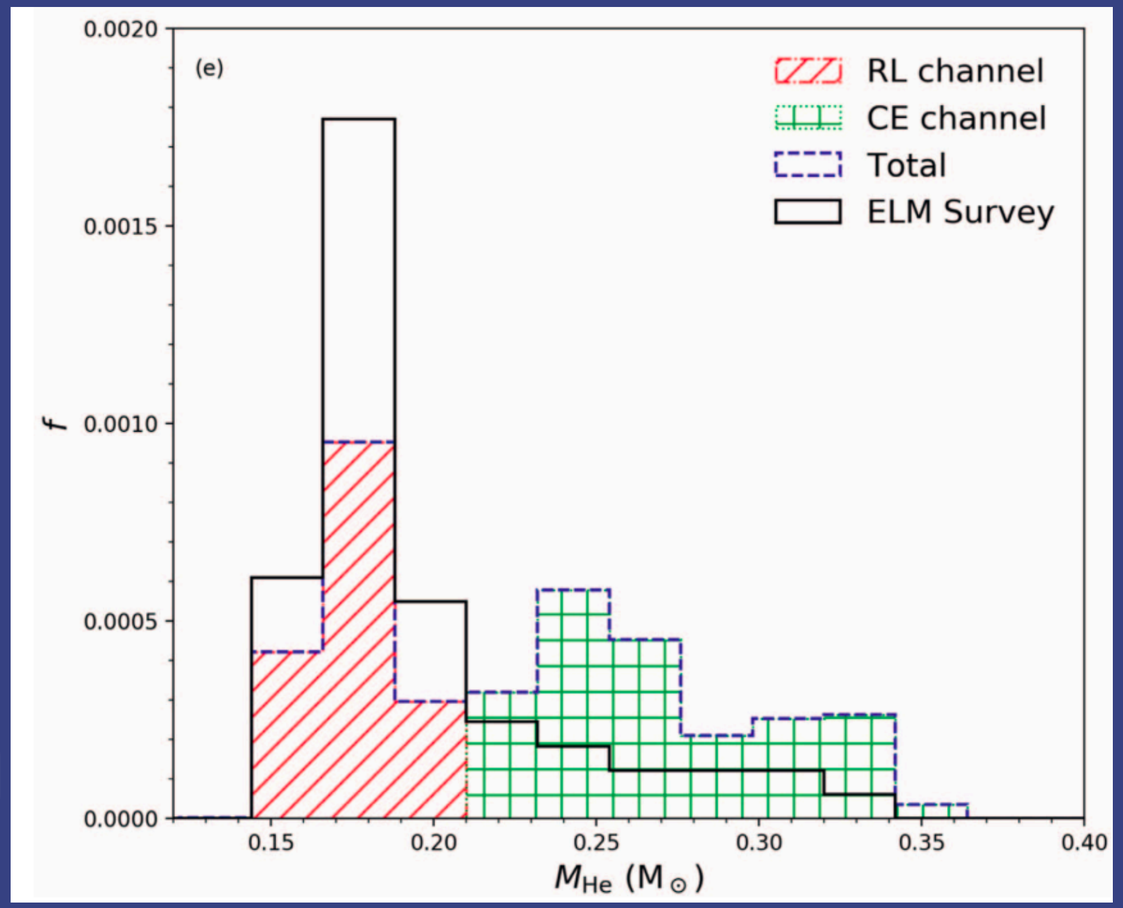
Zhenwei Li et al. Formation of Extremely Low-mass White Dwarfs in Double Degenerates. Apj, 2019.

ELM survey

P_{orb} < 2 days
k > 75 km/s



15 < g < 20



Zhenwei Li et al. Formation of Extremely Low-mass White Dwarfs in Double Degenerates. Apj, 2019.

Towards an all-sky volume-limited sample

ELM survey

- Mainly northern sky
- magnitude-limited

- Period selection

Our goals

Towards an all-sky volume-limited sample

ELM survey

- Mainly northern sky
- magnitude-limited

- Period selection

Our goals

- All-sky

Towards an all-sky volume-limited sample

ELM survey

- Mainly northern sky
- magnitude-limited

- Period selection

Our goals

- All-sky

- Volume-limited

Towards an all-sky volume-limited sample

ELM survey

- Mainly northern sky
- magnitude-limited
- Period selection

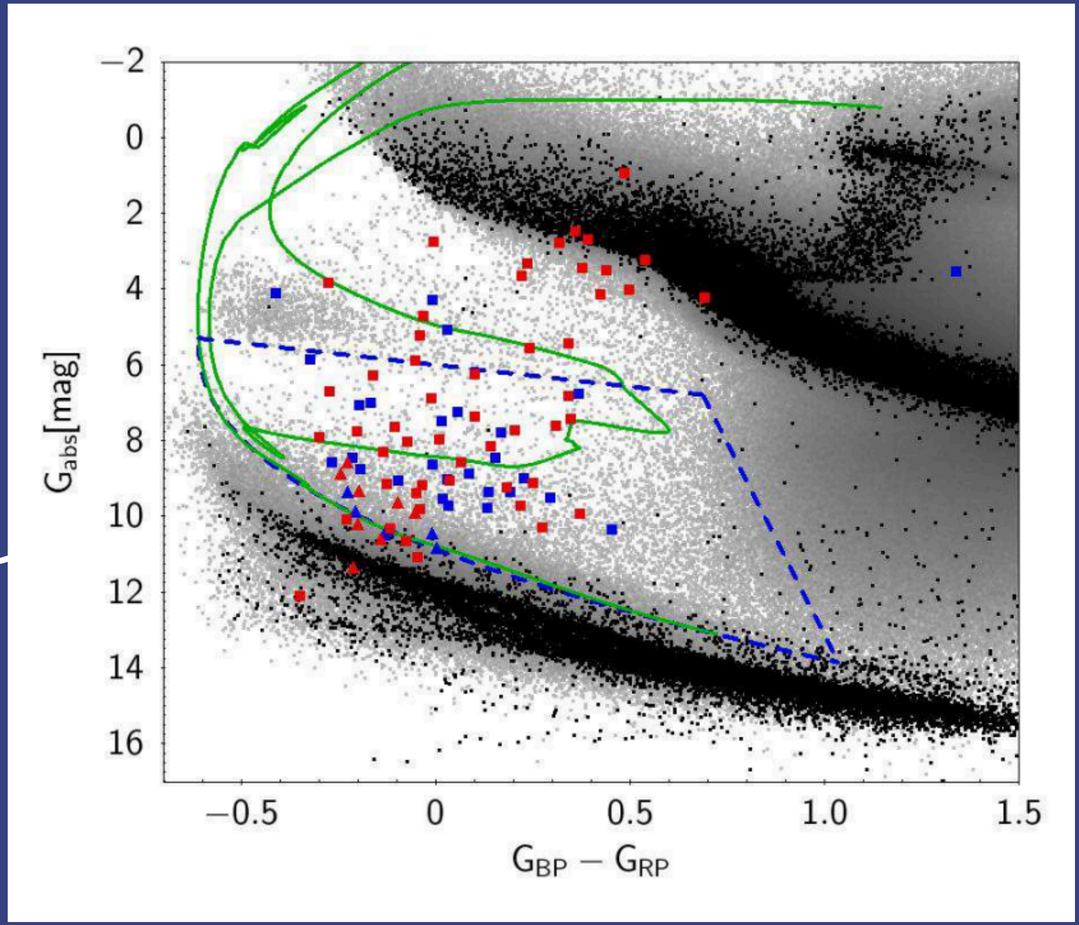
Our goals

- All-sky
- Volume-limited
- Sensitive to longer periods

Towards an all-sky volume-limited sample

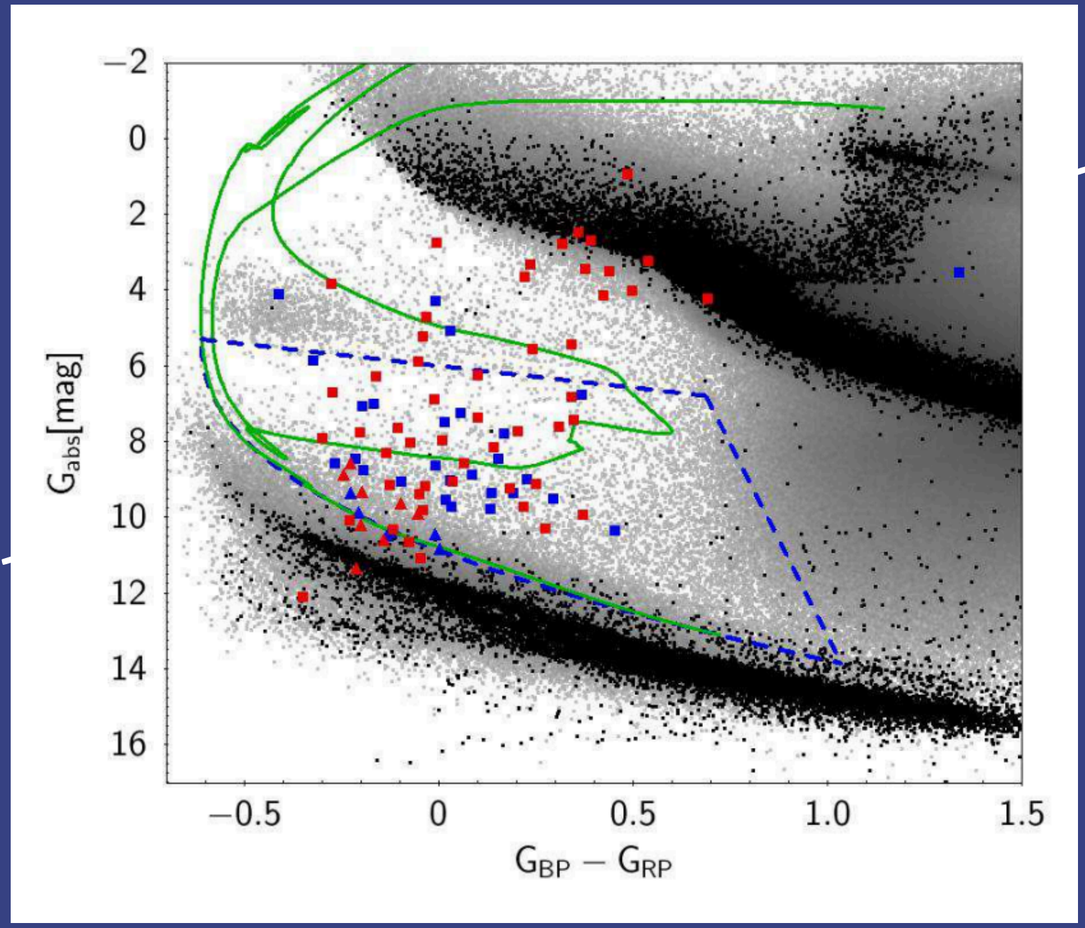
Gaia DR2 Catalogue
of ELM Candidates

Ingrid Pelisoli & Joris Vos



Towards an all-sky volume-limited sample

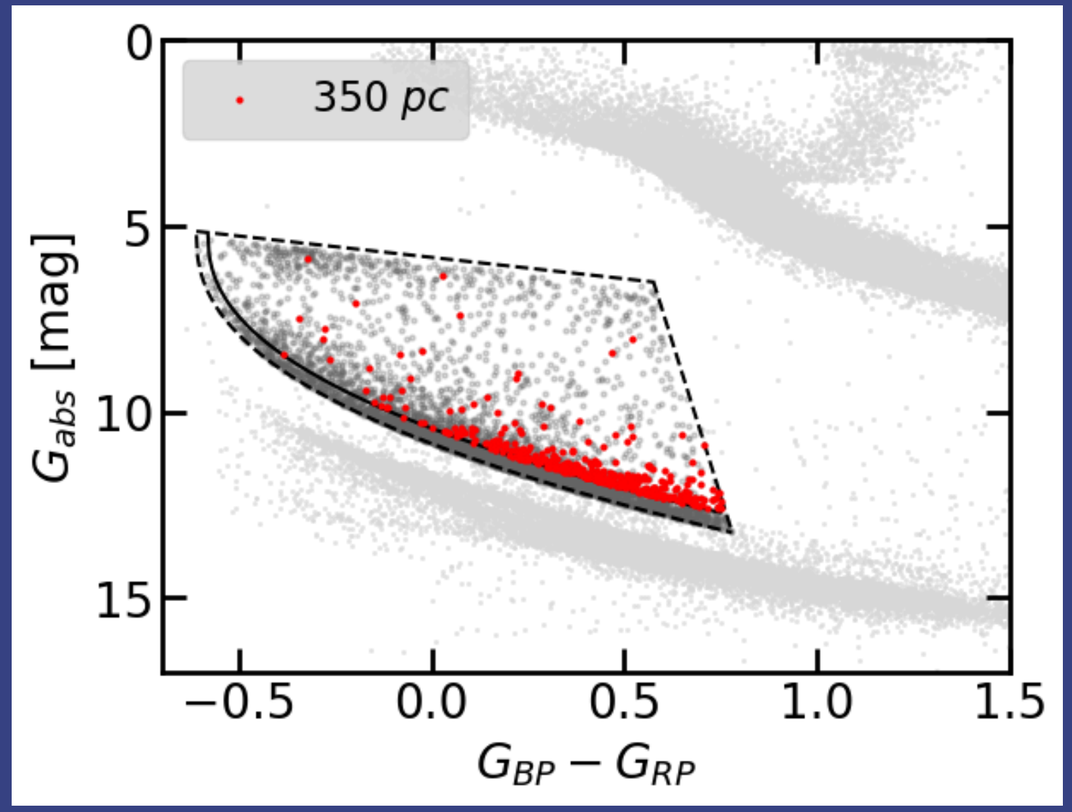
Gaia DR2 Catalogue
of ELM Candidates
Ingrid Pelisoli & Joris Vos



5762 candidates

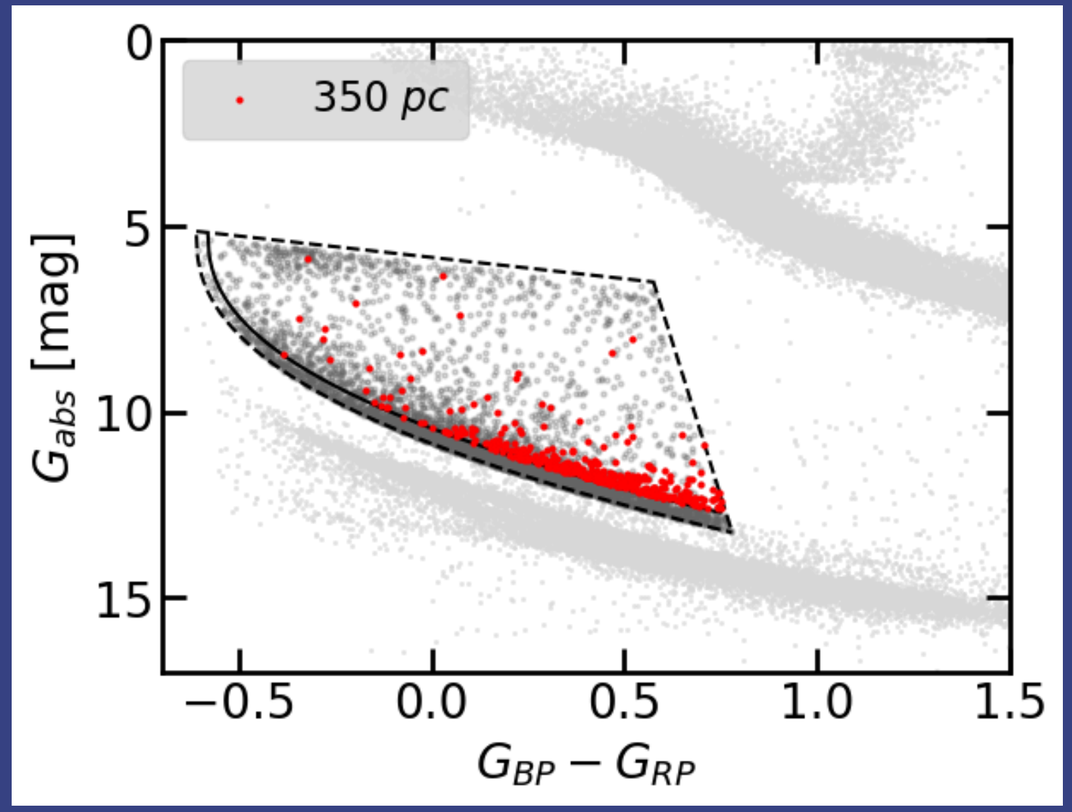
Towards an all-sky volume-limited sample

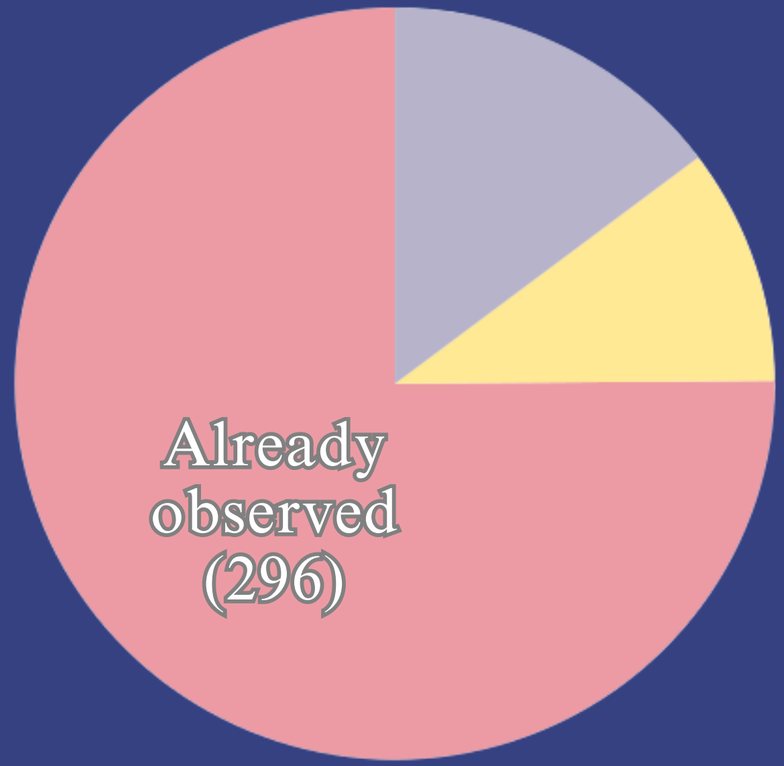
394 candidates



Towards an all-sky volume-limited sample

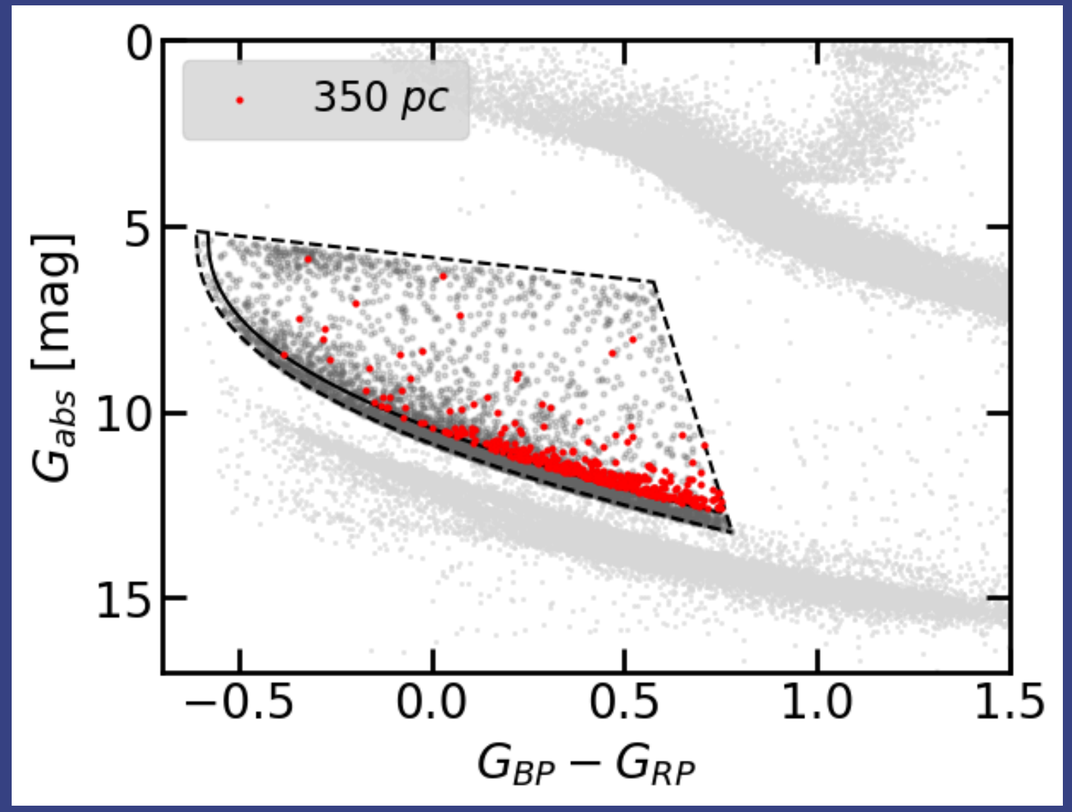
394 candidates

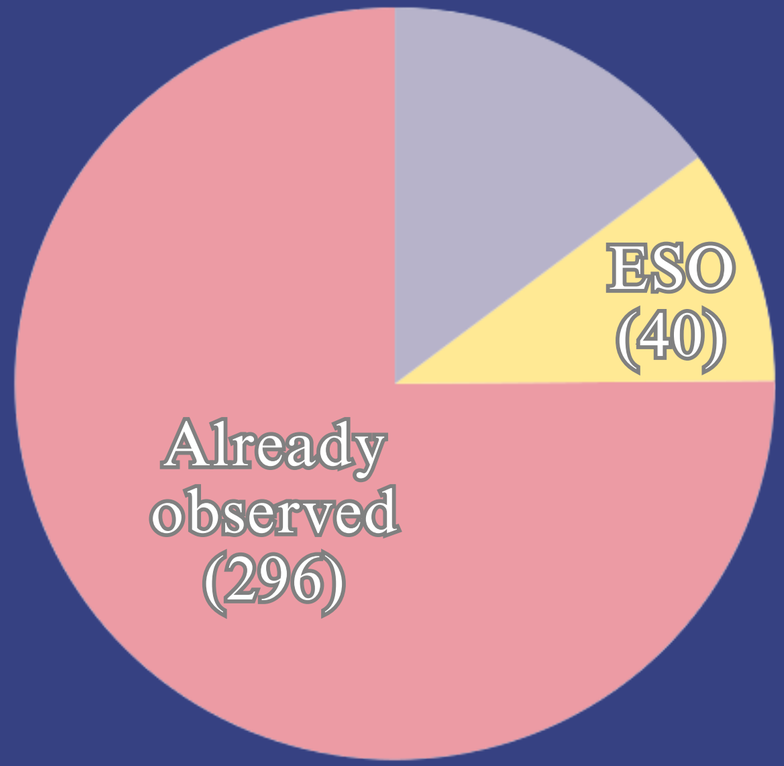




Towards an all-sky volume-limited sample

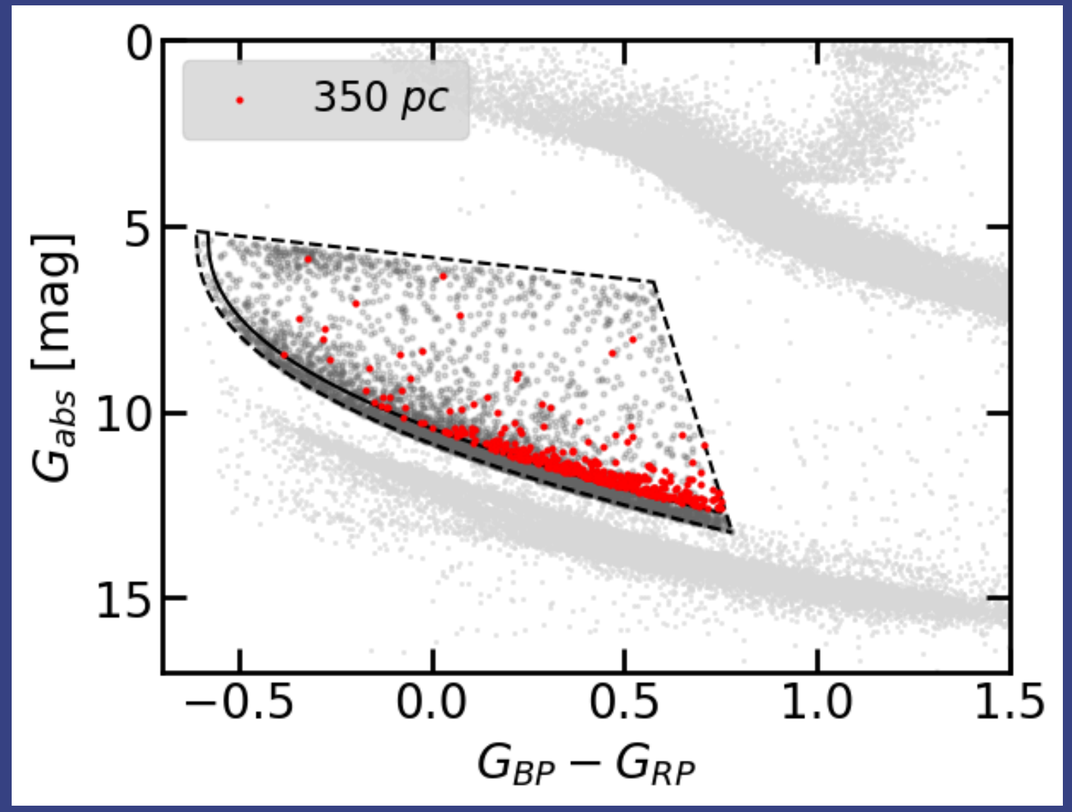
394 candidates

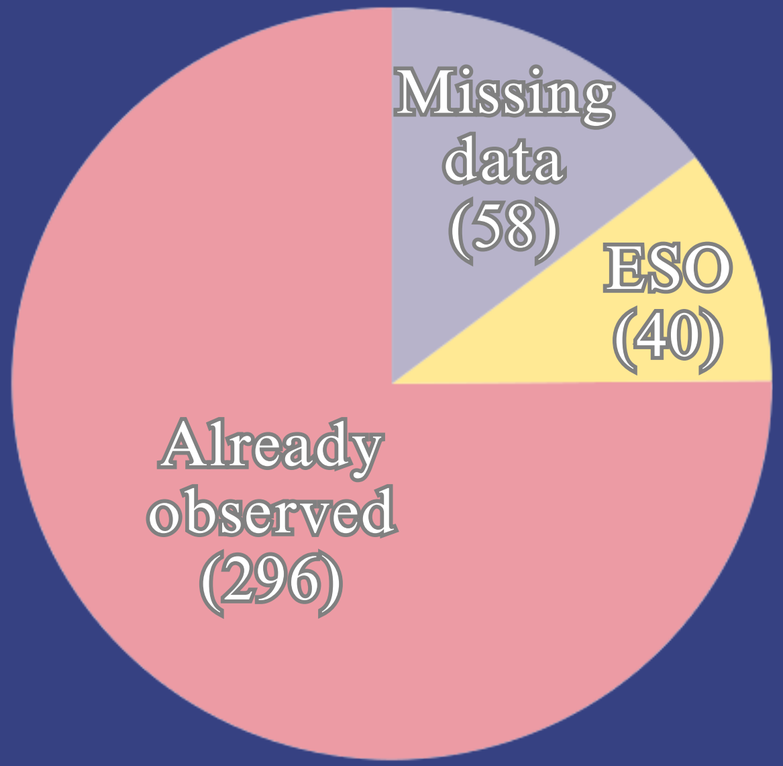




Towards an all-sky volume-limited sample

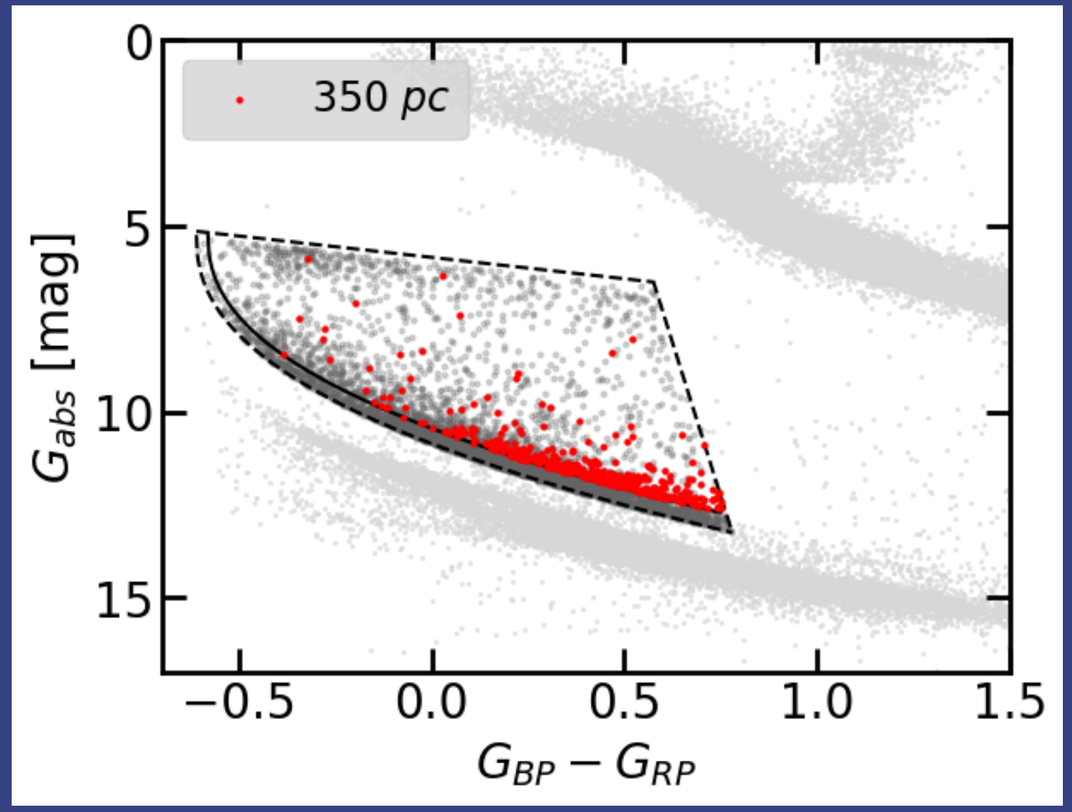
394 candidates





Towards an all-sky volume-limited sample

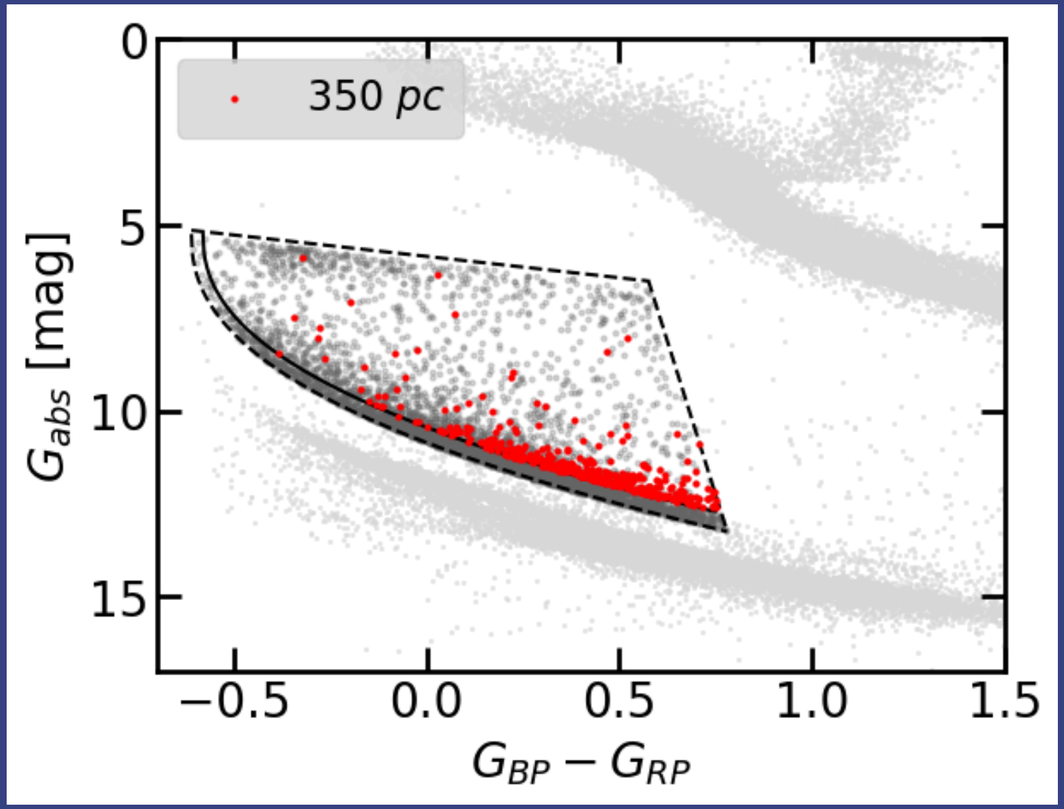
394 candidates



Data strategy:

Towards an all-sky volume-limited sample

394 candidates

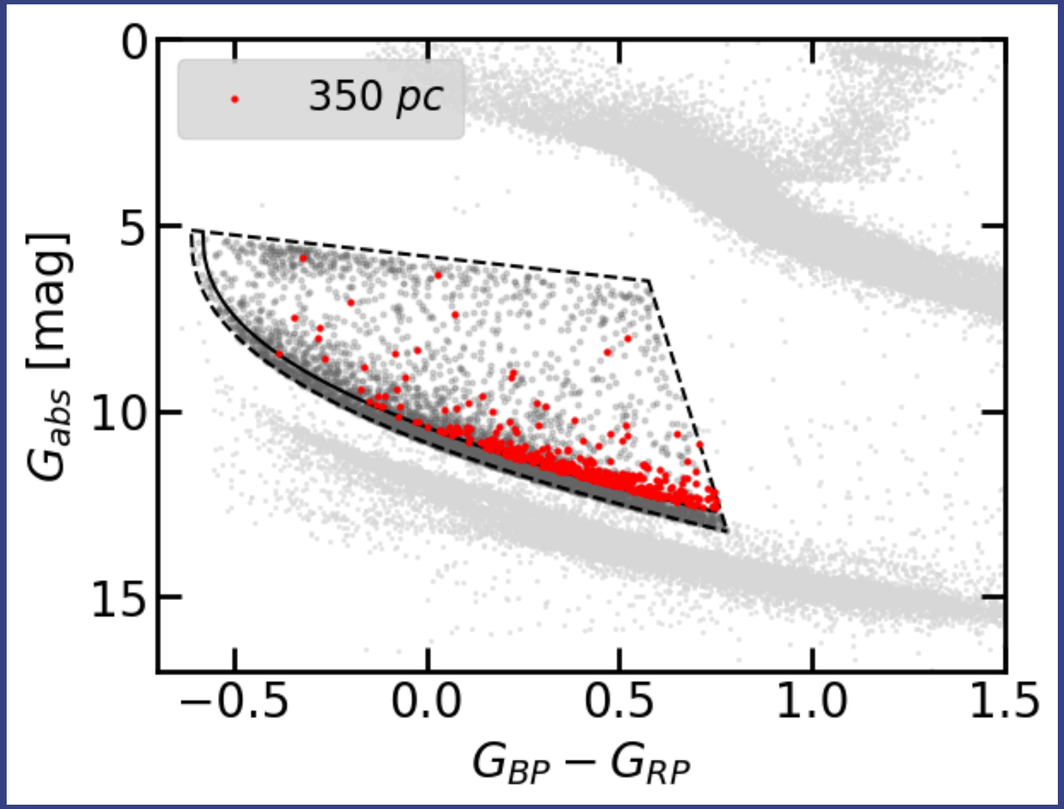


Data strategy:

- 2 on the same night

Towards an all-sky volume-limited sample

394 candidates



Data strategy:

- 2 on the same night
- +1 after some days

Future Work

Spectroscopic Data

Future Work

Spectroscopic Data

Automatically reduce

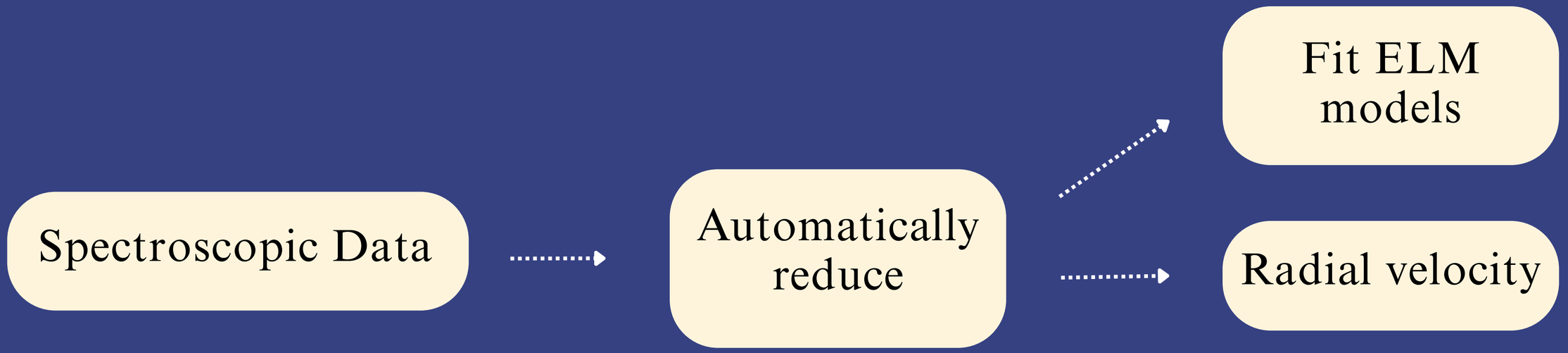
Future Work

Spectroscopic Data

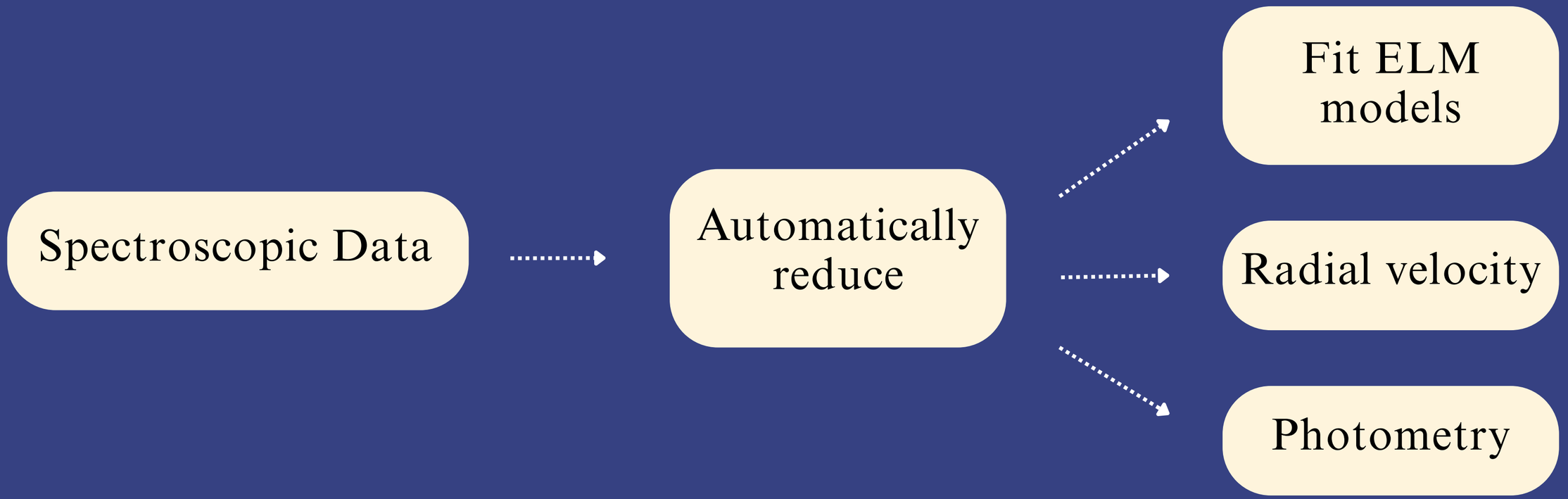
Automatically reduce

Fit ELM models

Future Work


Spectroscopic Data
Automatically reduce
Fit ELM models
Radial velocity

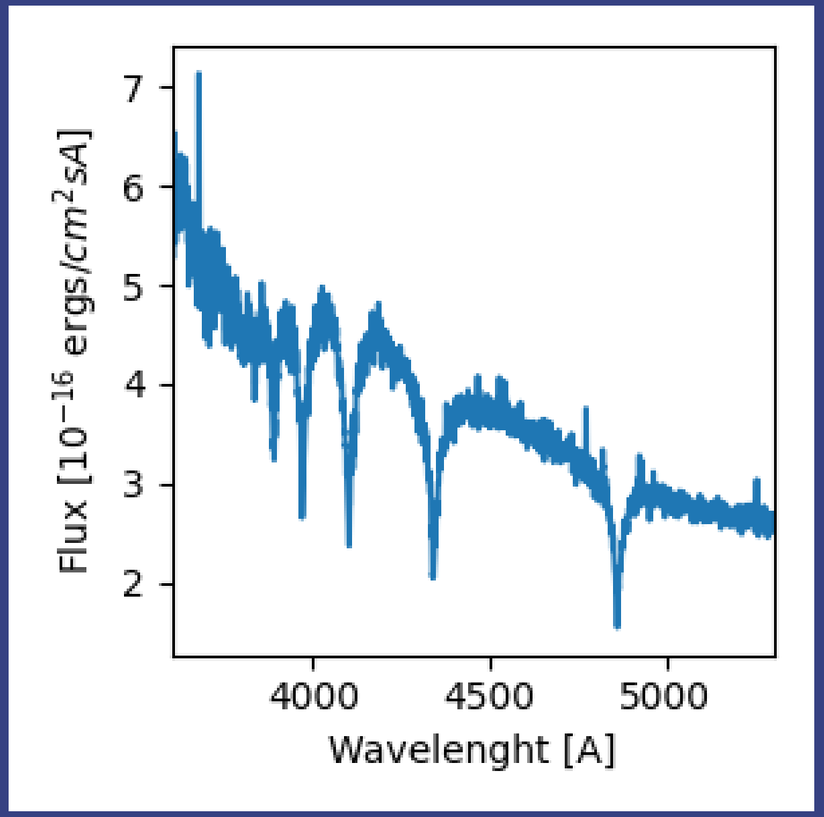
Future Work

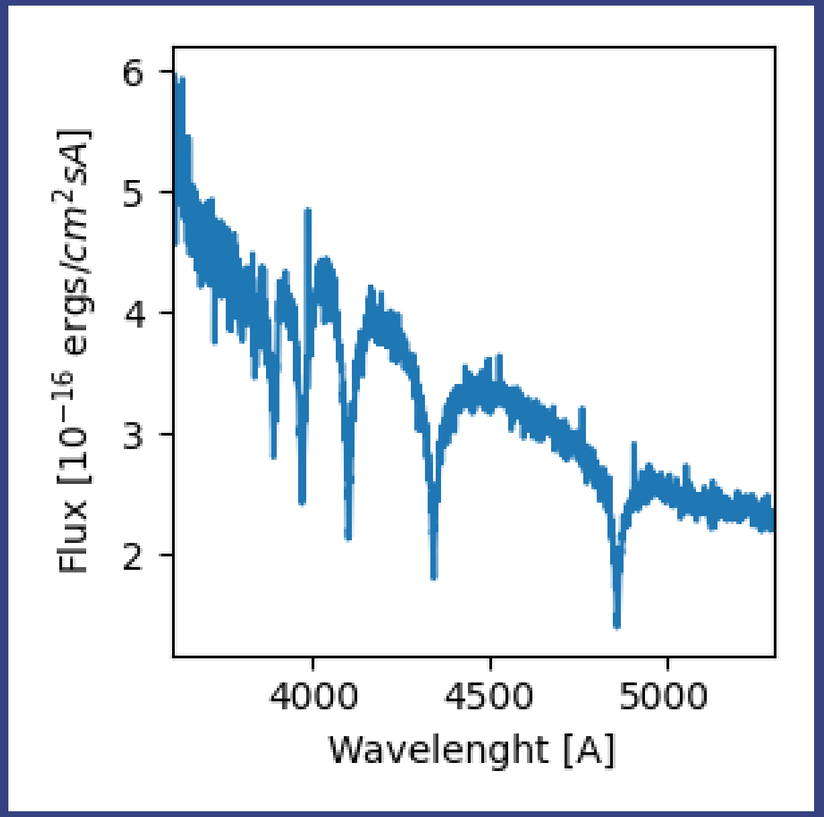

Spectroscopic Data
Automatically reduce
Fit ELM models
Radial velocity
Photometry

Summary

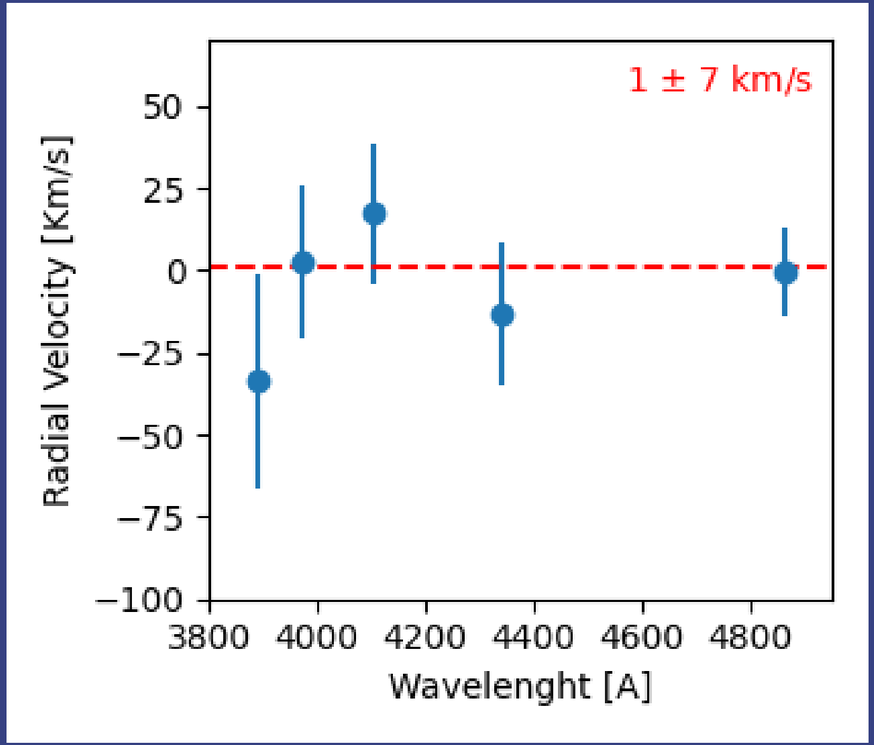
- ELMs can only be explained by interacting binary evolution;
- There exist ELM samples, but they are biased towards short orbital-period systems and luminous ELMs;
- We are constructing the first all-sky volume-limited sample of ELMs.

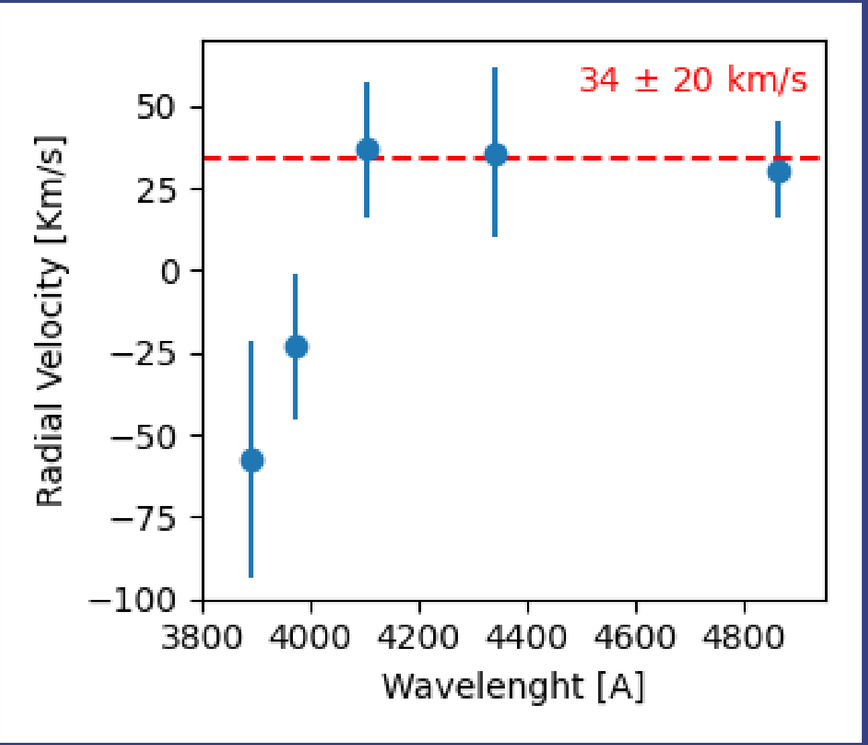
Example


Flux [10^{-16} ergs/cm^2sA]
7
6
5
4
3
2
4000
4500
5000
Wavelenght [A]


Flux [10^{-16} ergs/cm^2sA]
6
5
4
3
2
4000
4500
5000
Wavelenght [A]

Example


1 ± 7 km/s
Radial Velocity [Km/s]
50
25
0
−25
−50
−75
−100
3800
4000
4200
4400
4600
4800
Wavelenght [A]


34 ± 20 km/s
Radial Velocity [Km/s]
50
25
0
−25
−50
−75
−100
3800
4000
4200
4400
4600
4800
Wavelenght [A]

Telescopes

- ESO
- LAMOST
- SDSS
- SOAR
- INT
- GTC
- GEMINI

Future Work

78 with data from ESO, LAMOST, or SDSS

218 with data from SOAR, INT, GTC, or GEMINI

Automatically reduce

Fit ELM models

Observe +40 ELMs with ESO

Observe the remaining 58

?