

The White Dwarf Photosphere Experiment: An Update

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Acknowledgments



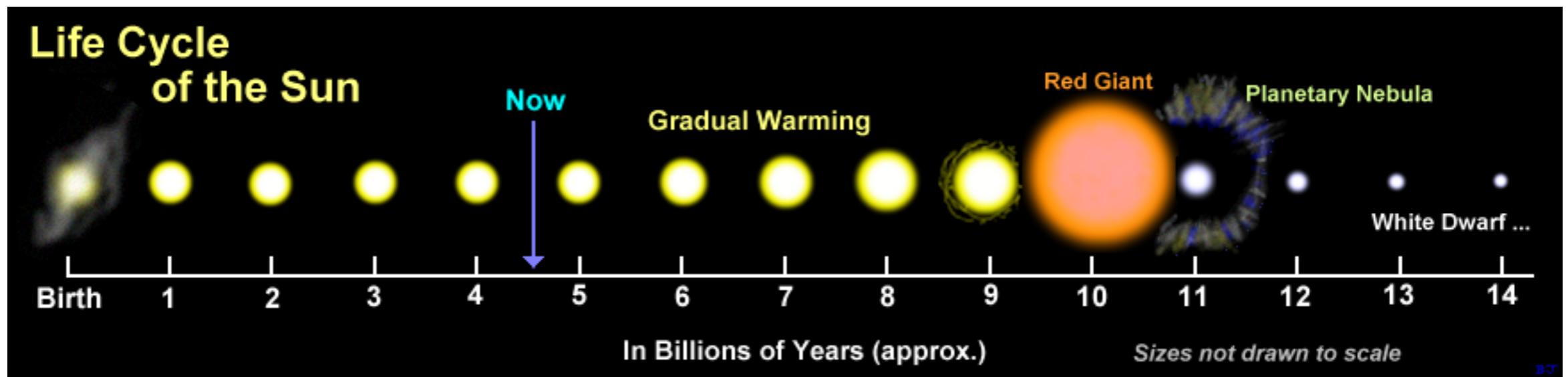
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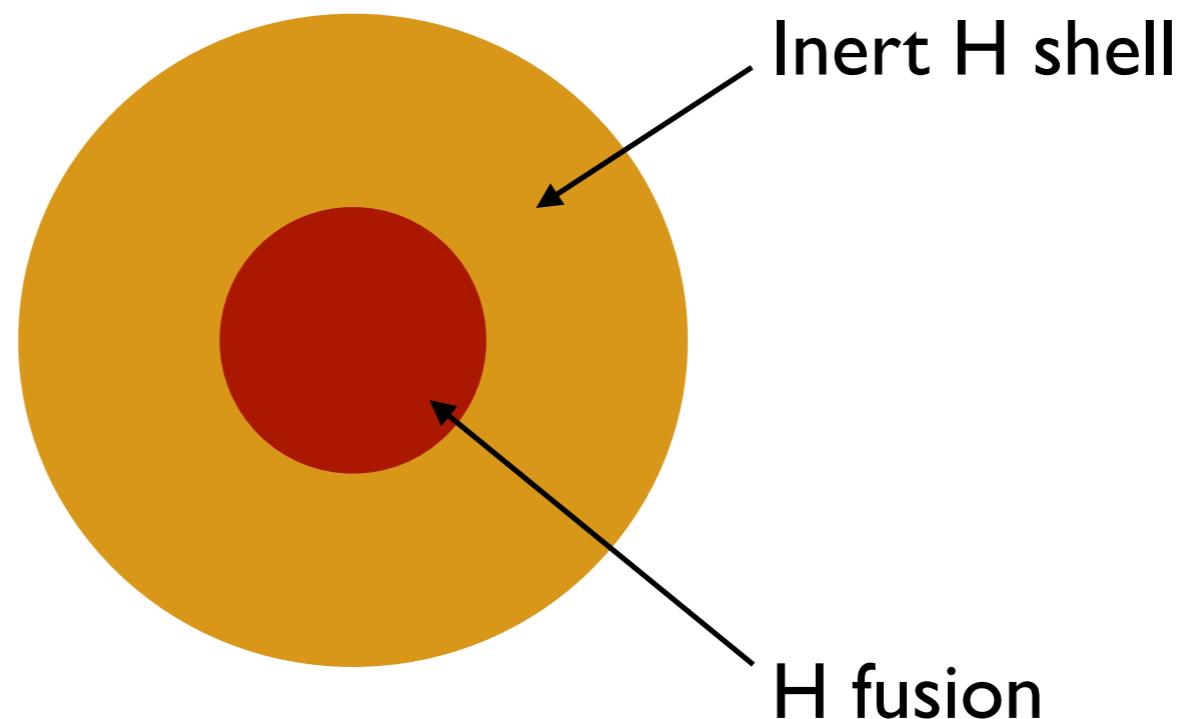
Ross E. Falcon
James E. Bailey
Guillaume Loisel
Taisuke Nagayama
Gregory A. Rochau
Dave E. Bliss
Dan Sciglietti

Thomas A. Gomez
Michael H. Montgomery
Don Winget
Zachary Swindle
Sean Moorhead
Travis Pille
Benjamin Quick

What is a white dwarf?

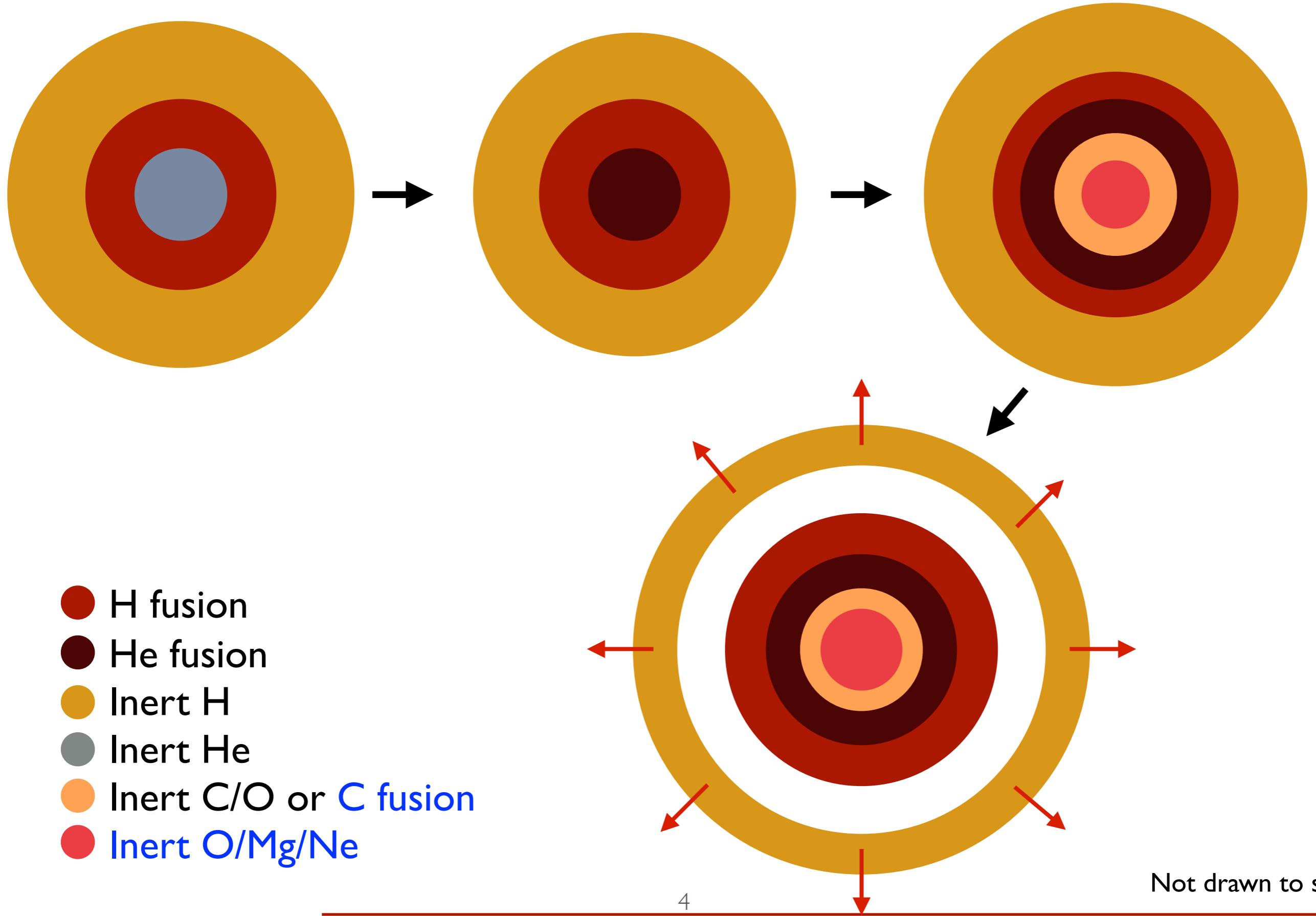


Main sequence:



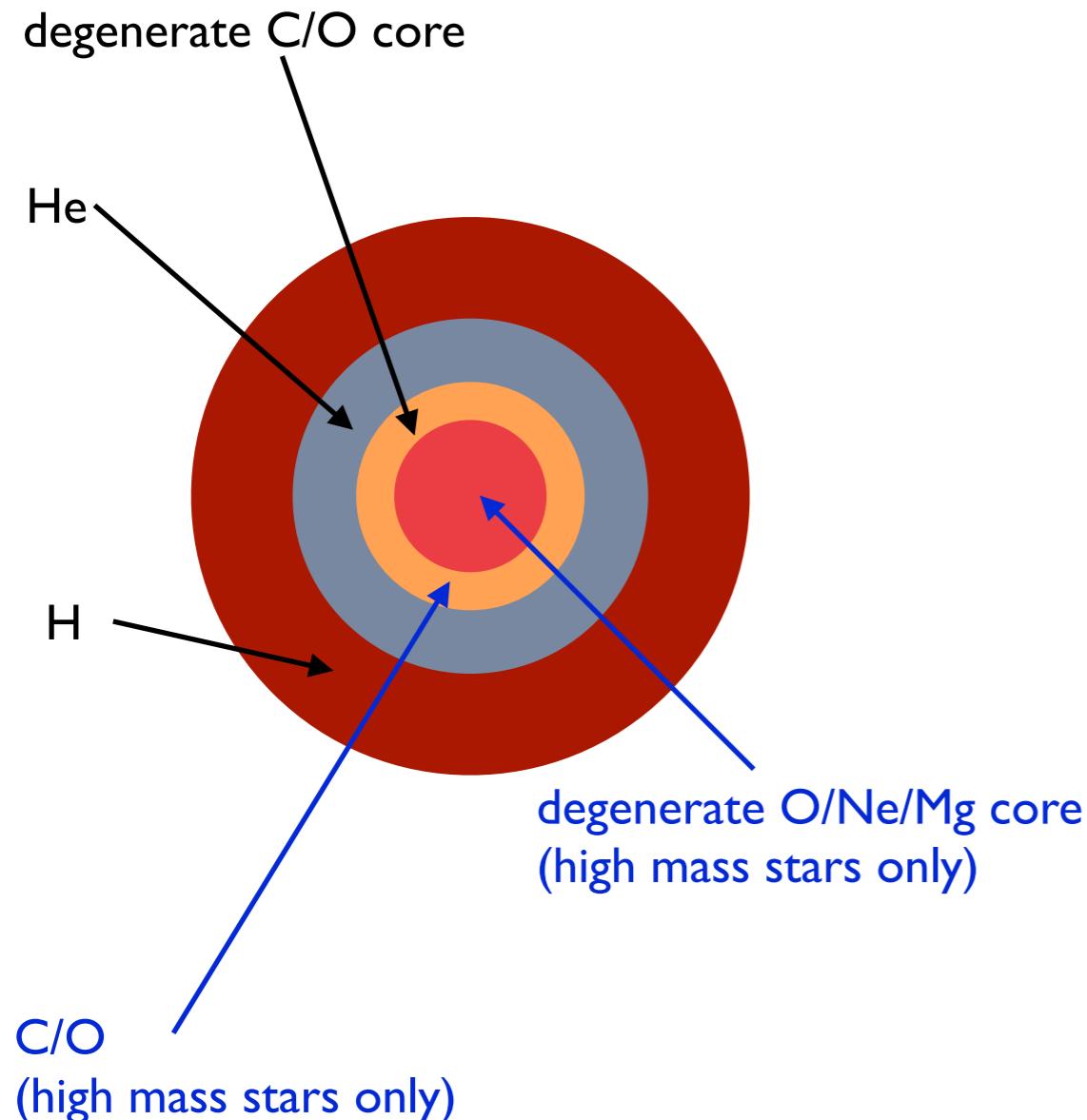
Not drawn to scale!

What is a white dwarf?



What is a white dwarf?

White Dwarf:



Typical parameters:

radius:

$\sim r_{\text{earth}}$

mass:

$\sim 2/3 m_{\text{sun}}$

surface temperature:

$\sim 10,000 \text{ K} (\sim 1 \text{ eV})$

surface gravity:

$\sim 10^8 \text{ cm/s}^2$

surface electron density: $\sim 1 \times 10^{17} \text{ cm}^{-3}$

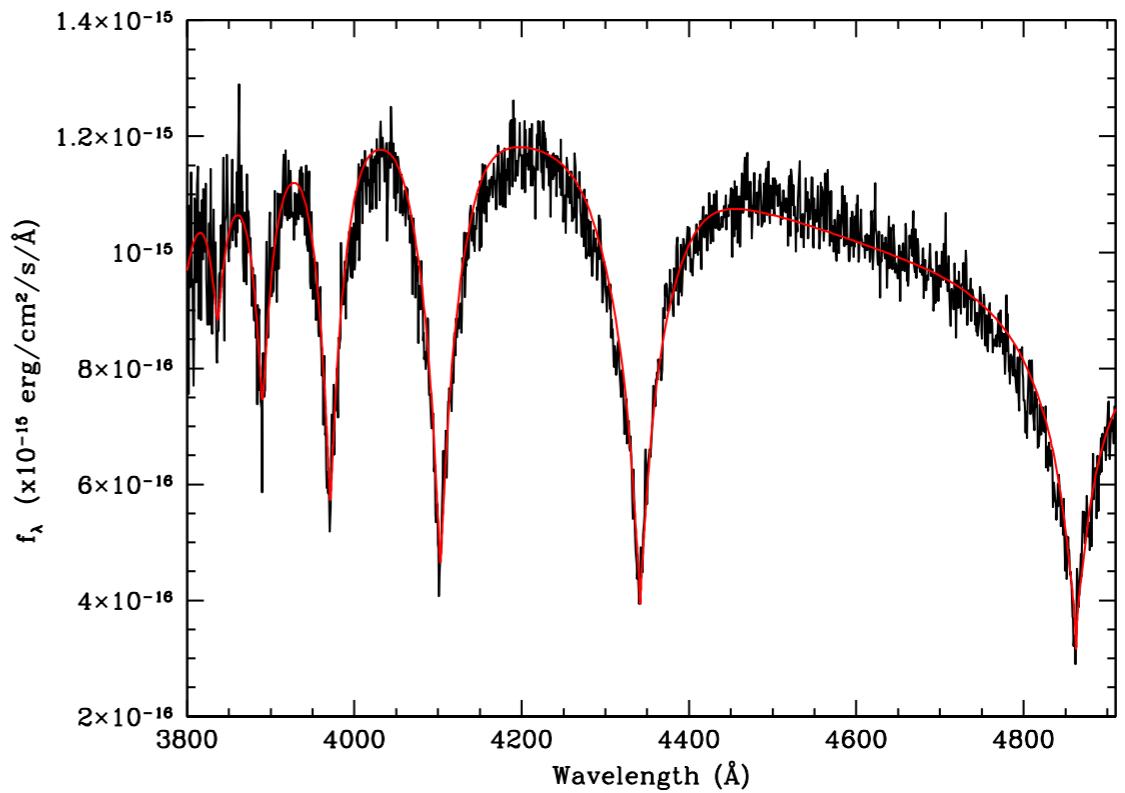
Not drawn to scale!

Past work

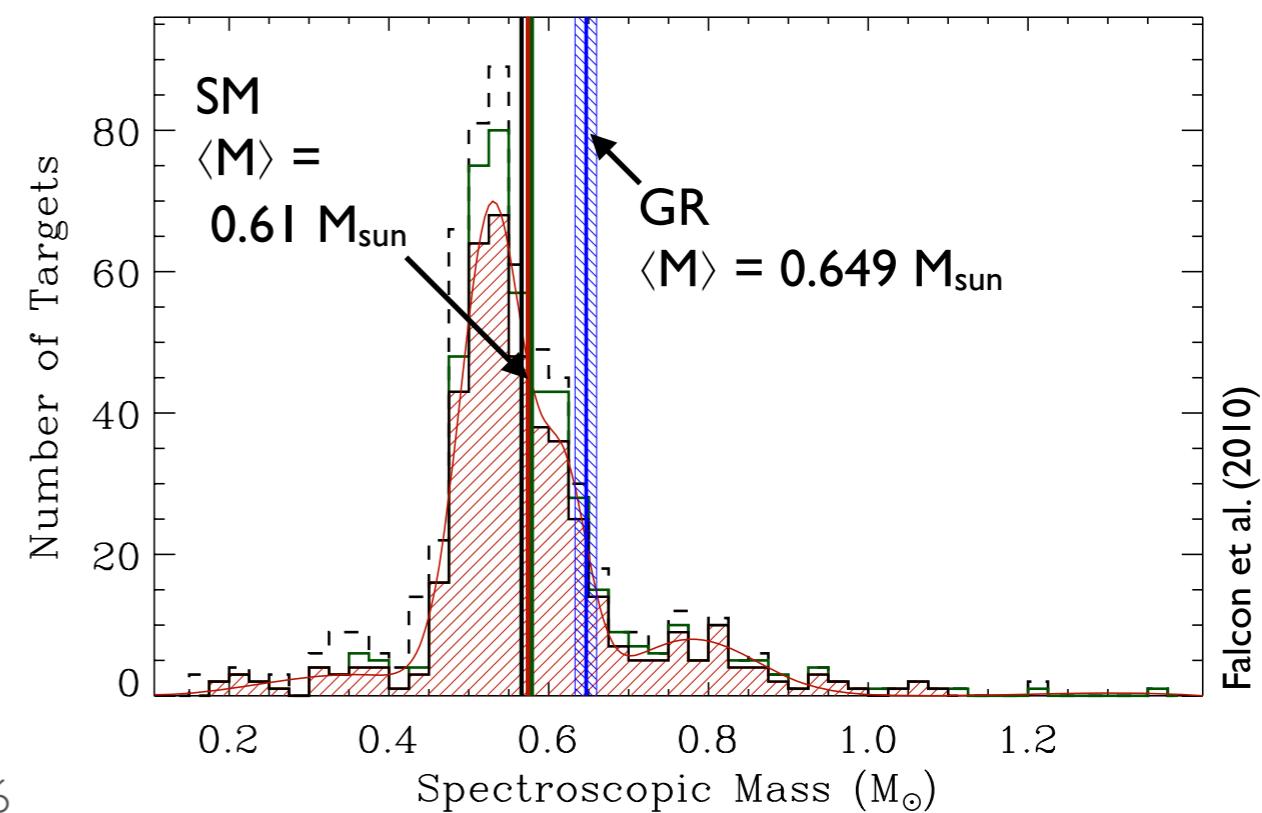
- Disagreement in derived hydrogen-dominated (DA) white dwarf masses using two independent methods:

- spectroscopic (fitting synthetic to observed spectra)
- gravitational redshift:

$$v_g = \frac{c\Delta\lambda}{\lambda} = \frac{GM}{Rc}$$



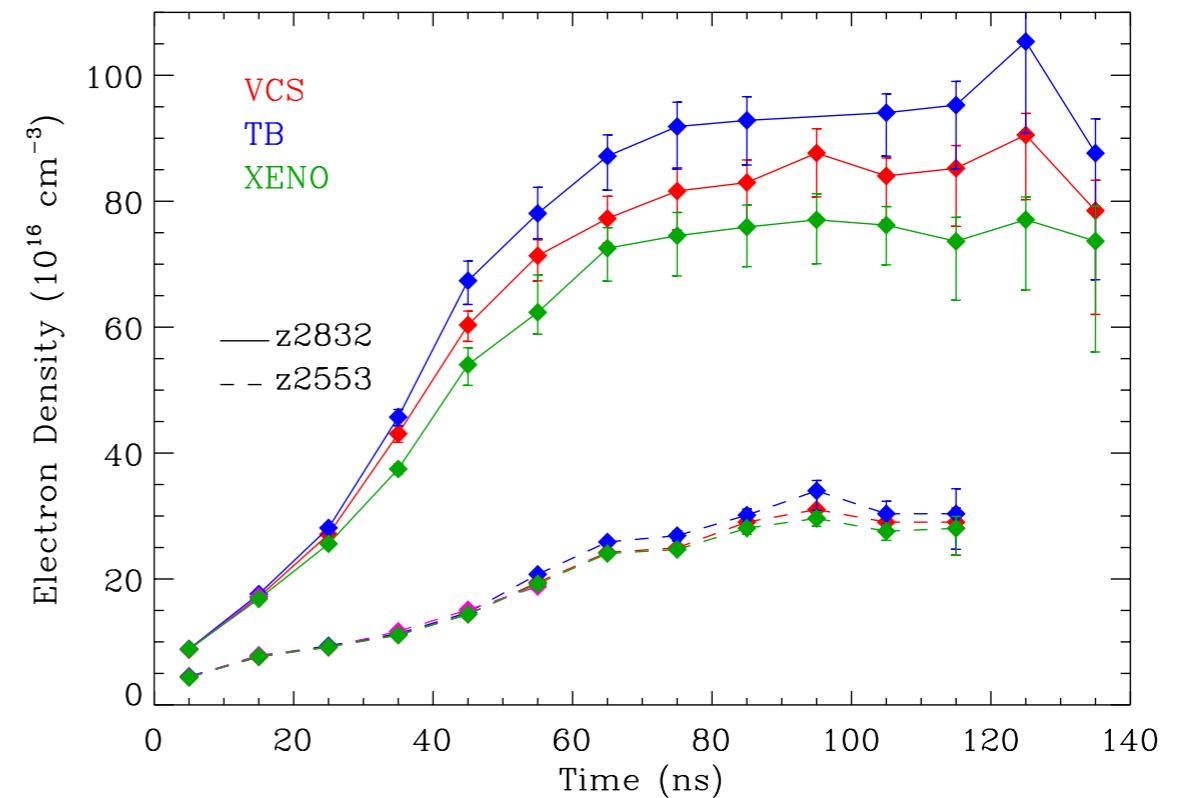
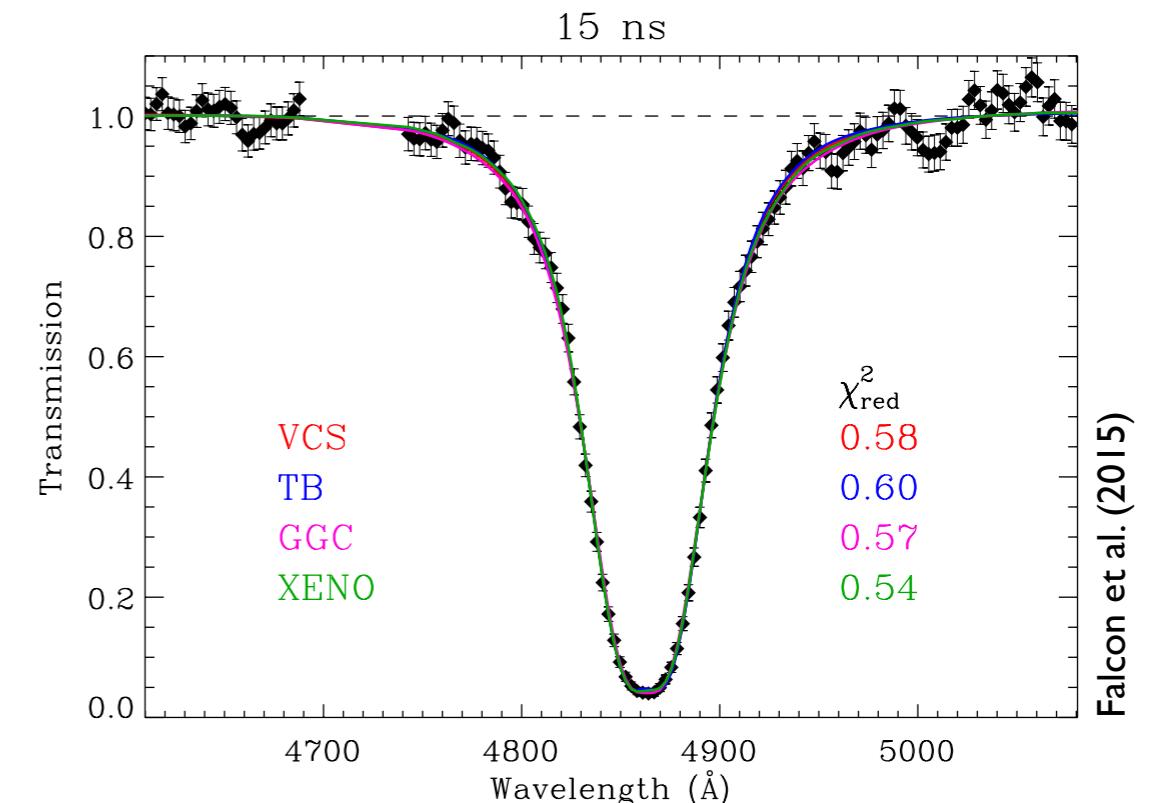
Hermes et al. (2011)



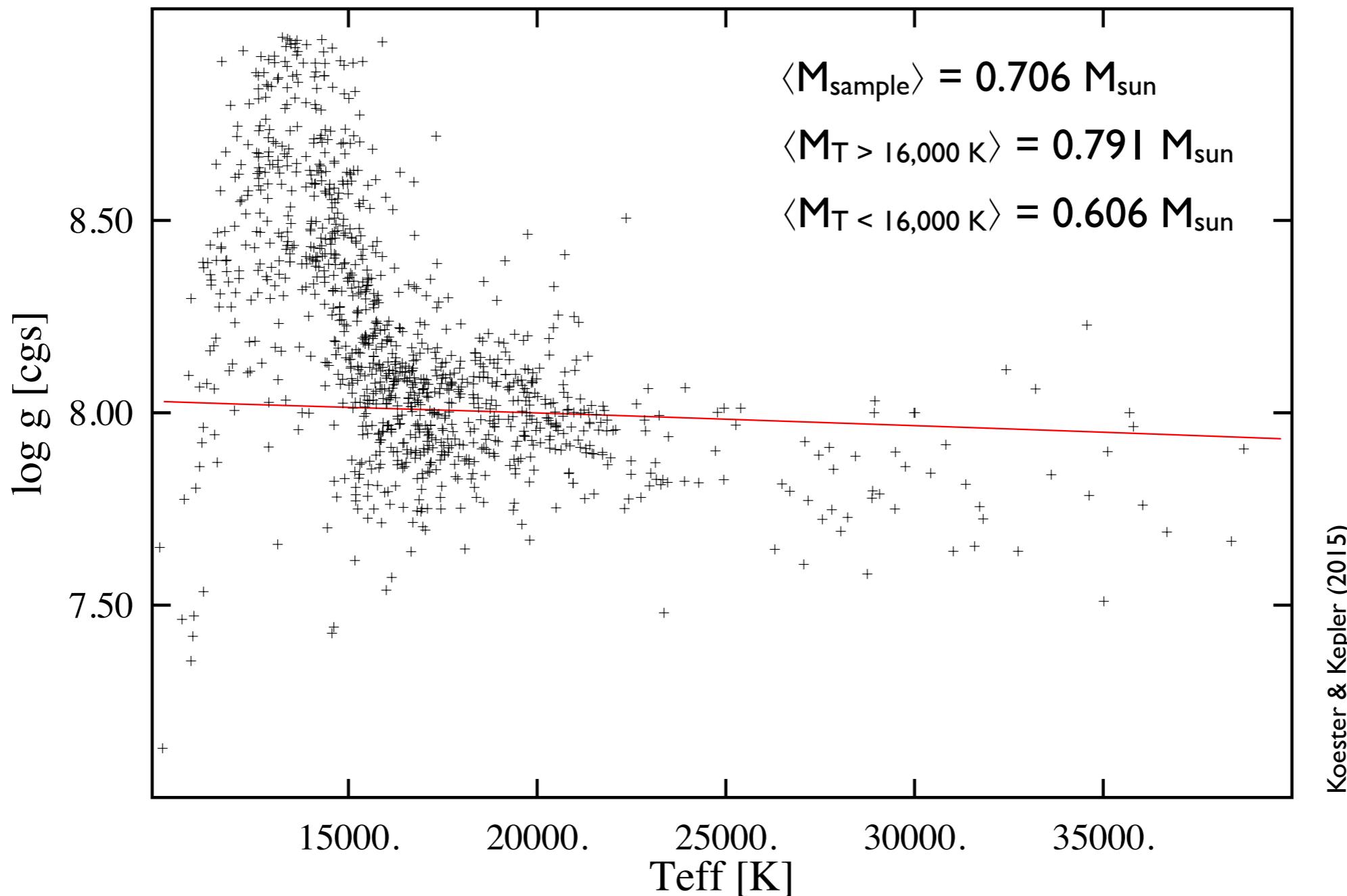
Falcon et al. (2010)

Past work

- Experiment was designed to measure transmission spectra of Balmer series at white dwarf photosphere conditions.
- New advances in line-shape theory at low densities resulted from our measurements. High density theory still questionable.



Present work



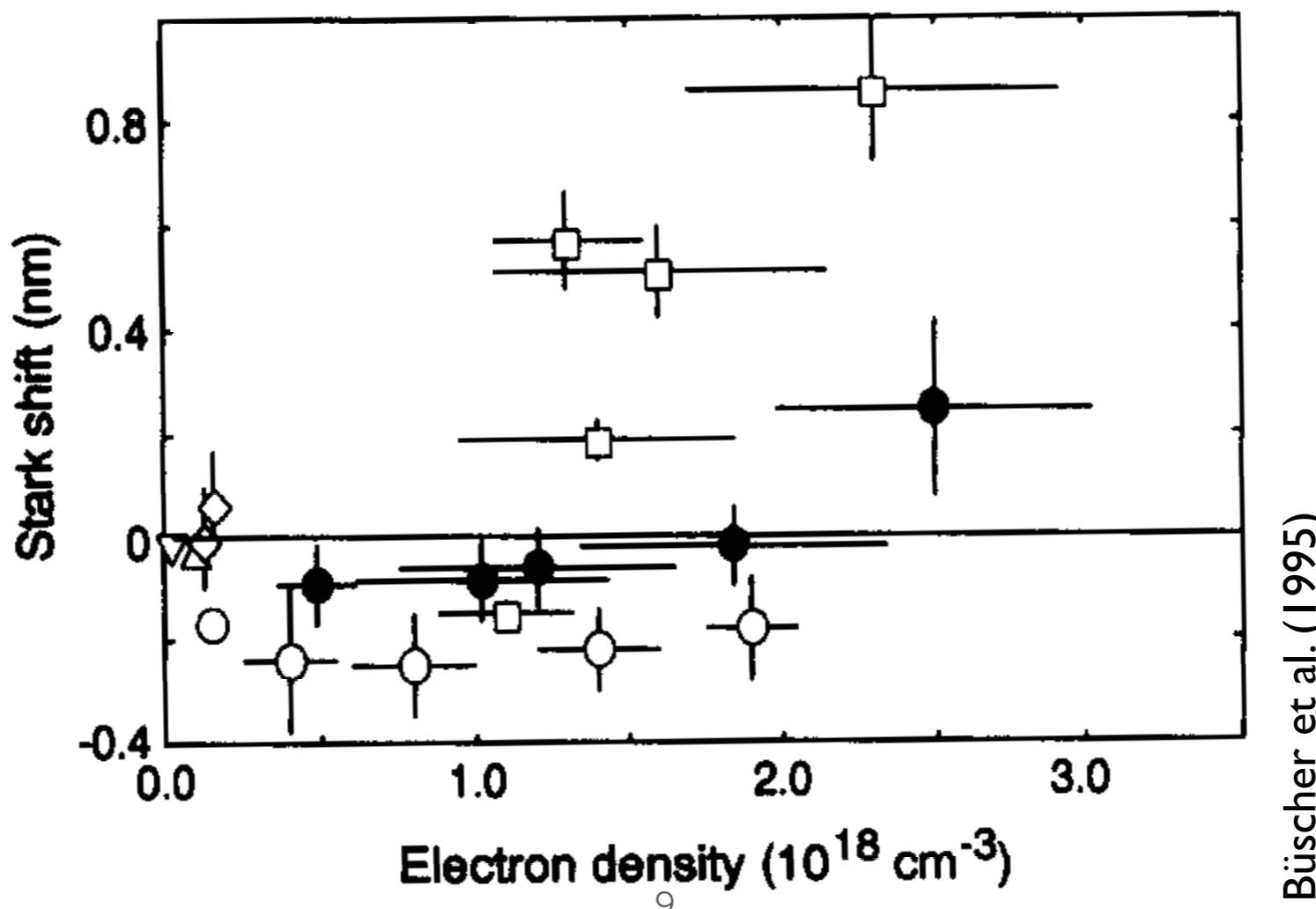
Present work

- Falcon et al. (2012) found:

$$\langle M_{DB, GR} \rangle = 0.710 M_{\text{sun}}$$

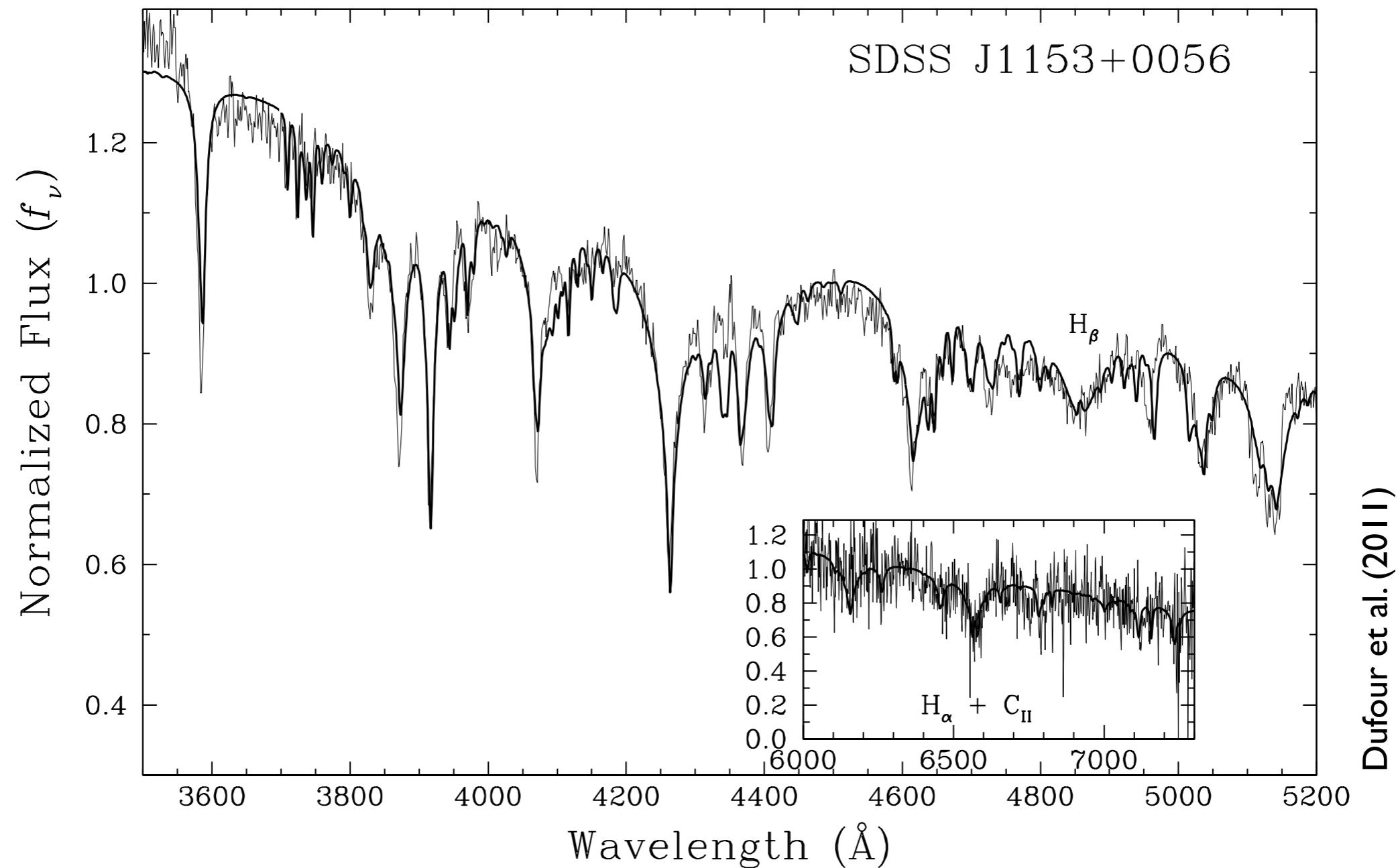
$$\langle M_{DA, GR} \rangle = 0.647 M_{\text{sun}}$$

- But:



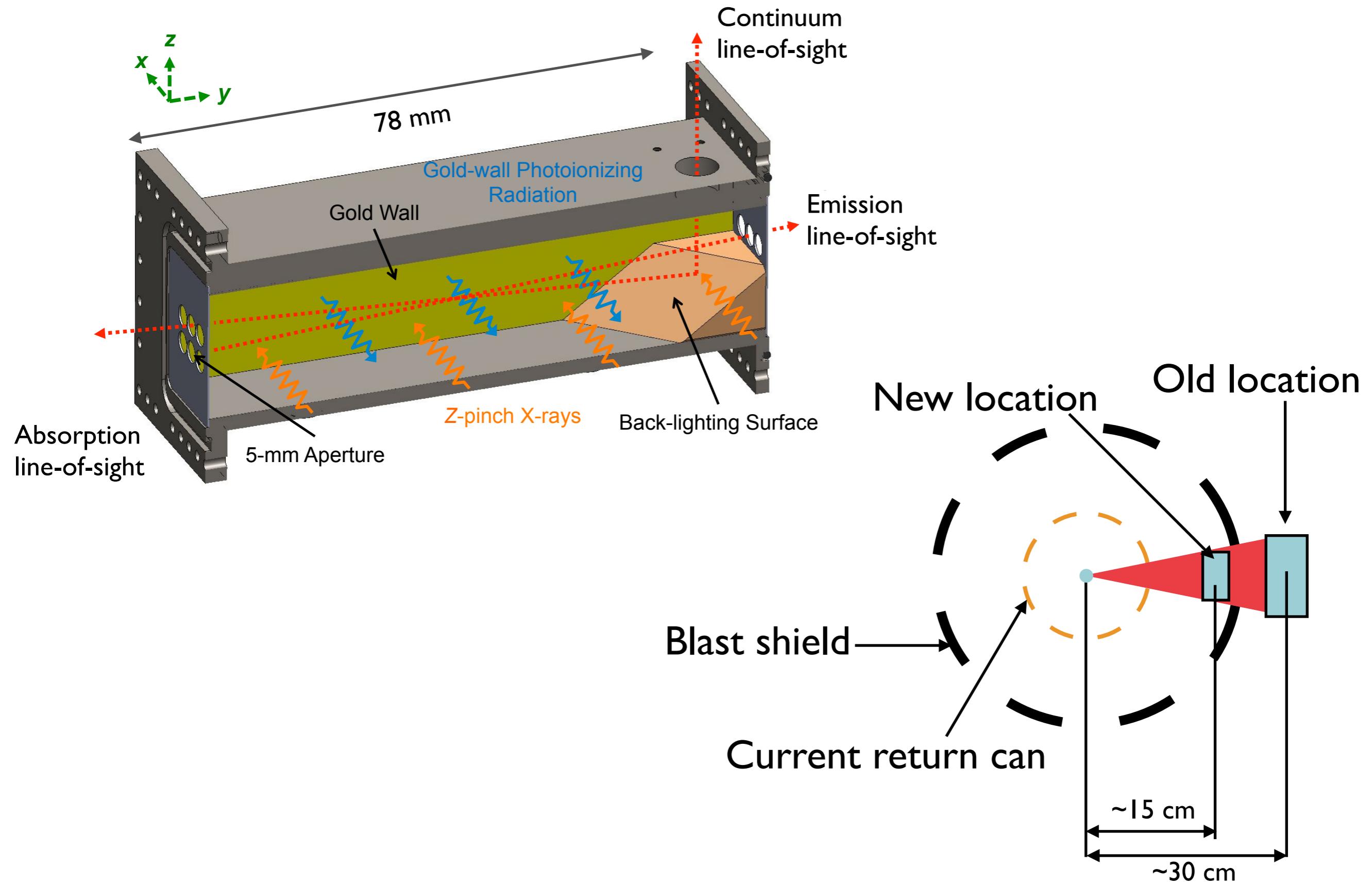
Büscher et al. (1995)

Present work

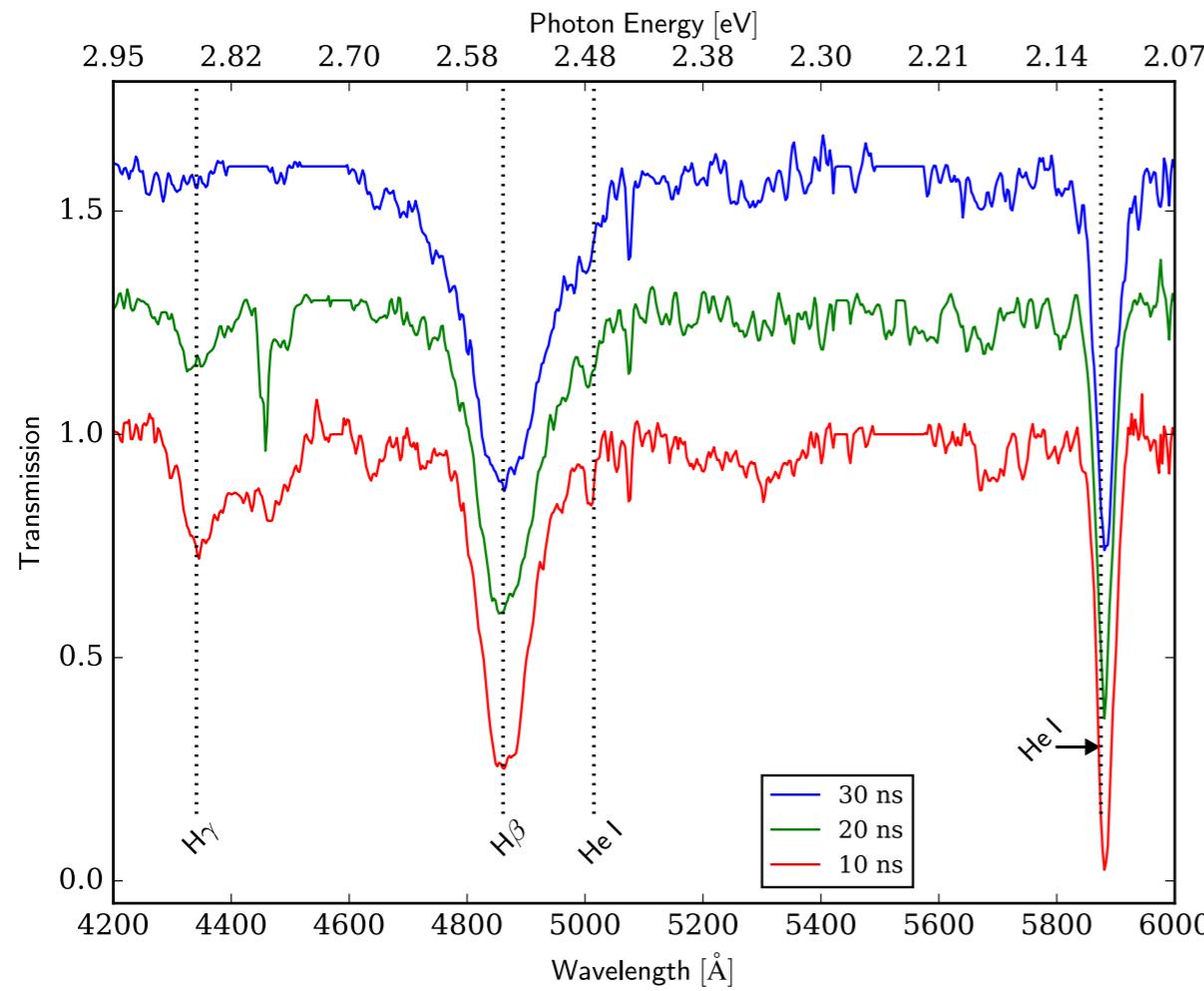


Spectrum of recently discovered carbon dominated (DQ)
white dwarf with surface temperatures of 18,000 K - 23,000K

Updates to experimental platform



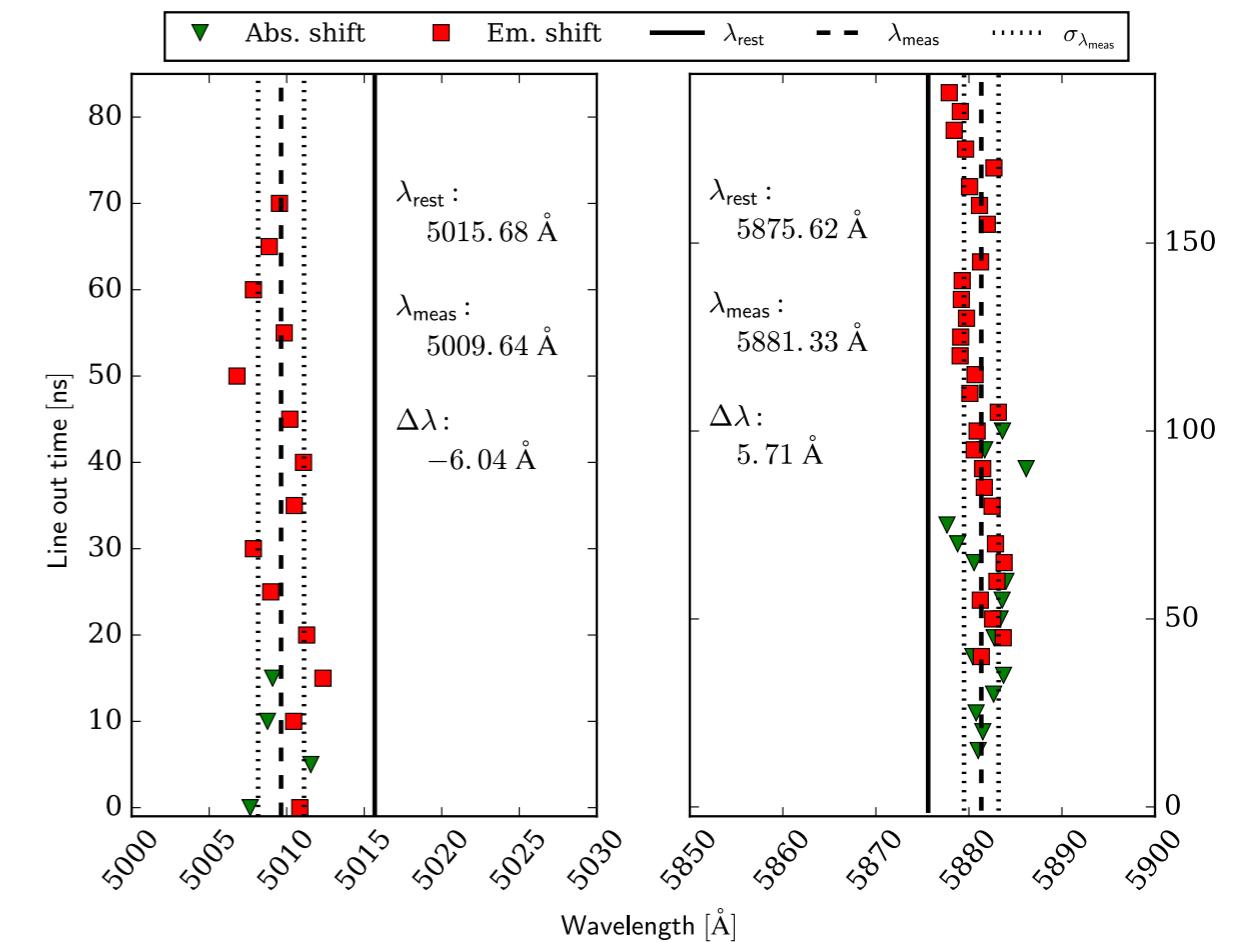
Preliminary Helium results



Transmission spectra of a 50/50 H-He gas mixture in our old experimental platform. From H β we infer:

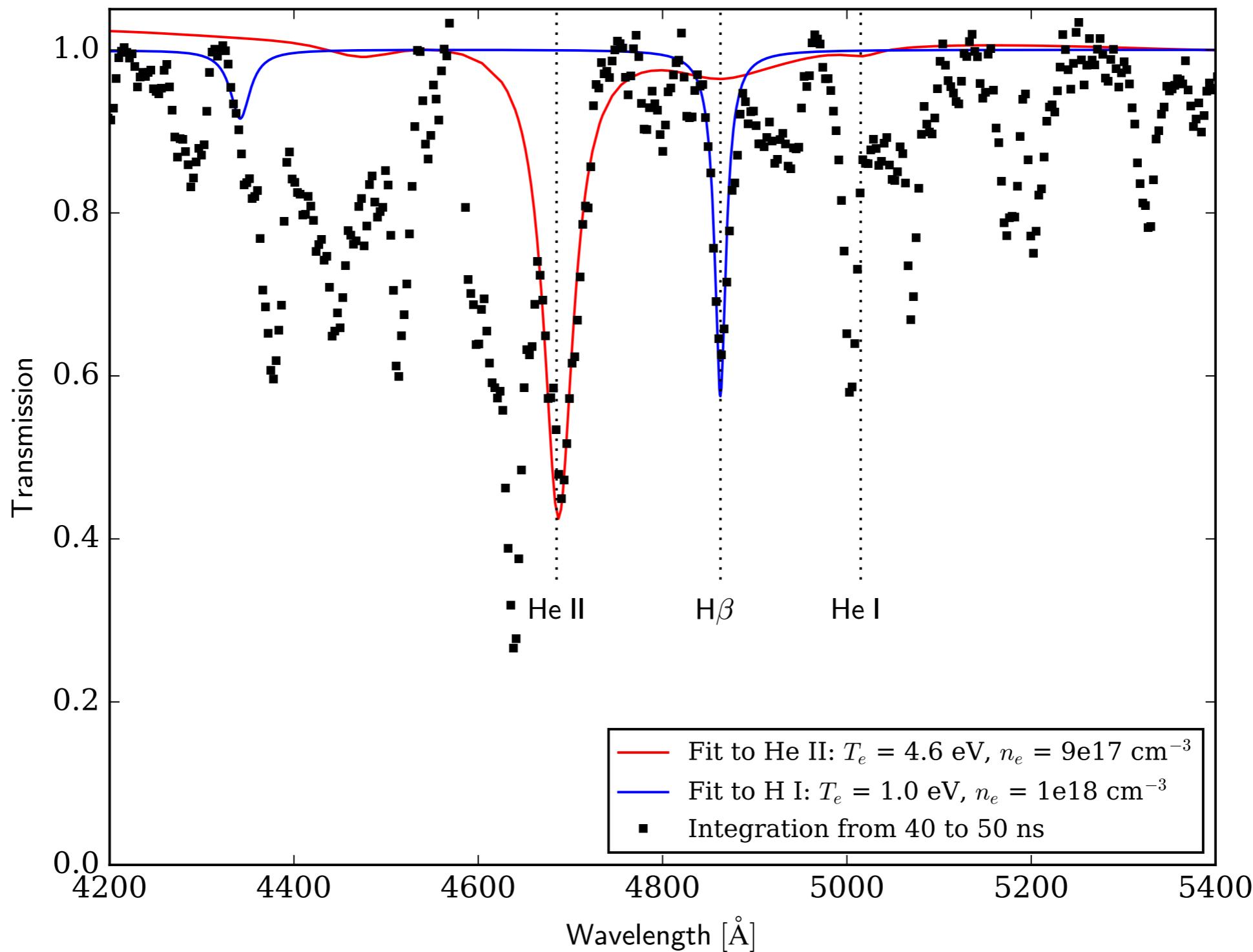
$$T_{\text{plasma}} \sim 1.0 - 1.5 \text{ eV}$$

$$n_e \sim 1 \times 10^{17} \text{ cm}^{-3} - 6 \times 10^{17} \text{ cm}^{-3}$$

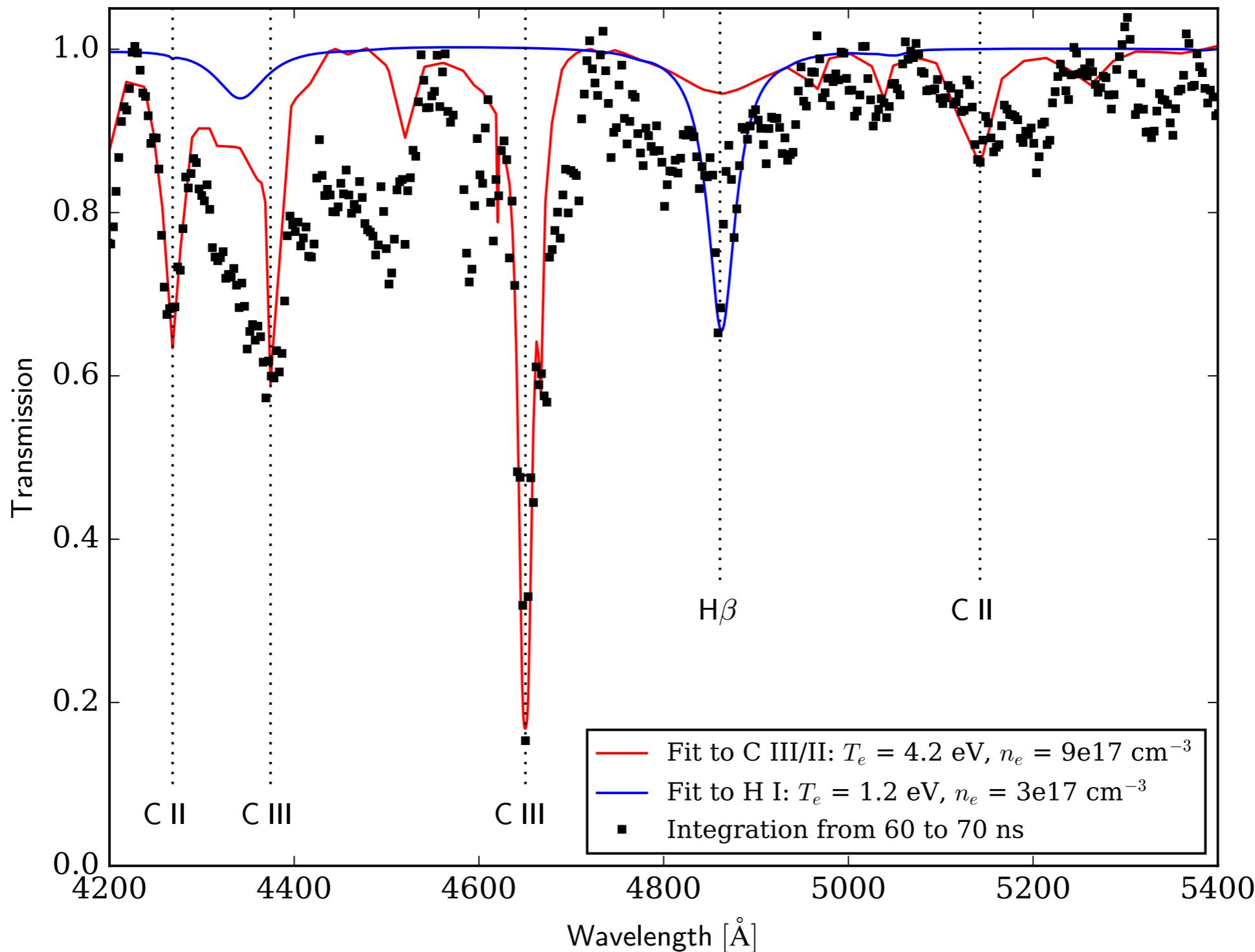


Apparent shift of the He I lines at 5015 Å and 5875 Å

Preliminary H/He results



Preliminary C results



Summary

- Experimental hydrogen results have guided theoretical developments in low density regime. High density still uncertain.
- Preliminary data using other gas fills (He, C) has proven versatility of platform
- Initial fits to new data shows very high temperatures and densities, beyond those needed for white dwarf astronomy