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The White Dwarf Photosphere Experiment

Bart Dunlap, UT Austin

Z Fundamental Science Workshop

Breakout Session

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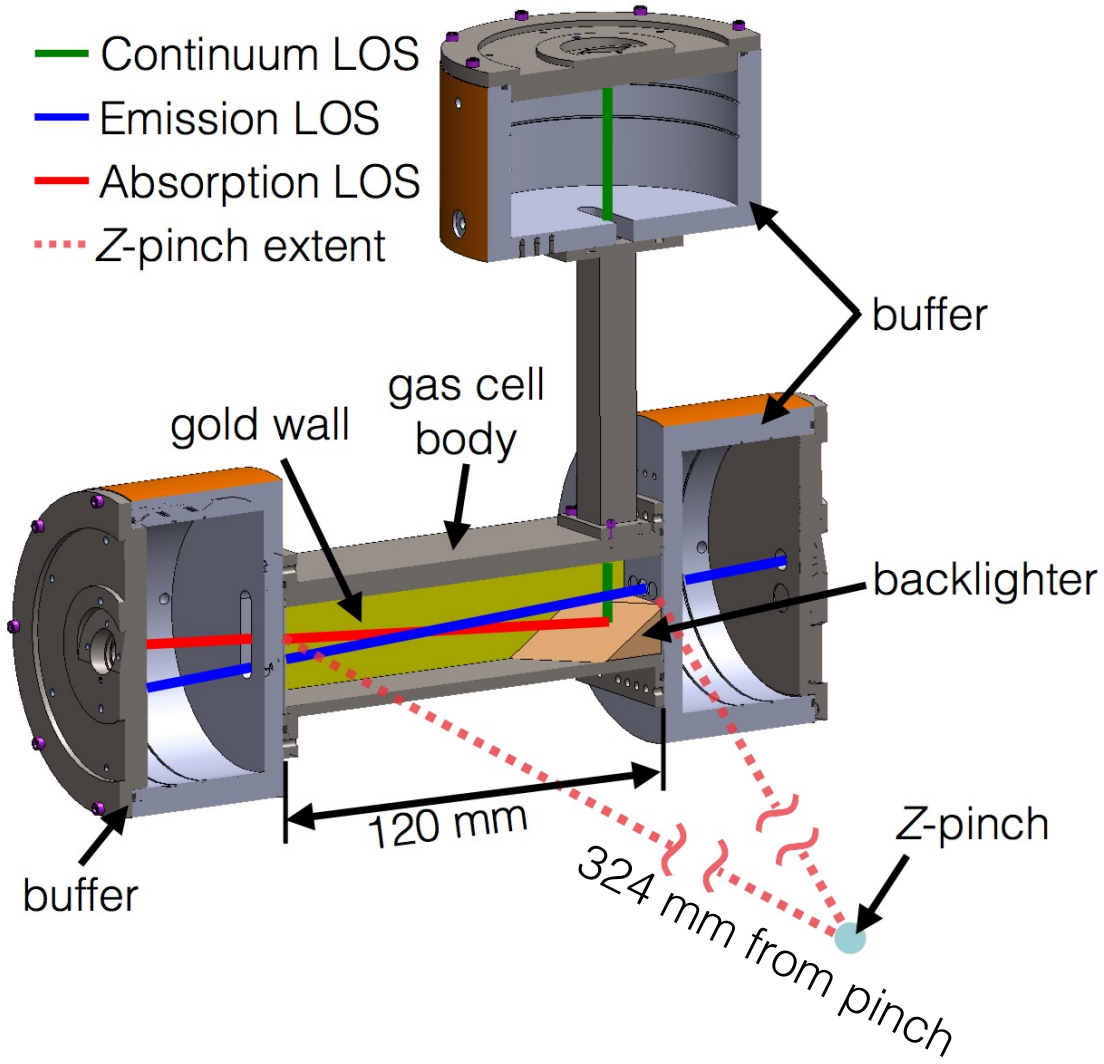
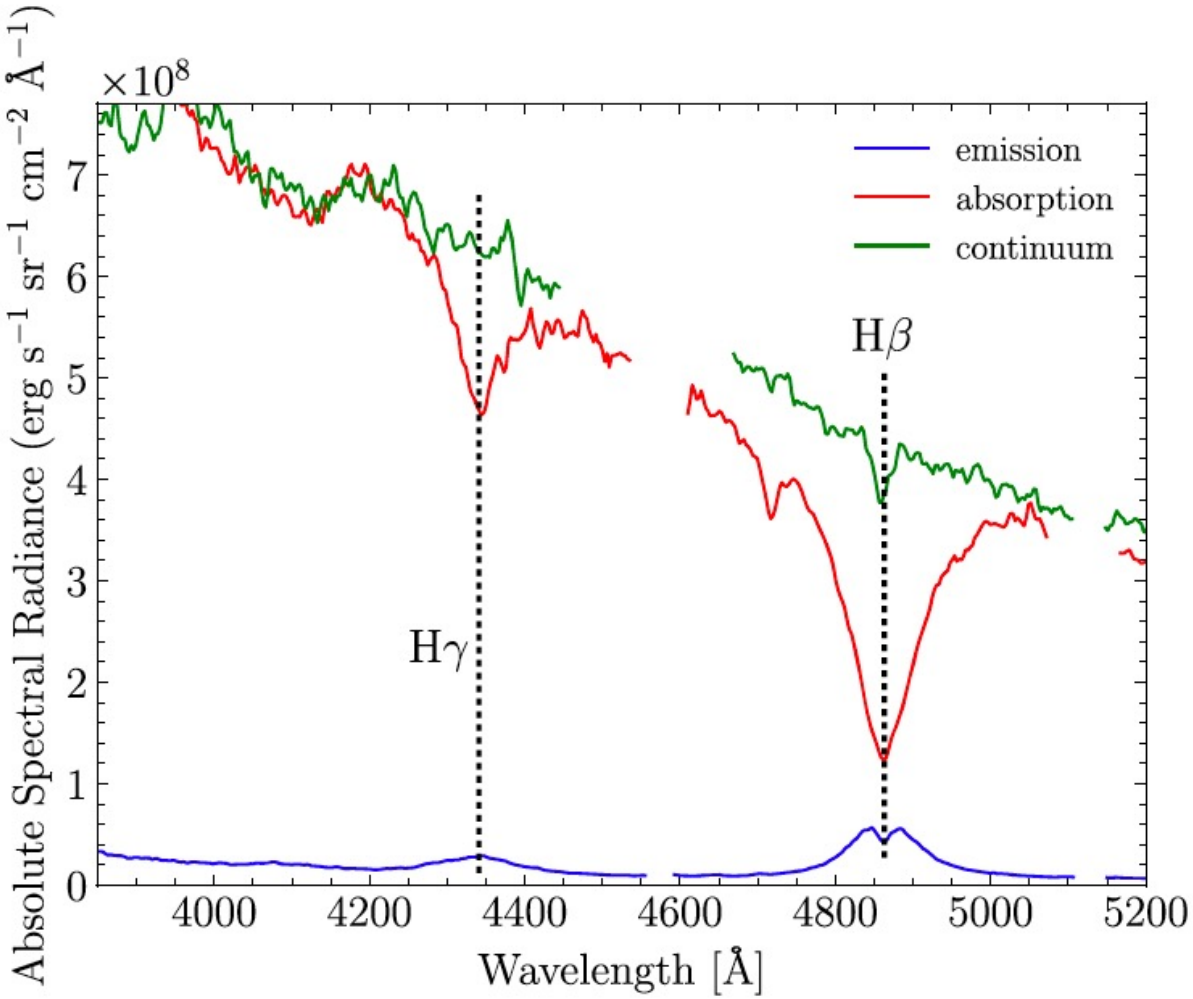
The White Dwarf Photosphere Experiment on the Z-machine



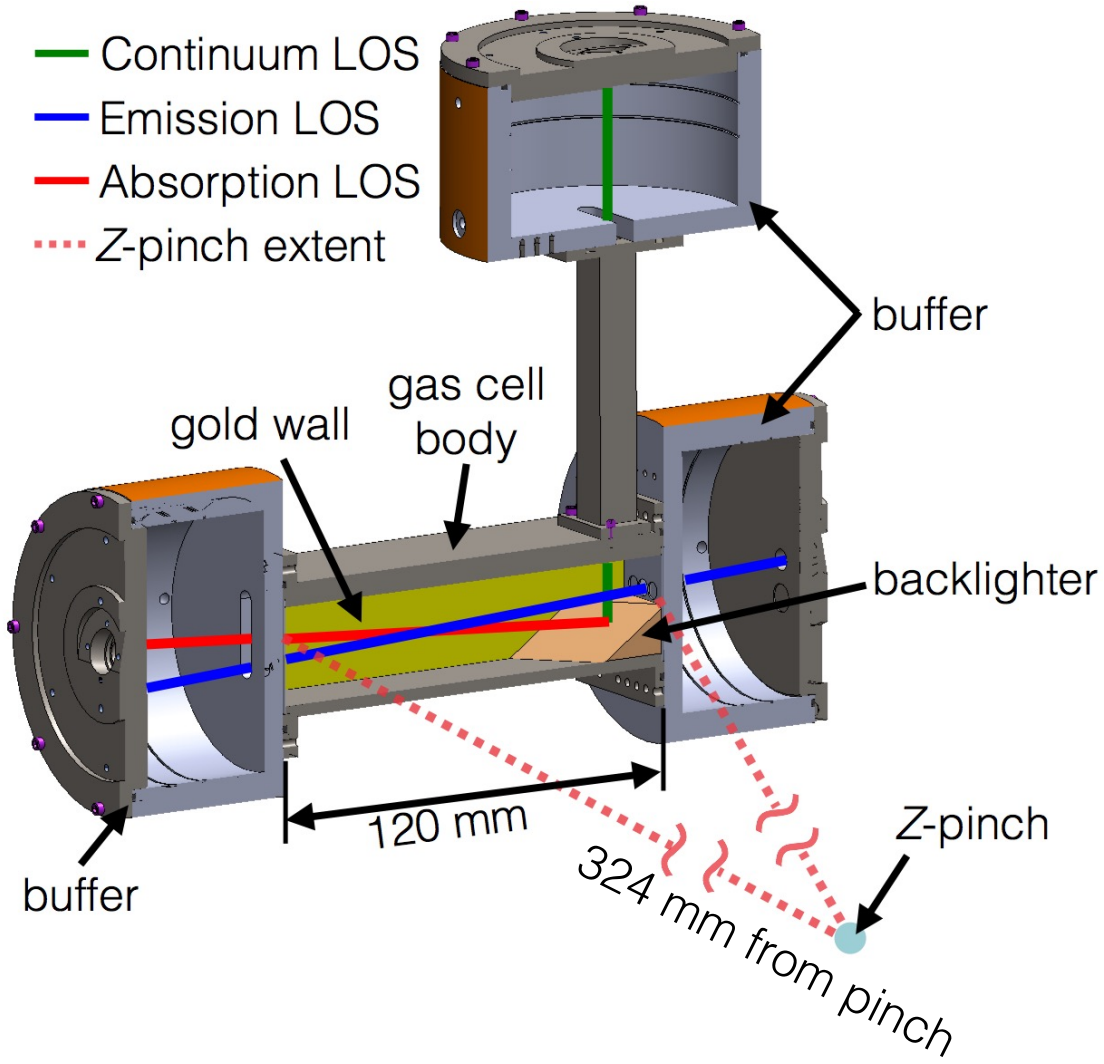
Schaeuble et al. (2019)



Schaeuble et al. (2019)

The White Dwarf Photosphere Experiment on the Z-machine

Across a range of n_e during each experiment.



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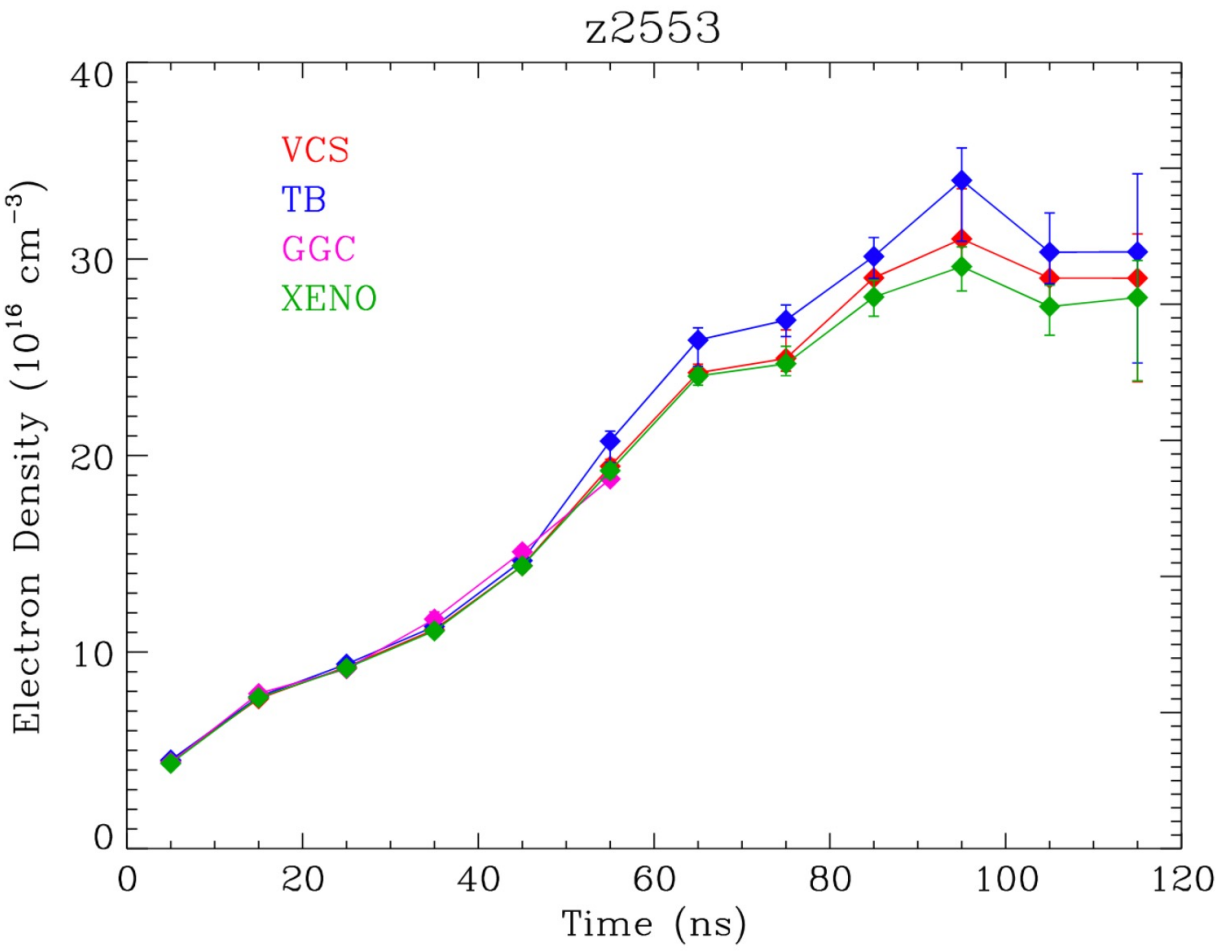
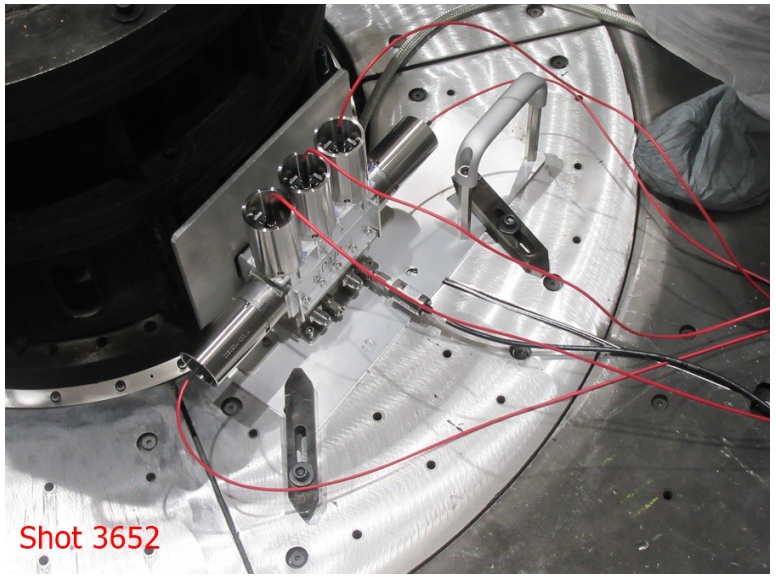
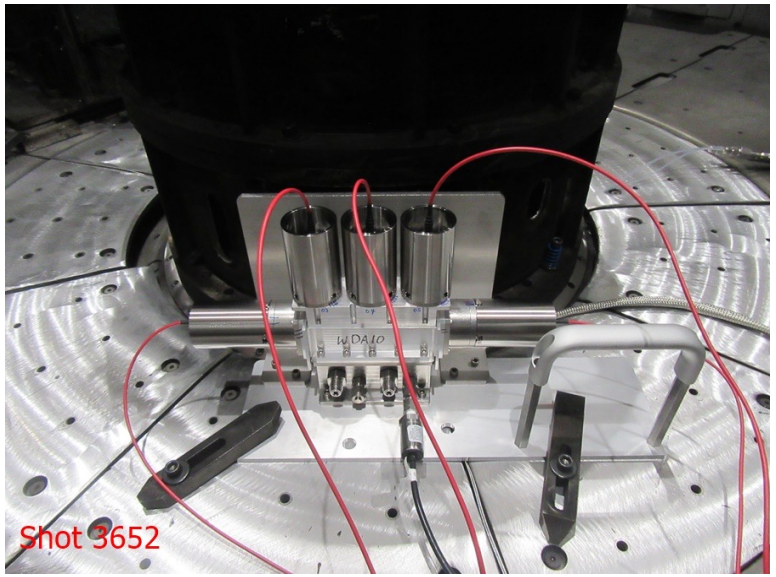
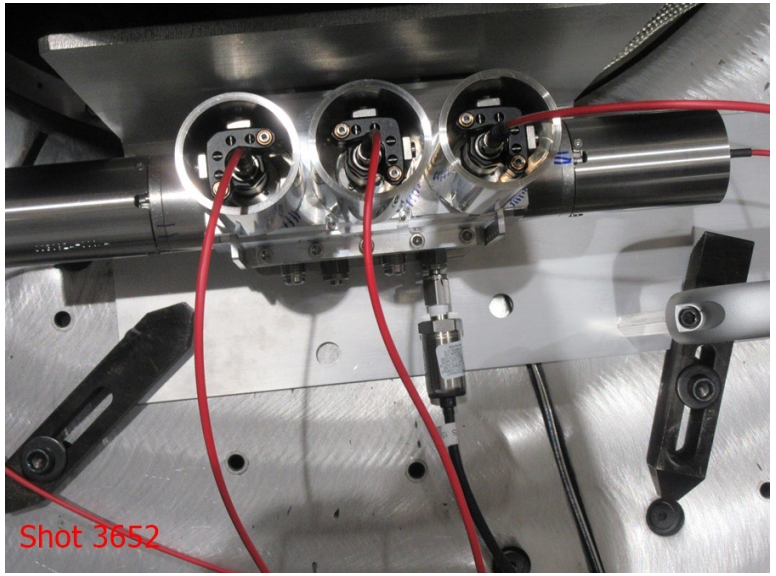


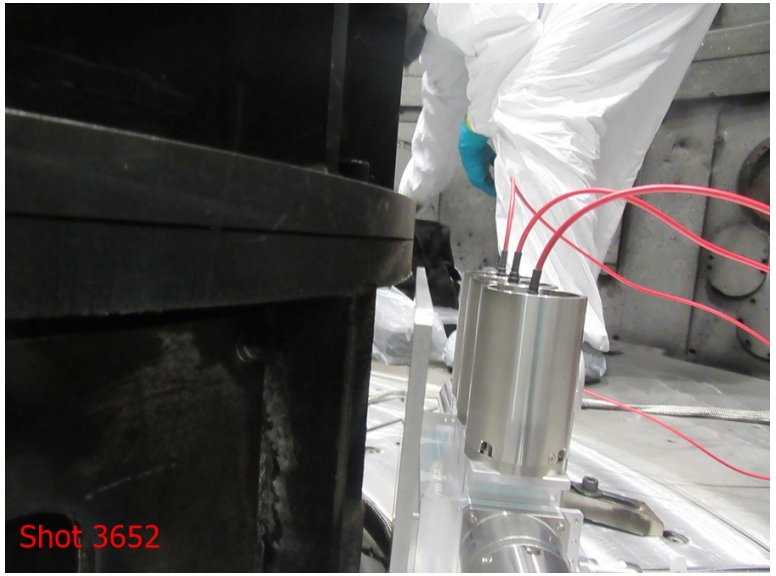
Falcon et al. ApJ (2015)

The White Dwarf Gas Cell in Chamber



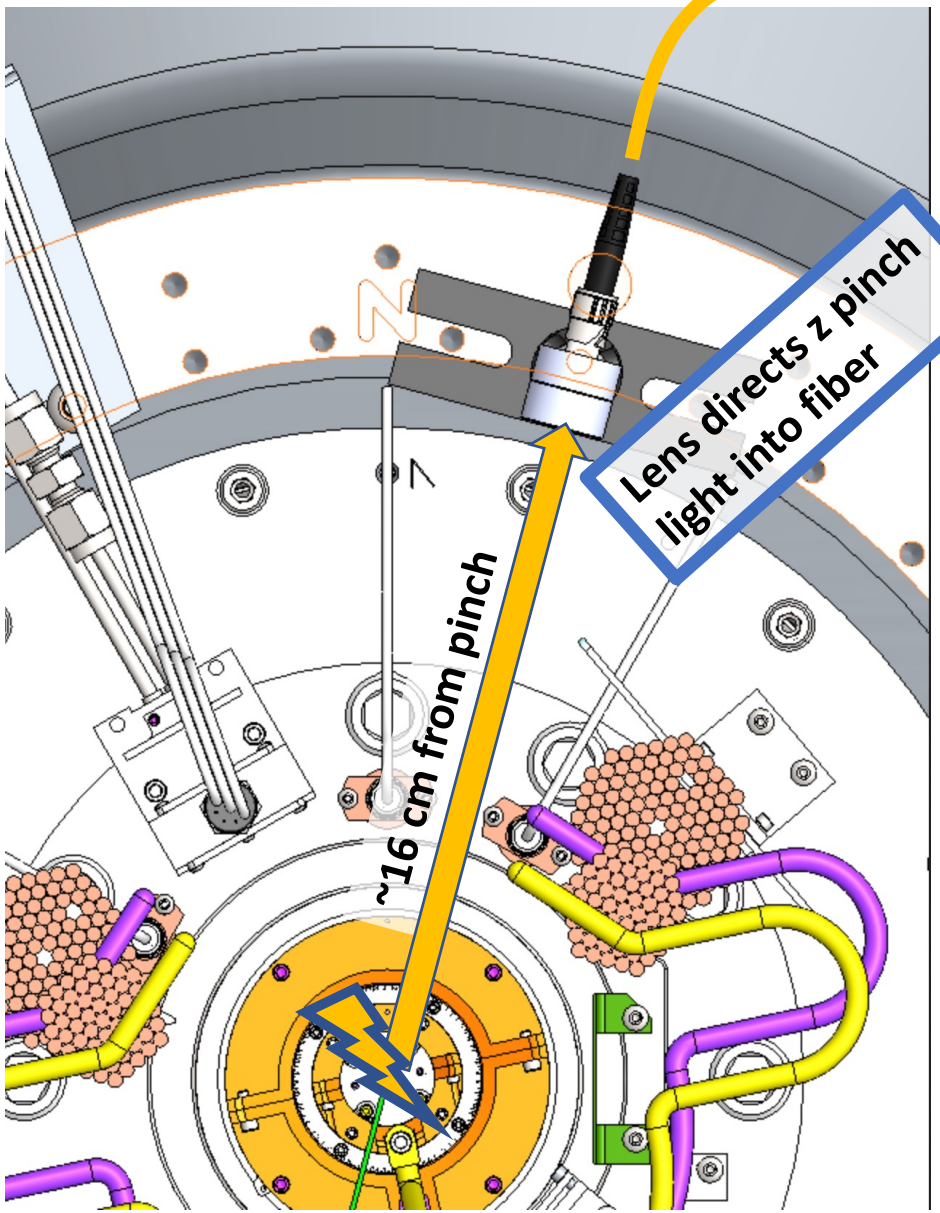






The White Dwarf Gas Cell Post Shot

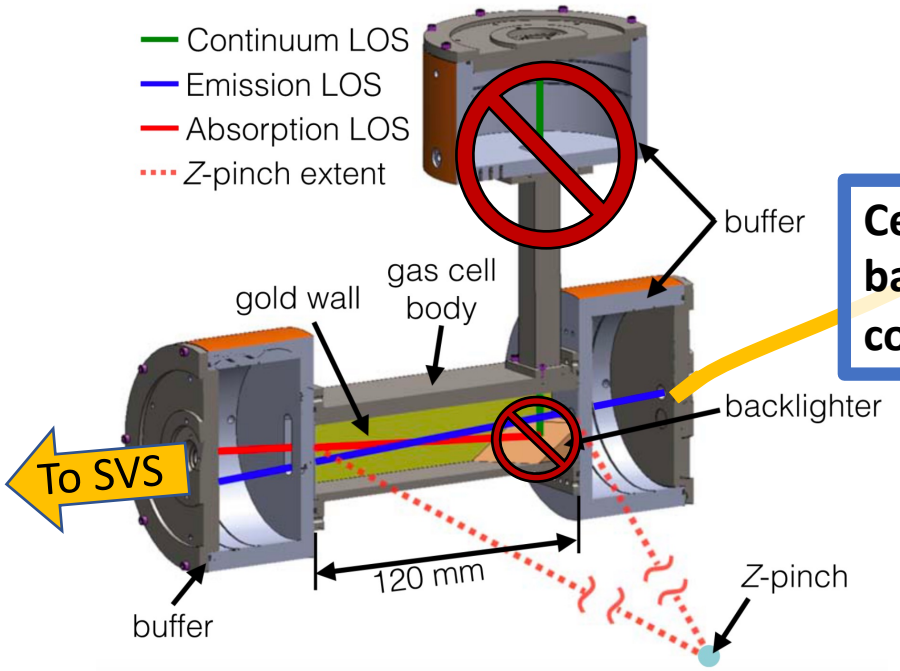
Light from pinch is used to backlight plasma in cell



Long fiber delays light and directs it into cell

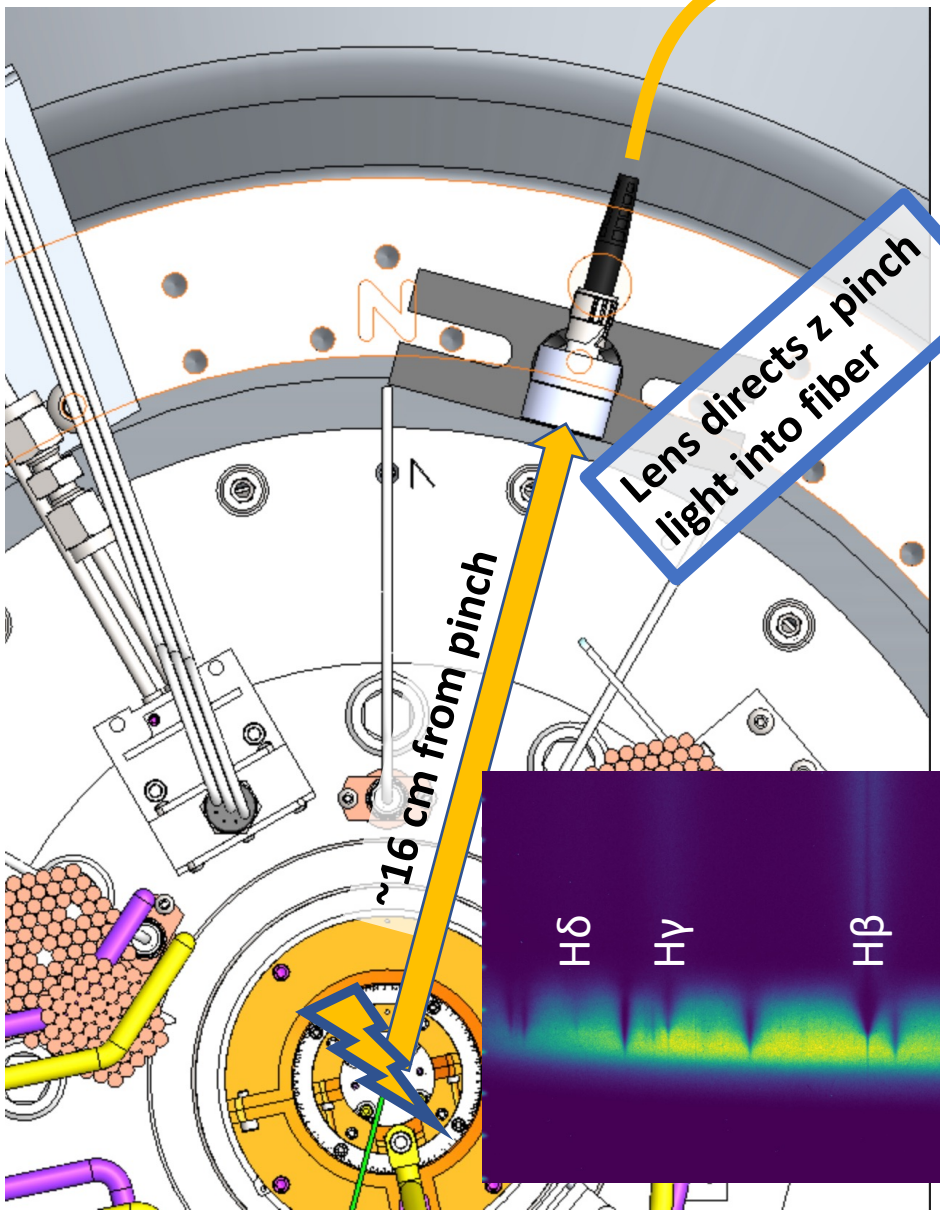
To SVS

Dual core fiber allows direct measurement of backlighting signal



Cell no longer needs backlighting wedge or continuum line of sight

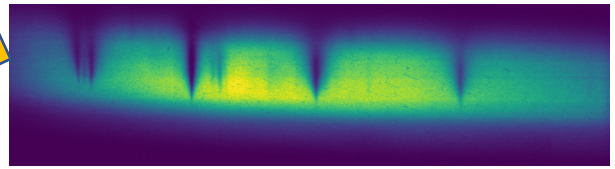
Light from pinch is used to backlight plasma in cell



Lens directs z pinch light into fiber

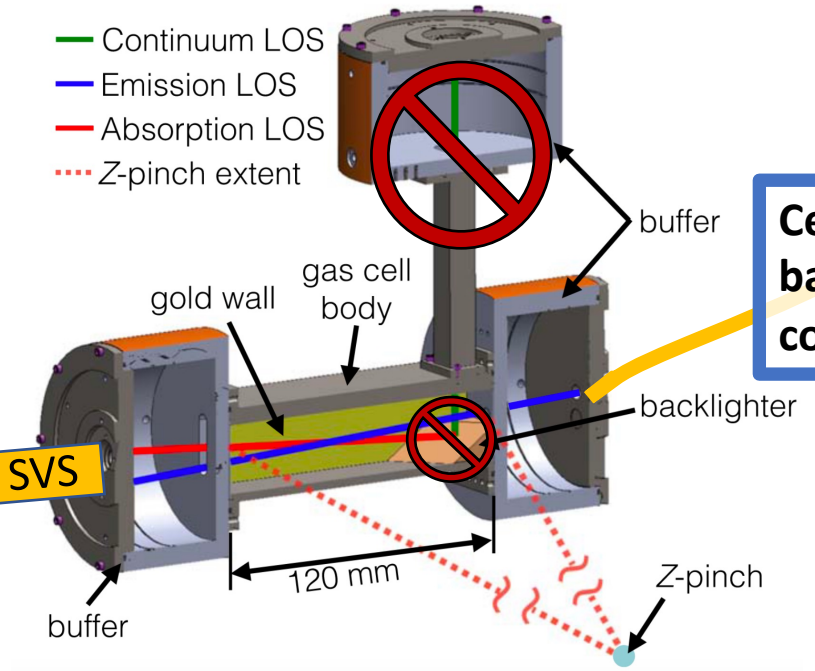
Long fiber delays light and directs it into cell

To SVS



Dual core fiber allows direct measurement of backlighting signal

To SVS

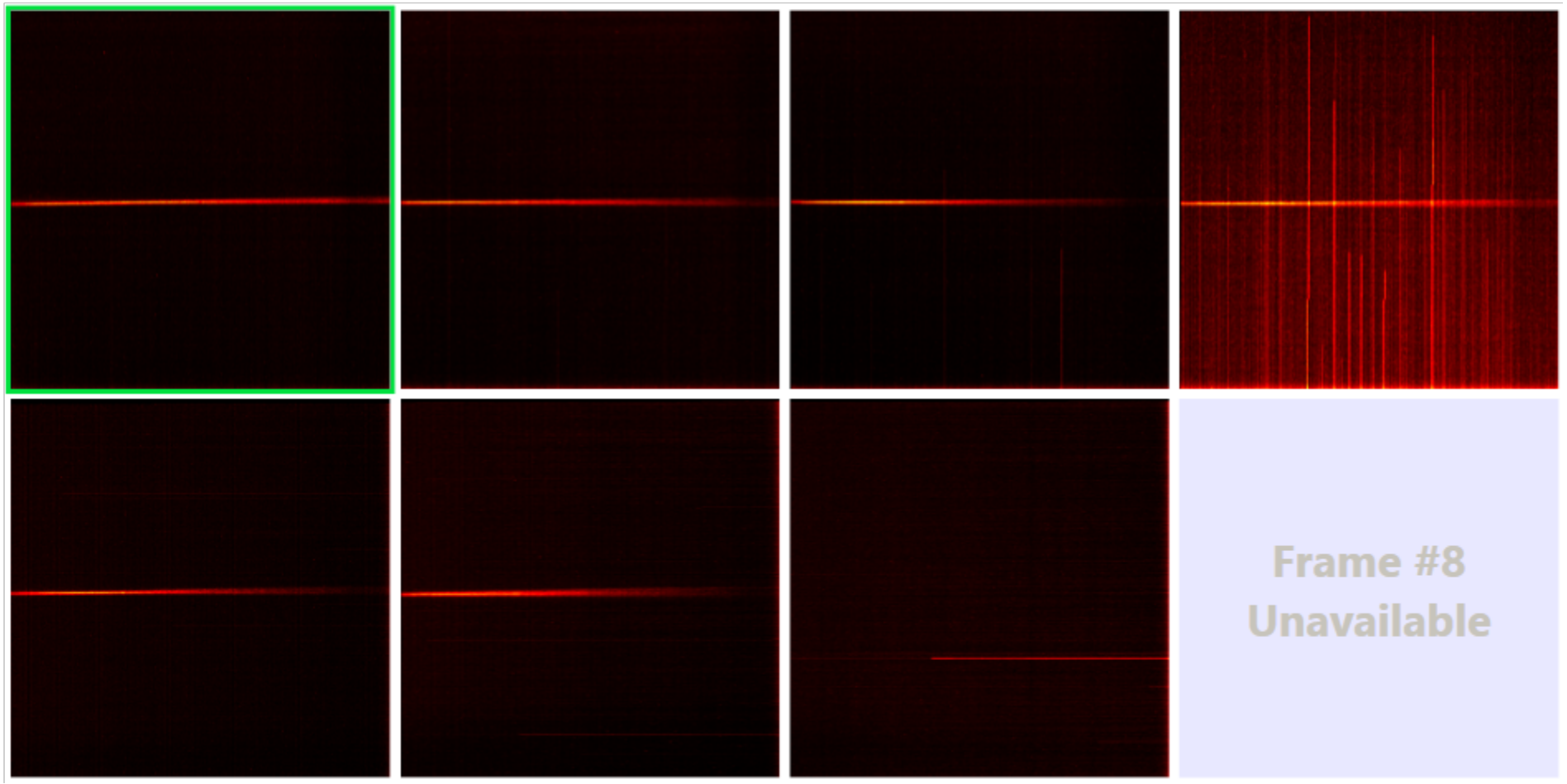


Cell no longer needs backlighting wedge or continuum line of sight

Increased Spectroscopic Resources Are Enabling New Measurements

- Currently, we have 2 Streaked Visible Spectroscopy (SVS) systems with CCDs
- The 2 SVS film systems are being replaced with CCDs. One is already in the lab; the other should arrive soon.
- We have 1 single frame gated system, which allows multiple (up to ~7) lines of slight on the same frame using a linear fiber array aligned along the slit
- We have a new multi-frame gated system, which can record 2, 4, or 8 frames at different times, and also allows multiple fibers along the slit.
  - We successfully fielded this for the first time last week, though there are still some bugs to work out.

First successful fielding of Cordon 8-frame gated system (z3721)



New UV Spectroscopy Could Enable New Science

- A new UV spectroscopy system was fielded (in the LOS 130 screenbox) for the first time on Friday.
- The current detector is a single frame gated system on a Princeton Instruments IsoPlane spectrometer, which permits multiple fibers along the slit with no astigmatism.
- Currently might be able to get down to 2500 Ang.
- This would be immediately useful for studying
  - Occupation probability/continuum lowering in hydrogen
  - UV lines of C, O, & He

New UV Spectroscopy Could Enable New Science

- Development is underway on a vacuum UV spectrograph, which will be fielded first on Mykonos.
- This could allow measurement of hydrogen Ly-alpha
- As well as numerous C, O, and He lines

See Jackson White's Poster

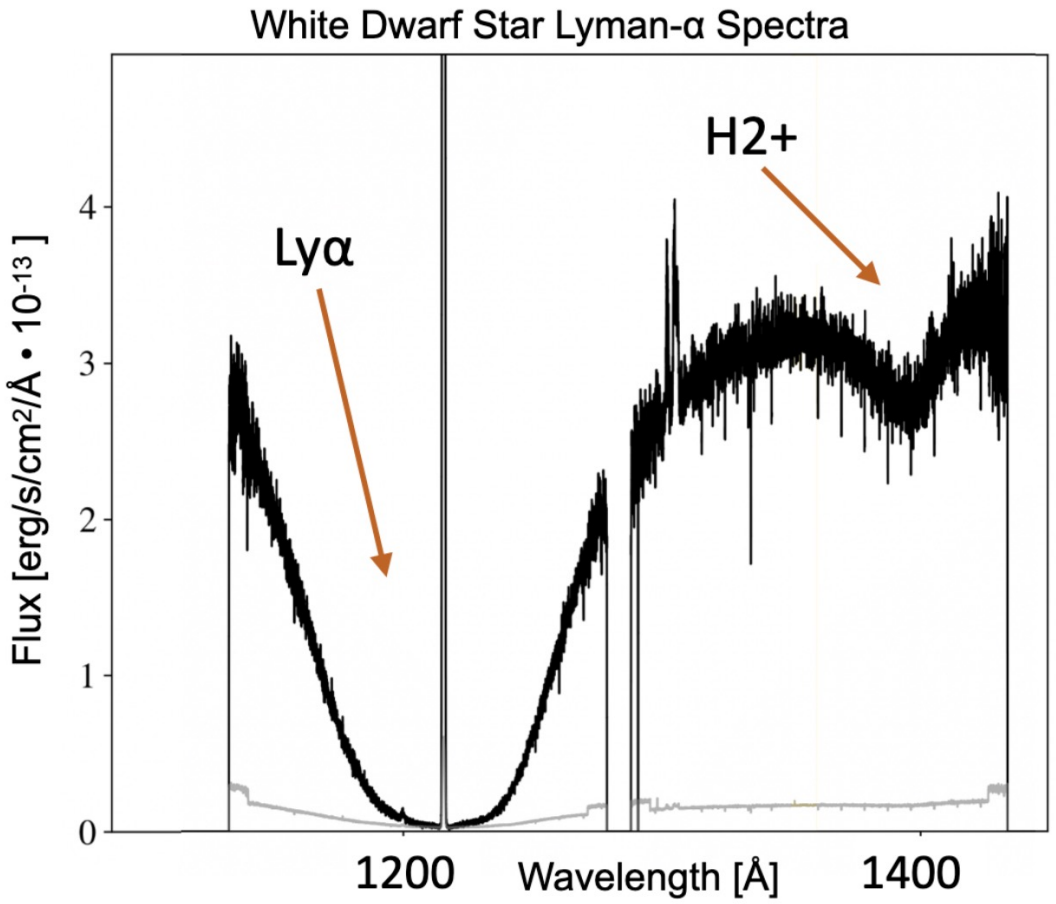
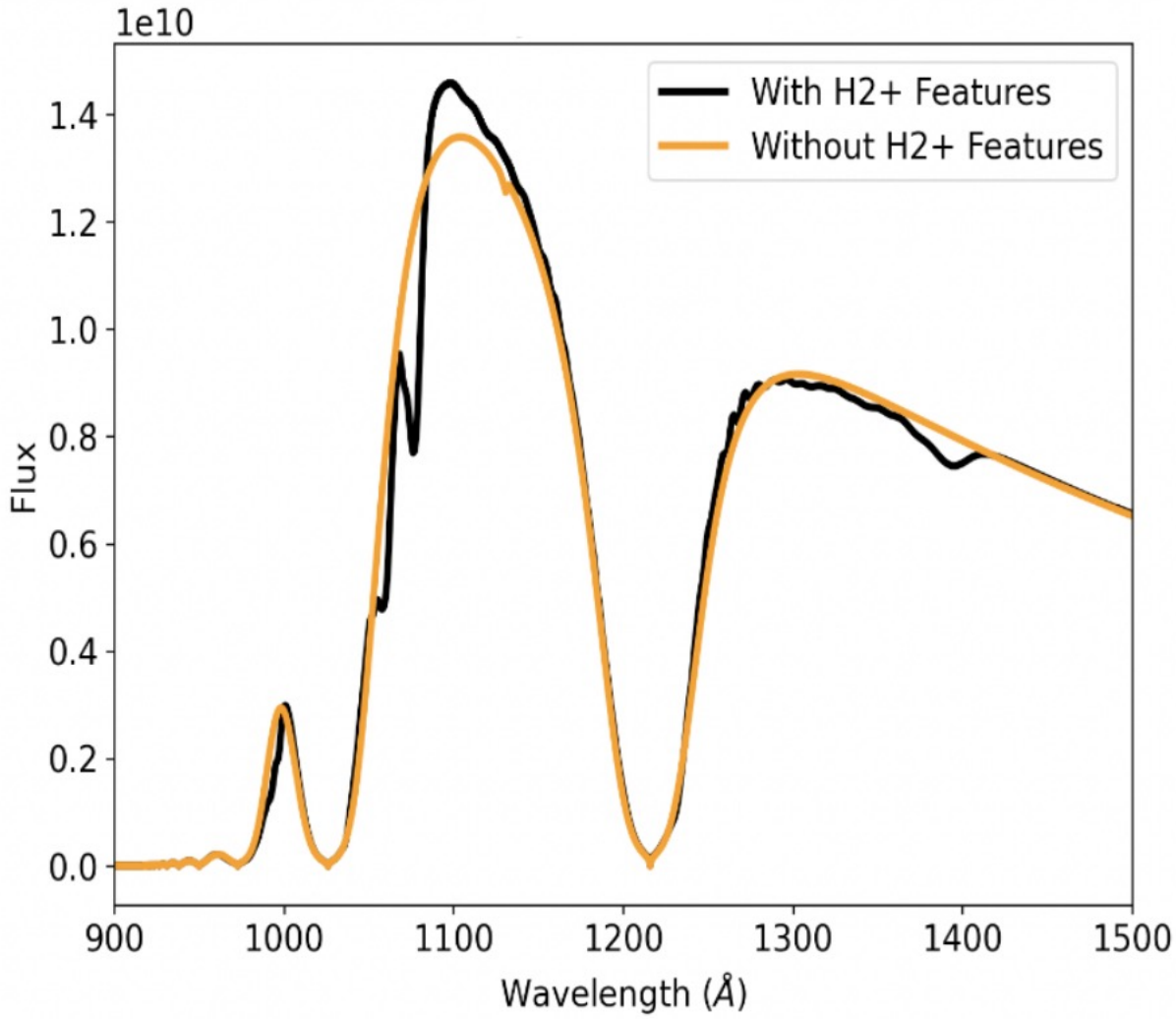
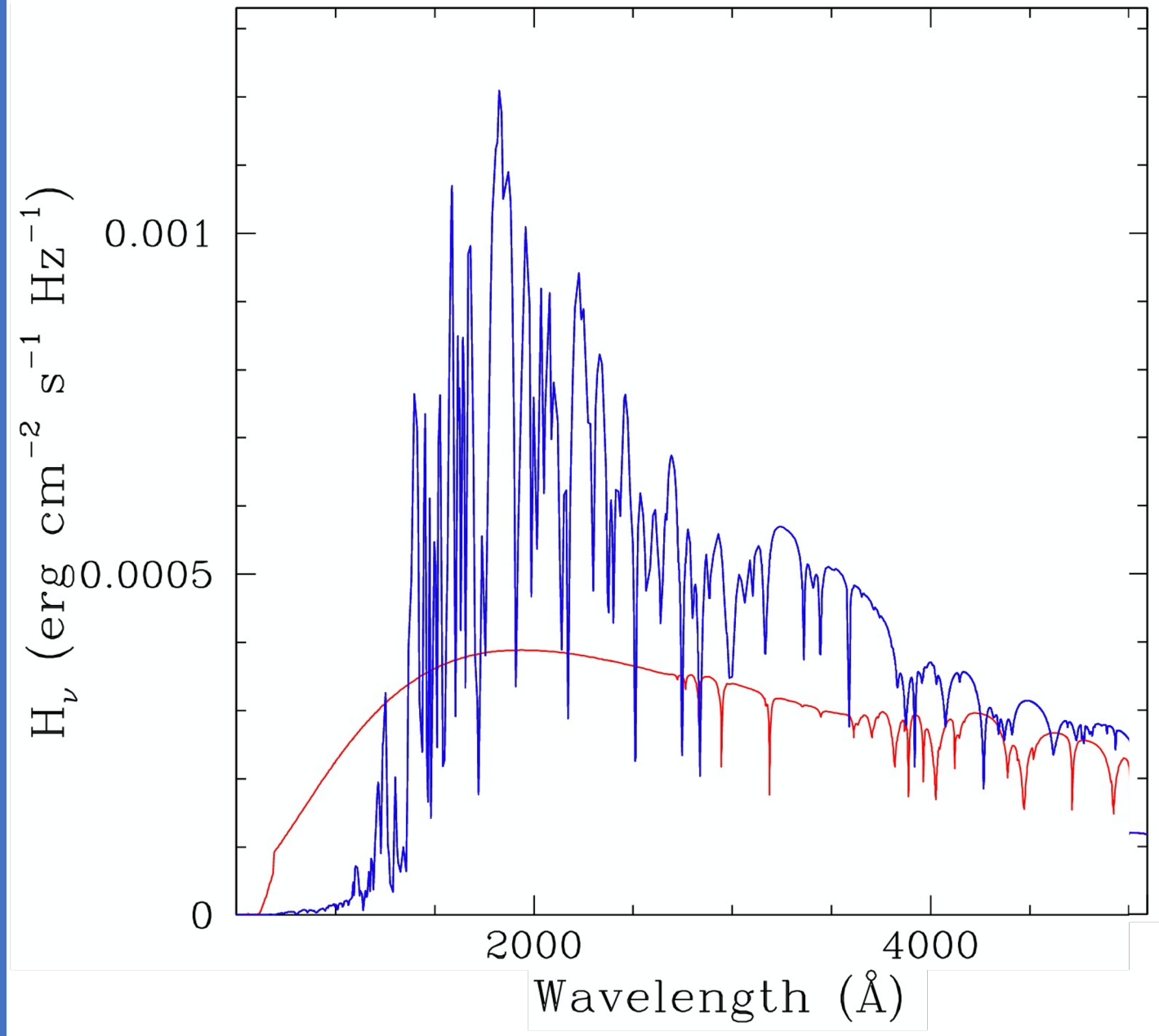


Fig.1: Ultraviolet spectra of DA white dwarf star WD1713+695 from the *Hubble Space Telescope* (HST), illustrating the 1400Å quasi molecular feature associated with the $3d\sigma_g \rightarrow 2p\sigma_u$ transition in H2+

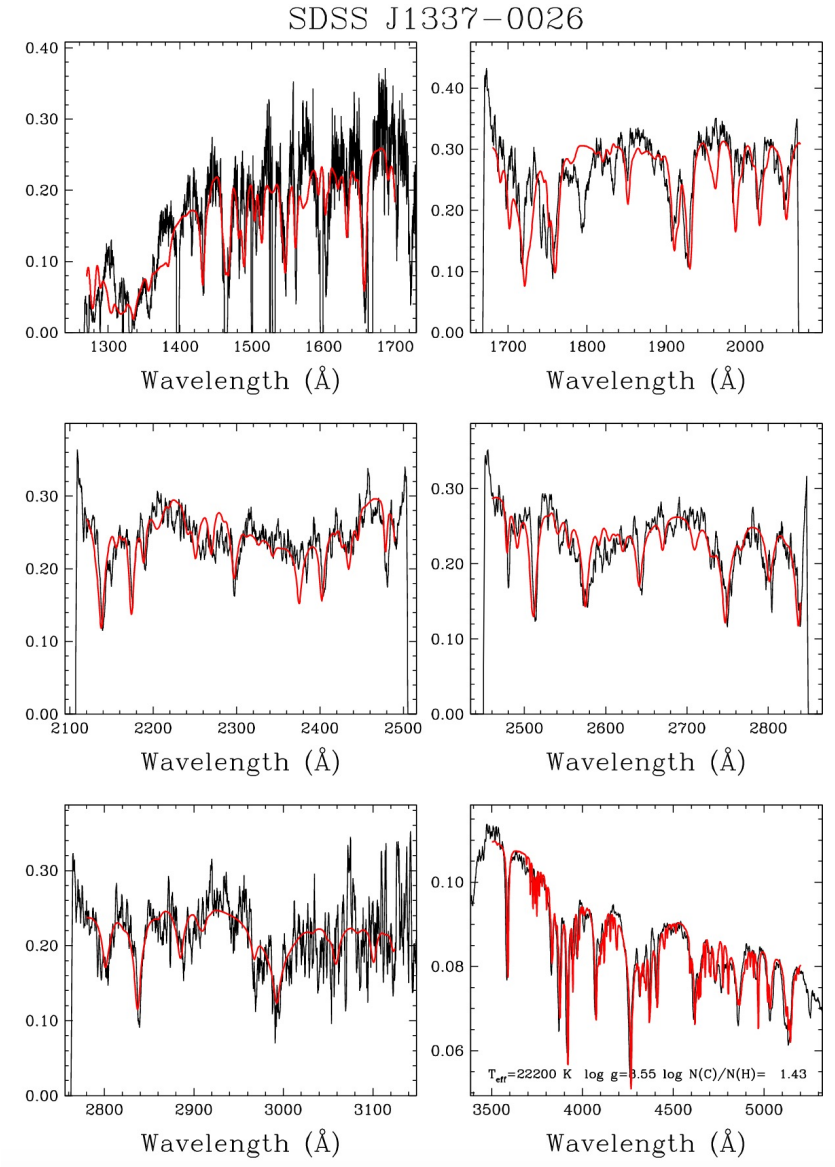


Model UV Spectra of Helium- and Carbon-Atmosphere White Dwarfs



Dufour et al. 2008

HST/COS observations of C/O Atmosphere White Dwarfs



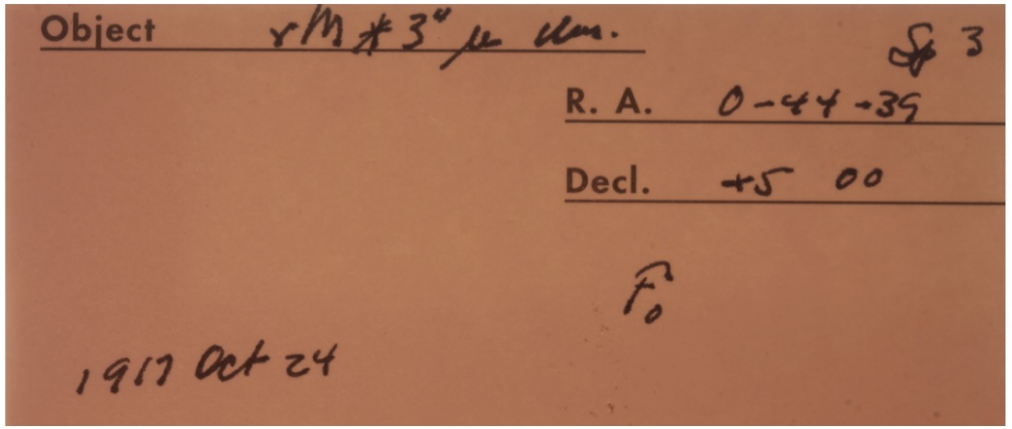
Dufour et al. 2010

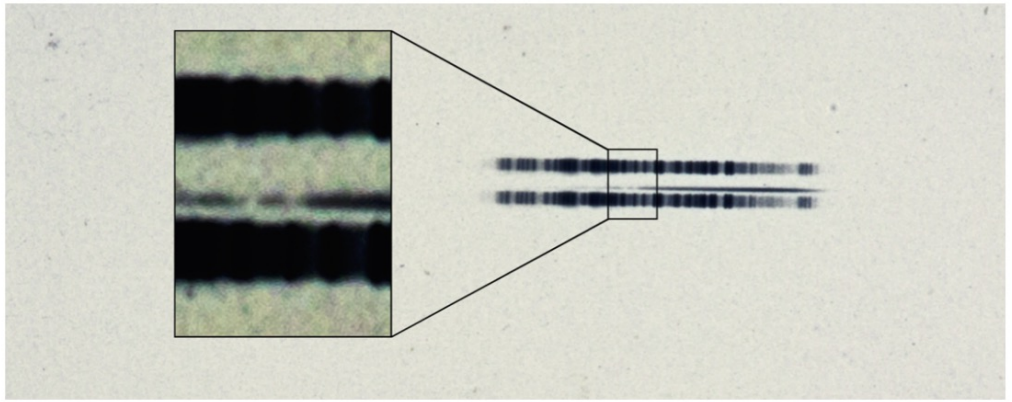
White Dwarfs Reveal Planetary Interiors

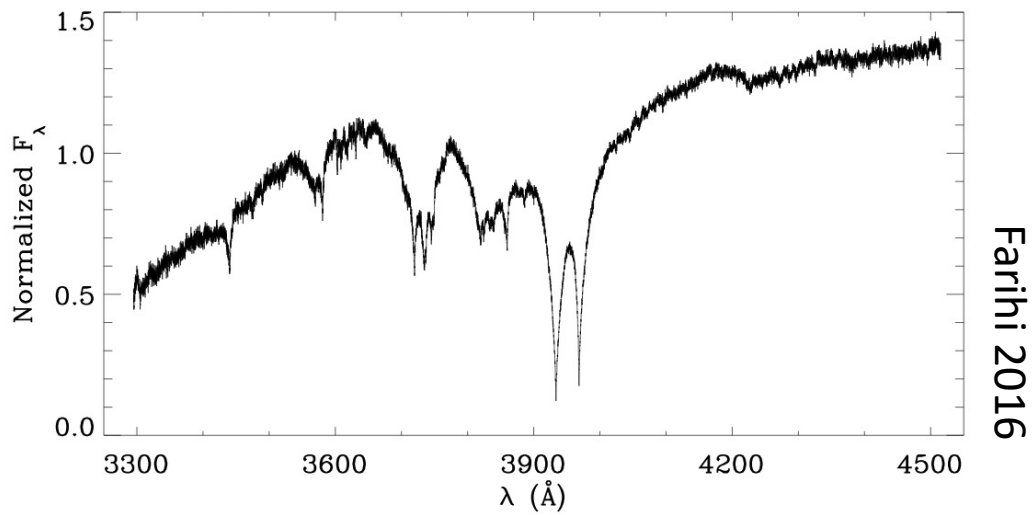
They Crush Exoplanetary Rocky Debris & Accrete It

Spectra Give Abundances

Accurate log g Necessary to Infer Composition







Farihi 2016

Achieving higher densities in the White Dwarf Photosphere Experiment

- Using *thinner windows* from Luxel and *higher pressure*, we have been able to get to higher density in hydrogen (> 10^{18} cm^{-3}) in our standard setup (outside the blast shield and 10 mm from the gold back wall).
- We could likely increase our He densities by a factor of a few with the same strategy.
- To get to higher, more interesting densities in He would likely require a different platform.
- Marc Schaeuble developed and fielded an inside-the-blast-shield design.
- This platform combined with, e.g., a 1 mg/cc CH foam might allow us to increase our densities to ~10^{20} cm^{-3}.