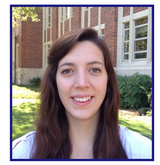
Do Massive Stars Have Planets?

Sara D. Barber[1], Mukremin Kilic[1]

1: The University of Oklahoma

More Information



Background

- The vast majority of planets have been discovered using transits, radial velocity, and imaging. These methods break down, however, with increasing stellar mass.
- One can more easily search for planets around massive ($M > 3M_{\odot}$) stars in post main-sequence.
- Some white dwarfs (WDs) exhibit excess emission in the IR due to reprocessed light from circumstellar dust.
  - Dust disks result from tidal disruption of asteroids that pass within WD's Roche lobe (Debes & Sigurdsson 2002; Jura 2003).
- Disks serve as tracers for planets at WDs.
  - Abundance analysis of dusty WDs shows that accreted metals are similar in composition to bulk Earth (Zuckerman et al. 2007; Xu et al. 2013).

First Detection

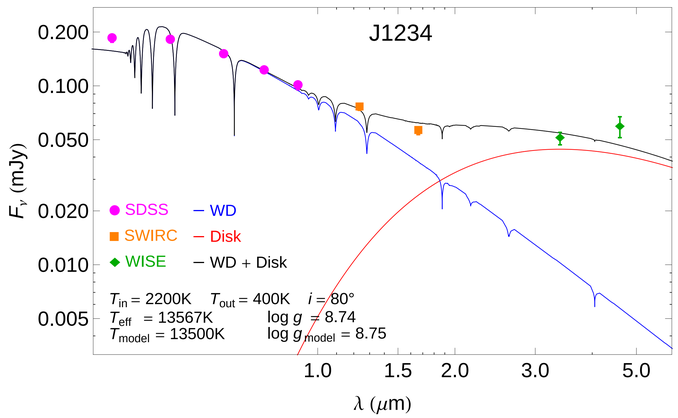


Figure 1: Spectral energy distribution of the most massive WD found to host circumstellar dust (Barber et al. 2014). J1234 has a mass of 1.04 $M_{\odot}$ (progenitor mass 5.4 $M_{\odot}$) and its discovery offers the first confirmation that massive WDs (and their massive progenitor stars) host planetary systems.

Observations

- We chose a sample of 100 WDs in SDSS with $M > 0.8M_{\odot}$ and 9500 $< T_{eff} <$ 22,500 K.
  - This temperature range is where almost every known dusty WD system lies and this temperature cut optimizes our chance of finding disks.

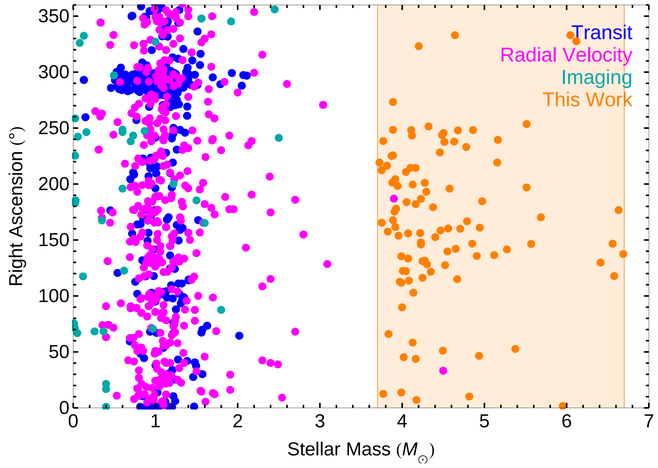


Figure 2: There is a strong cutoff in exoplanet detections around stars above 3 $M_{\odot}$. Our 100 massive WDs probe an untapped parameter space by looking for planets in post main-sequence.

- We obtained 4.5 μm IRAC photometry of 100 WDs in *Spitzer* Cycle 9
- We are in the process of following up 23 WDs with 4.5 μm excess in the 3.6 μm IRAC band in *Spitzer* Cycle 10 to rule out extraneous sources of the observed excesses.
- We will also obtain NIR photometry of the WDs with an infrared excess using the MMT+SWIRC to constrain the parameters of our disk models.

Preliminary Results

- Out of 100 WDs observed with *Spitzer* in the 4.5 μm band, 23 exhibit excess emission.
- We are observing these 23 WDs in the $3.6\mu m$ band and so far have two with excesses consistent with circumstellar dust.

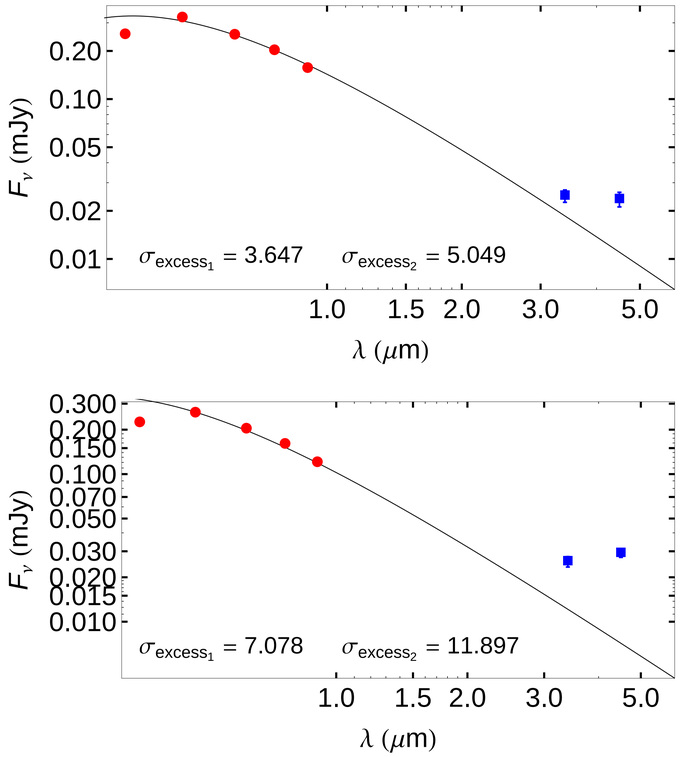


Figure 3: Spectral energy distributions of two massive WDs with infrared excesses indicating the presence of circumstellar dust.

References

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Xu, S., Jura, M., Klein, B., Koester, D., & Zuckerman, B. 2013, ApJ, 766, 132

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