

Planetary Remnants Orbiting White Dwarfs

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Background

- Circumstellar debris detected as flux excess in IR
 - Post-MS mass loss + giant planets perturb orbits of minor bodies
 - Minor bodies are tidally disrupted when brought near WD
 - Debris eventually embodies disk geometry
- 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)
 - Disk frequency gives lower limit on frequency of planets at WDs
- We present a near- and mid-IR search with MMT/SWIRC, UKIDSS, and WISE of the $\sim 18,000$ WDs in the SDSS DR7 WD catalog for dusty disks orbiting WDs

Observations

- Cross-correlation of $\sim 18,000$ WDs between SDSS DR7 and WISE finds 52 WD+disk candidates (Debes et al., 2011)
- Some excesses may be due to contaminating sources in WISE 6" beam
- MMT+SWIRC J & H band imaging (0.5–1.5" PSF) of 16 WD+disk candidates

Results

- Optical data fit with DA WD atmosphere models (Gianninas et al., 2011)
- Infrared excesses fit with physically thin, optically thick disk models (Jura, 2003)
 - Contaminants in WISE PSF for 11 candidates, one WD+dM
 - Confirm four WD+disk candidates as dusty WDs in SWIRC data
 - Two dusty WDs in UKIDSS LAS data

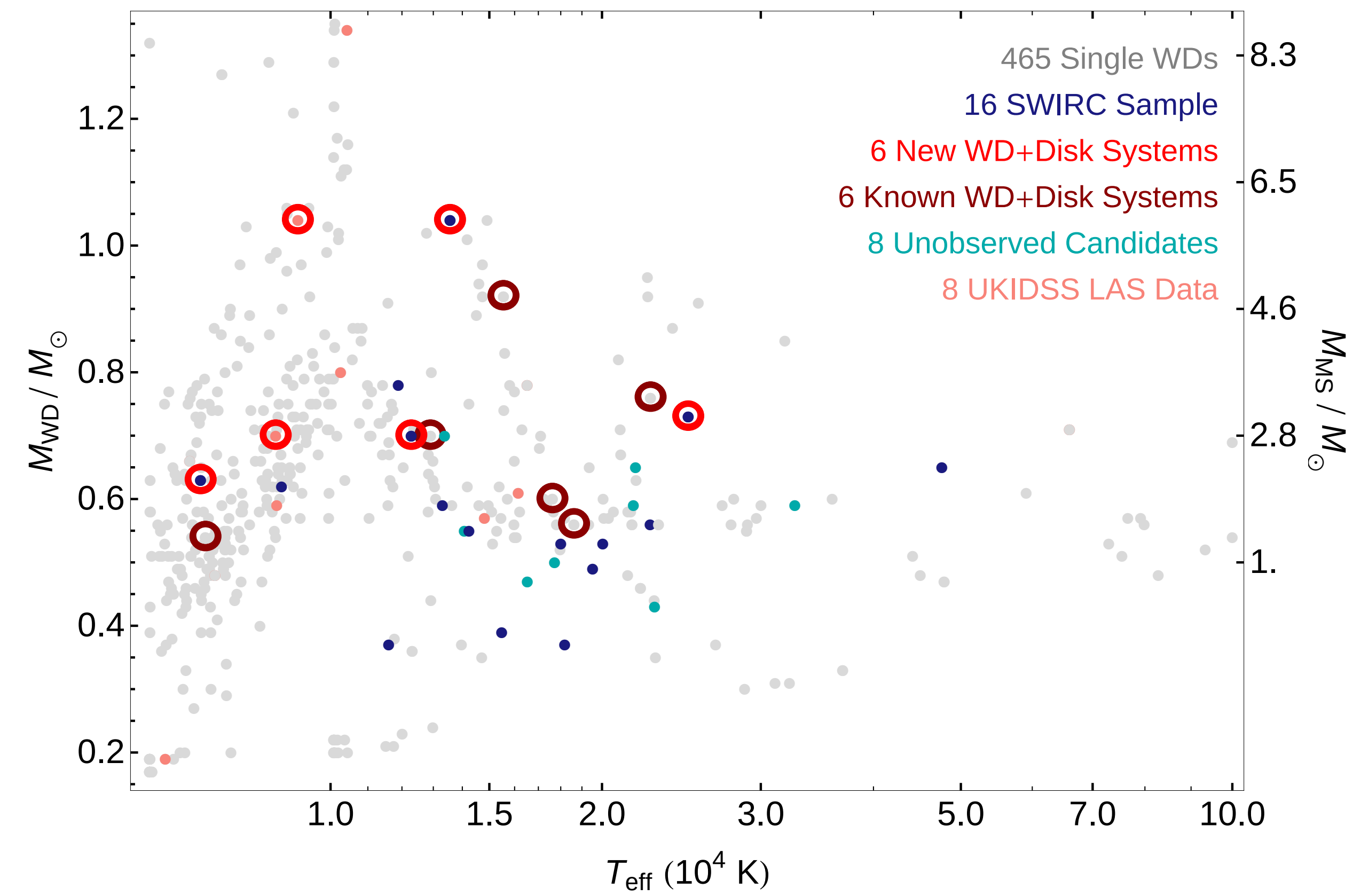


Figure 1: Single WD sample from Debes et al. (2011). Indicated are which targets we observed with SWIRC, which are known or new disk discoveries, as well as which have UKIDSS LAS data and which remain to be observed in the near-IR.

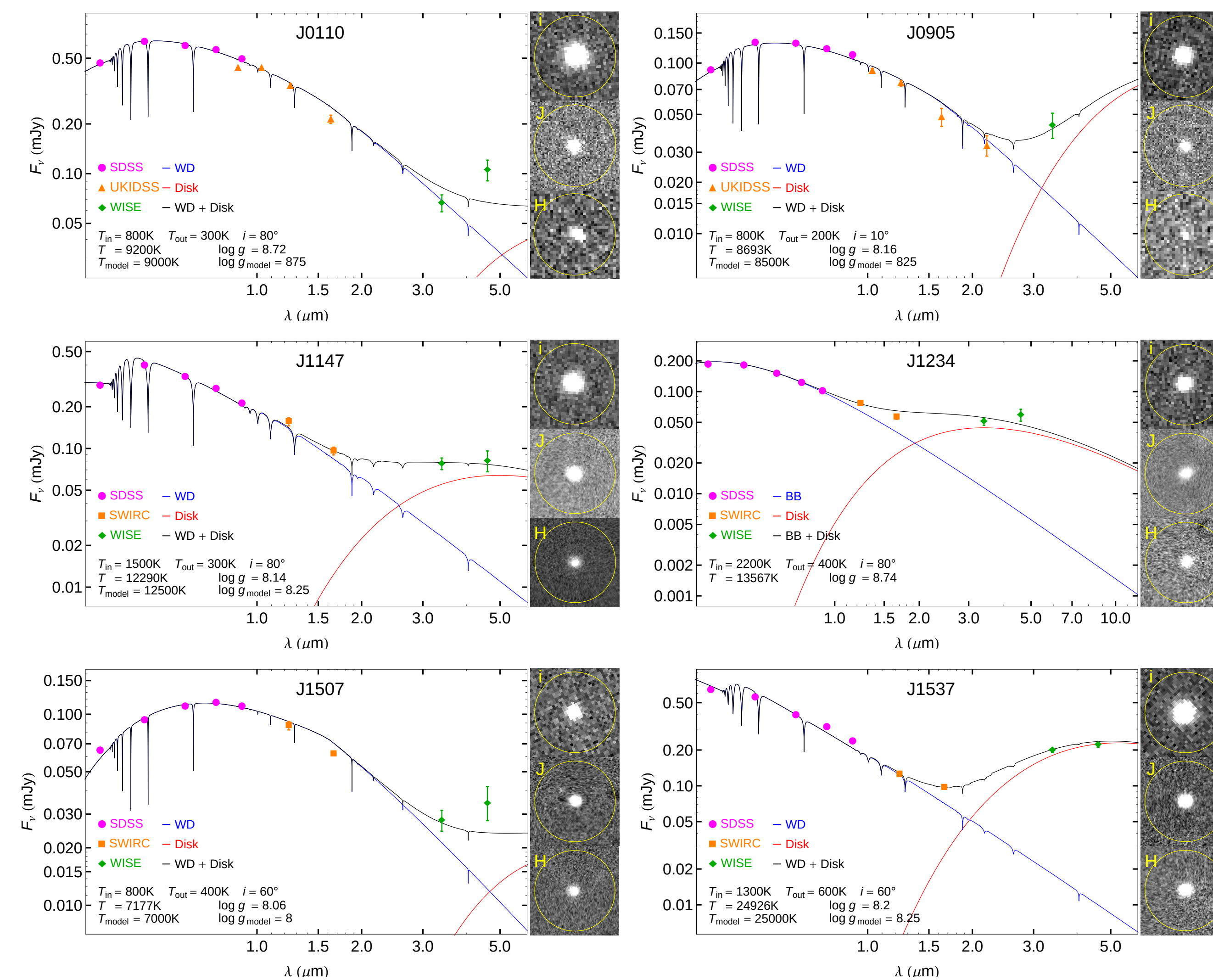


Figure 2: The spectral energy distributions of six WD+dust disk systems identified using SDSS+SWIRC(UKIDSS)+WISE photometry. The blue line shows the synthetic WD spectrum, the red line shows the best-fit disk model, and the black line shows the combination of the WD photosphere and circumstellar disk emission.

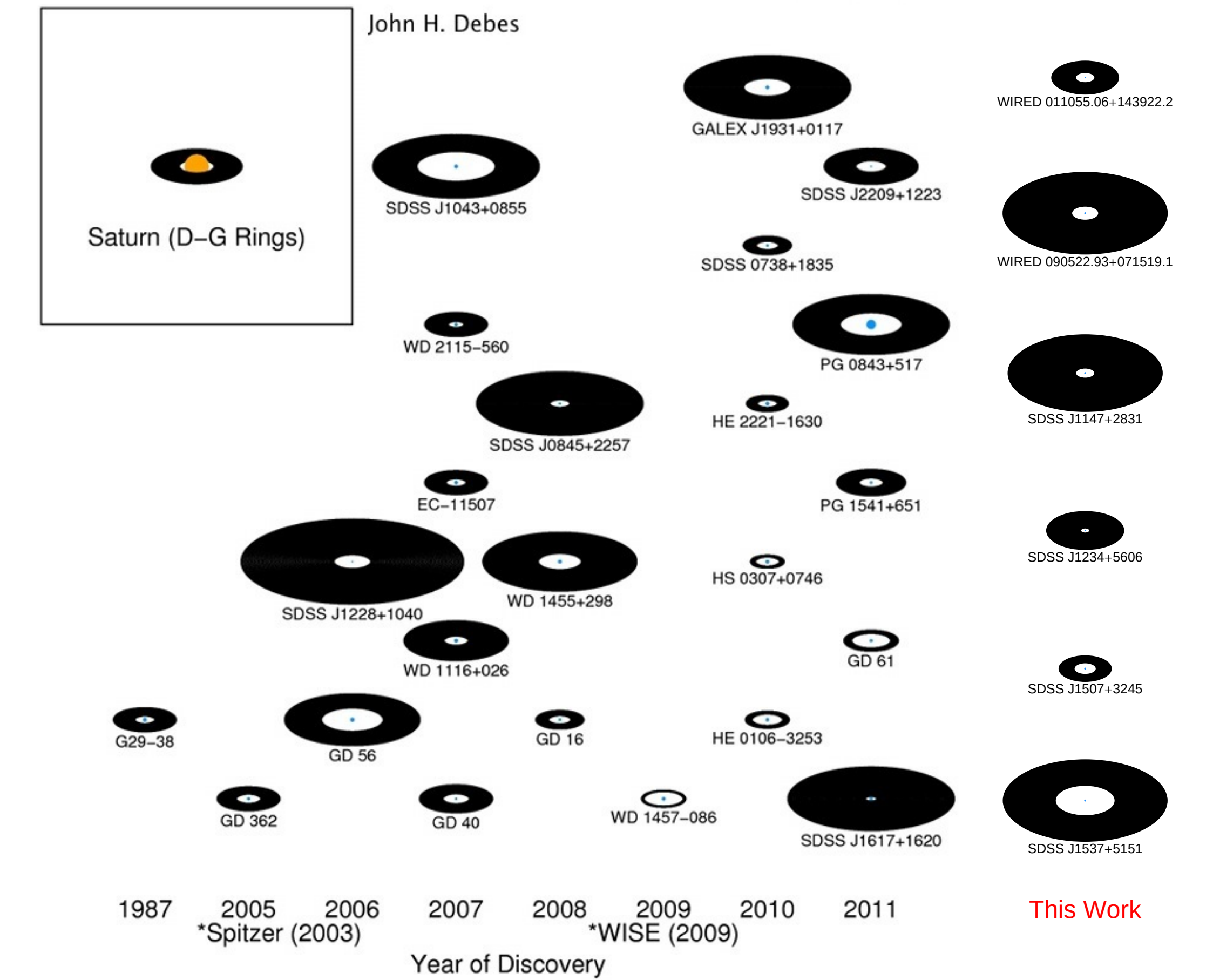
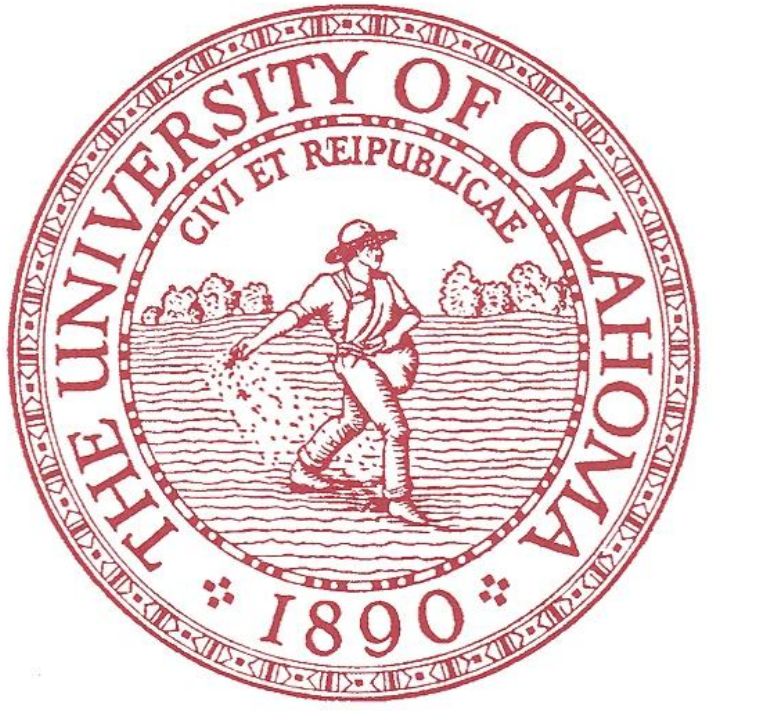
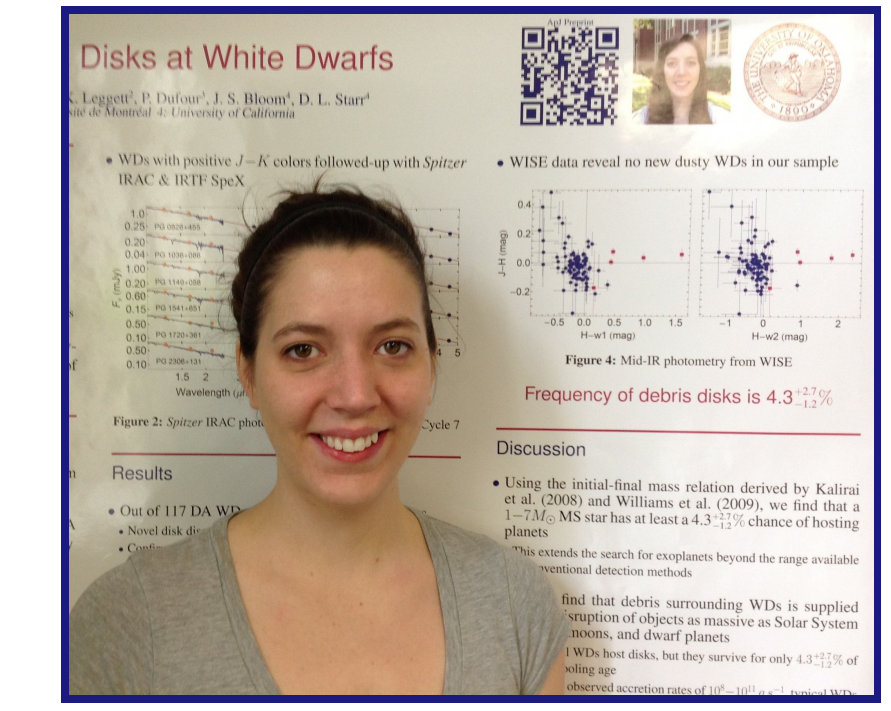


Figure 3: Dusty WD discoveries over time.

Discussion

- We find 12 disks in a sample of 465 single WDs which gives a 2.6% frequency of dusty WDs
 - This significantly increases the sample of known dusty WDs
 - Eight WD+disk candidates remain unobserved in the near-IR which could bring this frequency up to 4.5% if all eight host dust
- Using the initial-final mass relation derived by Kalirai et al. (2008), we find that a $M < 8M_{\odot}$ MS star has at least a 2.6% chance of hosting planets
 - This extends the search for exoplanets beyond the stellar mass range available to conventional detection methods

References

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