An Extended Unbiased Survey to Determine the Frequency of White Dwarf Debris Disks

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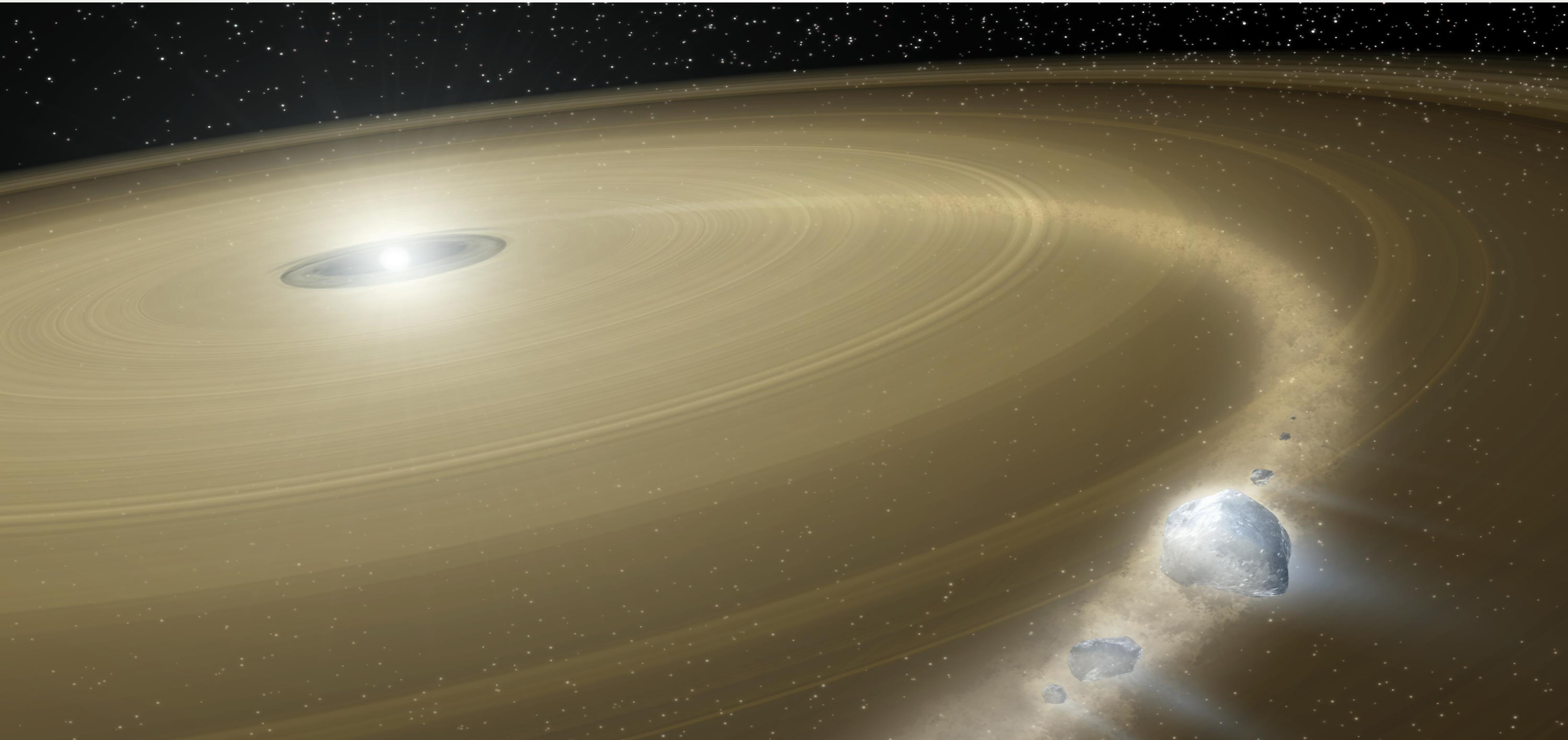
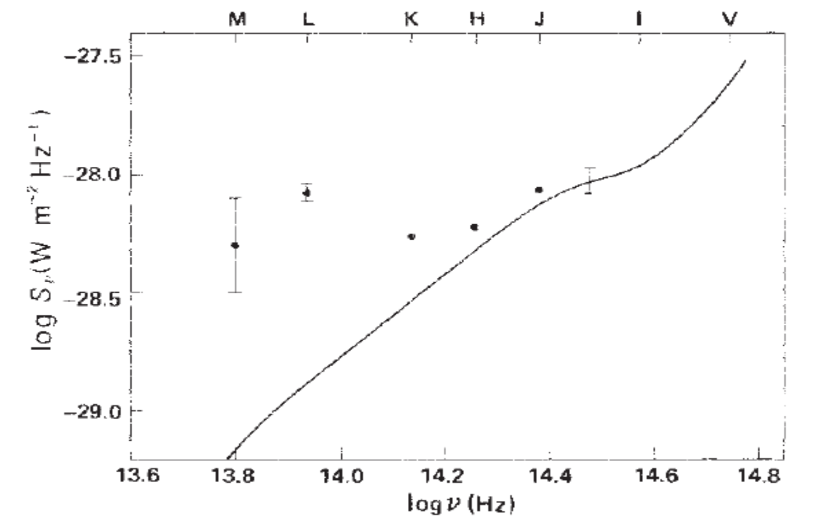
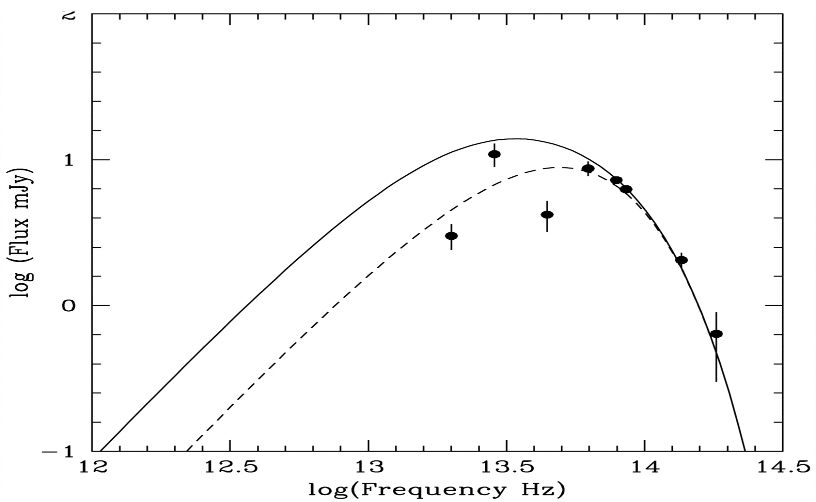
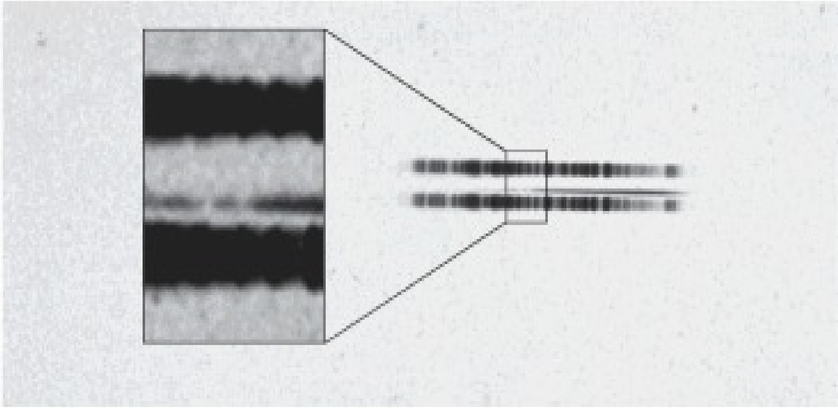
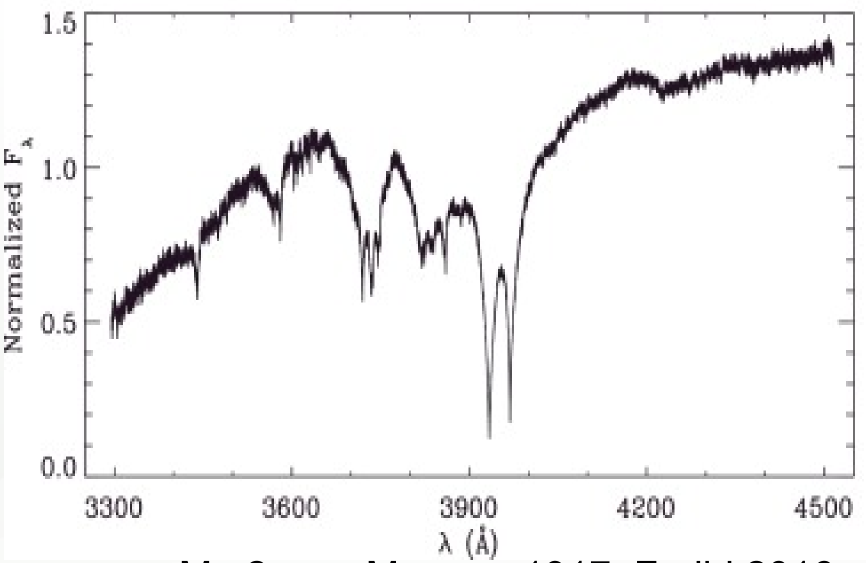


How do we find debris disks?







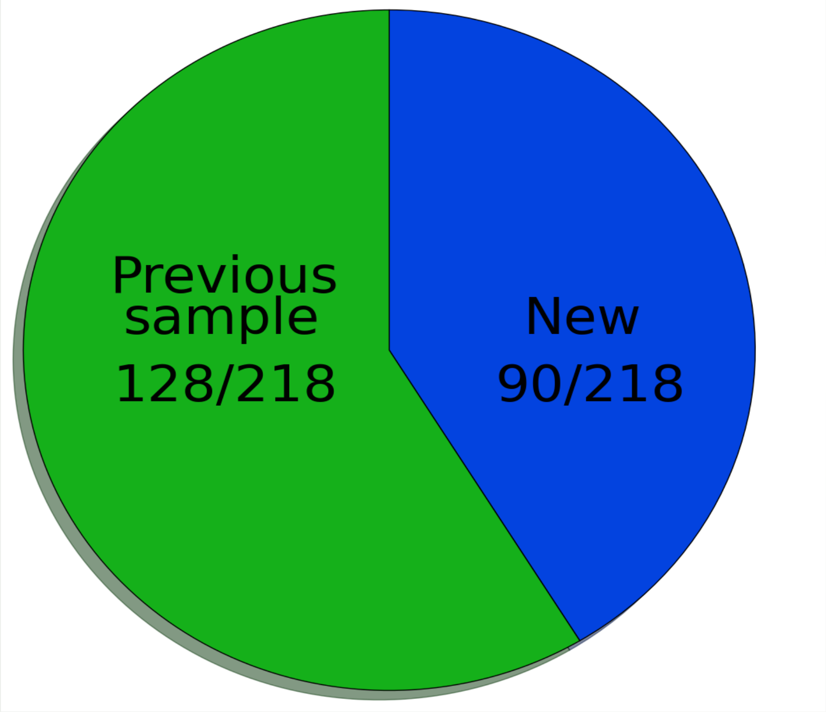


G29-38; Zuckerman & Becklin 1987; Jura 2003

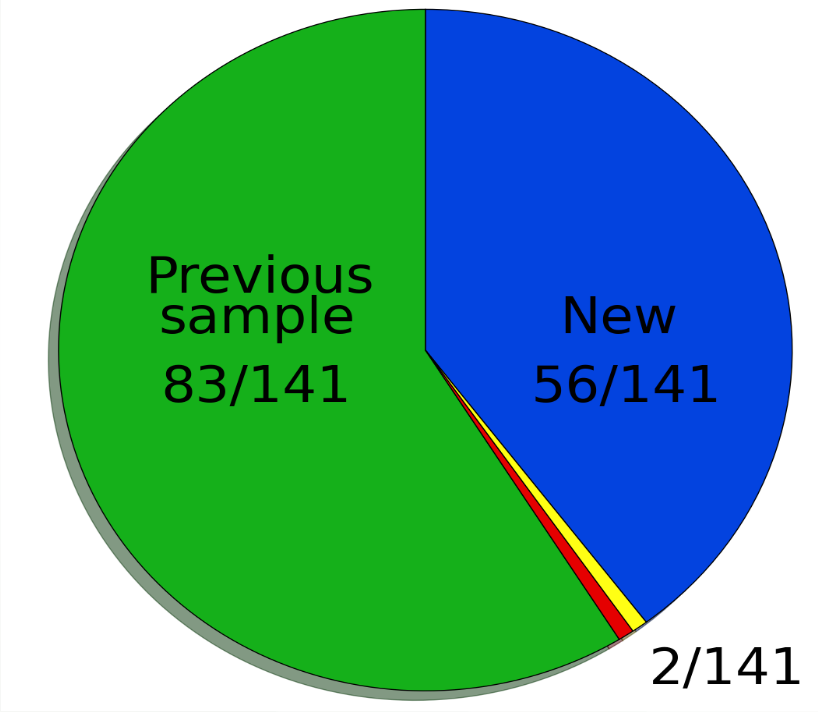
v Ma 2; van Maanen 1917; Farihi 2016

Our unbiased sample(s)

Infrared excess sample

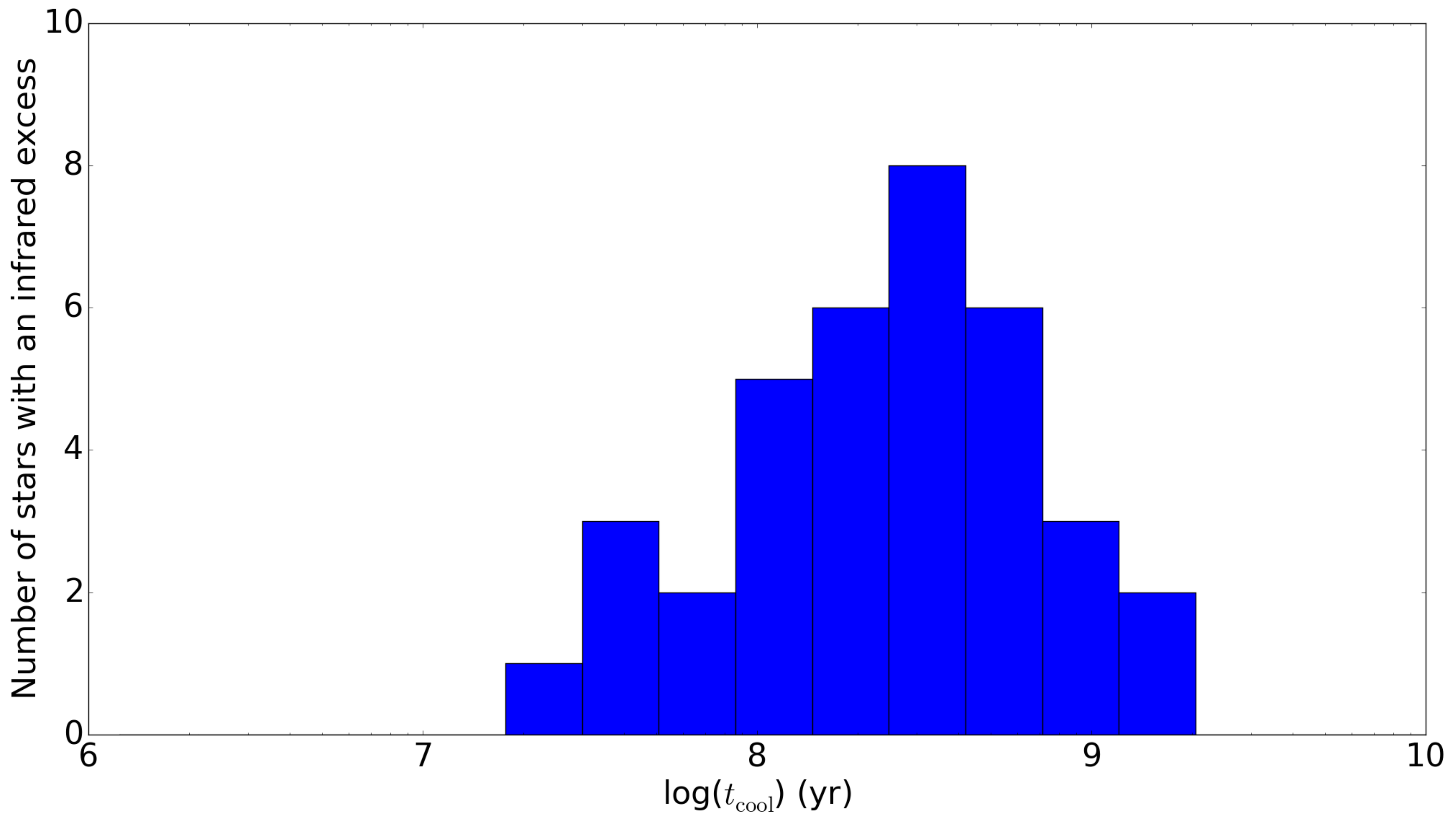


Atmospheric metals sample

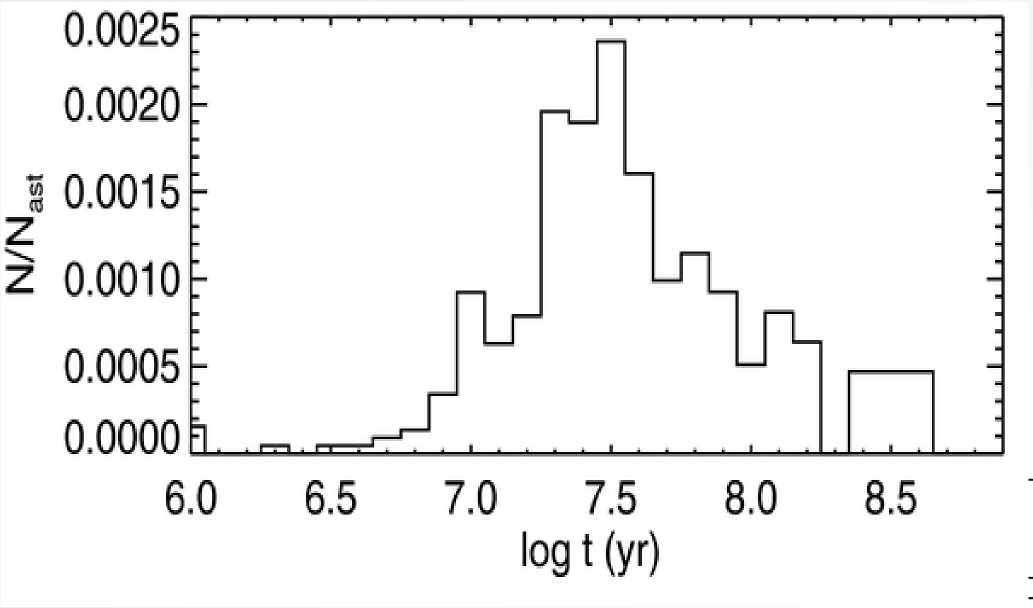


- 90 single DA WDs observed with Spitzer/IRAC, 56 observed with HST/COS
- Metals detected in 2 stars in sample in other studies

What do we know so far?

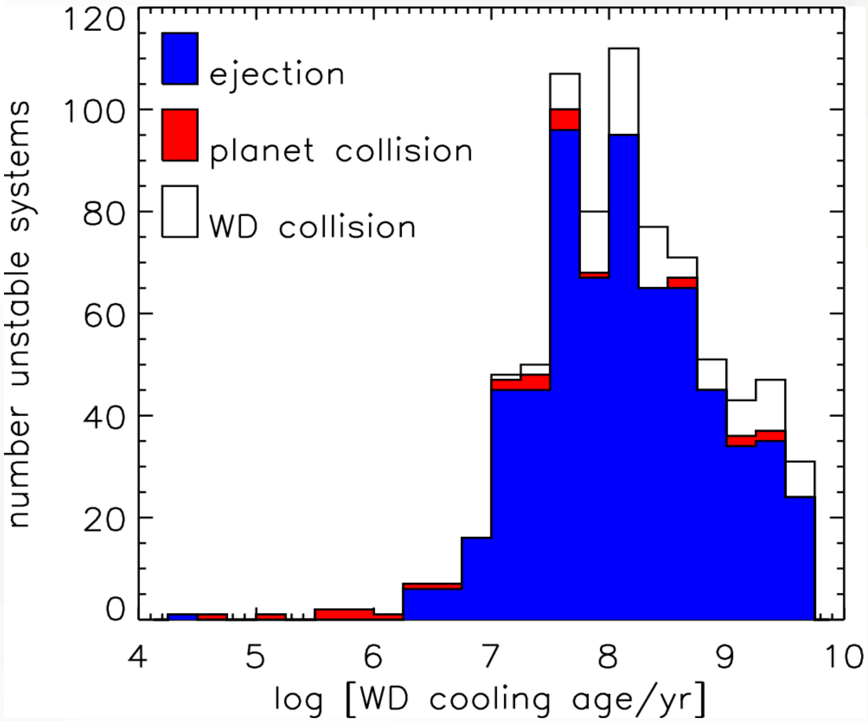


Why do we see this?



- Frequency of asteroids tidally disrupted after perturbation via resonance with a giant planet

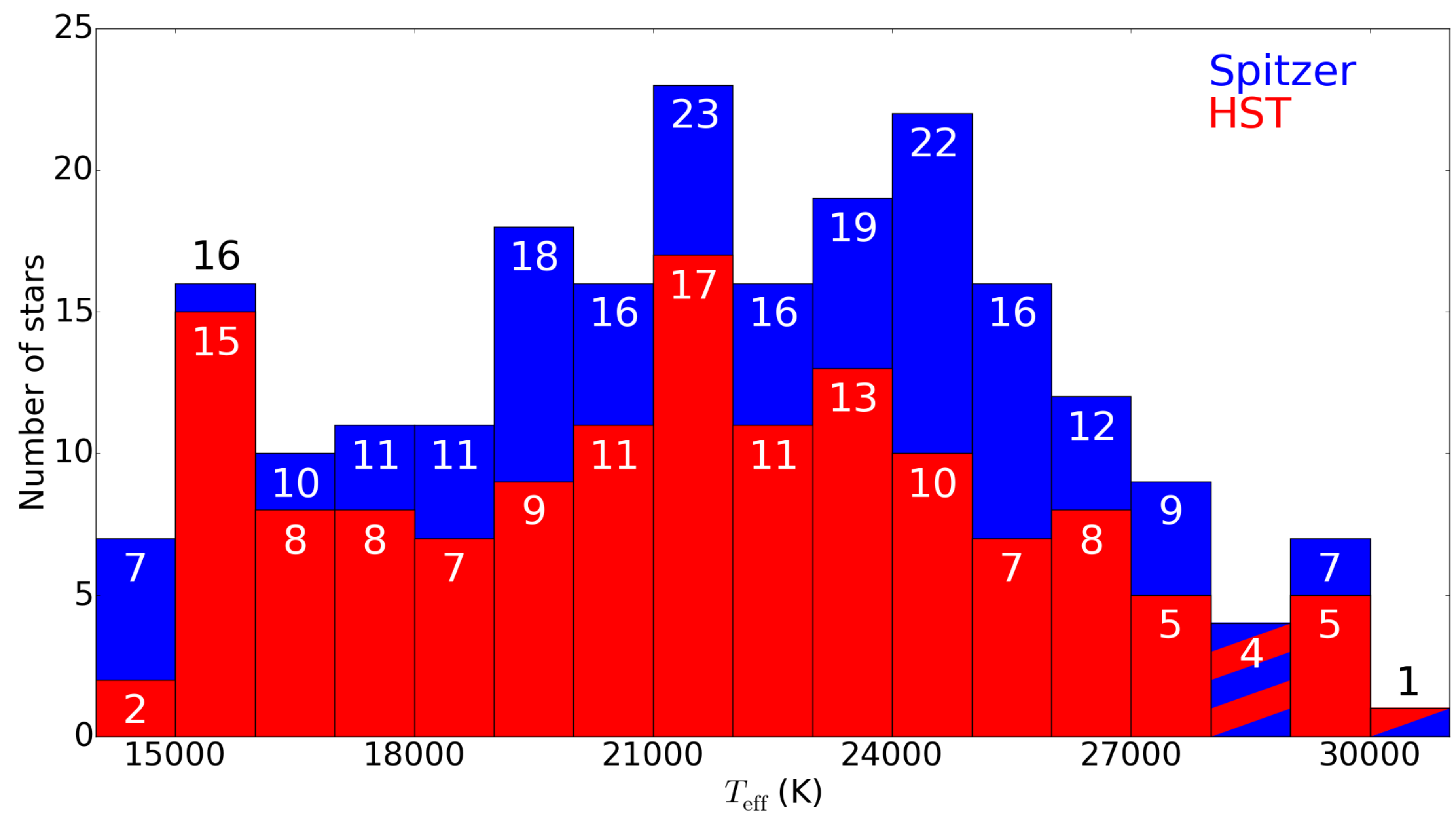
Debes+ 2012



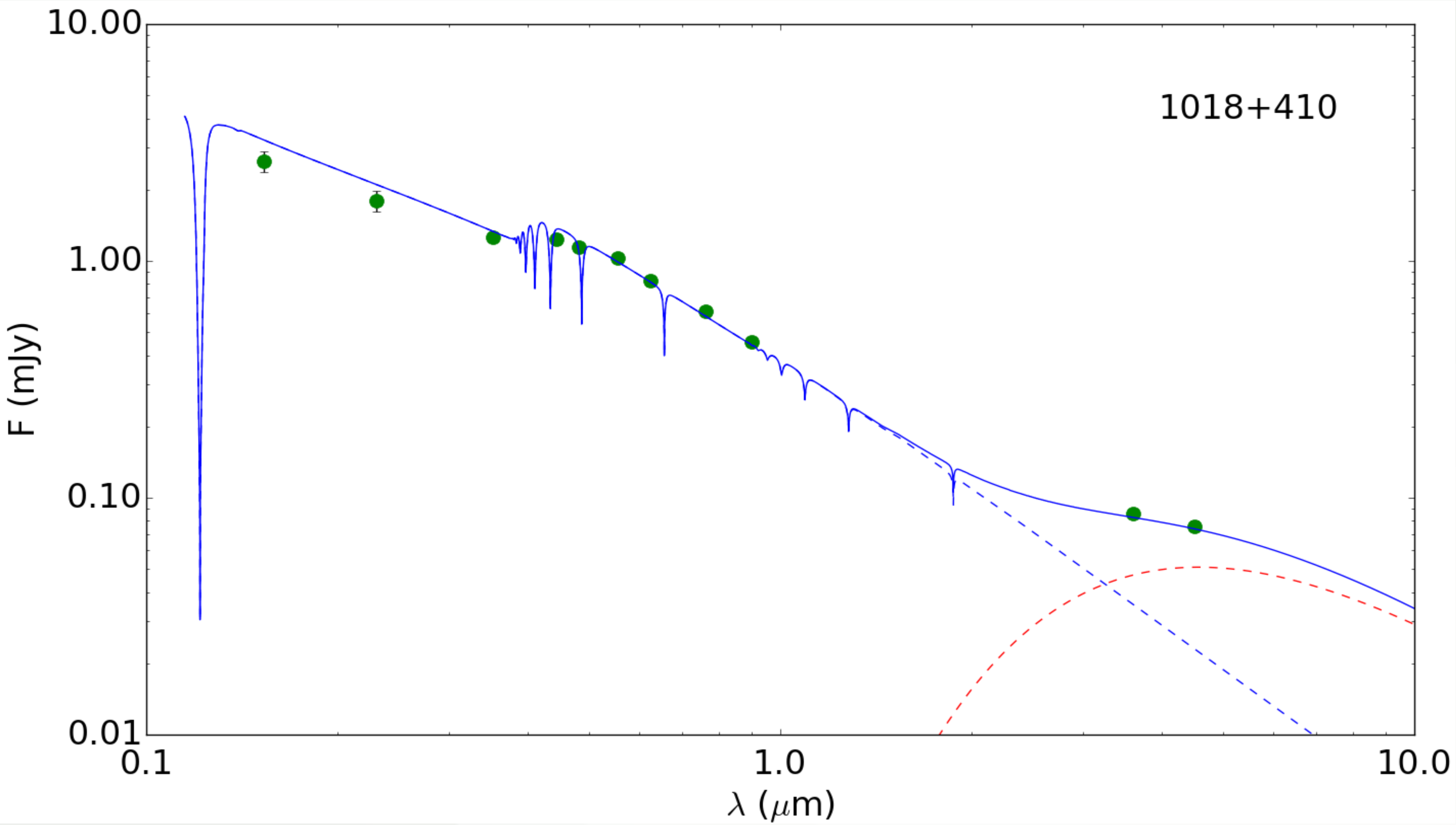
- Planet perturbation via 2 and 3 planet interactions

Veras+ 2013; Mustill+ 2014

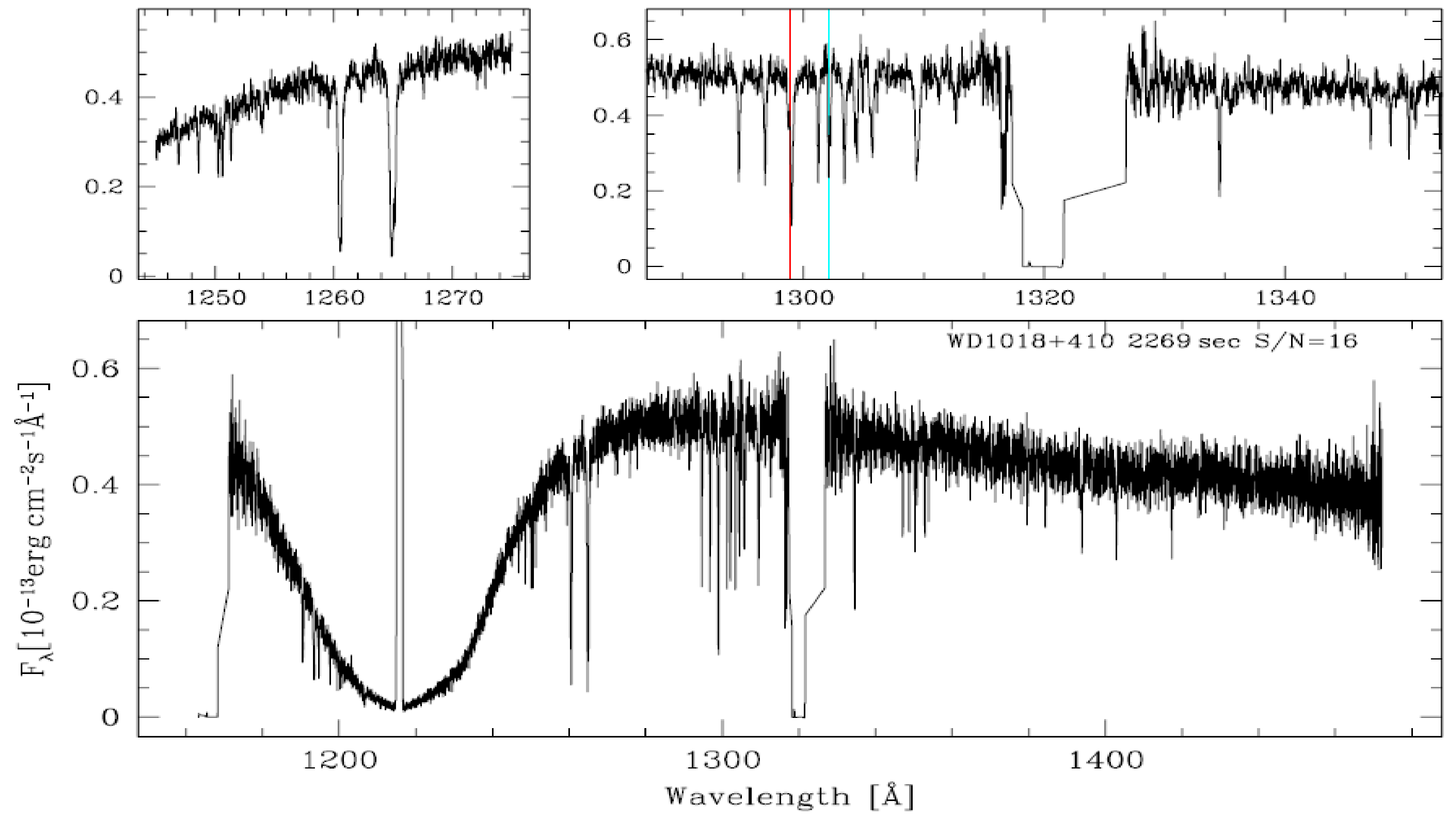
The complete sample



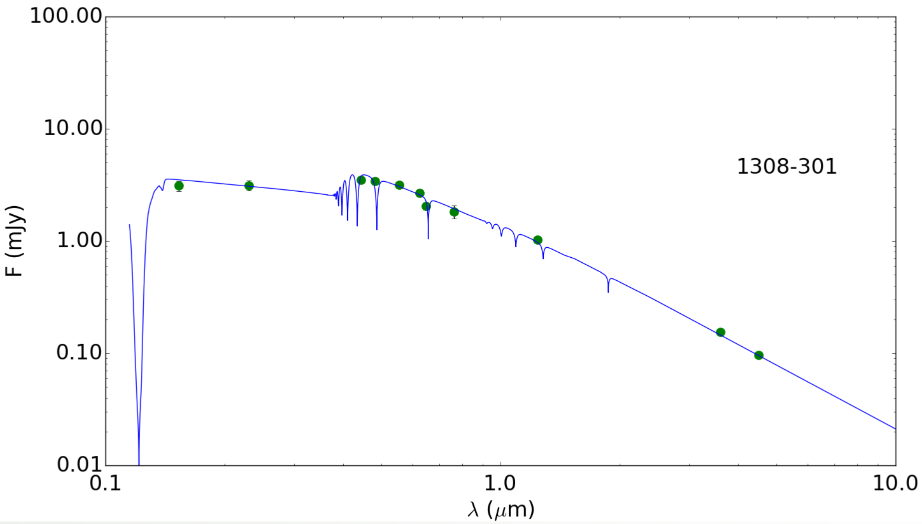
Observations

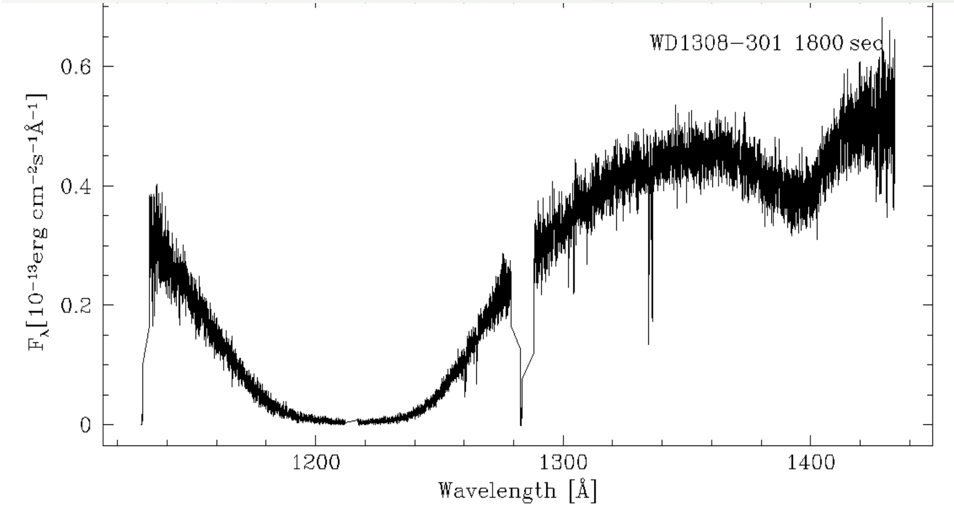


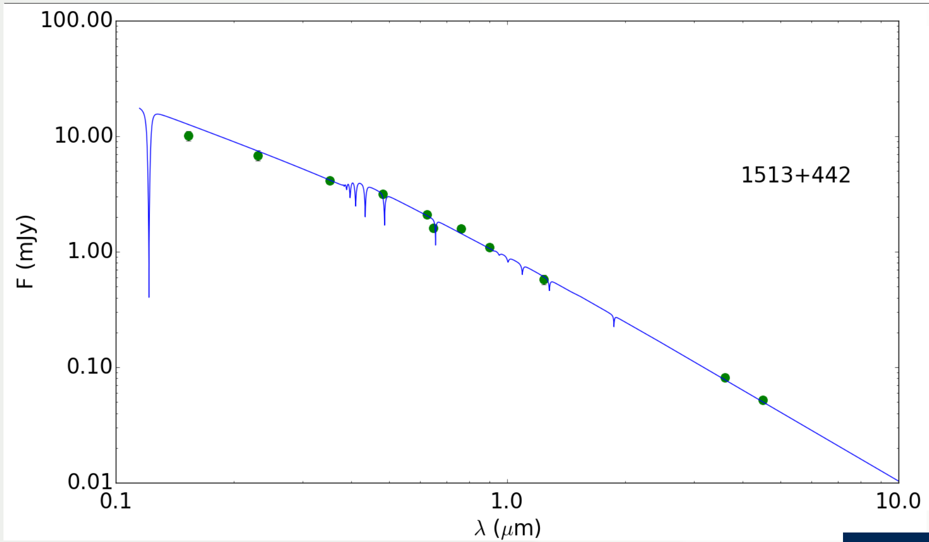
Observations

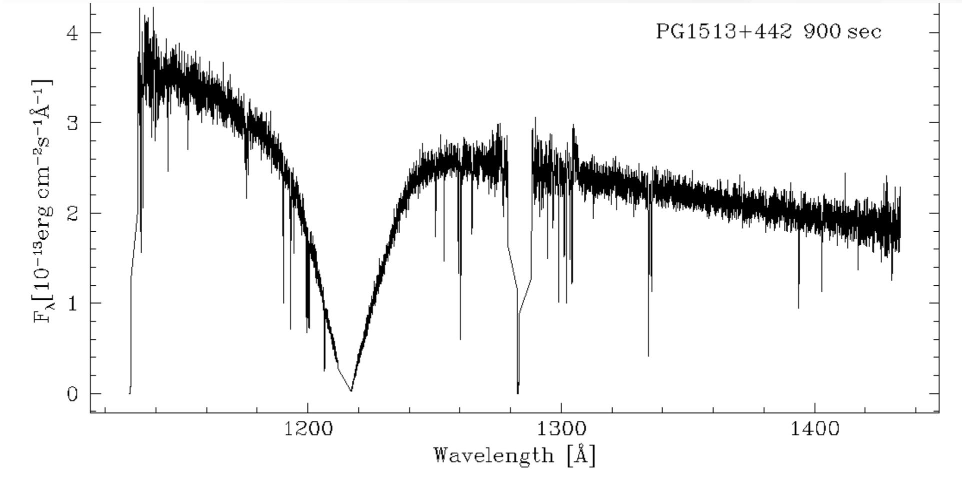


Observations

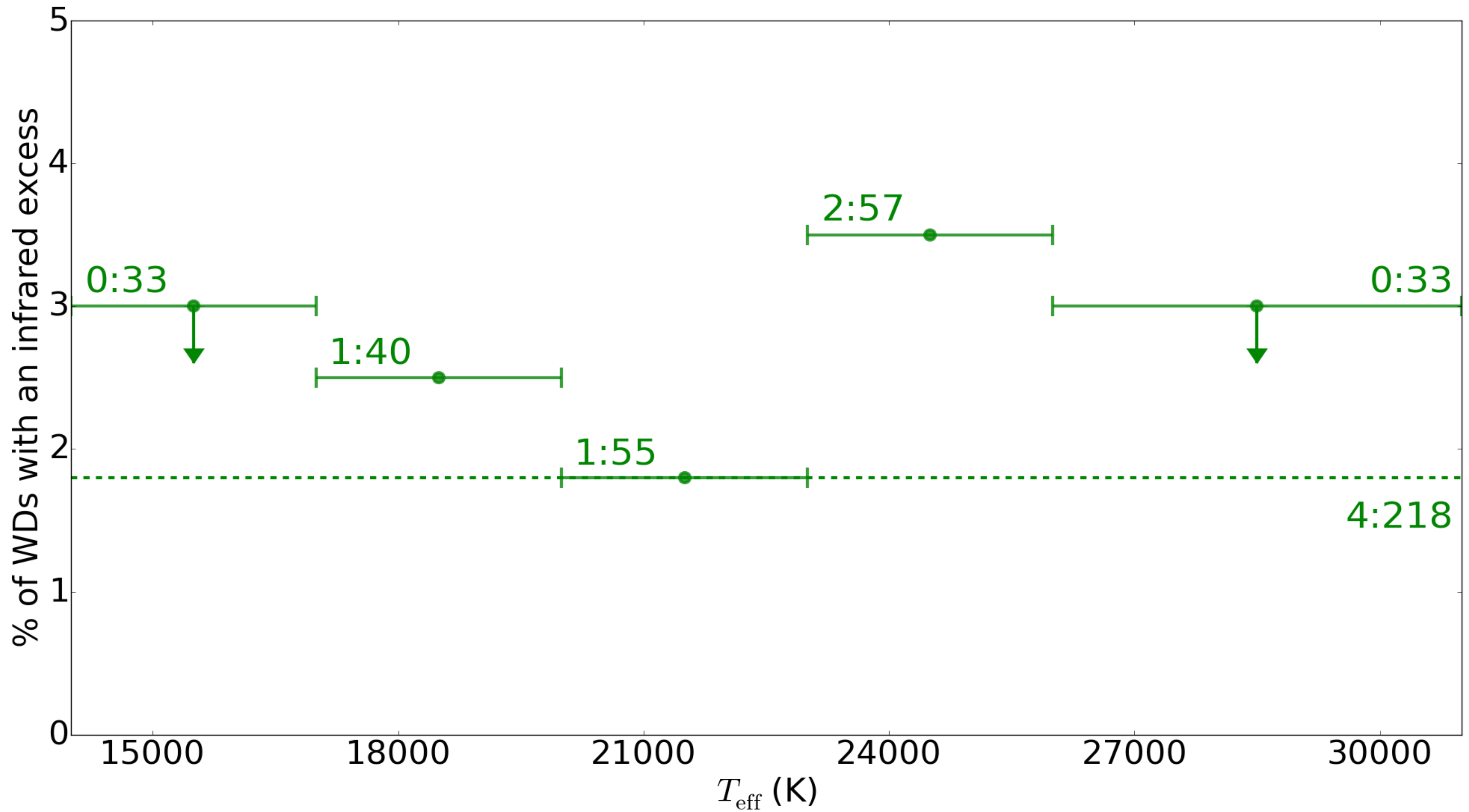




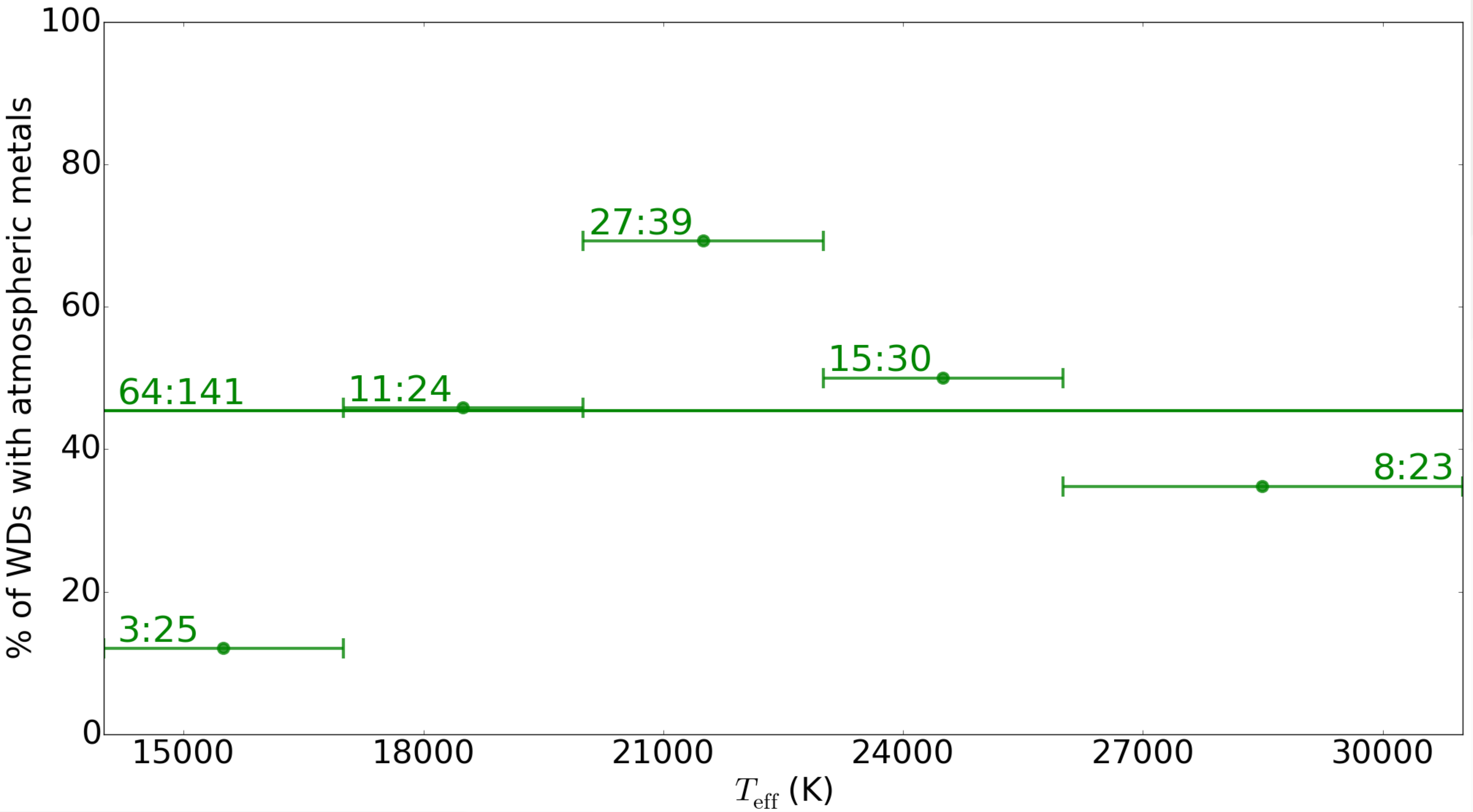




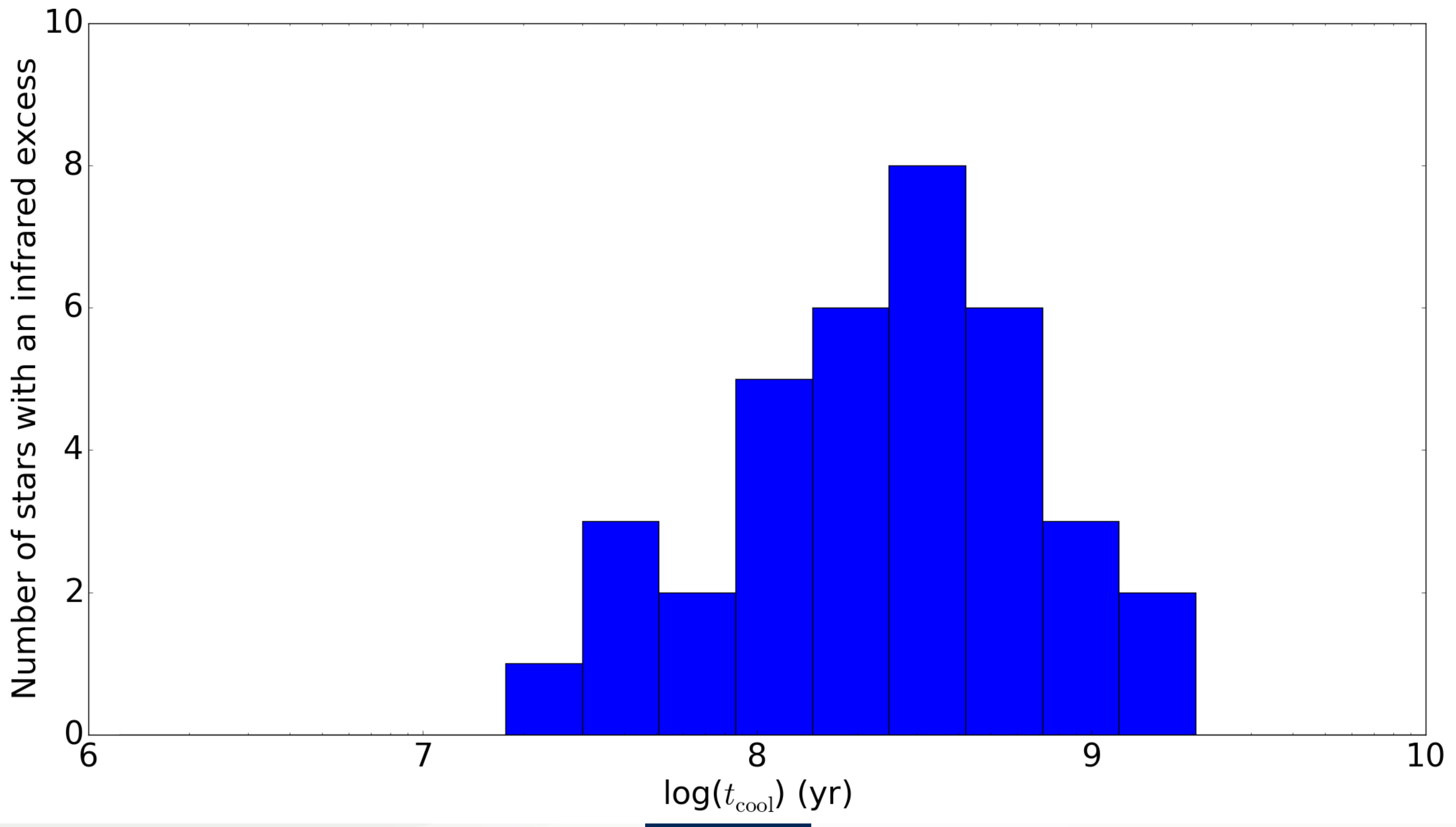
Infrared excess frequencies



Atmospheric metals frequencies



The big picture



Conclusions

- The only unbiased Spitzer and HST single DA WD sample over a large temperature/age range
- 4 out of 218 stars have an infrared excess, yielding a frequency of 1.8%, 64 out of 141 stars have atmospheric metals, 45%
- No new infrared excesses seen at young WDs supporting simulations, however could be due to narrow disks rather than rarity
- Significant percentage of debris disks still remain unobserved via infrared excesses