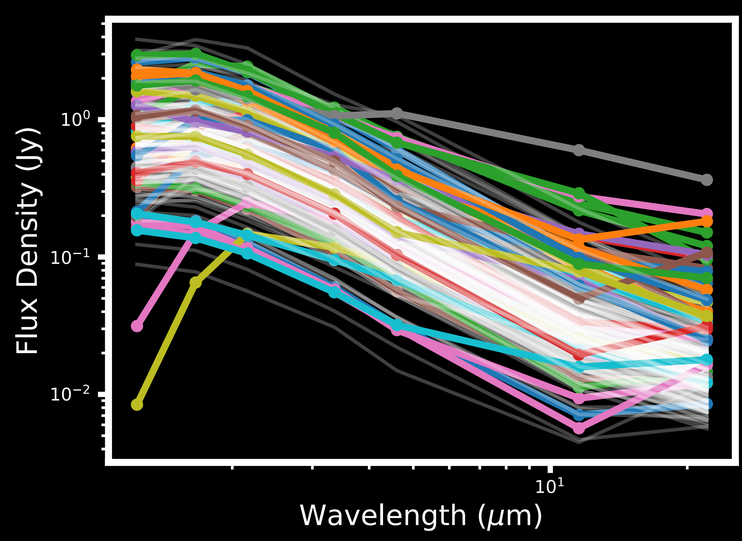
# A SAMPLE OF POTENTIAL DISK HOSTING FIRST ASCENT GIANTS

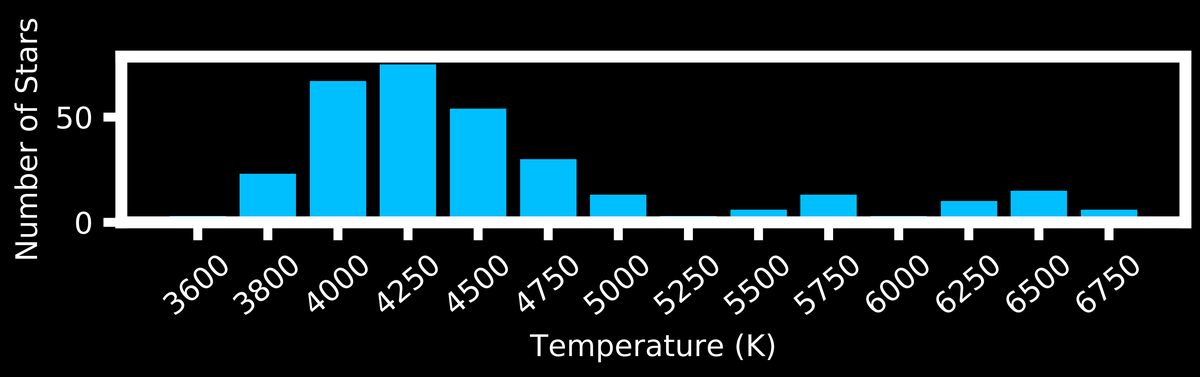
Amy Steele[1], John Debes[2], and Drake Deming[1]
1. University of Maryland and 2. Space Telescope Science Institute

The DISK DETECTIVE (DD) project, DiskDetective.org, is a NASA-sponsored, citizen-science based all-sky search for circumstellar disks in the AllWISE Data Release. Over 30,000 users have made more than 2.5 million classifications of WISE sources since the site launched in January 2014. Currently, over 180,000 sources have been classified by citizen scientists. DD is not magnitude limited in V and is therefore sensitive to mid- and late-type stars. Our initial cuts to the source catalog require Gaia parallaxes with $\pi/\sigma_\pi>5$, W1 > 3.5, W1-W4>0.25, and W4 excess significant at the 5-$\sigma$ level. From these initial cuts, we selected first ascent giant stars with IR excess by requiring [J-K] > 0.45, K-W4 < 3.5, and absolute K magnitude < 2.07. With these criteria, we find approximately 300 stars in the DD catalog that potentially host circumstellar disks. We summarize the overall sample properties in the table below and with the SEDs to the right.




The flux densities of those stars in our sample with a W4 excess significance of at least 5-$\sigma$. The wavelengths are 2MASS J, H, K, and WISE 1,2,3,4.

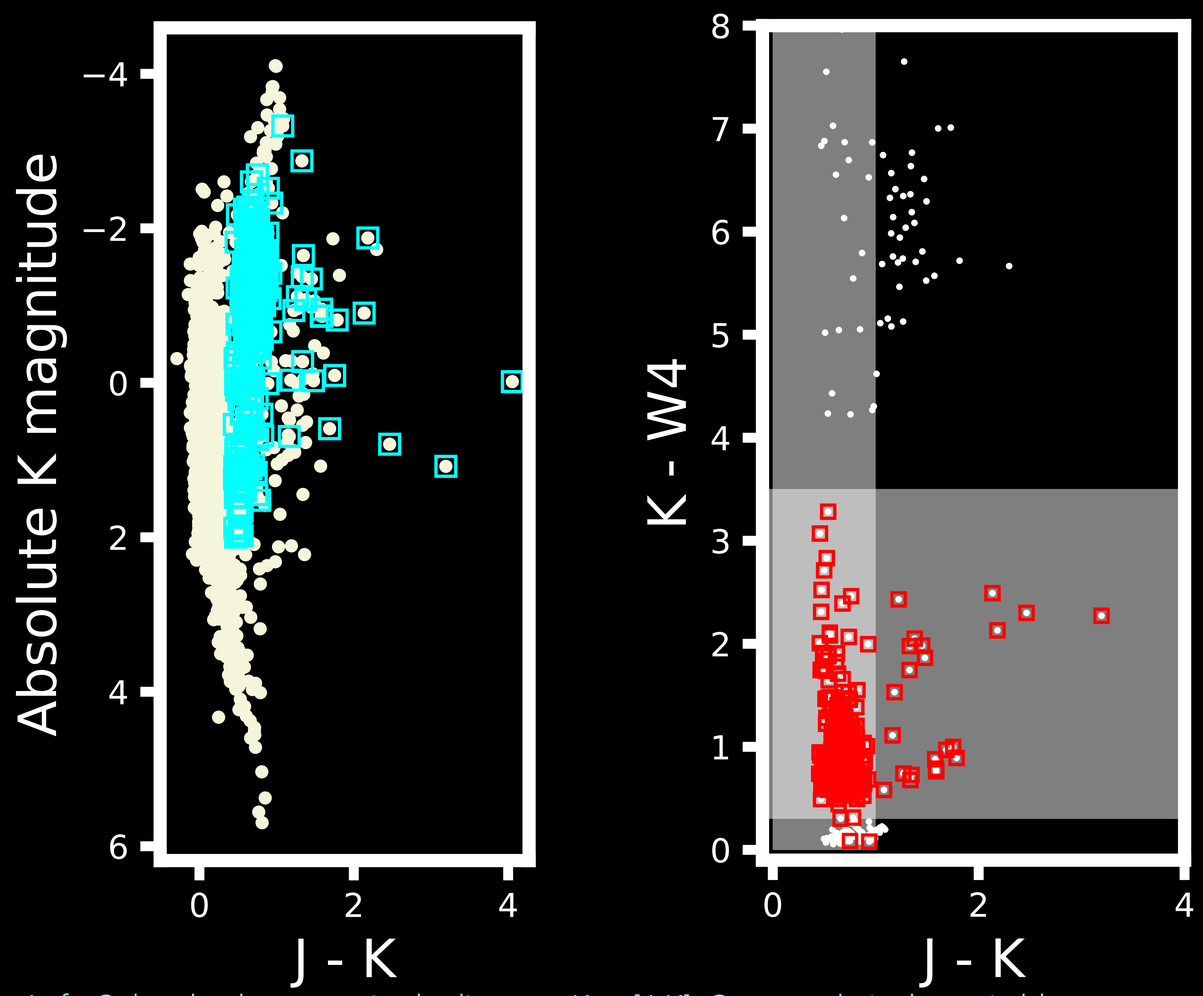
| Temp (mode) (K) | Distance (pc) | Li-rich | Rapid Rotation |
|---|---|---|---|
| ~4000 | 110 – 840 | >2 | >2 |



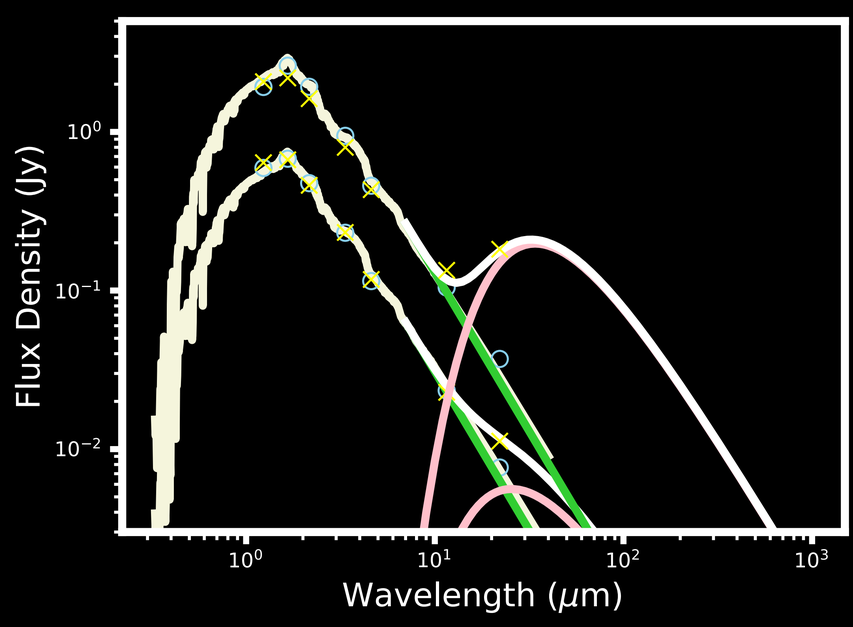

## Potential Connection between Li-enrichment and Rapid Rotation

Evolved stars displaying faster than expected rotation rates, enhanced Li-abundance, and IR excesses have been observed (e.g. Da Silva et al. 2015, Kumar et al. 2015, Rebull et al. 2015). Far IR- and sub-mm-wavelength observations of such systems present opportunities to investigate circumstellar material around post-main-sequence stars, while probing giant star evolution/mass loss, planet engulfment, and/or the late evolution of debris disks.

Our sample contains two stars that have enhanced rotation rates and IR excesses. These stars are part of the Rebull et al. 2015 sample, which includes stars with previous IR detections, well-defined rotation, Li abundance measurements with no previous IR measurements, and a number of RGs asserted to be Li-rich in the literature. **We have SMA data in hand for two post-main-sequence stars with expected mm-wavelength fluxes (PI: Amy Steele).** Follow-up observations of the two systems from our new DD sample are planned as part of an ongoing effort to determine the mm-wavelength fluxes (and therefore Rayleigh-Jeans slopes) of the thermally emitting material around these post-main-sequence stars.




Left: Color-absolute magnitude diagram, K vs [J-K]. Our sample is shown in blue squares. Right: Color-color diagram, [K-W4] vs [J-K]. Our sample is shown in red squares. The shaded regions show our selection criteria mentioned above.




Spectral energy distributions of the two rapid rotators in our sample with IR excess. These stars are prime candidates for the HAWC+ instrument on SOFIA. Kurucz-Lejeune model photospheres shown in solid lines, a RJ tail in green, Coelho model photometry shown in open circles, and data shown with 'x'.

Observations of (sub)giants with planets and disks provide the first set of proof that disks can survive the first stages of post-main-sequence evolution.

**We present a sample of potential disk hosting first ascent red giants. These stars all have infrared excesses at 22 microns and possibly host circumstellar debris. We summarize the characteristics of the sample to better inform the incidence rates of thermally emitting material around giant stars.**

A thorough follow-up up study of these candidates would provide clues about debris disk evolution following the main-sequence.

References: Silverberg et al. 2016, Majewski et al. 2011, Kuchner et al. 2016, Gaia DR1 Brown et al. 2016, and Coelho et al. 2014. Acknowledgements: We would like to thank Marc Kuchner, Steven Silverberg, Bernie Shiao for their help in making the MAST DD database, and of course, all ~30,000 users who have classified objects. MAST DD database was funded through the Director's Discretionary Fund at the Space Telescope Science Institute

Contact: Amy Steele
asteele@astro.umd.edu
4th year PhD Candidate