NIRDS IRTF/SpeX Survey Characterization of Stellar Abundances & Fluxes in Nearby Sun-Like Systems

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Abstract: A broad range of planetary types and locations have been discovered in recent RV and transit surveys. Planets have been found around stars of classes A through M, with densities varying from less than the 1g/cm^3 of water (so-called styrofoam planets") up to 8g/cm^3, denser than Mercury or Earth in our system, and approaching the density of bulk iron. Planets have been found with extremely close in orbits that barely skirt their star's coronal atmosphere, and out to many times the distance of Pluto in what would be the equivalent of a star's Kuiper belt.

Stellar abundances are thought to reflect the feedstocks available for making a star's planets. A simple argument contends that systems of high metallicity have relatively more of the material needed to make rocky terrestrial planets and planetary cores. I.e., systems with high Si/H and Fe/H and Mg/H ratios have relatively more of the material required to make silicate dominated planetesimals, like the asteroids and terrestrial planets found in our system. Systems with unusually high C/O ratios may tend to make "carbon planets" based on SiC geochemistry instead. And systems with very high O/H ratios are thought to lead to water-rich worlds.

As part of the project at ASU funded by NASA's Nexus for Exoplanet System Science program (ASU NExSS, PI Steve Desch), we have used the results from our 100+ hours, 50+ systems NASA/IRTF 3m Near InfraRed Disk Survey (NIRDS; [1]), a spectral survey utilizing the R~1000, 0.8 - 5.0 µm spectra provided by the SpeX spectrometer [2] to understand the nature of 50+ star systems. AFGK systems were selected for observation if they have been reported to host planets or circumstellar debris disks.

In conjunction with the stellar spectra in the SpeX cool star library [3], we find that we can measure a star's photospheric emission from 0.8-5.0 um to 1% relative precision. This spectral range contains absorption features of Ca, Na, Mg, Al, Fe, Si, C, and H we have used to measure their abundances in the host star, while at the same time classifying the star & characterizing much of the astrobiologically active flux (especially for the later K and M stars), filling in an important gap in knowledge of a system (most groups simply rely on inaccurate coarse photometry for this purpose). We have also searched for emission above the primary's photosphere due to belts of comets, asteroids, and KBOs, for material that could supply astrobiological material to any in situ planets, while also providing clues to the evolutionary state of the system.

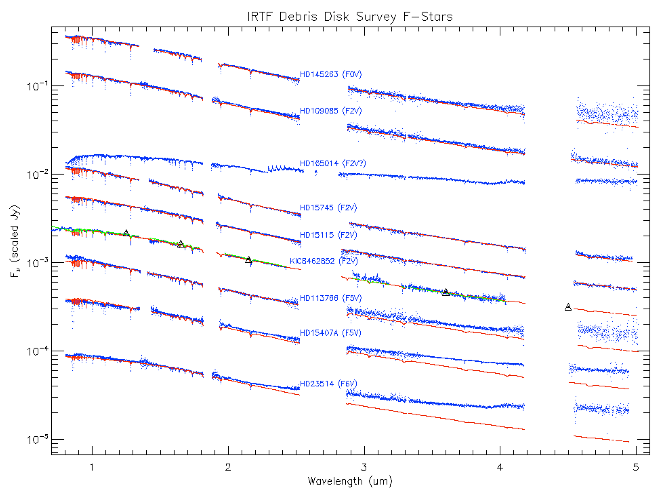

Fig. 1 - NIRDS F-star observations to date, showing the broad range of SpeX spectral behaviors found in this stellar class. SpeX data in blue, stellar photospheric models in red. The strong absorption lines used for stellar classification and abundance determination are readily seen from 0.8 -2.5.

In this paper we present the latest stellar abundance and stellar flux results for the NIRDS systems. We are also interested in talking with researchers who might need stellar abundance and characterization information for their work.

References: [1] Lisse *et al.* 2013, AAS Meeting #221, id.325.04 2015; Lisse *et al.* 2015, ApJ Lett. 815, L27; Lisse *et al.* 2017, IRTF/SPEX Observations of the HR 4796A Cometary Ring System, AJ (resubmitted) [2] Rayner *et al.* 2003, *PASP* **115**, 362; Vacca *et al.* 2003, *PASP* **115**, 389; Vacca *et al.* 2004, *PASP* **116**, 352; Cushing *et al.* 2004, *PASP* **116**, 362 [3] Rayner et al. 2009, *ApJ Suppl.* **185**, 289