**Exoplanet Science with a Starshade: The Exo-S Final Report.** M. C. Turnbull,[1] S. Seager[2], A. Roberge[3], S. Domagal-Goldman[3], S. Shaklan[4], W. Sparks[5], Exo-S Science and Technology Definition Team, [1]Global Science Institute (turnbull.maggie@gmail.com), [2]MIT, [3]NASA-Goddard, [4]JPL, [5]STScI.

**Introduction:** "Exo-S" is NASA's first community-directed study of a starshade (or "external occulter") plus telescope system for a space-based direct imaging mission to discover and spectrally characterize exoplanets. The Exo-S final report will be submitted in early 2015, and it includes two options: (1) a standalone mission using a modest aperture (1.1-m) space telescope launched together with a 30-m starshade, and (2) a 34-m starshade launched independently to rendezvous with an existing larger space telescope (in this case we specifically consider WFIRST). In this talk we will describe the Exo-S mission options and present the estimated science yields in terms of detecting and spectrally characterizing planets of different sizes and temperatures around our nearest neighbors. Both options can image nearby exo-Earths, sub-Neptunes, and previously known and newly discovered Jupiters. Both missions can characterize the atmospheres of giant planets with low-resolution spectroscopy, while the larger mission can also characterize exo-Earths and mini-Neptunes. Finally, we describe different approaches to target selection, where the search is optimized either for Earth-like habitable planets, or for a wider diversity of planets of all sizes and temperatures.

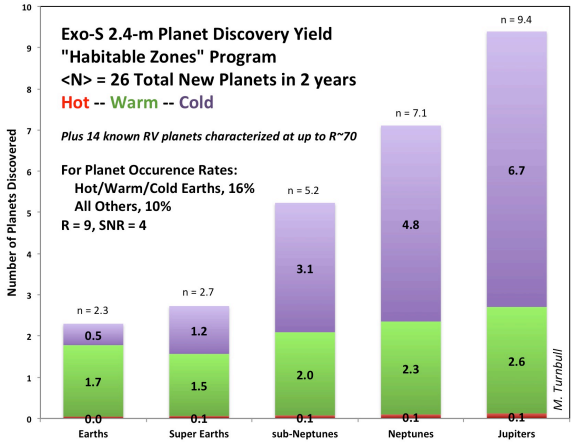


Figure 1. The predicted discovery yield for the first 2 years of the Exo-S 2.4-m mission, with an observing program optimized for detecting habitable Earths. Hot, warm, and cold planets (red, green, and purple bars) correspond to planets interior to, within, and exterior to a circumstellar habitable zone location extending from 0.75 to 1.77 AU, scaled by the square root of the bolometric stellar luminosity [1].

| Planet | Radius ($R_{Earth}$) | Geo. Albedo |
|---|---|---|
| Earths | 1 | 0.2 |
| Super Earths | 1.4 | 0.2 |
| Hot Sub-Neptunes | 2.0 | 0.2 |
| Warm Sub-Neptunes | 2.0 | 0.5 |
| Cold Sub-Neptunes | 2.0 | 0.4 |
| Hot Neptunes | 3.9 | 0.2 |
| Warm Neptunes | 3.9 | 0.5 |
| Cold Neptunes | 3.9 | 0.4 |
| Hot Jupiters | 11 | 0.2 |
| Warm & Cold Jupiters | 11 | 0.5 |

Table 1. The assumed planet characteristics for yield calculations given in Figure 1.

**References:**

[1] Kopparapu, R. K. et al. (2013) ApJ, 765, 131.