HabEx: The Habitable Exoplanet Imaging Mission. S. D. Domagal-Goldman[1] and the HabEx Team [1]Planetary Environments Laboratory, NASA Goddard Space Flight Center, 8800 Greenbelt Road, Greenbelt, MD 20771, USA; shawn.goldman@nasa.gov.

Introduction: HabEx – the Habitable Exoplanet Imaging Mission - is one of four flagship mission concepts that NASA is studying in advance of the next Astrophysics Decadal Survey. The goal of HabEx will be to directly image and characterize rocky planets in the habitable zones of other stars [1]. Specifically, HabEx aims to search for signs of liquid water oceans and biological activity on such worlds. Additionally, HabEx will also enable a broad range of Galactic, extragalactic, and solar system astrophysics, from resolved stellar population studies that inform the stellar formation history of nearby galaxies, to characterizing the life cycle of baryons as they flow in and out of galaxies, to detailed studies of bodies in our own solar system.

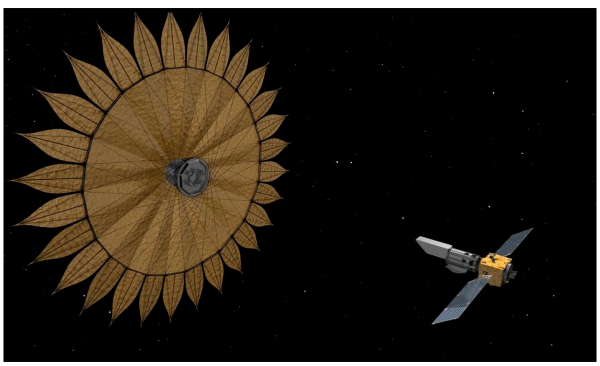

Figure: Artist's concept of a moderate-diameter space telescope and an associated external occulter (starshade) for high-contrast imaging studies of exoplanets. Credit: NASA/JPL-Caltech.

Results: The technical drivers for HabEx will be determined by the significant challenges associated with the direct imaging and characterization of potentially habitable exoplanets. This requires a large enough collecting area to collect light from these very dim targets, and the ability to block light from the dramatically brighter host star the planet orbits. There are multiple approaches to these challenges, and the goal of the HabEx study is to demonstrate that at least one is feasible in the time period covered by the 2020 Astrophysics Decadal Survey.

Constraining the habitability of a distant exoplanet will likely require the capability to characterize the planetary surface environment. Photometry and moderate resolution spectroscopy, which may span the ultraviolet through near-infrared spectral range, can allow for the detection of key atmospheric species and properties. For a moderate signal-to-noise ratio spectrum of an Earth-twin covering this wavelength range, water vapor, molecular oxygen, Rayleigh scattering from molecular nitrogen and oxygen, and, potentially, ozone could all be detected. As the signal-to-noise ratio of this spectrum increases, so does our ability to quantify gas abundances and certain atmospheric properties, like cloud coverage and/or cloud thickness.

The detection and biosignatures and life requires a significant amount of context regarding the planetary environment and the host star. For the latter, HabEx aims to measure stellar spectral energy distributions across the entire ultraviolet to near-infrared spectral range. Confirming the biotic nature of a certain biosignature gas is likely to require in-depth spectroscopic studies of the planet, which may enable the detection of atmospheric species that provide the necessary context for a biosignature.

In this presentation, we will discuss the top-level exoplanet science goals of HabEx, and how those goals led to basic and preliminary architectural properties such as aperture size, starlight suppression technique, wavelength range, etc. We then discuss how these architectural properties will enable both the characterization of potentially habitable exoplanets and the search for biosignatures from such worlds.

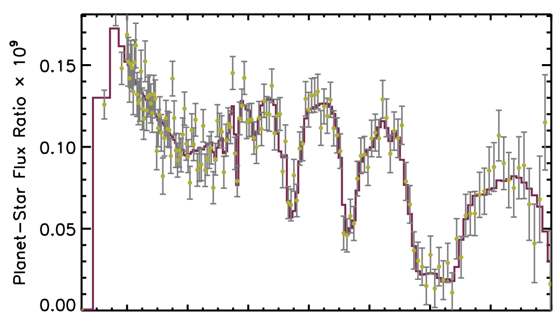

Figure: Example spectrum of an Earth-twin, scaled to have a signal-to-noise of 10 at 0.55 μm [2]. Per imaging bandpass, such a spectrum would require about 10 hr of integration for a target at 5 pc and a 4m aperture.

References: [1] Seager S. (2013) *Science*, *340*, 577. [2] Robinson T. D. et al. (2016) *Publ Astron Soc Pacific, 128*, 025003.