EXO-EARTH YIELDS FROM LUVOIR (Large UV-Optical-IR) OBSERVATORIES. A. M. Mandell[1], C.S. Stark[2], A. Roberge[1], S. D. Domagal-Goldman[1], K. R. Stapelfeldt[1], T. D. Robinson[3], M. Clampin[1], N. Rioux[1], M. Postman[2], and H. Thronson[1]. [1]NASA Goddard Space Flight Center, 8800 Greenbelt Road, Greenbelt, MD 20771 (contact: avi.mandell@nasa.gov), [2]Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218, [3]ORAU Fellow in residence at NASA Ames Research Center, Moffett Field, CA 94035

A Large UV-Optical-InfraRed (LUVOIR) telescope was recommended by the recent AURA Beyond JWST report [1]. A critical science metric for constraining the exoplanet science requirements of this mission is the discovery and characterization of Earth-like planets around Sun-like stars using high-contrast imaging. A key driver for the observatory architecture, cost, and schedule is the telescope aperture size. Therefore it is important to provide as much constraint as possible on the required aperture size early in the design and planning process.
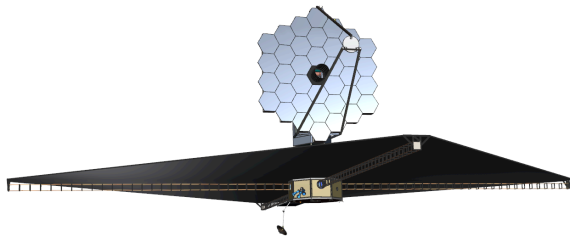

Figure 1: The image is a representation of ATLAST (Advanced Technology Large Aperture Space Telescope). ATLAST is a 9.2 meter LUVOIR telescope designed to search for life. The segmented architecture draws upon experience and lessons learned to minimize risk.

An estimate of the detection yield for Earth-like planets can be calculated using a Monte Carlo simulation of a design reference mission (DRM), allowing the exploration of a variety of mission design and astrophysical parameters. We have developed a new strategy called altruistic yield optimazation (AYO) that optimizes the target list and exposure times to maximize mission yield for a specific set of mission parameters [2]. However, many of the important astrophysical quantities and future technical capabilities that feed into these parameters are not well constrained. This leads to a large uncertainty in the final mission architecture needed to achieve a specific exo-Earth yield.

In this presentation we discuss the various physical and technological parameters that go into the DRM simulations, and the associated uncertainties based on the current state of research. This will include a discussion of the sensitivity of contrast to stability of the telescope, which is one of the major technical challenges faced by this mission. We conclude with a discussion

of the current range in telescope aperture size associated with each risk level.

A future LUVOIR telescope must also support major advances in astrophysics, and these are also facilitated by a significant increase in aperture size. For example, a telescope of aperture ≥10 meters would be able to resolve all galaxies to 100 pc, anywhere in the universe, a major advance that would transform our understanding of origins of galaxies, stars, and planetary systems.
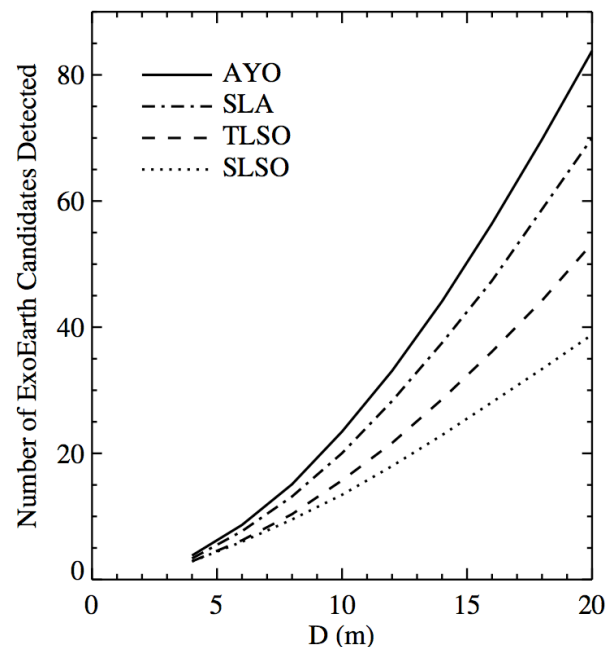

Figure 2: Number of exoEarth candidates detected vs. telescope diameter for different yield calculation methods. AYO increases yield by up to ~100%. with previous yield calculation methods: Stellar Luminosity-Adjusted (SLA), Tuned Limiting Search Observation (TLSO), and Strict Limiting Search Observation (SLSO).

References:

[1] Tumlinson, J., Seager, S., Dalcanton, J., et al. 2015, American Astronomical Society Meeting Abstracts, 225, 338.19.

[2] Stark, C. C., Roberge, A., et al. (2014). *The Astrophysical Journal*, *795*(2), 122.