Exo-Earth Discovery and Characterization with Large UV-Optical-IR Observatories

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Abstract

A Large UV-Optical-InfraRed (LUVOIR) telescope was recommended by the recent AURA Beyond JWST report [1] and our study team is developing the concept further for consideration by the US National Research Council 2020 Decadal Survey. A critical metric for constraining requirements of this mission is the discovery and characterization of Earth-like planets around Sun-like stars using high-contrast imaging, and we have focused on using exo-Earth yield to provide constraints on technical requirements early in the design process. 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, exposure times, and number of revisits to maximize mission yield for a specific set of mission parameters [2]. 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. We will also discuss the potential follow-up science capabilities for spectroscopic characterization facilitated by a large aperture. For example, a telescope of aperture ≥10 meters would be able to measure integrated exo-Earth fluxes with multi-hour integration times, providing a map of albedo variations as the planet rotates. A large aperture would also provide reasonable inner working angles for coronographic observations beyond the visible wavelength range, enabling detections of important atmospheric molecules such as CH4 and CO2.

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