Interpreting Exo-Planetary Atmospheres with the Next Generation Space-Based Telescope

Natasha Batalha, NASA Ames Research Center
Natasha.e.batalha@nasa.gov@nasa.gov

ABSTRACT: We will soon have the technological capability to measure the atmospheric composition of temperate Earth-sized planets orbiting nearby stars. Interpreting these atmospheric signals poses a new challenge to planetary science. In contrast to jovian-like atmospheres, whose bulk compositions consist of hydrogen and helium, terrestrial planet atmospheres are likely comprised of high mean molecular weight secondary atmospheres, which have gone through a high degree of evolution. In order to understand the processes which affect a planetary atmosphere, I use early Mars as a case study. I leverage a combination of one-dimensional climate, photochemical and energy balance models in order to create one self-consistent model that closely matches currently available climate data. However, unlike in-situ observations from our own solar system, remote sensing techniques need to be developed and understood in order to accurately characterize exo-atmospheres. I describe the models used to create synthetic transit transmission observations, which includes models of transit spectroscopy and instrumental noise. Using these, I lay the framework for an information content-based approach to optimize our observations and maximize the retrievable information from exo-atmospheres. First I test the method on observing strategies of the well-studied, low-mean-molecular weight atmospheres of warm-Neptunes and hot Jupiters. Upon verifying the methodology, I finally address optimal observing strategies for temperate, high-mean-molecular weight atmospheres (Earths/super-Earths).