

Announcing the Final Examination of Ryan Challenger for the degree of Doctor of Philosophy in Physics

Date: March 31, 2020

Time: 11:00 a.m.

Zoom Link: <https://ucfmed.zoom.us/j/7348915062>

Dissertation title: Exoplanets: Correlated Noise and Cautionary Tales

Abstract:

Transiting exoplanets provide the best opportunity for planetary characterization, and, thus, the search for life outside the Solar System. These planets orbit such that they pass in front (a “transit”) and behind (and “eclipse”) of their host, and a spectrum of the lost flux constrains the atmospheric properties of the planet. In transits, the flux modulation scales with the cross-sectional area of the planet, and the spectrum includes spectral signatures of molecules in the upper atmosphere of the planet’s terminator, which the host star’s light passes through on the way to the observer. With eclipses, the lost flux is the direct emission of the planet, a spectrum of which contains emission and absorption features of molecules in the atmosphere depending on atmospheric thermal structure. These signals scale with the size and brightness of the planet and are so dwarfed by the brightness of the host star that only ≈ 1000 K Jupiter-sized planets are observable with current instrumentation.

In this work, I develop new techniques and compare existing data analysis methods to extract weak planetary signals. Chapter 1 describes a new elliptical photometry data analysis approach to disentangle exoplanet observations from telescope vibrations. Chapter 2 describes an analysis of *Spitzer Space Telescope* observations of eclipses of the planet WASP-29b using elliptical photometry and two different light-curve modeling methods, and addresses the differences between results. In Chapter 3, I analyze two similar observations of WASP-34b using a grazing eclipse light-curve model. Finally, in Chapter 5 I reanalyze all *Spitzer* eclipse observations of the Neptune-sized GJ 436b, applying the lessons learned from my earlier works and comparing my results with the literature.

Outline of Studies:

Major: Physics, Planetary Sciences Track

Educational Career:

B. S. University of Rochester, NY, 2014

B. A. University of Rochester, NY, 2014

Committee in Charge:

Dr. Joseph Harrington (Chair)

Dr. Daniel Britt

Dr. Eduardo Mucciolo

Dr. Drake Deming (External Committee Member)

Approved for distribution by Dr. Joseph Harrington, Committee Chair, on March 20, 2020.

The public is welcome to attend remotely.