Boston University College of Arts & Sciences Institute for Astrophysical Research

BOSTON UNIVERSITY

2023—2024 ASTROPHYSICS SEMINAR SERIES

A Holistic Perspective of Gas-Giant Planet Formation via Atmospheric Characterization, Planet-Star Synergy, and Large Sky Surveys

Over the past two decades, we have sketched the broad outline of exoplanet demographics. The frontier of the next decade hinges on our ability to understand the formation history of these exoplanets through their compositions, masses, and birth environments. There is a community-wide interest in studying planet formation via measuring their elemental abundances (e.g., carbon-to-oxygen ratio; C/O), given that different formation processes yield distinct relative compositions between planets and their parent stars. In this talk, I will introduce an ongoing spectroscopic program designed to measure elemental abundances across a large ensemble of directly imaged exoplanets, benchmark brown dwarfs, and their host stars. I will spotlight a remarkable planetary system to illustrate our analysis approaches. Our spectroscopic analysis of planets leverages (1) a novel retrieval framework that we developed to robustly characterize cloudy self-luminous atmospheres, and (2) a Bayesian forward-modeling framework enhanced by machine learning techniques and Gaussian processes. By applying these methods to the benchmark brown dwarfs within our sample, we have been quantifying the systematic errors inherent in state-of-the-art model atmospheres, enabling reliable atmospheric characterization for gas-giant planets. Looking ahead, the wealth of forthcoming data from large sky surveys such as LSST and Gaia DR4 will substantially expand the targets of our program, illuminating the diversity of outcomes in the realm of planet formation.

Monday, September 25th
3:30 - 4:30 p.m.
CAS 502

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