**Mock Proposal Abstract:**

Planets in the 1 - 4 R\_Earth radius regime seem to be the most common product of planet formation. These planets undergo a myriad of evolutionary processes shortly after formation, leading to two distinct populations: super-Earths and sub-Neptunes. However, very few young planets in this regime have been discovered leaving many open questions about the origin of this schism. K2-25b is a recently discovered sub-Neptune (R ~ 3.5 R\_Earth) around an M dwarf star in one of the youngest (~600 - 800 Myr old) planetary systems yet discovered, but its mass remains unconstrained. We propose for Habitable-zone Planet Finder (HPF) radial-velocity observations of the K2-25 system. With these observaitons, (1) we will make the first mass constraint of this young planet, and (2) estimate the stellar obliquity of K2-25. The high resolution of HPF is uniquely suited to measuring the signal of planets of this size. The mass of an exoplanet is necessary to model the internal and atmospheric structure of the planet, so measuring K2-25b’s mass will be essential to revealing the nature of this young world. The stellar obliquity is directly connected to the dynamical history of the planetary system and has only been measured for 3 other M dwarfs. Therefore, measuring this obliquity will shed light into the dynamics that led to K2-25b’s current status, as well as contributing a novel window into the dynamics of M dwarf systems in general. These results, coupled with K2-25b’s unique status as a young planet, will offer an unprecedented window into the evolution of super-Earth and sub-Neptune planets and provide new empirical constraints on planetary system dynamics.

**Original Paper Abstract:**

Using radial-velocity data from the Habitable-zone Planet Finder, we have measured the mass of the Neptune- sized planet K2-25b, as well as the obliquity of its M4.5-dwarf host star in the 600-800MYr Hyades cluster. This is one of the youngest planetary systems for which both of these quantities have been measured, and one of the very fewM dwarfs with a measured obliquity. Based on a joint analysis of the radial velocity data, time- series photometry from the K2 mission, and new transit light curves obtained with diffuser-assisted photometry, the planet’s radius and mass are 3.44±0.12R⊕ and 24.5+5.7−5.2M⊕. These properties are compatible with a rocky core enshrouded by a thin hydrogen-helium atmosphere (5% by mass). We measure an orbital eccentricity of e = 0.43±0.05. The sky-projected stellar obliquity is λ = 3±16◦, compatible with spin-orbit alignment, in contrast to other "hot Neptunes" that have been studied around older stars.

**Link to paper:** <https://arxiv.org/abs/2007.12766>

**Title:** The Habitable-zone Planet Finder Reveals A High Mass and a Low Obliquity for the Young Neptune K2-25b.

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