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THIRSTEE: testing the water world hypothesis on the small transiting exoplanet population

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The sub-Neptune population currently poses a conundrum. Are the smallest sub-Neptunes “gas dwarfs” (Earth-like cores surrounded by H/He envelopes) or “water worlds” (planets composed of ice and rock that migrated inward after forming beyond the snow line)? And if both populations exist, what are their distinguishing properties, and how do they depend on stellar type? Recent studies propose that for M dwarfs, the observed radius valley in the sub-Neptune population could stem from compositional differences (supporting the water-world hypothesis) instead of atmospheric mass loss. A similar result for FGK stars would reshape our interpretation of planet demographics, and influence formation and evolution theories, but testing this requires a larger sample of well-characterized exoplanets across diverse stellar types. The dependence on planet bulk density with host spectral type contains the most information to connect the observed population with global models of planet formation and evolution. On the other hand, a sample of sub-Neptunes with ranging equilibrium temperatures and host spectral types is necessary to constrain the chemistry and interior structure of this population via atmospheric characterisation.The THIRSTEE program aims at investigating the origin and nature of sub-Neptunes by collecting extremely precise radial velocity data for small transiting planets using ultra-precise spectrographs to : 1) expand the sample of small planets around M dwarfs, and 2) refine mass estimates of seemingly intermediate water mass fraction planets around FGK stars. I will present the program’s design and initial results, focusing on four newly-characterized M-dwarf systems. Our early findings suggest that most THIRSTEE-observed systems align with a water-world or Earth-like population.

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