

Search for helium in the atmospheres of small planets around M dwarfs with Subaru/IRD

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Thanks to space telescopes like Kepler and TESS, more than 2,000 small planets (1-4 Earth radii) have been discovered, establishing them as a common population in the Milky Way. However, their formation and evolution are still not fully understood. Observations from NASA's Kepler space telescope revealed a bimodal size distribution, known as the radius valley (1.5-2 Earth radii), which is thought to reflect the transition from rocky to non-rocky planets (Fulton et al. 2017). Furthermore, the composition and internal structure of small planets likely depend on their formation pathways (e.g., Zeng et al. 2019). Studying their atmospheres provides key insights into these differences.

Infrared helium triplet is a good indicator of a primary atmosphere accreted from the protoplanetary nebula. Recent studies have shown that the strength of this absorption feature is influenced by stellar X-ray and Extreme Ultraviolet (EUV) radiation, with K-type stars offering particularly favorable conditions (Oklopčić et al. 2020). Moreover, the latest models incorporating geometric effects suggest that planets orbiting nearby late M-dwarfs provide the best conditions for detection (Biassoni et al. 2023). However, previous studies have detected the infrared helium triplet in the atmosphere of only two planets orbiting M-type stars (Palle et al. 2020, Orell-Miquel et al. 2022), despite successful detections in a dozen other planets. Further observation of helium absorption in more planets around M-dwarfs help us to better understand this discrepancy.

We observed four small planets (~1.7-2.4 Earth radii) near the radius valley around M-dwarfs to search for helium triplets with Subaru/IRD and determined an upper limit for each planet. In this poster, we will report on these results and discuss them compared with model spectra.

Keywords: small planet, planetary atmosphere, high-resolution spectroscopy