Proof of concept for probing Na absorption in hot Jupiters' atmospheres using the narrow-band filters of MuSCAT3/4

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Despite the discoveries of hundreds of close-in Jovian exoplanets (hot Jupiters) in the last two decades, their formation and evolution histories have yet to be fully understood. Unveiling the atmospheric compositions of these planets by transmission spectroscopy using the ongoing and forthcoming space telescopes (e.g., HST, JWST, and Ariel) must be a crucial step to understanding their origins. However, past observations have revealed that the atmospheres of many hot Jupiters are covered by clouds or hazes, which mute atomic and molecular absorption features. These cloudy/hazy planets therefore require repeated observations to detect atoms and molecules in their atmospheres. Increasing the number of hot Jupiters that have a clear atmosphere is thus essential in unveiling the statistical properties of hot Jupiters' atmospheres. To achieve this purpose, we newly installed narrow-band filters to search for the opacity of exoplanet atmospheres using the Na absorption feature in the third and fourth versions of the optical multi-band simultaneous camera series, namely MuSCAT3 in Hawaii and MuSCAT4 in Australia, respectively. In this presentation, we will introduce our narrow-band filters and report the result of the observed well-known hot Jupiters using MuSCATs and narrow-band filters to provide proof of concept.

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