

Detectability of the coolest Y-type brown dwarfs by a next-generation infrared satellite

*Yui Kawashima¹, Shota Miyazaki¹, Hajime Kawahara¹

1. Japan Aerospace Exploration Agency

Brown dwarfs, objects bridging the gap between planets and stars, offer a unique opportunity to comprehensively understand various processes in the subdwarf mass regime, such as atmospheres, formation, and thermal evolution. Among the three spectral types of brown dwarfs, the coolest Y-type ($T_{\text{eff}} \leq 500$ K) corresponds to the same temperature range of not only giant planets in our solar system but also the primary targets of near-future atmospheric characterization of exoplanets. Thus, the atmospheric characterization of Y-type brown dwarfs provides a strong synergy to gain a comprehensive understanding of physical and chemical atmospheric processes for such temperature regime, including thermal balance, cloud formation, chemical reactions, and dynamics. While such Y-type brown dwarfs are expected to be much more abundant than their hotter counterparts, the current detected number is significantly limited (~ 50) due to their faintness.

Currently, a next-generation infrared satellite, GREX-PLUS, is being proposed as a JAXA's strategic L-class mission in the 2030s. GREX-PLUS has ~ 100 times more sensitivity than WISE, which has detected all the currently known Y-type brown dwarfs. In this study, we estimate the detectability of Y-type brown dwarfs, assuming the specifications of GREX-PLUS. Thanks to its excellent sensitivity, we expect ~ 1000 new discoveries of Y-type brown dwarfs, which will enable us to perform, for the first time, systematic characterization of the coolest spectral type atmospheres via not only photometric observation by GREX-PLUS itself at the time of the discoveries but also follow-up spectroscopic observation by other telescopes such as JWST.

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