A feasibility study on the detection of molecular species in exoplanet atmospheres by high-resolution transmission spectroscopy with SPICA/SMI

*Kawauchi Kiyoe[1], Yui Kawashima[2], Teruyuki Hirano[3], Yuka Fujii[4], Taro Matsuo[5], Kazumasa Ohno[3], Ayaka Okuya[3]

1. University of Tokyo, 2. SRON - Netherlands Institute for Space Research, 3. Tokyo Institute of technology, 4. Earth-Life Science Institute, Tokyo Institute of technology, 5. Nagoya University

Spectroscopic observations during planetary transits allow us to probe atmospheres of exoplanets (so-called "transmission spectroscopy").
In particular, high-resolution spectroscopy (R>20,000) has been proved to be one of the most powerful tools to directly investigate specific atoms/molecules in exoplanet atmospheres.
At optical wavelengths, alkali metals (i.e., Na and K) and Hα lines have been traditionally studied by ground-based telescopes (e.g., Casasayas-Barris et al. 2018, Gibson et al. 2018). In more recent studies, atoms and molecules, such as He and CO, were also detected by near-infrared high-resolution spectroscopy (e.g., Salz et al. 2018, Brogi et al. 2016), but more molecules in exoplanet atmospheres are still awaiting detections by current and future instruments.
Rich features and absorption bands of many molecules, which are important to understand the planet formation and evolution, are also located in the mid-infrared region (>5 micron); for instance, disequilibrium species such as HCN and C2H2 are crucial in the context of testing scenarios of UV irradiation and atmospheric mixing on exoplanets. However, detections of those molecules in the mid-infrared are unfeasible with observations from the ground, due to strong background emissions. Those molecules are expected to be detected by future observations from the space, such as by the JWST and SPICA missions.
In order to conduct a feasibility study on the detections of those molecules by future space missions, we performed a series of numerical simulations for high-resolution spectroscopy in the mid-infrared, taking into account the expected instrumental properties and background noises.
We specifically focused on SPICA/SMI observations, which provide us a unique opportunity to perform mid-infrared high-resolution spectroscopy. In this presentation, we will report on the results of our simulations and discuss the prospect to study exoplanet atmospheres using mid-infrared spectroscopy.

Keywords: Exoplanet Atmosphere, Transmission spectroscopy, Space telescope

