Condensation Growth Model of Cloud Particles with Size Distribution for Exoplanetary Atmospheres

*Kosuke Seki[1], Satoshi Okuzumi[1], Kazumasa Ohno[1]

1. Tokyo Institute of Technology

The atmospheric properties are the keys to understand the planet formation or evolution after planets are formed. Recent transit observations reveal that a number of super-Earth has featureless transition spectra, which imply the presence of high-altitude clouds.
Cloud models for exoplanetary atmospheres are important to understand the atmospheric properties.

Previous studies investigated the cloud-top height of exoplanets which have the featureless transmit spectra using the single size approximation. However, it is unclear that the size distribution of cloud particles is enough narrow and the featureless transmission spectra have not been reproduced by the single approximation models for some exoplanets.

In this study, we investigate the size distribution of dust cloud particles and cloud-top height of the super-Earth GJ1214 b, using a microphysical model that takes into account the size distribution through the vertical transport and condensation growth of cloud condensate nuclei (CCNs).
We find that low CCN number density leads to broader size distribution of cloud particles. The cloud-top height ascends higher than the height calculated by the single size approximation model, yet is still low to explain its featureless transmission spectra in the case of the atmospheric metallicity is the solar metallicity.

Our results suggest that the size distribution of the cloud particles is a key to understanding the cloud formation in the exoplanetary atmosphere. We need to investigate the size distribution for higher metallicity cases and consider collisional growth of cloud particles in future studies.

Keywords: super-Earth, Dust Clouds