

CONTROL ID: 2251411

TITLE: Possibility of Detecting the H₂O Snowline in Protoplanetary Disks Using Spectroscopic Observations

ABSTRACT BODY:

Abstract Body: Inside the H₂O snowline in protoplanetary disks, H₂O evaporates from grain surfaces into the gas. On the other hand, it is frozen out on the grain surface in the cold region beyond the H₂O snowline. The H₂O snowline is thought to divide the regions of rocky planet and gas giant planet formation. Observationally measuring the position of the H₂O snowline in protoplanetary disks in exoplanetary systems will constrain modern theories of planet formation. In disks around solar-mass T-tauri stars, the H₂O snowline is thought to exist at a few AU from the central star. Therefore, it is difficult to detect the H₂O snowline of exoplanetary systems by direct imaging, since the spatial resolution of existing telescopes is insufficient. In this work, we propose a method of detecting the H₂O snowline directly by analyzing the velocity profiles of H₂O line spectra which can be obtained by high dispersion spectroscopic observations in the near future.

First, we use self-consistent physical models of protoplanetary disks (e.g., Nomura & Millar 2005, Nomura et al. 2007, Walsh et al. 2010, 2012) to investigate the abundance distribution of H₂O gas and the position of the snowline. We confirm that the abundance of H₂O gas is high not only inside the H₂O snowline near the equatorial plane but also in the hot surface layer of the outer disk. Second, we calculate the emergent intensity of H₂O emission lines from protoplanetary disks that are assumed to rotate with Keplerian velocity profiles. We can find information on the H₂O snowline through investigating the profiles of emission lines that have small Einstein A coefficients and large excitation energies. The wavelengths of the useful H₂O emission lines range from mid-infrared to sub-millimeter wavelengths. These lines will be observable with future high dispersion spectroscopic observations (e.g., ALMA, TMT).

CONTACT (NAME ONLY): Shota Notsu

CONTACT (E-MAIL ONLY): snotsu@kusastro.kyoto-u.ac.jp

AUTHORS/INSTITUTIONS: S. Notsu, D. Ishimoto, Department of Astronomy, Kyoto University, Kyoto, JAPAN|H. Nomura, D. Ishimoto, Department of Earth and Planetary Sciences, Tokyo Institute of Technology, Tokyo, JAPAN|C. Walsh, Leiden Observatory, Leiden University, Leiden, NETHERLANDS|M. Honda, Department of Mathematics and Physics, Kanagawa University, Hiratsuka, Kanagawa, JAPAN|T.J. Millar, School of Mathematics and Physics, Queen's University Belfast, Belfast, UNITED KINGDOM|

PRESENTATION TYPE: Oral