



Dr. Tamami Okamoto
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Carbon depletion inside the snow line

Time: 10:00-10:40, 5 November (Tuesday), Shanghai time

Venue: N600 (TDLI)

Host: Masahiro Ogihara

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Meeting ID: 544140472

Abstract:

Earth and other rocky bodies in the inner Solar System are significantly depleted in carbon compared to the Sun and interstellar medium (ISM) dust. Observations indicate that over half of the carbon in the ISM and comets is in refractory forms, like amorphous hydrocarbons and complex organics, which can be building blocks of rocky bodies. While amorphous hydrocarbons are destroyed by photolysis and oxidation, radial transport of solid particles can limit carbon depletion, except when complex organics, which are less refractory, are the main carbon source. We aim to identify conditions for severe carbon depletion in the inner Solar System by introducing more realistic factors: differences in stickiness between icy and silicate particles, and high-temperature regions in the disk's upper optically thin layer, which were not considered in previous studies. We perform a 3D Monte Carlo simulation of radial drift and turbulent diffusion in a steady accretion disk, incorporating ice evaporation/recondensation, photolysis/oxidation of hydrocarbons in the upper layer, and pyrolysis of complex organics. Our results show that the carbon fraction drops by two orders of magnitude inside the snow line under two conditions: i) silicate particles are much less sticky than icy particles, leading to a rapid decline in icy pebble flux while silicates accumulate inside the snow line, and ii) high-temperature regions in the disk's upper layer stir silicate particles into UV-exposed areas. These conditions reproduce carbon depletion patterns consistent with observations and allow for diverse carbon fractions in rocky bodies.

Biography:

Tamami Okamoto is a Ph.D student at Earth-Life Science Institute (ELSI) in Institute of Science Tokyo (previously, Tokyo Institute of Technology). Her research uses computational calculations to understand dust motion and its chemical composition in protoplanetary disks. She received her B.S. in Science from Keio University and is scheduled to receive her Ph.D in Science from Science Tokyo in Mar 2025.

