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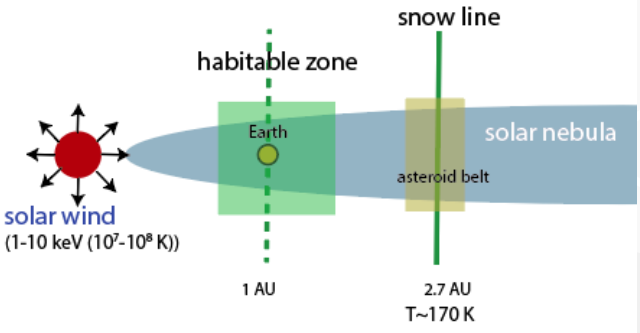
Venue: Meeting Room #674
Science Research Bldg. 1, 6th floor.
Ehime Univ.



The role of the solar wind as an origin of volatiles on terrestrial planets: An experimental study

The solar wind is a possible source of water and other volatile elements that may solve a puzzle of how did terrestrial planets (within the snow line) get a substantial amount of water during their formation. To understand the possible role of the solar wind, we conducted high-energy proton implantation experiments for olivine, orthopyroxene and quartz, and results were analyzed using nuclear resonance reaction analysis. We also conducted a numerical experiment on hydrogen implantation on small dusts and found that for not much hydrogen is trapped in small dusts whose size is comparable to or less than the mean free path of H in the mineral. Using these results, we conclude: (i) a large amount of H can be implanted into these minerals quickly, (ii) the amount of hydrogen implanted in dusts depends on the dust size with a peak at ~0.1 – 1 micron, and (iii) because the energy of D is ~twice higher than that of H in the solar wind, the D/H ratio of trapped H and D in the dusts will be higher than the D/H of the solar wind. For a plausible dust size in the nebular disk (~1 micron), one can get enough water to make a wet planet quickly (<1000 years). We also studied the nature of change in physical properties of mineral (olivine) by high-energy proton irradiation. Irradiation makes olivine mechanically weak and likely increases the dielectric constant.

A serious problem of this model is that the majority of the proto-solar nebula is opaque and not much solar wind particles reach dust grains. We propose a possible model to deal with where the role of turbulent mixing is emphasized: the mixing time scale in the disk can be estimated based on the mixing length model of turbulent flow and it is 1-10000 years, much less than the life time of a disk (~1 million years).

Keywords: 1. Water in terrestrial planets
2. Snow line
3. Solar wind

GRC

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