Shock condition for icy grain evaporation by nebular shocks

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Evaporation condition for icy grains

Recent ALMA observation showed an enhanced SO line emission that distributes compactly around a protostar [1]. It is suggested that the gas infall induces accretion shocks, in which icy grains suffer from evaporation. Some authors examined the evaporation of icy grains using numerical simulations [2-4]. In this study, we investigate the shock conditions for the icy grain evaporation comprehensively in order to confirm whether the icy grains can evaporate significantly by typical accretion shocks or not.

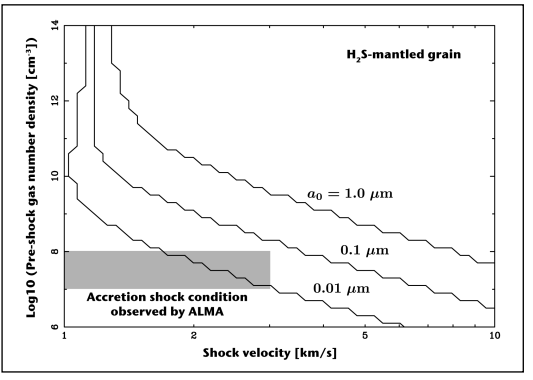

Figure 1: Shock conditions for complete evaporation of H_2S-mantled grains with various initial radii (shock diagram).

Results and Discussion

We numerically simulated the shock heating induced by accretion shocks for various icy grain materials such as N_2, CO, CH_4, H_2S, CO_2, NH_3, and H_2O. Numerical result indicates that the shock condition for the icy grain evaporation depends on the grain size. Namely, smaller grains evaproate more easily mainly due to their small emissivities. For example, a H_2S-mantled grain hardly evaporates by a typical accretion shock if the grain size is greater than about 0.1 μm, which is an typical size of interstellar grains. The origin of the enhanced molecular line emission may be revisited based on the shock diagram.

[1] Sakai et al. (2014) *Nature* **507**, 78. [2] Lunine et al. (1991) *Icarus* **94**, 333. [3] Neufeld & Hollenbach (1994) *ApJ* **428**, 170. [4] Aota et al. (2015) *ApJ* **799**, 141.