How to put Heated Grains into Frozen Comets

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Comets are rich in water ice and must have formed in the outer parts of the solar system. Yet samples from Comet Wild 2 contain abundant refractory grains including CAIs (Brownlee et al. 2006). CAIs are thought to have formed during a brief period in the hot inner region of the solar nebula. We suggest that CAIs can be transported within the disk by hydrodynamic processes. We model the solar nebular as a marginally gravitationally unstable disk such as is thought to occur during the FU-Orionis stage of a young star. We follow trajectories of small (0.1 - 10 cm) melilite grains through the disk as they interact with the spiral arms formed in the disk (Boss 2008, Haghighipour and Boss 2003).

Such grains can traverse large regions of the disk and visit regions that are at radial distances of 1 to 10 AU. During these journeys the grains experience temperatures that vary from 60 K to more than 1500 K (Boss et al. 2012). This leads to an interaction with the surrounding gas that includes vaporization of the melilite grain, recondensation of the evaporated material, and condensation of water vapor as well. Typical trajectories will be shown and the resulting grain structure discussed. Some additional results for larger particles, up to 10 m will be presented and the implications for the composition of small bodies will be discussed.

References

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