Joint EPS / Astronomy Colloquium

Thursday, November 29, 2007
4-5 p.m.
1 LeConte Hall

"The Origin of Crystalline Silicates Around Stars: New Evidence from the Stardust Comet Sample Return Mission"

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It is widely believed that the crystalline silicates observed in disks around stars formed by modest heating (annealing) of amorphous interstellar grains. The Stardust comet sample return mission collected thousands of samples from a Jupiter family comet and returned them to Earth for detailed study in laboratories around the World. The collected materials are expected to be representative samples of solid materials that were at the edge of the solar nebula disk at the time of its formation. A striking finding from the samples is that most of the silicates do not appear to have formed by modest heating of interstellar grains. Instead they are complex rocks that formed the hot regions of the solar nebula at temperatures in the 1400-1700K range. One particle is a calcium aluminum inclusion (CAI) that is linked to CAIs found in asteroidal meteorites by elemental, isotopic and mineralogical composition. CAI's from meteorites are the oldest solar system solids and they appear to have formed in a hot localized region over a time a brief time period <20,000 years. Most of the mass of the comet appears to be material that formed in the hot inner regions of the solar nebula that was then transported to the Kuiper Belt where it mixed with ices formed at <50K. The fire/ice mix in comets is evidence that large-scale radial mixing was very effective in the solar nebula for 1-30μm particles. The results indicate that the majority of crystalline solids of micron and larger size, in all regions of the solar nebula were produced by nebular processes at moderate to severe temperatures that are much higher than temperatures required to anneal interstellar silicate grains.