Tiny particles key to understanding early solar system

April 16 2012

Hubble Panoramic View of Orion Nebula. Credit: hubblesite.org

(Phys.org) -- New research from The Australian National University has answered a decades old cosmic conundrum on how 'chondrules' – tiny particles found within meteorites – could have formed in extreme heat, especially when the meteorite structure surrounding them remained cold.

Chondrules are spherical particles of molten material found in meteorities but their origins have long been a mystery. No longer than about 1mm in diameter, they melted at temperatures of more than 1000 degrees Celsius, while the cooler materials surrounding them only

experienced temperatures of a few hundred degrees Celsius.

ANU researchers Dr. Raquel Salmeron from the Research School of Astronomy and Astrophysics, and Dr. Trevor Ireland from the Research School of Earth Sciences, have proposed a new theory as to how chondrules formed in the early solar system.

“Most of the solar system is cold, so it’s been unclear for decades what caused the chondrules to experience such extreme heat. We believe that chondrules formed in jets of material ejected from flattened disks, called ‘protostellar disks’, which encircle young stars,” Dr. Salmeron said.

“These disks are somewhat like the rings around the planet Saturn. The modern planets are the remnants of material of these disks clumping together. In observations of the formation of new stars, we can see jets of material accelerating out of protostellar disks.

“We show that as these jets shoot out of the disks, from about the Earth-Sun distance away, the materials brought with them are heated to the point of melting. The heavier items in them then drop back into the disks, where they cool and re-form.”

Dr. Salmeron said that this theory challenged old assumptions about the formation of chondrules.

“For decades it has been assumed that jets could only form chondrules through the heating of materials in the vicinity of the Sun, followed by their transportation into protostellar disks,” Dr. Salmeron said.

“We believe that our new theory explains how chondrules – among the earliest materials in the solar system – reached the temperatures required for melting, even though the early solar nebula was cold. It also explains

the fairly uniform size of chondrules and provides a means for them to mix and combine with unheated material."

Provided by Australian National University