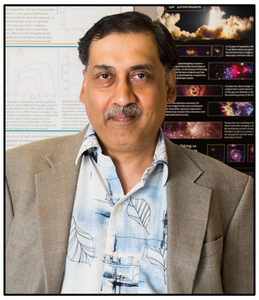
ASTROPHYSICS SEMINAR SERIES



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Tuesday, April 23   12:30 pm - Rm 184 NSH

Investigating a stellar wind origin for the formation of the solar system

A critical constraint on solar system formation is the high 26Al/27Al abundance ratio of 5e-5 at the time of formation, which was about 17 times higher than the average Galactic ratio, while the 60Fe/56Fe value was about 2e-8, lower than the Galactic value of 3e-7. This challenges the assumption that a nearby supernova was responsible for the injection of these short-lived radionuclides into the early solar system. We show that this conundrum can be resolved if the Solar System was formed by triggered star formation at the edge of a Wolf-Rayet (W-R) bubble. Aluminium-26 is produced during the evolution of the massive star, released in the wind during the W-R phase, and condenses into dust grains that are seen around W-R stars. The dust grains survive passage through the reverse shock and the low density shocked wind, reach the dense shell swept-up by the bubble, detach from the decelerated wind and are injected into the shell. Some portions of this shell subsequently collapse, due to triggering by the effects of shock fronts and ionization fronts, to form the dense cores that give rise to solar-type systems. The subsequent aspherical supernova does not inject appreciable amounts of 60Fe into the proto-solar-system, thus accounting for the observed low abundance of 60Fe. We discuss the details of various processes within the model using numerical simulations, as well as nucleosynthesis modelling, and analytic and semi-analytic calculations. We conclude that it is a viable model that can explain the initial abundances of 26Al and 60Fe. We also suggest that the model can explain abundances of other short-lived radionuclides in the early solar system, such as 10Be, 36Cl, 41Ca, 53Mn, 107Pd, 129I, and 182Hf.

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