Source : www.thehindu.com Date : 2019-05-12

FAST NEUTRINO OSCILLATIONS MAY HOLD KEY TO SUPERNOVAE FORMATION

Relevant for: Geography | Topic: The Earth and the Solar System

A NASA Hubble Space Telescope composite image shows star cluster NGC 2060 | Photo Credit: Reuters

Neutrinos could be the driving force behind supernova explosions, a new theoretical study from Tata Institute of Fundamental Research finds. The study which makes a fundamental advance in modelling neutrinos inside stars puts forth the idea that “fast neutrino oscillations” could hold the key to why some stars explode forming supernovae at the end of their lives.

Neutrinos come in three flavours: electron neutrino, muon neutrino and tau neutrino, so named because of the corresponding leptons they are associated with (electron, muon and tau). There are several puzzles they have posed, including how they are ordered according to mass and this puzzle still remains to be solved.

Earlier when measuring the number of neutrinos coming from the sun, experimentalists found that only a third of the number of solar neutrinos that was expected was being intercepted on earth. This was later explained by the understanding that they have a small mass and they can change from one flavour to another – a phenomenon named neutrino oscillations.

Fast neutrino oscillations are another phenomenon – When the same neutrinos are in the presence of many other neutrinos and when the different flavours are emitted slightly differently in various directions (anisotropy) the oscillations from one flavour to another happen at a higher frequency. This is called fast oscillation and is proportional to the density of neutrinos in the medium, and not the masses of the neutrinos.

“Any star that collapses under its own gravity after having run out of its fusion fuel is called a supernova. Usually stars more massive than eight times the Sun’s mass enter this phase of explosive death,” explains Basudeb Dasgupta of Tata Institute of Fundamental Research, Mumbai, one of the authors of the paper published in Physical Review Letters, in an email to *The Hindu*.

He further explains that this has not been observed as it requires a large neutrino density and anisotropy, conditions that can be met only in the hearts of massive stars, neutron star collisions etc.

“Our key advance is to treat neutrino collisions and oscillations self-consistently in a single calculation,” says Dr Dasgupta. In earlier work, it was assumed that high density and anisotropy conditions were put in by hand, while the neutrinos were assumed to travel in straight lines without colliding. In the present work the authors include collisions that lead to the high anisotropy conditions. They show how in the presence of collisions the fast oscillations take place. “This was technically very challenging and the first calculation of its kind. Our computer-based calculation took several days on a cluster of high performance computers,” he adds.

NASA wants to study the effects of spaceflight on a woman

END