Notre Dame Science
Department of Physics

CONSTRAINING PROPERTIES OF NEUTRON STARS WITH TERRESTRIAL NUCLEAR REACTIONS

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4:00 P.M. NSH 118
(Refreshments at 3:30 P.M. NSH 202)

Neutron stars are highly condensed stellar objects produced in supernova explosions, the end point in the evolution of more massive stars. The masses of neutron stars are in the range of 1-2 times of the sun, whereas their typical radii are only 10-20km. The matter they contain, primarily neutrons, is therefore the densest found outside black holes in the universe. Neutron stars thus provide a laboratory to test our understanding of nature at the extreme, and verify our theories of matter, energy and their interactions. However, neutron stars are still among the most mysterious objects in the universe and they pose a great scientific challenge. The structure and properties of neutron stars are determined by the Equation of State (which is a relationship among the pressure, density and temperature) of neutron-rich nuclear matter. For the EOS of neutron-rich nuclear matter, what has been most uncertain is the symmetry energy term related to the energy cost of converting protons into neutrons in nuclear medium at various densities. Nuclear reactions conducted in terrestrial laboratories, especially heavy-ion reactions induced by highly neutron-rich radioactive beams, can produce nuclear matter similar to those contained in neutron stars. In this talk, I will first review the latest theoretical and experimental progress in constraining the EOS of neutron-rich nuclear matter, especially the density dependence of the nuclear symmetry energy, using nuclear reactions in terrestrial laboratories. I will then discuss several key astrophysical ramifications of the EOS partially constrained by the latest experimental data from several nuclear physics laboratories around the world.

Host: Prof. Umesh Garg

Colloquium

All interested persons are cordially invited to attend.