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Unified equations of neutron-star interiors: role of the symmetry energy

Formed in the aftermath of gravitational core-collapse supernova explosions, neutron stars are the most compact observed stars. Their average density exceeds than that found inside the heaviest atomic nuclei. Neutron stars are also endowed with the strongest magnetic fields known, which can reach millions of billions times that of the Earth. According to our current understanding, a neutron star is stratified into distinct layers. The surface is probably covered by a metallic ocean. The solid layers beneath consist of a crystal lattice of pressure-ionized atoms embedded in a highly degenerate electron gas. With increasing density, nuclei become progressively more neutron rich until neutrons start to drip out of nuclei thus delimiting the boundary between the outer and inner regions of the crust, where neutron-proton clusters are immersed in a neutron liquid. At about half the density of heavy nuclei, the crust dissolves into an homogeneous liquid mixture of nucleons and leptons. During this talk, our latest series of unified and thermodynamically consistent equations of state of dense matter in neutron stars will be presented. These equations of state were specifically developed to assess the role of the symmetry energy on neutron-star properties.

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