Neutron Stars: with and without Dark Matter

Abstract:

The Equation of State (EoS) of nuclear matter is obtained from the density dependent M3Y effective nucleon-nucleon interaction. The theoretically obtained values of the symmetric nuclear matter incompressibility, isobaric incompressibility, symmetry energy and its slope agree well with the experimentally extracted values. The high-density behavior of symmetric and asymmetric nuclear matter satisfies the constraints from the observed flow data of heavy-ion collisions. The neutron star properties studied using β-equilibrated neutron star matter obtained from this effective interaction for a pure hadronic model agree with the recent observations of the massive compact stars. The masses and radii of non-rotating and rotating configurations of pure hadronic stars mixed with self interacting fermionic Asymmetric Dark Matter are calculated within the two-fluid formalism of stellar structure equations in general relativity. The EoS of self-interacting dark matter is taken from two-body repulsive interactions of the scale of strong interactions. The conditions of equal and different rotational frequencies of nuclear matter and dark matter are explored and it is found that the maximum mass of differentially rotating stars with self-interacting dark matter of particle mass 1 GeV to be ~1.94 $M_\odot$ with radius ~10.4 km.