

Equation of state of dense matter from multi-messenger observations of neutron stars

Sunday, 8 September 2024 16:20 (25 minutes)

The understanding of neutron star equation of state hinges on a comprehensive analysis of multi-messenger, multi-wavelength data. The recent scrutiny of PSR J0030+0451 data by NICER introduces complexities, unveiling a tension with another X-ray observation of the central compact object in HESS J1731-347, specifically concerning the mass-radius constraint of low-mass neutron stars. This tension persists when integrating NICER's updated data with LIGO/Virgo's gravitational-wave data from the GW170817 binary neutron star merger. Despite attempts to reconcile these disparate observations, the current combined data still can not distinguish different types of neutron stars – whether they are pure neutron stars or hybrid stars. Bayesian inference indicates only modest changes in the posterior ranges of parameters related to the nuclear matter and deconfinement phase transition. This ongoing exploration underscores the intricate challenges in precisely characterizing neutron stars. It also points out that it is possible to probe the equation of state at different density regimes from future more accurate radii of neutron stars with various masses.

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Session Classification: Nuclear Matter, Neutron Stars and Black holes

Track Classification: Nuclear Matter, Neutron Stars and Black holes