

Properties of dense nucleonic matter

The equation of state of nuclear matter is relevant in a broad range of nuclear physics and astrophysics:

- Neutron stars and supernovae:

EOS related to the structure of neutron stars and drives the supernovae explosion.

Neutrino emissivity, cooling rates, and other properties related to the symmetry energy.

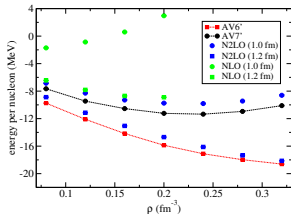
- Heavy nuclei:

symmetry energy governs several properties of medium/heavy nuclei.

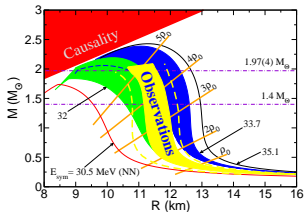
Intense experimental activity aiming to measure the symmetry energy and its slope in several facilities, as well as dense nuclear and neutron matter.

Present Status

- Nuclear matter much more challenging than neutron matter. Perturbative calculations not reliable.
- Most of the calculations *assume* a quadratic dependence to the isospin asymmetry
- Several observables in nuclear experiments are model dependent
- Neutrino rates in neutron stars described with simple models
- Symmetry energy related to skin thickness of nuclei, P-REX and C-REX
- Present models limited to (2-3) ρ_0



nuclear matter EOS with chiral forces



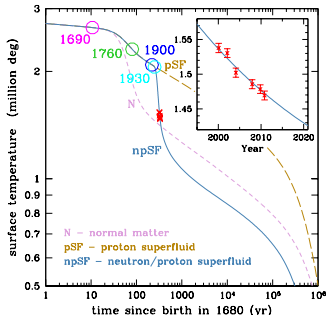
Neutron star structure, theory vs observations

Future Challenges:

- Compare theoretical uncertainties in medium/heavy nuclei with infinite matter
- Understand the dynamics including weak response of low-density asymmetric nuclear matter, pairing correlations and clustering phenomena
- Compare theoretical models with cooling rates of neutron stars
- Constrain the EOS from neutron star mass/radii, gravitational waves and heavy ion collision experiments
- Finite temperature effects to neutron and nuclear matter

Requirements: Faculty/Staff, postdocs, and students.

Large-scale computing essential.



Cooling of Cassiopeia A, obs. vs theory