Equilibrium and dynamics of star matter

The validity of the models of neutron star matter must be gauged beyond their ability to predict acceptable values of masses and radii

- Equilibrium
  The EoS determines the equilibrium properties of the star: mass/radius relation, composition, neutrino emission rates

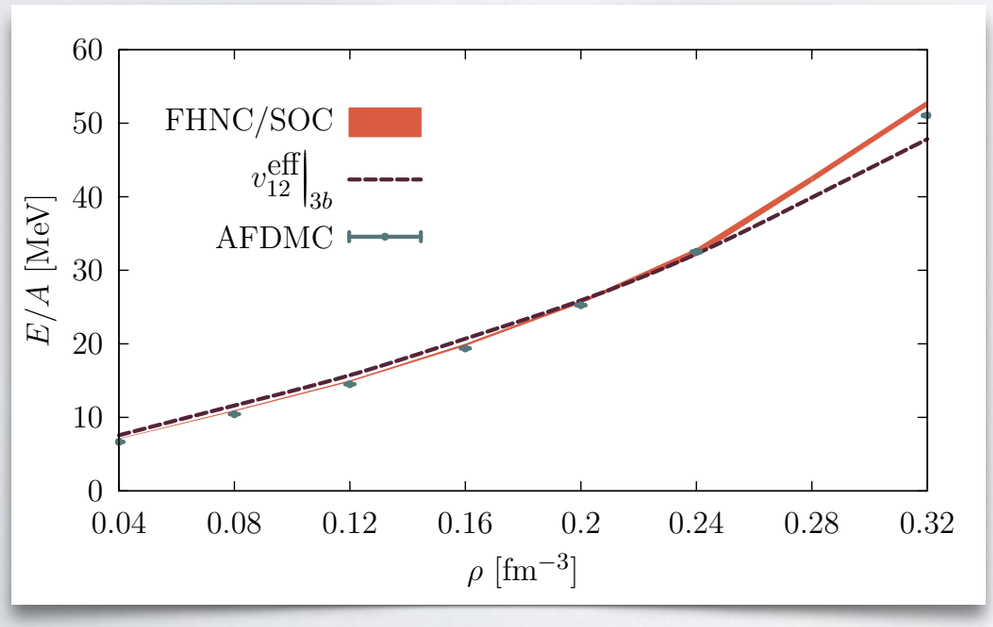
- Dynamics
  Transport properties determine the onset of the gravitational-wave driven instabilities, the dissipation of magnetic fields…

  Neutrino interactions determine the cooling rate of neutron star

  Superfluid gap modifies the neutrino emission, scattering and absorption rates, as well as of the transport coefficients.

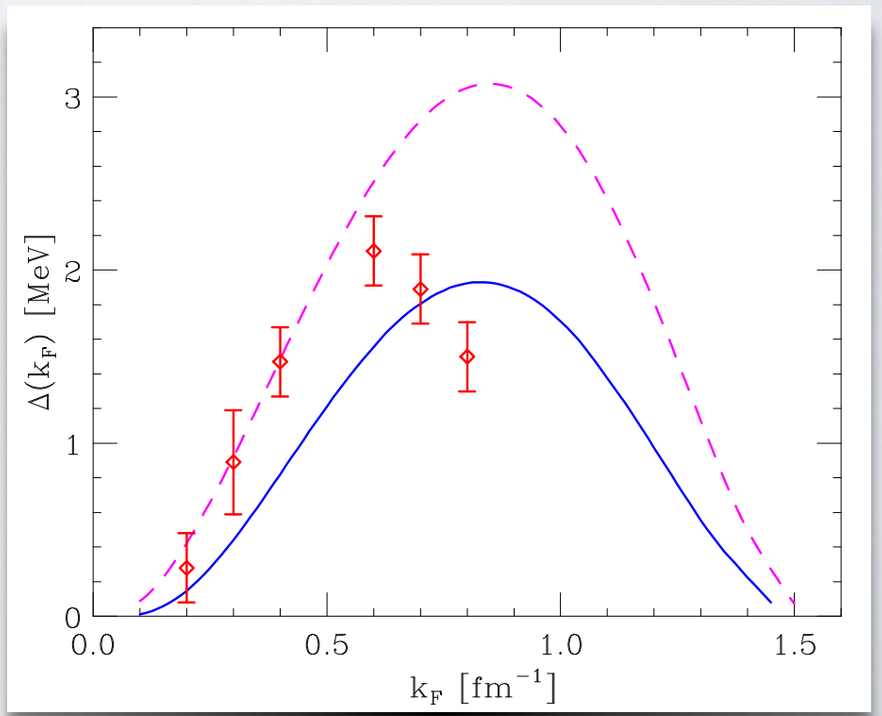
Present Status

- Large degeneracy associated with models of the EOS providing similar values of neutron stars' mass and radius
- Most calculations use different models to obtain the EoS and to describe transport properties.
- Need for a consistent framework for dynamical and equilibrium properties of neutron star matter
- Effective interaction from realistic nuclear hamiltonian

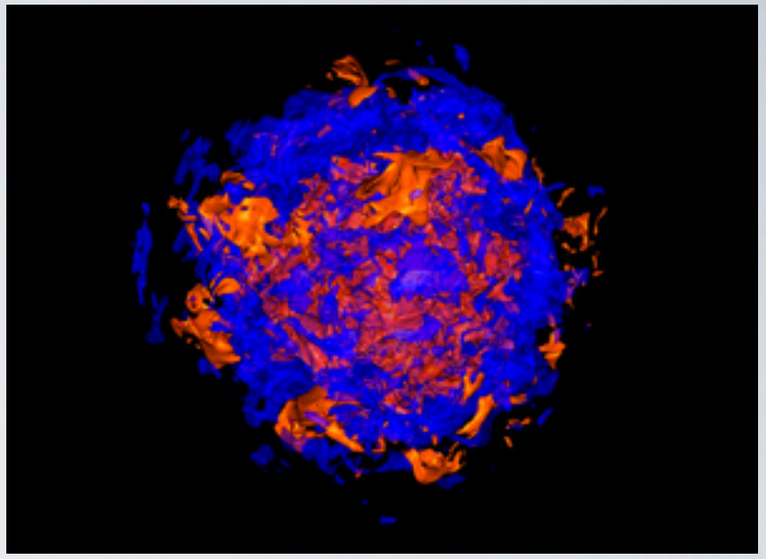


left: CBF effective interaction and AFDMC EoS of neutron matter

right: CBF effective interaction and AFDMC superfluid gap



Future Challenges



- Use the result of benchmark calculations carried out within exact Quantum Monte Carlo approaches to test the effective interactions

- Establish the robustness of the effective interaction formalism using different many-body approaches (CBF, G-matrix, SRG…)

- Extend the effective interaction approach to treat finite temperature and non isospin-symmetric matter

- Promote the synergy between the nuclear theory, astrophysics and relativity communities

Requirements: Faculty/Staff plus several students and postdocs; medium-scale computing