Spin Susceptibility in Neutron Matter from QMC Calculations

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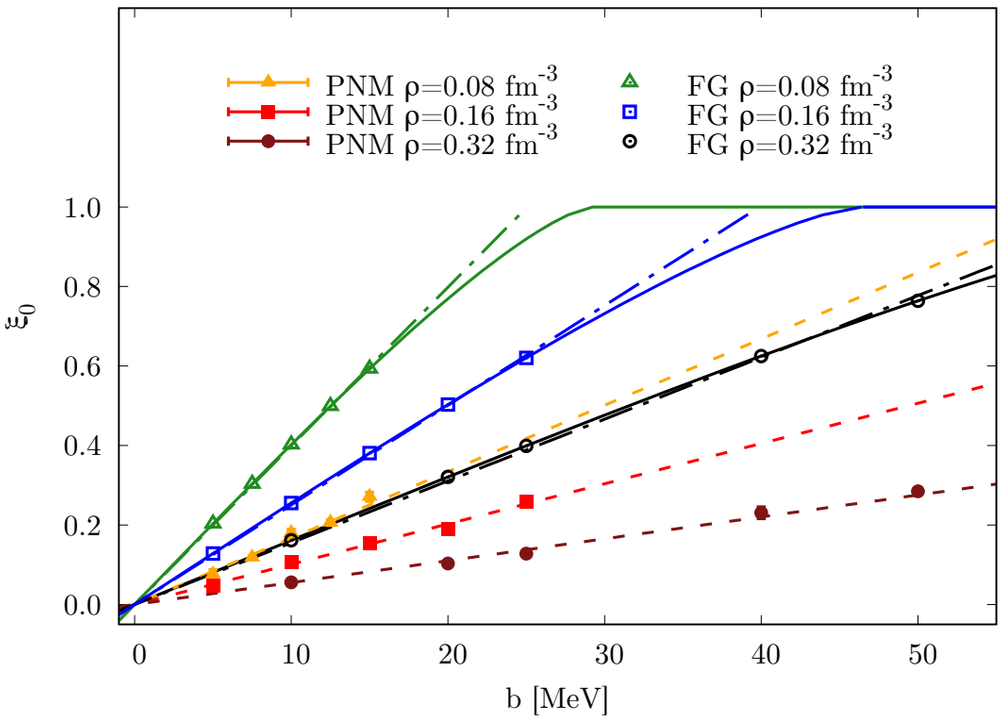
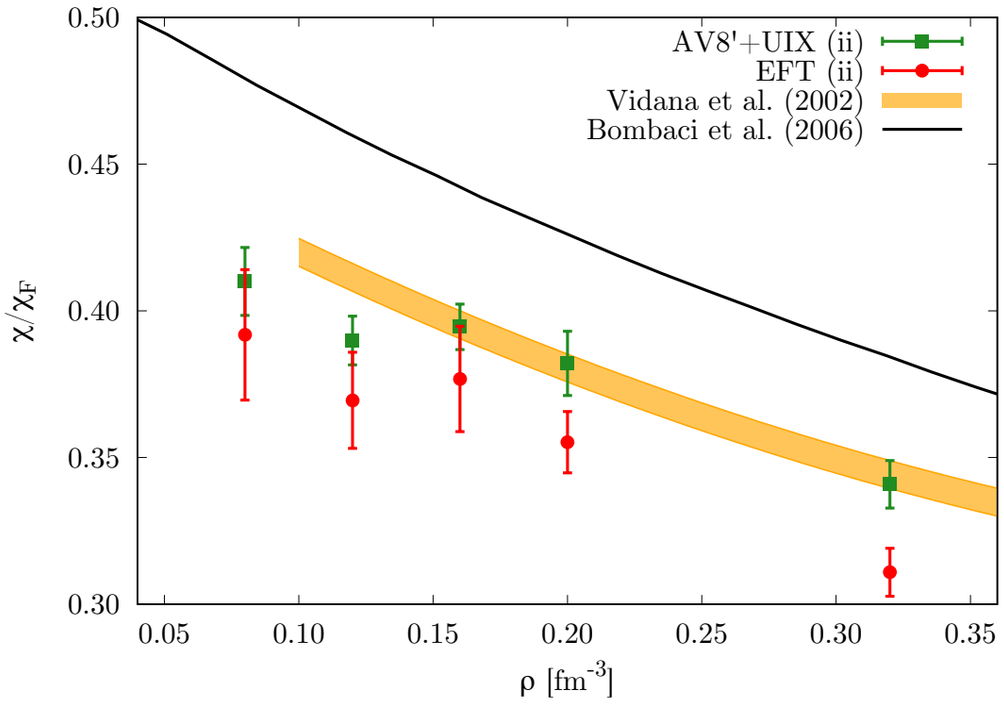
FACILITY FOR RARE ISOTOPE BEAMS



Ground-state spin polarization as a function of the external magnetic field in PNM and the free Fermi gas.



Spin susceptibility in PNM as a function of the density.

Objectives

- We study the spin susceptibility in pure neutron matter (PNM) using quantum Monte Carlo (QMC) techniques.
- We employ both phenomenological potentials and interactions derived from chiral effective field theory.
- We perform calculations for different spin polarizations, and we use twist-averaged boundary conditions to reduce finite-size effects.

Impact

- We observe that the predicted ground-state spin polarization of the interacting system (PNM) is much lower than the one predicted for the free Fermi gas.
- We verify that three-body forces have a 10-15% effect on the predicted PNM spin susceptibility. However, realistic Hamiltonians provide consistent results regardless the scheme of the nuclear interaction.
- Accurate results for the spin susceptibility are needed for general relativity simulations of violent phenomena, such as supernova explosions or neutron star mergers.

Accomplishments

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- L. Riz, F. Pederiva, D. Lonardoni, and S. Gandolfi, Particles 2020, 3(4), 706-718