



清华大学高等研究院

Institute for Advanced Study, Tsinghua University

物理学术报告 Physics Seminars (biweekly)

Title: Strong-coupling ansatz for the 1D Fermi gas
in a harmonic potential

Speaker: Jesper Levinsen (*Monash University*)

Time: 4:00pm, Wednesday, Nov 11, 2015
(3:30~4:00pm, Tea, Coffee, and Cookie)

Venue: Conference Hall 322, Science Building, Tsinghua University

Abstract

The 1D Fermi gas with repulsive short-range interactions provides an important model of strong correlations and is often amenable to exact methods. However, in the presence of confinement, no exact solution is known for an arbitrary number of strongly interacting fermions. Here, we propose a novel ansatz for generating the lowest-energy wave- functions of the repulsive 1D Fermi gas in a harmonic potential near the Tonks-Girardeau limit of infinite interactions. We specialize to the case of a single impurity particle interacting with N majority particles, where we may derive analytic forms of the approximate wavefunctions. Comparing with exact numerics, we show that the overlap between the wavefunctions from our ansatz and the exact ones in the ground-state manifold exceeds 0.9997 up to $N=8$. Moreover, the overlap for the ground-state wavefunction at strong repulsion extrapolates to 0.9999 in the thermodynamic limit. Thus, our ansatz is essentially indistinguishable from numerically exact results in both the few- and many-body limits. I will also discuss recent extensions of this work to investigate magnetism in a strongly-interacting two-component Bose gas.

References:

Jesper Levinsen, Pietro Massignan, Georg M. Bruun, Meera M. Parish, *Science Advances* 1, e1500197 (2015)

Pietro Massignan, Jesper Levinsen, Meera M. Parish, arxiv:1507.02814