武汉物数所理论交叉学术交流系列报告

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

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频标楼4楼报告厅

About the Speaker:

Jesper Levinsen is a senior research fellow of Monash University at Australia. He is a very young and talented theoretical researcher. He gratulated with PhD degree from the University of Colorado at Boulder, USA. He has received several internationally competing fellowships including Marie-Curie Intra European Fellow and Carlsberg Foundation Fellowship, University of Cambridge, etc. He has published more than 7 PRLs in recent years. Current research interest: strongly interacting quantum systems on the interface between condensed matter physics and the physics of ultracold atomic gases. He works on aspects of superfluidity, impurities in degenerate quantum gases, few-body physics, and low-dimensional systems.

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.

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