北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Weekly Seminar

Interaction-induced Haldane fractional exclusion statistics in one and higher dimensions: insights and evidences from cold atoms

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Time: 4: 00 Pm, Nov. 27, 2019 (Wednesday)

2019 11 27 4:00

Venue: Room W563, Physics building, Peking University

563

Abstract

Haldane fractional exclusion statistics (FES) has a long history of intense studies, but its realization in physical systems is rare. Here we study repulsively interacting Bose gases at and near a quantum critical point, and find evidences that the particle-hole symmetry breaking in such strongly correlated gases takes a particularly simple form depicted by non-mutual FES, which then largely determines the macroscopic physical properties of these gases over a wide range of interaction strengths in both one and two dimensions. Based on exact solutions in one dimension, quantum Monte Carlo simulations and experiments in both dimensions, we show that a group of thermodynamic properties of these interacting gases are essentially equivalent to those of non-interacting particles with FES. Accordingly, we establish a generic approach that both quantifies the interaction-induced particle-hole symmetry breaking (depicted by FES) and reveals a deep connection between such symmetry breaking and measurable macroscopic properties of quantum many-body systems in arbitrary dimensions. Whereas strongly interacting Bose gases reach full fermionization in one dimension, they exhibit incomplete fermionization in two dimensions.

In addition, I will discuss our recent experimental progress at ICQM towards realizing 2D spin-orbit coupling in ultracold fermions of Sr 87.

About the speaker

Xibo Zhang is an assistant professor at ICQM, PKU since 2016.