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: **Dissipation Dose Matter**

——A study on non-equilibrium phenomena in open cold atom systems

Speaker: **Wei Zheng 郑炜 *(University of Cambridge)***

Time: **4:00pm, Tuesday, Dec. 12, 2017**

(3:30~4:00pm, Tea and Coffee)

Venue: **Conference Hall 322, Science Building, Tsinghua University**

Abstract

One of the most interesting directions of research in coherent quantum systems concerns the collective behavior of coupled atom-photon ensembles. Coupling cold atoms even to a single cavity mode can dramatically change not only the steady state, but also the nonequilibrium dynamics of the atomic gas.

In this talk, I will introduce our recent works on nonequilibrium dynamics of Atoms coupled to optical cavity. I will first talk about the dynamics of fermions in an optical lattice with cavity induced hopping. For an infinite lattice, we find a superradiant phase with an infinitesimal pumping threshold which induces a directed particle flow. We explore the fate of this flow in a finite lattice with boundaries, studying the nonequilibrium dynamics including fluctuation effects. The short-time dynamics is dominated by superradiance, while the long-time behavior is governed by cavity fluctuations. We show that the steady state in the finite lattice is not unique and can be understood in terms of coherent Bosonic excitations above a Fermi surface in real space.

Second I will discuss a cavity-induced dynamical optical lattice, in which the dynamical lattice is chosen to have a period that is incommensurate with that of an underlying static lattice. This dynamical lattice can be regarded as a dynamical version of the Aubry-Andr′e model, which can cause localization of single-particle wave functions. We show that atomic wave packets in this dynamical lattice generically spread via anomalous diffusion, which can be tuned between super-diffusive and sub-diffusive regimes. To understand this anomalous diffusion, we use the quantum trajectory picture to map the dynamics into a Le'vy walk with rests.