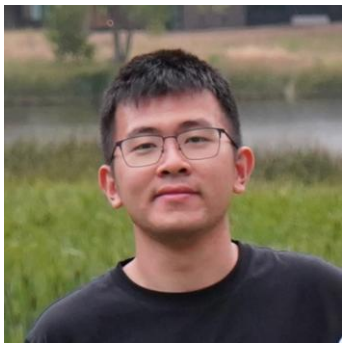
THE CHINESE UNIVERSITY OF HONG KONG

Department of Physics

COLLOQUIUM

Collective Physics with Many Atoms in Optical and Microwave Cavities

by



Dr. Chengyi LUO (羅程禕博士)
Department of Applied Physics and Materials Science
California Institute of Technology, USA

Date: November 17, 2025 (Monday)
Time: 1:45 - 2:45 p.m.
Place: LT, William M W Mong Engineering Building, CUHK

ALL INTERESTED ARE WELCOME
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Abstract

Cavity quantum electrodynamics (cavity-QED) offers a powerful toolbox for engineering light-matter and matter-matter interactions, which is fundamental to various applications in quantum science. Mediated by the photons in cavity, long-range interactions can be established between atoms and give rise to novel collective phenomena. In this talk, I will focus on how to engineer all-to-all exchange interaction between atoms coupled to a common resonator mode, and the resulting coherence protection mechanism with two different cavity-QED systems. The first system is with cold atoms coupled to an optical cavity. By exploiting the interplay between atomic matter waves and the cavity mode, we realized a novel momentum-exchange interactions. The emerging many-body energy gap gives rise to a collective atomic recoil mechanism that effectively binds wave packets together to suppress Doppler dephasing, akin to the Mössbauer effect. In the second experiment, I will switch to a different platform with solid-state spins coupled to a microwave resonator. In this system, we demonstrated an on-demand long-lived microwave memory, in which the spin inhomogeneity is suppressed by the many-body energy gap arising from the cavity-mediated spin-exchange interactions.

Enquiries: 3943 6303