THE CHINESE UNIVERSITY OF HONG KONG

Department of Physics

SEMINAR

Phonon Engineering of TLS Defects in Superconducting Circuits

by

Dr. Mo CHEN (陳墨博士)
Department of Applied Physics and
The Institute for Quantum Information and Matter
California Institute of Technology, USA

Date: July 24, 2023 (Monday)
Time: 3:00 - 4:00 p.m.
Place: Rm G25, Science Centre North Block, CUHK

ALL INTERESTED ARE WELCOME
****

Abstract

Superconducting quantum processors have emerged as the leading platform for quantum computing, with demonstrated potential for quantum error correction. However, achieving scalable fault-tolerant quantum computation requires significant improvements in qubit coherence, which is primarily limited by the presence of microscopic two-level system (TLS) defects at the qubit's constituent material interfaces. Under the assumption that the unfavorable TLS properties cannot be changed, previous efforts to tackle this challenge mostly focused on superconducting circuit designs that reduce the negative impact of TLS, but advancements have started to plateau.

In this seminar, I will introduce an orthogonal approach that engineers TLS properties and makes them favorable. First, I will introduce a hybrid platform which embeds the superconducting circuits and TLS within an acoustic metamaterial design that features a GHz-wide acoustic bandgap at microwave frequencies. This bandgap structures the acoustic bath of TLS, suppresses direct phonon emission from TLS, and extends their relaxation time by two to three orders of magnitude, with the longest T1 exceeding 5 ms. Next, I will discuss quantum sensing of individual low-frequency TLS fluctuators (MHz) in this hybrid platform, using the long-lived TLS as a probe to gain further insights into the defect physics.