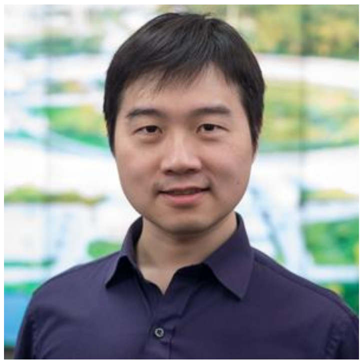
Single Electrons on Solid Neon: a New Solid-State Qubit Platform with Ultralong Coherence
(onsite and online)

Seminar jointly organized by the Department of Mechanical Engineering and the Department of Physics

Date: 6 December, 2022 (Tuesday)
Time: 11:00 a.m. (Hong Kong Time)
Venue: Room CBC, Chow Yei Ching Building, HKU



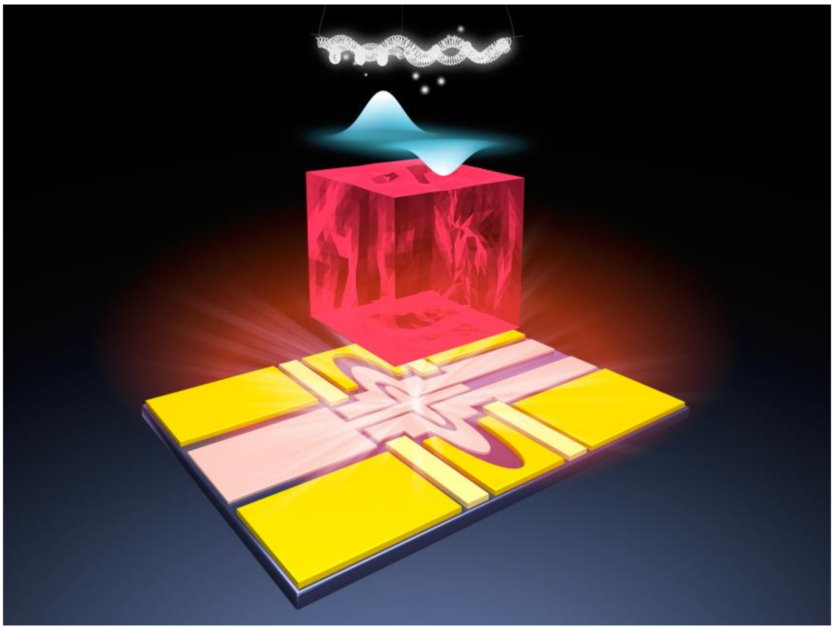
Speaker: Prof. Dafei Jin
Department of Physics & Astronomy
University of Notre Dame

Zoom Online Lecture: https://tinyurl.com/3nnrpr4x

Meeting ID: 946 3830 1701
Password: 527950

Abstract:

Progress towards the realization of quantum computers requires persistent advances in their constituent building blocks – qubits. Novel qubit platforms that simultaneously embody long coherence, fast operation, high fidelity, and large scalability offer compelling advantages in the construction of quantum computers. Electrons, ubiquitous elementary particles of non-zero charge, spin and mass, have commonly been perceived as paradigmatic local quantum information carriers. Despite superior controllability and configurability, their practical performance as qubits through either motional or spin states depends critically on their material environment. In this talk, I will present our experimental realization of a new qubit platform based upon isolated single electrons trapped on an ultraclean solid neon surface in vacuum. By integrating an electron trap in a superconducting quantum circuit, we achieve strong coupling between the motional states of a single electron and a single microwave photon in an on-chip resonator [1]. Qubit gate operations and dispersive readout are successfully implemented. The measured relaxation time T1 and coherence time T2 are both on the order of 0.1 milliseconds. [2]. The single-shot readout fidelity is 98.1% and single-qubit gate fidelity is 99.97%. Simultaneous strong coupling of two qubits with a microwave resonator is also demonstrated, as a first step toward two-qubit entangling gates for universal quantum computing. These results show that electron-on-solid-neon (eNe) qubits outperform all existing charge qubits to date and rival state-of-the-art superconducting transmon qubits, offering an ideal platform for scalable quantum computing.



References:

[1] X. Zhou … and D. Jin, "Single electrons on solid neon as a solid-state qubit platform", Nature 605, 46–50 (2022).

[2] X. Zhou … and D. Jin, "Electron charge qubits on solid neon with 0.1 millisecond coherence time", arXiv:2210.12337 (2022).

Biography:

Dafei Jin is an Associate Professor of Physics at University of Notre Dame and a Quantum Scientist at Argonne National Laboratory. He received his Ph.D. from Prof. Humphrey Maris' group in low temperature physics at Brown University. He performed postdoctoral research in quantum nanophotonics and nanoelectronics in Prof. Nicholas Fang's group at Massachusetts Institute of Technology (MIT) and Prof. Xiang Zhang's group at University of California (UC) Berkeley. He is the lead of the Quantum Matter and Devices Labs at Notre Dame and Argonne. His research team works in broad areas across quantum materials, quantum devices, and nonequilibrium systems. At present, his main focus is on the development of a novel quantum information architecture based on quantum solids and superconducting circuits. He has over 80 scientific publications in high-impact journals, including Nature, Science, Nature sub-journals, PNAS, Physical Review Letters, etc. His research was funded by grants and awards from the National Science Foundation, Department of Energy, and the Julian Schwinger Foundation.

ALL INTERESTED ARE WELCOME

For further information, please contact Prof. Nicholas Fang at 3917 2639.