RIKEN QUANTUM COMPUTING

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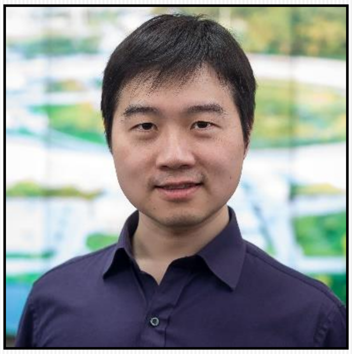
25th RQC Colloquium

Single electrons on solid neon – a long-coherence high-fidelity qubit platform



Prof. **Dafei Jin**

University of Notre Dame

June 17, 2024(Mon) **16:00 – 17:00**(JST)

This colloquium will be held in **HYBRID** format.

On-site Venue: Wako C61 Welfare and Conference Building, 2F Large Meeting Room
Online Venue: Zoom. To receive the link, register in advance at
https://krs2.riken.jp/m/rqc_registration_form

In this talk, I will present our discovery and development of a new qubit platform based upon isolated single electrons trapped on an ultraclean solid neon surface in a vacuum [1,2]. Our electron-on-solid-neon (eNe) charge (motional) qubits are controlled and readout by microwave photons in an on-chip superconducting resonator. The measured relaxation and coherence times have both reached the order of 0.1 ms, surpassing all existing charge qubits and rivalling state-of-the-art superconducting transmon qubits. Single-shot readout fidelity without a quantum-limited amplifier has reached 98.1%. Average single-qubit gate fidelity with Clifford-based randomized benchmarking has reached 99.97%. Utilizing a high-kinetic-inductance resonator, our latest results have shown much enhanced electron-photon coupling strength. This paves the way towards strong-dispersive coupling between two qubits and hence realization of two-qubit entangling gates for universal quantum computing.

[1] X. Zhou *et al.*, "Single electrons on solid neon as a solid-state qubit platform", Nature **605**, 46–50 (2022).
[2] X. Zhou *et al.*, "Electron charge qubits with 0.1 millisecond coherence time", Nature Physics **20**, 116–122 (2024).