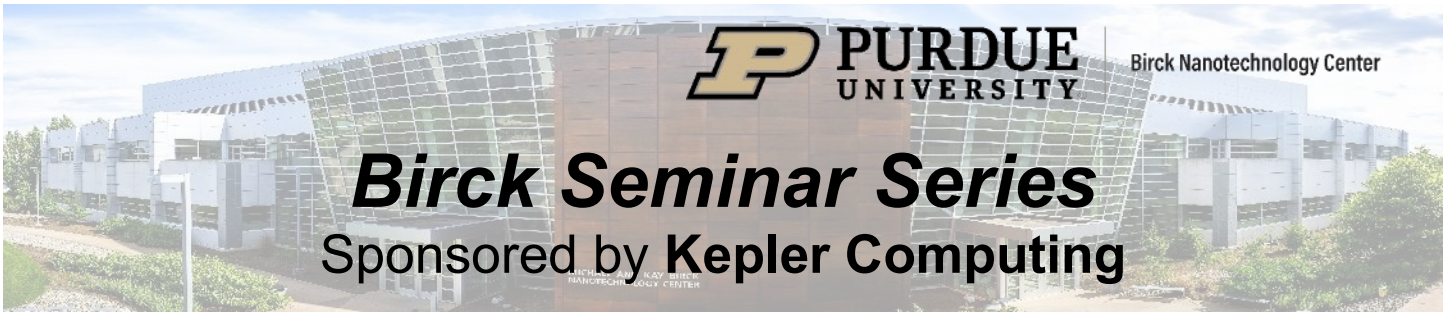

Exploring Synthetic Quantum Matter with Superconducting Circuits: How to control and probe quantum correlations using dissipation

Alex Ruichao Ma

Assistant Professor, Department of Physics and Astronomy

Wednesday, Jan. 28th @ 2:00 pm in BRK 1001

Coffee and snacks served before seminar

also on Microsoft Teams

Abstract: One of the central challenges in modern physics is to understand how quantum entanglement shapes the behavior of many interacting particles, especially in systems that are open to their surroundings or driven far from equilibrium. We approach this challenge using quantum simulators built from superconducting circuits. By arranging superconducting qubits and resonators into carefully designed arrays, these circuits act as synthetic materials where we can explore new phases of quantum matter. In this talk, I will describe our recent experiments to both control and probe collective quantum behavior in such systems. I will first show how engineered interactions with the environment can be harnessed to autonomously create and stabilize entangled states. I will then introduce new methods we developed to probe these synthetic materials, including in-situ measurements of quantum transport and tunneling spectroscopy. Together, these results open new possibilities for creating, manipulating, and observing complex quantum phases and dynamics in the laboratory.

Bio: Alex Ruichao Ma received his Ph.D. in Physics from Harvard University in 2014, where he studied many-body physics using ultracold atoms in optical lattices. From 2015 to 2019, he worked on superconducting qubits for quantum simulation as a Kadanoff-Rice Postdoctoral Fellow at the James Franck Institute, University of Chicago. In 2019, Alex joined Purdue University as an Assistant Professor in the Department of Physics and Astronomy. His experimental group focuses on quantum many-body physics and quantum information science using superconducting circuits. He is a recipient of the NSF CAREER Award in 2022.

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