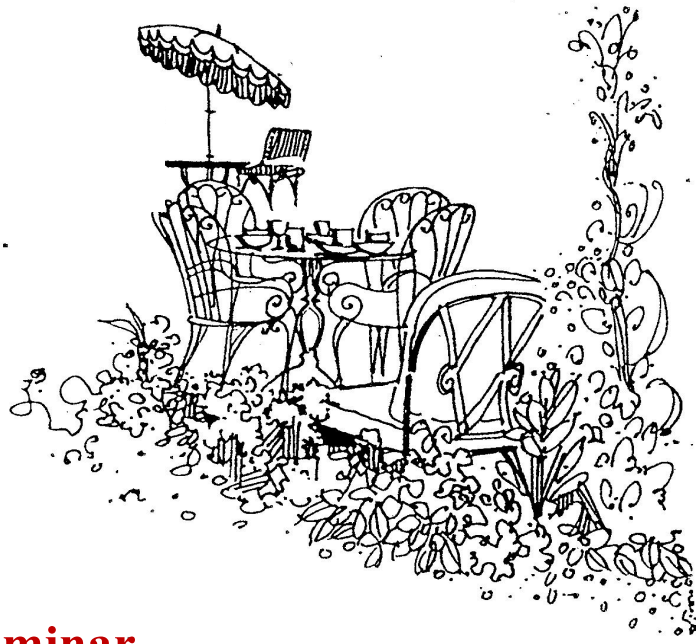
Chez Pierre

Presents ...

Monday, April 22, 2024
12:00 pm - 1:00 pm
Duboc Room - 4-331



Chez Pierre Seminar

Ilan T. Rosen, Research Laboratory for Electronics, MIT

"Emulating 2D materials on superconducting quantum computers".

The application of superconducting qubits arrays as analog quantum simulators is receiving growing interest. Here, microwave excitations in the array behave as strongly interacting particles according to the Bose-Hubbard model. In this talk, I will give an overview of superconducting qubit-based simulators with a focus on emulating two-dimensional materials. I will then describe two of our recent experiments using a 4-by-4 square array of coupled transmon qubits.

First, we measure the entanglement entropy scaling of many-body states prepared at various energies. Rather than preparing a definite state, we simultaneously drive all lattice sites, generating highly entangled many-body states [1]. By changing the frequency of the drive, we can vary the energy of the states. After preparing the states, their entanglement entropy is determined through state tomography. We observe volume-law entanglement scaling for states prepared near the center of the energy spectrum and a crossover to the onset of area-law scaling near its edges [2].

Second, we discuss the emulation of magnetic fields in the superconducting processor. Magnetic fields are a central ingredient in many interesting condensed matter systems, yet are antagonistic to superconducting hardware. Here, we introduce a scheme to generate synthetic magnetic fields by parametrically modulating the transmon qubits [3]. We verify key signatures of the field's presence, including the Aharonov-Bohm effect, gauge invariance, the Faraday effect, and the Hall effect.

[1] Y. Yanay et al. npj Quantum Inf. 6, 58 (2020)
[2] A. Karamlou, **ITR**, et al. Nature, in print (2024)
[3] **ITR** et al., in preparation (2024)