Solid State Technology and Devices Seminar

Quantum Interconnects for Superconducting Quantum Processors

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Abstract: The ability to store, transfer, and process quantum information promises to transform how we calculate, communicate, and measure. In the past two decades, superconducting microwave circuits based on Josephson junctions emerged as a powerful platform for quantum computation. However, these systems operate at low temperatures and microwave frequencies, and require coherent optical interconnects to transfer quantum information across long distances. In this talk, I will present our recent experiments demonstrating the transduction of a superconducting qubit excitation to an optical photon. I will present an integrated device platform combining superconducting qubits, piezoelectric transducers, and optomechanical transducers for converting quantum states between superconducting circuits, single phonons, and single optical photons. I will discuss how we use nanomechanical oscillators in their quantum ground states to convert single photons from microwave frequencies to the optical domain. I will conclude by discussing the prospects of this approach for realizing future quantum communication networks based on superconducting quantum processors, and discuss our plans on acoustic engineering of superconducting quantum processors for improved quantum coherence and protection from cosmic ray events.

Bio: Dr. Alp Sipahigil is the Chang Hui Faculty Fellow and an Assistant Professor of Electrical Engineering and Computer Sciences at the University of California, Berkeley. He has joint appointments as a Faculty Scientist at the Materials Sciences Division at Lawrence Berkeley National Laboratory and a supporting appointment at UC Berkeley Physics. His research is in solid-state quantum technologies, with a focus on hybrid quantum devices based on superconducting qubits, nanomechanics, nanophotonics, and atom-like defects in solids. Prior to joining Berkeley in 2021, he was an Institute for Quantum Information and Matter postdoctoral scholar at Caltech. He received his Ph.D. in Physics from Harvard University in 2017 and his B.S. degrees in Physics and Electrical Engineering from Bogazici University in 2010.