



# Department of Physics Colloquium

April 3, 2023



3:00 PM

## Systematic Improvements in Transmon Qubits Coherence Enabled by Comprehensive Investigations of Defects and Inhomogeneities Akshay Murthy

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With massive improvements in device coherence times and gate fidelity over the past two decades, superconducting transmon qubits have emerged as a leading platform for next generation computing. While much of these improvements have been driven through optimized device designs and geometries, the presence of defects, impurities, interfaces, and surfaces in the constituent materials continue to limit performance and present a critical barrier in achieving scalable quantum systems with long coherence times. As part of the Superconducting Quantum Materials and Systems (SQMS) center, we have embarked on an unprecedented, coordinated effort using state-of-the-art materials characterization techniques to identify structural defects and chemical inhomogeneities in superconducting qubits. In this talk, I will discuss our group's recent findings as they relate to the inherent surfaces, interfaces, impurities, and defects in these devices. Based on these findings, we identify that the oxide present at the niobium surface serves as the primary source of loss. As a result, we investigate encapsulation strategies to passivate this niobium surface and observe a 3-5x improvement in the coherence times of transmon qubit devices.

**This colloquium will be held in-person, at SERC 116  
unless announced otherwise.**