DEPARTMENT OF PHYSICS
COLLEGE OF ARTS AND SCIENCES

SUMMER RESEARCH OPPORTUNITIES FOR UNDERGRADUATE students

APPLICATION DEADLINE: 03/01/2024

PROJECT TITLE: Developing superconducting resonators using oxide perovskites for quantum information technology

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Project Description

This project is at the intersection of experimental condensed matter physics and material science, with implications in the larger field of Quantum Information Science and Engineering (QISE). One of the broader practical challenges in QISE lies in figuring out how to operate hybrid computing architectures at cryogenic temperatures (100 mK or less), where most current quantum systems operate. Superconductors (materials whose electrical resistance becomes zero at very low temperatures) are key enablers for operating with quantum information.

The student will contribute towards enabling the use of superconducting oxide perovskites, in particular Strontium Titanate ($SrTiO_3$), for cryogenic quantum technologies. The project will involve testing different geometries of micro/nano resonators patterned on single crystals of $SrTiO_3$. Resonators are vital constituents of microwave circuits as they can perform a variety of functions, one of which is enhancing interaction between electromagnetic waves and quantum systems. Here the resonator devices will be capacitively coupled to Hall bars, for leveraging controlled tunability of superconductivity in $SrTiO_3$ using confined electric fields. Therefore, engaging in this project will enable the student to learn basics of quantum device design, cryogenic experiments, and Python-based measurement instrumentation control.

The project will be led by a postdoc and a faculty member, as primary and secondary mentors respectively, and the student will perform temperature dependent measurements of electrical conductivity and device tunability with side gate voltages. This project is best suited for physics and engineering majors, who have basic familiarity with Python, electrical circuits and

introductory electromagnetism.