DEPARTMENT OF PHYSICS
COLLEGE OF ARTS AND SCIENCES

SUMMER RESEARCH OPPORTUNITIES FOR UNDERGRADUATE students

APPLICATION DEADLINE: 03/01/2024

PROJECT TITLE: <u>Noise as the signal in electrical current measurement</u>

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Project Description

Measurements of electrical current, resistance and conductance are cornerstones of experimental physics and engineering. Their magnitude is a conveniently accessible signal that can be compared to one of the many available theoretical models. This project will explore using the noise in electrical current (i.e. random fluctuations of its magnitude) as the measured experimental signal. Certain types of noise that dominate at low temperatures and narrow device dimensions can carry unique and otherwise difficult to access information about the nature of electrical charge carriers in the device.

The student will join an experimental physics laboratory focused on low temperature measurement of electrical signal magnitude. For these experiments, we fabricate micrometer- and nanometer-scale devices from materials that show interesting electronic behavior, for example superconductivity (zero electrical resistance at low temperatures).

The student will learn the basics of measurement instrument control with python and develop the technical capability to measure electrical noise in our lab. This will involve accurately quantifying the amplitude of noise as a function of temperature and device resistance to distinguish thermal noise from the more interesting "shot" noise that originates from the discrete nature of electrical charge and electrons. The long-term goal of this project is to measure shot noise in a nanostructure fabricated from an oxide material that shows unusual superconductivity and thus help elucidate its microscopic origins.

This project is most naturally suited for physics or engineering majors. Interest in or prior exposure to coding with Python, electrical circuits, audio or electrical signal processing, hands-on tinkering with electronics are good indicators that you are likely to enjoy this project.