Cryogenic detectors for fundamental physics: from the Cosmic Microwave Background to QCD Axions

Prof. Dr. Kent David Irwin

Physics Department, Stanford University

Cryogenic detectors offer unprecedented sensitivity for the measurement of energy deposition due to their low thermal noise and due to remarkable material properties available at low temperatures. One invaluable cryogenic material property is superconductivity. Over the last several decades, cryogenic detectors including superconducting transition-edge sensors, magnetic calorimeters, SQUIDs, and microwave kinetic inductance detectors have been important in fields including Cosmic Microwave Background cosmology, dark-matter searches, x-ray astronomy, neutrino physics, and materials analysis. In this talk, I will first describe the development of superconducting transition-edge sensors and SQUIDs as essential tools for the measurement of the Cosmic microwave background. I will then discuss the development of a new generation of coherent based on cryogenic sensors based on superconductivity that are capable of evading standard quantum limits set by the Heisenberg Uncertainty Principle, greatly accelerating the search for QCD axion dark matter.