Contribution ID: **124** Type: **Parallel session talk**

Geant4 Condensed Matter Physics Simulations of Kinetic Inductance Phonon-Mediated Detectors

Wednesday 8 October 2025 11:00 (15 minutes)

Kinetic inductance phonon-mediated (KIPM) detectors are superconducting microcalorimeters that show promise in applications toward low-threshold rare-event searches. Despite an excellent sensor energy resolution, the overall energy resolution of KIPM detectors is limited by an observed single-percent phonon collection efficiency. Monte Carlo simulations of charge and phonon processes using the Geant4 Condensed Matter Physics (G4CMP) package provide a microphysical picture of KIPM detectors that is not directly accessible through experimental measurements. By comparing these simulations to position-dependent pulsed LED measurements of a KIPM detector, we illustrate the mechanisms of phonon loss that underpin our low phonon collection efficiency. In this talk, we will present simulation results of position-dependent phonon energy collection as well as phonon lifetimes. We will then compare these results to pulsed LED measurements, which were enabled by use of a micro-electro-mechanical system to steer the optical beam over the full footprint of the 2.2 cm $\times$ 2.2 cm silicon chip. We will also illustrate new developments in the G4CMP software package for state-of-the-art modeling of phonon-quasiparticle processes in superconducting thin films.

Author: DANG, Selby (Stanford University/SLAC National Accelerator Laboratory)

Co-authors: SMITH, Zoë (Stanford University/SLAC National Accelerator Laboratory); KURINSKY, Noah (SLAC/Stanford); LINEHAN, Ryan (Fermi National Accelerator Laboratory); TEMPLES, Dylan (Fermilab); WEN, Osmond (Stanford University)

Presenter: DANG, Selby (Stanford University/SLAC National Accelerator Laboratory)

Session Classification: RDC 8 Quantum & Superconducting Sensors

Track Classification: RDC 8 Quantum & Superconducting Sensors