

Developing Qubit-based Detectors for Low-threshold Dark Matter Searches in the LOUD Facility at Fermilab

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Developments over the last decade have pushed the search for particle dark matter (DM) to new frontiers, including the keV-scale lower mass limit for thermally-produced DM. Galactic DM at this mass is kinematically matched with the energy needed to break a Cooper pair in common superconductors (\sim meV). Quantum sensors that are sensitive to these broken Cooper pairs can potentially be exploited as low-threshold detectors for particle-like DM scattering. The Quantum Science Center group at Fermilab is currently exploring the possibility of employing superconducting qubits in this capacity, and has developed LOUD, a fast-turnaround cryogenic test platform for qubit performance testing. A separate effort to simulate the effect of charge and phonon propagation in qubit substrates to understand impacts on qubit coherence times is also underway. Together, these complementary efforts are intended to inform iterations on device design to push detection thresholds into the sub-eV regime. This poster will discuss recent progress of the LOUD facility as well as elements of simulation that enable mapping of particle impacts to qubit performance.

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