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Developing Novel Low-Threshold, Phonon-Mediated Qubit Sensors

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Particle interactions in a superconducting qubit chip generate non-equilibrium quasiparticles that can tunnel across the Josephson junction and can be detected as an error (or treated as a signal) in the qubit. Large energy deposits, such as those from ionizing radiation, can cause such errors (our signals) across multiple qubits on the same chip and are correlated in space and time. We present recent results on the correlation between radiation flux and the stability of qubit gate charge from measurements of an array of weakly charge-sensitive superconducting qubits in a low background environment at NEXUS. We propose a continuation of this study by running two new devices in a similar low background environment: an array of tantalum transmon qubits and a SQUAT device from SLAC, which are less and more sensitive to charge noise and radiation environments, respectively. Results from these studies will be input into qubit response simulations and will inform design choices for new sub-eV superconducting quantum sensors for particle detection.

Primary author: BRATRUD, Grace (Northwestern University)

Presenter: BRATRUD, Grace (Northwestern University)

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