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Applications of Strain Sensing for Superconducting Qubit Devices

Optomechanical strain sensing provides attractive opportunities for studying stress-induced (i.e. non-radiogenic) phonon bursts, which have been demonstrated to limit the coherence times and minimum charge jump rates of superconducting qubits [1,2,3]. We are investigating SiN microring optical resonator strain sensors, developed at Purdue University [4], for applications in QIS and fundamental particle sensing. These sensors can be embedded in the substrate upon which superconducting qubits are patterned, providing a handle to distinguish decoherence events of radiogenic origin from those due to crystal stress, as they are expected to be largely inert to the former. These strain sensors have so far found application in photonics and communications, but provide unique capabilities for studying the stresses present within superconducting films and device substrates in order to improve qubit error-robustness and coherence times. A test platform for these devices has been established at Fermilab to evaluate their cryogenic performance and investigate the feasibility of deploying them alongside superconducting qubits to understand the impact of stress release on qubit operation.

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