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# Membrane materials in superconducting electromechanical circuits

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Nanomechanical devices have allowed for the study of the motion of macroscopic objects near their quantum ground state for mechanical motion. Coupling these devices to resonant electrical circuits provides a method of measuring with standard laboratory electronics, and a means to interact and cool towards the ground state. We report on current work, in microwave $LC$ resonators, using graphene and niobium diselenide ($NbSe_2$) membranes as one electrode in a parallel plate capacitor with a mechanical degree of freedom. The membrane's light mass, non-linear response to an applied force and tunability potentially enable stronger electromechanical amplification and coupling than bulk materials. Previous work using graphene in similar devices shows that its electrical resistance is a limiting factor when attempting to cool via electromechanical sideband interactions. $NbSe_2$ is a superconductor even in single layer form, and this property provides a system with lower loss while driving with increasing photon number, as compared to the graphene-based systems. Such resonant systems also allow study of the material behaviours of graphene and $NbSe_2$, including nonlinear effects from a strong drive signal. In this talk we show fabrication, modelling and progress towards quantum-limited measurements.

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