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Demonstration of the Phononic Bandgap Isolation for Silicon Nitride Membrane Resonators PEN-LI YU, JILA, University of Colorado and NIST, Boulder, KATARINA CICAK, National Institute of Standards and Technology, Boulder, NIR KAMPEL, YEGHISHE TSATURYAN, THOMAS PURDY, JILA, University of Colorado and NIST, Boulder, RAYMOND SIMMONDS, National Institute of Standards and Technology, Boulder, CINDY REGAL, JILA, University of Colorado and NIST, Boulder — Silicon nitride membranes offer great potential for sensing weak forces at the standard quantum limit, realizing a mesoscopic quantum harmonic oscillator, and converting quantum information between different quantum systems. An important current limitation to these applications comes from the acoustic coupling between the membrane and its support structure. Such coupling can be controlled by micromachining the support structure to create a phononic crystal. With such a structure, we demonstrate the phononic bandgap isolation for MHz Si_3N_4 membrane resonators. We probe the membrane modes and the non-membrane modes by measuring the displacement spectra of the membrane and different components of the support structure. We find that inside the observed bandgaps, the density and amplitude of the non-membrane modes are greatly suppressed, and the membrane modes are shielded from an external mechanical drive by a factor up to 30 dB.

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