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Optomechanics in a Millikelvin Environment: Towards QND Measurements

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It is well known that objects containing many atoms, such as superfluids and superconductors, can behave quantum mechanically when each particle occupies the same ground state. But can large objects demonstrate collective quantum behavior even when their constituent particles do not? For example, can a nanomechanical resonator be coaxed into a ground state of a vibrational degree of freedom? In this talk, I will discuss our progress towards the goal of demonstrating quantum nondemolition measurements of a nanomechanical resonator. In particular, we have developed an optomechanical measurement system based on tapered optical fibers that operates on the baseplate of our dilution refrigerator at 9 mK. Our intent is to demonstrate ground state occupation via quantum jump spectroscopy of the energy of such a quantum nanomechanical resonator.

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