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Cooper-Pair Molasses: Cooling a nanomechanical resonator with quantum backaction A.K. NAIK, O. BUU, M.D. LAHAYE, K.C. SCHWAB, Laboratory for Physical Science, A.D. ARMOUR, School of Physics and Astronomy, University of Nottingham, Nottingham, United Kingdom , A.A. CLERK, Department of Physics, McGill University, Montreal, QC Canada, M.P. BLENCOWE, Department of Physics and Astronomy, Dartmouth College, Hanover, NH USA — We have measured the back-action of a superconducting single electron transistor using a radio frequency nanomechanical resonator. The backaction forces are a factor of 15 above the intensity required by the Heisenberg uncertainty principle: $\sqrt{S_x S_f} = 15\frac{\hbar}{2}$. This system has also shown a record position and force sensitivity of $0.4fm/\sqrt{Hz}$ and $0.5aN/\sqrt{Hz}$, and the closest approach to the quantum ground state of a mechanical system (N=25) (1). In addition, we have discovered a novel cooling mechanism, analogous to optical molasses, which is a result of resonant Josephson effects in the transistor (2,3). Using devices of similar design and performance, we are anticipating the observation of squeezed, superposition, and entangled states of a mechanical device.

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A.K. Naik

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