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Feedback Cooling of an rf Nanomechanical Resonator MATTHEW LAHAYE, OLIVIER BUU, BENEDETTA CAMAROTA, University of Maryland, College Park, KEITH SCHWAB, Laboratory for Physical Sciences — Ultra-sensitive force detection and direct observation of the quantum mechanical properties of nanomechanical resonators may require cooling of the resonators to temperatures which are virtually inaccessible by conventional, passive refrigeration techniques. We have recently demonstrated an alternative active cooling technique based upon the radio frequency single electron transistor (RFSET) displacement detector and optimal feedback. Preliminary data has shown that we are able to optimally damp the motion of a MHz-range nanoresonator by continuously monitoring its displacement with a RFSET, generating the appropriate feedback signal with a Kalman Filter controller, which then applies a force with a nearby electrode. With realistic improvements, it is believed that this technique can be used to cool nanoresonators to their ground-state as well as generate quantum squeezed-states.

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