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Intrinsic Noise Properties of Atomic Point Contact Displacement Detectors N. E. FLOWERS-JACOBS, K. W. LEHNERT, JILA, NIST and the University of Colorado, and the Department of Physics, University of Colorado, Boulder, Colorado 80309-0440, USA — By coupling an atomic point contact (APC) to a nanomechanical beam, we measure the noise properties of an APC, an object which is the basis of scanning tunneling microscopy and is used to create electrical contact to single molecules. Using a microwave technique, we detect the resonant motion of the nanomechanical beam at frequencies up to 200 MHz. This measurement is sensitive enough to observe the random thermal motion of the nanomechanical beam at 250 mK. We use this thermal motion to evaluate the noise properties of the APC, demonstrating a displacement imprecision limited by the shot-noise in the number of electrons that tunnel across the APC and observing the force due to measurement backaction. Together, the imprecision and backaction yield a total uncertainty in the beam's displacement that is 42 times the standard quantum limit. In addition, we detect the beam's response to piezoelectric, electric, and magnetic forces, and use feedback to "squash" the shot-noise.

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