Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Momentum statistics of tunneling electrons in nanoelectromechanical systems STEVEN D. BENNETT, AASHISH A. CLERK, McGill University — When a mesoscopic conductor is used to measure the position of a nanomechanical oscillator, electrons in the conductor exert a fluctuating back-action force on the oscillator. What is the statistical distribution of the momentum transferred to the oscillator by this force? Motivated by recent experiments that studied a mechanical oscillator coupled to a single tunnel junction [1] or a quantum point contact [2], we investigate theoretically the statistics of back-action force in these systems as well as correlations between the force and the current. Our approach is based on a scattering matrix that depends parametrically on the oscillator position, allowing us to go beyond weak tunneling and study conductors with arbitrary transmission. We identify two mechanisms of momentum transfer: one involves forces exerted in the scattering region and dominates in the limit of weak tunneling; the other is associated with transferred electron momentum and dominates in the limit of perfect transmission. We also discuss the effects of a spatially asymmetric conductor on the force noise and on the quantum limit of position detection.

[1]N. E. Flowers-Jacobs *et al.*, Phys. Rev. Lett. **98**, 096804 (2007).
[2]M. Poggio *et al.*, Nat. Phys. **4**, 635 (2008).

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Date submitted: 20 Nov 2008 Electronic form version 1.4