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Shot noise and strong feedback effects in nanoelectromechanical systems STEVEN BENNETT, McGill University, AASHISH CLERK, McGill University — Quantum nanoelectromechanical systems have attracted much attention recently, offering potential for applications as well as insight into fundamental physics. Using a quantum noise approach, we study theoretically a nanomechanical oscillator coupled to a superconducting single-electron transistor (SSET). Incoherent Cooper pair tunneling processes in the SSET can lead to a negative damping instability, where the oscillator's amplitude increases as it absorbs energy from the SSET [1]. Here, we focus on the current noise of the SSET in the negative damping regime, in which the growing amplitude of the oscillator becomes large enough that the motion of the oscillator and the dynamics of the SSET depend strongly on each other. We describe the inherent non-linearity of this regime using effective, energy-dependent damping and temperature, and discuss characteristic timescales for dynamics in the system. The current noise is of particular interest because it can be directly observed, and current experiments are probing this regime [2].

[1]Clerk, Bennett, NJP **7**, 238 (2005).
[2]K. Schwab *et al.* (in preparation).

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