Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Quantum back-action evading measurement of micro-mechanical motion JUNHO SUH, AARON WEINSTEIN, CHAN U LEI, EMMA WOLLMAN, KEITH SCHWAB, Cal Inst of Tech (Caltech) — Quantum mechanics imposes unavoidable finite back-action in measuring a mechanical resonator's position and places limits on its ultimate sensitivity, which is well known as the standard quantum limit (SQL). However, if the detector couples to only a single quadrature of motion, it is possible to place this quantum back-action in the uncoupled quadrature, realizing sensitivity below SQL. We demonstrate this back-action evading measurement using a micro-electromechanical device tightly coupled to a superconducting microwave resonator. We observe classical and quantum back-action from microwave photons, and demonstrate that the measurement back-action is 9dB lower than that from microwave shot noise. The measurement imprecision reaches 2dB smaller than the zero-point fluctuation level at the same time, showing the detector noise product five times from the quantum limit. We expect further improvements of this technique would provide a route to the generation of quantum squeezed states of motion, highly desirable for precision measurement of force and quantum engineering applications.

Junho Suh
Cal Inst of Tech (Caltech)

Date submitted: 14 Nov 2013 Electronic form version 1.4