Quantum Dynamics of a Cooper-Pair Box Coupled to a Micromechanical Resonator

A. D. Armour
The Blackett Laboratory, Imperial College of Science, Technology and Medicine,
London SW7 2BW, United Kingdom
M. P. Blencowe
Department of Physics and Astronomy, Dartmouth College,
Hanover, New Hampshire 03755
K. C. Schwab
Laboratory for Physical Sciences
College Park, Maryland 20740

We investigate the quantum dynamics of a Cooper-pair box coupled electrostatically to a micromechanical resonator. With suitable pulsed-gate control of the Cooper pair quantum state, we show that it is possible to drive the coupled system into an entangled state, with the two states of the mechanical oscillator being mesoscopically distinct for sufficient electrostatic coupling strength. Again with appropriate pulsed-gate control, signatures of the Schrödinger cat nature of the mechanical oscillator state can be imprinted on the Cooper-pair state, and thus be inferred by probing the Cooper pair system alone. The necessary pulsed-gate control technology has been demonstrated by Nakamura *et al.* [Nature **398**, 786 (1999)], while the state of the Cooper pair system can be probed using the radio frequency single electron transistor electrometer demonstrated by Schoelkopf *et al.* [Science **280**, 1238 (1998)].