Abstract for an Invited Paper
for the MAR09 Meeting of
The American Physical Society

Measurement of Dispersive Coupling Between a Nanoresonator and a Superconducting Qubit

MATTHEW LAHAYE, California Institute of Technology

Incorporating superconducting qubit technology into nanoelectromechanical systems (NEMS) should enable the observation of quantum behavior in NEMS. Ultimately, it is expected that coupled qubit-NEMS systems could serve as a test bed for studying fundamental issues of quantum mechanics including the quantum limits of measurement and the quantum-classical divide. Proposals in the literature posit the qubits as veritable toolboxes for preparing, manipulating and measuring quantum states of a nanomechanical resonator (or 'nanoresonator'), and range from the nondestructive read-out of quantized-energy states (or 'Fock states') to the generation of Schrodinger-cat states. In an initial step toward implementing these advanced strategies, we have performed the first measurements of a nanoresonator coupled to a superconducting qubit, the Cooper-pair box (CPB). We find that the coupling produces a CPB-state-dependent shift in the frequency of the nanoresonator that is analogous to the single-atom phase shifts experienced by superconducting resonators in the dispersive limit of cavity quantum electrodynamics (CQED). In my talk, I will report on our latest measurements of the dispersive interaction between the CPB and nanoresonator, including how we utilize it to read-out quantum interference effects in the CPB. In the end, I will discuss how the interaction could soon be utilized for exploring the quantum limit of NEMS.