Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

**Quantum information processing with a Josephson ring modulator** NICOLAS BERGEAL, FLAVIUS SCHACKERT, MICHAEL METCALFE, R. VIJAY, VLADIMIR MANUCHARYAN, LUIGI FRUNZIO, ROBERT SCHOELKOPF, STEVEN GIRVIN, MICHEL DEVORET, Yale University —
We have developed and operated a new type of phase preserving parametric amplifier, the Josephson Parametric Converter, which approaches the quantum limit. Our device consists of two microwave resonators coupled to each other through a Josephson Ring Modulator. This latter element resembles a DC-SQUID, but has four junctions, and four active current modes instead of two. A pump line is non-resonantly coupled to one of the modes of the ring while the signal and idler are serviced by two others and are tuned in the band of the resonators. The fourth mode, which is the dc superconducting circulating current in the ring, is biased with half a flux quantum. Our design ensures that the non-linearity presented by the Ring Modulator is pure and involves the minimal number of modes, thus placing the JPC very close to the ideal non-degenerate parametric amplifier. This is supported by recent results on the amplification and frequency conversion operations. Furthermore, measurements of the noise temperature with an auto-calibrated source based on a nanowire in the hot electron regime will be presented. In combination with correlation measurements of the noise at the signal and idler ports, these results show that the JPC can perform two-mode squeezing of quantum noise.

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Date submitted: 21 Nov 2008 Electronic form version 1.4