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Fast Quantum Nondemolition Readout by Parametric Modulation of Longitudinal Qubit-Oscillator Interaction JÉRÔME BOURASSA, Cégep de Granby, NICOLAS DIDIER[1], McGill University and Université de Sherbrooke, ALEXANDRE BLAIS, Université de Sherbrooke and Canadian Institute for Advanced Research — For quantum information processing, qubit readout must be fast, of high-fidelity and ideally quantum non-demolition (QND). To rapidly reuse the measured qubit, fast reset of the measurement pointer states is also needed. Combining these characteristics is essential to meet the stringent requirements of fault-tolerant quantum computation. For superconducting qubits, a common strategy is the dispersive readout where the qubit is coupled to an oscillator acting as pointer. In this talk, we present an alternative strategy based on parametric modulation of longitudinal qubit-oscillator interaction. We show that compared to dispersive readout it leads to a faster, high-fidelity and ideally QND qubit readout with a simple reset mechanism [1]. We moreover show how to exponentially improve the signal-to-noise ratio (SNR) of this measurement with the help of single-mode squeezed input state on the oscillator. We present an implementation of this longitudinal parametric readout in circuit quantum electrodynamics along with results using realistic experimental parameters. [1] N. Didier, J. Bourassa and A. Blais, Phys. Rev. Lett., In Print (2015)

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