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Large gain quantum-limited qubit state measurement using a two mode nonlinear cavity SAEED KHAN, McGill University, R. VIJAY, Tata Institute of Fundamental Research, IRFAN SIDDIQI, University of California, Berkeley, AASHISH CLERK, McGill University — A single nonlinear cavity dispersively coupled to a qubit functions as a large gain detector near a bifurcation, but also has an unavoidable large backaction that prevents quantum-limited measurement at weak couplings [1]. We show theoretically that a modified setup involving two cavities (one linear, one nonlinear) and a dispersively coupled qubit allows for a far more optimal measurement. In particular, operating near a point of bifurcation, one is able to both achieve a large gain as well as a near quantum-limited backaction. The increased system flexibility also enables large measurement rate and smaller nonlinear shot noise dephasing than is possible with single nonlinear cavity setups. We present analytic results for the gain and noise of this detector and a heuristic understanding of the physics, thus presenting a complete description of this new way of performing weak qubit state measurements. The setup we describe can easily be realised in experiments with superconducting circuits involving Josephson junctions [2, 3].

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[3] M. Hatridge et al., Phys. Rev. B 83, 134501 (2011)

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