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Fast high fidelity quantum non-demolition qubit readout via a non-perturbative cross-Kerr coupling

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Qubit readout is an indispensable element of any quantum information processor. In this work, we propose an original coupling scheme between a qubit and a cavity mode based on a non-perturbative cross-Kerr interaction. This scheme, using the same experimental techniques as the perturbative cross-Kerr coupling (dispersive interaction), leads to an alternative readout mechanism for superconducting qubits. This new process, being non-perturbative, maximizes the speed of qubit readout, its single-shot readout fidelity and its quantum non-demolition (QND) behavior at the same time, while minimizing the effect of unwanted decay channels such as, for example, the Purcell effect. We observed 97.4 % single-shot readout fidelity for short 50 ns pulses. Using long measurement, we quantified the QND-ness to 99 %.

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