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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 %.

Primary author(s) : DASSONNEVILLE, Rémy (Institut Néel); RAMOS, Tomas (Institute of Fundamental Physics, IFF-CSIC, Madrid, Sp); MILCHAKOV, Vladimir (Institut Néel, Grenoble, France); PLANAT, Luca (Institut Néel, Grenoble, France); DUMUR, Etienne (Institut Néel, Grenoble, France); FOROUGHI, Farshad (Institut Néel, Grenoble, France); PUERTAS, Javier (Institut Néel, Grenoble, France); LEGER, Sebastien (Institut Néel, Grenoble, France); BHARADWAJ, Karthik (Institut Néel, Grenoble, France); DELAFORCE, Jovian (Institut Néel, Grenoble, France); NAUD, Cécile (Institut Néel, Grenoble, France); Prof. HASCH-GUICHARD, Wiebke (Institut Néel, Grenoble, France); Prof. GARCIA-RIPOLL, Juan Jose (Institute of Fundamental Physics, IFF-CSIC, Madrid, Spain); ROCH, Nicolas (Institut Néel, Grenoble, France); BUISSON, Olivier (Institut Néel, Grenoble, France)

Presenter(s) : DASSONNEVILLE, Rémy (Institut Néel)

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