Transmon qubit readout using a nonlinear cross-Kerr interaction: QNDness versus readout photon number

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Résumé

In the standard transmon readout scheme, the qubit is coupled directly to a microwave resonator through a transverse coupling. It has been observed that the qubit fidelity and readout QNDness deteriorate even under moderate drive powers and the qubit suffers from Purcell decay. To address these issues, our experiment relies on a multimodal circuit called the transmon molecule, consisting of a qubit mode and an ancilla mode, with a non-perturbative cross-Kerr interaction between them (1,2). The circuit is placed inside a 3D readout cavity such that the qubit mode (resp. the ancilla mode) is uncoupled (resp. coupled) to the cavity field. The ancilla-cavity coupling leads to two hybridized polaritonic meters which also inherit the cross-Kerr coupling to the qubit. This results in a large qubit-dependent displacement of the meters that can be read out without causing Purcell decay. The talk will present this alternative readout scheme and discuss the impact of increasing readout power on the readout fidelity and QNDness. (1) I. Diniz et al, Phys. Rev. A 87 033837 (2013). (2) R. Dassonneville et al, Phys. Rev. X 10, 011045 (2020).

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