Qubit readout with a non-linear cavity coupled to a transmon qubit via direct cross-Kerr coupling

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The multimodal circuit nicknamed Quantromon has two orthogonal modes: a transmon qubit and a linear oscillator coupled to each other via direct cross-Kerr coupling. An integrated qubit-cavity system is realized using these modes with the linear oscillator playing the role of the readout cavity. We previously demonstrated a high measurement fidelity of 97.6% without using the Josephson parametric amplifier due to the possibility of using higher photon numbers in the Quantromon. In this work, we replace the linear oscillator mode with a non-linear Josephson junction based oscillator. This enables the possibility of accessing the parametric amplification and bifurcation regime of the non-linear oscillator for integrated amplification in the measurement cavity. Previous experiments have explored integrated amplification using non-linear readout cavity e.g. the quantronium qubit in the charging regime [1] and a transmon qubit coupled transversely to a non-linear oscillator [2]. More recently, a transmon qubit readout using in-situ bifurcation of a nonlinear dissipative polariton has been demonstrated [3]. We will discuss the different operating regimes of our device and present experimental data demonstrating qubit measurement. We will also compare our technique and results with the others mentioned above and discuss key similarities and differences.

References

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