Longitudinal qubit readout from Jaynes-Cummings coupling and strong drive

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In superconducting qubits, the standard measurement strategy is dispersive readout, where the qubit is coupled to an off-resonant cavity via a Jaynes-Cummings coupling [1]. This readout scheme works well for weak readout pulses, but its fidelity diminishes when the strength exceeds a critical value [2] due to the appearance of measurement-induced state transitions [3].
Here, we introduce a new dispersive qubit readout scheme specially designed for strong readout pulses. By applying a specific pulse shape, we can correct non-QND features of qubit readout and induce a longitudinal readout despite the qubit-cavity coupling being of the Jaynes-Cummings type. Based on exact stochastic numerical simulations of the measurement dynamics [4], we show that this readout protocol achieves a high fidelity and QND-ness at moderate driving strength, reaching infidelities below 10^{-3} for state-of-the-art parameters, only fundamentally limited by finite qubit decay.

References

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