Dynamical decoupling on a superconducting qubit with a microscopic fluctuator-induced noise model

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Abstract

We examine the dynamics of a superconducting qubit subject to noise that we model as induced by a fluctuator. The fluctuator, modelled by a two level system, is itself coupled to a bath described by a collection of bosonic harmonic oscillators. We employ a second order master equation [1] to study the dynamics of the combined (qubit+fluctuator) system, from which we can extract the behavior of the qubit. The goal of this research is to find mitigation strategies for the noise effects, as characterised by the infidelity of the qubit. To this purpose, we act with dynamical decoupling pulses on the qubit and study their effects in different modelling scenarios [2] and the relation of its effectiveness with the non-Markovianity of the evolution [3].

References

[1] Breuer, H. P., Petruccione, F. (2002). *The theory of open quantum systems*. Great Clarendon Street: Oxford University Press.

[2] Cattaneo, M., Giorgi, G. L., Maniscalco, S., & Zambrini, R. (2019). *Local versus global master equation with common and separate baths: superiority of the global approach in partial secular approximation*. In New Journal of Physics (Vol. 21, Issue 11, p. 113045). IOP Publishing

[3] Berk, G. D., Milz, S., Pollock, F. A., & Modi, K. (2021). *Extracting Quantum Dynamical Resources: Consumption of Non-Markovianity for Noise Reduction* (Version 1).

Figures

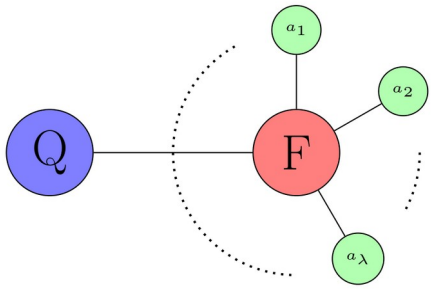

Figure 1: Schematic picture of the model. The qubit (Q) is coupled to the fluctuator (F), which in turn is coupled to its own bath of harmonic oscillators.