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Non-additivity of decoherence rates in superconducting qubits GUIDO BURKARD, IBM Research / University of Basel, Switzerland, FREDERICO BRITO, University of Campinas, Brazil / IBM Research — We show that the relaxation and decoherence rates T_1^{-1} and T_2^{-1} of a qubit coupled to several noise sources are in general not additive, i.e., that the total rates are not the sums of the rates due to each individual noise source. To demonstrate this, we calculate the relaxation and pure dephasing rates T_1^{-1} and T_ϕ^{-1} of a superconducting (SC) flux qubit in the Born-Markov approximation in the presence of several circuit impedances Z_i using network graph theory and determine their deviation from additivity (the mixing term). We find that there is no mixing term in T_ϕ^{-1} and that the mixing terms in T_1^{-1} and T_2^{-1} can be positive or negative, leading to reduced or enhanced relaxation and decoherence times T_1 and T_2. The mixing term due to the circuit inductance L at the qubit transition frequency ω_{01} is generally of second order in $\omega_{01}L/Z_i$, but of third order if all impedances Z_i are pure resistances. We calculate $T_{1,2}$ for an example of a SC flux qubit coupled to two impedances.

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