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Landau-Zener dynamics in qubits-oscillator settings SIGMUND KOHLER, MARTIJN WUBS, PETER HÄNGGI, Institut fur Physik, Universitat Augsburg, Germany, KEIJI SAITO, Department of Physics, Tokyo University, Japan, YOSUKE KAYANUMA, Department of Mathematical Science, Osaka Prefecture University, Japan — In a Cooper-pair box realization of a qubit, the energy splitting of the logical states can be tuned upon variation of the penetrating magnetic flux. Then the coupling of the qubit to a circuit QED oscillator can induce Landau-Zener transitions between the qubit levels. By summing a perturbation series to all orders, we obtained an exact expression for the corresponding LZ transition probability. Moreover, we determined the parameters for which a non-adiabatic transition is accompannied by single-photon generation and showed that LZ transitions can create qubit-oscillator entanglement in a controlled manner [1]. Replacing the oscillator by a quantum heat bath, we encounter a nontrivial problem of dissipative quantum mechanics which can be solved in a similar way. As a main application, we discuss the determination of both the reorganization energy and the integrated spectral density of the bath [2]. Moreover, this provides a convenient test bench for numerical schemes for real- time dissipative quantum dynamics.
[1] K. Saito *et al.*, Europhys. Lett. **76**, 22 (2006).
[2] M. Wubs *et al.*, Phys. Rev. Lett. **97**, 200404 (2006).

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