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Dynamics of superconducting qubits in open transmission lines
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— The time and space resolved dynamics of a superconducting qubit with an Ohmic coupling to propagating 1D photons is studied, from weak coupling to the ultrastrong coupling regime (USC). A nonperturbative study based on Matrix Product States (MPS) shows the following results [1]: (i) The ground state of the combined systems contains excitations of both the qubit and the surrounding bosonic field. (ii) An initially excited qubit equilibrates through spontaneous emission to a state, which under certain conditions, is locally close to that ground state, both in the qubit and the field. (iii) The resonances of the combined qubit-photon system match those of the spontaneous emission process and also the predictions of the adiabatic renormalisation [2]. These results set the foundations for future studies and engineering of the interactions between superconducting qubits and propagating photons, as well as the design of photon-photon interactions based on artificial materials built from these qubits.

[1] B. Peropadre, D. Zueco, D. Porras, J. J. G. R., arXiv:1307.3870
[2] A. J. Leggett *et al*, Rev. Mod. Phys. 59, 1, (1987)

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