Dynamics of superconducting qubits in open transmission lines
GARCIA-RIPOLL JUAN JOSE, Instituto de Física Fundamental, IFF-CSIC, Calle Serrano 113b, Madrid 28006, Spain, DAVID ZUECO, Fundacion ARAID, Paseo Maria Agustin 36, Zaragoza E-50004, Spain, DIEGO PORRAS, Fac. CC. Físicas, Univ. Complutense de Madrid, Madrid E-28040, Spain, BORJA PEROPADRE, Instituto de Física Fundamental, IFF-CSIC, Calle Serrano 113b, Madrid 28006, Spain — 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.