

# **Lindblad master equation for deep strong coupling regime of the quantum Rabi model**

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The quantum Rabi model, describing a two-level system - a qubit - dipole coupled to a single electric field mode, constitutes a fundamental quantum model of light-matter interaction. Recent experiments have put the focus on the deep strong coupling regime of the model, when the light-matter coupling strength exceeds the mode frequency. For the field mode further coupled to a thermal bath - an open quantum system - the existing quantum master equations describing the deep strong coupling regime are typically formulated in terms of the exact eigenvalues and eigenfunctions of the quantum Rabi model, and hence amenable to numerical analysis only. Here we derive a simple Lindblad master equation, formally valid in the perturbative deep strong coupling regime where the light-matter coupling strength is much larger than the mode frequency. The Lindblad equation is benchmarked against the corresponding Bloch-Redfield equation and very good agreement is found for both equilibrium as well as non-equilibrium - transport as well as time-dependent - situations. Both numerical and analytical results are discussed.