Free Space QED and Emergent Universal Dynamics with a Single Rydberg Superatom

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In this poster, we present the theoretical background of the experimental demonstration of strong coherent coupling between a single Rydberg superatom and a propagating light pulse containing only a few photons [1]. Using the input-output formalism and integrating out the photonic field, it is possible to efficiently calculate higher-order correlation functions which are in perfect agreement with the experimental results [2].

We also study the influence of interaction-induced dephasing due to coherent exchange of virtual photons in a simple one-dimensional setup [3]. We show that the coherent exchange interaction gives rise to a universal dynamics with coherent oscillations and dephasing on a time scale that grows with the number of atoms in the cloud. Further, we discuss a possible experimental setup to decouple coherent and dissipative dynamics and make the universal dynamics visible.

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