Maximally Entangled Dark Steady states for interacting Rydberg atoms

Durga Bhaktavatsala Rao Dasari, Klaus Mølmer

Department of Physics and Astronomy, Aarhus University, Aarhus C, DENMARK
dasari@phys.au.dk

It is well known that dissipation can induce coherent effects like Electromagnetically Induced Transparency, Coherent Population Trapping etc., in three level atoms [1]. The presence of dark states which do not involve the decaying states are crucial for observing these effects. The same is not true for interacting three level atoms as the dark states of the system involve the decaying states that are unstable [2].

We present a scheme to observe coherent dark state effects for interacting Rydberg atoms induced by dissipation. The combination of a two-photon excitation process towards long-lived Rydberg states with a finite interatomic excitation strengths, a dark state interference effect in the individual atoms, and spontaneous emission from the short-lived excited states lead to the formation of a dark steady state which is maximally entangled. The time scale of formation for this entangled state is dependent on the coherent Raman and Rabi fields applied to the atoms, and is surprisingly independent of the interaction strength and the decay rate responsible for observing the effect.

References:
[1] Marlan O. Scully and M. Suhail Zubairy, "*Quantum Optics*," Cambridge (1997).
[2] Ditte Møller, Lars Bojer Madsen, and Klaus Mølmer, *Phys. Rev. Lett.* **100**, 170504 (2008).