Super-/sub-radiance and entanglement of coupled quantum emitters in confined light fields

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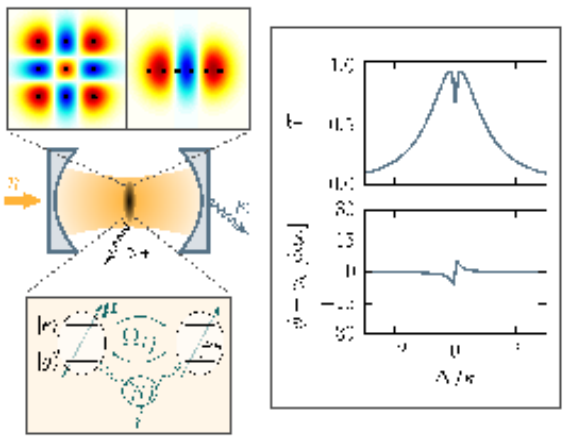
Spontaneous emission of atoms is modified by the presence of other atoms in close vicinity inducing collective super- as well as sub-radiance. The most sub-radiant states of pairs of two-level emitters are maximally entangled anti-symmetric singlet states. Selective addressing of these states can be the basis of improved precision spectroscopy. The idea can be generalized to atomic states with N > 1 independent spontaneous decay channels, where similar highly entangled states of at least N+1 particles can be found, which completely decouple from the vacuum radiation field. These will not decay spontaneously nor absorb any resonant laser light. Optimizing the geometry of dark states with respect to the spatial profile of a near resonant optical cavity mode allows to increase the ratio between collective light scattering into the cavity mode and free space by several orders of magnitude. The optimal effective collective cooperativity here exhibits a highly nonlinear particle number scaling increasing much faster than the typical linear scaling of independent emitters.



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