Inverse spontaneous emission of an atom in free space – an example of time reversal symmetry in optics

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The coupling between light and a single atom is probably the most fundamental process in quantum optics. The best strategy for efficiently coupling light to a single atom in free space depends on the goal. If the goal is to maximally attenuate a laser beam, narrow-band on-resonance laser radiation is required as well as a wave front approaching the atom from a 2_ solid angle. If, on the other hand, the goal is to fully absorb the light bringing the atom to the excited state with unit success probability one will have to provide a single photon designed to represent the time reversed wave packet which the atom would emit in a spontaneous emission process. Among other conditions this requires the single photon wave packet impinging from the full 4_ solid angle and having the correct temporal shape. The state of the art is reviewed and the experimental progress is discussed. If the interaction is strong enough it will allow for building a few photon quantum gate without a cavity, with possible applications in quantum information processing.

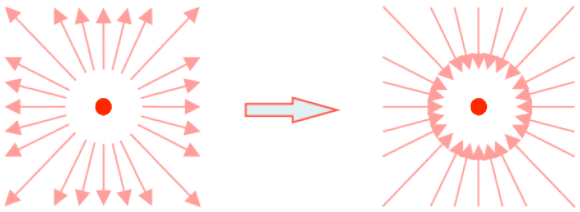

Fig.: Full absorption corresponds to time reversed emission

Latest references:

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