Entangling atoms and photons in photonic crystals. Single photon switches and more.

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We show how highly non-linear interactions between single photon pulses can be realized in a photonic crystal doped with four level atoms. We describe how two photons, each coupled to a different atomic transition in such atoms, can manifest strong amplitude correlations. In some cases one single photon can trigger the absorption of the other and the device could thus operate as an ultrasensitive nonlinear photon-switch. These effects also allow for the creation of three-partite entangled states of the GHZ form. The realization of a possible GHZ type of non-locality test is investigated. We note the simplicity of the above case over the usual EIT type of schemes requiring the existence of external coupling lasers.

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