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Entangling photons by means of the nonlinear response of quantum wells to an ultrashort pulse[1] MIKHAIL EREMENTCHOUK, MICHAEL LEUENBERGER, University of Central Florida — Polarization-entangled photons can be produced from semiconductor bulk crystals made of CuCl through resonant hyperparametric scattering off the bound biexciton state with a yield exceeding 10^{-5}, much higher than yields $< 10^{-9}$ achieved with bulk nonlinear crystals. Here we show a different method to produce pairs of entangled photons in the short time response of a quantum well excited by a short intense pulse. At the time scales, where the biexciton effect is not yet pronounced, the Pauli exclusion principle is responsible for many-body correlations among excitons, giving rise to the production of entangled photons with a yield of around 10^{-2}. We make use of a quantum-field theoretical two-particle density matrix to calculate the entanglement for arbitrary emission angles of the entangled pairs of photons. At the time scales, where the heavy-light hole splitting is resolved, the resonances corresponding to different two-exciton states are developing, so that a simple kinematic theory can be presented, which relates the states of the outgoing photons with the respective two-exciton states. We study remarkably strong nontrivial dependence of entanglement on the emission angles of the entangled photons and on the ellipticity parameters of the incident photons. We show that the emitted entangled 2-photon states are always in a triplet state.

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