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An Ultra-Bright Omnidirectional Atomic-Vapor Photon-Pair Source Based on Doppler-Free Four-Wave-Mixing and Collective Emission[1] YUPING HUANG, MICHAEL MOORE, Michigan State University — Four-Wave Mixing (FWM) in atomic vapors has become competitive with solid-state down-conversion as a source of entangled photon pairs. FWM schemes rely on collective enhancement to generate strong pair correlation. In general, collective enhancement is only achieved in a very narrow emission solid-angle, restricting the obtainable beam brightness of photon pairs. To substantially increase the pair production rate, we propose a novel 'butterfly' level scheme for omnidirectional photon pair generation. With multi-photon Doppler-free pumping, background Rayleigh scattering is dipole-forbidden, and collective emission is permitted in all directions. A pair production rate of 10^{12} per second should be obtainable with an ensemble of only $\sim 10^6$ atoms. Individual pairs also exhibit near-maximum polarization entanglement over a wide solid-angle. In addition, suppressed Rayleigh scattering significantly reduces recoil-induced heating, which enables the use of atomic samples ranging from hot vapors to Bose-Einstein condensates.

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