

Spectrally entangled two-photon state of cascade emissions from Doppler-broadened atomic ensemble

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We theoretically investigate the spectral entanglement of two-photon state from Doppler-broadened atomic ensemble. The two-photon state is spontaneously generated from weak two-color excitations in a diamond-type atomic level under the four-wave mixing condition. The upper and lower transitions can be in telecom and infrared wavelengths, which respectively are preferential for quantum communication and quantum memory. In a Doppler-broadened atomic ensemble, the spectral entanglement is determined by excitation pulse duration, superradiant linewidth of the lower transition, and the temperature of atoms. We derive the spectral function of this two-photon source, and use Schmidt decomposition to study the competing effect of temperature and superradiant linewidth on the continuous frequency entanglement. This enables quantum control and manipulation of spectral entanglement of the two-photon source, which is potentially useful for quantum information applications in vapor cells.