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Correlation in photon pairs generated using four-wave mixing in a cold atomic ensemble[1] ANDREW RICHARD FERDINAND, Center for Quantum Information and Control, University of New Mexico, ALEJANDRO MANJAVACAS, University of New Mexico, FRANCISCO ELOHIM BECERRA, Center for Quantum Information and Control, University of New Mexico — Spontaneous four-wave mixing (FWM) in atomic ensembles can be used to generate narrowband entangled photon pairs at or near atomic resonances. While extensive research has been done to investigate the quantum correlations in the time and polarization of such photon pairs, the study and control of high dimensional quantum correlations contained in their spatial degrees of freedom has not been fully explored. In our work we experimentally investigate the generation of correlated light from FWM in a cold ensemble of cesium atoms as a function of the frequencies of the pump fields in the FWM process. In addition, we theoretically study the spatial correlations of the photon pairs generated in the FWM process, specifically the joint distribution of their orbital angular momentum (OAM). We investigate the width of the distribution of the OAM modes, known as the spiral bandwidth, and the purity of OAM correlations as a function of the properties of the pump fields, collected photons, and the atomic ensemble. These studies will guide experiments involving high dimensional entanglement of photons generated from this FWM process and OAM-based quantum communication with atomic ensembles.

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