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Spectral shaping of the biphoton state from multiplexed thermal atomic ensembles[1] T. H. CHANG, G. -D. LIN, Department of Physics, National Taiwan University, H. H. JEN, Institute of Physics, Academia Sinica — We theoretically investigate the spectral property of a biphoton state from multiplexed thermal atomic ensembles. This biphoton state originates from the cascade emissions, which are generated by two weak pump fields under the four-wave mixing condition. The cascade configuration composes of lower and upper transitions, where for rubidium atoms they can be $5S_{\frac{1}{2}}$, $5S_{\frac{3}{2}}$, and $6S_{\frac{1}{2}}$, respectively. We obtain the spectral property under different superradiant decay rates of the lower transition ($5S_{\frac{1}{2}}$ to $5S_{\frac{3}{2}}$), excitation pulse durations, and temperature of the medium. By multiplexing multiple thermal atomic ensembles with frequency-shifted cascade emissions, we are able to shape the spectral function of the biphoton state. The entropy of entanglement, which can be quantified by Schmidt decomposition, increases with more multiplexed ensembles involved. We also investigate the lowest entropy of entanglement allowed in the multiplexing scheme, which is preferential for generating a pure single photon source. The multimode structures created by multiplexing atomic ensembles are useful in long-distance quantum communication and multimode quantum information processing.

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