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Spatial EPR entanglement in atomic vapor quantum memory MICHAL PARNIAK, MICHAL DABROWSKI, WOJCIECH WASILEWSKI, Faculty of Physics, University of Warsaw — Spatially-structured quantum states of light are staring to play a key role in modern quantum science with the rapid development of single-photon sensitive cameras [1]. In particular, spatial degree of freedom holds a promise to enhance continous-variable quantum memories. Here we present the first demonstration of spatial entanglement between an atomic spin-wave and a photon [2] measured with an I-sCMOS camera. The system is realized in a warm atomic vapor quantum memory based on rubidium atoms immersed in inert buffer gas. In the experiment we create and characterize a 12-dimensional entangled state exhibiting quantum correlations between a photon and an atomic ensemble in position and momentum bases. This state allows us to demonstrate the Einstein-Podolsky-Rosen paradox in its original version [3], with an unprecedented delay time of 6 μs between generation of entanglement and detection of the atomic state.

[1] R. Chrapkiewicz, M. Jachura, K. Banaszek, and W.Wasilewski, Nat. Photonics 10, 576 (2016).
[2] M. Dabrowski, M. Parniak and W. Wasilewski, "Einstein-Podolsky-Rosen Paradox in a Hybrid Bipartite System", arXiv:1607.05865
[3] A. Einstein, B. Podolsky, and N. Rosen, Phys. Rev. 47, 777 (1935)

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