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Rotating a Bose-Einstein condensate using photons with orbital angular momentum MIKKEL ANDERSEN, PIERRE CLADE, CHANGHYUN RYU, VASANT NATARAJAN, KRISTIAN HELMERSON, WILLIAM PHILLIPS, NIST — The transfer of spin (or internal) angular momentum from photons to matter has been well understood and studied for a long time. On the other hand, one can use light fields where the photons also carry orbital angular momentum. The first-order Laguerre-Gaussian field is one such light field where each photon carries one unit of orbital angular momentum along its direction of propagation. We experimentally demonstrate that this quantum of angular momentum can be coherently transferred to sodium atoms in a Bose-Einstein condensate (BEC). The experiment uses a set of counter-propagating Gaussian and Laguerre-Gaussian beams, where an atom in the BEC can absorb a photon from one beam and emit a (stimulated) photon into the other beam. We also create vortices with higher angular momentum by transferring the angular momentum of several photons per atom. Finally, we demonstrate the coherent superposition of different rotational states, and show that the phase in these is determined by the phase of the light used for their generation.

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