

Abstract Submitted
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Light-induced Azimuthal Gauge Potentials and Spin-orbital-angular-momentum coupling in Bose-Einstein condensates YU-JU LIN, PAO-KANG CHEN, LI-REN LIU, NENG-CHUN CHIU, HONG-REN CHEN, KUAN-YU LIN, MENG-JU TSAI, Institute of Atomic and Molecular Sciences, Academia Sinica, SUNGKIT YIP, Institute of Physics, Academia Sinica, YUKI KAWAGUCHI, Department of Physics, Nagoya University, MING-SHIEN CHANG, Institute of Atomic and Molecular Sciences, Academia Sinica, IAMS, ACADEMIA SINICA TEAM, INSTITUTE OF PHYSICS, ACADEMIA SINICA COLLABORATION, NAGOYA UNIVERSITY COLLABORATION — We demonstrate coupling between the atomic spin and orbital-angular-momentum (OAM) of the atom's center-of-mass motion in a Bose-Einstein condensate (BEC), referred to as “spin-orbital-angular-momentum coupling”. This is achieved by using two co-propagating Raman-dressing beams to couple the atoms in the hyperfine spin $F=1$ manifold while transferring orbital-angular-momentum (OAM) to the atoms' center-of-mass. One of the Raman beam is a Laguerre-Gaussian (LG) beam carrying OAM of light. In this system, we create synthetic azimuthal gauge potentials which act as effective rotations. We exploit the azimuthal gauge potential to demonstrate the Hess-Fairbank effect, the analogue of Meissner effect in superconductors. Here, the BEC in the absolute ground state is a coreless vortex state and transits into a polar-core vortex when the synthetic magnetic flux is tuned to exceed a critical value. Our demonstration serves as a paradigm to create topological excitations by tailoring atom-light interactions. Further, the gauge field in the stationary Hamiltonian opens a path to investigating rotation properties of atomic superfluids under thermal equilibrium.

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