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Scissors mode and rotational properties of a spin-orbit coupled Bose-Einstein condensate CHUAN-HSUN LI, Purdue University, West Lafayette, Indiana 47907, USA, CHUNLEI QU, JILA and Department of Physics, University of Colorado, Boulder, Colorado 80309, USA, DAVID BLASING, YONG CHEN, Purdue University, West Lafayette, Indiana 47907, USA — The rotational properties of a Bose-Einstein condensate (BEC) are important to study its superfluidity. Recent studies have found that spin-orbit (SO) coupling can change a BEC's superfluid properties. In addition, the scissors mode of a BEC, where the condensate's angle oscillates with respect to trap axes, has been demonstrated to be important for probing rotational properties and superfluidity. Here, we study the scissors mode of a Raman-induced SO coupled BEC of ^{87}Rb atoms in a synthetic magnetic field B. A SO coupled BEC is first prepared in the presence of B field generated by a spatially-varying Raman coupling. We then quench the Raman coupling or detuning to apply a spatially-varying synthetic force, which pushes and shears the BEC. After such a quench, both the dipole and scissors modes are excited in the trap, and their dynamical evolutions are studied in the presence of SO coupling and B field. We experimentally find that the measured scissors frequency does not agree with the prediction based on effective masses. The GPE simulations reveal the existence of two scissors frequency components, which are important to understand the measured results. Our work may allow us to study how SO coupling modify the BEC's rotational properties.

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