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Ultra stable Matter wave gyroscopy using Orbital Angular Momentum induces atomic vortices SULAKSHANA THANVANTHRI, Louisiana State University, KISHOR KAPALE, Western Illinois University, JONATHAN DOWLING, Louisiana State University — It has long been known that matter-wave gyroscopes are orders of magnitude more sensitive that optical gyroscopes. The creation of matter-wave currents that can achieve such sensitivity is a continuing challenge. We propose the use of Optical Angular Momentum (OAM) induced vortices in Bose-Einstein Condensates (BECs) as an ideal candidate for quantum gyroscopy. Coherent superpositions of left and right rotating quantum states of a trapped condensate lead to an interference pattern that rotates when the trap rotates—in accordance with the Sagnac effect. Two important benchmarks for any gyroscope are it's sensitivity and stability. Atomic beam gyroscopes while having high sensitivity ($10^{-9}\mathrm{s}^{-1}\ \mathrm{Hz}^{-1/2}$), also suffer from instability due to drift caused by difficulties in beam pointing and thermal expansion of atom beams. Since the sensitivity of a gyroscope utilizing the Sagnac effect is directly proportional to the area (or atomic beam path lengths) of the interferometer, there is trade-off between sensitivity and stability. While focusing on the new application of BEC vortex superposition, we find that it leads to a highly stable gyroscope. We will also comment on increasing the sensitivity of the gyroscope without sacrificing stability.

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