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Atom Interferometry in an Optical Cavity and Applications

JUSTIN BROWN, BRIAN ESTEY, PAUL HAMILTON, HOLGER MÜLLER, University of California Berkeley — Light pulse atom interferometers use pulses of light to coherently split matter waves and utilize interference to measure the relative phase between paths. Measurement sensitivity increases with the enclosed space-time area. Several techniques have been developed to increase momentum transfer including high order Bragg diffraction. This has been limited to 24 $\hbar k$ in a single pulse by laser power and beam quality such as wavefront distortions. We are developing an interferometer in a vertically-mounted 40 cm long Fabry-Perot cavity using cold Cs atoms. The cavity enhances available laser power, controls optical wavefronts, and is expected to provide $> 100\ \hbar k$ momentum transfer in a single Bragg diffraction process. Such a demonstration would provide a competitive gravimeter in a compact device. In addition, the optical cavity reduces uncertainties in beam alignment and divergence. This feature allows light pulses to enclose a well-defined spatial area for a Sagnac gyroscope with high scale factor stability. Finally, the compact design and large momentum transfer expected allow for the introduction of two source masses for a possible demonstration of the gravitostatic Aharonov-Bohm effect. We report on our experimental progress and discuss these applications.

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