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Atomic Interaction Effects in Precision Bose-Einstein Condensate Interferometry ALAN O. JAMISON, University of Washington - Physics, J. NATHAN KUTZ, University of Washington - Applied Math & Physics, VLADYSLAV V. IVANOV, ANDERS H. HANSEN, ALEXANDER KHRAMOV, WILLIAM H. DOWD, SUBHADEEP GUPTA, University of Washington - Physics — We propose to measure h/m and α to sub-ppb precision with a Bose-Einstein condensate (BEC) interferometer. Since atomic interactions are among the most pernicious systematic effects in a BEC, we present theoretical tools for predicting and reducing the effects of atomic interactions in a broad class of BEC interferometry experiments. To address mean-field shifts during free propagation, we derive a robust scaling solution that reduces the three-dimensional Gross-Pitaevskii equation to a set of three simple differential equations valid for any interaction strength. To model the other common components of a BEC interferometer—condensate splitting, manipulation, and merging—we generalize the slowly-varying envelope reduction, providing both analytic handles and dramatically improved simulations. Applying these tools to a contrast interferometry setup, we demonstrate the potential for a sub-ppb determination of h/m and α, even for atomic species with relatively large scattering lengths. These tools can make BEC interferometry a viable scheme for a broad class of precision measurements. Our experimental progress will be reported.

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