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Bloch-band analysis of optical beam splitters in a matter-wave interferometer[1] DANIEL GOCHNAUER, KATHERINE E MCALPINE, TAHIYAT RAHMAN, SUBHADEEP GUPTA, University of Washington — Using standing-wave light pulses on a Yb Bose-Einstein condensate source, we demonstrate a matter-wave contrast interferometer (CI) with large momentum separation of up to 112 photon recoils between outer paths [1]. The CI phase evolution is quadratic with the number of recoils and the observed phase stability depends crucially on the suppression of undesired diffraction phases. We apply a Bloch-band approach to the analysis of our pulsed optical standing waves, which predicts accurate Rabi frequencies for diffraction pulses and is useful in understanding diffraction phases, an important systematic effect in precision atom interferometry. We have demonstrated a method to determine atomic band structure in an optical lattice through the analysis of the consequent diffraction phase shifts in our CI. The Bloch-band approach also illuminates a solution to minimize the phase instability typically observed in the usage of Bloch oscillations (BO) as beam splitters by conducting the BO in the second excited band rather than the ground band. We will report on our work toward demonstrating a phase stable CI with BO beam splitters and report on a comparison with other beam splitting techniques. [1] B. Plotkin-Swing et al, Phys. Rev. Lett. 121, 133201 (2018).

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