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Bloch-bands Picture and Diffraction Phase Control in Atom Interferometry[1] KATHERINE E. MCALPINE, DANIEL GOCHNAUER, TAHIYAT RAHMAN , SUBHADEEP GUPTA, University of Washington — Our ytterbium (Yb), three-path matter wave contrast interferometer (CI) measures the ratio of Plancks constant and the mass of Yb toward a fine-structure constant measurement. The CI uses a Bose-Einstein Condensate atom source and pulsed optical standing wave diffraction gratings, using which we have demonstrated phase stable interferometer signals with path separations up to 112 photon recoils [1]. The CI signal is sensitive to intensity fluctuations of acceleration pulses via a momentum-dependent AC Stark shift leading to a diffraction phase. We have modeled the system using a Bloch-bands picture which informs optimal pulse parameters, provides accurate Rabi frequencies for acceleration pulses, and can be used to interferometrically measure lattice band structure. The CI used sequential Bragg pulses to accelerate the atoms to their highest momentum, limited by finite acceleration pulse efficiency. Guided by our model, we are exploring the use of high-efficiency excited-band Bloch Oscillation acceleration pulses in a regime of suppressed diffraction phase effects. We will report on our assessment of these different acceleration techniques and their implications for precision contrast atom interferometry. [1] B. Plotkin-Swing et al., Phys. Rev. Lett. 121, 133201 (2018).

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Katherine Mcalpine
University of Washington

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