Abstract Submitted
for the DAMOP20 Meeting of
The American Physical Society

Demonstration of multiple round-trip waveguide atom interferometer HYOSUB KIM, KATARZYNA KRZYZANOWSKA, KEVIN HENDERSON, CHANGHYUN RYU, MALCOLM BOSHIER BOSHIER, Los Alamos National Laboratory — Atom interferometers in which the atoms move inside waveguides can be much smaller than devices in which the atoms move in free space. A potential issue with this approach is that fringe contrast can drop rapidly as the distance traveled inside the waveguide increases because of effects associated with residual curvature in the waveguide. We have found that the loss of contrast is much smaller in an interferometer in which the atoms make many small-amplitude round trips during the measurement cycle instead of a single large-amplitude round trip. We use a weakly-interacting gas to reduce scattering when the wavepackets pass through each other. In this way we have demonstrated a linear interferometer with interrogation time longer than any previous waveguide interferometer. For this experiment, we produce a condensate with ~5,000 atoms of ^{39}K $|F, m_F>=|1, -1>$by exploiting a magnetic Feshbach resonance at ~562 G in an optical dipole trap formed by crossed horizontal and vertical 1064 nm beams. The s-wave scattering length is set to a desired value by sweeping the magnetic field, and the vertical beam is turned off to put the atoms into a one-dimensional waveguide. Retro-reflecting a blue detuned 767 nm laser forms a Bragg grating along the waveguide axis that imparts a $2\hbar k$ momentum kick. The interferometer uses a $\pi/2$-$[-\pi-]^n$-$\pi/2$ pulse sequence with up to n=50 π-pulses. The pulse sequence could be useful for an atomic Sagnac interferometer if the waveguide is synchronously shifted during interrogation in order to form an enclosed area.

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Date submitted: 31 Jan 2020 Electronic form version 1.4