DAMOP05-2005-000265

Abstract for an Invited Paper
for the DAMOP05 Meeting of
the American Physical Society

An Atom Michelson Interferometer on a Chip[1]

DANA Z. ANDERSON, Department of Physics, University of Colorado, and JILA, University of Colorado and National Institute of Standards and Technology

An atom Michelson interferometer is implemented on an "atom chip." The chip uses lithographically patterned conductors and external magnetic fields to produce and guide a Bose-Einstein condensate. Splitting, retroreflecting, and recombining of condensate atoms are achieved within the magnetic waveguide by a standing-wave light field having a wave vector aligned along the guide. Splitting and recombining are achieved with a pair of standing light field pulses each 20 μs in duration and separated by 63 μs. This pair of pulses is such that an a single BEC cloud initially at rest is converted into a pair of oppositely directed clouds having momentum $p = \pm 2\hbar k$ with essentially no atoms remaining stationary or in higher diffracted orders. Retroreflection of the two clouds is achieved by a longer (150 μs) pulse of the standing wave. When the atoms have returned to their starting position, the recombining pulse pair leaves the atoms in three clouds representing two different states: one cloud with zero momentum, $|p = 0\rangle$ and a pair of clouds representing the state $|p = \pm 2\hbar k\rangle$. The population of these two states corresponds to the intensity of light from the two output ports of the beamsplitter in an optical Michelson interferometer. A differential phase shift between the two arms of the atom interferometer is introduced either with a magnetic-field gradient or with an initial condensate velocity. The populations of the two states is seen to vary sinusoidally and in anti-phase with the path difference as expected. We find that the interference contrast decays with propagation time in the waveguides: 20% contrast is observed with an atom propagation time of 10 ms.

[1]UCAO Collaboration