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Optical Phase Coherence in the Adiabatic Rapid Passage (ARP) Force[1] BRIAN ARNOLD, TAICHI INAKI, YIFAN FANG, HAROLD METCALF, Physics Dept., Stony Brook University, Stony Brook NY 11794-3800 — The huge optical force on atoms implemented using ARP results from coherent exchange of momentum between atoms and the light field. This is done with counterpropagating beams of chirped, pulsed light that alternately produce absorption followed by stimulated emission, and has been demonstrated for atoms at rest[2]. How does the ARP force depend on atomic velocities v_a? Atomic motion in the lab frame corresponds to Doppler-shifted frequencies in the atomic frame, so we use oppositely detuned laser beams to simulate v_a. For large v_a this uses two different lasers, but the coherent momentum exchange requires phase locking them[3]. This has been implemented and the first results show that the force is nearly constant at low v_a but decreases at higher v_a. For an ARP frequency sweep range of $\pm\,\delta_0$, one intuitively expects a range of v_a between 1/4 and 1/2 of $\pm\,\delta_0/k$, and our initial measurements corroborate this. Our new tools enable further exploration of the dependence of the ARP force on v_a as well as the role of phase noise that can be inserted experimentally.

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[2]X. Miao, Phys. Rev. A 75, 011402 (2007).
[3]J. Elgin, Ph.D Thesis, Stony Brook University, 2015.

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