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Observing matter-wave stability under small displacements with an atom interferometer[1] SAIJUN WU[2], EDWARD J. SU[3], Dept. Physics, Harvard University, ERIC J. HELLER, Dept. Physics and Dept. Chemistry, Harvard University, MARA G. PRENTISS, Dept. Physics, Harvard University — We discuss a recently-developed 4-pulse atom interferometry scheme in terms of spatial-displacement echoes, and experimentally study the stability of matter-wave dynamics in a magnetic guiding potential as a function of small spatial displacements. We observe that the displacement-induced dephasing factor saturates to a constant value at long interrogation time, and can be almost completely suppressed when the displacement across the guide is smaller than the coherence length of the atomic sample. Our observations illustrate the insensitivity of matter-wave dynamics to small spacial displacements as well as the feasibility of manipulating magnetically-guided atoms with optical pulses at high fidelity. We also demonstrate an interferometric method for in situ probing of the coherence length of confined atomic sample.

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