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Quantum Tunneling of a Macroscopic Matter-wave Soliton[1] S.E. POLLACK, D. DRIES, E.J. OLSON, R.G. HULET, Rice University — A fascinating property of many nonlinear wave equations is the existence of non-dispersive waves known as solitons, which provide unique possibilities in photonics as well as to investigate manifestations of quantum mechanics at the macroscopic scale. We create a stable bright matter-wave soliton consisting of ultracold ^{7}Li atoms in an optical dipole trap, and offset it from the center of the trap by pulsing a magnetic field gradient. At the center of the trap we place a Gaussian barrier with a waist of comparable size to the nonlinear wave. By adjusting the velocity of the soliton and the height of the barrier we observe both reflection from and transmission through the barrier, as well as the splitting of the wave into two pieces. The two-piece object is allowed to complete an oscillation in the harmonic trap and reimpinge on the barrier, where it recombines. We report our results and discuss the possibilities of using this setup as a matter-wave beamsplitter for atom interferometry.

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