Abstract Submitted
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Interactions of Bright Matter-Wave Solitons with a Barrier Potential[1] PAUL DYKE, LEI SIDONG, SCOTT POLLACK, DAN DRIES, RANDY HULET, Department of Physics and Astronomy and Rice Quantum Institute, Rice University, Houston, TX 77005 — Nondispersive solitary waves (solitons) can be produced in a one-dimensional Bose-Einstein condensate (BEC) with weak attractive interactions. We have created bright matter-wave solitons with $N \sim 2 \times 10^5$ ultracold ^{7}Li atoms by tuning the scattering length to small negative values via the broad $|1,1\rangle$ Feshbach resonance. In this work, we study the interaction between a kicked soliton and a thin barrier potential generated by a near-resonant cylindrically focused laser beam. Our results show that by varying the soliton kinetic energy, as well as the potential strength, it is possible to reflect, transmit, or even split the soliton. We investigate the possibilities for creating a matter-wave beamsplitter and a matter-wave interferometer by examining the recombination of the solitons. Theory has shown that in certain cases the solitons behave as single quantum mechanical object that may split into a Schrödinger cat state.

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Paul Dyke
Department of Physics and Astronomy and Rice Quantum Institute,
Rice University, Houston, TX 77005

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