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Phase-Dependent Interactions of Bright Matter-Wave Solitons[1]

PAUL DYKE, SIDONG LEI, RANDALL HULET, Rice University — We investigate the interaction of bright matter-wave solitons with a thin repulsive barrier. The solitons are formed from a Bose-Einstein condensate of ^{7}Li atoms confined in quasi-1D by a focused laser beam. We use the broad Feshbach resonance for ^{7}Li in the $|1,1\rangle$ state to tune the scattering length through zero to small negative values to produce bright matter-wave solitons with atom numbers close to the critical number for collapse. The barrier is generated by a near-resonant cylindrically focused laser beam that perpendicularly bisects the trapping beam. By adjusting the barrier potential, the soliton can either be split in two, transmitted or reflected. We apply a phase imprinting laser beam to one arm of the split soliton to study phase dependent interactions. We also investigate the transmission and reflection probabilities as a function of the strength of non-linear interactions which are tuned via the Feshbach resonance.

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