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Frequency Modulation of Ultracold Atoms by an Oscillating Barrier[1] ANDREW PYLE, DREW ROTUNNO, SHUANGLI DU, SETH AUBIN, College of William Mary — We present progress on an experiment to study 1D quantum mechanical scattering by an amplitude-modulated barrier. Classically, the oscillating barrier imparts or subtracts kinetic energy in a continuous manner from the scattered atoms. The quantum mechanical energy spectrum of the scattered atoms shows that kinetic energy is added or subtracted in discrete amounts, and thus resembles a comb with a tooth spacing of $\hbar\omega$ where ω is the oscillation frequency of the barrier. We present an atom chip-based experimental system to study the scattering dynamics with Bose-Einstein condensates (BEC) of ^{87}Rb. The experiment operates by releasing a BEC from a magnetic chip trap and directing it horizontally towards a tightly focused laser beam that serves as an oscillating barrier. A magnetic field gradient is used to control the vertical motion of the BEC. This method can be used to study the resulting momentum distributions with a BEC in the presence of no or weak interactions. This experiment represents a first step toward implementing a quantum pump for ultracold atoms based on two such barriers modulated out of phase with one another.

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