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Tunable Lattice-Induced Opacity for Matter Wave Transport CHEN ZHANG, JILA and University of Colorado at Boulder, Physics department of Purdue University, CHRIS H. GREENE, Physics department of Purdue University — We describe the novel phenomena of lattice-induced opacity in the process of matter wave scattering from a two dimensional atomic lattice. As an analogue to the confinement-induced resonance, the two dimensional atomic lattice can be tuned to complete opacity to a normally incident low energy matter wave, by changing the s-wave scattering length between the matter wave and the atoms in the lattice. A scheme for a matter wave transistor is proposed based on the transmission-reflection properties of the matter wave through the atomic lattice. We also propose a matter wave cavity, constructed by two parallel 2D atomic lattices that are both opaque to the matter wave. In higher kinetic energy regimes of the matter wave, the two dimensional atomic lattice is shown to be a matter wave beam splitter and wave plate, with tunable peak intensity into different directions.

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