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Coherent Control of Wannier-Stark States in a Tilted-Washboard Potential CHAO ZHUANG, IOS, CQIQC, and Dept of Physics, University of Toronto, SAMANSA MANESHI, XIAOXIAN LIU, ARDAVAN DARABI, LUCIANO CRUZ, AEPHRAIM STEINBERG — We study the coupling of Wannier-Stark states of ^{85}Rb atoms trapped in a one-dimensional tilted-washboard potential. The tilted-washboard potential is formed by a vertical optical lattice plus the gravitational potential. Two methods are used to couple the states. The first one is a combination of lattice displacements and time delays, or phase modulation (PM). The second method is a modulation of the lattice depth, or amplitude modulation (AM). The efficiencies of different PM pulses in coupling the lowest two states are compared. The PM pulses we studied include a single shift; two single shifts with a time delay; displacements with Gaussian time profiles; displacements with sinusoidal time profiles; and displacements with frequency-chirped sinusoidal time profiles, to implement adiabatic rapid passage. Finally, we studied simultaneous PM at ω and AM at 2ω, where absorption of 2 PM quanta or 1 AM quantum could lead to the same final state. We demonstrate interference between these processes, leading to quantum control of the transfer efficiency to different Wannier-Stark levels.

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