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Ballistic Atom Pumps[1] TOMMY BYRD, MEGAN IVORY, A.J. PYLE, SETH AUBIN, College of William and Mary, KUNAL DAS, Kutztown University of Pennsylvania, KEVIN MITCHELL, University of California, Merced, JOHN DELOS, College of William and Mary — Researchers have long been interested in electron transport through mesojunctions containing time-dependent potential barriers, a process often called "quantum pumping." A useful model of such a system is a ballistic atom pump: two reservoirs of neutral ultracold atoms connected by a channel which has oscillating repulsive potential-energy barriers. Particles move through the pump independently, and only interact with the walls and potentials. Such a system can transport particles from one reservoir to the other, even when the reservoirs have equal chemical potentials. It can also transfer energy from one reservoir to the other, even if there is no net particle pumping. Another type of pump, a rectifier– which only allows current to flow in one direction–can be constructed by tuning the potentials. While these phenomena are often called "quantum pumping," we have found that the quantum description cannot be fully understood without analysis of the underlying classical dynamics. Classically, the system is a nice model of chaotic transport. We use classical trajectories, along with phase information, to construct a semiclassical approximation to the quantum description. This approach explains the locations and relative heights of Floquet peaks seen in the quantum theory.

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