Abstract Submitted
for the DAMOP15 Meeting of
The American Physical Society

Atom and Electron Pump Based on Oscillating Wells: Classical versus Quantum features[1] JOSHUA GARNER, KEVIN RUPPERT, KUNAL DAS, Kutztown University of Pennsylvania — The transport dynamics of ultracold atoms in quasi one-dimensional (1D) waveguides share much in common with that of electrons and holes in nanowires. In the latter system, biasless transport by time-varying potential, commonly called quantum pumping, has been much researched theoretically as a mechanism that can provide significant control over the current. With scant experimental success, ultracold atoms provide a promising alternate for exploring quantum pumps. Prior studies of quantum pumps have generally focused on using potential barriers as the pump elements. In this study, we undertake a first detailed study of the scattering dynamics involved in using quantum wells to drive the pumping. Specifically, we do a comparative study using quantum, classical and semiclassical picture in a common wavepacket approach that also allows direct comparison of quantum versus classical features. Notably, a static well, unlike a barrier, does not reflect; but oscillating ones do even in the classical limit, and moreover, particles can be trapped in wells indefinitely. Such features lead to distinctive features for well-based pumps that can have both practical and fundamental physics implications. Our study is done in the context of several different pump configurations.

[1]Supported by NSF Grant No. PHY-1313871 and grants from PASSHE-FPDC and Kutztown University

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Date submitted: 27 Jan 2015 Electronic form version 1.4