Abstract Submitted
for the DAMOP12 Meeting of
The American Physical Society

Single Mode Quantum Pumps using Wavepackets of Bose-Einstein Condensates[1] KUNAL DAS, PETER KOUFALIS, ANDREW PYLE[2], Kutztown University of Pennsylvania — Quantum pumps generate transport by time-varying potentials but implementation in mesoscopic systems has remained elusive despite much interest. We apply a novel approach using counter-propagating wavepackets [1] to study this quantum transport mechanism at the single mode level. This allows us to probe features not accessible with standard methods of mesoscopic physics: We examine the rich momentum distributions resulting from quantum pumps in different configurations, including a new one that operates like a "quantum paddlewheel." We find that with dual periods, the momenta present a Floquet structure that interweaves both. Our simulations easily translate to experiments with Bose-Einstein Condensates in waveguides, being currently developed. One of the key advantages of our simulations, as well as related experiments, is that we can examine the effects of nonlinearity on quantum pumps. Despite the intrinsic spatial non-uniformity of wavepackets, we show that convergent results for nonlinear transport are obtained as packet widths are increased, provided that the peak density is kept constant. Our basic approach can be generalized to study most mesoscopic transport phenomena with ultracold atoms.

[1] Kunal K. Das, Phys. Rev. A 84, 031601(R)

[1]We acknowledge funding from NSF Grant No. PHY-0970012.
[2]Currently at The College of William and Mary

Kunal Das
Kutztown University of Pennsylvania

Date submitted: 26 Jan 2012 Electronic form version 1.4