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"Trickle Meter Gravimetry": Precision Interferometry from Residual Berry Phase Edge Effects Involving Atoms Exiting an Accelerating Optical Lattice SCOTT CHUBB, Naval Research Laboratory — From a generalization of conventional band theory[1], derived from a many-body form of multiple scattering theory, I rigorously showed that the semi-classical theory of cold atom transport in optical lattices could be related to changes in the zero of momentum of the ground state. The new formulation includes finite size effects. When the effects of excitation, associated with the loss of atoms at the boundaries of the lattice are included, in the adiabatic limit, in which the perturbing potential acts sufficiently slowly and weakly, topological changes in phase (which are equivalent to Berry phase effects in the conventional semi-classical theory) take place that introduce discontinuous changes in wave function phase (and flux). In a situation involving an accelerating optical lattice, containing ultra cold atoms in a Bose Einstein Condensate, these changes in wave function phase can be monitored and used to systematically alter the acceleration of the lattice (by altering the chirp frequency of one of one of the counter-propogating lasers), in such a way that a form of edge-effect interferometry can be performed, which, in principle, can be used to make precision measurements of gravity, with unprecedented accuracy.

[1]S.R.Chubb, Proc Roy Soc A, submitted (2006).

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