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Critical Time and Length Scales and New Procedures for Performing "Squeezed State Atom Interferometry," Using BEC's in Finite Optical Lattices SCOTT CHUBB, Naval Research Laboratory — Kasevich has suggested[1] that "squeezed state interferometry," using Bose Einstein Condensates (BECs) in Optical Lattices, may be useful for developing new, potentially revolutionary procedures for measuring gravity, acceleration and/or values of $\hbar/m_{atom}$. The essential physics associated with his argument involves being able to address and manipulate, many atoms, in a BEC, at many locations, simultaneously, coherently (using an Optical Lattice), beginning from a non-BEC, many-body Fock state (for example, initialized from a Mott insulating state). A variant of his idea includes an additional procedure in which the Optical Lattice is accelerated coherently for discrete intervals of time in such a way that the BEC effectively "sees" an Umklapp transition in the direction of gravity and then (using a rotated lattice) perpendicular to it. A complication, associated with the new procedure, involves identifying the effects of boundaries and limitations associated with the finiteness of the lattice. Using a generalization of band theory to finite lattices[2], estimates of critical time and length scales, based on simulations of the propagation of representative wave-packets, are used to quantify the effects of these limiting factors.

[1]M. Kasevich, Compte Rendus, Serie IV, 2,, #3 : 497-507
[2]Scott R Chubb, Bull of the APS, v 49,#1, part 2, 549 (2004.)

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