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Modeling the Speed and Efficiency of an Optical Conveyor[1] GARRETT HICKMAN, MARK SAFFMAN, University of Wisconsin - Madison — Fast, high-fidelity transport of cold atoms has been the subject of considerable theoretical and experimental effort. Much theoretical work has focussed on the corresponding 1D problem. These solutions may suffice for experiments in which an atom has been cooled to its 3D motional ground state, so that motion in the transverse plane can be neglected. In other cases however this may not be true. In particular, 3D ground-state cooling is more difficult in systems for which one or more trap frequencies is relatively small, since resolving motional sidebands might not be possible. This is particularly true of many optical conveyor setups. In these and similar cases it has been unclear whether a 1D model will be adequate. Here we present a numerical quantum 1D model that characterizes heating and atom loss in a realistic optical conveyor. The model depends on dephasing in the density matrix formalism to account for effects of motion in the transverse plane. We compare its predictions against measurements of an experimental system in which atoms are transported into an optical fiber cavity, and against a 3D classical Monte Carlo simulation. Comparisons indicate that the addition of dephasing into the model allows it to capture essential features of the 3D motion during transport.

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