Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Parallel Coupling of Symmetric and Asymmetric Exclusion Processes KONSTANTINOS TSEKOURAS, Rice University, ANATOLY KOLOMEISKY, Rice University Chemistry Department — A system consisting of a simple symmetric exclusion process (SSEP) and a totally asymmetric exclusion process (TASEP) coupled to each other at every site is constructed as a simplified model of a microtubule and the surrounding medium within the context of intracellular particle transport. Transitions between the channels are allowed at every site of both lattices. A cluster-based mean-field theory allows calculation of stationary phase diagrams, particle currents and densities for symmetric/asymmetric transition rates between the channels. It is shown that in general there are three stationary phases, similar to the case of a single-channel totally asymmetric exclusion process.Density profiles are identical in both channels if transition rates are symmetric, not so if they are asymmetric.At certain limiting values of the transition rates our theory provides exact solutions, so that the system can be described as a partially asymmetric exclusion process (PASEP). Extensive Monte Carlo simulations generally support theoretical predictions, although simulated stationary-state properties slightly deviate from calculated in the mean-field approximation. Dynamic properties and phase diagrams are discussed by analyzing symmetry requirements and constraints on the particle currents, as are possible implications for the problem of intracellular particle transport.

Konstantinos Tsekouras
Rice University Physics Department

Date submitted: 21 Nov 2008 Electronic form version 1.4