MAR12-2011-001307

Abstract for an Invited Paper
for the MAR12 Meeting of
the American Physical Society

Cooperativity-Driven Singularities in Cooperative Asymmetric Exclusion[1]

SIDNEY REDNER, Boston University

We investigate the effect of cooperative interactions on the asymmetric exclusion process. In the simplest case a particle can hop to its vacant right neighbor only if its left neighbor is occupied. We show that an initial density downstep develops into a rarefaction wave that can have a jump discontinuity at the leading edge, while an upstep results in a shock wave. We also investigate a more general model in which the particle velocity can be an increasing function of the density. Within a hydrodynamic theory, initial density upsteps and downsteps can evolve into: (a) shock waves, (b) continuous compression or rarefaction waves, or (c) a mixture of shocks and continuous waves. These unusual phenomena arise because the current versus density relation has an inflection point, so that the group velocity can either be an increasing or a decreasing function of the density on either side of the inflection point.

[1]Suported by NSF grant DMR-0906504