Driving kinetically constrained models into nonequilibrium steady states: transport properties and confinement

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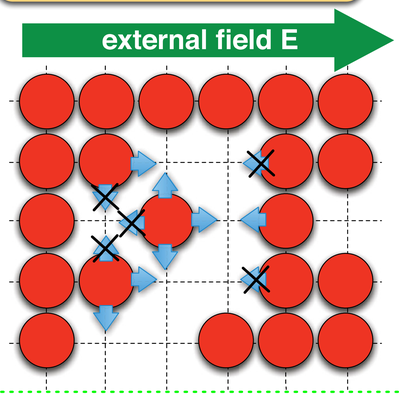
Kinetically Constrained Asymmetric Simple Exclusion Process [4]

2d Lattice Gas with **constrained** moves: mimics the **cage effect** present in **glasses** and **jammed** granular materials.

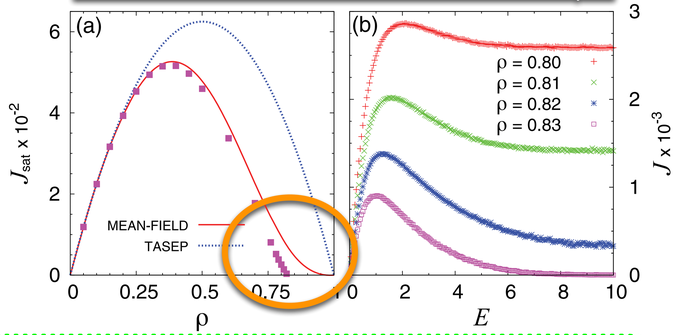
- Fixed **density** of particles **ρ** on a 2d lattice with periodic boundaries.
- Particles move if and only if they have at least **two** empty neighbors **before** and **after** the move.
- An external field is applied so that the probability to do backward moves decreases **exponentially**:

$$p_{back}=exp[-E]$$

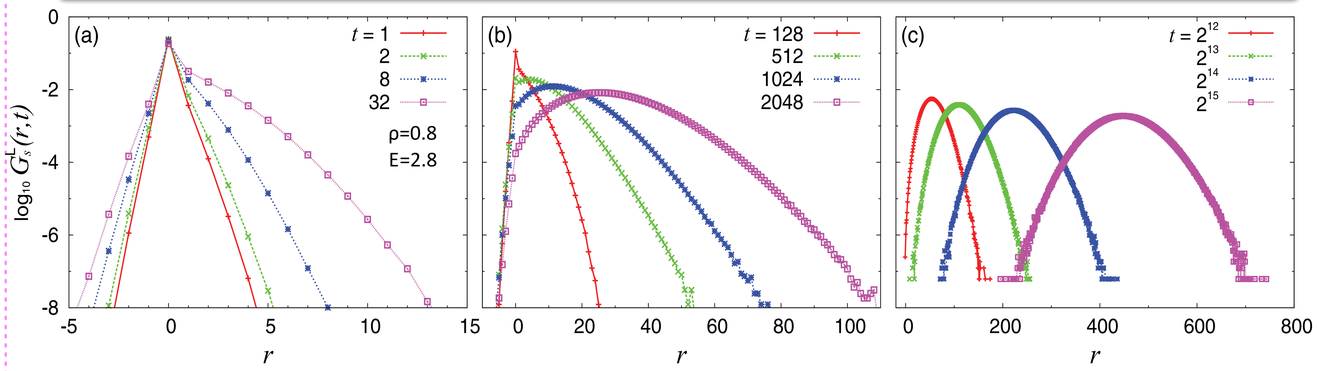
- in the transverse direction, the motion is **unbiased**.



Non monotonic Current at high ρ

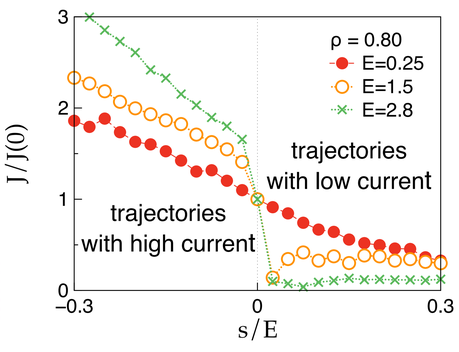


Long-lived non-Gaussianity of the longitudinal displacement distributions



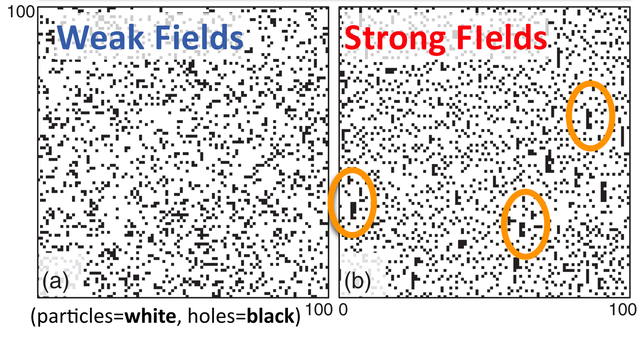
At short times, **exponential tails** in the van Hove functions reveal the presence of cage dynamics. The competition between external driving and kinetic constraints induce a **long-lived asymmetry** in the distributions: structural rearrangements in the backward direction are rare [1].

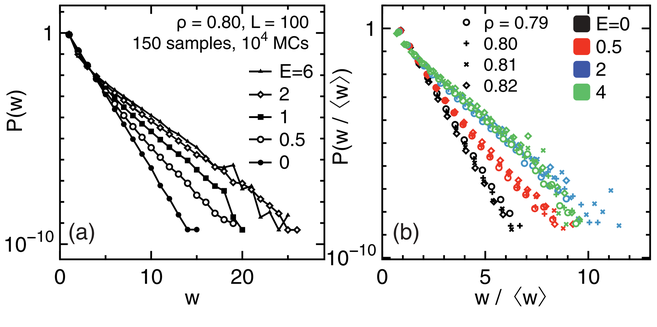
Dynamical phase transition



With a **biased dynamics** [3] (parameter **s**) one can show that the emergence of heterogeneous spatial structures at strong fields corresponds to a **separation** between **trajectories** with high/low current. The transition is **discontinuous** in the strong field limit.

Intermittent spatial heterogeneities

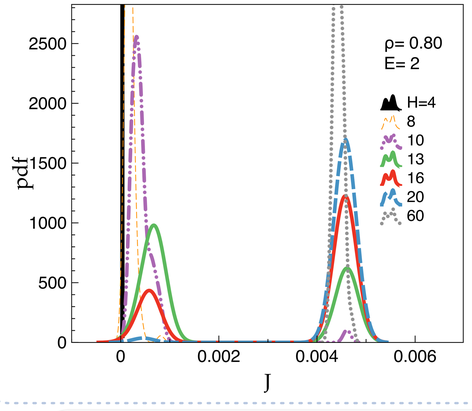


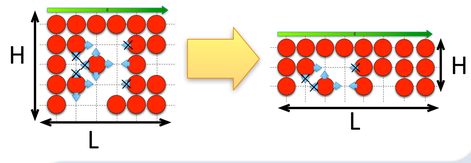


At **high densities** , the current is **non-monotonic** with increasing the field intensity. At the same time, **spatial structures appea**r in the transverse direction. They have finite life-times and they are non-localized.

The transverse **length distributions** of such structures are **exponential**: a **growing characteristic correlation length** can be linked to the increase of the field intensity. This length eventually **saturates** This **cooperative** length is responsible for the macroscopic behavior of the model.

Confinement effects





Changing the **aspect ratio** of the model allows to reveal the **bimodal nature** of the current distribution [2].

Indeed, with reducing the **transversal dimension**, the dynamics gets more and more affected by the characteristic length of the intermittent structures. This allows to distinguish the **flowing** trajectories from the **non-flowing** ones .

References

[1] F. Turci, E. Pitard, and M. Sellitto, Physical Review E 86, 031112 (2012).
[2] F. Turci and E. Pitard, Fluct. Noise Lett. 11, 1242007 (2012).
[3] F. Turci and E. Pitard, Epl 94, 10003 (2011).
[4] M. Sellitto, Phys Rev Lett 2008 vol. 101 (4), 48301 (2008).