Contribution ID: **43** Type: **Talk**

Transport in the Asymmetric Simple Inclusion Process and an Unexpected Unification of Bosons and Fermions

Wednesday, 3 May 2023 11:30 (30 minutes)

We study the counting statistics of the asymmetric simple inclusion process (ASIP), which describes the dissipative transport of bosons along a one dimensional lattice. By combining exact numerical simulations with a field-theoretical analysis, we evaluate the current fluctuations for this process and determine their asymptotic scaling. Surprisingly, our findings show that the ASIP falls into the KPZ universality class and therefore, despite a drastic difference in the underlying particle statistics, exhibits the same scaling relations as the celebrated asymmetric simple exclusion process (ASEP) for fermions. We observe, however, crucial differences between the two processes in the shape of the distribution function, which we reconcile by mapping both models to the physics of one dimensional interfaces. This unified description shows that bosonic transport corresponds to interface growth, while its fermionic counterpart maps onto an eroding interface instead. Beyond their transport-theoretical interest, these fundamental relations can be probed in various experiments with cold atoms or with long-lived quasi-particles in nano-photonic lattices.

Abstract category

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