Extreme events in a driven system of hardcore particles out of equilibrium

V. Popkov[a], G. Schütz[b] and D. Simon[c]

[a] *Università di Firenze, Dipartimento di Fisica, via Sansone 1, 50019 Sesto Fiorentino, Italy. E–mail: popkov@fi.infn.it*
[b] *Forschungszentrum Jülich GmbH Wilhelm-Johnen-Strasse, 52428 Jülich Germany*
[c] *Université Pierre et Marie Curie (Paris 6),4 place Jussieu, 75252 Paris Cedex 05, France*

We study a one-dimensional system of classical hardcore particles known as Asymmetric Simple Exclusion Process, which represents the most simple version of a "driven" Ising system and plays therefore a fundamental role in the theory of many-particle systems out of equilibrium. We ask how such a system may produce an atypically large currents over large period of time, which is an extremely rare event. The dynamics, initially strictly local, under such a restriction develops long-range interactions which may be described via an effective Markov process. The form of the long-range potential, the stationary state, and the rates for the effective Markov process are found analytically. Finally, we find surprising connections to a quantum system of free fermions and Dyson's circular unitary ensemble of random matrices (CUE).