

A Non-Markovian Asymmetric Simple Exclusion Process

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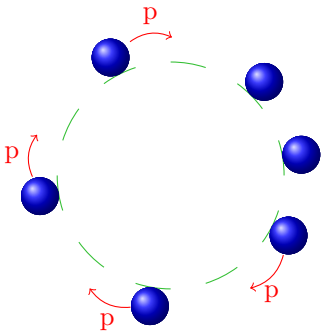
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Outline

- 1 The Asymmetric Simple Exclusion Process (ASEP)
- 2 Results of simulations in the condensed regime
 - Time picked by the pack leader
 - Clump formation time
 - Lifetime of a full clump
 - Interclump time
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The Asymmetric Simple Exclusion Process (ASEP)

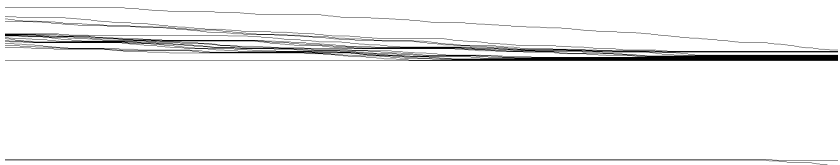


Markovian models

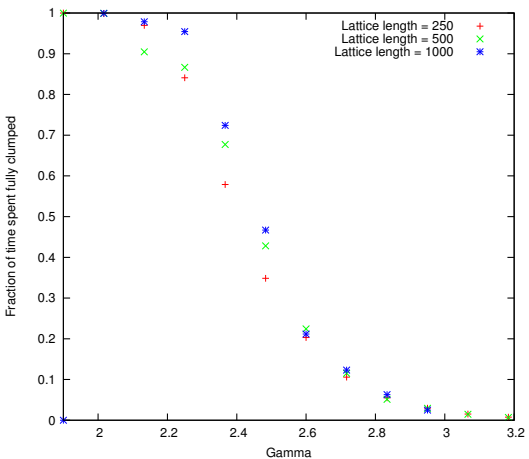
$$\text{Waiting time distribution} = W(t) = A \exp[-t/\tau]$$

Our Non-Markovian model

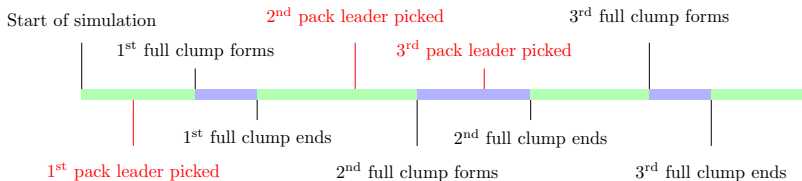
$$\text{Waiting time distribution} = W(t) = (\gamma - 1)t^{-\gamma}$$



Part of the collapse of the system to a full condensate in the $\gamma < 3$ regime. Time increasing to the right



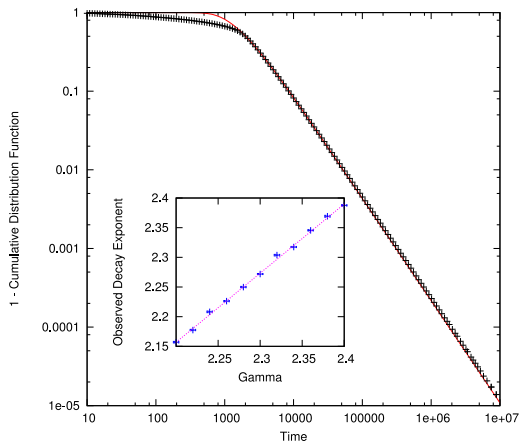
Fraction of time spent in the fully clumped configuration, from simulations with one particle per 10 sites.



A cartoon of the typical lifetime of a simulation. Green shows the system is unclumped, and blue is used when the system is in the fully clumped state.

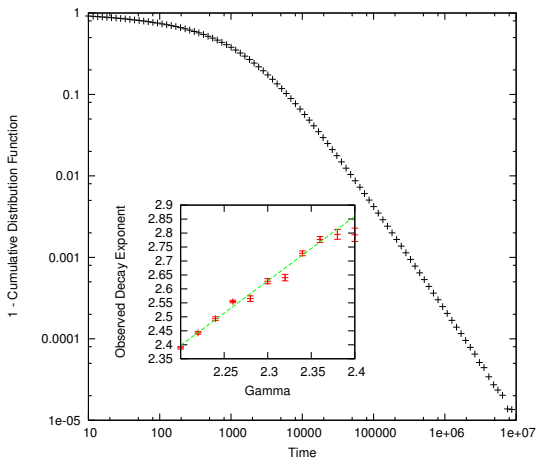
Time picked by the pack leader

$$P(t|N) = (\gamma - 1)Nt^{-\gamma}(1 - t^{1-\gamma})^{N-1}$$



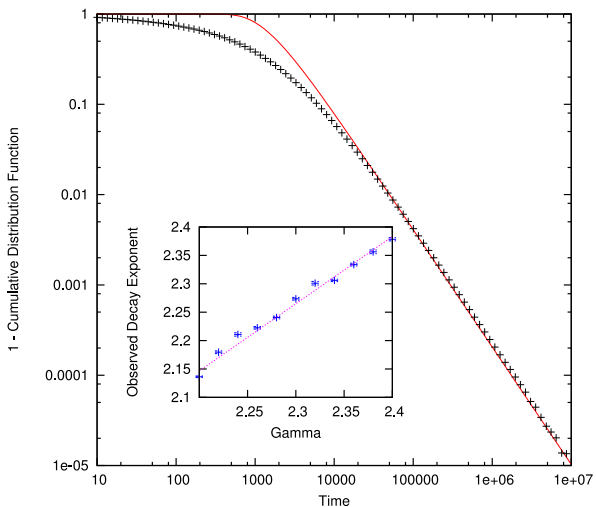
Time picked by packleader from simulations with 5 particles on 500 sites. *Main* Black crosses: Time picked by pack leader, Red line: Fréchet distribution with fitting parameter $n = 13683 \pm 0.3$ *Inset* Blue crosses: Decay parameter observed for a given γ , Pink line: Line of best fit $-0.41 \pm 0.04 + (1.17 \pm 0.02)\gamma$

Clump formation time



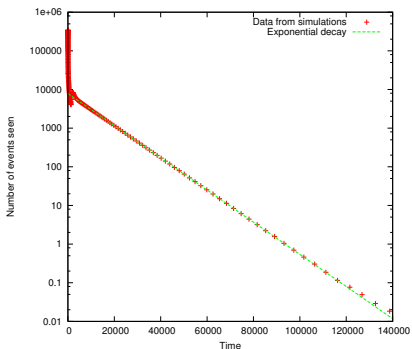
Main Formation time distribution from simulations with 5 particles on 500 sites, $\gamma = 2.3$. *Inset* Red marks: decay parameter from simulations, Green line: Line of best fit $-2.7 \pm 0.2 + (2.3 \pm 0.1)\gamma$

Lifetime of a full clump



Lifetime of a full clump from simulations with 5 particles on 500 sites. *Main* Black crosses: Clump lifetime, Red line: Fréchet distribution with fitting parameter $n = 12973 \pm 2$ *Inset* Blue crosses: Decay parameter observed for a given γ , Pink line: Line of best fit $-0.5 \pm 0.1 + (1.18 \pm 0.04)\gamma$

Interclump time



Time between full clumps from simulations with 5 particles on 500 sites, $\gamma = 2.3$. The exponential is an exponential decay of the form $N(t) = N_0 \text{Exp}[-t/\tau]$ where the fitting parameters are $N_0 = 7829 \pm 3$ and $\tau = 10461 \pm 3$

- Using a waiting time update, we can easily modify the ASEP. We used a power law distributed waiting time.
- This non-Markovian ASEP shows fundamentally different behaviour to the standard ASEP.
- We see a novel spatio-temporal condensate, whose properties are non-trivial.