Scaling limits for the exclusion process with a slow site

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SSEP with a Slow Site

Let η_t be the process with time speeded up by n^2. The emperical measure is defined by

$$\pi_t^n(du) := \frac{1}{n}\sum \eta_t(x)\delta_{x/n}(du). \tag{1}$$

The process has a family of reversible measures $\nu_p, p \in [0,1]$. Density field is defined by

$$\mathcal{Y}_t^n = \frac{1}{\sqrt{n}}\sum \left(\eta_t(x) - E_p[\eta_t(x)]\right)\delta_{x/n}. \tag{2}$$

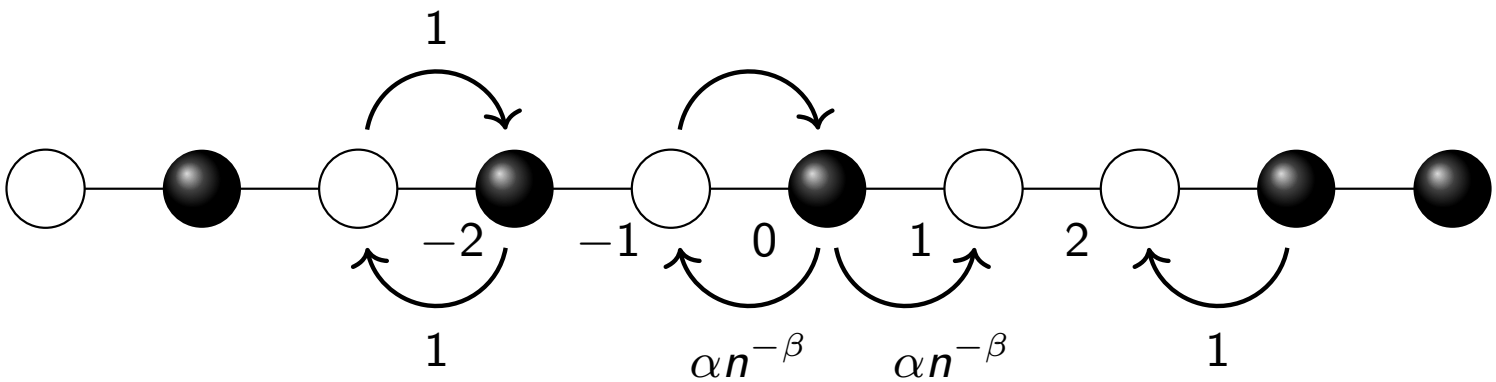

Figure: At most one particle per site. A particle at the origin jumps at a lower rate $\alpha n^{-\beta}$.

Hydrodynamics and Equilibrium Fluctuations

On $\mathbb{T}_n$, Law of Large Numbers, FGMZ, 2019+

If initially, $\pi_0^n(du) \to \rho_0(u)du$ in probability, then for any $t > 0$, $\pi_t^n(du) \to \rho(t,u)du$ in probability, where $\rho(t,u)$ is the heat equation with periodic conditions if $0 \leq \beta < 1$, with Robin boundary conditions if $\beta = 1$, and with Neumann boundary conditions if $\beta > 1$.

On $\mathbb{Z}$, Central Limit Theorems, FGMZ, 2019+

Suppose that the process starts from ν_ρ. Then $\{\mathcal{Y}_t^n, 0 \leq t \leq T\}$ converges to the generalized Ornstein-Uhlenbeck process with the corresponding boundary conditions depending on whether $0 \leq \beta < 1$, $\beta = 1$ or $\beta > 1$.

Remark

The case $\beta > 1$ was proved ealier by the first two authors and G. M. Shütz in 2016.