

Critical dynamical fluctuations in reaction-diffusion processes

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We consider a one-dimensional microscopic reaction-diffusion process obtained as a superposition of a Glauber and a Kawasaki dynamics. The reaction term is tuned so that a dynamical phase transition occurs in the model as a suitable parameter is varied. We study dynamical fluctuations of the density field at the critical point. We characterise the slowdown of the dynamics at criticality, and prove that this slowdown is induced by a single observable, the global density (or magnetisation). We show that magnetisation fluctuations are non-Gaussian and characterise their limit as the solution of a non-linear SDE. We prove, furthermore, that other observables remain fast: the density field acting on the fast modes (i.e. on mean-0 test functions) and with Gaussian scaling converges, in the sense of finite dimensional distributions, to a Gaussian field with space-time covariance that we compute explicitly. The proof relies on a decoupling of slow and fast modes relying in particular on a relative entropy argument. Major technical difficulties include the fact that local equilibrium does not hold due to the non-linearity, and proving replacement estimates on diverging time intervals due to critical slowdown. Joint work with B. Dagallier, Dauphine, France.

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