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Exact correlations in the one-dimensional coagulation-diffusion process by the empty-interval method

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The long-time dynamics of reaction-diffusion processes in low dimensions is dominated by fluctuation effects. The one-dimensional coagulation-diffusion process describes the kinetics of particles which freely hop between the sites of a chain and where upon encounter of two particles, one of them disappears with probability one. The empty-interval method has been a convenient tool for the exact calculation of time-dependent particle densities in this model. We generalize the empty-interval method by considering the probability istributions of two simultaneous empty intervals at a given distance. While the equations of motion of these probabilities reduce for the coagulation-diffusion process to a simple diffusion equation in the continuum limit, consistency with the single-interval distribution introduces several non-trivial boundary conditions which are solved for the first time. In this way, exact space-time-dependent correlation functions can be directly obtained and their dynamic scaling behaviour is analysed for large classes of initial conditions.

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