Spatial-temporal intermittency in equilibrium systems described by Burgers equation

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14 December 2006

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We consider a system described by the one-dimensional Stochastic Burgers equation:

$$u_t + uu_x = \nu u_{xx} + \partial_x \xi(x,t) \tag{1}$$

where ξ is a random pumping short correlated in time and space. Here, $u(x,t)$ is a function of the spatial coordinate x and time t, the parameter ν plays the role of viscosity, and $\xi(x,t)$ is a random short-correlated (in space and time) force with a zero average satisfying Gaussian statistics. This system can be formally considered as equilibrium, and one can show that the probability distribution functional of $u(x,t)$ is Gaussian. In our work we study the different time correlation functions

$$\mathcal{K}(X,t) = \langle u(0,0)u(X,t)\rangle \tag{2}$$

$$T(X,Y,t) = \langle u(0,0)u(Y,0)u(X,t)\rangle \tag{3}$$

$$S(X,Y,\Delta,t) = \langle u(0,0)u(Y,0)u(X,t)u(X+\Delta,t)\rangle \tag{4}$$

in the limit of small time t and large separation X. We find an explicit expression for these correlation functions and show that the system is strongly intermittent: all the correlation have the same exponential asymptotic

$$\mathcal{K}(X,t) \sim T(X,Y,t) \sim S(X,Y,\Delta,t) \sim \exp\left(-\frac{\beta X^3}{3t^2}\right) \ll 1 \tag{5}$$

which means that the fourth order correlation function is much larger than its reducible part.

References

[1] I.V. Kolokolov, K.S. Turitsyn, JETP 94 (6) 1193-1200 (2002)