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One-dimensional hydrodynamic equation generating turbulent scaling laws and self-similar singular solutions[1] TAKASHI SAKAJO, TAKESHI MATSUMOTO, Kyoto Univ — One of the remarkable features of the stochastic laws of fluid turbulence is the emergence of the inertial range in the energy density spectrum on which the energy cascades self-similarly. In the Kolmogorov's theory of fluid turbulence, it is suggested by Onsager that singular solutions of the Navier-Stokes equations in the inviscid limit or the Euler equations that does not conserve the energy play an important role. The existence of energy dissipating weak solution of the Euler equations with 1/3-Hölder continuity has recently been established by Buckmaster et al. Nevertheless, it remains a theoretical challenge to deduce the stochastic laws from such singular solutions. To gain an insight into this problem, we propose a one-dimensional hydrodynamic nonlinear equation based on the Constantin-Lax-Majda-DeGregorio model. The equation admits an invariant quantity and a finite-time blowup solution in the inviscid case, while with the viscous term and a steady forcing, we obtain a singular steady solution in its inviscid limit. In addition, there emerges the inertial range corresponding to the cascade of the inviscid invariant under a random forcing. In the presentation, we provide recent results on the relation between the turbulent stochastic laws and the singular solutions.

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Takashi Sakajo
Kyoto Univ

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