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Intermittency in self-organized shear flows EUN-JIN KIM, University of Sheffield, H.-L. LIU, HAO/NCAR, J. ANDERSON, University of Sheffield — Understanding multi-scale interactions is an outstanding problem in astrophysical plasmas. Despite complex nonlinear dynamics, coherent structures such as shear flows often form from small-scale turbulence, which then feed back on small-scales. A remarkable consequence of this mutual interaction is self-organization, which provides a powerful paradigm for understanding complexity in many systems. In this contribution, we present a novel statistical theory of self-organisation of forced shear flows, modeled by a nonlinear diffusion equation [1]. A non-perturbative method based on a coherent structure is utilized for the prediction of the PDFs, showing strong intermittency with exponential tails. We confirm these results by numerical simulations. The predicted power spectra are also in a good agreement with simulation results. Furthermore, the results reveal a significant probability of supercritical states due to stochastic perturbation. To elucidate a crucial role of relative time scales of relaxation and disturbance in the determination of the PDFs, we present results obtained in a threshold model where the diffusion is given by discontinuous values. Our results highlight the importance of the statistical description of gradients, rather than their average value as has conventionally been done.

[1] E Kim, H-L Liu and J Anderson, Phys. Plasmas, v16, 052304 (2009).
[2] E Kim and J Anderson, Phys. Plasmas, v15, 114506 (2008).

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