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Culmination of the inverse cascade - mean flow and fluctuations

ANNA FRISHMAN, Princeton Center for Theoretical Science, Princeton University, Princeton, New Jersey 08544, USA, CORENTIN HERBERT, Univ Lyon, ENS de Lyon, Univ Claude Bernard, CNRS, Laboratoire de Physique, F-69342 Lyon, France — An inverse cascade–energy transfer to progressively larger scales - is a salient feature of two-dimensional turbulence. If the cascade reaches the system scale, it terminates in the self organization of the turbulence into a large scale coherent structure, on top of small scale fluctuations. A recent theoretical framework in which this coherent mean flow can be obtained will be discussed. Assuming that the the quasi-linear approximation applies, the forcing acts at small scales, and a strong shear, the theory gives an inverse relation between the average momentum flux and the mean shear rate. It will be argued that this relation is quite general, being independent of the dissipation mechanism and largely insensitive to the type of forcing. Furthermore, in the special case of a homogeneous forcing, the relation between the momentum flux and mean shear rate is completely determined by dimensional analysis and symmetry arguments. The subject of the average energy of the fluctuations will also be touched upon, focusing on a vortex mean flow. In contrast to the momentum flux, we find that the energy of the fluctuations is determined by zero modes of the mean-flow advection operator. Using an analytic derivation for the zero mo

Anna Frishman
Princeton Center for Theoretical Science, Princeton University

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