



TOR VERGATA
UNIVERSITÀ DEGLI STUDI DI ROMA

Dipartimento di Fisica



European Research Council
Established by the European Commission

Seminar

Tuesday, 24 October 2023 - h. 14:00

Fisica della Materia room (Department of Physics)

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“A non-equilibrium statistical mechanics perspective on turbulent energy cascade”

Abstract

3D turbulent flows are characterized by an average flow of energy from the large forced scales to the small dissipative ones, a scenario called "direct energy cascade". This behaviour makes them systems out of statistical equilibrium, due to the unbalance between energy currents, and therefore breaks the time-reversal symmetry. On the other hand, (truncated) inviscid flows can be described as dynamical systems in statistical equilibrium, in which there is zero average energy flux and detailed balance holds.

In the present work we aim at characterizing the non-equilibrium properties of turbulent cascades in a 3D shell model of turbulence with tools from non-equilibrium statistical physics, also making comparisons with the results found for the inviscid equilibrium system. We show that anti-symmetric time correlation functions not only discriminate between turbulent and inviscid models, but also provide information on the source of irreversibility: the energy cascade. The study of the average effect of a local energy perturbation on nearby length scales is also performed, and the asymmetric relaxation behaviour observed in the turbulent system is an indicator of the direction of the underlying energy flux. Then, forcing at intermediate scales one obtains a coexistence of both equilibrium and non-equilibrium features in the same model, and our results support the scenario according to which scales larger than the forced ones are in statistical equilibrium.

ERC-2019-ADG Grant N. 882340 “Smart-TURB”

(P.I. Prof. Luca Biferale)

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