



TOR VERGATA
UNIVERSITÀ DEGLI STUDI DI ROMA

Dipartimento di Fisica



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Seminar

Thursday, 11 January 2024 - h. 14:00

Fisica della Materia room (Department of Physics)

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Eindhoven University of Technology

“Pattern formation by turbulent cascades: the case of odd viscosity”

Abstract

We study the influence of non-dissipative viscosity on fluid turbulence. Such viscosity, called odd, Hall or gyro viscosity, can emerge in chiral systems ranging from plasma and bio-active media to quantum fluids. We show that odd viscosity has a tendency to revert the turbulent cascade at a characteristic length scale, leading to a non-dissipative arrest of the kinetic energy transfer and hence accumulation of energy at intermediate scales. We identify this as a paradigmatic example of non-linear pattern formation. The observed phenomenology can be understood from a generalization of the Taylor-Proudman theorem, leading to an interpretation of odd viscosity as an effective, wavenumber dependent rotation, which crucially has a stronger effect at larger wavenumbers, contrary to canonical rotating turbulence. The fundamental consequence, which we unveil using a combination of large scale simulations and scaling theory, is that both direct and inverse energy cascades carry energy to the characteristic intermediate scale, leading to selection of a dominant wavelength in the flow. Beyond odd viscosity, this type of cascade-induced pattern formation may play an important role in several natural systems including atmospheric flows, stellar plasma such as the solar wind, as well as the pulverization of objects or the coagulation of droplets where mass rather than energy cascades.

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(P.I. Prof. Luca Biferale)

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