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Dipartimento di Fisica

Seminar

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Sala Grassano (Dipartimento di Fisica)

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"Blowup as a mechanism responsible for energy cascade and statistical anomaly"

Abstract

Since Kolmogorov proposed his phenomenological theory of hydrodynamic turbulence in 1941, the description of the mechanism leading to the energy cascade and anomalous scaling remains an open problem in fluid mechanics. Soon after, in 1949, Onsager noticed that the scaling properties in the inertial range imply nondifferentiability of the velocity field in the limit of vanishing viscosity. This observation suggests that the turbulence mechanism may be related to a finite-time singularity (blowup) of incompressible Euler equations. However, the existence of such blowup is still an open problem too. In this work, we give a numerical evidence that the blowup indeed represents the driving mechanism of the inertial range for a simplified (shell) model of turbulence. Here, blowups generate coherent structures (instantons), which travel through the inertial range in finite time and are described by universal self-similar statistics. The anomaly (deviation of scaling exponents of velocity moments from the Kolmogorov theory) is related analytically to the process of instanton creation using the large deviation principle.