Plenary-12

Energy fluxes, scale energy and turbulent separation

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Most of the statistical theory of turbulence concerns the mechanisms that sustain turbulent fluctuations against dissipation, namely production of turbulent kinetic, spatial flux of turbulent kinetic energy (Townsend, 1976), and the flux of energy across the different scales of motion (Frisch, 1995). In the classical picture, the energy flux and production are single point statistical observables unable to distinguish between the different scales of motion. On the other hand, the spectrum of turbulent kinetic energy and the spectral balance allow to address each scale of motion separately (Monin & Yaglom, 1971). As a main drawback, the spectral description does not permit to localize in space the energy transfer process, due to projection on non-local Fourier modes. Physical and spectral views were reconciled already in the early stages of turbulent research, when Kolmogorov devised his description of turbulence in terms of structure functions. The implications of his extremely elegant and beautiful theory for inhomogenous and complex flows was not recognized until recently through generalizations to shear dominated anisotropic flows (Casciola, 2003; 2005) and, finally, to generic configurations (Hill, 2002). The present talk will focus on the use of such machinery to understand the flow dynamics from data-bases of either numerical and experimental origin. Beside describing results concerning simple turbulent shear flows, the talk will focus on recent results by the authors, still unpublished at the moment of writing, where the generalized Kolmogorov equation is used to address the dynamics of turbulent separation over complex geometries.

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