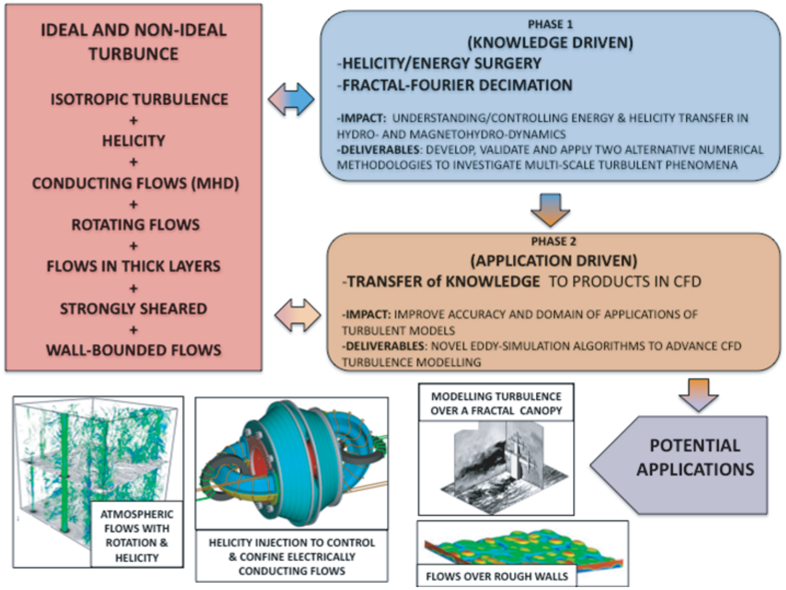

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Παντα ρει

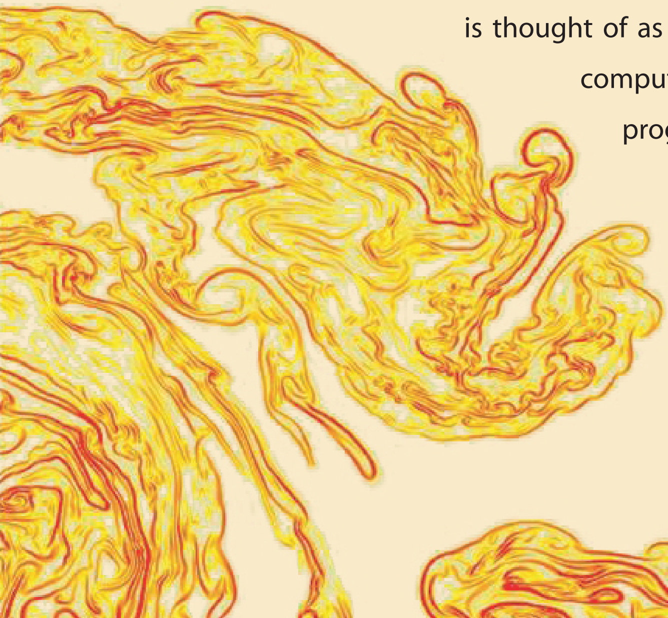
TUTTO SCORRE

AdG 2013
NewTURB

New eddy-simulation concepts and methodologies for frontier problems in TURBulence

Advances in transportation, energy harvesting, chemical processing, climatology, atmospheric and marine pollution are obstructed by the lack of understanding of **turbulence**. The reason is that turbulence underlies all natural and technological flows as soon as mass transport is large. Turbulence is also one of the fundamental problems of classical physics unsolved yet. Consequently, it is incontestable that numerical simulations of turbulent flows are of outstanding importance for the physics community as well as for the engineering community.

The turbulent energy flux across scales can be positive (direct cascade), or negative (inverse cascade). The energy transfer toward small-scales is intermittent, i.e. characterized by highly non-Gaussian and out-of-equilibrium fluctuations that cannot be described by mean-field theories or traditional closure approximations. State-of-the-art computers and algorithms do not allow us to perform brute-force direct numerical simulations of any realistic turbulent configuration, e.g. a direct computation of a flow over the wing of an airplane would require 1016 discretization points: modelling is mandatory. On the other hand, turbulence models are often strongly limited by our lack of understanding of fundamental mechanisms. As a result, we have a deadlock: turbulence is thought of as **'unsolvable'** theoretically and computationally **'intensive'**. Indeed, progress by using conventional methods has been slow.



NewTURB is a laboratory in-silico aimed to disentangle and model turbulence by changing the nature of the non-linear terms of Navier-Stokes equations, aspects otherwise inaccessible by using conventional experimental and numerical methods. NewTURB will additionally investigate the role of symmetries, by breaking first reflection and then rotational invariance, in order to solve the riddle of flows under rotation, in thick layers, or in electrically conducting fluids where the energy/magnetic cascades sometimes are reverted, as in many atmospheric applications or in dynamo production.

The ultimate goal of NewTURB is to integrate this fresh knowledge to go well beyond the current state-of-the-art for turbulence modelling, exploiting the possibility to reduce the number-of-degrees-of-freedom in an innovative way to deliver alternative frontier multi-resolved eddy-simulation methodologies for both unbounded and bounded flows with smooth walls or in a multi-scale heterogeneous landscape.