Seminar

Tuesday, 16 April 2024 - h. 14:30

Fisica della Materia room (Department of Physics)

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"Subcritical transition to elastic turbulence in parallel shear flows"

Abstract

Solutions of long, flexible polymer molecules are complex fluids that simultaneously exhibit fluid-like and solid-like behaviour. When subjected to an external flow, dilute polymer solutions exhibit elastic turbulence - a unique, chaotic flow state absent in Newtonian fluids, like water. Unlike its Newtonian counterpart, elastic turbulence is caused by polymer molecules stretching and aligning in the flow, and can occur at vanishing inertia. While experimental realisations of elastic turbulence are well-documented, there is currently no understanding of its mechanism.

In this talk we will review our recent progress in identifying the mechanism of elastic turbulence in pressure-driven flows through straight channels. Using large-scale direct numerical simulations of such flows we demonstrate that the transition to elastic turbulence is sub-critical, giving rise to spot-like flow structures that, further away from the transition, eventually spread throughout the domain. Furthermore, phase-space projections using suitable observables suggest that the dynamics are organised by the presence of invariant solutions to the equations of motion. In summary, our numerical results produce circumstantial evidence suggesting that the transition to elastic turbulence proceeds in a similar way as the transition to turbulence in Newtonian parallel shear flows, that is, mediated by exact unstable solutions of the equations of motion.