Fachbereich 4
Produktionstechnik
Maschinenbau &
Verfahrenstechnik

CENTER OF
APPLIED SPACE TECHNOLOGY
AND MICROGRAVITY
ZARM

Fluids and Space Engineering Seminar

Date: Wednesday, October 30, 2019 at 13:00
Location: ZARM, Room 1730

Elasto inertial turbulence and the MDR state of polymer drag reduction

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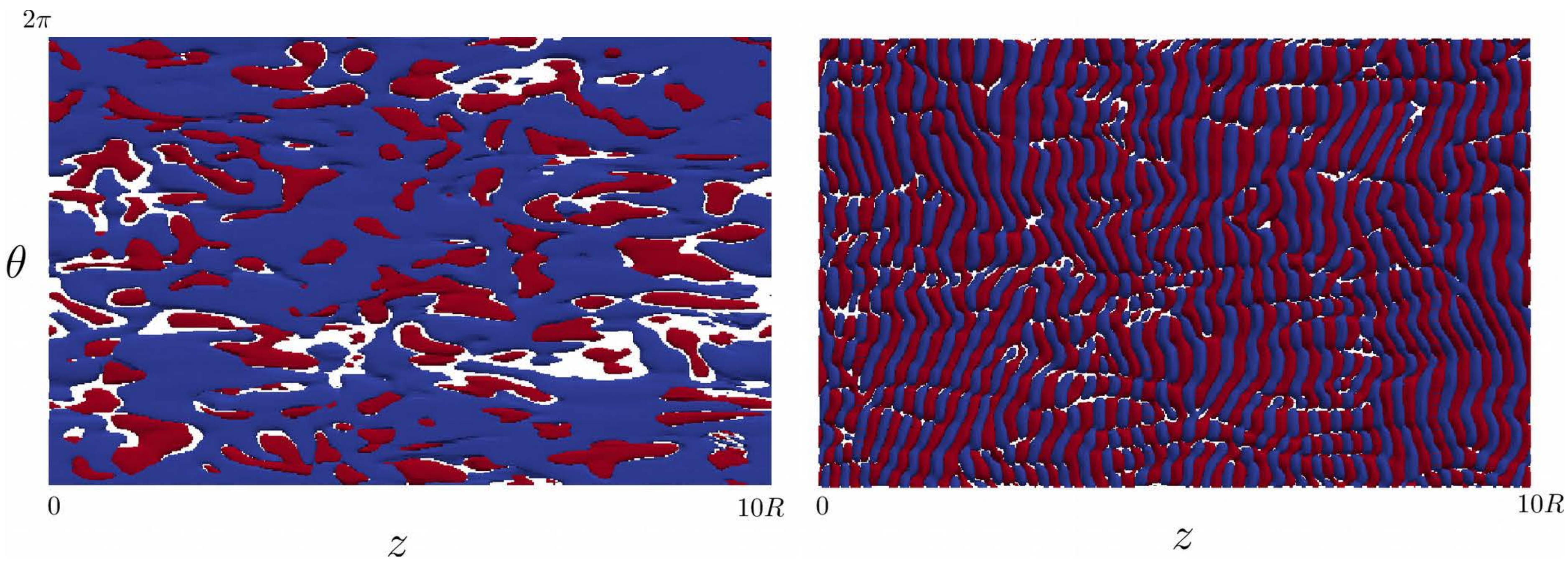

Near wall turbulent structure for Newtonian dominated turbulence (a) and elasto-inertial turbulence (b) illustrated through isosurfaces of the second invariant of the velocity gradient Q = -0.005 (blue) and Q = 0.005 (red).

The drag of turbulent flows can be drastically decreased by addition of small amounts of high molecular weight polymers. While drag reduction initially increases with polymer concentration, it eventually saturates to what is known as the maximum drag reduction (MDR) state. Surprisingly, MDR is insensitivity to the polymers and solvent used, a feature that is generally attributed to the dynamics being reduced to a marginal yet persistent state of subdued turbulent motion. In this seminar, I will present a body of numerical and experimental evidence that challenges this commonly accepted view and suggests that the universality of MDR is instead connected to a new type of turbulence, dubbed elasto-inertial turbulence (EIT), which fully replaces Newtonian-like turbulence in viscoelastic parallel shear flows. Distinctive structural and statistical features of EIT as compared with ordinary Newtonian turbulence will be discussed (see Fig. 1). While it is known that EIT arises from a viscoelastic flow instability (VFI), the nature of this instability is still unclear. I will discuss potential mechanisms that might cause this VFI and show recent experiments by our group suggesting that EIT might be the result of a supercritical transition scenario. Finally, if the time permits, I will also discuss a novel turbulent drag reduction strategy based on flow rate control which has been recently proposed by our research group.