Pole vaulting of long fibres in a turbulent wall-bounded flow

Christophe Brouzet[a], Jérémie Bec[b], and Christophe Henry[c]

a *Institut de Physique de Nice, Université Côte d'Azur, CNRS, France*
b *Center for Material Forming (CEMEF UMR7635 CNRS–MINES ParisTech), France*
c *Inria d'Université Côte d'Azur, France*

Keywords: turbulence, multiphase flows, anisotropic particles, fluid-structure, interactions, elasticity, wall-bounded flows

The dynamics of flexible fibres in wall-bounded turbulent flows is a topic of great concern in various fields, such as environmental science, pharmaceutical or pulp and paper industries. The transport and orientation of fibres in wall-bounded turbulent flows have been extensively studied in the past decades, but mainly for rigid and short fibres. I will present recent results on the transport of long flexible fibres in a turbulent channel flow, obtained through direct numerical simulations. These fibres sample non-linear variation of the fluid velocity along their length. As they rotate and collide with the boundaries, they bounce off with an impulse that propels them toward the center of the flow, similar to pole vaulting. As a result, the fibres migrate away from the walls, leading to depleted regions near the boundaries and more concentrated regions in the bulk. These higher concentrations in the center of the channel result in a greater net flux of fibres than what was initially imposed by the fluid. This effect becomes more pronounced as fibre length increases, especially when it approaches the channel height. I will also describe an experimental setup currently under construction to address this problem experimentally.