Transport of Long and Flexible Fibres in Turbulence

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Résumé

Turbulent flows laden with complex-shaped objects arise in contexts ranging from the paper-making industry to phytoplankton in the ocean. Notably, microplastics observed in marine environments have been reported to exhibit a fibre-like morphology with varying flexibilities, highlighting the importance of understanding the interaction between elongated, deformable objects and turbulent flows. Yet, the impact of deformability and aspect ratio on the transport properties of such objects in turbulence remains poorly understood.

We explore the dynamics of long, flexible fibres in homogeneous isotropic turbulence by means of Direct Numerical Simulations, and adopt the slender-body approximation to describe fibre motion, neglecting both fibre inertia and its back-reaction on the flow. We focus on single-fibre velocity and acceleration statistics to disentangle how length and flexibility affect correlations, mean values, and fluctuations, and compare our results with the case of rigid rods.

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