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Helical Instability of an Eccentric Coated Fiber SHAHAB EGHBALI, LUDOVIC KEISER, EDOUARD BOUJO, FRANOIS GALLAIRE, Laboratory of Fluid Mechanics and Instabilities, EPFL — We study the destabilization of a gravity-driven viscous flow coating a vertical fiber. Numerous studies have focused on the transition of a liquid thread into a downward traveling train of beads along a fiber, a phenomenon known as Rayleigh-Plateau instability, in the limit of small Bond numbers, Bo, where the surface tension dominates over gravity. We here explore the limit of large Bo, i.e. centimetric radial sized liquid column. The experiments are carried out using highly viscous silicone oils to focus on inertialess flows (large Ohnesorge number, Oh). We observe the formation of a helical interface, coiling around the thin fiber, in this limit of high Oh and Bo. We address theoretically the physical mechanism underlying the observed interface coiling and its associated geometric and hydrodynamic thresholds, by means of the linear stability analysis of a unidirectional flow along a rigid eccentric fiber. The asymmetry of the drainage velocity (shear distribution) above a certain threshold induces coiling. Overall, small fiber radius and large eccentricity tend to promote the coiling of the interface ($m = 1$ modes), while reducing Bo tends to preserve an axisymmetric interface ($m = 0$ modes). We will compare the predictions of our model with experimental results.

Franois Gallaire
Laboratory of Fluid Mechanics and Instabilities, EPFL

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