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Curling dynamics of naturally curved ribbons from high to low Reynolds numbers[1] OCTAVIO ALBARRAN ARRIAGADA, GLADYS MASSIERA, MANOUK ABKARIAN, Laboratoire Charles Coulomb Université Montpellier 2-CNRS — Curling deformation of thin elastic sheets appears in numerous structures in nature, such as membranes of red blood cells, epithelial tissues or green algae colonies to cite just a few examples. However, despite its ubiquity, the dynamics of curling propagation in a naturally curved material remains still poorly investigated. Here, we present a coupled experimental and theoretical study of the dynamical curling deformation of naturally curved ribbons. Using thermoplastic and metallic ribbons molded on cylinders of different radii, we tune separately the natural curvature and the geometry to study curling dynamics in air, water and in viscous oils, thus spanning a wide range of Reynolds numbers. Our theoretical and experimental approaches separate the role of elasticity, gravity and hydrodynamic dissipation from inertia and emphasize the fundamental differences between the curling of a naturally curved ribbon and a rod described by the classical Elastica. Our work shows evidence for the propagation of a single instability front, selected by a local buckling condition. We show that depending on gravity, and both the Reynolds and the Cauchy numbers, the curling speed and shape are modified by the large scale drag and the local lubrication forces.

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