The shapes of rainbow twirlers

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The rainbow twirler is a set of slender ribbons connected to the top of a stick and to a slider free to translate and rotate about the stick. Beyond its colors, this toy shows interesting static and dynamic shapes (fig. 1).

We first focus on the static shapes of the ribbons sagging under gravity. Then, the effect of a constant rotation about the toy's axis is studied. The experimentally observed rotation-invariant shapes are well predicted by numerical solutions of the Kirchhoff equations [1]. The shapes are parameterized by dimensionless numbers comparing the effects of gravity and bending stiffness on the one hand, and centrifugal forces and bending stiffness on the other hand.

Finally, we explore the dynamics of this system under oscillatory forcing. Hopping and torsion modes are observed. The corresponding new time-dependent and complex shapes of the ribbons are observed and qualitatively described.

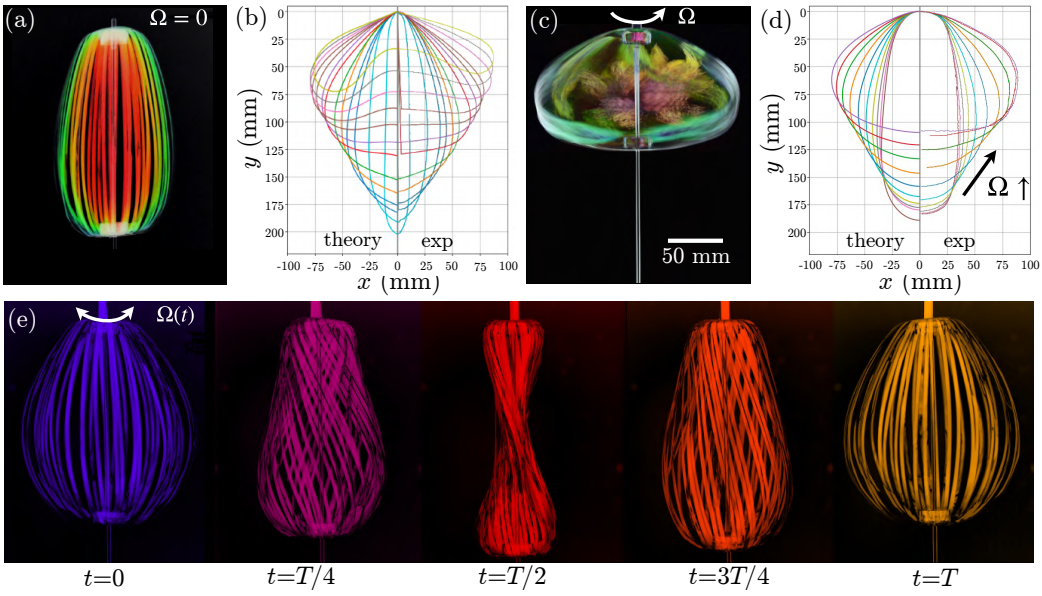

Figure 1. (a) Static rainbow twirler with an elasto-gravity number of order unity and (b) comparison of the numerical (left) and experimental (right) shapes of ribbons for different values of the top to bottom distance. (c) Rotating twirler with elasto-gravity and rotation-gravity numbers of order unity and (d) corresponding numerical and experimental shapes. (e) Snapshots of an oscillating twirler over one period.

Références

1. B. Audoly and Y. Pomeau, *Elasticity and Geometry*, Oxford University Press (2010).