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Laboratoire PMMH
10 rue Vauquelin, 75231 Paris Cedex 05

Séminaire PMMH

Bureau d'Études, Bâtiment L, 2 ème étage

Vendredi 13 juin 2014, 11h00-12h00

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Morphological instabilities of a stretched twisted ribbon

Finding strategies toward developing functional shapes at smaller and smaller scales has been a focus of intense research in elastic materials. Our investigations show that a wide variety of shapes and instabilities can be obtained by simply varying the applied twist and tension [1]. Due to its geometry which is intermediate between rod and plate, a ribbon can coil and form loops but wrinkles and stress localization can also been seen yielding a surprisingly rich variety of shapes. Using the twist angle, the tension, the thickness and the length as control parameters, the various configurations including longitudinal and transverse wrinkling, and creasing can be rationalized in a 4D phase diagram. We show that this experimental phase diagram can be quantitatively explained using a theoretical framework based on (i) a covariant form of the Föppl-von Kàrmàn equations which is necessary to obtain the correct stress field ; and (ii) a far from threshold analysis which describes a longitudinally-wrinkled state with negligible compression [2]. Our study has both impact on fundamental theory of thin elastic materials [3] and development of smart, reliable, and efficient strategy to build complex structures starting with graphene sheets, and flat semiconductor nanoribbons and biomaterials.

[1] J. Chopin and A. Kudrolli, Phys. Rev. Lett. 111, 174302 (2013), URL : http ://journals.aps.org/prl/abstract/10.1103/PhysRevLett.107.208304
[2] J. Chopin, V. Démery, and B. Davidovitch, ArXiv e-prints, 1403.0267 (2014), URL : http ://arxiv.org/abs/1403.0267
[3] C. Santangelo, Journal Club for Condensed Matter Physics (2014), URL : http ://www.condmatjournalclub.org/ ?p=2330

Prochain séminaire : Vendredi 20 juin, 11h00-12h00, Michael L. Falk (Johns Hopkins University)
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