LadHyX Seminar – May 25, 10:45 – LadHyX library

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How viscous bubbles collapse: a peephole into geometrically-nonlinear and topologically-nontrivial hydrodynamics

Floating viscous bubbles whose interior gas is rapidly depressurized exhibit a fascinating instability, whereby radial wrinkles permeate the liquid film in the course of its flattening (Debregeas et al, Science 1998; DaSilviera et al., Science 2000, Oratis et al., Science 2020). We show that this instability emerges from a largely unexplored type of Stokes hydrodynamics, that is geometrically-nonlinear flow of curved,volumetrically-incompressible films. This theoretical framework highlights profound similarities and differences between the mechanics of elastic sheets and viscous films, revealing the experimental observations of Oratis et al. as a universal, curvature-driven surface dynamics, imparted by viscous resistance to temporal variations of the surface's Gaussian curvature. This novel surface dynamics has close ties to the kinetics of first-order phase transitions and to "Jelium physics" in continuum media, where topological defects, akin to charges in electrostatic media, spontaneously emerge to screen stress within the film.