PHYSICAL MATHEMATICS SEMINAR

Instabilities and Morphological Phases of Stressed Elastic Membranes

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ABSTRACT:

Crumpled papers, wrinkled skins, and buckled plant leaves are few familiar examples of the rich variety of patterns that elastic membranes may exhibit under various constraints. One may ask: Does a morphological "phase space" exist, according to which the many possible membrane patterns are classified? What are the *relevant* parameters that determine whether a complicated distribution of forces gives rise to a smooth shape (e.g. periodic wrinkles) or to an irregular one, characterized by localized ridges and vertices (e.g. crumpled sheets) ?

In this talk I will address these questions, by focusing on an elementary case: highly-symmetric membrane (homogenous, isotropic, of rectangular shape) that is buckled under uniaxial compression. I will show that a surprisingly rich "phase diagram" of distinct morphologies is spanned by a pair of dimensionless parameters that encapsulate the *relevant* constraints: The mechanical parameter (ε) is the ratio between compression and tension in the orthogonal direction, and the geometric parameter (ν) is a wavelength-contrast that quantifies the deviation from an ideal one-dimensional shape along the tension direction. In particular, a novel series of "period fissioning" instabilities at $\varepsilon \ll 1$ is shown to underlie a recently-discovered phenomenon: A smooth cascade of wrinkles, in uniaxialy-compressed membranes, floating on liquid and subject to large interfacial tension.

TUESDAY, MARCH 3, 2009
2:30 PM
Building 2, Room 105

Refreshments at 3:30 PM in Building 2, Room 349
(Applied Math Common Room)

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