Carnegie Mellon
Materials Science and Engineering Seminar Series

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"Spheres, doughnuts, pretzels and frustrated nematic order"

Friday, January 20, 2011
11:30AM Seminar in Wean Hall 7500

Ordered materials on curved spaces often have topological defects in their ground states. The north and south poles of the Earth's globe and the pentamers of the soccer ball provide familiar realizations of this fact. When the order is nematic and the space is a spherical shell, a variety of defect structures is observed; these all comply with the topological constraints imposed by the spherical geometry. Our experimental results and elastic energy calculations suggest that it is the shell thickness inhomogeneity what controls the defect location in this case. For topologies different from the spherical, the defect structures are expected to be different than those observed in spheres. Motivated by this, we have generated and stabilized non-zero genus droplets and have recently began to look at the ordering when a nematic liquid crystal lives inside these non-spherical spaces.

Our laboratory studies the physics of soft materials with a focus on the connection between microscopic order and macroscopic properties. The underlying theme is to pursue basic understanding and address fundamental questions. However, we also address applied problems and pursue industrial collaborations since many of the materials we study can be viewed as model systems for those that are often used in applications. Current projects include (i) studying the phase behavior and properties of packed soft objects, (ii) understanding the consequences of confinement and curvature over the equilibrium states of ordered materials, which in many cases require the existence of topological defects in their ground states, and (iii) developing microfluidic techniques to study fundamental fluid mechanic questions and to generate new materials through directed assembly and mixing of the components.