



Fay Ajzenberg-Selove Colloquium

Friday, February 18, 2011 • 4:00 P.M. • 2241 Chamberlin Hall

Coffee & Cookies Served at 3:30 p.m

Monica Olvera de la Cruz

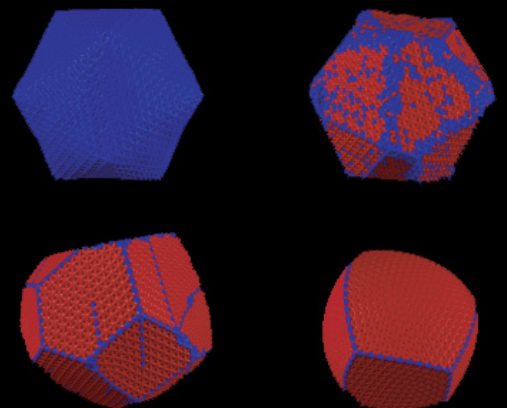
Northwestern University

Host: Gilbert

Regular and Irregular Polyhedra in Multi-Component Crystalline Shells

Department of Physics Colloquium

The captivating charm of uniform convex polyhedra such as Platonic and Archimedean solids has beguiled scientist, philosophers, and artists for millenia. In our modern era, it is incorporated in the revolutionary Descartes' geometrization of nature, and still reflects the common practice of introducing esthetic elements in physical sciences. While mathematicians have rigorously captured the "morphological essence" of such highly regular polytopes by classifying and formalizing their symmetries and isometries, the search of such structures in the realm of nature has been rather elusive. Icosahedral shapes, among all Platonic polyhedrals, have been identified in molecular elastic shells such as large viral shells or fullerenes. We demonstrate that other geometries, including some Archimedean polyhedrals, arise spontaneously in shells formed by more than one component. We study the buckling of an elastic shell with two coexisting elastic components, at different relative concentrations. By using theoretical arguments and numerical simulations we find various polyhedra and n-gonal hosohedra shapes. Our work explains the principles to design various hollow polyhedra and the existence of the regular and irregular polyhedra shells recently observed in organelles. Our analysis suggests that these polyhedral shapes are ubiquitous in cellular shells and in closed elastic membranes made of various proteins. We provide experimental evidence of the spontaneous buckling phenomena in shells made of mixtures of cationic and anionic amphiphiles, where electrostatics drives their co-assembly, and orders the assembly into faceted ionic structures.



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