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Deformation and stability of lipid membranes in electric fields

PETIA VLAHOVSKA, Brown University

The challenges and recent advances in the theoretical modeling of lipid membrane dynamics in electric fields will be overviewed. Vesicle shapes and the stability and poration of lipid bilayers will be discussed in relation to the complex electromechanics of membranes: First, the lipid membrane is an insulating shell impermeable to ions. Second, it is essentially a two-dimensional incompressible-fluid sheet; under stress lipid membranes store elastic energy in bending, while membranes made of cross-linked polymers are more likely to be stretched and sheared. Third, lipid membranes are extremely soft and they are easily bent by the thermal noise. I will show how the dynamical coupling of interface charging, membrane deformation, lipid density redistribution, and fluid motion gives rise to rich and sometimes surprising behavior of lipid membranes in electric fields.