Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Stability of a Lipid Bilayer Membrane Subjected to a DC Electric Pulse JONATHAN SCHWALBE, Northwestern University, PETIA VLAHOVSKA, Dartmouth College, MICHAEL MIKSIS, Northwestern University — An analytical theory is developed to study the dynamics of a lipid bilayer membrane subjected to a DC electric pulse. The thin lipid membrane is impermeable to ions and thus acts as a capacitor. The model consists of conservation of current, which obeys Ohm's law, and the Stokes equations to describe fluid motion. The effects of membrane fluidity and incompressibility, variations in lipid density along the monolayers, and resistance to bending are taken into account. Small amplitude perturbations of a planar membrane are considered. The result is a time dependent system of equations for the growth rate as a functions of wave number. Variation of the applied voltage and a difference in the conductivities of the bulk fluids yield a long-wave instability in the system. The theory highlights that the membrane charging time is critical for the instability. Our theoretical findings are relevant to understanding the physical mechanisms of electroporation of biomembranes.

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Date submitted: 30 Jul 2009 Electronic form version 1.4