Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Ellipsoidal relaxation of electrodeformed vesicles MIAO YU, HAO LIN, Department of Mechanical and Aerospace Engineering, Rutgers, The State University of New Jersey, RAFAEL LIRA, RUMIANA DIMOVA, Department of Theory and Bio-Systems, Max Planck Institute of Colloids and Interfaces, KARIN RISKE, Department of Biophysics, Federal University of Sao Paulo — Electrodeformation has been extensively applied to investigate the mechanical behavior of vesicles and cells. While the deformation process often exhibits complex behavior and reveals interesting physics, the relaxation process post-pulsation is equally intriguing yet less frequently studied. In this work theoretical analysis and experimental quantification on the ellipsoidal relaxation of vesicles are presented, which reveal the simplicity and universal aspects of this process. The Helfrich formula, which is derived only for equilibrated shapes, is shown to be applicable to dynamic situations such as in relaxation. A closed-form solution is derived which predicts the vesicle aspect ratio as a function of time. Scattered data are unified by a timescale, which leads to a similarity behavior, governed by a distinctive solution for each vesicle type. Two separate regimes in the relaxation are identified, namely, the "entropic" and the "constant-tension" regime. The bending rigidity and the initial membrane tension can be simultaneously extracted from the data/model analysis, posing the current approach as an effective means for the mechanical analysis of biomembranes.

Miao Yu
Department of Mechanical and Aerospace Engineering,
Rutgers, The State University of New Jersey

Date submitted: 31 Jul 2015 Electronic form version 1.4