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Poking vesicles in silico[1] BEN BARLOW, MARTIN BERTRAND, BELA JOOS, University of Ottawa, Canada — The Atomic Force Microscope (AFM) is used to poke cells and study their mechanical properties. Using Coarse-Grained Molecular Dynamics simulations, we study the deformation and relaxation of lipid bilayer vesicles, when poked with a constant force. The relaxation time, equilibrium area expansion, and surface tension of the vesicle membrane are studied over a range of applied forces. The relaxation time exhibits a strong force-dependence. Our force-compression curves show a strong similarity with results from a recent experiment by Schafer et al. (Langmuir, 2013). They used an AFM to "poke" adherent giant liposomes with constant nanonewton forces and observed the resulting deformation with a Laser Scanning Confocal Microscope. Results of such experiments, whether on vesicles or cells, are often interpreted in terms of dashpots and springs. This simple approach used to describe the response of a whole cell —complete with cytoskeleton, organelles etc.— can be problematic when trying to measure the contribution of a single cell component. Our modeling is a first step in a "bottom-up" approach where we investigate the viscoelastic properties of an in silico cell prototype with constituents added step by step.

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