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Relaxation of a Simulated Lipid Bilayer Vesicle Compressed by an AFM

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The Atomic Force Microscope (AFM) lets us reach out and touch cells, on force and length scales native to them. But what *physically* happens when the AFM's tip touches a cell? The membrane is a first point of contact, and that is why we begin by studying vesicles —cell membranes laid bare. Using Coarse-Grained Molecular Dynamics simulations, we study the relaxation of uniaxially compressed bilayer vesicles. The relaxation time exhibits a strong force-dependence. This suggests that the results of the widely used AFM probe are greatly dependent on the manner in which the tip is applied to a vesicle.
We explain the strong force dependence of the relaxation time in terms of the undulations present in lipid bilayers, and can fit our simulations with the results of an attractive theory developed by Helfrich and Servuss. Force-compression curves are very similar to recent experiments wherein giant unilamellar vesicles were compressed in a nearly identical manner.

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