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Stochastic fluctuations of vesicles – Extracting material parameters from incomplete projected information

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The mechanical properties of phospholipid membranes have been extensively studied over the past few decades [1]. Their ability to bend under very low stress is one of the main mechanical properties of such soft materials. This softness is characterized by a very small value of the bending modulus (on the order of 10 k_BT). As a result, a flaccid vesicle can attain many thermally allowed shapes at constant volume, which leads the thin-walled vesicles to fluctuate (the so-called flicker phenomenon) [1].

Measurements of these stochastic fluctuations have been used to estimate the bending modulus of red blood cells and artificial vesicles [2, 3, 4]. Here, we re-examine this methodology and discuss some of its limitations; e.g., video-microscopy gives only partial information in the sense that it provides a two-dimensional view of the three-dimensionally fluctuating vesicle. In order to overcome this technical limitation, we develop two new possible methods for inferring mechanical information about membranes from the projected intensity of fluorescent quasi-spherical vesicles.

References

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