

Dynamics in a membrane with immobile inclusions

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A membrane is a fluid bilayer of lipid molecules, used for various functions in nature, e.g., isolating the cell from the outer environment. We model a bare membrane as a two-dimensional liquid surrounded by a three-dimensional one [1]. Biological membranes contain a high concentration of inclusions, e.g., membrane proteins or domains. We investigate the hydrodynamic response of a membrane containing a finite area fraction of immobile inclusions, mimicking, for example, membrane proteins bound to the cytoskeleton. In response to a force, momentum would either spread within the plane of the membrane, propagate through the outer liquid, or get lost to the immobile particles. In the last of these three regimes, taking place at sufficiently large distances, momentum conservation is violated, and the membrane behaves similar to a fluid in a porous matrix. We calculate the decrease of the corresponding screening length with increasing area fraction of immobile inclusions.

[1] N. Oppenheimer and H. Diamant, Biophys. J. 96, 3041 (2009)