Nanodroplets at interfaces and membranes: Line tension effects

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Nanodroplets in contact with interfaces and membranes are affected by the line tension of the three-phase contact line. It is generally agreed that the magnitude of this tension is of the order of 10^{-11} N, but its sign is still a matter of debate. In addition, little is known about the wetting and nucleation behavior of nanodroplets at deformable substrates such as membranes and vesicles.

In this study, we use molecular simulations to study the effect of line tension on the behavior of nanodroplets at lipid bilayers. These nanodroplets are stable provided the interfacial tension exceeds a certain threshold value. The membrane is observed to engulf the nanodroplet, thereby forming a membrane bud, in order to reduce the area of the liquid-liquid interface. For relatively large membrane tension, the droplet-induced membrane bud has an axisymmetric shape, see Fig. 1a, which becomes, however, non-axisymmetric for low values of the membrane tension, see Fig. 1b. [1] To understand this unexpected breaking of axial symmetry, we studied the force balance along the contact line [2] from which we obtained a *negative* value of the line tension. This negative line tension provides the driving force for the non-axisymmetric bud shape.

We now apply our approach to simpler systems as provided by liquid lenses between two bulk phases, see Fig.1c. In such geometry, the line tension can be measured via deviations from Neumann's triangle [3]. We use this setup to understand the parameter dependence of the line tension and of the associated force balance along the contact line.

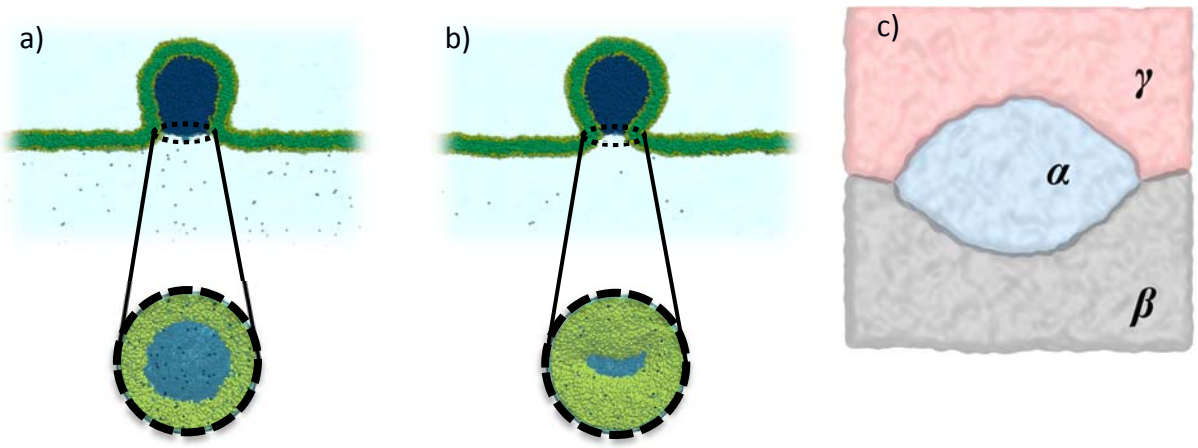

Figure 1. (a,b) Cross-section of a nanodropet adhering to a membrane (a) under high and (b) under low mechanical tension. The membrane is axi-symmetric and non-axisymmetric in (a) and (b), respectively; and (c) Cross-section of a liquid lens α between two bulk liquid phases β and γ.

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