STABILITY OF THE TUBULAR LIPID MEMBRANES WITH NONZERO SPONTANEOUS CURVATURE PULLED FROM THE VESICLES

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In the present work we perform a theoretical analysis of experiments with tubular lipid membranes (TLMs), in which lipid tubes are pulled from lipid vesicles and stabilized by the action of proteins or amphiphilic polymers [1,2]. Polymers insert into the outer layer of lipids and thus change the spontaneous curvature of the lipid bilayer. As a result such TLMs with nonzero spontaneous curvature become stable even in the absence of any external pulling force.

Proposed model of a joint equilibrium of the TLM and the vesicle takes into account spontaneous curvature of the TLM bilayer, its surface tension and pressure difference between inner and outer medium of the system. We establish the stability region of individual TLM with respect to the effective dimensionless parameters $\langle \alpha_C, \alpha_F \rangle$ (normalized spontaneous curvature and normalized pulling force accordingly). Joint stability analysis of the vesicle and the TLM which was pulled from it shows that equilibrium states of the complex system form a line in $\langle \alpha_C, \alpha_F \rangle$ space. The equilibrium of the system is limited by the point of Euler-type instability. In the vicinity of this point in the TLM two modes with different symmetry become unstable simultaneously. In the present work we also show that such critical behavior can be investigated experimentally.

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References

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