

Preface

In this work we analyse aspects of dynamics and organization of biological membranes from a physical prospective. We provide an analysis of the process of self-assembly and spatial organization of membrane proteins. We illustrate the analysis by considering a channel activated by membrane tension called mechanosensitive channels (MS), in *E. coli* and the twin arginine translocation system (Tat).

We analyse the mechanism of formation of oligomeric protein complexes formed by identical subunits. By derivation of a mathematical approach based on Smoluchowski coagulation equation, we study the efficiency of the process of complex formation, taking into account both irreversible aggregation, as well as fragmentation. We find that a small fragmentation rate increases the efficiency of the formation process, however if the fragmentation rate vanishes the irreversible process is very inefficient.

Our second aim is to determine how the spatial organization can affect the function of channels, which are regulated by elastic forces. We map these short-range interactions into a discretized system, from which we obtain the spatial distribution of the channels and its effect on the gating dynamics. We find that organized channels activate at lower membrane tensions, but possess a delay in the reaction time.

In the last part we determine how the formation of transient pores on the membrane depends on the dynamics of its assembly process. We analyse the pores formed by the Tat complex, which is responsible for protein transport through the membrane. This system functions by polymerization in response to a signal of transport demand from a protein in the cell cytoplasm. The direct correlation of the size of the assembled pore and the size of the protein determines the speed of the translocation process. Using a differential equation approach we obtain that the flux of a given protein depends quadratically on its size.

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