Lipids diffusion anomalies in bilayer membranes at main phase transition

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The diffusion coefficient jump by an order of magnitude at the liquidgel phase transition in the lipid membranes so far was missing theoretical description. Rattling in the cage microscopic mechanism of lipids self-diffusion responsible for the jump is captured by our microscopic model. We found analytically temperature dependencies of the major thermodynamic characteristics of the lipid membranes including diffusion coefficient, membrane thickness, volume per lipidmolecule. Dependence of phase transition temperature on lipid chain length is in quantitative agreement with experimental data.

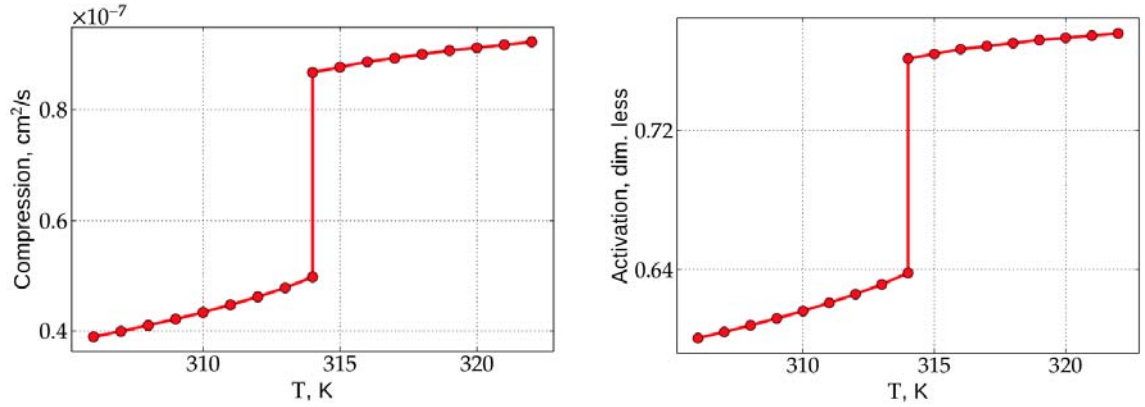

Figure 9: Separately plotted compression (left) and activation (right) factors contributions to the self-diffusion coefficient Eq.(1). At phase transition compression changes by two times, whereas activation contribution is relatively less pronounced All results are calculated using our previously developed microscopical model [1]-[3].

$$D = \underbrace{D(A_n)\exp\left(-\frac{A_n}{A-A_n}\right)}_{compression}\cdot\underbrace{\left(1+\frac{E_a}{k_BT}\right)\exp\left(-\frac{E_a}{k_BT}\right)}_{activation} \qquad (1)$$

References

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[3] Mukhin S.I. and Baoukina S.V.: *Analytical derivation of thermodynamic characteristics of lipid bilayer from flexible string model*, Phys. Rev. E, **71**, 061918-6 (2005).