The mechanics of osmotic pressure

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Level: M2

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Scientific context

Is osmotic pressure a mechanical pressure? Osmotic pressure being the driving force of molecular fluxes through semi-permeable membranes, whether they are in our cells or in blue energy power plants, how it deforms a membrane is a fundamental yet unanswered question [1, 2].

The aim of this project is to elucidate the mechanical nature of osmotic pressure. To this end, we will experimentally measure the deformations of a soft semi-permeable membrane under an osmotic flux (Fig. 1A). Based on preliminary results, we will engineer hydrogel semi-permeable membranes seeded with nanotracers in microfluidic chips, and quantify material displacements with confocal imaging techniques [3] (Fig. 1B). Beyond bringing fundamental insight into soft membranes, we expect this project will have far-reaching implications in the fields of biophysics and polymer physics.

Outlooks You will be using state of the art imaging and numerical analysis tools, and the expected results are likely to be published in a peer-reviewed international journal. The opportunity to continue as a Ph.D. student can be considered and will require a funding application.

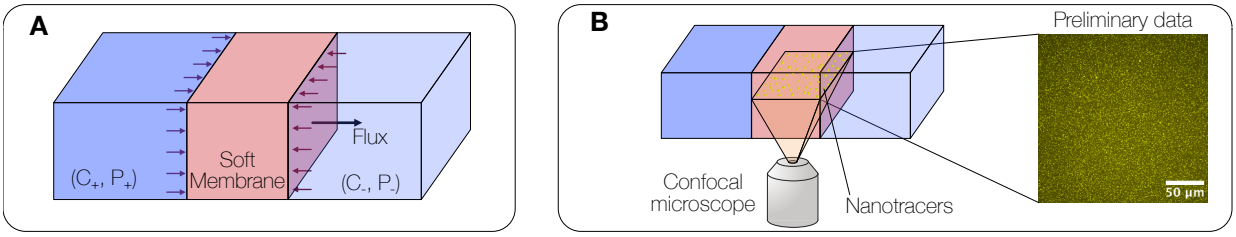

Figure 1: Project overview (A) Concentration differences between two sides of a membrane create a pressure difference and a net flux. (B) We will use micromechanics experiments to measure deformations inside a soft membrane.

Bibliography

[1] G. S. Manning and A. R. Kay. en. 2023.
[2] S. Marbach and L. Bocquet. en. *Chemical Society Reviews* (2019).
[3] N. Bain et al. *arXiv preprint arXiv:2410.09158* (2024).