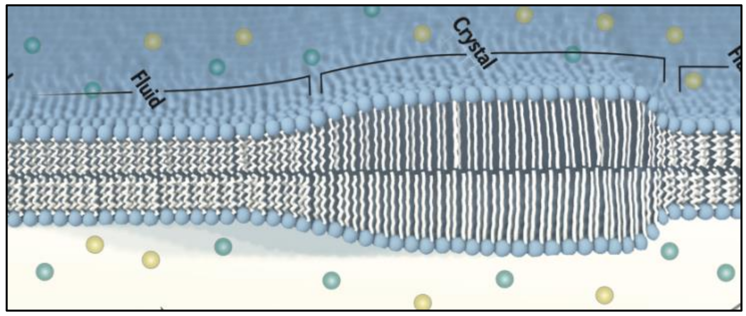
Longitudinal electromechanical pulses and their interactions near phase transitions



Fox, Sci Am, 2018

Short background: The superposition principle fails when a system approaches a phase transition, leading to the emergence of novel nonlinear properties in sound. Evidence suggests that phenomena such as wave-wave interactions may manifest in this regime. Interestingly, longitudinal pulses in lipid membranes that cross a phase transition reversibly exhibit striking similarities to action potentials – electric pulses that propagate along the lipid membrane of excitable living cells.

The goal of this project is to study and clarify the physical mechanism involved in these nonlinearities using theoretical and computational modeling that relies on physicochemical properties of the system. The work will include a collaboration with the research group of Prof. Matthias Schneider (TU-Dortmund, Germany) where such pulses are studied experimentally in lipid monolayers.

Application: Ideal candidates would have an MSc in physics, mechanical engineering, materials science, or a related field, preferentially with experience in computational modeling. Interested applicants are invited to email a curriculum vitae (CV) and a brief description of their research interests to mmussel@univ.haifa.ac.il. Applications will be reviewed continuously until the position is filled.

References

[1] M Mussel, and MF Schneider (2021), Sound pulses in lipid membranes and their potential function in biology, Progress in Biophysics and Molecular Biology, 162:101-110.

[2] M Mussel, and MF Schneider (2019), It sounds like an action potential: unification of electrical, chemical and mechanical aspects of acoustic pulses in lipids, Journal of the Royal Society Interface, 16(151): 20180743.