# Soft Living Active and Adaptive Matter

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## A bifurcation integrates information from many noisy ion channels and allows for milli-Kelvin thermal sensitivity in the snake pit organ

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## Abstract:

The thermal imaging organ of pit vipers is a remarkable example for how biological systems integrate information from many noisy sensors into a collective response. Single nerve fibers innervating the organ robustly respond to milli-Kelvin changes in temperature, even though the opening probability of each individual temperature-sensitive ion channel only changes by 0.1%. Here, we propose a mechanism for the integration of this noisy molecular information into an amplified response. Amplification arises due to proximity to a dynamical bifurcation, separating a regime with frequent and regular firing of action potentials (APs), from one with irregular and infrequent firing. Near the transition, AP frequency can have an extremely sharp dependence on temperature, and most of the information in molecular receptors is efficiently transmitted to AP firing even if additional noise corrupts the signal or readout. Our model explains several key features of experimental data. Most significantly, it predicts that the coefficient of variation in the distribution of times between APs decreases for larger AP frequency. It also suggests that the intrinsic channel timescale may be slower than the timescale of the cell's voltage dynamics, thereby leading to memory in the state of the channels.

**Date:**
11/13/2023

**Time:**
9:00 AM-10:15 AM (PT)

## About the speaker:

Isabella Graf is a Postdoctoral Fellow in the Physics department at Yale University. She is broadly interested in using methods and tools of statistical mechanics, nonlinear dynamics, and information theory to describe and help understand biological phenomena. Her current research in Ben Machta's group focuses on signal amplification and information integration in biological sensory systems and on the phase behavior of mixtures with many components.

Before joining Yale University, she was a PhD student in Physics in Erwin Frey's group at LMU Munich, Germany, where she worked on collective dynamics and self-organization in the context of the cell cytoskeleton and on non-equilibrium self-assembly of heterogeneous structures.

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