

**ICB seminar series 2024/25**

chairman: Prof. Dr. Kjell Jorner

## STOCHASTIC PROCESSES IN CELLS AND TISSUES

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**Wednesday, 27/11/2024, 4 pm**

ETH Hönggerberg, HCI J 7



**Abstract:** Stochastic phenomena play a fundamental role in many biological systems, ranging from gene regulation to cell-fate determination. Understanding such phenomena raises new theoretical challenges at the interface between stochastic processes, statistical physics and computation. In this talk I will present some recent advances that our group has made in this direction. In the first part of the talk, I will show how cells can use phase coexistence to control and suppress protein concentration fluctuations. Using a non-equilibrium model that links active protein synthesis and turnover to the physics of multicomponent phase separation, I will show that concentration fluctuations can be strongly reduced in the presence of phase separated compartments. I will present experimental single-cell data in synthetic and endogenous compartments, which support this prediction. In the second part of my talk, I will focus on inverse problems and how stochastic processes can be robustly inferred from limited experimental data. As an example, I will present a statistical method to quantify CTCF/cohesion-mediated chromatin looping dynamics from two-point live-imaging measurements. The method combines a simple polymer model with a Bayesian filtering approach to infer loop lifetimes and frequencies. When applied to experimental data, this method revealed that chromatin loops are surprisingly rare (~5% looped fraction) and short-lived (~10-30mins loop lifetime). I will conclude my talk by outlining several important challenges for the future.

**Bio:** Christoph Zechner received his Master's degree at TU Graz in 2010. For his PhD, he relocated to the Automatic Control Lab at ETH Zurich to work under the supervision of Heinz Koepl. After his graduation in 2014, he joined the lab of Mustafa Khammash at the BSSE in Basel as a SystemsX.ch fellow. Since 2017 he has been a research group leader at the Max Planck Institute of Molecular Cell Biology and Genetics and the Center for Systems Biology Dresden. In December 2018 he became a member of the Faculty of Computer Science at TU Dresden as a TUD Young Investigator. He became an EMBO Young Investigator in 2021.