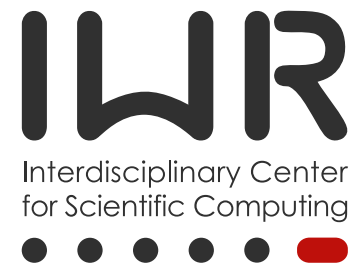


MATHEMATICS  
OF LIFE



HGS MathComp



Interdisciplinary Center  
for Scientific Computing



UNIVERSITÄT  
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IWR COLLOQUIUM WS 2022/23 • SPECIAL INTEREST GROUP “MATHEMATICS OF LIFE”

**Dr. Johannes Zierenberg**  
Max Planck Institute for Dynamics  
and Self-Organization

## Neuromorphic Computing With Self-Organized Networks

Our brains are comprised of billions of neurons that form a complex network. This network is a result of both evolutionary optimization (fostering a modular arrangement including highly specialized areas) and our own experience (storing memories and skills by adapting connection strengths) and determines how we process sensory input to produce meaningful responses. Since neurons communicate with short electrical pulses only when necessary, they are extremely energy efficient. Given our worldwide increase in computing demand, there is thus a strong incentive to develop low-energy neuromorphic computing paradigms that mimic the working principles of the brain. But what are the relevant working principles of the brain? How does a neural network develop useful dynamics?

In this seminar, I will present minimal principles to ensure stable collective neural dynamics from a statistical physics perspective, discuss how these can be used to tune network states to task requirements and show how they can be applied to neuromorphic computing. While I mainly focus on experience-driven self-organization, I will finish with some ideas to include evolutionary-driven architectures in the future.



**November 30, 2022 • 16:15**

Mathematikon • Conference Room / 5th Floor  
Im Neuenheimer Feld 205 • 69120 Heidelberg  
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