Colloquium

Tunable Matter

Carl Goodrich

Host: Jérémie Palacci

If the emergence of AI has taught us nothing else, it is that simple functions, connected together at scale, can lead to extreme emergent behavior provided the internal settings are adjusted just so. Does this principle apply to material systems as well? Can simple, well-understood physical interactions enable complex, maybe even life-like behavior if tuned at scale? Unlike most areas of science where we are trained to reduce the parameterization of a problem, answering such questions forces us to embrace high-dimensional spaces in order to understand when and where extreme behaviors emerge. I will discuss efforts within my group to understand the physics of highly tunable material systems. First, I will explain how physics-imposed constraints shape design spaces of self-assembling nanostructures, leading to a quasi-analytical description of the system's expressiveness. Then, I will discuss how tunable materials can contain a physical memory of their past. While I will initially present the concept of a physical memory in the context of tuned disordered solids, the resulting theory provides a general framework for predicting and understanding memory in a range of tunable systems, and I will speculate on such connections, from evolution to cellular structure, and from machine learning to the brain. Together, these results provide critical foundational structure for the emerging interdisciplinary field of tunable matter.

Monday, April 27, 2026 11:30am - 12:30pm

ISTA | Central Building | Raiffeisen Lecture Hall

This invitation is valid as a ticket for the ISTA Shuttle from and to Heiligenstadt Station. Please find a schedule of the ISTA Shuttle on our webpage: https://ista.ac.at/en/campus/how-to-get-here/ The ISTA Shuttle bus is marked ISTA Shuttle (#142) and has the Institute Logo printed on the side.