universität innsbruck

Department of
Theoretical Physics

# Theory Colloquium

**Lukas Fiderer, University of Innsbruck**

"Information-Theoretic Principles of Percept–Action Loops: Towards a Theory of Intelligent Systems"

**Abstract**

Despite substantial progress in the study of intelligent systems, the fundamental principles that constrain intelligent behaviour across artificial and biological systems remain only partially understood. Such principles are relevant for understanding agency, feedback and control, and the physical limits of intelligent behaviour. As the minimal structure of agent–environment interaction, the percept–action loop provides a natural starting point for an information-theoretic account of intelligent systems.

In this talk, I will outline a research programme based on this perspective. After introducing complementary formalisms for modelling percept–action loops, including circuit, channel, hidden Markov model, and causal-network descriptions, I will discuss three connected directions: information-theoretic limits on prediction, memory, and modelling; information-thermodynamic constraints on adaptive behaviour; and quantum extensions based on channels and combs. I will conclude by identifying open problems and future research directions.

**Wednesday | 10.06.2026 | 3:30pm**

**SR 2S17 | ICT building**