UNIVERSITÄT BONN

Bethe Colloquium

Philipp Hauke

University of Trento

Quantum Simulating Holographic Quantum Matter

Holographic field theories represent a phase of matter that is dual to bulk gravity and that provides paradigms for non-Fermi-liquid behavior and for extreme quantum chaos, making it relevant for communities from quantum gravity, quantum information, and condensed matter. Quantum simulators based on ultracold atoms and similar platforms with pristine microscopic control offer the exciting prospect to probe its properties from first principles and in the presence of strong quantum fluctuations. However, it remains an exceedingly hard challenge to realize such holographic matter in quantum simulator laboratory experiments.
In this talk, I will give an overview of exotic properties of holographic matter, including its large quantum chaoticity and its strong complexity in terms of quantum-information resources, focusing on the paradigmatic Sachdev-Ye-Kitaev (SYK) model, a model of fermions with disordered all-to-all interactions, as well as an extension dubbed Yukawa-SYK where the interactions between fermions are mediated by bosons. I will also highlight recent theoretical and experimental progress of how such models could be realized in setups of ultracold fermionic atoms. With this, I aim to illustrate the extreme richness of physics encountered in the quantum simulation of holographic matter.

BCTP, Room W 2.019 - Wegelerstr. 10 - 53115 Bonn

Thursday, October 30, 2025 at 4:15 p.m.

Bethe Center for Theoretical Physics

Physikalisches Institut
Universität Bonn
Nussallee 12
53115 Bonn

phone (+49) 228/73-3770
mail theory@physik.uni-bonn.de

bctp

For detailed information visit us at: http//bctp.uni-bonn.de