universität innsbruck

Department of Theoretical Physics

Theory Colloquium

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"Synthetic quantum matter out of equilibrium: A few recent advances from theory to simulation"

Abstract

"Synthetic matter" has emerged as a new paradigm of quantum many-body physics, characterized by unprecedented degree of spatiotemporal control and programmability of Hamiltonian interactions. If on the one hand these experimental developments bring us closer to Feynman's vision of a universal quantum simulator for challenging open many-body problems, on the other hand new fundamental theory questions on the behavior of quantum matter far from thermal equilibrium become accessible. Thermalization dynamics of isolated quantum systems and non-thermal states of matter are now at the center of multiple research efforts in theoretical physics. In this talk I will describe recent advances in understanding the mechanism of thermalization as well as long-lived non-equilibrium states of matter.

Specifically, I will introduce an influence-functional approach to quantum many-body dynamics and describe preliminary evidence that it helps classifying non-equilibrium universal behavior. Furthermore, I will discuss the synthetic-matter version of the celebrated Coleman's false-vacuum decay scenario, and show that unique dynamical features appear, including emergent quasi-many-body-localized dynamics of interfaces and metastable long-range order. In parallel, I will describe how such theoretical advances led to unforeseen developments in applications, from a numerical method for strongly correlated electrons to a strategy for quantum simulation of real-time phenomena in lattice gauge theories.

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SR 2 | ICT building