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Department of
Theoretical Physics

Theory Colloquium

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"Dynamics of Fracton Quantum Matter"

Abstract

Recent conceptual and experimental progress made it possible to explore strongly-correlated non-equilibrium states of matter, which exhibit a wealth of exotic dynamical phenomena. Despite this apparent complexity, the far-from-equilibrium dynamics of generic interacting quantum systems is characterized by a handful of universal guiding principles, among them the diffusive hydrodynamic transport of globally conserved quantities. Recent developments, however, showed, that in certain constrained many-body systems the structure of conservation laws can cause a drastic modification of this universal dynamical behavior. An example are fracton quantum systems, which possess excitations with constrained mobility.

Fracton systems conserve in addition to a global charge, the associated center of mass (or equivalently the dipole moment). These systems exhibit a novel type of localization transition separating an ergodic dynamical phase from a frozen one; a phenomena known as Hilbert space fragmentation. Even in the ergodic phase, transport is anomalously slow and exhibits sub-diffusive scaling. In this colloquium, I will review some of the theoretical progress in studying anomalous transport in fracton quantum matter, discuss their relations to gauge theories, and propose how these effects may be observed experimentally.

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