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Emergent hydrodynamics in constrained quantum matter

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The far-from-equilibrium dynamics of generic interacting quantum systems is characterized by a handful of universal guiding principles, among them the diffusive transport of globally conserved quantities. Certain systems with kinetic constraints or constrained interactions, however, defy these expectations and exhibit anomalous transport instead. In this talk, we will discuss some of these exceptions. For example, systems with conserved, and sometimes hidden, spin patterns, including XNOR or tJz models, show anomalously slow spin relaxation dynamics. In these models, spin transport is governed by tracer diffusion, which describes the diffusion of a tagged particle with hard-core constraints. Another example are fracton systems, which conserve the dipole moment (or equivalently the center of mass). Fracton systems exhibit a localization transition as a function of the density 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 subdiffusive scaling. We will discuss relations and differences between the two cases and also draw connections to recent quantum simulation experiments with ultracold atoms.

Orateur: KNAP, Michael (Technical University of Munich)