Physics Colloquium

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“Transport Dynamics in Ultracold Atoms”

The world around us is not in equilibrium, but slowly (or quickly) relaxing through transport of conserved quantities such as energy, charge, and momentum. However, transport is challenging to calculate ab initio, leaving many open questions (such as high-temperature superconductivity) and room for new theoretical paradigms (such as holographic duality). Ultracold atoms provide an ideal platform for the study of non-equilibrium quantum physics, since samples are isolated from the environment, and the strength of interactions can be tuned.

In this talk, I will discuss two experiments that use cold atoms to explore transport dynamics. In the first experiment, we explore how particle-current is dissipated in a perfect and rigid crystal, due to interactions in a system with broken Galilean invariance. In the second experiment, we measure spin diffusion in a strongly interacting Fermi gas. We observe a kind of quantum "speed limit" on the transport rate.

Seen from another perspective, these experiments implement quantum simulations, which are very specialized quantum computations. Although neither error-corrected nor universal, quantum simulators can be built now, can exceed the computational capability of a numerical simulation, and are ready to be applied to important open questions and challenges.

The speaker attended Harvey Mudd College as an undergraduate and earned a doctorate at Harvard University. In 2003, he established an experimental research group to study ultracold Fermi gases at the University of Toronto. In 2014, he was elected a Fellow of the American Physical Society; since last year, he has served as Associate Chair for Graduate Studies in the Department of Physics.

Thursday, May 5, at 4:25 PM via Zoom

On the regular schedule that starts at 4:25 PM

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(This is an online colloquium)