

# Non-equilibrium dynamics of large bosonic quantum many-body systems under the microscope

*mardi 6 février 2024 15:15 (45 minutes)*

Quantum gas microscopy (QGM) provides unique access to the properties of quantum many-body system in- and out-of-equilibrium. In this talk, I will report recent work on thermalization dynamics of hard-core bosons in quasi-1D systems. We make use of site-resolved density snapshots in order to monitor the full counting statistics of particle-number fluctuations in optical lattices, contrasting systems with ballistic and chaotic dynamics.

We find excellent agreement between our results and predictions using macroscopic fluctuation theory (MFT), which allows us to accurately extract diffusion constants from fluctuation growth. Our results suggest that large-scale fluctuations of isolated quantum systems display emergent hydrodynamic behavior, expanding the applicability of MFT to the quantum regime. In the second part of my talk, I will focus on new experimental results, where we have developed a technique to measure kinetic operators, such as kinetic energy or current operators, in QGMs by projecting the many-body wave function onto isolated double wells.

These operators can be measured and manipulated with single-bond resolution, hence, significantly expanding the toolbox of QGMs. Beyond simple expectation values of these observables, the single-shot measurements allow to access full counting statistics and complex correlation functions. This paves the way for the implementation of efficient quantum state tomography and hybrid quantum computing protocols for itinerant particles on a lattice.

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