Contribution ID: **62**

Type: **Poster**

Dynamics after a quantum quench in Bose-Hubbard systems: Correlation spreading and disorder-free localization

Wednesday, 13 September 2023 22:40 (20 minutes)

We study quantum many-body dynamics after a quantum quench in systems of optical lattices loaded with ultracold Bose gases, which can be quantitatively described by the Bose-Hubbard model. We focus on two kinds of dynamics, namely, spreading of spatial correlations and non-ergodic dynamics associated with the Hilbert space fragmentation. For the former case, we start with a Mott-insulating state at two dimensions (2D) and consider a situation in that the optical lattice depth is quenched to a parameter region near the quantum phase transition point between the superfluid and Mott-insulating states. We make quantitative comparisons between the time dependence of the single-particle correlation function obtained from quantum-simulation experiments [1] and that from a few numerical methods, including the SU(3) truncated Wigner approximation (TWA) [2] and 2D tensor-network method based on the projected entangled pair states (PEPS) algorithm [3]. We show that PEPS can accurately capture correlation-spreading dynamics for a longer time scale than SU(3)TWA and it allows for extracting the velocity of the correlation propagation. As for the non-ergodic dynamics, we consider a one-dimensional geometry in the presence of a parabolic trapping potential and start with a state in which even-numbered (odd-numbered) sites are doubly occupied (empty) [4]. We show that when the onsite interaction is sufficiently large, the system does not exhibit thermalization, i.e., the dynamics is nonergodic, due to the Hilbert space fragmentation. We utilize a Bose-Hubbard quantum simulator at Kyoto University in order to experimentally corroborate this theoretical prediction.

References:
[1] Y. Takasu et al., Sci. Adv. 6, eaba9255 (2020).
[2] K. Nagao et al., Phys. Rev. Res. 3, 043091 (2021).
[3] R. Kaneko and I. Danshita, Commun. Phys. 5, 65 (2022).
[4] M. Kunimi and I. Danshita, Phys. Rev. A 104, 043322 (2021).

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Session Classification: Poster Session III

Track Classification: Quantum Gases in Low Dimensions