Contribution ID: **160** Type: **Poster**

Coarsening dynamics in far-from-equilibrium two-dimensional Bose gas: How far is far?

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

Understanding many-body systems far-from equilibrium is an outstanding challenge in physics. It was proposed that such systems generically feature universal dynamic scaling while approaching non-thermal fixed points; the associated dynamical scaling exponents would provide a classification of the nonequilibrium phenomena analogously to the equilibrium universality classes. First evidence for such scaling has been observed in thermalization dynamics of three- and quasi-one- dimensional closed quantum systems.

Here, we experimentally study such dynamics in a two-dimensional Bose gas. The starting point is a system in a non-interacting, far-from equilibrium state which features a reduced occupation of low momenta and a sharp cut-off at high momenta. Subsequently, the relaxation is initiated by quenching on the interparticle interactions. We observe a redistribution of particles and energy in momentum space through self-similar scaling. Additionally, utilizing the precise control over the initial state preparation, we investigate the emergence of the universal dynamic scaling as the system is brought further and further from equilibrium.

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Session Classification: Poster Session III

Track Classification: Quantum Gases in Low Dimensions