Abdus Salam prize talk: Bose gases quenched to unitarity

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Understanding strongly-correlated many-body systems, and especially their dynamics far from equilibrium, is one of the grand challenges of modern physics. The field of ultracold atoms is well suited to explore such systems due to the pristine control of atom-trapping geometries, the experimentally resolvable intrinsic time scales, and the ability to tune the interparticle interactions. In particular, they allow access to the unitary regime, where the interparticle interactions are as strong as allowed by the laws of quantum mechanics.

Following more than a decade of exciting experiments on unitary Fermi gases, in particular those exploring the crossover between Bose-Einstein condensation and Bardeen-Cooper-Schrieffer superconductivity, unitary Bose gases have more recently emerged as a new experimental frontier.

However, in Bose gases the strong interactions also lead to particle loss and heating, which establishes a complex interplay between the coherent and the dissipative dynamics, and makes the study of the unitary Bose gas an intrinsically non-equilibrium problem.

I will present some of our recent experiments trying to understand the dynamics and thermodynamics of Bose gases following a rapid quench into the unitary regime. Our momentum- and time-resolved measurements allow us to disentangle the coherent from the dissipative dynamics, observe that the gas attains a quasi-equilibrium state, known as a prethermal state, and obtain first quantitative results on this state. Our experiments also uncover a remarkable degree of universality in the post-quench behavior.