The Abdus Salam International Centre for Theoretical Physics

Conference on Many-Body-Localization:
Advances in the Theory and Experimental Progress
Trieste, 10 - 14 July 2017

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Probing Many-Body Localisation from an Ultracold Atom Perspective

A fundamental assumption in statistical physics is that generic closed quantum many-body systems thermalise under their own dynamics. Recently, the emergence of many-body localised (MBL) systems has questioned this concept, challenging our understanding of the connection between statistical physics and quantum mechanics. In my talk, I will report on several recent experiments carried out in our group on the observation of Many-Body Localisation in different scenarios, ranging from 1D fermionic quantum gas mixtures in driven and undriven Aubry-André type disorder potentials and 2D systems of interacting bosons in 2D random potentials. It is shown that the memory of the system on its initial non-equilibrium state can serve as a useful indicator for a non-ergodic, MBL phase. Furthermore, I will present new results on the slow relaxation dynamics in the ergodic phase below the MBL transition and experiments that explore the resilience of a 2D MBL phase when coupled to a finite thermal bath.

Our experiments represent a demonstration and in-depth characterisation of many-body localisation, often in regimes not accessible with state-of-the-art simulations on classical computers.
