Abstract:

The dynamics of one-dimensional few-particle systems are key to understand the phenomenological differences between single- and many-body systems, and ultimately the transition to the thermodynamic limit. While experimentally such systems become increasingly controllable, with particle interactions tunable from strongly attractive to strongly repulsive and short- (contact) to long-range (Coulomb), exact numerical approaches are feasible but challenging.

In the first part of this talk we demonstrate an exact treatment of two indistinguishable, Coulomb-interacting bosons in a one-dimensional trapping potential, by numerical diagonalization of the many-body Hamiltonian after discretization in an appropriate finite element basis. In the second part we show how the dynamics of a simple single-particle observable allows us to distinguish long-ranged Coulomb from short-ranged contact interactions. This bears new insights in the interaction-dependence of few-body dynamics, and can be verified via state-of-the-art experiments with ultracold atoms.