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The Frontier of the Few

Masud HAQUE
Max Planck Institute for Physics of Complex Systems,
Dresden, Germany

Abstract:

Ultracold atom physics is widely acknowledged to have opened up research frontiers through high tunability, precision, and novel realizations of many-body Hamiltonians. A less appreciated direction is the exploration of the collective physics of few-component systems, such as the dynamics of few-particle and few-vortex systems.

This is in fact a true new frontier, because probing several-particle or several-vortex physics is difficult in traditional condensed matter settings, while collective effects have not been the main focus of atomic or optical physics. Systems of a few particles can support intriguing cooperative behaviors, while still allowing detailed understanding.

I will present two examples of collective physics in few-component systems related to ultracold atoms.

First, I will present the dynamics of a vortex dipole in a non-rotating trapped condensate. I will show how characteristic vortex pair trajectories emerge out of the interplay of trap-induced motion and intrinsic dipole motion.

Second, I will examine a few bosons in open Bose-Hubbard chains, and identify edge-localization phenomena that occur due to purely collective (rather than single-particle) effects.