Harvard Quantum Optics Center

ITAMP
Institute for Theoretical Atomic Molecular and Optical Physics

Joint Quantum Sciences Seminar

Wednesday, March 9, 4:00 pm

Jefferson 250

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"Butterfly Molecules in a Bose-Einstein Condensate"

This talk will give an overview of recent experiments in my group studying Rydberg excitations and their dynamics in ultracold quantum gases. We use ionization processes of Rydberg atoms and molecules as a continuous probe of the system. For very small atomic samples with dimensions of a few micrometers, we reach the superatom limit, where only one excitation fits into the sample at the same time. For increasing size, driving strength and for finite detuning we observe the transition to a multiple excitation regime, where small clusters and correlated dynamics appear. For large Bose-Einstein condensates these clusters contain several hundred excitations and lead strongly correlated ion bursts emitted from the system.

The discovery of Rydberg molecules offers another route to study degenerate quantum gases. Taking advantage of a single-photon excitation scheme to molecular Rydberg states, we can continuously measure the number of produced molecules. This has allowed us to probe in real time the double occupancy during a sweep over the superfluid to Mott insulator transition.

Butterfly molecules are a special type of Rydberg molecules with exceptional properties. Using a single photon excitation to a Rydberg p-state, we observe for the first time these molecules. Due to their large dipole moment in combination with a small bond length, we resolve the rotational and pendular structure in an electric field. This opens new possibilities to study Rydberg molecules with long-range interactions in optical lattices.

Student Presentation by Richard Schmidt will begin at 4:00 PM
Guest Presentation will begin at 4:30 PM
Refreshments will be provided