SFB/TRR 21 - Seminar

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Ground state atoms and Rydberg atoms under tight confinement

Cold atomic gases have proven extremely useful for the exploration of fundamental questions arising not only from atomic physics but being also of great relevance for the complex systems and condensed matter community.

In the first part of my talk I will give an overview of various techniques for confining gases of ground state atoms in low dimensions and various topologies. Special focus is set on the discussion of so-called ‘radio-frequency-dressed adiabatic potentials’ which allow for a coherent manipulation of ultracold atomic gases. Recent experimental and theoretical results for low-dimensional Bose-gases manipulated by this technique are presented.

The second part is dedicated to the discussion of Rydberg atoms in tight magnetic and electric traps. Unlike ground state atoms, which for all practical purposes can be considered point-like, Rydberg atoms can possess a spatial extension up to several hundred nanometers. On this lengthscale variations of trapping fields are no longer negligible which in turn affects the trapping of these electronically highly excited atoms. Moreover, Rydberg atoms can develop significant dipole moments which enable them to interact strongly over large distances.

This interaction cannot only be utilized to create dipolar gases but also offers new possibilities for the coherent manipulation of quantum systems. In particular I will show how the strong state-dependent dipole moment, exhibited by Rydberg states, provides a new handle for the quantum control of trapped ions.

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