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Seminar über Quanten-, Atom- und Neutronenphysik (QUANTUM)

July 7, 2022 at 2 p.m. c.t.
Lorentz-Raum 05-127

Prof. Dr. Svetlana Malinovskaya
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Entanglement of trapped Rydberg atoms by chirped laser pulses

Atoms in their highly excited electronic states, referred to as Rydberg atoms, have extraordinary nonlinear optical properties. Such atoms are highly polarizable and interact with each other via the dipole-dipole or the van-der-Waals interactions. Owing to these interactions, Rydberg atoms in optical traps possess the condensed matter-like collective behavior. They serve as a viable platform to study quantum many-body physics. Spin degrees of freedom of trapped Rydberg atoms bring rich new physics including quantum magnetism, quantum phases, and entanglement - a crucial resource in many quantum information and quantum communication tasks. In this talk, I will present a study of alkali rubidium atoms trapped in an optical lattice and controllably excited to the Rydberg states by linearly chirped laser pulses [1]. I will introduce a quantum control methodology to create entangled states of two typical classes, the W and the Greenberger-Horne-Zeilinger (GHZ) [2]. I will show that the entangled states of Rydberg atoms can be used to create the multiphoton entangled radiation states in a cavity and in free space [3]. The methodology exploits chirped-pulse adiabatic passage and provides a key step toward the resolution of a general problem of creating entanglement in high-dimensional quantum entities.

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