Physikalisches Kolloquium — Physics Colloquium

Einladung — **Invitation**

Monday, 02 December 2024

Lecture Hall N24/H13, at 16:15
Coffee and cookies will be served in front of the lecture hall from 16:00

Polyatomic ultralong-range Rydberg molecules

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Rydberg atoms have played a crucial role in the birth of quantum mechanics [1,2], and scattering theory as well as in the development of high precision spectroscopic techniques [3]. Due to their exotic properties, Rydberg atoms are unique probes of their environment, which can be easily controlled and manipulated using electromagnetic fields. In the last decades, Rydberg physics has attracted increasing interest because it provides a unique opportunity to address fundamental questions in quantum mechanics and for its applications in quantum technologies [4-6]. Rydberg atoms also form exotic ultralong-range molecules when combined with ground-state atoms [7,8], ions [9], or polar molecules [10,11], which inherit these exciting properties.
In this talk, we will explore the interaction, via anisotropic scattering, of a polar molecule with a Rydberg atom creating a polyatomic Rydberg molecule [10,11]. Our focus is the regime where the charge-dipole interaction of the Rydberg electron with the molecular electric dipole moment induces a coupling between the quantum defect states and the nearest degenerate hydrogenic manifold [10-12]. Based on these non-adiabatic couplings, we propose a protocol to create the Rydberg molecules experimentally in a mixture of ultracold atoms and ultracold molecules [13]. We will also present the first experimental demonstration of the Rydberg blockade due to this charge-dipole interaction between a Rb atom and a RbCs molecule [14]. The atom and molecule are confined in optical tweezers, which are used to control their relative distance. For a separation of 310 nm, the charge-dipole interaction between the Rydberg electron and atomic core with the dipole moment of RbCs provokes the blockade of the transition to the Rb(52s) Rydberg state. The observed excitation dynamics are in excellent agreement with the theoretical results obtained using the electronic structure of the Rydberg molecule Rb-RbCs [14].

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Host: Prof. Dr. Susana Huelga, Institute of Theoretical Physics

Organisation: Prof. Dr. Jens Michaelis, Institute of Biophysics, jens.michaelis@uni-ulm.de, +49-731-50-23050