Q 1: Tutorial Rydberg Physics (joint session AKjDPG/SYRY/Q)

Time: Monday 11:00–13:00 Location: AKjDPG-H17

Tutorial Q 1.1 Mon 11:00 AKjDPG-H17

From the Rydberg Formula to Rydberg arrays — •Jan Michael Rost — Max Planck Institute for the Physics of Complex Systems, Dresden, Germany

Covering milestones in the development of Rydberg physics, the tutorial will introduce the properties of Rydberg atoms and major elements for a theoretical description. Milestones include hydrogen in a magnetic field and doubly excited states of atoms with their connection to classical chaos and periodic orbits through the semiclassical nature of Rydberg electrons. With ultracold environments and traps ultra long-range Rydberg molecules as seeds for Rydberg chemistry have been realized as well as ultracold plasmas. Fundamental phenomena such as the interaction blockade and Rydberg dressing have been identified as major tools to establish and control correlation in Rydberg dynamics on the way to quantum computation with Rydberg arrays which will be the covered in the second tuturial.

Tutorial Q 1.2 Mon 12:00 AKjDPG-H17

Quantum simulation and quantum computation with Rydberg atom arrays — •Johannes Zeiher — Max Planck Institute of Quantum Optics, 85748 Garching, Germany — Munich Center for Quantum Science and Technology (MCQST), 80799 Munich, Germany

Understanding quantum mechanical systems of many particles at a microscopic level is one of the grand challenges of modern physics. In 1982, Feynman addressed this issue by formulating his vision that one can use well-controlled quantum systems to simulate and understand other quantum systems. Single atoms trapped in individual optical traps coupled to Rydberg states have recently emerged as a versatile experimental platform geared towards realizing Feynman's vision. In this tutorial, I will focus on the basics of this platform. First, I will describe how individual atoms are loaded, detected, and manipulated in optical tweezers. Afterwards, I will explain how strong, switchable interactions between highly excited atomic Rydberg states emerge, and how they can be induced and controlled by lasers. This will set the stage for highlighting the accessible many-body models for quantum simulation and the potential of the platform for quantum computation, followed by a brief discussion of recent experimental breakthroughs in the field.