Working Group "Young DPG"
Arbeitskreis junge DPG (AKjDPG)

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Be welcome to this year's program of the Working Group young DPG!

To those, who are new to the conference and are feeling lost in view of the various sessions, we want to offer the chance to build a solid foundation and to learn about the hot topics of the conference. You are cordially invited to visit the tutorials on Monday morning and learn about Ryberg physics and strong light-matter interaction with pulsed light!

With our PhD-Symposium we want to explore the fascinating physics of solid state quantum emitters coupled to optical microcavities. The symposium is especially designed to give an introduction into the topic and will feature well known experts on the field.

In joint work with the Working Group Information (AGI) we offer the Hacky Hours on Wednesday. This session gives you the opportunity to share the tools which ease your daily research and to learn about the favorite software used by your peers.

We are looking forward to seeing you at our events!

Overview of Invited Talks and Sessions

(Lecture hall AKjDPG-H17 and AKjDPG-H18)

Invited Talks

AKjDPG 1.1	Mon	11:00–12:00	AKjDPG-H17	**From the Rydberg Formula to Rydberg arrays** — •Jan Michael Rost
AKjDPG 1.2	Mon	12:00–13:00	AKjDPG-H17	**Quantum simulation and quantum computation with Rydberg atom arrays** — •Johannes Zeiher
AKjDPG 2.1	Mon	11:00–12:00	AKjDPG-H18	**Atoms and molecules in strong fields and how to observe times and phases** — •Manfred Lein
AKjDPG 2.2	Mon	12:00–13:00	AKjDPG-H18	**Ultrafast light-matter interaction: Measuring and controlling quantum dynamics with attosecond and femtosecond flashes of light** — •Christian Ott

Sessions

AKjDPG 1.1–1.2	Mon	11:00–13:00	AKjDPG-H17	**Tutorial Rydberg Physics (joint session AKjDPG/SYRY/Q)**
AKjDPG 2.1–2.2	Mon	11:00–13:00	AKjDPG-H18	**Tutorial Strong Light-Matter Interaction with Ultrashort Laser Pulses (joint session AKjDPG/A)**
AKjDPG 3.1–3.3	Wed	14:00–15:45	AGI-H20	**Hacky Hour I (joint session AGI/AKjDPG)**
AKjDPG 4.1–4.2	Wed	16:00–17:15	AGI-H20	**Hacky Hour II (joint session AGI/AKjDPG)**

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

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

Tutorial AKjDPG 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 AKjDPG 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.

AKjDPG 2: Tutorial Strong Light-Matter Interaction with Ultrashort Laser Pulses (joint session AKjDPG/A)

Time: Monday 11:00–13:00 Location: AKjDPG-H18

Tutorial AKjDPG 2.1 Mon 11:00 AKjDPG-H18
Atoms and molecules in strong fields and how to observe times and phases — •Manfred Lein — Institute of Theoretical Physics, Leibniz University Hannover

The interaction of strong laser fields with atoms and molecules leads to a number of nonlinear, i.e., multiphoton processes such as above-threshold ionization, high-harmonic generation, or frustrated tunnel ionization. This talk reviews the fundamental mechanisms and theoretical methods related to these processes. We will also review schemes for observing the spatiotemporal properties of strong-field dynamics, including for example ionization times, target structure, and the phases of electron wave packets.

Tutorial AKjDPG 2.2 Mon 12:00 AKjDPG-H18
Ultrafast light-matter interaction: Measuring and controlling quantum dynamics with attosecond and femtosecond flashes of light — •Christian Ott — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany

Ultrafast light-matter interaction is an exciting aspect of modern quantum physics, directly resolving the fastest motion of electrons inside and in between atoms and molecules that constitute the matter that is surrounding us, where the coherence times can be as short as femtoseconds or even attoseconds. Strong laser fields are available as pulsed flashes of light, with durations of only a few optical oscillation periods in the single-digit femtosecond regime, and an electric field strength that becomes comparable to the electromagnetic binding forces within atoms and molecules. These pulses allow one to measure, understand and control the electron dynamics in natural quantum systems at a fundamental level. In combination with new attosecond light sources at extreme ultraviolet and x-ray wavelengths, derived from high-order harmonic generation or at (x-ray) free-electron laser facilities, this allows one to obtain dynamic fingerprints that are very specific for each atomic species (i.e., time-resolved ultrafast x-ray spectroscopy).

In this lecture I will give a basic introduction into this research topic with focus on absorption spectroscopy of atoms and molecules, and how the resonant transmission of ultrashort and intense light pulses through an absorbing target can be modified and controlled with strong fields and how the control of the dipole response of light-matter interaction develops on the ultrafast timescale.

AKjDPG 3: Hacky Hour I (joint session AGI/AKjDPG)

Time: Wednesday 14:00–15:45 Location: AGI-H20

Invited Talk AKjDPG 3.1 Wed 14:00 AGI-H20
Practical semantic data management with CaosDB — •Alexander Schlemmer[1,2,3], Ulrich Parlitz[1,3,4], and Stefan Luther[1,3,5] — [1]Max Planck Institute for Dynamics and Self-Organization, Göttingen, Germany — [2]IndiScale GmbH, Göttingen — [3]German Center for Cardiovascular Research (DZHK), Partner Site Göttingen — [4]Institute for the Dynamics of Complex Systems, University of Göttingen — [5]Institute of Pharmacology and Toxicology, University Medical Center Göttingen

In practice, scientific data management comprises many different tasks and workflows that are typically accompanied by software in varying degrees. It is a common issue to find the right balance between standardization and flexibility, automation and interactivity, complexity and comprehensibility.

CaosDB is an Open Source (AGPLv3) research data management system (RDMS) that combines multiple data management concepts and practical tools for efficiently integrating daily research data management into scientific workflows. Especially noteworthy are the flexible semantic data model, the intuitive semantic query language CQL and the file crawler framework for automatic data integration.

In this talk the software and the central concepts will be discussed presenting use cases from daily scientific research. A practical introduction to the graphical user interface, the query language, the API and the crawler framework will be given to demonstrate how these concepts can facilitate data management and provide a deeper insight into complex and heterogeneous research data.

AKjDPG 3.2 Wed 14:45 AGI-H20
Snakemake: Making data workflows easier and more reproducible — •Johannes Hampp — Center for international Development and Environmental Research, Justus Liebig University Giessen

Daily scientific work often involves handling research data from experiments or simulations. Necessary data wrangling and analysis steps are usually repeated following predefined steps. Snakemake aims to make this process easier, faster, less error-prone, improving transparency and reproducibility. Individual steps are split into standalone rules, which

are flexibly combined into workflows. Workflows are defined in a simple and human-readable format. They are automatically executed to keep any data dependencies up-to-date. Snakemake thus ensures ordered, transparent and documented data workflows, significantly reducing human errors from manual workflow execution or from improvised, self-written workflow solutions. Snakemake is open source software and supports popular programming languages like R, Python and Julia. Furthermore, integration with other programming languages or programmes is possible as long as they offer a command line interface. Many more features are available.

For yourself, Snakemake makes your life easier, more productive and more fun. For other researchers, well-documented and automatic workflows increase the accessibility and reproducibility of your research and research data.

AKjDPG 3.3 Wed 15:15 AGI-H20

Controling laboratory equipment using Python and `pylablib` — •Alexey Shkarin — Max Planck Institute for the Science of Light, 91058 Erlangen, Germany

As experiments become progressively more complicated and generate more data, there is a need for automation of the equipment control and data acquisition. This often requires orchestrated control of multiple devices, which demands custom experiment-specific software. For a long time LabView has been a de-facto standard in this domain, but over the last decade Python has been gaining more traction due to its universaility, simplicity, and its already wide support on the data processing side.

In this talk I will introduce basics of device control, specifically focusing on the Python libraries which are most useful in these tasks. Then I will present `pylablib`, a software package dedicated to control of specific devices. Finally, I will show how `pylablib` can be used in a couple of simple examples where several devices need to be controlled at the same time.

AKjDPG 4: Hacky Hour II (joint session AGI/AKjDPG)

Time: Wednesday 16:00–17:15 Location: AGI-H20

Invited Talk AKjDPG 4.1 Wed 16:00 AGI-H20

Physicist in IT: Physics in Advent — •André Wobst — wobsta GmbH, Augsburg

For more than 17 years I am working as a service provider in planning, realization and administration of physics-related IT projects. Here I present one of the projects, namely a physics Advent calendar. The technology stack is rather common and efficient: Python, Flask, PostgreSQL to name just the most important building blocks. The load of such a project (more than 66,000 users in 2021, all within a few weeks and with high daily return rate) is operated on moderate infrastructure by taking into account efficiency right from the start. I overview challenges that arise during implementation and operation and show some web analytics, monitoring data and report on attacks. I will also discuss a few pitfalls like avoiding backpressure (a term adopted from fluid dynamics to IT).

AKjDPG 4.2 Wed 16:45 AGI-H20

Scientific 3D-renderings with blender — •Dominik Rattenbacher — Max Planck Institute for the Science of Light, 91058 Erlangen, Germany

Surely, you have all seen fancy 3D-renderings in one or the other talk or some journal publications. These are not only an eye catcher, but can play a key role in visualizing a model or experiment for the audience.

In this talk, I will give an introduction to the open-source 3D-rendering software blender (blender.org), which is a powerful tool to create such images or even animations. I will start by giving an overview of its history and then dive into ray-tracing, which is the general process behind it. In the second half we will go step-by-step through a little example that shows you how to create an animation of a tunable laser beam being reflected by a mirror.