

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 Sunday afternoon and learn about quantum simulation and computing as well as molecular spectroscopy!

With our PhD-Symposium we want to explore the fascinating physics of many-body physics in ultracold quantum systems. The symposium is especially designed to give an introduction into the topic and will feature well known experts on the field.

Be welcome to join the tower building contest on Tuesday right after the plenary talk and to explore Hannover's night life during the pub crawl on Tuesday evening.

We are looking forward to seeing you at our events!

Overview of Invited Talks and Sessions

Invited Talks

AKjDPG 1.1	Sun	17:00–17:45	B305	A Tutorial on Quantum Simulation — •CHRISTIAN GROSS
AKjDPG 1.2	Sun	17:45–18:30	B305	Developing utility scale quantum computers with trapped ions — •WINFRIED HENSINGER
AKjDPG 2.1	Sun	17:00–17:45	B302	New perspectives in the investigation of ultrafast molecular dynamics — •ANDREA TRABATTONI
AKjDPG 2.2	Sun	17:45–18:30	B302	Femtosecond spectroscopy in the condensed and gas phase — •LUKAS BRUDER

Invited Talks of the joint PhD-Symposium – Many-body Physics in Ultracold Quantum Systems

See SYPD for the full program of the symposium.

SYPD 1.1	Thu	14:30–15:00	E415	Entanglement and quantum metrology with microcavities — •JAKOB REICHEL
SYPD 1.2	Thu	15:00–15:30	E415	Many-body physics in dipolar quantum gases — •FRANCESCA FERLAINO
SYPD 1.3	Thu	15:30–16:00	E415	Quantum Simulation: from Dipolar Quantum Gases to Frustrated Quantum Magnets — •MARKUS GREINER
SYPD 1.4	Thu	16:00–16:30	E415	Quantum gas in a box — •ZORAN HADZIBABIC

Sessions

AKjDPG 1.1–1.2	Sun	17:00–18:30	B305	Tutorial Quantum Simulation and Computing
AKjDPG 2.1–2.2	Sun	17:00–18:30	B302	Tutorial Molecular Spectroscopy

AKjDPG 1: Tutorial Quantum Simulation and Computing

Time: Sunday 17:00–18:30

Location: B305

Tutorial AKjDPG 1.1 Sun 17:00 B305
A Tutorial on Quantum Simulation — •CHRISTIAN GROSS —
 Physikalisches Institut, Universität Tübingen

Quantum simulation is one of the upcoming quantum technologies. In this tutorial we provide an introduction to quantum simulation and discuss different flavors and platforms. We highlight the state of the art of the field for the simulation of fermionic Hamiltonians and discuss key techniques and experiments. We will also discuss the close interconnection between quantum simulation and quantum computation.

Tutorial AKjDPG 1.2 Sun 17:45 B305
Developing utility scale quantum computers with trapped ions — •WINFRIED HENSINGER — Sussex Centre for Quantum Technologies, Department of Physics and Astronomy, University of Sussex, Brighton BN1 9QH, United Kingdom

Trapped ions are arguably the most mature technology capable of constructing practical quantum computers. Most disruptive quantum

computing applications require quantum error correction with quantum computers operating in the fault-tolerant quantum computing operating modus, therefore requiring hundred thousands or millions of qubits. While prototype trapped ion quantum computers have already been built featuring performance specifications featuring world-leading performance specifications, the next challenge consists to develop technologies capable of supporting operation with large number of qubits.

In this tutorial presentation I will provide an introduction to the general field of trapped ion quantum computing and explain key concepts including the fabrication of ion trap microchips. I will focus on techniques capable of scaling to large qubit numbers including the use of long wavelength radiation for the scalable implementation of trapped ion quantum information processing.

In order to be able to build large scale device, a quantum computer needs to be modular. I will discuss different approaches to modularity and report a recent demonstration to couple different quantum computing modules with specifications sufficient for fault-tolerant quantum computing.

AKjDPG 2: Tutorial Molecular Spectroscopy

Time: Sunday 17:00–18:30

Location: B302

Tutorial AKjDPG 2.1 Sun 17:00 B302
New perspectives in the investigation of ultrafast molecular dynamics — •ANDREA TRABATTONI — Center for Free-Electron Laser Science, Deutsches Elektronen-Synchrotron DESY, Hamburg, 22607, Germany — Institute of Quantum Optics, Leibniz Universität Hannover, Welfengarten 1, 30167 Hannover, Germany

Imaging the microscopic world in real space and real time is a grand challenge of science. In this context, the landscape of techniques to image ultrafast molecular dynamics is vast, including promising and powerful methods such as lightwave-driven scanning tunnelling microscopy or photoelectron diffraction. In this tutorial, the main methods and results in the field of ultrafast molecular physics will be presented, with a particular emphasis on laser-induced electron diffraction (LIED) in terms of experimental results and advanced modeling. Possible perspectives toward the future advancement of time-resolved molecular imaging will be discussed.

Tutorial AKjDPG 2.2 Sun 17:45 B302

Femtosecond spectroscopy in the condensed and gas phase — •LUKAS BRUDER — Institute of Physics, University of Freiburg, Hermann-Herder-Str. 3 79104 Freiburg

Molecular processes can be extremely fast and often involve many degrees of freedom. This poses a major challenge for experiments. The problem can be tackled with femtosecond spectroscopy, which allows to resolve the molecular dynamics in real-time. The majority of femtosecond spectroscopy is performed in the condensed phase, which is the natural environment of most molecular processes. On the contrary, experiments in the gas phase allow to study molecular model systems such as isolated molecules and molecular complexes. This provides a complementary view on the molecular dynamics. Hence, both approaches are important in order to improve our understanding of molecular dynamics.

In this tutorial I will give a basic introduction to femtosecond spectroscopy including coherent multidimensional spectroscopy and discuss the technical differences for experiments in the condensed phase and gas phase.