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

Vivienne Leidel
Fraunhofer-Institut für Angewandte Festkörperphysik
Tullastraße 72
79108 Freiburg
leidel@jdpg.de

## Overview of Invited Talks and Sessions

(Lecture halls HS 3042 and HS 3044)

### Sessions

| | | | | |
|---|---|---|---|---|
| AKjDPG 1.1–1.2 | Sun | 17:00–18:30 | HS 3042 | **Tutorial: Mass Spectrometry** |
| AKjDPG 2.1–2.2 | Sun | 17:00–18:30 | HS 3044 | **Tutorial: Dipolar Gases** |

## AKjDPG 1: Tutorial: Mass Spectrometry

Time: Sunday 17:00–18:30 Location: HS 3042

**Tutorial** AKjDPG 1.1 Sun 17:00 HS 3042
**High-precision Penning-trap mass spectrometry: Basics and Applications** — •Klaus Blaum — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg

Like few other parameters, the mass of an atom, and its inherent connection with the atomic and nuclear binding energy and thus with the acting forces is a fundamental property, a unique fingerprint of the atomic nucleus. Depending on the mass precision reached the applications range from the verification of nuclear mass models, nuclear astrophysics, determination of fundamental constants, to a test of the Standard Model of particle physics. The introduction of Penning traps and storage rings into the field of mass spectrometry has made these methods a prime choice for high-precision mass measurements on short-lived and stable nuclides. In this tutorial the basics of Penning-trap mass spectrometry and its most recent applications will be presented.

**Tutorial** AKjDPG 1.2 Sun 17:45 HS 3042
**Radioactive ions in heavy-ion storage rings: Intersection of nuclear, atomic and astrophysics** — •Yury A Litvinov — GSI Helmholtz Center for Heavy Ion Research GmbH, Planckstrasse 1, 64291 Darmstadt

Storage of freshly produced secondary particles in an ion trap or a storage ring is a straightforward way to achieve the most efficient use of these rare species. Heavy-ion storage rings are multi-purpose machines with versatile capabilities for beam manipulations. The number of physics cases possible to address is enormous. Following the introduction to storage rings, the focus of the tutorial will be on precision experiments with highly-charged ions at the intersection of atomic physics, nuclear structure and astrophysics. We will mainly discuss the storage-ring mass spectrometry, which is complimentary to the one at the Penning traps, and exotic radioactive decays, which open up only in highly-charged ions.

## AKjDPG 2: Tutorial: Dipolar Gases

Time: Sunday 17:00–18:30 Location: HS 3044

**Tutorial** AKjDPG 2.1 Sun 17:00 HS 3044
**Experiments with Ultracold Quantum Gases of Magnetic Atoms** — •Lauriane Chomaz — Physikalisches Institut, Universität Heidelberg, Im Neuenheimer Feld 226

Ultracold quantum gases provide a pristine platform to study few-body and many-body quantum phenomena with an exquisite degree of control. The achievement of quantum degeneracy in gases of atoms with large magnetic dipole moments in their electronic ground states has opened new avenues of research in which long-range anisotropic dipole-dipole interactions play a crucial role. In this one-hour introductory lecture, I will give an overview of the magnetic quantum gas experimental platform and of the recent discoveries based on this platform [1]. Magnetic quantum gases allow easy access to ultracold temperature and quantum degeneracy in many-particle systems, and provide a wide variety of tuning knobs, in particular over the interaction competition and the gas confinement geometry. Fine control of this interaction competition and gas geometry has led in recent years to the discovery of novel many-body quantum states, including liquid-like droplets, droplet crystals, and supersolids, a paradoxical phase of matter that simultaneously exhibits solid and superfluid orders. I will highlight current research directions and prospects opened up by these discoveries and the increasing level of control.

[1] L. Chomaz, I. Ferrier-Barbut, F. Ferlaino, B. Laburthe-Tolra, B. L. Lev, and T. Pfau, Dipolar physics: a review of experiments with magnetic quantum gases, Rep. Prog. Phys. 86, 026401 (2023).

**Tutorial** AKjDPG 2.2 Sun 17:45 HS 3044
**Theoretical modelling of dipolar quantum gases** — •Thomas Bland — Universität Innsbruck, Institut für Experimentalphysik, Innsbruck, Austria

Since the first observation of a Bose-Einstein condensate (BEC) made from strongly magnetic atoms, these systems have proven to be a rich source of new and fascinating phenomena arising from the long-range and anisotropic dipole-dipole interaction. In this tutorial, I will introduce the underlying theoretical models of these systems; ranging from mean-field theories for bulk gases that predict, for example, the existence of the supersolid phase, to many-body theories for atoms trapped in optical lattices, where the long-range interactions introduce a plethora of new quantum phases with links to a broad range of condensed matter and solid-state systems.