Q 1: Tutorial Chirality (joint session AKjDPG/Q)

Time: Sunday 16:00–18:00 Location: b305

Tutorial Q 1.1 Sun 16:00 b305

Photoionization with polarization-shaped ultrashort laser pulses — •Matthias Wollenhaupt — Carl von Ossietzky Universität Oldenburg, Institut für Physik, Oldenburg

Nowadays, multiphoton ionization (MPI) using advanced light sources and sophisticated detection techniques is investigated to observe and control ultrafast quantum dynamics. In this tutorial, we present an introduction to the coherent control of photoionization with ultrashort laser pulses and give an overview on experimental techniques for femtosecond laser pulse shaping and tomographic reconstruction of 3D photoelectron momentum distributions. Based on relevant experiments, we will discuss the underlying physical mechanisms of controlled MPI. In the first experiment, phase-locked double pulse sequence laser pulses are used to control interferences in the momentum distribution of free electron wave packets [1]. We introduce non-perturbative control by manipulation of dressed state population dynamics through the optical phases. The main part of the tutorial deals with 3D control of the momentum distribution of free electron wave packets. We discuss the creation of vortex-shaped photoelectron momentum distributions with counterrotating circularly polarized femtosecond laser pulses [2] and highlight experiments with bichromatic carrier-envelop phase-stable polarization-tailored laser pulses to generate c7 rotationally symmetric and asymmetric momentum distributions [3].

[1]M. Wollenhaupt et al., Phys. Rev. Lett. 89, 173001 (2002)
[2]D. Pengel et al., Phys. Rev. Lett. 118, 053003 (2017)
[3]S. Kerbstadt et al., Nat. Comm. 10, 658 (2019)

Tutorial Q 1.2 Sun 17:00 b305

The orbital angular momentum of light — •Giacomo Sorelli — Département ElectroMagnétisme et Radar, Onera - Palaiseau - France — Laboratoire Kastler Brossel, Sorbonne Université, CNRS, ENS-Université PSL, Collège de France, Paris, France

Light carries energy, as well as linear and angular momenta. While the energy and the linear momentum were already understood in the second half of the nineteenth century, the history of the angular momentum of light is more recent. The angular momentum of an electromagnetic wave can be decomposed into two parts: a spin contribution associated with the vectorial nature of the electromagnetic field, and an orbital contribution which is related to the light's spatial intensity and phase profiles. The spin component of light was already studied in the thirties by Beth, who established a connection between angular momentum and circular polarisation. On the contrary, the orbital contribution was not investigated before the 1990s when Allen and coworkers showed that some paraxial light beams carry a well defined orbital angular momentum (OAM). These beams have a very peculiar spatial profile, which is characterised by a central dark area around the beam axis and a spiral phase front. In this talk, I first introduce the angular momentum of the electromagnetic field from a classical electrodynamics' viewpoint and present some paraxial light beams carrying OAM. I then quantise the electromagnetic field and discuss some quantum properties of the angular momentum of photons. Finally, I describe how OAM-carrying photons are produced in the laboratory and discuss some of their applications in quantum information.