

11<sup>th</sup> July 2019 - 10:00 h

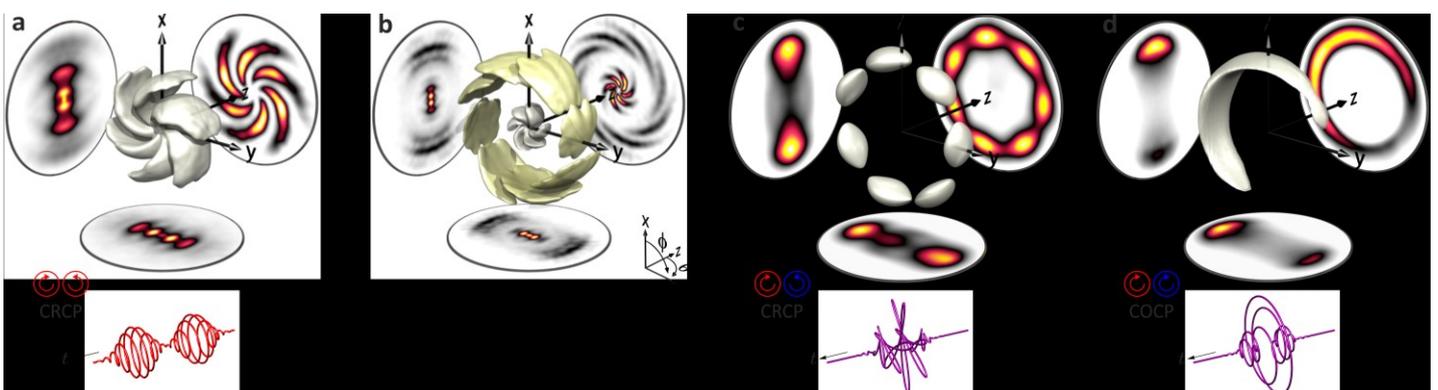
CFEL – Building 99, seminar room I+II (ground floor)

## Matthias Wollenhaupt

Carl von Ossietzky Universität Oldenburg, Germany

### Control of free electron wave packets by bichromatic CEP-stable polarization-tailored supercontinua

Three-dimensional photoelectron momentum distributions (PMDs) with unusual symmetry properties are generated by multiphoton ionization (MPI) of atoms using polarization-tailored ultrashort laser fields. The PMDs are manipulated by the pulse parameters including the carrier-envelope phase (CEP). In the experiment, we combine supercontinuum pulse shaping with photoelectron tomography for 3D reconstruction of the PMD. A  $4f$  polarization pulse shaper is used to sculpture bichromatic fields from a CEP-stable white light supercontinuum by spectral amplitude and phase modulation. MPI of atoms with single-color sequences of counterrotating circularly polarized (CRCP) femtosecond laser pulses produces vortex-shaped PMDs with even-numbered rotational symmetry ( $c_4$ ,  $c_6$  and  $c_8$ ). In contrast, bichromatic ( $3\omega/4\omega$ ) CEP-stable counter- (CRCP) and corotating (COCP) femtosecond laser pulses generate  $c_7$  rotationally symmetric or asymmetric PMDs. Using bichromatic parallel linearly polarized (PLP) and orthogonally linearly polarized (OLP) fields, we controlled the directional photoemission and observed asymmetric PMDs by the interference of angular momentum states with opposite parities and orthogonal symmetry axis. We investigated the interrelation of the polarization profile of the driving field and the symmetry properties of the electron wave packets by varying the optical field parameters. Our analysis showed that the interplay of nonlinear spectral interference and  $N$ - vs  $M$ -photon multipath quantum interference is the key to controlled bichromatic MPI.



Experimental results: (a) single-color CRCP pulses create free electron vortices with  $c_6$  rotational symmetry at the ionization threshold and (b)  $c_8$  rotational symmetry in the ATI. (c) Bichromatic ionization with CRCP pulses creates