Universität Regensburg

FAKULTÄT FÜR PHYSIK
Lehrstuhl für Experimentelle und Angewandte Physik

Prof. Dr. Rupert Huber

Seminar within CRC 1277

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Dynamical phase measurements via all-optical attosecond interferometry

Abstract:
Interferometry has been at the heart of wave optics since its early stages, resolving the coherence of the light field and enabling the complete reconstruction of the optical information it encodes. In my talk I will describe a novel scheme for attosecond interferometry, based on an all-optical approach, obtaining a direct access to the optical phase of coherent XUV light, generated via high-harmonic generation (1). This scheme also addresses one of the most important challenges in attosecond science, controlling the polarization state of attosecond pulses. By creating a collinear superposition of two independent, phase-locked, orthogonally polarized XUV sources and accurately controlling their relative delay we control the polarization state, unlocking a new method to probe chirality using attosecond pulses (2).
Recently, we have extended attosecond interferometry to the time-domain, following the evolution of the phase of attosecond pulses within a fraction of the optical cycle, establishing attosecond-gated interferometry. This scheme increases the dimensionality of the measurement by combing it with in-situ subcycle gating, following the evolution of the interferogram with the gate position. Using this scheme, we probe the evolution of an electronic wavefunction under the tunnelling barrier and record the phase acquired by an electron as it propagates in a classically forbidden region (3). In the most recent work, we demonstrated attosecond transient interferometry, recovering the lost phase information, so far hidden in transient absorption measurements (4). We reveal how such phase measurement enables us to completely decouple the various quantum paths that are induced by the nonlinear interaction, isolating their coherent contribution and following their temporal evolution.

(1) Azoury, D., Kneller, O. et al. “Electronic wavefunctions probed by all-optical attosecond interferometry”, Nature Photonics (2019).
(2) Azoury, D.*, Kneller, O.* et al. “Interferometric attosecond lock-in measurement of extreme-ultraviolet circular dichroism”, Nature Photonics (2019).
(3) Kneller O., Azoury D. et al. “A look under the tunnelling barrier via attosecond-gated interferometry”, Nature Photonics (2022).
(4) Kneller O.*, C. Mor* et al. “Attosecond transient interferometry”, under review. Preprint: doi:10.21203/rs.3.rs-2615689/v1

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