Polychromatic photoionization of atoms in atto- and femtosecond domain

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Attosecond pulses are crucial for the investigation of valence and core-electron dynamics on its natural timescale. So far, the only viable route for the reproducible generation of attosecond pulses is the process of high-order harmonic generation in gases. The temporal characterization of the isolated or trains of attosecond pulses is usually based on the cross-correlation between the extreme ultraviolet waveform and a synchronized infrared field. Attosecond waveform shaping has been limited so far to a few experimental results based on the use of metallic filters [1,2], multilayer mirrors [3], and the shaping of the driving field [3]. However, in these methods amplitude and phase control are connected to each other and they do not allow for a pure amplitude and/or phase control. The generation of intense, multicolor fields in the extreme ultraviolet spectral range at Free Electron Lasers (FELs) opens new perspectives for the characterization and control of nonlinear processes in atoms and molecules. These sources can deliver pulses with the high peak intensities enabling the observation of nonlinear processes. The seeded FEL FERMI (Trieste, Italy) offers the possibility to synthetize multicolor coherent fields, whose amplitudes and relative phases can be independently controlled. The first experimental demonstration of the coherent control in the XUV spectral region was reported by combining two harmonics with adjustable relative phase and by measuring the photoelectron angular distribution generated by the single and two-photonionisation process [5]. In this context, the coherent superposition of several harmonics of the seeded FEL FERMI would offer new perspectives in the synthesization of complex extreme ultraviolet waveforms.
I will present novel results about the synthesis and temporal characterization of attosecond multicolor fields in the XUV and X-ray spectral range using FELs.
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