Shaping polarization of attosecond pulses via laser control of electron and hole dynamics

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We present [1] a way to control and shape the polarization of attosecond pulses generated by HHG by using the combination of the fundamental radiation and its second harmonic, both linearly polarized, in perpendicular geometry. We explore the vast possibilities of this control mechanism by extending the multi-electron analysis done for the CO_2 molecule in previous works [2] to treat the two-colour laser fields. This second colour component of the field allows one to control the angle of recombination of the electron which, in turns, controls the relative magnitudes of the different recombination channels as each of these channels has preferred recombination angles. At the same time, this second field also induces dynamics in the molecular ion upon ionization, which leads to population transfer between the different ionic states. Therefore the magnitude of additional recombination channels can be controlled by the relative intensity and the phase delay between the two driving fields. This control scheme is ready for experimental tests, as the setup has already been implemented in recent experiments [3-4].

The manipulation of amplitude and phases of several interfering HHG channels results in fine control of the polarization properties of the XUV emission, as can be seen in Figure 1, where three examples of such control are shown. The instantaneous rotation of the time-dependent polarization ellipse is plotted. As it can be seen, one of the pulses of each example is close to circularly polarized virtually everywhere, while the other one has almost linear polarization, with a pronounced rotation of the polarization ellipse.

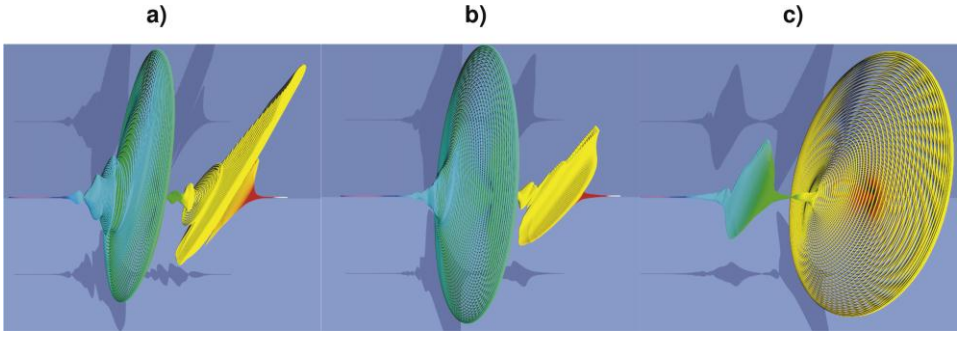

Fig. 1 Three examples of attosecond pulses produced by filtering the calculated HHG signal (a) around harmonic 23 for delay between the two colors $\varphi = 3\pi/8$ rad, (b) around harmonic 21, delay $\varphi = \pi/2$ rad, (c) around harmonic 19, delay $\varphi = 5\pi/8$ rad. The fundamental field intensity is $I = 1.25 \times 10^{14}$ W/cm^2, and the second harmonic field is set at 144% of intensity of the fundamental. The molecule is aligned 35 degrees with respect to the fundamental field. The plots shows instantaneous rotation of the time-dependent polarization ellipse.

References:

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