Multiphoton Ionization in Counter Rotating Circularly Polarized Two-Color Laser Fields

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Synopsis The electron energy spectrum generated via strong field ionization by a circularly polarized laser field is compared to the spectrum of a counter rotating two-color laser field while both are measured the intensity regime of multiphoton ionization.

Strong laser fields efficiently ionize atoms and molecules. A laser pulse composed of two harmonic colors allows to control the shape of the electric field with various combinations of the polarizations, intensities and relative phase of the two-color laser field. This allows to shape the light field and thus to steer the electron motion in the continuum [1, 2]. Particularly versatile and in addition well controllable waveforms are generated by counter rotating circular two-color (CRTC) fields as shown in Fig. 1. In the tunneling regime ($\gamma < 1$) emitted electrons that recollide with their parent ions in CRTC fields have been used to generate circularly polarized higher harmonic light [3] and investigate the energy spectrum

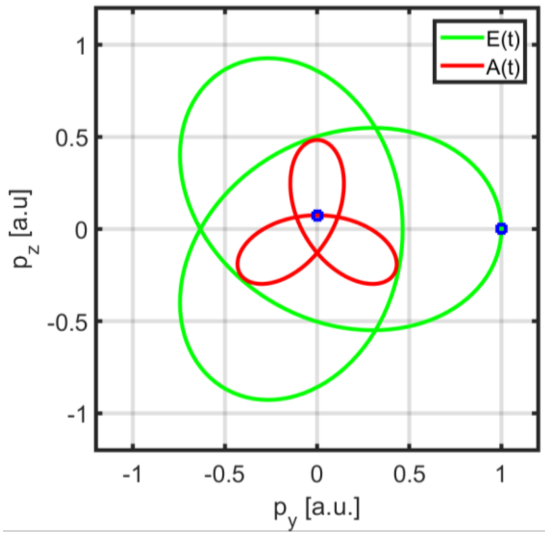

Figure 2: Electric field E(t) in green and the corresponding vector potential A(t) in red. The marked blue points indicate the given vector potential for the maximum electric field.

of the recolliding electron [4]. We investigate CRTC fields in the multiphoton regime ($\gamma > 1$) which gives us the opportunity to learn more about the ionization process in strong-fields [5]. We ionize argon atoms using a CRTC field and compare the resulting energy spectrum of the electron with ionization that occurred only by the second harmonic field. The CRTC field is dominated by 390 nm with an intensity of $7.5 * 10^{13}\ W/cm^2$ for the second harmonic and $1.0 * 10^{13}\ W/cm^2$ for the fundamental wavelength. The intensities of the individual colors are in the multiphoton regime with Keldysh parameters of

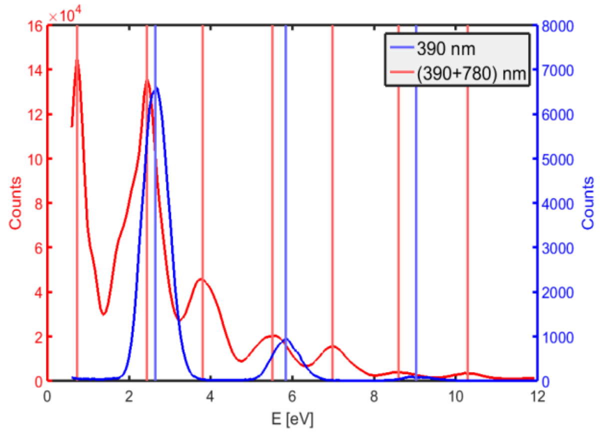

Figure 1: Comparison of the energy spectrum of the CRTC (390 nm + 780 nm) and the second harmonic field (390 nm). The peaks in the energy spectrum are marked as vertical lines, in red for the CRTC field and in blue for the simple second harmonic field. For the simple second harmonic field ATI structure can be seen. As expected the peaks are shifted to lower energies for the CRTC field.

$\gamma_{390nm} = 2.7$ and $\gamma_{780nm} = 3.7$. For the combined electric field structures which might not be described by multiphoton ionization are observed. We will present data in the described regime which could be related to non-adiabatic tunneling [5]. The used field and the corresponding vector potential are shown in figure 1. First preliminary results are shown in figure 2.

References

[1] C.A. Mancuso et al. 2015 Phys. Rev. A 91 031402
[2] Ji-Wei Geng *et al.* 2015 *Phys. Rev. Lett.* **115** 193001
[3] W. Becker *et al.* 1999 *Phys. Rev. A* **60** 1721-1722
[4] S. Eckart *et al. 2016 Phys. Rev. Lett.* **117** 133202
[5] M. Y. Ivanov *et al. 2005 J. Mod. Opt.* **52** (2-3) 165-184

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