Intracycle interference in ionization of Ar by a laser assisted XUV pulse

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Synopsis We present a theoretical and experimental study of the subcycle interference in laser assisted XUV ionization of Ar atoms. Averaging over the focal volume happens to blur the intracycle interference, which thus cannot be measured directly. We show that even in these conditions, the intracycle interference can be obtained through the subtraction of two different angle and energy-resolved distributions at slightly different laser intensities.

Intracycle interferences are crucial in the understanding of above-threshold ionization by near infrared lasers [1]. Recently, it was calculated for the case of laser assisted XUV ionization [2,3].

In this work, we show that even in experiments where interferences are missing or hidden by the varying intensities in the focal volume, the intracycle interference evidenced in the modulation of the sidebands emerges when the two angle-resolved and energy-resolved distributions taken at somewhat different laser intensity are subtracted.

The experiments presented here are carried out using recently constructed XUV time delay compensating monochromator beamline [4] and a velocity map imaging spectrometer. This system is capable of producing a wavelength-selected, but short XUV pulse and thus is best suitable for studying laser-assisted XUV ionization processes. In the experiments, Atoms are ionized by 29.5 eV photons in the presence of IR field, which leads to generation of several sidebands.

In Figure 1 we observe the difference of the angle and energy-resolved distribution photoelectron distribution recorded for two different laser intensities. The red color corresponds to positive values and the blue color to negative ones. Near zero values of the difference are in white color. We see the resemblance between the calculated map by numerically solving the time-dependent Schrödinger equation and the measured map. In both, the distributions align around the polarization axis of both IR and XUV fields (0 and 180 deg.).

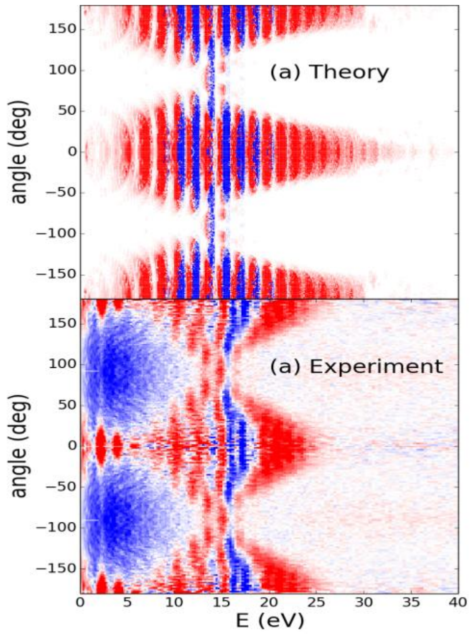

Figure 1. Difference of photoelectron distributions for two somewhat different laser intensities: around I ~ 6 × 10^{13} W/cm^2 for the Ar atom ionized by an XUV pulse due to the 19th harmonic of a laser pulse of λ = *800* nm. (a) Theory, (b) Experiment. The red color corresponds to positive values and the blue to negative. The laser field is linearly polarized along the z-axis.

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