Photoelectron Angular Distributions at the Ionization of Atoms by Intense Sub-one-cycle Laser Pulses

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Synopsis: The phase sensitivity of the photoelectron angular distributions by intense sub-one-cycle linearly polarized laser pulses has been investigated within the analytic Landau–Dykhne approximation. In both cases of sine and cosine laser pulses most of the electrons are ejected along the polarization axis of the laser field. Nevertheless the electron yield and the electron kinetic energies are much larger for the cosine waveform pulse.

The phase sensitivity of the photoelectron angular distributions by intense sub-one-cycle linearly polarized laser pulses is discussed within the analytic Landau-Dykhne approximation. In the case of many-cycle pulses, for this approximation to be valid it is required that the photon energy $\hbar\omega$ of the laser radiation be small compared to the atomic ionization potential E_i. For sub-one-cycle laser pulses the generalized Keldysh parameter $\gamma = \sqrt{2E_i}/F\tau$ depending on the duration of the laser pulse was introduced. The non-relativistic ionization rate is of the form

$$w \sim \exp\left\{-(2/\hbar)\,\mathrm{Im}\int_0^{t_0}\left[E(t)+E_i\right]dt\right\}$$

(with the exponential accuracy).

With the Landau-Dykhne approach, we obtained analytic expressions for the energy spectra.

In the case of sine and cosine waveform laser pulses most of electrons are ejected along the polarization axis of the laser field. But the electron yield and electron kinetic energies are much larger for cosine waveform pulse. We conclude that the carrier-envelope-phase difference is one of the essential control parameters in few-cycle pulses applications and attosecond science.

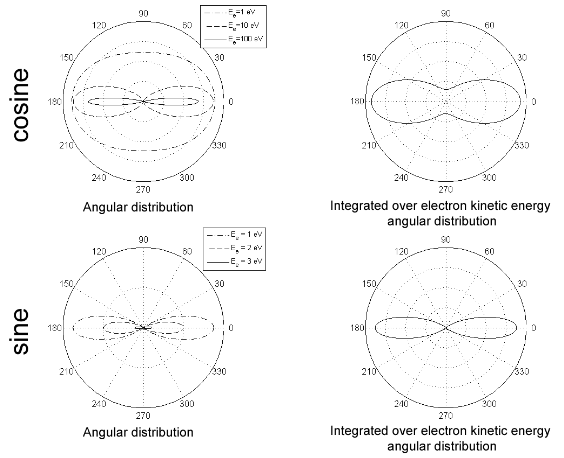

Fig. 1. Some results of numerical calculation.

References

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