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Temporal Talbot effect in propagation of attosecond electron waves

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The rapid development in extreme strong-field and extreme short-pulse laser physics provide us with many potentials to explore the dynamics of fundamental processes taking place in light-matter interactions and in propagation of electromagnetic [1] or matter waves [2]. The present paper discusses the propagation of above-threshold electron waves generated by (not necessary ultra-short) strong laser fields. Recently we have shown [3] that – in analogy with the formation of attosecond light pulses by interference of high-order harmonics – the wave components of photoelectrons are naturally assembled in attosecond spikes, through the Fourier synthesis of these de Broglie waves. We would like to emphasize that the proposed scheme does not presupposes an *a priori* ultrashort excitation. Owing to the inherent dispersion of electron waves even in vacuum, the clean attosecond structure (emanating perpendicularly from a metal target surface) is gradually spoiled due to destructive interference. Fortunately the collapsed fine structure recovers itself at certain distances from the source within well-defined 'revival layers'. This is a temporal analogon of the optical Talbot effect representing the self-imaging of a grating, which is illuminated by stationary plane waves, in the near field. The 'collaps bands' and the 'revival layers' introduced in ref. [3] have been found merely on the basis of some numerical illustrations of the dynamics of the above-threshold current. The locations and durations of the attosecond layers turned out to show certain reguralities. In the meantime we have derived approximate analytic formulae for the propagation characteristics, with the help of which we can keep track of the locations of the 'collaps bands' and the 'revival layers' on a larger scale. We shall report on these semiclassical results, and also discuss their possible connection with the recently found entropy remnants [4] in multiphoton Compton scattering by electronic wave packets.

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Optimization of the produced wakefield by two intense short laser pulses

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In this work it is shown that the electrons can be trapped and accelerated to the higher energies by two pulses in comparing to the single laser pulse with the same energy. A detailed analytical study of wakefield amplification making use of two laser pulses copropagating one behind the other, with a fixed time between them is presented. Three basic pulses in the shape of rectangular, Gaussian and sinusoidal are considered. It is found that when the first of the two laser pulses is rectangular and the second pulse is sinusoidal the produced wake field is maximum.