

# Momentum mapping of continuum electron wave packet interference

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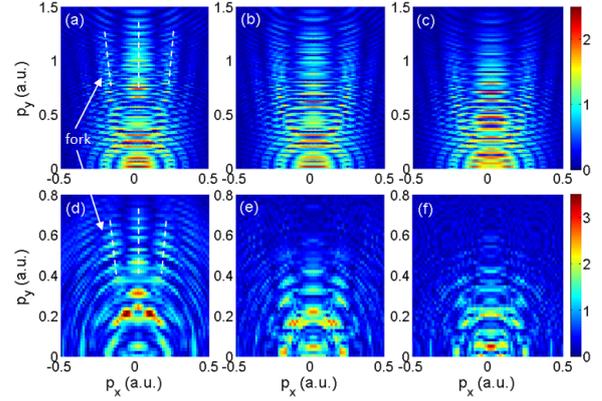
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**Synopsis** We analyze the two-dimensional photoelectron momentum distribution of Ar atom ionized by midinfrared laser pulses and mainly concentrate on the energy range below  $2U_p$ . We demonstrate firstly that a profound ring-like pattern coming from the interplay between the intra- and inter-cycle interference of electron trajectories can be observed in deep tunneling ionization regime. Moreover, we found that the rescattered electrons play a negligible role on the formation of ring-like interference pattern, and the appearance of the ring-like interference pattern masks the holographic interference structure. Our results provide an appropriate experimental condition for observation of the photoelectron holography and help to gaining physical insight into corresponding ultrafast electron dynamic process with attosecond temporal resolution.

Coulomb potential effects in photoelectron holography (PH) with midinfrared wavelength laser pulses are investigated by solving numerically the time-dependent Schrödinger equation (TDSE) and using a generalized quantum-trajectory Monte Carlo (GQTMC) method. It is found that the Coulomb potential plays a key role in the interference of PH, especially in the parameter region  $\gamma \sim 1$  ( $\gamma = \sqrt{I_p/2U_p}$  is the Keldysh parameter) where the potential barrier combining with the laser and Coulomb field changes drastically. The interference structure of PH can be observed in photoelectron momentum distribution (PMD) in tunneling regime where  $\gamma < 1$  either with or without considering the long-range Coulomb potential. The interference structure of PH cannot be observed without the long-range Coulomb potential in the parameter region where  $\gamma \sim 1$ . With the help of the GQTMC simulation, we show that the wavepacket dynamics of rescattered electrons can be influenced strongly by the Coulomb field. The rescattered electrons miss the first return to the parent ion without the long-range Coulomb potential. Therefore, the interference between the direct and rescattered electron wavepackets can hardly occur without the driving of the Coulomb force, which agrees well with the TDSE simulation. Moreover, the interference structures in PMD for different laser parameters provide the information of electron dynamics with sub-optical-cycle resolution.



**Figure 1.** (Color online) Photoelectron momentum distribution for ionization of Xe by a laser pulse with 1700 nm, (a), (b), and (c)  $7.0 \times 10^{13}$  W/cm<sup>2</sup>, and  $\gamma = 0.55$ , and (d), (e) and (f)  $1.2 \times 10^{13}$  W/cm<sup>2</sup>, and  $\gamma = 1.33$ , calculated by the TDSE with (a) and (d) the full long-range Coulomb potential, (b) and (e) the modified potential with  $r_c = 5$ , and (c) and (f) the modified potential with  $r_c = 2$ .

## References

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