Universal Description of Attoclock with Two-Color Corotating Circular Fields

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Tracking ultrafast electron dynamics on the attosecond time scale is essential to understand the mechanism of fundamental photoionisation processes. With the development of ultrashort pulses, it becomes possible to probe ultrafast electron dynamics during photoionisation, like the so-called ‘attoclock’ technique [1], which is based on the strong-field ionisation with few-cycle circularly polarised pulses. Recently, the double-pointer attoclock has been established with the two-colour corotating circular fields, in which the fundamental field acts as the hour pointer while the second harmonic field acts as the minute pointer of the clock [2]. This interaction geometry can be directly mimicked as the rotating temporal double-slit experiment. With this time-resolved electron interferometry, in principle, one can retrieve the information of ionisation dynamics from the interference pattern. Previous work has shown that the photoelectron momentum distribution (PMD) in such interaction geometry depends on the relative intensity of the two colours [3,4]; thus it is necessary to give a general description on how the double-pointer attoclock works at various relative intensities.

Experimentally, we measure the laser-intensity-dependent PMDs of Ar atoms with two-colour corotating circularly polarised fields [5]. The interference patterns on PMDs reveal complex structures with respect to the laser intensity ratio. Using strong-field approximation, we analytically explain how the interference pattern on PMD evolves with respect to the relative laser intensity. By analysing the interference pattern, we reveal the phase difference and the temporal evolution of the emitting electron wave packets. We show that, when monitoring the intensity ratio, the double-pointer attoclock geometry with co-rotating circular fields can be universally mimicked as the spatially-rotating temporal double-slit experiments with the variable slit width, which can be used to probe and control strong-field ionisation.

References