Spectral Signatures of Resonant and Nonresonant Electron Dynamics in a Dynamically Dressed Atom

A Csehi[1]

[1] *Department of Theoretical Physics, University of Debrecen, 4026 Bem tér 18., Debrecen, Hungary.*
Contact Phone: +36704223317
Contact Email: csehi.andras@science.unideb.hu

We study the resonance-enhanced multiphoton ionization (REMPI) of atoms under intense and short laser pulses, *via* solving the time-dependent Schrödinger equation [1-4]. Owing to the resonant or near-resonant Stark-shifted intermediate levels, transient resonance suppressions and enhancements significantly modify the multiphoton ionization pathway, leaving clear fingerprints (asymmetry, splitting, shifting and multipeak pattern) in the energy spectrum of emitted photoelectrons [3]. We demonstrate that both Rabi oscillations (ROs) and dynamic interference (DI) lead to pronounced multipeak patterns in the spectrum of ionized photoelectrons. Since these two prominent dynamical effects usually coexist in REMPI, they are hard to distinguish. Revisiting the multipeak pattern of the Autler-Townes (AT) doublet, we uncover its physical origin by calculating the photoelectron spectrum accurately [5,6]. Our joint analytical and numerical analysis reveals that selectively populating the two emerging dynamically dressed states is key to an efficient balancing between ROs and DI. We demonstrate physical situations where either ROs or DI dictate the spectrum shape, and explore the transition between these regimes. Furthermore, we show that the asymmetry of the AT doublet is sensitively modified by different factors, such as the dynamic Stark shifts, frequency detuning, pulse shape or laser phase modulation. Our results contribute to the understanding and control of ultrafast coherent phenomena *via* the energy spectrum of particles emitted during the dynamical process under investigation.

References

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