Atomic and Molecular Dynamics in Ultrashort Intense Laser Pulses 1a-TH-2

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High-order harmonic generation (HHG) represents a versatile and highly successful avenue towards an ultrashort coherent light source in the extreme ultraviolet (XUV) and soft X-ray regions. This development has opened new research areas such as attosecond science. We theoretically study the atomic dynamics in such ultrashort intense laser and XUV pulses, based on the direct numerical solution of the time-dependent Schrödinger equation.

- **Dramatic enhancement of high-order harmonic generation and attosecond phenomena:** We have shown [1] that the irradiation of the XUV pulse boosts HHG by orders of magnitude. This dramatic enhancement (DE) effect has recently been experimentally demonstrated [2], and we propose its application as attosecond enhancement gate for isolated pulse generation (AEGIS)[3]. We also propose a temporal Young's interference experiment by attosecond double and triple soft-x-ray pulses combined with ultrashort laser pulses [4].
- **Wavelength-dependence of high-order harmonic generation**: The wavelength-dependence of HHG has recently become an issue of major interest. We have not only confirmed the global λ^{-5} scaling but also observed rapid fluctuations on a fine λ scale [5-7], originating from quantum path interferences. Furthermore, the DE harmonics exhibit surprisingly gentle global λ scaling (Fig. 1) and identified its origin as the initial spatial width of the wave function [8].

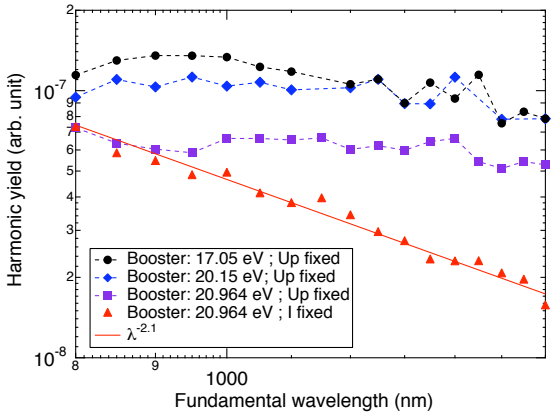

Fig. 1 Wavelength dependence of the calculated DE harmonic yield from He between 30 and 60 eV, for different values of booster photon energy.

References

[1] K. Ishikawa, Phys. Rev. Lett. **91**, 043002 (2003).
[2] E. J. Takahashi, T. Kanai, K. L. Ishikawa *et al.*, Phys. Rev. Lett. **99**, 053904 (2007).
[3] K. L. Ishikawa, E. J. Takahashi, and K. Midorikawa, Phys. Rev. A **75**, 021801(R) (2007).
[4] K. L. Ishikawa, Phys. Rev. A **74**, 023806 (2006).
[5] K. Schiessl, K. L. Ishikawa, E. Persson, and J. Burgdörfer *et al.*, Phys. Rev. Lett. **99**, 253903 (2007).
[6] K. Schiessl, K. L. Ishikawa, E. Persson, and J. Burgdörfer *et al.*, J. Mod. Opt. **55**, 2617 (2008).
[7] K. L. Ishikawa, K. Schiessl, E. Persson, and J. Burgdörfer *et al.*, Phys. Rev. A, in press (2009).
[8] K. L. Ishikawa, E. J. Takahashi, and K. Midorikawa, arXiv:0901.1727v1 [physics.atom-ph]

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