Chirp compensation of attosecond high harmonic pulses by the harmonic generation medium itself

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Attosecond pulse generation from high harmonics has been actively investigated in recent years and this has opened the new research area of attosecond physics and science [1]. The characterization of attosecond pulse train can be performed using the method of Reconstruction of Attosecond Beating by Interference of Two-photon Transitions (RABITT). High harmonic generation theory and experiments have shown that attosecond harmonic pulses are positively chirped mainly due to the quadratic spectral phase variation [2-4]. The attosecond pulse chirp compensation has been an issue limiting the achievement of transform-limited attosecond pulse. Chirp compensation using the dispersion property of an x-ray filter material was theoretically proposed [3] for the attosecond pulse chirp compensation and was experimentally implemented [4]. In this work, we report on the chirp compensation of attosecond harmonic pulses using the dispersion property of harmonic generation medium itself, not necessitating additional external control. We obtained an attosecond pulse train with a pulse width of 206 as from high harmonics from argon, which is very close to the transform limited pulse of width 200 as. The corresponding spectral range in this case corresponds from 40eV to 60eV, wherein a chirped compensating x-ray filter material is difficult to realize. This self-compression method is advantageous over that requiring an x-ray filter as the chirp compensated attosecond pulse is stronger as it does not suffer the strong absorption of the oxide layer on the x-ray filter material.

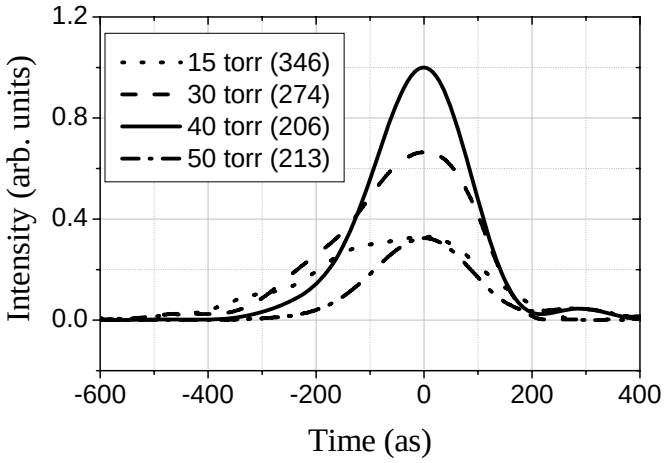

Fig. 1. Reconstructed attosecond pulse profile for different gas pressure.
The pulse widths in FWHM are shown in legend.

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