高次高調波によるアト秒X線パルスの増幅

AUTHOR(S):

Serrat, Carles

CITATION:

Serrat, Carles. 高次高調波によるアト秒X線パルスの増幅. 京都大学化学研究所スーパーコンピュータシステム研究成果報告書 2023, 2022: 87-87

ISSUE DATE:

2023-03

URL:

http://hdl.handle.net/2433/283203

高次高調波によるアト秒 X 線パルスの増幅
Amplification of X-ray attosecond pulses

Department of Physics, UPC-Polytechnic University of Catalonia, Carles Serrat

研究成果概要

In 2022, as a continuation of our research performed in 2021 and 2020, we have further investigated the amplification of attosecond pulses in helium. In 2020, the research was based on the single-electron numerical solution of the time-dependent Schrödinger equation (TDSE) for atomic processes in intense laser fields. The simulations performed with helium as amplifying medium provided interesting insight of the physical processes involved in the experimentally observed amplification around 100 eV, far from the ionization threshold of helium. An article reporting both theoretical and experimental results was published [C. Serrat, J. Seres, E. Seres, T-H. Dinh, N. Hasegawa, M. Nishikino and S. Namba, "Parametric attosecond pulse amplification from high order harmonic generation in He^+ far from the ionization threshold.", Optics Express 28, 24243 (2020)]. In order to simulate propagation effects in parametric amplification process, in we then performed numerical simulations based on the single-atom response calculated by solving the 1D Schrödinger equation in the strong field approximation (SFA) in the nonadiabatic form, so that the full electric field of the laser pulse is used to calculate the nonlinear dipole moment. The simulations were compared with recently obtained results from the experiments and we found good agreement between theory and experimental measurements, demonstrating a new nonlinear effect on the parametric amplification produced by plasma dispersion. These results were published in: J. Seres, E. Seres, C. Serrat, T. H. Dinh, N. Hasegawa, M. Ishino, M. Nishikino, K. Nakano, and S. Namba "Nonlinear propagation effect in x-ray parametric amplification during high harmonic generation", J. Opt. Soc. Am. B 39, 1263 (2022). As a continuation of our research, we have considered full 3D propagation of harmonics within the SFA for the single atom interaction and considering several T-shaped amplification geometries, extensively studying many different medium and laser parameters in order to reproduce the recent experimental results. The present simulations are being analyzed and a combined experimental and theoretical article is being prepared.

発表論文（謝辞あり）

“Nonlinear propagation effect in x-ray parametric amplification during high harmonic generation”, J. SERES, E. SERES, C. SERRAT, T. H. DINH, N. HASEGAWA, M. ISHINO, M. NISHIKINO, K. NAKANO, AND S. NAMBA, J. Opt. Soc. America B34, pp.1263-1271 (2022).