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Proposal for a comprehensive characterization method for attosecond pulses generated by relativistic plasmas

Chaoneng Wu

Shenzhen Technology University, China

To date, surface High-Order Harmonic Generation (HHG) has emerged as a promising method to address the limitations of gas-based HHG for producing ultra-bright EUV/XUV attosecond sources. However, spatiotemporal characterization of attosecond pulses remains a significant challenge due to their octave bandwidth and highly modulated spectral profiles. To optimize higher-order harmonics generated by laser-irradiated plasma surfaces, we explore the use of Spectral Phase Interferometry for Direct Electric-field Reconstruction (SPIDER) through detailed numerical simulations in the relativistic regime.

The HHG signals, driven by two spectrally sheared infrared pulses, were simulated in the near-field region using the particle-in-cell algorithm, and the wave propagation to the far-field detector was analyzed using Kirchhoff diffraction theory. Experimental alignments were discussed in terms of interference, considering the optical apparatus resolution and experimental setup requirements. Simulation results indicate that complete temporal characterization of HHG from laser-irradiated plasma can be achieved with a well-aligned interference system, validated by both near-isolated and multi-pulsed temporal profiles. This robust, full-optical, single-shot characterization method provides insights into the complex radiation processes in highly nonlinear laser-plasma interactions. When combined with wave-front measurements using a high numerical aperture Hartmann wave-front sensor, this approach allows for the full evaluation of spatiotemporal information and precise control of ultrafast EUV/XUV pulse.

Biography

Chaoneng Wu is a postdoctoral fellow at Shenzhen Technoledge University, works in the research group led by prof. Lu Li. His areas of research interst are high-order harmonic generation and the ultrafast spatiotemporal characterizations. .