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European Congress on LASER, OPTICS AND PHOTONICS

November 24-25, 2022 | Webinar

Proposal for complete characterization method of attosecond pulse from relativistic plasmas

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To date, the surface high-order harmonic generation (HHG) process has been recognized as a promising way to overcome the shortages of gas HHG for achieving an ultra-bright EUX/XUV attosecond source. However, the spatiotemporal characterization of attosecond pulses, a critical step towards its application, is a challenging problem due to its inherent nature, including the octave bandwidth and highly modulated spectral profiles. To optimize the higher-order harmonics generated by the laser-irradiated plasma surface, complete reconstruction using the spectral phase interferometry for direct electric-field reconstruction (SPIDER) method is studied in detail with numerical simulations in the relativistic region. The HHG signals driven by two individual spectrally sheared infrared pulses were simulated in the near-field region using the particle-in-cell algorithm. The wave propagation process to the far-field detector was evaluated using the Kirchhoff diffraction theory. Experimental alignments were discussed for the interference, taking into account the resolution of the optical apparatus and the requirements of the experimental setup. The simulation results suggest that complete temporal characterization of the HHG of a laser-irradiated plasma can be achieved with a properly aligned interference system, verified with both the near-isolated and multi-pulsed temporal profiles. This robust, full-optical, single-shot characterization method provides a route to unveil the complex radiation process in highly non-linear laser-plasma interactions. Combined with the wave-front measurements achieved using a high numerical aperture Hartmann wave-front sensor, the complete spatiotemporal information can be evaluated, allowing full control of ultrafast EUV/XUV pulses.

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.