Relativistic-intensity laser-plasma interaction at kHz repetition rate on a liquid sheet target

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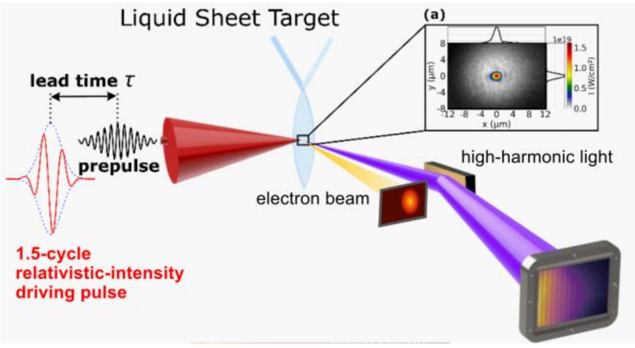
Plasma mirrors—reflective, overdense plasmas formed on condensed-phase targets—serve as versatile active optical devices for ultra-high intensity lasers and as model systems for studying (relativistic) plasma dynamics. Relativistic high-harmonic generation (RHHG) from plasma mirrors offers a promising route to generate intense attosecond pulses, efficiently converting laser light into XUV and soft X-ray pulses [1].

Traditionally, plasma mirrors have relied on bulk solid targets, which limit shot numbers due to surface refresh requirements. The advent of liquid-leaf targets with their continuous replenishment at multi-kHz rates marks a breakthrough in laser-plasma interactions, e.g. for particle acceleration [2]. The first demonstration of RHHG in a single-shot application [3] has proven that their surface quality is also suitable for plasma mirrors.



By employing flat ethylene glycol sheet targets with controlled plasma density gradients and relativistic-intensity, waveform-controlled near-single-cycle laser pulses, we have achieved reproducible high-flux RHHG with unprecedented stability [4]. Tuning of the driving laser waveform enables the generation of continuous XUV spectra, indicative of the isolated attosecond pulses [4].

The combination of laser waveform stability and liquid sheet targets yields a reliable, high-flux XUV beam, corresponding to a kHz-train of attosecond pulses with record-high intensity potential. This scalability paves the way for next-generation high-energy attosecond lasers.

REFERENCES

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