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Looking into solid-density plasmas with a pseudo-spectral solver and attosecond dispersion

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Extreme-ultraviolet pulses can propagate through ionized solid-density targets, unlike optical pulses, and thus have the potential to probe the interior of such plasmas on an attosecond time-scale. We present a synthetic diagnostic method for solid-density laser-generated plasmas based on the dispersion of an extreme-ultraviolet attosecond probe pulse, in a pump–probe scheme.

In our approach, the plasma dynamics in the presence of an optical pump is simulated using Smilei, while the dispersion of the probe is calculated with an external pseudo-spectral (PS) wave solver implemented in Python, allowing for high accuracy when calculating the dispersion. To this end, the output from Smilei must be read and interpolated by the PS code; at the moment, we can read either ParticleBinning or TrackParticles diagnostics. The tools, both for reading/interpolating Smilei output and for running the PS computation, are freely available on GitHub.

We illustrate the application of this method on thin-film plastic and aluminium targets irradiated by a high-intensity pump pulse. By comparing the dispersion of the probe pulse at different delays relative to the pump, it is possible to follow the time evolution of the plasma as it disintegrates.

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