

Multi-TW peak power laser pulses with sub-5 fs duration from a single thin plate compressor

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Post-compression of ultrashort pulses down to the single-cycle regime has been already demonstrated by spectral broadening in multiple dielectric thin plates (MPC) in the sub-mJ energy range with high optical efficiency [1,2]. Energy scaling was also explored down to 10 fs duration with 100 TW-class input pulses [3]. Single-cycle pulses with above mJ energy have only been achieved via the use of the hollow-core fiber technique [4].

Here we present our experimental results on the post-compression of the 12 fs pulses of the 10 Hz SEA laser and the 8 fs pulses of the kHz SYLOS2 laser close to single optical cycle with the use of a single thin fused silica plate. The so far common requirement of the use of multiple thin plates could be relaxed in our case to a single plate, as the initially top-hat input beam was spatially filtered prior to compression. With an injected pulse energy of 13 and 17 mJ, and peak powers of 1.1 and 2.7 TW, respectively, we obtained 3.8 and 4.8 fs pulse duration with 12 and 16 mJ output after compression. Compressed pulses were thoroughly characterized in the spatial, spectral and temporal domains, which revealed high spatio-temporal quality at the output. The single-cycle >3 TW pulses are used for ion acceleration and neutron generation experiments.

References

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2. M. Stanfield et al, Opt. Express 29, 9123-9136 (2021).
3. J. I. Kim et al, Opt. Express 30, 8734-8741 (2022).
4. T. Nagy et al, Opt. Lett. 45, 3313-3316 (2020).

Short abstract

Results of the post-compression of SYLOS lasers to the single-cycle regime are presented with unprecedentedly high 1.1 TW to 2.7 TW input peak power. Spatial filtering of the input pulses and by utilizing a single thin fused silica plate as the nonlinear medium allowed us to reach well compressed 1.4- and 1.8-cycle pulses at 10 Hz and 1 kHz repetition rates starting from 12 fs and 7.5 fs durations, respectively. Spatio-spectral and temporal characterization of the compressed pulses confirmed their high quality. The >3 TW pulses will be used for ion acceleration and neutron generation experiments.