Compact 200 kHz few-cycle OPCPA at 800 nm with stable CEP

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Abstract

For attosecond technology, carrier envelope phase (CEP) stabilization in the few-cycle regime combined with high repetition rates is essential for studying ultrafast electronic processes in atoms, molecules, solids, and complex many body systems [1-3].

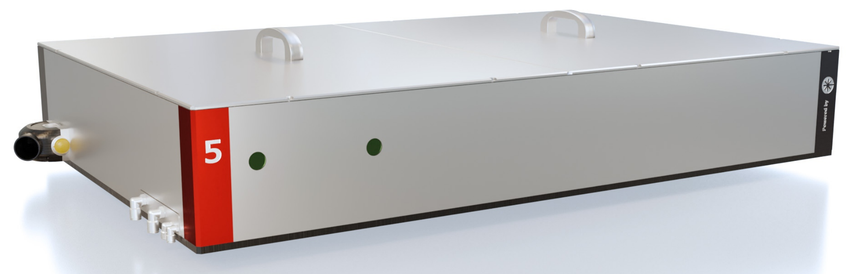
Therefore, a laser system was designed, where the laser pulses are generated from a single white-light generation (WLG) source operating at 200 kHz, providing CEP stable pulses at 800 nm with pulse durations of < 10 fs, and pulse energies of 15 µJ. A passive CEP jitter over 10 min was measured with an f-to-2f interferometer below 170 mrad rms.

Additionally, a second output is optionally available providing simultaneously CEP stable pulses at 2 µm which allows for pump-probe measurements.

The system is robust and compact, with a footprint of less than a square meter, and commercially available from Class 5 Photonics GmbH.

Parameter summary

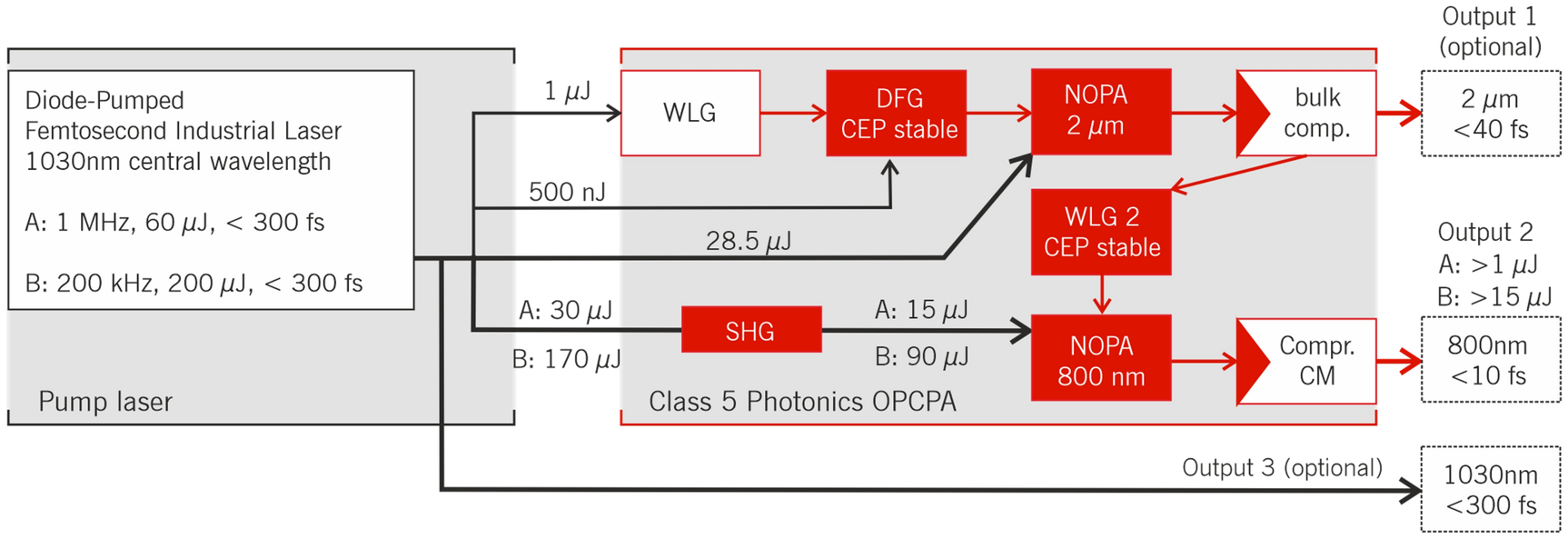
Wavelength	**800 nm**	**2000 nm**
Pulse energy	15 µJ	1 µJ
Repetition rate	200 kHz	200 kHz
Pulse duration	< 9 fs	< 40 fs
CEP stability (rms)	< 170 mrad	-
Power fluctuation (rms)	< 0.3 %	-
Output power	3 W	0.2 W



Schematic layout WD-HE-800 CEP stable

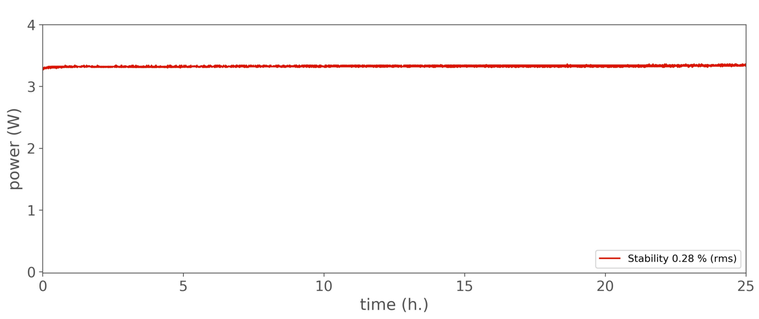
Pump laser:
Option A: Coherent Monaco 60 W
Option B: LC Carbide 40 W

White Dwarf HE OPCPA:
Passive CEP stable 800 nm few-cycle OPCPA with dual output at 2 µm.

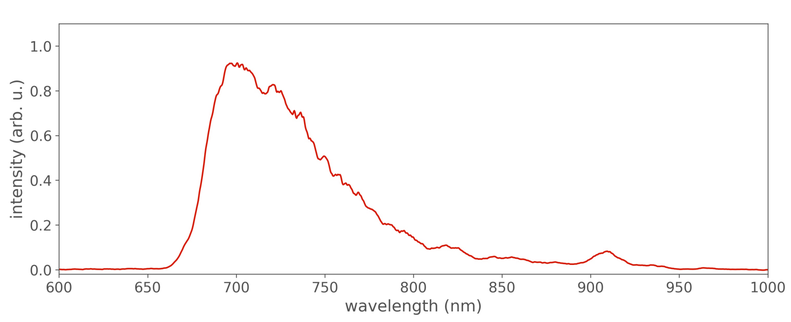


Output parameters WD-HE-800 CEP stable

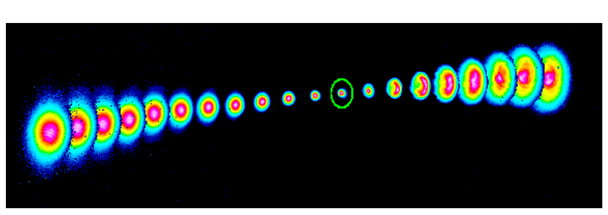
Power stability: < 0.28% rms over 24 hours



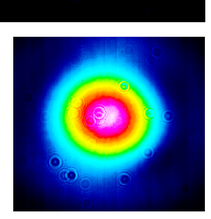
Spectrum 800 nm with sub 9 fs pulses



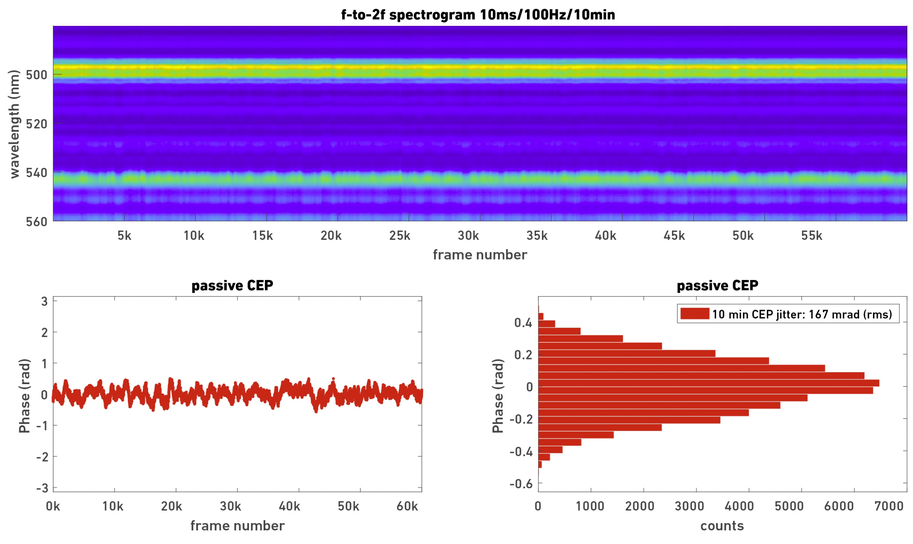
Beam quality M2 < 1.2



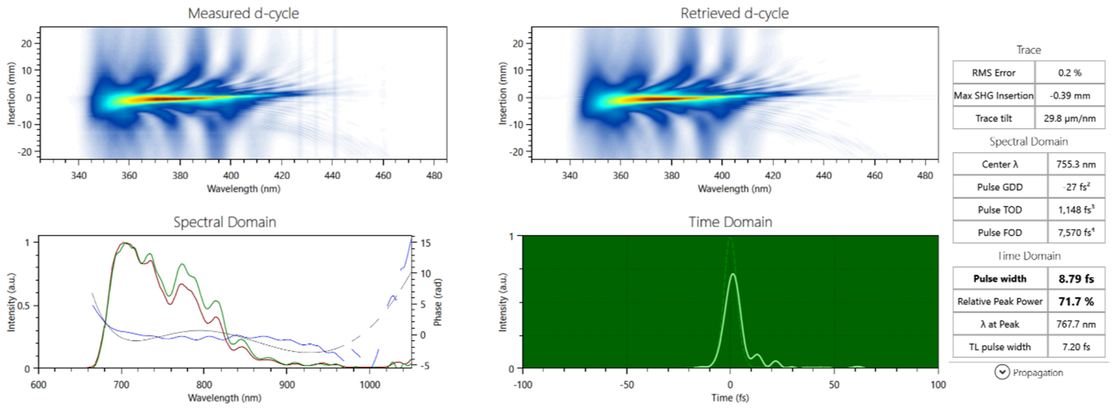
Ellipticity 0.94 (round = 1)



f-to-2f interferometer: < 170 mrad rms CEP stability (no feedback, open loop)



D-scan: 8.8 fs (FWHM) pulse duration



Let's connect

References

[1] Calegari, F., et-al. "Ultrafast electron dynamics in phenylalanine initiated by attosecond pulses", Science, 336-339 (2014)
[2] Uzan, A.J, et al. "Attosecond spectral singularities in solid-state high-harmonic generation.", Nat. Photonics 14, 183–187 (2020).
[3] Harth, A., et.-al. "Compact 200 kHz HHG source driven by a few-cycle OPCPA", Journal of Optics 20, 014007 (2017)