

# OPCPA

## Optical Parametric Chirped-Pulse Amplification Systems

### FEATURES OVERVIEW

- Customizable light source for applications requiring the shortest pulses and extreme peak and average powers
- 800 nm – 3  $\mu\text{m}$  wavelengths, extendable to mid-IR
- Up to 5 TW peak power
- Down to 6.5 fs pulse duration
- 100 Hz – 200 kHz repetition rate
- < 250 mrad CEP stability

Optical parametric chirped-pulse amplification (OPCPA) is the only currently available laser technology simultaneously providing high peak and average power, as well as few-cycle pulse duration required by the most demanding scientific applications.

LIGHT CONVERSION's answer to these demands is a portfolio of cutting-edge OPCPA products based on years of experience in developing and manufacturing optical parametric amplifiers and femtosecond lasers.

OPCPA system delivering 5.5 TW peak power (6.6 fs, 36 mJ) pulses.

Built for ELI-ALPS in collaboration with Ekspla.



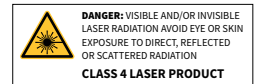
# ORPHEUS | OPCPA

## Compact Few-cycle CEP-stable OPCPA Systems Pumped by PHAROS or CARBIDE Lasers

Benefiting from the industrial-grade stability and reliability of the PHAROS and CARBIDE lasers, ORPHEUS-OPCPA delivers few-cycle, CEP-stable pulses in a package as compact as our standard parametric amplifiers. The different ORPHEUS-OPCPA models all use the same base architecture to produce CEP-stable, few-cycle pulses in one of the four wavelength ranges. ORPHEUS-OPCPA is available in versions with pulse compressors for direct use in applications or in versions intended as seed sources, delivering background-free pulses with near-single-cycle bandwidths, excellent spectral phase coherence, and CEP stability.



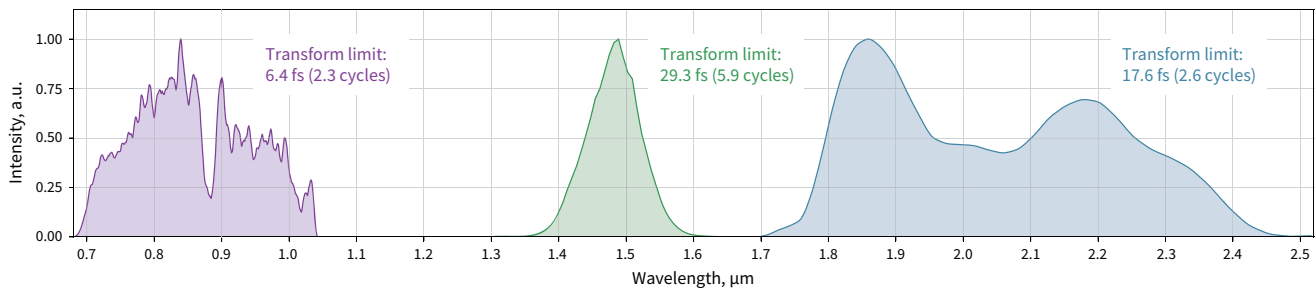
ORPHEUS-OPCPA-HR



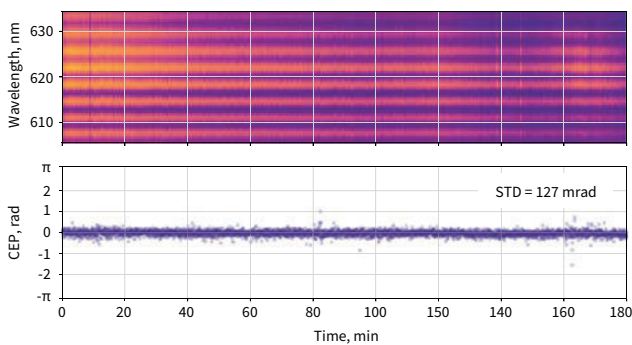
### CONFIGURATIONS

Wavelength	800 nm	1.6 $\mu\text{m}$	2 $\mu\text{m}$	3 $\mu\text{m}$
Pulse duration (compressed)	< 10 fs	< 40 fs	< 25 fs	< 45 fs
Transform-limited pulse duration (uncompressed, for seeding larger amplifiers)	< 6 fs	< 30 fs	< 15 fs	< 35 fs

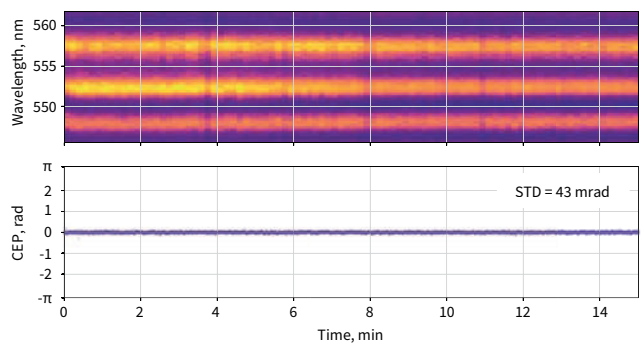
	Repetition rate	Pulse energy / Output power			
<b>ORPHEUS-OPCPA</b>	10 kHz	120 $\mu\text{J}$ / 1.2 W	240 $\mu\text{J}$ / 2.4 W	180 $\mu\text{J}$ / 1.8 W	120 $\mu\text{J}$ / 1.2 W
<b>ORPHEUS-OPCPA-HE</b>		0.55 mJ / 5.5 W	1.1 mJ / 11 W	0.8 mJ / 8 W	0.5 mJ / 5 W
<b>ORPHEUS-OPCPA-HR</b>	100 kHz	25 $\mu\text{J}$ / 2.5 W	55 $\mu\text{J}$ / 5.5 W	40 $\mu\text{J}$ / 4 W	30 $\mu\text{J}$ / 3 W
<b>ORPHEUS-OPCPA-HP</b>		100 $\mu\text{J}$ / 10 W	220 $\mu\text{J}$ / 22 W	150 $\mu\text{J}$ / 15 W	120 $\mu\text{J}$ / 12 W



Example spectra of three models of ORPHEUS-OPCPA



CEP stability of ORPHEUS-OPCPA (800 nm, 100 kHz)  
All CEP values calculated from unaveraged, single-shot measurements!



CEP stability of ORPHEUS-OPCPA (3  $\mu\text{m}$ , 1 kHz)  
All CEP values calculated from unaveraged, single-shot measurements!

# OPCPA | HR

## High Repetition Rate OPCPA Systems

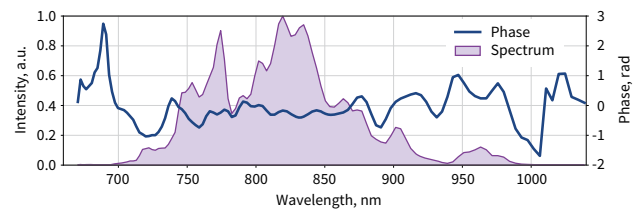
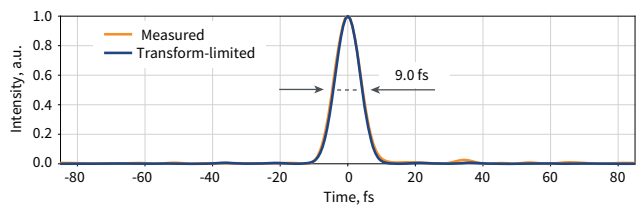
Pumped by InnoSlab or Thin-Disk Lasers, Optionally Seeded by ORPHEUS-OPCPA

InnoSlab and thin-disk lasers based on Yb:YAG are the state-of-the-art high average power lasers of today. These lasers lend themselves extremely well to pumping OPCPA systems, and LIGHT CONVERSION is happy to offer OPCPA solutions designed to work with these lasers. Available either bundled with state-of-the-art multi-100 W lasers or as standalone modules designed to work with your laser.

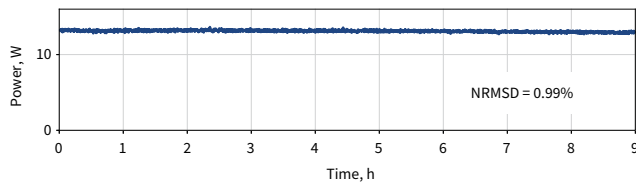
- Wavelength(s), pulse duration, and energy are customizable – contact sales@lightcon.com for more details.
- A single pump laser can be combined with more than one OPCPA option in either switchable or simultaneous operation

### CONFIGURATIONS

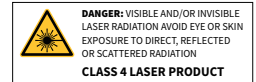
Wavelength	800 nm	1.6 μm	2 μm	3 μm	
Pulse duration	< 9 fs	< 35 fs	< 25 fs	< 35 fs	
	Repetition rate	Pulse energy / Output power			
<b>HR-20</b>	20 kHz	0.8 mJ / 16 W	1.6 mJ / 32 W	1.3 mJ / 26 W	0.8 mJ / 16 W
<b>HR-200</b>	200 kHz	110 μJ / 22 W	270 μJ / 54 W	200 μJ / 40 W	130 μJ / 26 W



ORPHEUS-HR output pulse and spectrum



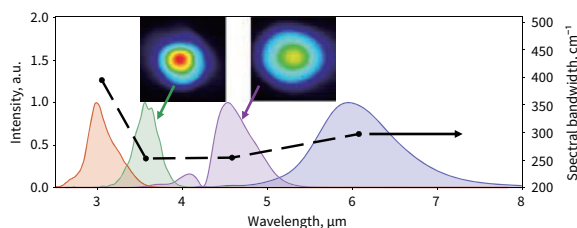
Output power stability over 9 h of OPCPA-HR (800 nm, 100 kHz)



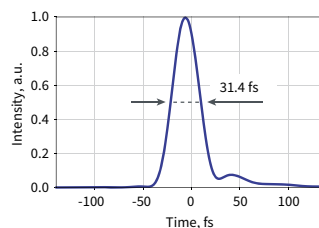
## Mid-IR Wavelength Extensions

For ORPHEUS-OPCPA and OPCPA-HR

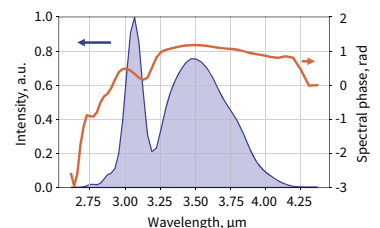
2 μm models of ORPHEUS-OPCPA and OPCPA-HR can be equipped with a DFG module for efficient generation of tunable broad-bandwidth mid-IR pulses; contact sales@lightcon.com for more details.



Example spectra using ORPHEUS-OPCPA DFG module



Output pulse and spectrum at 3.4 μm using ORPHEUS-OPCPA DFG module





## High Energy OPCPA Systems

Pumped by Picosecond Nd:YAG Lasers, Seeded by ORPHEUS-OPCPA

Applications like high-energy attosecond pulse generation, generation of high harmonics from solid targets, and laser electron acceleration all benefit from few-cycle pulse durations and excellent pulse contrast while requiring multi-millijoule pulse energy. Our most powerful high energy OPCPA systems are scalable to multi-TW peak powers at kHz repetition rates while maintaining few-cycle pulse durations. They will fit the most demanding requirements while providing stability and reliability unprecedented for systems of this scale.

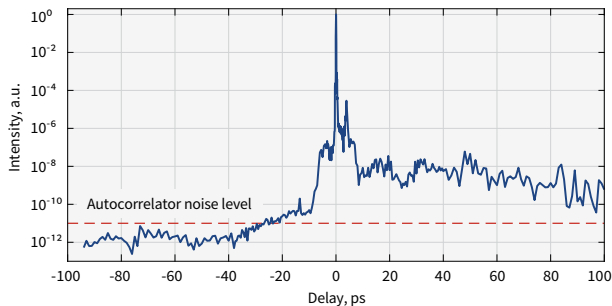
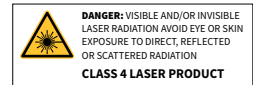


SYLOS launched in ELI-ALPS facility

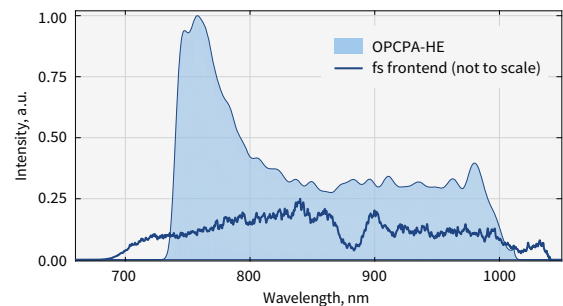
### CONFIGURATIONS

Wavelength	800 nm	1.6 μm	2 μm	
Pulse duration	< 9 fs	< 50 fs	< 30 fs	
	Repetition rate		Pulse energy / Output power	
HE-100 <sup>1)</sup>	100 Hz	50 mJ	100 mJ	50 mJ
HE-1000 <sup>2)</sup>	1 kHz	50 mJ / 50 W	100 mJ / 100 W	50 mJ / 50 W

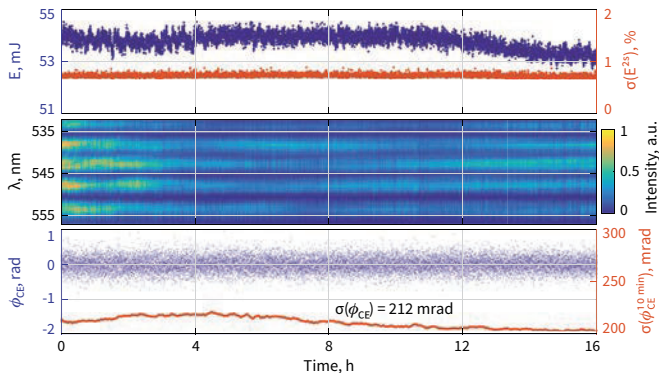
<sup>1)</sup> Cost- and size-effective highly-stable multi-TW source.  
<sup>2)</sup> Cutting-edge combination of peak and average power.



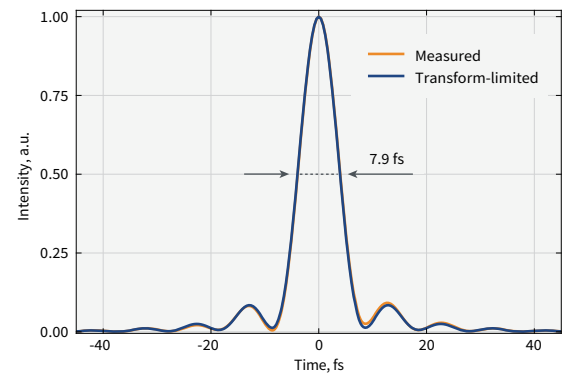
High-dynamic-range third order autocorrelation measurement of an OPCPA-HE system



OPCPA-HE output spectrum



OPCPA-HE pulse energy, f-2f interferogram and CEP stability measured over 16 h



Temporal profile of OPCPA-HE output pulses measured with a self-referenced spectral interferometry device