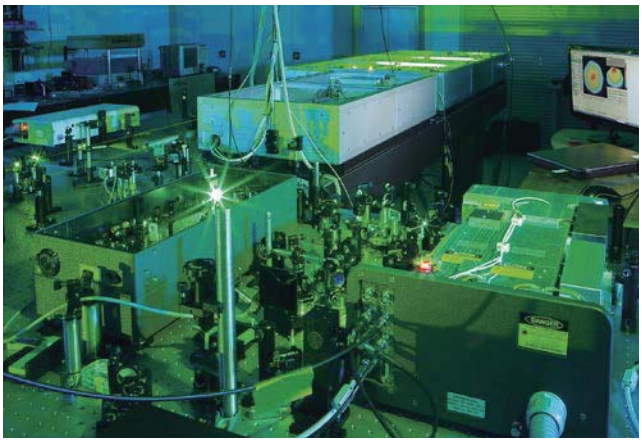
# OPCPA

## Custom Optical Parametric Chirped Pulse Amplification Systems



### FEATURES

- Front end is based on field-proven PHAROS laser
- Passive CEP stabilization is done employing a temperature controlled Optical Parametric Amplifier (OPA)
- White light continuum (WLC) generation provides background free broadband seed, ensuring excellent temporal pulse contrast
- Reliable direct optical synchronization: the PHAROS laser provides options for directly seeding a variety of Yb- or Nd- based high energy picosecond lasers, allowing to combine our frontend and OPCPA technologies with all common types of high energy and/or high power picosecond pump lasers

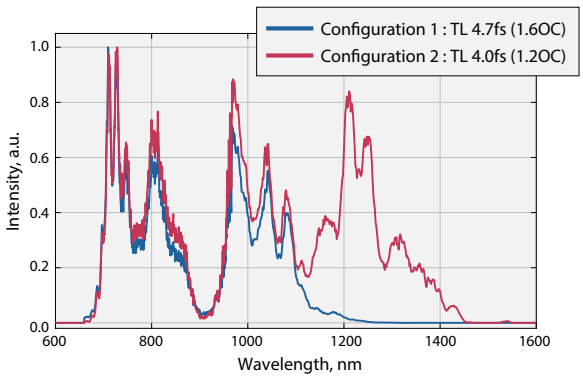
Optical parametric chirped pulse amplification is the only currently available laser technology simultaneously providing high peak and average power, as well as few cycle pulse duration required by the most demanding scientific applications. LIGHT CONVERSION's answer to these demands is a portfolio of cutting-edge OPCPA products that are based on years of experience in developing and manufacturing of Optical Parametric Amplifiers and Femtosecond Lasers.

## OPCPA frontends

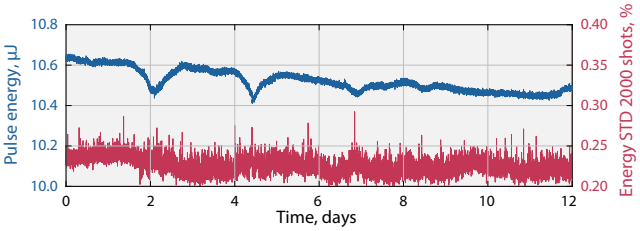
### FEATURES

- Scalable in repetition rate from < 1 to 100 kHz and above
- High pulse energy (up to 100 µJ pulse energy at 1 – 10 kHz) improves contrast of OPCPA output
- Intrinsically free from ASE background; postpulse-free versions available
- Passive CEP stabilization eliminates complex electronics
- Sub-200 mrad CEP noise
- Bandwidths down to the near-single-cycle regime in the NIR
- Output spectra can be engineered to maximize energy in a desired spectral range
- Can also be used as reliable high energy, high contrast seed source for Ti:Sa amplifiers
- Central wavelength up to 2.2 µm is available on request

Our OPCPA frontend technology marks a solid step up from seeding an OPCPA directly from a Ti:Sapphire oscillator. The OPCPA frontend setups are based on the industrial-grade PHAROS laser and femtosecond optical parametric amplification technology. We use passive CEP stabilization and take advantage of the femtosecond pulse duration of the PHAROS laser to produce extremely clean broadband OPCPA seed pulses.




Spectra of pulses produced by OPCPA frontends, two configurations are available




Energy and energy stability of the passively CEP stabilized pulses generated in an OPCPA frontend measured over 12 days

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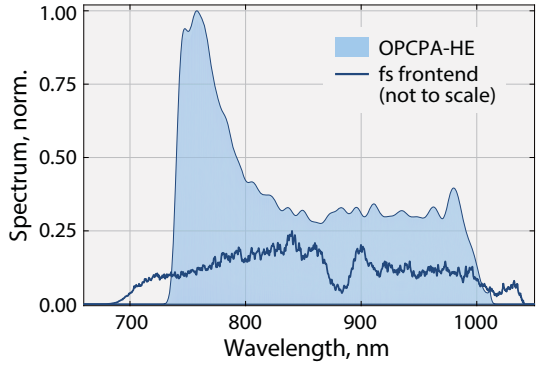
# OPCPA-HE

Driving low efficiency nonlinear processes, such as high harmonic generation laser-driven THz generation, requires high pump energies. For applications of this type, LIGHT CONVERSION produces OPCPA systems delivering up to 50 mJ pulse energy, combined with exceptional energy and CEP stability, as well as temporal contrast, owing to the advanced front-end technology and favourable properties of the OPCPA process.

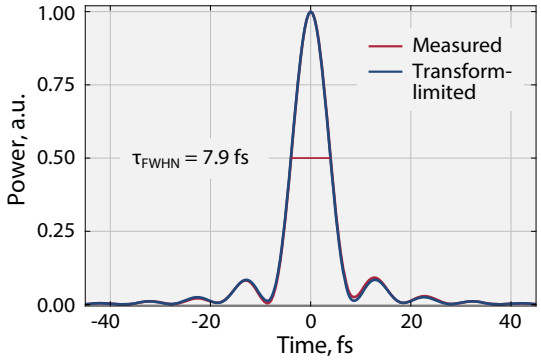
LIGHT CONVERSION and EKSPLA consortium has recently set a new standard in the field by delivering a 5.5 TW, 1 kHz few cycle OPCPA system to ELI-ALPS. Besides the record-setting output parameters, the system also exhibits excellent short-and-long-term stability and reliability. More information about this system can be found in: *https://doi.org/10.1364/OE.25.005797*.

## FEATURES

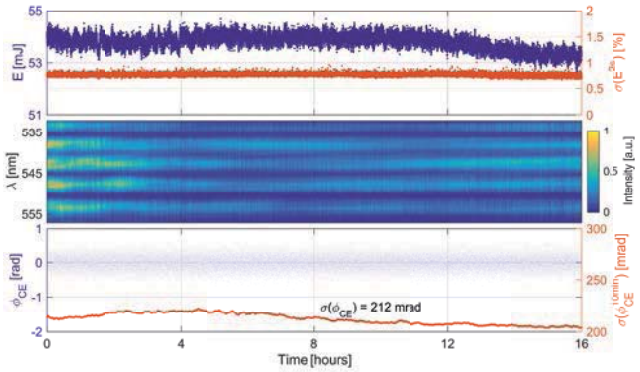
- Multi-TW peak power pulses produced at up to 1 kHz repetition rate
- Pre-pulse contrast exceeding $10^{12}$ achievable without complex and lossy nonlinear pulse cleaning techniques
- Sub-220 mrad CEP noise and < 1 % energy stability maintained throughout full day of operation
- Pulse duration down to < 9 fs
- Safe and simple spectral-temporal shaping of output pulses possible
- Integrated control and diagnostics system
- Less than 1 hour warm-up time



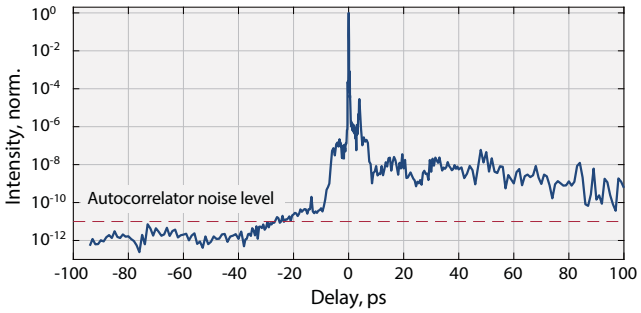

OPCPA-HE output spectrum




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




OPCPA-HE pulse energy, f-2f interferogram and CEP stability measured during a 16-hour test run




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

## SPECIFICATIONS

| Product name | Output Energy | Output power | Output pulse duration | Max. Peak Power | Repetition rates |
|---|---|---|---|---|---|
| **OPCPA-HE** | 1 – 50 mJ | up to 50 W | < 10 fs | up to 5 TW | up to 1 kHz |
| **OPCPA-HR** | 10 µJ – 1 mJ | up to 100 W | < 10 fs | up to 100 GW | up to 200 kHz |

*Different pulse repetition rates, output energies, pulse durations and wavelengths are also available – please contact LIGHT CONVERSION for more information.*

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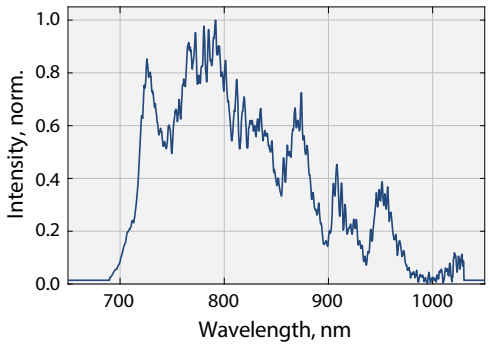
# OPCPA-HR

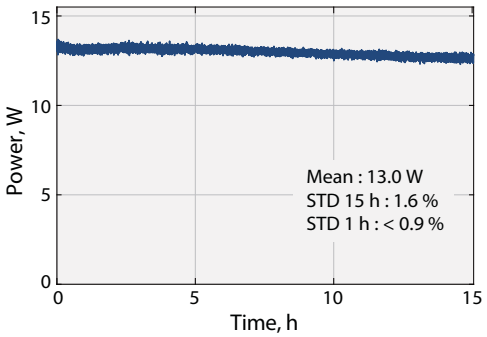
The technology developed by LIGHT CONVERSION can be readily integrated with high repetition rate pump lasers to create high average power OPCPA systems. In this regime, few cycle pulses can be produced at repetition rates up to 200 kHz. A special dual pulse picker system in the Pharos laser can be used to adjust the repetition rate of the frontend independently of the pump laser. This allows to conveniently reduce the output power for alignment of experimental setups without affecting pulse energy or beam direction. Furthermore, residual pump beams can readily be used, for example, to generate photoelectron bunches synchronized with OPCPA output for advanced experiments.

## FEATURES

- Pulse repetition rates up to 200 kHz
- Average power > 15 W at 100 kHz
- Passive CEP stabilization available
- Pulse duration down to < 8 fs
- Arbitrary division of OPCPA pulse repetition rate possible
- Convenient integrated control and monitoring software
- Compact footprint




OPCPA-HR pulse spectrum

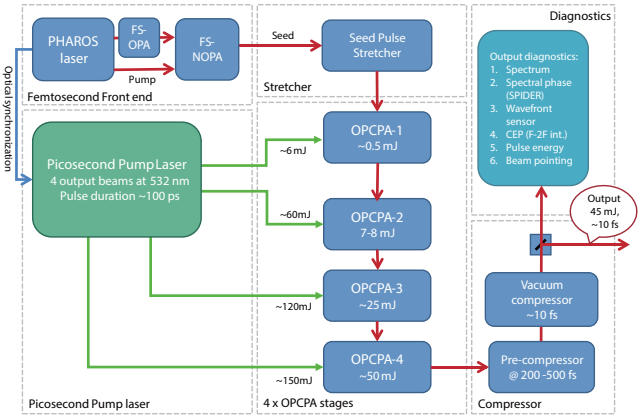



Output power of OPCPA-HR measured over 15 hours

## INSTALATIONS

LIGHT CONVERSION and EKSPLA Consortium have won the public procurement tender of the ELI-ALPS facility for the design and construction work for the SYLOS laser system. To our knowledge, the SYLOS laser system will be able to generate four times higher peak power pulses than the current state of the art at 1 kHz rep rate. The system is based on LIGHT CONVERSION's Optical Parametric Chirped Pulse Amplifiers driven by LIGHT CONVERSION's femtosecond (fs) laser PHAROS and EKSPLA's picosecond laser.

PHAROS pumps two fs OPAs: the first (FS-OPA) produces passively CEP stabilized pulse at 1.3 µm used for generation of CEP stable WLC, while the second (FS-NOPA) amplifies WLC in 700 – 1000 nm range providing high contrast seed pulse for the subsequent OPCPA stages. The pulse amplified to 50 mJ of energy at an 850 nm central wavelength is compressed in a sequence of glass blocks and chirped mirrors down to 10 fs pulse duration.




ELI-ALPS OPCPA laser system SYLOS block diagram

SYLOS has been launched in ELI-ALPS facility in Hungary on 15th of May, 2019

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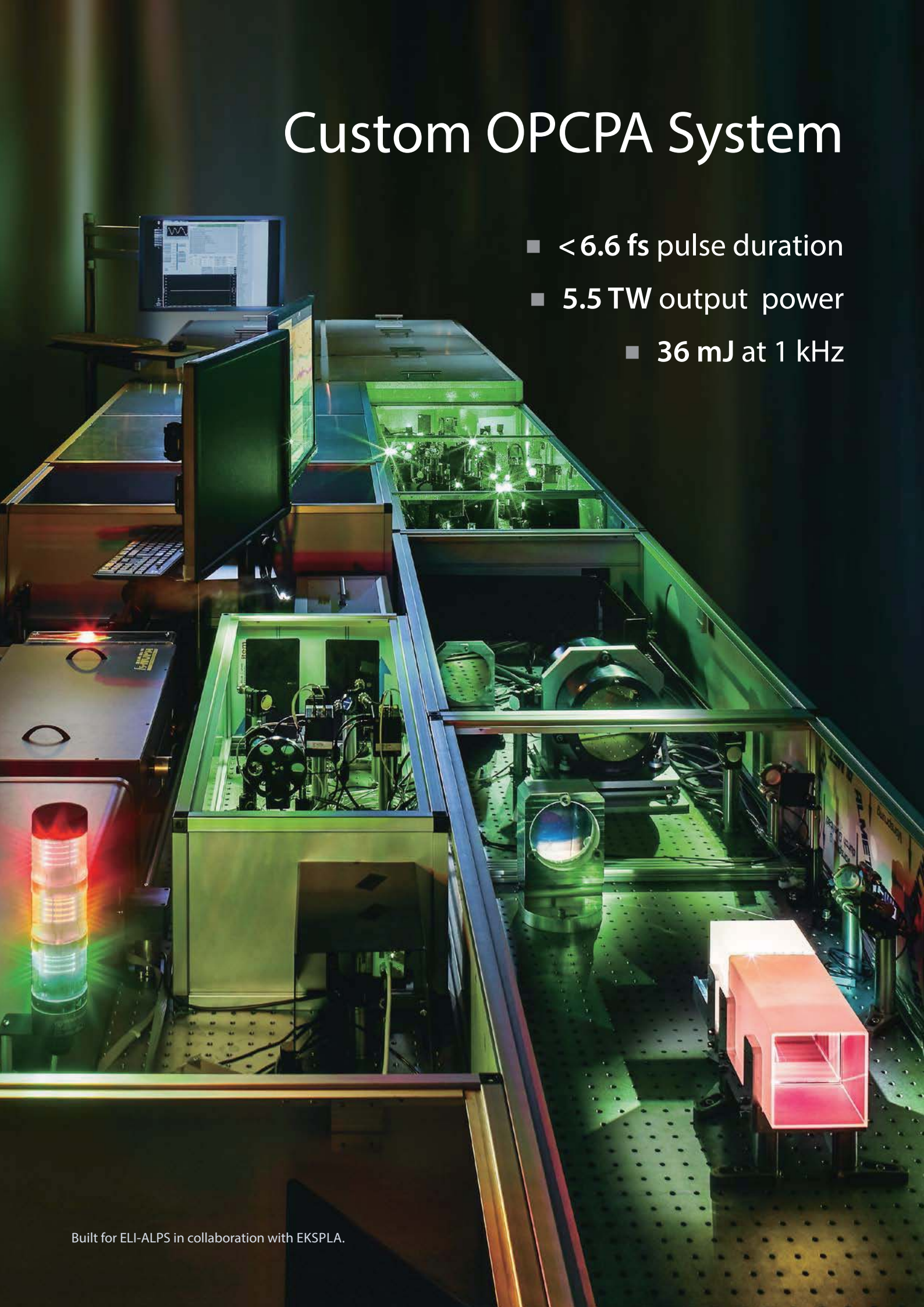
# Custom OPCPA System

- **< 6.6 fs** pulse duration
- **5.5 TW** output power
- **36 mJ** at 1 kHz



Built for ELI-ALPS in collaboration with EKSPLA.