EKSPLA

High Intensity Laser Systems

fs, ps, ns
pulse durations

from single shot to
kHz repetition rates

highly customizable

2020

High Intensity Laser Systems

Today laser intensities reached levels where relativistic effects dominate in laser-matter interaction. New applications of high pulse energy lasers emerge in various disciplines ranging from fundamental physics to materials research and life sciences. Ekspla presents line of nanosecond and picosecond high pulse energy lasers and amplifiers. Our broad knowledge in high energy laser physics, non-linear materials and more that 27 years of experience in laser design enables us to offer unique solutions for high pulse energy systems.

Our high pulse energy lasers features flash lamp pump for ultra-high pulse energy, diode pump for high average power. Innovative solutions for pulse shaping, precise synchronization between different laser sources enables fit these systems to numerous experiments of modern fundamental science.

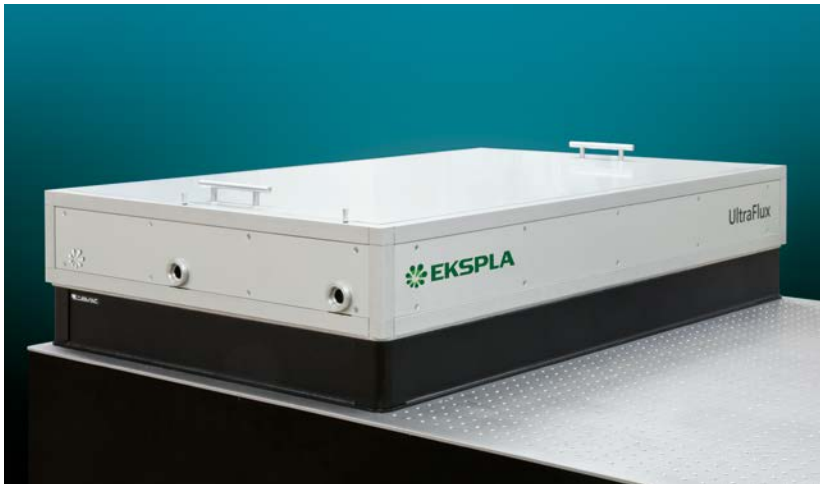
SHORT SELECTION GUIDE

For Your convenience, table contains all available options and highest parameter values. Not all output specifications are available at the same time simultaneously. Please refer to the catalog page for exact specifications and available options.

Series	Pulse duration	Pulse energy at 1064 nm	Repetition rate, up to	Special feature	Page
UltraFlux	down to 11 fs	up to 50 mJ	1 kHz	Patented fiber based front end	2
APL2100	90 ± 10 ps	up to 2.2 J	10 Hz	DPSS regenerative amplifier	8
APL2200	90 ± 10 ps	up to 130 mJ	1 kHz	High power amplifiers	11
APL4206	90 ± 10 ps	up to 8 channels 130 mJ each	1 kHz	Spatial and temporal beam profiles tailored for OPCPA pumping	14
NL120	2 ± 0.5 ns	up to 10 J	10 Hz	High energy single longitudinal mode Q-switched Nd:YAG laser	16
NL310	4–6 ns	up to 10 J	10 Hz	High pulse energy, cost effective solution	19
NL940	3–10 ns (adjustable)	up to 10 J	10 Hz	Temporaly shaped pulse based on electrooptical modulator driven by programmable arbitrary waveform generator (AWG)	22
ANL	2 – 4 ns	up to 1 J	up to 1 kHz	High energy and high repetition rate DPSS	25
Nd:Glass	500 ps – 20 ns	up to 160 J	1 shot in 1 – 20 min	DPSS master oscillator and Nd:Glass power amplifiers	27
NL941 **NL942**	5 ns 50 ns	up to 2 J	20 kHz	High energy temporaly shaped DPSS nanosecond lasers	29

UltraFlux
FT300 SERIES

Tunable Wavelength Femtosecond Laser Systems



UltraFlux FT300 series is a compact high energy tunable wavelength femtosecond laser system which incorporates the advantages of ultrafast fiber laser, solid-state and parametric amplification technologies. Novel OPCPA front-end technology uses the same picosecond fiber laser for seeding both picosecond DPSS pump laser and femtosecond parametric amplifier by spectrally broadened output. This approach greatly simplifies the system – excludes femtosecond regenerative amplifier and eliminates the need of pump and seed pulse synchronization. In addition to that, contrast of the output pulses in picosecond to nanosecond time scale is potentially increased.

All UltraFlux series laser systems are assembled on a rigid breadboard to ensure excellent long-term stability. Modular internal design offers high level of customization and easy scalability. These systems can be customized according to customer requirements.

Incorporation of parametric amplification technology together with a novel ultrafast fiber laser helped to create and bring to the market a new tool for femtosecond pump-probe, nonlinear spectroscopy, emerging high harmonic generation experiments and other femtosecond and nonlinear spectroscopy applications. With this laser ultrafast science breakthrough is closer to any photonics lab than ever before.

FEATURES

- *Based on the novel **OPCPA** (Optical Parametric Chirped Pulse Amplification) technology – simple and cost-efficient operation*
- *Patented front-end design (patents no. EP2827461 and EP2924500)*
- *Hands free wavelength tuning*
- *Up to **1 kHz** repetition rate*
- *Up to **3 mJ** pulse energy*
  - *Excellent pulse energy stability: < 1.5 % rms*
  - *Excellent long-term average power stability: < 1.5 % rms over > 12 hour period*
- *High contrast pulses without any additional improvement equipment*

APPLICATIONS

- *Broadband CARS and SFG*
- *Femtosecond pump-probe spectroscopy*
- *Nonlinear spectroscopy*
- *High harmonic generation*

OPTIONS

- ***SH/TH** harmonics module: SH **375 – 480 nm,** TH **250 – 320 nm***
- ***SH/TH/FH** harmonics module: SH **375 – 480 nm,** TH **250 – 320 nm** FH **210 – 230 nm***
- *Optically synchronized ps output*
- *PLL (Phase Locking Loop) for precise (<1 ps, rms) locking with external synchronization pulse*

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REV. 20200123

SPECIFICATIONS [1]

Model	UltraFlux FT031k	UltraFlux FT31k	UltraFlux FT310
MAIN SPECIFICATIONS			
Max. Pulse energy	300 µJ	3 mJ	
SH output [4]	–	20 % conversion at 440 nm	
TH output [4]		5 % conversion at 290 nm	
FH output [4]		1 % conversion at 220 nm	
Wavelength tuning range			
Standard version	700 – 1010 nm	750 – 960 nm	
SH output [4]	–	375 – 480 nm	
TH output [4]		250 – 320 nm	
FH output [4]		210 – 230 nm	
Scanning steps			
SH output [4]	–	5 nm	
TH output [4]		3 nm	
FH output [4]		2 nm	
Pulse duration	35 – 60 fs	20 – 60 fs	
Pulse repetition rate	1 kHz		10 Hz
Pulse energy stability	< 1.5 %, rms		
Long-term power stability	< 1.5 %, rms		
Spatial mode	Super Gaussian		
Beam diameter ($1/e^2$)	2 mm	7 mm	
Pulse contrast [2]	≥ 10^{-6} : 1 (within ± 50 ps)		
	≥ 10^{-8} : 1 (in ns range)		
Polarization	Linear, horizontal		
Beam pointing stability	≤50 µrad, rms		
Optical to RF signal jitter [3]	< 1 ps		
Footprint on optical table	1.2 × 0.75 m	1.2 × 2.0 m	

[1] Presented parameters are from delivered systems and can be customized to meet customer's requirements.

[2] Pulse contrast is only limited by amplified parametric fluorescence (APF) in the temporal range of ~90 ps which covers OPCPA pump pulse duration and is better than 10^6 : 1. APF contrast depends on OPCPA saturation level (Fig. below). Our system is ASE-free and pulse contrast value in nanosecond range is limited only by measurement device capabilities (third-order autocorrelator). There are no pre-pulses generated in the system and post-pulses are eliminated by using wedged transmission optics.

[3] With -PLL option purchased.

[4] With SH/TH or SH/TH/FH module.

PERFORMANCE

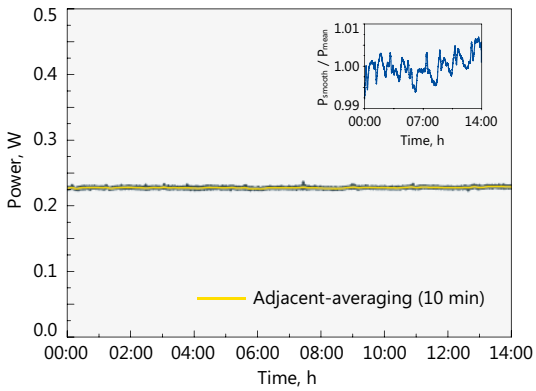

Fig 1. Long-term power stability measurement at 800 nm wavelength

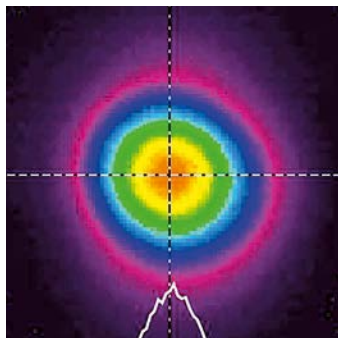

Fig 2. Typical beam profile of FT031k. Output pulse energy 0.3 mJ at 890 nm

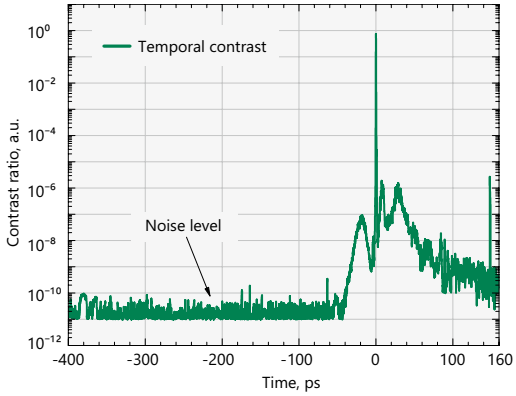

Fig 3. Typical temporal contrast of UltraFlux systems

DELIVERED SYSTEMS

UltraFlux FT310. Customised compact (1.2 × 0.9 m), fully diode pumped, tunable wavelength femtosecond laser system delivering up to 2.5 mJ pulse energy with pulse duration down to 20 fs. Optically synchronized (low jitter) fs and ps outputs available.

UltraFlux
FF/FT 5000 SERIES

High Energy Tunable Wavelength Femtosecond Laser Systems

UltraFlux FF/FT 5000. Custom high pulse energy femtosecond fixed wavelength laser system delivering up to 40 mJ pulse energy with pulse duration down to 11 fs.

FEATURES

- *Based on the novel **OPCPA** (Optical Parametric Chirped Pulse Amplification) technology – simple and cost-efficient operation*
- *Patented front-end design (patents no. EP2827461 and EP2924500)*
- *Hands free wavelength tuning*
- *Up to **1 kHz** repetition rate*
- *Up to **50 mJ** pulse energy*
  - *Excellent pulse energy stability: < 1.5 % rms*
  - *Excellent long-term average power stability: < 1.5 % rms over > 12 hour period*
- *High contrast pulses without any additional improvement equipment*

APPLICATIONS

- *Broadband CARS and SFG*
- *Femtosecond pump-probe spectroscopy*
- *Nonlinear spectroscopy*
- *High harmonic generation*
- *Particle acceleration in plasma*

The UltraFlux FF/FT 5000 laser is a 2 TW tabletop femtosecond OPCPA (Optical Parametric Chirped Pulse Amplification) based system operating at 10 Hz. Originally built for ELI-ALPS (Extreme Light Infrastructure – Attosecond Light Pulse Source) in Hungary, this laser is now available for a wide variety of applications.

The master oscillator is a patent pending (EP2827461A2) all-in-fiber Yb fiber picosecond laser seed source with two fiber outputs. One seeds the OPCPA Front-End and another seeds the Picosecond Pump Laser (PPL). Both outputs originate from the same fiber so they are synchronized optically. This approach eliminates the need for a complex temporal synchronization system typically present in other OPCPA systems.

The Nd:YAG Picosecond Pump Laser (PPL) system is comprised of several sub-systems: diode pumped Regenerative Amplifier, diode pumped Preamplifier, two flash lamp pumped Amplifiers, and Second Harmonic Generators which convert fundamental 1064 nm wavelength to 532 nm. PPL outputs four beams at 532 nm and 10 Hz pulse repetition rate. One beam is directed to NOPCPA Front-End subsystem and others are directed to NOCPA stages.

The Front-End NOPCPA (Non-collinear Optical Parametric Chirped Pulse Amplifier) consists of several sub-systems: Picosecond Optical Parametric Amplifier (ps-OPA) amplifying oscillator output pulses, Grating Compressor compressing ps-OPA output pulses, White Light Generator (WLG) broadening the spectrum of ps-OPA output pulses and Femtosecond Non-collinear Optical Parametric Amplifier (fs-NOPA) amplifying WLG output pulses.

The Stretcher sub-system is a Grism (diffraction gratings combined together with prisms) based pulse stretcher, which stretches output pulse from NOPCPA Front-End and Dazzler (Acousto-Optic Programmable Dispersive Filter) for high order phase compensation.

Three stages of NOPCPA (Non-collinear Optical Parametric Chirped Pulse Amplifiers) are used to amplify the stretched pulse from the Stretcher up to 50 mJ.

Finally, amplified pulses are compressed down to 11 fs in the Pulse Compressor. Bulk glass compressors are combined together with chirped mirror compressors. Pulse energy after Compressor is >40 mJ.

The built-in Output Diagnostics stage ensures reliable, turn-key operation by monitoring critical parameters such as energy, duration, and beam profile.

SPECIFICATIONS [1]

Model	UltraFlux FT5010	UltraFlux FF50100
MAIN SPECIFICATIONS		
Max. Pulse energy	50 mJ	
SH output [4]	inquire	
TH output [4]	inquire	
FH output [4]	inquire	
Wavelength tuning range		
Standard version	750 – 960 nm, fixed at desired wavelength	
SH output [4]	375 – 480 nm	
TH output [4]	250 – 320 nm	
FH output [4]	210 – 230 nm	
Scanning steps		
SH output [4]	5 nm	
TH output [4]	3 nm	
FH output [4]	2 nm	
Pulse duration	20 – 60 fs	10 – 20 fs
Pulse repetition rate	10 Hz	100 Hz
Pulse energy stability	< 1.5 %, rms	< 2.0 %, rms
Long-term power stability	< 1.5 %, rms	
Spatial mode	Super Gaussian	Top-Hat
Beam diameter ($1/e^2$)	7 mm	20 mm
Pulse contrast [2]	≥ 10^{-6} : 1 (within ± 50 ps)	
	≥ 10^{-8} : 1 (in ns range)	
Polarization	Linear, horizontal	
Beam pointing stability	≤50 µrad, rms	
Optical to RF signal jitter [3]	< 1 ps	
Footprint on optical table	1.2 × 2.0 m	1.2 × 4.8 m

[1] Presented parameters are from delivered systems and can be customized to meet customer's requirements.

[2] Pulse contrast is only limited by amplified parametric fluorescence (APF) in the temporal range of ~90 ps which covers OPCPA pump pulse duration and is better than 10^6 : 1. APF contrast depends on OPCPA saturation level (Fig. below). Our system is ASE-free and pulse contrast value in nanosecond range is limited only by measurement device capabilities (third-order autocorrelator). There are no pre-pulses generated in the system and post-pulses are eliminated by using wedged transmission optics.

[3] With -PLL option purchased.

[4] With SH/TH or SH/TH/FH module.

BLOCK DIAGRAM

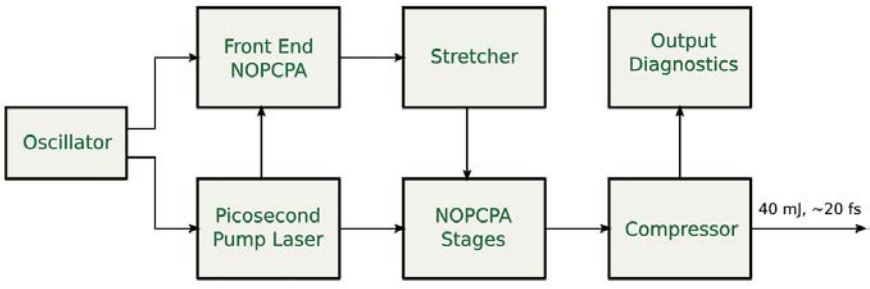

Fig. 1. UltraFlux FF/FT 5000 laser block diagram

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PERFORMANCE

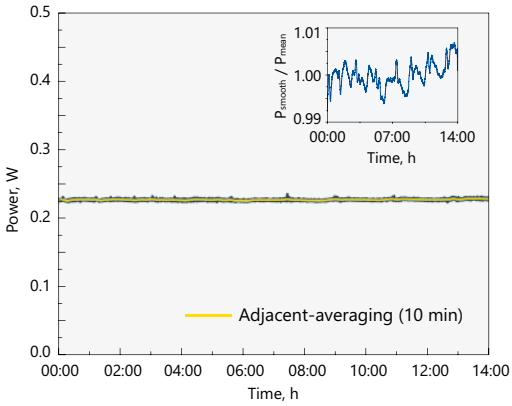

Fig 2. Long-term power stability measurement at 800 nm wavelength

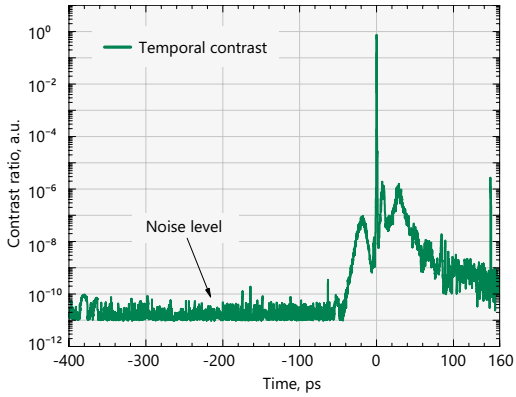

Fig 3. Typical temporal contrast of UltraFlux systems

BEAM PROFILE

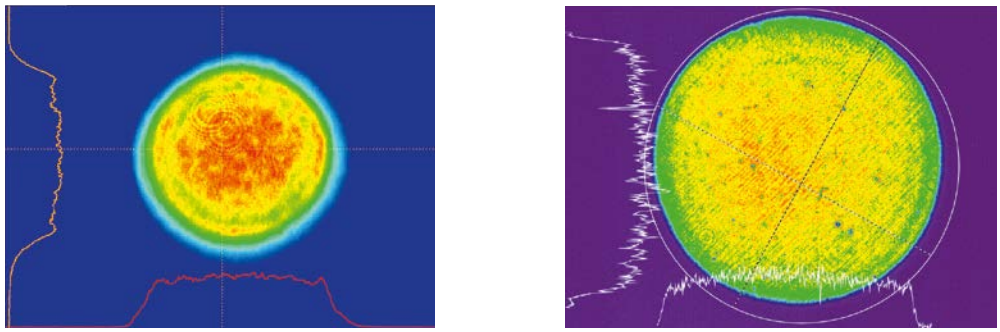

Fig 4. Typical UltraFlux system output at ~60 mJ energy (left) and 532 nm pump beam at 2.5 J energy (right) beam profiles

APL2100 SERIES

High Energy Picosecond Amplifiers

APL210x series amplifiers are designed to produce up to 2200 mJ picosecond pulses. High pulse energy, excellent pulse-to-pulse energy stability, superior beam quality makes APL210x series picosecond amplifiers well suited for applications like OPCPA pumping, non-linear optics and others. Ekspla can offer a seeder meeting customer's requirements.

Regenerative amplifier / Power amplifier design

APL210x series amplifiers are designed to be seeded by external seeding source. Diode pumped regenerative amplifier ensures amplification of seed signal to stable mJ level pulse for amplification in linear amplifiers. Advanced beam shaping ensures smooth, without hot spots beam spatial profile at the laser output. Low light depolarization level allows high efficiency generation of up to 4th harmonic with optional build-in harmonic generators.

Build-in harmonic generators

Angle-tuned DKDP crystals harmonic generators mounted in temperature stabilized heaters are used for second, third and fourth harmonic generation. Harmonic separation system is designed to ensure high spectral purity of radiation and direct it to the output ports.

Simple and convenient laser control

For customer convenience the amplifier can be controlled through remote control pad or USB interface. The control pad features a backlit display that is easy to read even while wearing laser safety eyewear. Alternatively, the amplifier can be controlled from personal computer with supplied software for Windows™ operating system. LabVIEW™ drivers are supplied as well.

Repetition rate and timing of the pulses can be locked to the external RF source (with –PLL option) or other ultrafast laser system (with –FS option).

FEATURES

- *Diode pumped regenerative amplifier*
- *Seeding of regenerative amplifier with customers super-continuum seeding source*
- *Wide selection of seeders available*
- *Flashlamp pumped power amplifier*
- *Advanced beam shaping for high pulse energy*
- *Thermally induced birefringence compensated design for high pulse repetition rates*
- *Low jitter synchronisation pulses for streak camera triggering with 10 ps rms jitter (optional)*
- *Water-water heat exchanger for cooling of pump chambers*
- *Remote control pad*
- *Control through CAN or USB interface (RS232 and LAN is optional)*
- *Optional temperature stabilized second, third and fourth harmonic generators*

APPLICATIONS

- *OPCPA pumping*
- *OPG/OPA pumping*
- *Other spectroscopic and nonlinear optics applications...*

APL2100 series available models

Model	Features
APL2101	Delivers 200 mJ, 90 ps pulses at 10 Hz repetition rate
APL2103	Delivers 300 mJ, 90 ps pulses at 10 Hz repetition rate
APL2105	Delivers 550 mJ, 90 ps pulses at 10 Hz repetition rate
APL2106	Delivers 1000 mJ, 90 ps pulses at 10 Hz repetition rate
APL2107	Delivers 2200 mJ, 90 ps pulses at 10 Hz repetition rate

SPECIFICATIONS [1]

Model	APL2101	APL2103	APL2105	APL2106	APL2107
Output energy					
at 1064 nm	200 mJ	300 mJ	550 mJ	1000 mJ	2200 mJ
at 532 nm [2]	100 mJ	150 mJ	250 mJ	500 mJ	1100 mJ
at 355 nm [3]	60 mJ	90 mJ	170 mJ	300 mJ	inquire
at 266 nm [4]	20 mJ	30 mJ	60 mJ	100 mJ	inquire
Pulse energy stability (StdDev) [5]					
at 1064 nm	1.5 %				
at 532 nm	2.5 %				
at 355 nm	5 %				
at 266 nm	7 %				
Pulse duration (FWHM) [6]	90 ± 10 ps				
Pulse repetition rate [7]	10 Hz				
Triggering mode	external				
Spatial mode [8]	super-Gaussian				
Beam divergence [9]	< 0.5 mrad				
Typical beam diameter [10]	~ 11 mm			~ 17 mm	~ 24 mm
Beam pointing stability [5]	< ±60 µrad				
Pre-pulse contrast	> 200 : 1				
Polarization	linear, > 100 : 1				
INPUT					
Wavelength	1064 nm				
Pulse duration range (FWHM)	20 – 90 ps				
Pulse repetition rate	50 – 95 MHz				
Average power	> 20 mW				
PHYSICAL CHARACTERISTICS					
Laser head size (W×L×H)	600 × 1500 × 350 mm			600 × 1800 × 350 mm	TBA
Power supply size (W×L×H)	550 × 600 × 1100 mm			550 × 600 × 1230 mm	TBA
OPERATING REQUIREMENTS					
Water service	< 12 l/min, below 20 °C				< 25 l/min, below 20 °C
Relative humidity	20–80 % (non condensing)				
Operating ambient temperature	22 ± 2 °C				
Mains voltage	208 or 230 V AC, single phase, 50/60 Hz				220, 380 or 400 V AC, three phases, 50/60 Hz
Power rating [11]	< 2 kVA	< 2 kVA	< 2.5 kVA	< 4.5 kVA	< 12 kVA

1) Due to continuous improvement, all specifications are subject to change. Parameters marked typical are illustrative; they are indications of typical performance and will vary with each unit we manufacture. Unless stated otherwise, all specifications are measured at 1064 nm and for basic system without options.

2) For APL210x-SH and APL210x-SH/FH options. Outputs are not simultaneous.

3) For APL210x-TH option. Outputs are not simultaneous.

4) For APL210x-SH/FH option. Outputs are not simultaneous.

5) Rms, measured over 30 s.

6) Optional 30 ps duration. Inquire for pulse energies.

7) Should be specified when ordering. Inquire for custom pulse repetition rates.

8) Gaussian fit >80%.

9) Full angle measured at the $1/e^2$ level at 1064 nm.

10) Beam diameter is measured at 1064 nm at the $1/e^2$ level.

11) Required current rating can be calculated by dividing power rating by mains voltage.

OPTIONS

- **Option P30.** Provides 30±3 ps output pulse duration. Contact EKSPLA for pulse energy specifications.
- **Seeder.** Optional seeder can be provided on request.
- **Option FS.** External seeder input via motorized spectral broadening stage for APL2100 series.
- **Option PLL.** Precise trigger to external RF signal with jitter < 1 ps.
- **AW Water-air cooling option.** Water-air cooling unit or chiller for APL2100 series.
- **20 Hz option.** 20 Hz output at all wavelengths with reduced energy output
- **Multiple channel option.** Multiple outputs of same or different wavelength/energy are available.

ORDERING INFORMATION

Note: Laser must be connected to the mains electricity all the time. If there will be no mains electricity for longer that 1 hour then laser (system) needs warm up for a few hours before switching on.

APL2105-P90-10-SH/TH/FH

- Model
- Pulse duration:
  P90 → 90 ps
  P30 → 30 ps
- Pulse repetition rate in Hz
- Harmonic generator options:
  SH → second harmonic
  TH → third harmonic
  FH → fourth harmonic

APL2200 SERIES

High Energy kHz Repetition Rate Picosecond Amplifiers

FEATURES

- *High pulse energy at **kHz** rate*
- *Diode pumped **solid state design***
- *Cooled by supplied chiller – tap water is not required (optional)*
- ***Low** maintenance **costs***
- *Remote control pad*
- *PC control via USB with supplied LabVIEW™ drivers*
- *Optional temperature stabilized second, third and fourth harmonic generators*

APPLICATIONS

- *OPG/OPA pumping*
- *OPCPA pumping*
- *Other spectroscopic and nonlinear optics applications...*

APL2200 series amplifiers are designed to produce up to 130 mJ picosecond pulses at kilohertz pulse repetition rate. Short pulse duration, excellent pulse-to-pulse stability, superior beam quality makes APL2200 series diode pumped picosecond amplifiers well suited for applications like OPCPA pumping, non-linear optics and others.

Regenerative amplifier / Power amplifier design

APL2200 series amplifiers consist of regenerative amplifier and power amplifiers. System could be seeded by built-in picosecond oscillator or other ultrafast laser system. Pulses from regenerative amplifier are spatially shaped and amplified in double-pass amplifiers with thermally induced birefringence compensation. Advanced optical design ensures smooth, without hot spots beam spatial profile at the laser output. Low light depolarization level allows high efficiency generation of up to 4th harmonic with build-in harmonic generators. Repetition rate and timing of the pulses can be locked to the external RF source (with –PLL option) or other ultrafast laser system (with –FS option).

Build-in harmonic generators

Angle-tuned LBO and/or BBO crystals mounted in temperature stabilized heaters are used for second, third and fourth harmonic generation. Harmonic separation system is designed to ensure high spectral purity of radiation and direct it to the output ports.

Simple and convenient laser control

For customer convenience the amplifier can be controlled through remote control pad or USB interface. Alternatively, the amplifier can be controlled from personal computer with supplied software for Windows™ operating system. LabVIEW™ drivers are supplied as well.

APL2200 series available models

Model	Features
APL2201	Delivers 10 mJ, 90 ps pulses at up to 1 kHz repetition rate
APL2203	Delivers 30 mJ, 90 ps pulses at up to 1 kHz repetition rate
APL2205	Delivers 60 mJ, 90 ps pulses at up to 1 kHz repetition rate
APL2206	Delivers 130 mJ, 90 ps pulses at up to 1 kHz repetition rate

SPECIFICATIONS [1]

Model	APL2201	APL2203	APL2205	APL2206
Output energy				
at 1064 nm	10 mJ	30 mJ	60 mJ	130 mJ
at 532 nm [2]	5 mJ	15 mJ	30 mJ	70 mJ
at 355 nm [3]	3 mJ	10 mJ	20 mJ	inquire
at 266 nm [4]	1 mJ	2.5 mJ	4 mJ	inquire
Pulse energy stability (StdDev) [5]				
at 1064 nm	1 %			
at 532 nm	1.5 %			
at 355 nm	2 %			
at 266 nm	4 %			
Pulse duration (FWHM) [6]	90±10 ps			
Pulse repetition rate [7]	1000 Hz			
Triggering mode	external			
Spatial mode [8]	super-Gaussian			
Beam divergence [9]	< 1 mrad	< 0.7 mrad		
Typical beam diameter [10]	~ 3 mm	~ 5 mm	~ 6 mm	~ 7 mm
Beam pointing stability [5]	< 100 µrad			
Pre-pulse contrast	> 100 : 1			
Polarization	linear, > 95 %			
INPUT				
Wavelength	1064 nm			
Pulse duration range (FWHM)	20 fs – 90 ps			
Pulse repetition rate	50 – 95 MHz			
Average power	>20 mW			
PHYSICAL CHARACTERISTICS				
Laser head size (W×L×H)	455 × 1035 × 242 mm	900 × 1500 × 350 mm	1200 × 2200 × 350 mm	TBA
Power supply size (W×L×H)	550 × 600 × 680 mm	550 × 600 × 1100 mm	550 × 600 × 1030 mm	TBA
Chiller size (W×L×H)	400 × 430 × 790 mm	400 × 430 × 790 mm	500 × 500 × 850 mm	600 × 600 × 600 mm
OPERATING REQUIREMENTS				
Water service	not required, air-cooled			water-cooled
Relative humidity	20–80 % (non condensing)			
Operating ambient temperature	22 ± 2 °C			
Mains voltage	208 or 230 V AC, single phase, 50/60 Hz			208 or 230 V AC, three phases, 50/60 Hz
Power rating [11]	< 1 kVA	< 2.5 kVA	< 5 kVA	< 14 kVA

1) Due to continuous improvement, all specifications are subject to change. Parameters marked typical are illustrative; they are indications of typical performance and will vary with each unit we manufacture. Unless stated otherwise, all specifications are measured at 1064 nm and for basic system without options.

2) For APL210x-SH and APL210x-SH/FH options. Outputs are not simultaneous.

3) For APL210x-TH option. Outputs are not simultaneous.

4) For APL210x-SH/FH option. Outputs are not simultaneous.

5) Rms, measured over 30 s.

6) Optional 30 ps duration. Inquire for pulse energies.

7) Should be specified when ordering. Inquire for custom pulse repetition rates.

8) Gaussian fit >80%.

9) Full angle measured at the $1/e^2$ level at 1064 nm.

10) Beam diameter is measured at 1064 nm at the $1/e^2$ level.

11) Required current rating can be calculated by dividing power rating by mains voltage.

OPTIONS

- **Option P30.** Provides 30±3 ps output pulse duration. Contact EKSPLA for pulse energy specifications.
- **Option FS.** External seeder input via motorized spectral broadening stage for APL2100 series.
- **Option PLL.** Precise trigger to external RF signal with jitter < 1 ps.
- **AW Water-air cooling option.** Water-air cooling unit or chiller for APL2100 series.
- **Multiple channel option.** Multiple outputs of same or different wavelength/energy are available.

BEAM PROFILE

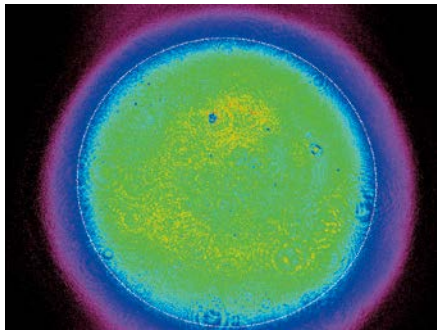

Fig 1. Typical beam profile at APL2200 amplifier output

OPTICAL LAYOUT

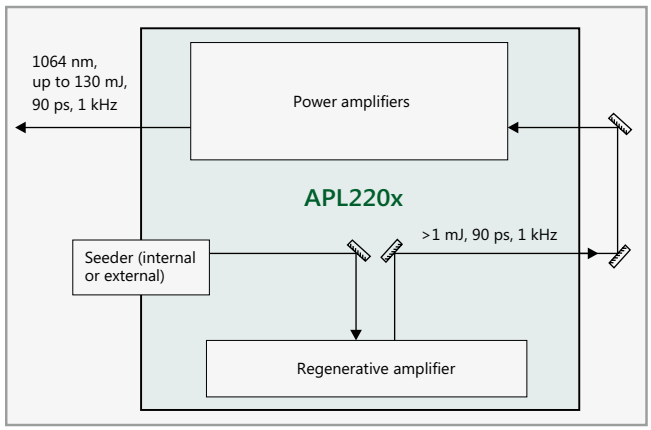

Fig 2. Block optical layout of APL2200 series amplifier

ORDERING INFORMATION

Recommended seed laser for 90 ps is PL2210B. For 30 ps pulse duration use PL2210A as seed laser.

Note: Laser must be connected to the mains electricity all the time. If there will be no mains electricity for longer that 1 hour then laser (system) needs warm up for a few hours before switching on.

APL2201-P90-1K-SH/TH/FH

- Model
- Pulse duration:
  P90 → 90 ps
  P30 → 30 ps
- Pulse repetition rate in Hz,
  1K = 1000 Hz
- Harmonic generator options:
  SH → second harmonic
  TH → third harmonic
  FH → fourth harmonic

APL4206 SERIES

High Energy Picosecond Amplifiers

FEATURES

- *High pulse energy up to **1 kHz** rate*
- *Diode pumped solid state design*
- *Cooled by supplied water-to-water chiller*
- *Low maintenance costs*
- *PC control via USB with supplied, LabVIEW™ drivers*
- *Optional temperature stabilized second, third and fourth harmonic generators*

APPLICATIONS

- *Multiple stage OPCPA pumping*
- *Non-linear optics*
- *Other spectroscopic and nonlinear optics applications*

APL4200 series amplifiers are designed to produce multiple outputs of up to 130 mJ picosecond pulses at up to 1 kHz pulse repetition rate. Short pulse duration, excellent pulse-to-pulse stability, superior beam quality makes APL4200 series diode pumped picosecond amplifiers well suited for applications like multiple stage OPCPA pumping, non-linear optics and others.

Regenerative amplifier/Power amplifier design

APL4200 series amplifiers consist of regenerative and power amplifiers. System could be seeded by built-in picosecond oscillator or other ultrafast laser system. Pulses from regenerative amplifier are spatially shaped and amplified in double-pass amplifiers with thermally induced birefringence compensation. Advanced optical design ensures smooth, without hot spots beam spatial profile at the laser output. Low light depolarization level allows high efficiency generation of up to 4th harmonic with build-in harmonic generators. Repetition rate and timing of the pulses can be locked to the external RF source (with –PLL option) or other ultrafast laser system (with –FS option).

Simple and convenient laser control

For customer convenience the amplifier can be controlled through Laser Control software via USB interface (control PC included). Alternatively, the amplifier can be controlled from personal computer with supplied software for Windows™ operating system. LabVIEW™ drivers are supplied as well.

Build-in harmonic generators

Angle-tuned LBO and/or BBO crystals mounted in temperature stabilized heaters are used for second, third and fourth harmonic generation. Harmonic separation system is designed to ensure high spectral purity of radiation and direct it to the output ports.

SPECIFICATIONS [1]

Model	APL4206
MAIN SPECIFICATIONS	
Central wavelength	1064 nm
Output energy	up to 8 channels × ≥130 mJ
Pulse energy stability [2]	≤ 1 %
Pulse duration (FWHM)	90 ± 10 ps
Pulse repetition rate	1 kHz
Spectral bandwidth	≤ 1 cm^{-1}
Triggering mode	external
Spatial mode	Top-Hat
Beam divergence	< 0.7 mrad
Beam diameter [3]	~ 8 mm
Beam pointing stability [2]	< 30 µrad
Beam local intensity fluctuation [4]	< ±15 %
Deviation of spatial parameters between beams	±10 %
Pre-pulse contrast [5]	> 200:1
Polarization contrast	> 100:1
Polarization	linear, horizontal
PHYSICAL CHARACTERISTICS	
Laser head size (W×L×H)	1500 × 3000 × 400 mm (preliminary)
Power supply size (W×L×H)	553 × 600 × 1200 mm – 1 unit 553 × 600 × 500 mm – 1 unit
OPERATING REQUIREMENTS	
Warm up time	< 30 min
Total water consumption	< 20 l/min, 2 bar, 20 °C
Relative humidity	20–80 % (non condensing)
Operating ambient temperature	22 ± 2 °C
Mains voltage	208, 380 or 400 V AC, three phases, 50/60 Hz
Power rating	< 22 kVA
Cleanness of the room	ISO Class 7 or 10000 as per U.S. Fed Std. 209 (5 VDI 2083, C GMP)

[1] With "-internal oscillator" and "-PLL" options.

[2] Rms, measured over 30 s.

[3] Beam diameter is measured at the $1/e^2$ level.

[4] From the average intensity across 80 % of beam cross-section (or beam diameter measured at $1/e^2$ level).

[5] Peak-to-peak in respect to residual pulses.

BEAM PROFILE

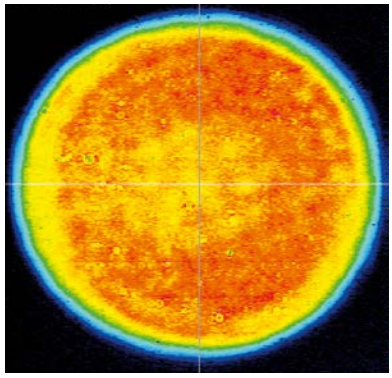

Fig 1. Typical beam profile of APL4206 series laser (measured at the relay image plane)

NL120 SERIES

SLM Q-switched Nd:YAG Lasers

FEATURES

- *Up to **10 J** pulse energy*
- *Diode-pumped, self-seeded Single Longitudinal Mode (SLM) master oscillator*
- *Stable master oscillator cavity producing TEM_{00} spatial mode output*
- *Excellent pulse energy stability*
- *Up to **10 Hz** pulse repetition rate*
- ***2 ns** pulse duration (7, 10 or 25 ns are optional)*
- *Temperature stabilized harmonic generator options*
- *Remote control via keypad*
- *Laser control from PC via USB port*

APPLICATIONS

- *Material processing*
- *OPO, OPCPA, Ti:Sapphire, dye laser pumping*
- *Holography*
- *Nonlinear laser spectroscopy*
- *Optics testing*

NL120 series electro-optically Q-switched nanosecond Nd:YAG lasers deliver up to 10 J per pulse with excellent stability. The innovative, diode-pumped, self-seeded master oscillator design results in Single Longitudinal Mode (SLM) output without the use of external expensive narrow linewidth seed diodes and cavity-locking electronics. Unlike more common designs that use an unstable laser cavity, the stable master oscillator cavity produces a TEM_{00} spatial mode output that results in excellent beam properties after the amplification stages.

NL120 series Q-switched nanosecond lasers are an excellent choice for many applications, including OPO, OPCPA or dye laser pumping, holography, LIF spectroscopy, remote sensing, optics testing and other tasks.

For tasks that require a smooth and as close as possible to the Gaussian beam profile, models with improved Gaussian fit are available.

The low jitter of the optical pulse with respect to the Q-switch triggering pulse allows the reliable synchronization between the laser and external equipment.

The optional second (SH) (for 532 nm), third (TH) (for 355 nm) and fourth (FH) (for 266 nm) harmonic generators provide access to shorter wavelengths.

The laser is controlled by a supplied PC via USB port with application for Windows™ operating system.

In addition, the main settings of the laser can be controlled through an auxiliary remote control pad. The remote pad features a backlit display that is easy to read even when wearing laser safety eyewear.

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REV. 20200123

SPECIFICATIONS [1]

Model	NL125	NL128	NL129
Pulse energy [2]			
at 1064 nm	1600 mJ	5000 mJ	10000 mJ
at 532 nm [4]	700 mJ	TBA [3]	TBA [3]
at 355 nm [5]	450 mJ	TBA [3]	TBA [3]
at 266 nm [6]	140 mJ	TBA [3]	TBA [3]
Pulse energy stability (StdDev) [7]			
at 1064 nm	< 1 %		
at 532 nm [4]	< 2 %		
at 355 nm [5]	< 3 %		
at 266 nm [6]	< 5 %		
Pulse duration at 1064 nm (FWHM) [8]	2 ± 0.5 ns (7, 10 or 25 ns are optional)		
Pulse repetition rate	10 Hz		
Linewidth	≤ 0.02 cm^{-1} (SLM)		
Polarization at 1064 nm [9]	linear, > 90 %		
Optical pulse jitter (StdDev) [10]	< 0.2 ns		
Beam spatial profile [11]	Hat-Top, > 70 % fit		
Typical beam divergence [12]	< 0.5 mrad		
Beam pointing stability [13]	< 25 µrad		
Typical beam diameter [14]	~ 12 mm	~ 20 mm	~ 27 mm
PHYSICAL CHARACTERISTICS			
Laser head size (W × L × H)	455 × 1220 × 270 mm	600 × 1500 × 300 mm	600 × 2000 × 300 mm
Power supply size (W × L × H)	550 × 600 × 1030 mm	550 × 600 × 1030 mm 2 units	550 × 600 × 1650 mm 2 units
Umbilical length	2.5 m		
OPERATING REQUIREMENTS			
Water consumption (max. 20 °C)	< 20 l/min		
Ambient temperature	22 ± 2 °C		
Relative humidity	10 – 80 % (non-condensing)		
Power requirements [15]	220, 380 or 400 V AC, three-phase 50/60 Hz		
Power consumption	< 5 kVA	< 8 kVA	< 10kVA

1) Due to continuous improvement, all specifications are subject to change without notice. Parameters marked typical are not specifications. They are indications of typical performance and will vary with each unit we manufacture. Unless stated otherwise, all specifications are measured at 1064 nm and for basic system without options.
2) Outputs are not simultaneous.
3) Contact EKSPLA for more information.
4) For NL12×-SH and NL12×-SH/FH options.
5) For NL12×-TH option.
6) For NL12×-SH/FH option.
7) Averaged over 30 s.
8) Optional 7, 10 or 25 ns pulse duration. Inquire for pulse energy specifications.
9) For models without harmonic generators.
10) With respect to Q-switch triggering pulse.
11) Measured at 1 m distance from the laser output. Improved Gaussian fit beam profile is available (contact Ekspla for details).
12) Full angle measured at the $1/e^2$ point at 1064 nm.
13) Full angle, rms measured over 30 s.
14) Beam diameter is measured at 1064 nm at the $1/e^2$ level.
15) Mains should be specified when ordering.

OPTIONS

▸ -P7, -P10 and -P25 options — 7 ns, 10 ns or 25 ns pulse duration

For applications requiring longer pulse duration the laser master oscillator cavity can be modified to produce 7 ns, 10 ns or 25 ns pulses. Note: some of other specifications can be changed. Please contact Ekspla for detailed datasheets.

ORDERING INFORMATION

Note: Laser must be connected to the mains electricity all the time. If there will be no mains electricity for longer that 1 hour then laser (system) needs warm up for a few hours before switching on.

NL125-10-P8-SH/TH

- Model
- Pulse repetition rate in Hz
- Pulse duration options:
  default → 2 ns pulse duration
  P8 → 8±2 ns pulse duration
- Harmonic generator options:
  SH → second harmonic
  TH → third harmonic

NL310 SERIES

High Energy Q-switched Nd:YAG Lasers

FEATURES

- *Up to **10 J** output energy*
- *Better than 0.5% rms pulse energy stability*
- ***4–6 ns** pulse duration*
- ***10** or **20 Hz** repetition rate*
- *Temperature stabilized second, third, fourth and fifth harmonic generators*
- *Remote control via keypad or USB-CAN port*
- *Low jitter internal/external synchronization*
- *Robust and stable laser head*

APPLICATIONS

- *OPO, Ti: Sapphire, dye laser pumping*
- *Material processing*
- *Plasma generation and diagnostics*
- *Nonlinear spectroscopy*
- *Remote sensing*

High pulse energy NL310 series lasers are targeted for applications like OPO or Ti: Sapphire pumping, material processing and plasma diagnostics. These lasers can produce pulse energies up to 10 J in fundamental wavelength at 10 Hz pulse repetition rate.

For the convenience of customers the NL310 series nanosecond Q-switched laser can be controlled either through a remote keypad or USB-CAN port. The remote keypad allows easy control of all parameters and features a backlit display that is easy to read even wearing laser safety eyewear.

Software for Windows™ operating system is provided to control the laser from PC. LabView™ drivers are supplied as well, allowing laser control integration into existing Labview™ programs.

The optional second (SH, 532 nm), third (TH, 355 nm), fourth (FH, 266 nm) and fifth (FiH, 213 nm) harmonic generators can be integrated into laser head or placed outside laser head into auxiliary harmonic generator module. Output wavelength switching is done manually. Motorized wavelength switching is available by request.

Triggering of the laser is possible from built-in internal or external pulse generator. Pulses with TTL levels are required for external triggering. Laser pulses have less than 0.5 ns rms jitter with respect to Q-switch triggering pulse in both cases.

The simple and field proven design ensures easy maintenance and reliable long-term operation of the NL310 series laser.

Optional Relay Imaging for smooth beam profile is available.

SPECIFICATIONS [1]

Model	NL311	NL313	NL314	NL315	NL317	NL319
Pulse energy:						
at 1064 nm	1300 mJ	1600 mJ	2000 / 1800 mJ	3500 mJ	5000 mJ	10000 mJ
at 532 nm [2] [6]	600 mJ	800 mJ	1000 / 900 mJ	1700 mJ	2500 mJ	5000 mJ
at 355 nm [3] [6]	390 mJ	490 mJ	610 / 600 mJ	1000 mJ	1300 mJ	2000 mJ
at 266 nm [4] [6]	130 mJ	180 / 150 mJ	190 / 160 mJ	270 mJ	400 mJ	700 mJ
at 213 nm [5] [6]	25 / 20 mJ	30 / 25 mJ	40 / 30 mJ	inquire		
Pulse energy stability (StdDev): [7]						
at 1064 nm	0.5 %					
at 532 nm	1.5 %					
at 355 nm	2.5 %					
at 266 nm	4.0 %					
at 213 nm	6.0 %					
Power drift [8]	± 2 %					
Pulse duration [9]	4–6 ns			4–7 ns		
Repetition rate	10 / 20 Hz			10 Hz		
Polarization	vertical, > 90 %					
Optical pulse jitter [10]	< 0.5 ns					
Linewidth	< 1 cm^{-1}					
Beam profile [11]	"Hat-Top" (near field), near Gaussian (far field)					
Typical beam diameter [12]	~ 10 mm	~ 12 mm		~ 18 mm	~ 21 mm	~ 27 mm
Beam divergence [13]	< 0.5 mrad					
Beam pointing stability [14]	± 50 µrad					
PHYSICAL CHARACTERISTICS						
Laser head (W × L × H)	460 × 1250 × 260 mm	310 × 800 × 230 mm / 460 × 1250 × 260 mm	460 × 1250 × 260 mm			600 × 1800 × 300 mm
Power supply unit (W × L × H)	553 × 600 × 653 mm / 553 × 600 × 832 mm		553 × 600 × 832 mm / 553 × 600 × 1020 mm	550 × 600 × 1250 mm		550 × 600 × 1640 mm
Umbilical length	2.5 m					
OPERATING REQUIREMENTS						
Water consumption (max 20 °C) [15]	< 8 / < 12 l/min		< 12 / < 16 l/min	< 12 l/min		
Ambient temperature	22 ± 2 °C					
Relative humidity	20 – 80 % (non-condensing)					
Power requirements [16]	208–240 V AC, single phase 50/60 Hz / 220, 380 or 400 V AC, three phases, 50/60 Hz		220, 380 or 400 V AC, three phases, 50/60 Hz			
Power consumption	<2 / <3.5 kVA	<2.5 / <4 kVA	<4 / <5 kVA	<5 kVA	<6 kVA	<8 kVA

1) Due to continuous improvement, all specifications subject to change without notice. Parameters marked typical are not specifications. They are indications of typical performance and will vary with each unit we manufacture. Unless stated otherwise, all specifications are measured at 1064 nm and for basic system without options.

2) For -SH harmonic generator option.

3) For -SH/TH harmonic generator option.

4) For -SH/FH, -SH/TH/FH or -SH/FH/FiH harmonic generator option.

5) For -SH/FH/FiH harmonic generator option.

6) Harmonic outputs are not simultaneous; only single wavelength beam is present at the output at once. Manual reconfiguration is required to switch wavelength.

7) Averaged from pulses, emitted during 30 sec time interval after 5–15 minutes of warm-up.

8) Measured over 8 hours period after 20 min warm-up when ambient temperature variation is less than ±2 °C.

9) FWHM.

10) Standard deviation value, measured with respect to Q-switch triggering pulse.

11) Near field (at the output aperture) TOP HAT fit is >70%.

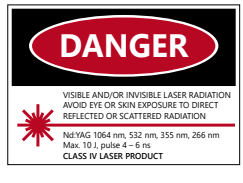
12) Beam diameter is measured at 1064 nm at the $1/e^2$ level.

13) Full angle measured at the $1/e^2$ level at 1064 nm.

14) Beam pointing stability is evaluated as movement of the beam centroid in the focal plane of a focusing element.

15) Water air cooling chiller is possible. Inquire for details.

16) Mains voltage should be specified when ordering.



OPTIONS

- **-G option.** For models NL311, NL313. Provides beam profile optimized for applications requiring smooth, without hot spots beam profile in the near and medium field.
  Pulse energies typically are lower by 30% in comparison to standard lasers without -G option.
- Multimode spatial beam profile for smooth envelope. M^2 > 20.
- **-RLI.** Optional Relay Imaging for smooth beam profile.

BEAM PROFILE

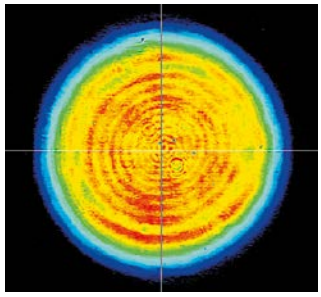


Fig 1. Typical beam profile of NL313 laser output

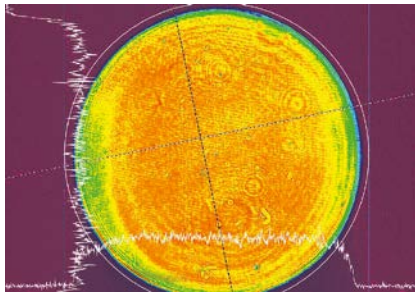


Fig 2. Typical NL319 beam profile after image relay system at 10 J at 1064 nm (with -RLI option)

OUTLINE DRAWINGS

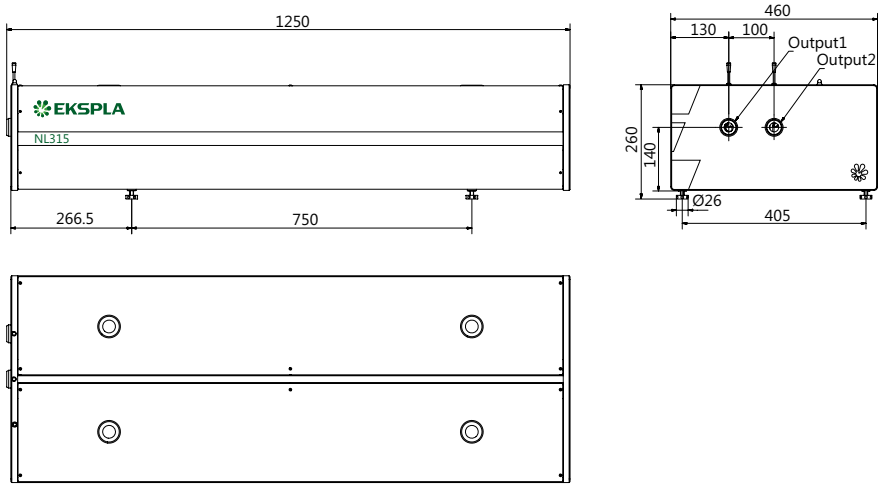


Fig 3. NL315 and NL317 lasers head outline drawing

ORDERING INFORMATION

Note: Laser must be connected to the mains electricity all the time. If there will be no mains electricity for longer that 1 hour then laser (system) needs warm up for a few hours before switching on.

NL313-10-SH/TH/FH-AW

- Model
- Pulse repetition rate in Hz
- Options:
  AW → water-air heat exchanger
- Harmonic generator options:
  SH → second harmonic
  TH → third harmonic
  FH → fourth harmonic
  FiH → fifth harmonic

NL940 SERIES

High Energy Temporaly Shaped Nanosecond Nd:YAG Lasers

FEATURES

- *Variable temporal pulse shape*
- *Up to **10 J** output energy*
- ***10 Hz** repetition rate*
- ***3–10 ns** adjustable pulse duration*
- *1064 or 532 nm output wavelength*
- *Spatial flat top beam profile*
- *Fiber front end output amplified in diode pumped regenerative amplifier*

Main laser feature is output of temporaly shaped pulses based on electrooptical modulator driven by programmable arbitrary waveform generator (AWG). Pulse shaping resolution is 125 ps, while maximum pulse length is 10 ns. Start of the system is single mode CW laser. Then light is amplified in fiber amplifier, later AWG driven modulator transmits only required temporal shape and duration pulse which is amplified in diode pumped regenerative amplifier in order to reach energy sufficient to amplify in single-pass flash-lamp pumped amplifiers. Power amplifier is a chain of single-pass amplifiers where pulse is amplified up to required energy. During amplification spatial beam shaping is used in order to get flat top shape at the output. Optional second/third harmonic generators are based on angle tuned nonlinear crystals placed in temperature stabilized heaters.

APPLICATIONS

- *OPCPA pumping*
- *Front end for power amplifiers*
- *Ti: Sapphire pumping*
- *Laser peening – material hardening by laser-induced shock wave*
- *Plasma and shock physics*

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REV. 20200123

SPECIFICATIONS [1]

Model	NL944	NL945	NL949
Pulse energy (rectangular pulse in time domain 5 ns FWHM)			
at 1064 nm	1.6 J	5 J	10 J
at 532 nm [2]	1.0 J	2.5 J	6 J
Pulse energy stability (Std Dev) [3]			
at 1064 nm	0.5 %		
at 532 nm	1.0 %		
Power drift [4]	± 2 %		
Pulse duration [5]	3–10 ns, variable with 125 ps resolution		
Repetition rate	10 Hz		
Polarization @ 1064 nm	vertical, > 90 %		
Optical pulse jitter [6]	< 30 ps		
Linewidth	< 0.1 cm^{-1}		
Beam profile	Hat-Top" (at laser output), without diffraction rings		
Typical beam diameter [7]	~ 11 mm	~ 22 mm	~ 33 mm
Beam divergence [8]	< 0.5 mrad		
Beam pointing stability	±50 µrad		
PHYSICAL CHARACTERISTICS			
Laser head (W × L × H)	750 × 1350 × 300 mm	700 × 2100 × 300 mm	1000 × 2100 × 300 mm
Power supply unit (W × L × H)	550 × 600 × 840 mm – 1 unit 550 × 600 × 670 mm – 1 unit	550 × 600 × 1220 mm - 2 units	550 × 600 × 1220 mm - 2 units 550 × 600 × 670 mm – 1 unit
Umbilical length	3 m		
OPERATING REQUIREMENTS			
Water consumption (max 20 °C)	< 8 l/min		< 40 l/min
Ambient temperature	22 ± 2 °C		
Relative humidity	20 – 80 % (non-condensing)		
Power requirements [9]	208/240 V AC, single phase, 50/60 Hz or 220, 380 or 400 V AC, three phases, 50/60 Hz		220, 380 or 400 V AC, three phases, 50/60 Hz
Power consumption	5.5 kW		13.2/6.6 kW

1) Due to continuous improvement, all specifications subject to change without notice. Parameters marked typical may vary with each unit we manufacture.Unless stated otherwise, all specifications are measured at 1064 nm and for basic system without options.

2) For NL94X-SH harmonic generator option. Harmonic outputs are not simultaneous; only single wavelength beam is present at the output at once. Manual reconfiguration is required to switch wavelength. Third harmonic available on request.

3) Standard deviation value averaged from 1000 shots after 20 minutes of warm-up.

4) Deviation from average value measured over 8 hours of operation when room temperature variation is less than ±2 °C.

5) Measured with photodiode with 100 ps rise time and oscilloscope with 600 MHz bandwidth.

6) Standard deviation value, measured with respect to triggering pulse.

7) Beam diameter is measured at 1064 nm at laser output at the $1/e^2$ level and can vary with each unit we manufacture.

8) Full angle measured at the $1/e^2$ level at 1064 nm.

9) Mains voltage should be specified when ordering.

BEAM PROFILE

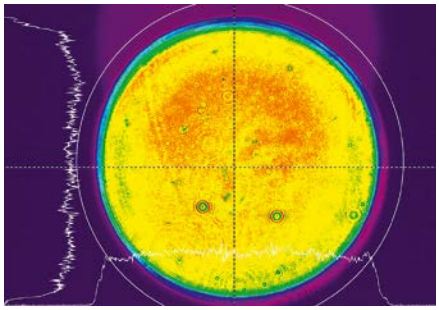


Fig 1. Typical NL949-SH near field beam profile at 5 J at 532 nm

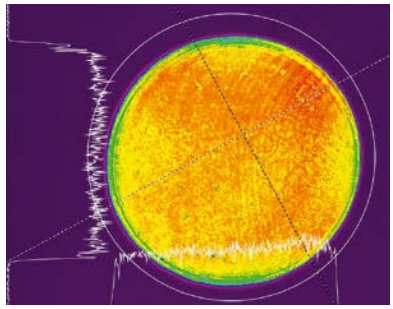


Fig 2. Typical NL945-SH system output beam profile at 532 nm

PERFORMANCE

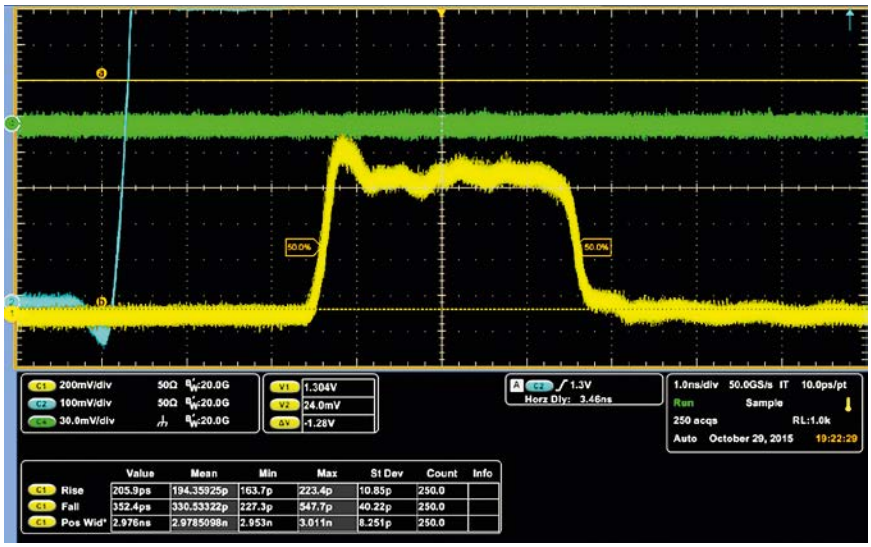


Fig 3. Example of temporal pulse shape, stability of pulse shape and optical pulse jitter

Note: Laser must be connected to the mains electricity all the time. If there will be no mains electricity for longer that 1 hour then laser (system) needs warm up for a few hours before switching on.

ANL SERIES
High Energy and High Repetition Rate DPSS Nanosecond Lasers

Highly Customizable to Meet Customer Needs

FEATURES

- *Up to **1 J** at **1064 nm** output pulse energy*
- *Up to **1 kHz** repetition rate*
- ***2 – 4 ns** or **5 ns** pulse duration*
- *Spatial flat top beam profile*
- *Low maintenance costs*
- *Various customizing possibilities to tailor for specific applications*
- *Optional second and third harmonics generators*
- *High efficiency diode pumping chambers*
- ***1×2 m** laser head footprint*
- *Internal system diagnostics*
- *Optional industrial grade, portable laser housing with integrated power supplies and cooling units*

ANL series electro-optically Q-switched nanosecond Nd:YAG lasers deliver high energy pulses at high repetition rates.

A diode-pumped Q-switched nanosecond laser, based on industry-tested technology is used as a master oscillator of the system. It produces high-intensity, high-brightness pulses and is well suited for further amplification in linear amplifiers for high-energy flat-top output pulses. Employing electro-optical cavity dumping, the master oscillator can produce pulses which are as short as several ns with uniform beam profile and low divergence.

Power amplifiers are a chain of low-maintenance diode-pumped single and double pass amplifiers where pulses are amplified up to the required energy. During amplification, spatial beam shaping is employed in order to get a flat top shape at the output. Optional second and third harmonic generators are based on angle-tuned nonlinear crystals placed in heaters.

For convenience, PC software for Windows™ (LabVIEW™ drivers are supplied as well) is used for laser operation, monitoring and internal system diagnostics.

To tailor the laser for specific applications or requirements, various customization possibilities are available such as industrial grade, portable laser housing with integrated power supplies and cooling units.

SPECIFICATIONS [1]

Model	ANL 2001k	ANL 4001k	ANL 1k200
MAIN SPECIFICATIONS			
Pulse energy			
at 1064 nm	> 200 mJ	> 400 mJ	> 1000 mJ
at 532 nm [2]	–		
Pulse energy stability (StdDev): [3]			
at 1064 nm	1.5 %		
at 532 nm	–		
Power drift [4]	± 2 %		
Pulse duration [5]	2 – 4 ns		~ 5 ns
Repetition rate	1000 Hz		200 Hz
Polarization at 1064 nm	horizontal		
Optical pulse jitter [6]	–		
Linewidth	–		
Beam profile	Hat-Top (at laser output), without diffraction rings		
Typical beam diameter [7]	~6 mm		~10 mm
Beam divergence [8]	< 1.0 mrad		< 0.5 mrad
Beam pointing stability	± 30 µrad [3]		
PHYSICAL CHARACTERISTICS			
Laser head (W × L × H)	1000 × 2000 × 490 mm		
Power supply unit (W × L × H)	553 × 600 × 700 mm		
Umbilical length	2.5 m		
OPERATING REQUIREMENTS			
Facility water consumption (max 20° C)	10 l/min	14 l/min	10 l/min
Ambient temperature	22 ± 2 °C		
Relative humidity	20 – 80 % (non-condensing)		
Power requirements [9]	208, 380 or 400 V AC, three phase, 50/60 Hz		
Power consumption	<10 kW	<12 kW	<6 kW

1) Due to continuous improvement, all specifications subject to change without notice. Parameters marked typical may vary with each unit we manufacture.Unless stated otherwise, all specifications are measured at 1064 nm and for basic system without options.

2) For NL94X-SH harmonic generator option. Harmonic outputs are not simultaneous; only single wavelength beam is present at the output at once.

3) Standard deviation value averaged over 30 s after 20 minutes of warm-up.

4) Deviation from average value measured over 8 hours of operation when room temperature variation is less than ±2 °C.

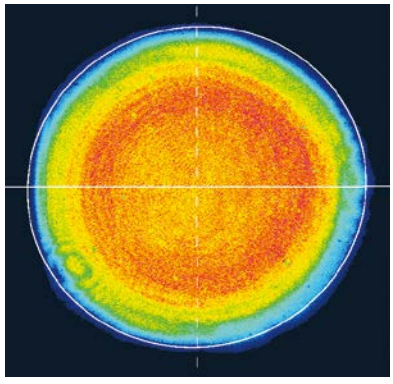
5) Measured with photodiode with 100 ps rise time and oscilloscope with 600 MHz bandwidth.

6) Standard deviation value, measured with respect to triggering pulse.

7) Beam diameter is measured at 1064 nm at laser output at the $1/e^2$ level and can vary with each unit we manufacture.

8) Full angle measured at the $1/e^2$ level at 1064 nm.

9) Mains voltage should be specified when ordering.



Typical beam profile of ANL4001k laser

Nd:Glass SYSTEMS

Nanosecond High Energy Laser Systems

160 J @ 1053 nm MM laser system

Ekspla offers wide range of high energy Nd:Glass laser systems. Typically Nd:Glass laser comprise SLM diode pumped master oscillator, pre-amplifier, pulse shaper and main lamp pumped amplifiers.

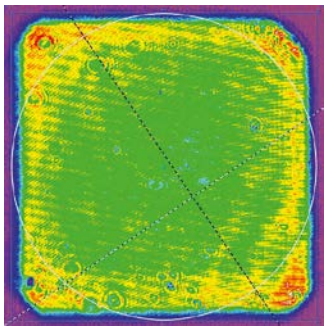
SPECIFICATIONS

Parameter	Value
Center wavelength	1053 – 1060 nm
Pulse width	500 ps – 20 ns
Max pulse energy single channel	160 J
Beam spatial profile (near field)	"Top Hat" across 80% of beam cross-section (beam local intensity fluctuation max ±20% from the average intensity)
Pulse repetition rates	depending on system configuration from 1 shot in 1 min to 1 shot in 20 min for output energies >10 J
Shot to shot stability	below 2.0 % rms @ fundamental in single channel configuration
Linewidth	< 0.02 cm^{-1} @ 2 ns for single longitudinal mode (SLM), < 1 cm^{-1} @ 4 ns for multimode (MM)
Pre-pulse contrast	better than 1 : 10^5
Polarization contrast	> 100 : 1
Output isolation from back-reflected light	> 500 : 1 (Faraday isolator contrast)
Optical pulse jitter	typical < 0.2 ns rms, optional < 10 ps rms
Flashlamp lifetime	2×10^5 shots typical (typically > 3000 hours of non-stop operation at PRR 1 shot/minute)
Pump diode lifetime	> 10 000 hours typical

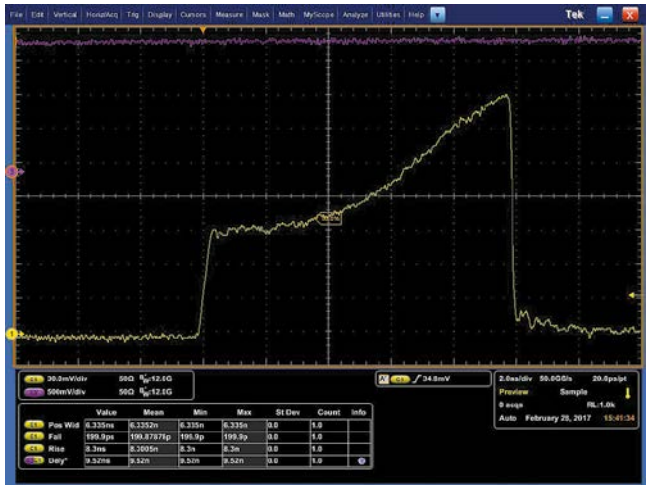
FEATURES

- *Front end options*
  - *Diode pumped SLM or MM master oscillator featuring excellent stability, long lifetime and maintenance-free operation based on Nd:glass or Nd:YLF*
  - *Temporally shaped seeder / regenerative amplifier configuration allowing application of smoothing technics*
  - *Wave front correction system based on DFM*
- *Optional SBS compressor ensuring high contrast pulses and controllable pulse duration*
- *Flashlamp / LD pumped pre-amplifier*
- *Up to Ø60 mm aperture Nd:glass power amplifiers*
- *Laser protection by Faraday isolators preventing damage of laser rods by back-reflected light*
- *Optimized design for maximum pulse energy extraction*
- *Separately controlled PFN circuits for each flash lamp*
- *Diagnostics and monitoring of system status based on microprocessor controller*
- *Software guide for step-by-step performance check at designated control points*
- *Optional second and third harmonic generators*

PERFORMANCE

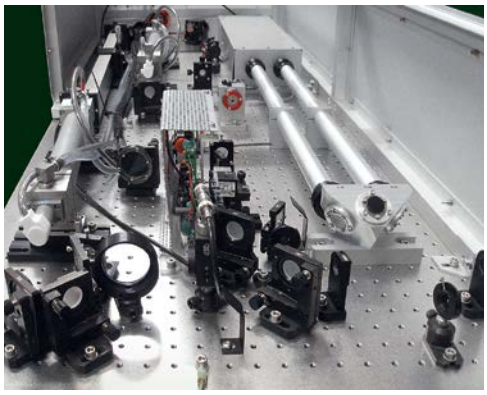


Spatial shaping of 33 J @ 1053 nm output pulses (beam of rectangular shape)

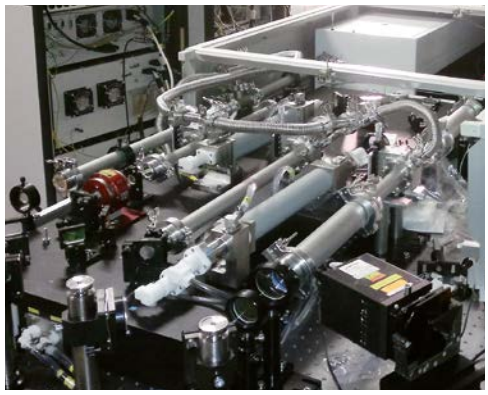


One example of the pulse wave form at the output @ 33 J (fundamental)

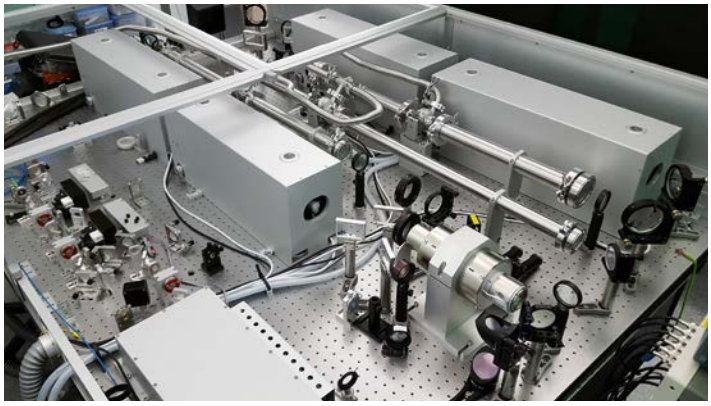
CUSTOM INSTALATIONS



Amplifier system delivering 1 J at center wavelength 1060 nm, pulse width 800 ps and ~ 4 nm (FWHM) gain bandwidth



12 J @ 527 nm laser system during development stage



30 J Nd:glass system featuring arbitrary shaped temporal pulse shape

NL941 SERIES
High Energy Temporaly Shaped DPSS Nanosecond Lasers

Tailored according to specific requirements

NL941 FEATURES

- *Up to **2 J** at **1064 nm** output pulse energy*
- *Bursts of up to **30** pulses at **1 kHz** repetition rate or **4** pulses at **20 kHz** repetition rate in 20 sec periods available in burst mode*
- ***5 ns** pulse duration*
- *Spatial flat top beam profile*
- *Temporal shaping by pulse processing with electrooptical modulator driven by arbitrary wave generator (AWG)*
- *High efficiency diode pumping chambers*
- ***1×2 m** laser head footprint*

NL941 and NL942-SH lasers were designed and manufactured according custom request and are used for plasma research. They are good examples of what can be achieved when long time experience and latest technologies are put together.

Main laser feature is output of temporaly shaped pulses based on electrooptical modulator driven by programable arbitrary wave generator (AWG). Pulse shaping resolution is 125 ps and pulse duration up to 50 ns. Start of the system is a single mode CW laser. Then light is amplified in fiber amplifier, later AWG driven modulator transmits only required temporal shape and duration pulse which is amplified in diode pumped regenerative amplifier in order to reach energy level sufficient to amplify in single-pass / double-pass diode pumped amplifiers. Diode pumping enables generating bursts of pulses with up to 20 kHz frequency in burst mode.

Power amplifier is a chain of diode pumped single-pass amplifiers where pulse is amplified up to required energy. During amplification spatial beam shaping is employed in order to get a flat top shape at the output. Optional second and third harmonic generators are based on angle tuned nonlinear crystals placed in heaters.

NL942-SH FEATURES

- *Two outputs up to **1.7 J** at **1064 nm** each*
- *Two outputs up to **0.9 J** at **532 nm** each*
- ***100 Hz** repetition rate*
- ***50 ns** pulse duration*
- *Spatial flat top beam profile*
- *Temporal shaping by pulse processing with electrooptical modulator driven by arbitrary wave generator (AWG)*
- *Internal system diagnostics*
- *High efficiency diode pumping chambers*
- *Industrial grade, portable laser housing with integrated power supplies and cooling unit*

SPECIFICATIONS [1]

Model	NL941	NL942-SH
MAIN SPECIFICATIONS		
Pulse energy		
at 1064 nm	2000 mJ	2 × 1700 mJ
at 532 nm [2]	–	2 × 900 mJ
Pulse energy stability (StdDev): [3]		
at 1064 nm	1.0 %	1.0 %
at 532 nm	–	2.0 %
Power drift [4]	± 2 %	
Pulse duration [5]	5 ns	50 ns
Repetition rate	bursts of 20 kHz every 20 s	100 Hz
Polarization at 1064 nm	vertical, > 90 %	
Optical pulse jitter [6]	< 30 ps	
Linewidth	< 1 cm^{-1}	
Beam profile	Hat-Top (at laser output), without diffraction rings	
Typical beam diameter [7]	~12 mm	~10 mm
Beam divergence [8]	< 0.5 mrad	
Beam pointing stability	± 50 µrad	
PHYSICAL CHARACTERISTICS		
Laser head (W × L × H)	1000 × 2000 × 400 mm	1000 × 2000 × 1800 mm
Power supply unit (W × L × H)	550 × 600 × 500 mm	–
Umbilical length	3 m	–
OPERATING REQUIREMENTS		
Facility water consumption (max 20° C)	8 l/min	20 l/min
Ambient temperature	22 ± 2 °C	
Relative humidity	20 – 80 % (non-condensing)	
Power requirements [9]	208/240 V AC, single phase 50/60 Hz or 220, 380 or 400 V AC, three phases 50/60 Hz	208, 380 or 400 V AC, three phase, 50/60 Hz
Power consumption	2.0 kW	9.4 kW

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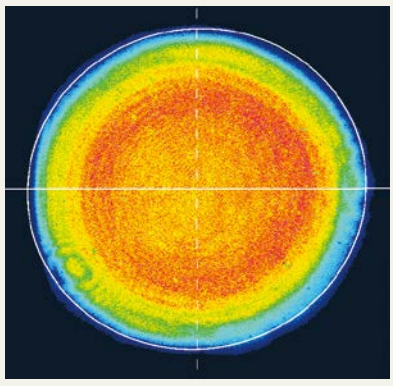

Typical beam profile of ANL4001k laser

Photo: Unique OPCPA based laser system, providing **~5 terawatts** of output power at **1 kHz** repetition rate has been produced by Ekspla and Light Conversion consortium. Sylos 1 named system is generating **7 fs** or shorter pulses and was designed and built for Extreme Light Infrastructure – Attosecond Light Pulse Source facilities (ELI-ALPS) located in Szeged, Hungary

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Phone: +370 5 264 96 29
Fax: +370 5 264 18 09
E-mail: sales@ekspla.com

Ask for quotation online at www.ekspla.com.

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