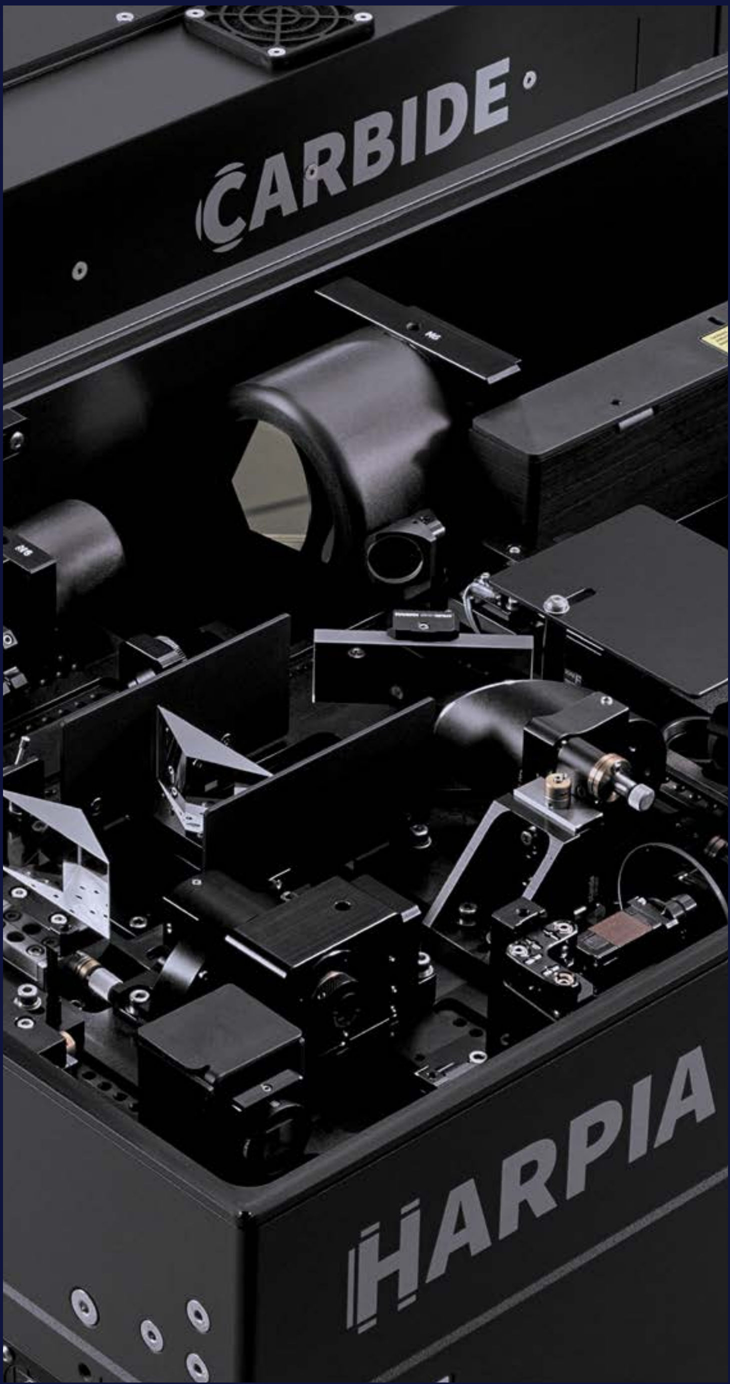
Femtosecond Laser Systems for Industry & Science

Product Catalog



lightcon.com

LIGHT CONVERSION is a global leader in ultrafast technology, designing and manufacturing:

- Femtosecond Lasers
- Wavelength-Tunable Sources
- OPCPA Systems
- Microscopy Sources
- Spectroscopy Systems

The comprehensive portfolio represents the best-in-class lasers tailored for industry, science, and medicine.

About Us

Founded in 1994, LIGHT CONVERSION has evolved into a leading company in ultrafast laser technology with over 9000 systems installed worldwide and 650 employees, 15% of whom focus on R&D. The company's lasers are used by all of the world's top 50 universities, highlighting its commitment to state-of-the-art research, while also ensuring the reliability and performance in 24/7 industrial applications. With international offices in the US, China, and Korea, along with a global representative network, the company ensures worldwide sales and service.

Contents


PHAROS
LIGHT CONVERSION
CARBIDE
LIGHT CONVERSION
FLINT

Femtosecond Lasers

LIGHT CONVERSION is world-renowned for its industrial-grade Yb-based femtosecond lasers, covering a wide range of scientific, industrial, and medical applications.

CARBIDE	Compact industrial design in air- or water-cooled models, providing up to 120 W, 1 mJ or 80 W, 2 mJ with excellent output stability.
PHAROS	Scientific flexibility and process-tailored output parameters, offering pulse durations down to 100 fs and pulse energies up to 4 mJ.
FLINT	Expanding the parameter range with repetition rates from 10 to 100 MHz, output power up to 20 W, and pulse durations down to 50 fs.

High average power and pulse energy at high repetition rates

Market-proven, industrial-grade stability and reliability

Tailored to the needs of both industry and science

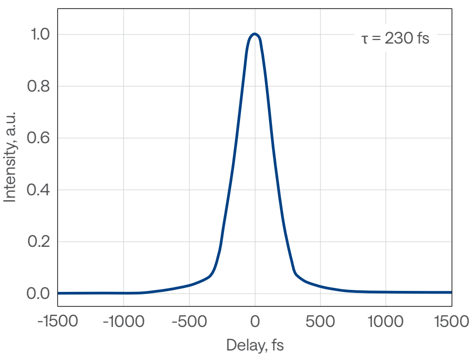
CARBIDE

Unibody-Design Femtosecond Lasers for Industry and Science

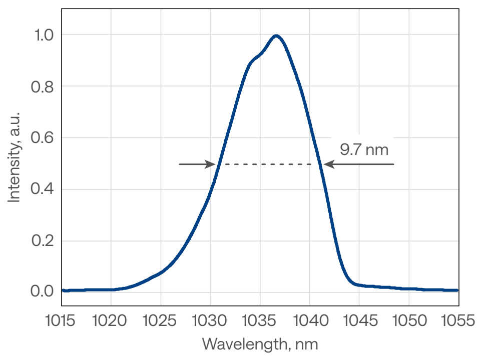
CARBIDE-CB3

- Maximum output of 120 W, 1 mJ or 80 W, 2 mJ
- Single-shot – 10 MHz repetition rate NEW
- Tunable pulse duration, 190 fs – 20 ps
- Pulse-on-demand and BiBurst for pulse control
- Automated harmonics up to the 5th or tunable extensions
- Air-cooled and water-cooled models
- Compact industrial-grade design

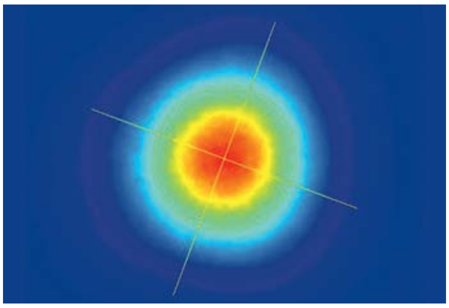
CARBIDE-CB3
Typical pulse duration



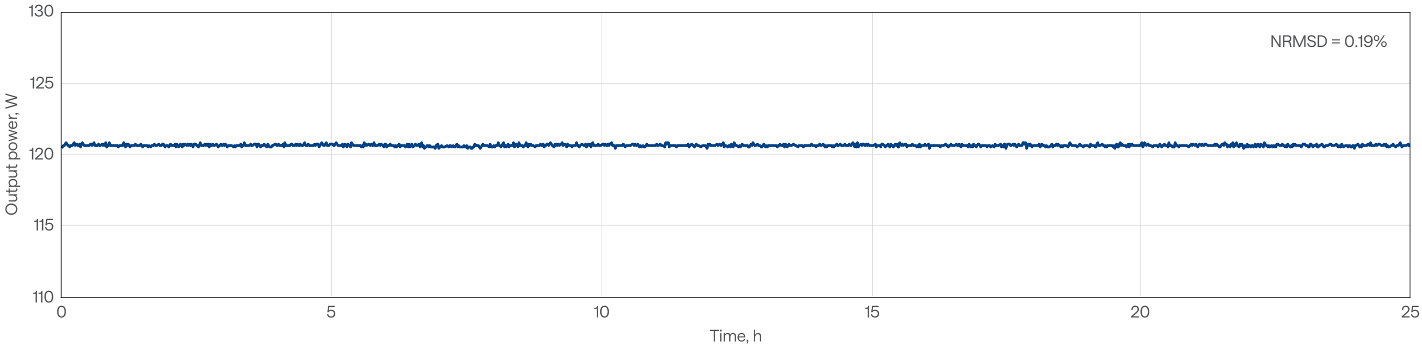
CARBIDE-CB3
Typical spectrum



CARBIDE-CB3
Typical beam profile



CARBIDE-CB3-120W
Long-term power stability



CARBIDE-CB3 specifications

NEW

OUTPUT CHARACTERISTICS

Model	CB3-20W	CB3-40W	CB3-40W-10MHz	CB3-80W		CB3-120W
Cooling method	Water-cooled					
Center wavelength	1030 ± 10 nm					
Maximum output power	20 W	40 W		80 W		120 W
Pulse duration [1]	< 250 fs				< 350 fs [2]	< 250 fs
Pulse duration tuning range	250 fs – 10 ps				350 fs – 10 ps	250 fs – 10 ps
Maximum pulse energy	0.4 mJ		0.2 mJ	0.8 mJ	2 mJ	1 mJ
Repetition rate	Single-shot – 1 MHz	Single-shot–1 MHz (2 MHz on request)	Single-shot – 10 MHz	Single-shot – 2 MHz		
Pulse selection	Single-shot, pulse-on-demand, any fundamental repetition rate division					
Polarization	Linear, vertical; 1 : 1000					
Beam quality, M^2	< 1.2					
Beam diameter [3]	3.9 ± 0.4 mm			4.2 ± 0.4 mm	5.1 ± 0.7 mm	5 ± 0.5 mm
Beam pointing stability	< 20 µrad/°C					
Pulse energy control	FEC [4]		Attenuator [5]	FEC [4]		
Pulse picker leakage	< 0.25%		< 0.5%	< 0.25%		
Pulse-to-pulse energy stability, 24 h [6]	< 0.5%					
Long-term power stability, 100 h [6]	< 0.5%					

MAIN OPTIONS

Model	CB3-20W	CB3-40W	CB3-40W-10MHz	CB3-80W	CB3-120W
Oscillator output [7]	< 0.5 W, 120 – 250 fs, 1030 ± 10 nm, ≈ 65 MHz				
Harmonic generator [8]	515 nm, 343 nm, 257 nm, or 206 nm; *see page 22*				
Optical parametric amplifier [9]	UV – MIR; *see page 30*				n/a
BiBurst option	Tunable GHz and MHz burst with burst-in-burst capability; *see page 13*				

PHYSICAL DIMENSIONS

Model	CB3-20W	CB3-40W	CB3-40W-10MHz	CB3-80W	CB3-120W
Laser head (L × W × H)	633 × 350 × 174 mm				
Chiller (L × W × H)	585 × 484 × 221 mm		680 × 484 × 307 mm		
24 V DC power supply (L × W × H)	280 × 144 × 49 mm [10]		320 × 200 × 75 mm		376 x 449 x 88 mm

ENVIRONMENTAL AND UTILITY REQUIREMENTS

Model		CB3-20W	CB3-40W	CB3-40W-10MHz	CB3-80W	CB3-120W
Operating temperature		15 – 30 °C				
Relative humidity		< 80% (non-condensing)				
Electrical requirements	Laser	100 V AC, 7 A – 240 V AC, 3A; 50 – 60 Hz		100 V AC, 12 A – 240 V AC, 5 A 50 – 60 Hz		100 V AC, 15 A – 240 V AC, 7 A 50 – 60 Hz
	Chiller	100 – 230 V AC; 50 – 60 Hz		200 – 230 V AC; 50 – 60 Hz		
Rated power	Laser	600 W		1000 W		2000 W
	Chiller	1400 W		2000 W		
Power consumption	Laser	500 W		900 W		1500 W
	Chiller	1000 W		1300 W		1800 W

1) *Assuming a Gaussian pulse shape.*
2) *Pulse duration can be reduced to < 250 fs if a pulse peak intensity of > 50 GW/cm² is tolerated by the customer setup.*
3) *FW 1/e², using maximum pulse energy.*
4) *Fast energy control (FEC) provides fast, full-scale individual pulse energy control; an external analog control input is available.*
5) *Waveplate-based variable optical attenuator (VOA); an external analog control input is available.*
6) *Under stable environmental conditions. Expressed as normalized root mean squared deviation (NRMSD).*
7) *Available simultaneously, requires a scientific interface. Contact sales@lightcon.com for more details or customized solutions.*
8) *Integrated. For an external harmonic generator, refer to HIRO.*
9) *Integrated. For more details and stand-alone OPAs, refer to wavelength-tunable sources.*
10) *Power supply can be different if an optional 2 MHz version is selected.*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

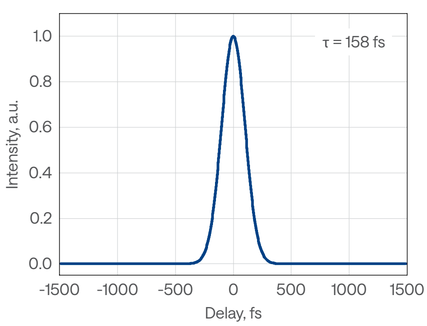
CARBIDE-CB5 specifications

Model	CB5		CB5-SP
OUTPUT CHARACTERISTICS			
Cooling method	Air-cooled [1]		
Center wavelength	1030 ± 10 nm		
Maximum output power	6 W	5 W	
Pulse duration [2]	< 290 fs		< 190 fs
Pulse duration tuning range	290 fs – 20 ps		190 fs – 20 ps
Maximum pulse energy	100 μJ	83 μJ	100 μJ
Repetition rate	Single-shot – 1 MHz		
Pulse selection	Single-shot, pulse-on-demand, any fundamental repetition rate division		
Polarization	Linear, vertical; 1 : 1000		
Beam quality, M^2	< 1.2		
Beam diameter [3]	2.1 ± 0.4 mm		
Beam pointing stability	< 20 μrad/°C		
Pulse energy control	Attenuator [4]	AOM [5]	Attenuator [4]
Pulse picker leakage	< 2%	< 0.1 %	< 2%
Pulse-to-pulse energy stability, 24 h [6]	< 0.5%		
Long-term power stability, 100 h [6]	< 0.5%		
MAIN OPTIONS			
Oscillator output	n/a		
Harmonic generator [7]	515 nm, 343 nm, 257 nm, or 206 nm; *see page 22*		
Optical parametric amplifier [8]	UV – MIR; *see page 30*		
BiBurst option	n/a		
PHYSICAL DIMENSIONS			
Laser head (L × W × H)	633 × 324 × 162 mm		
Chiller	Not required		
24 V DC power supply (L × W × H)	220 × 95 × 46 mm		
ENVIRONMENTAL AND UTILITY REQUIREMENTS			
Operating temperature	17 – 27 °C		
Relative humidity	< 80% (non-condensing)		
Electrical requirements	100 V AC, 3 A – 240 V AC, 1.3 A; 50 – 60 Hz		
Rated power	300 W		
Power consumption	150 W		

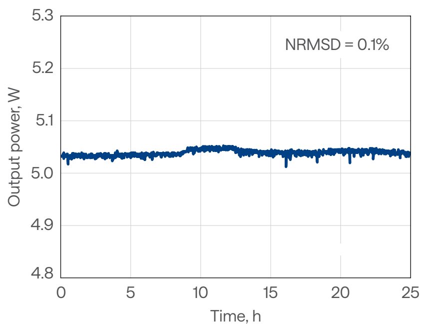
1) Water-cooled version available on request.
2) Assuming a Gaussian pulse shape.
3) FW 1/e², using maximum pulse energy.
4) Waveplate-based variable optical attenuator (VOA); an external analog control input is available.
5) Enhanced contrast AOM. Provides fast amplitude control of output pulse train.
6) Under stable environmental conditions. Expressed as normalized root mean squared deviation (NRMSD).
7) Integrated. For an external harmonic generator, refer to HIRO.
8) Integrated. For more details and stand-alone OPAs, refer to wavelength-tunable sources.

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

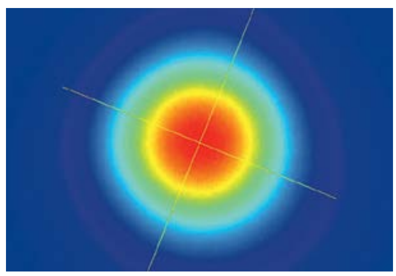
CARBIDE-CB5-SP
Typical pulse duration



CARBIDE-CB5
Long-term power stability

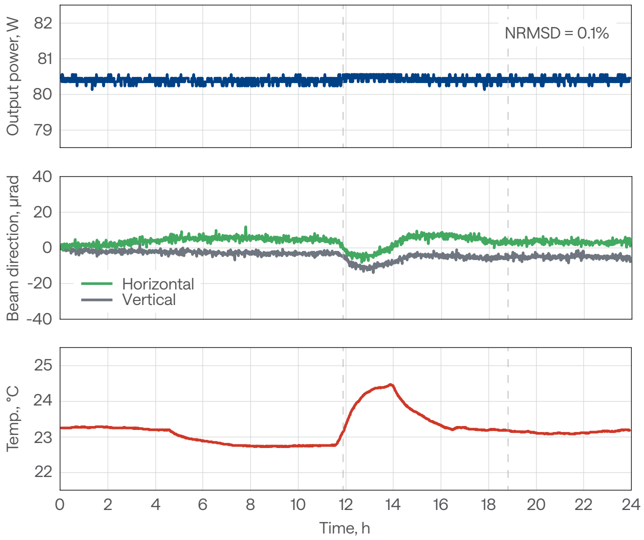


CARBIDE-CB5
Typical beam profile

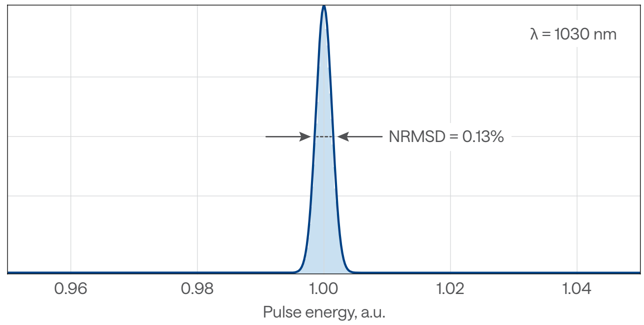


Stability measurements

CARBIDE-CB3 output power and beam direction stability with power lock enabled, across varying environmental conditions

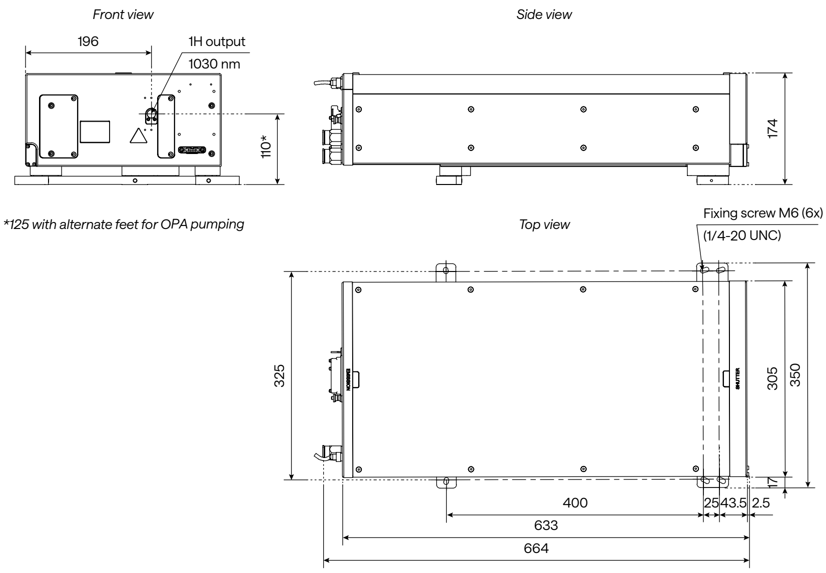


CARBIDE-CB3
Typical pulse-to-pulse energy stability

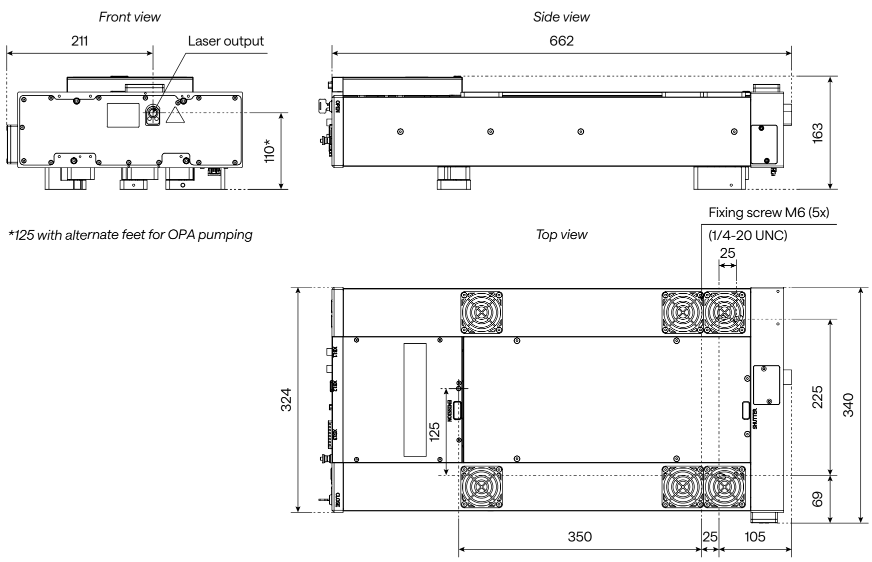


Drawings

CARBIDE-CB3



Air-cooled **CARBIDE-CB5** with an attenuator



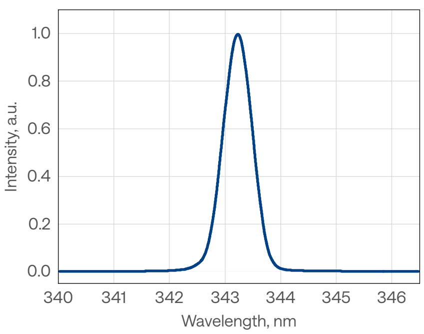
The drawings depend on the exact configuration. If crucial for integration, please contact sales@lightcon.com.

CARBIDE | CB3-UV

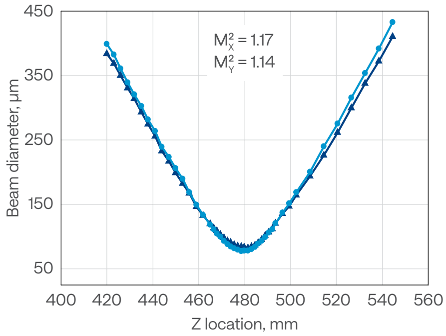
High-Power UV Femtosecond Lasers

- Maximum output of 50 W
- 500 fs pulse duration
- Up to MHz repetition rate
- High beam quality and stability
- Compact industrial-grade design

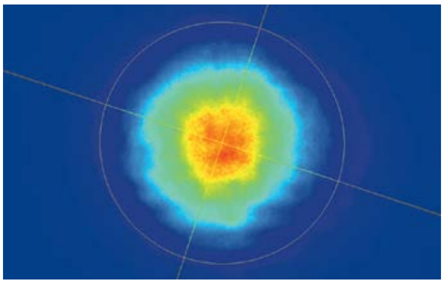
CARBIDE-CB3-UV
Typical spectrum



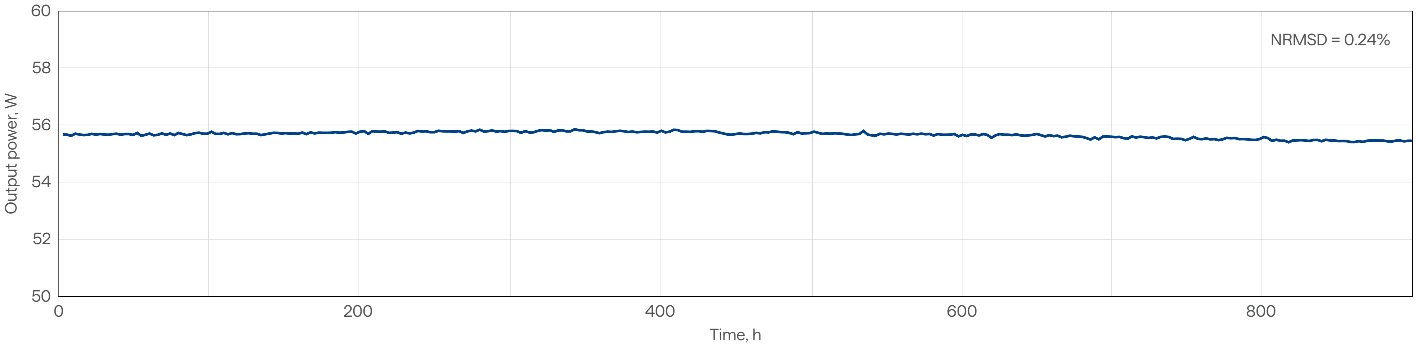
CARBIDE-CB3-UV
Typical M^2 measurement data



CARBIDE-CB3-UV
Beam profile



CARBIDE-CB3-UV-50W
Long-term power stability



Specifications

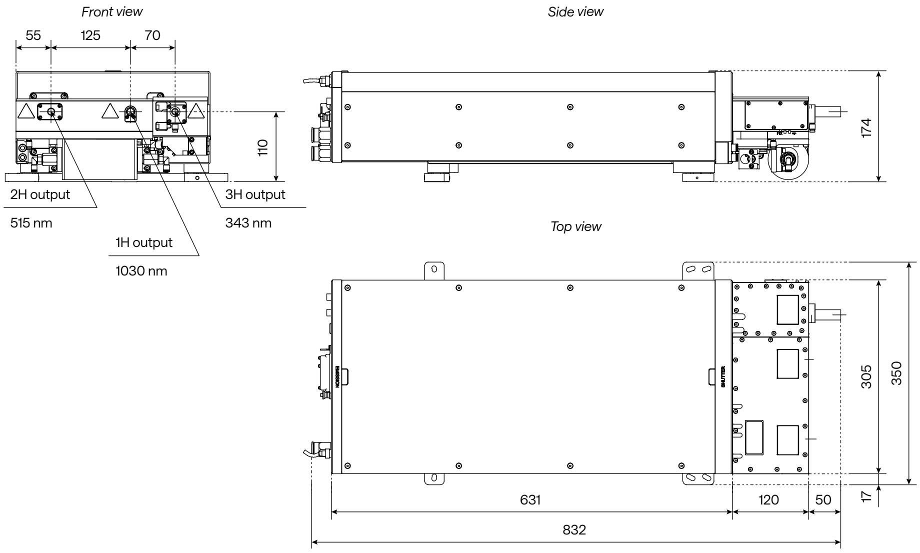
Model		CB3-UV-30W	CB3-UV-50W
OUTPUT CHARACTERISTICS			
Cooling method		Water-cooled	
Center wavelength		343 ± 3 nm	
Output power		> 30 W	> 50 W
Pulse duration [1]		≈ 500 fs	
Output pulse energy		35 – 150 µJ	
Repetition rate [2]		200 – 1000 kHz	300 – 1000 kHz
Polarization		Linear, vertical; 1 : 200	
Beam quality, M^2, typical values		< 1.3	
Beam diameter [3]		2 - 5 mm	
Long-term power stability, 12 h [4]		< 0.5%	
Lifetime		10 000 h	
MAIN OPTIONS			
Optional amplifier outputs		1030 nm, 515 nm	
PHYSICAL DIMENSIONS			
Laser head (L × W × H)		801 × 350 × 174 mm	
Chiller (L × W × H)		680 × 484 × 307 mm	
24 V DC power supply (L × W × H)		320 × 200 × 75 mm	376 × 449 × 88 mm
ENVIRONMENTAL AND UTILITY REQUIREMENTS			
Operating temperature		15 – 30 °C	
Relative humidity		< 80% (non-condensing)	
Electrical requirements	Laser	100 V AC, 12 A – 240 V AC, 5 A; 50 – 60 Hz	100 V AC, 15 A - 240 V AC, 7 A; 50 - 60 Hz
	Chiller	200 – 230 V AC; 50 – 60 Hz	
Rated power	Laser	1000 W	2000 W
	Chiller	2000 W	
Power consumption	Laser	900 W	1500 W
	Chiller	1300 W	1800 W

1) *Assuming a Gaussian pulse shape.*
2) *Repetition rate available up to 2 MHz at lower power.*
3) *FW 1/e², using maximum pulse energy.*
4) *Under stable environmental conditions. Expressed as normalized root mean squared deviation (NRMSD).*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

Drawings

CARBIDE-CB3-UV



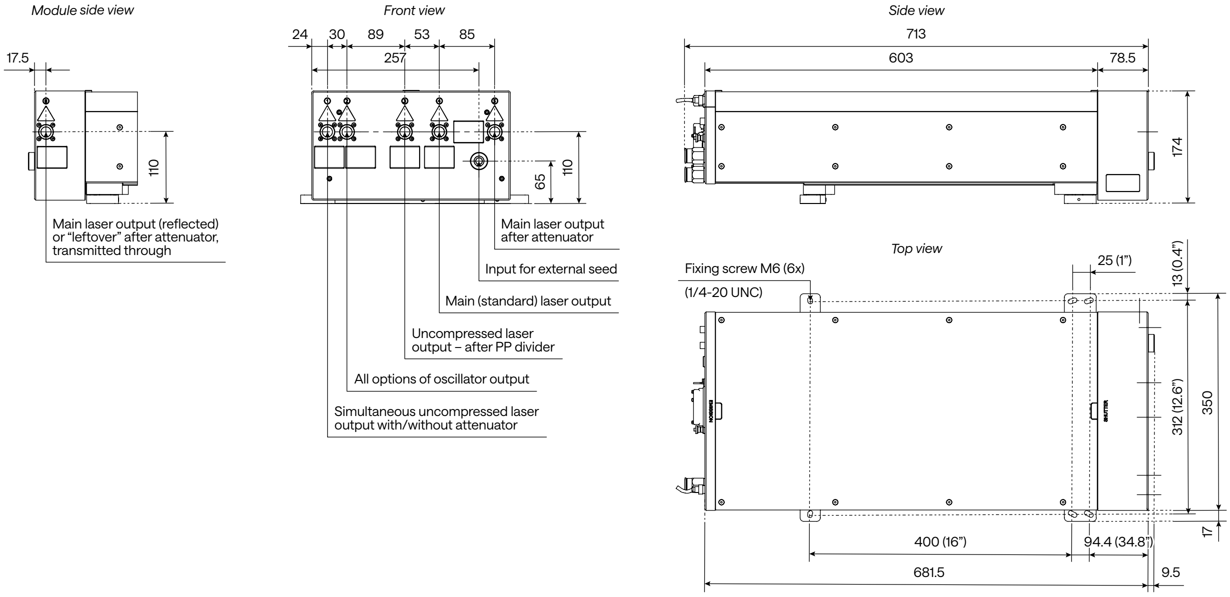
SCI-M | CARBIDE

Scientific Interface Module for CARBIDE

- Simultaneous or separate oscillator output
- Uncompressed laser output
- Seeding by an external oscillator
- Beam-splitting options

Drawings

CARBIDE-CB3-40W with a scientific interface module



BiBurst

Tunable GHz and MHz Burst with Burst-in-Burst Capability

PHAROS and **CARBIDE-CB3** lasers feature the tunable GHz and MHz burst option with burst-in-burst capability, known as BiBurst.

In standard mode, the laser emits a single pulse at a fixed frequency. In burst mode, the output consists of pulse packets instead of single pulses. Each packet consists of a specific number of equally separated pulses. MHz-Burst contains N pulses with a nanosecond period, while GHz-Burst contains P pulses with a picosecond period. When both burst modes are combined, the equally separated pulse packets contain sub-packets of pulses, forming the burst-in-burst or BiBurst.

PHAROS and **CARBIDE** lasers, equipped with tunable GHz and MHz bursts and BiBurst options, bring new capabilities to high-tech manufacturing industries, such as consumer electronics, integrated photonic chip production, advanced display manufacturing, and quantum technologies.

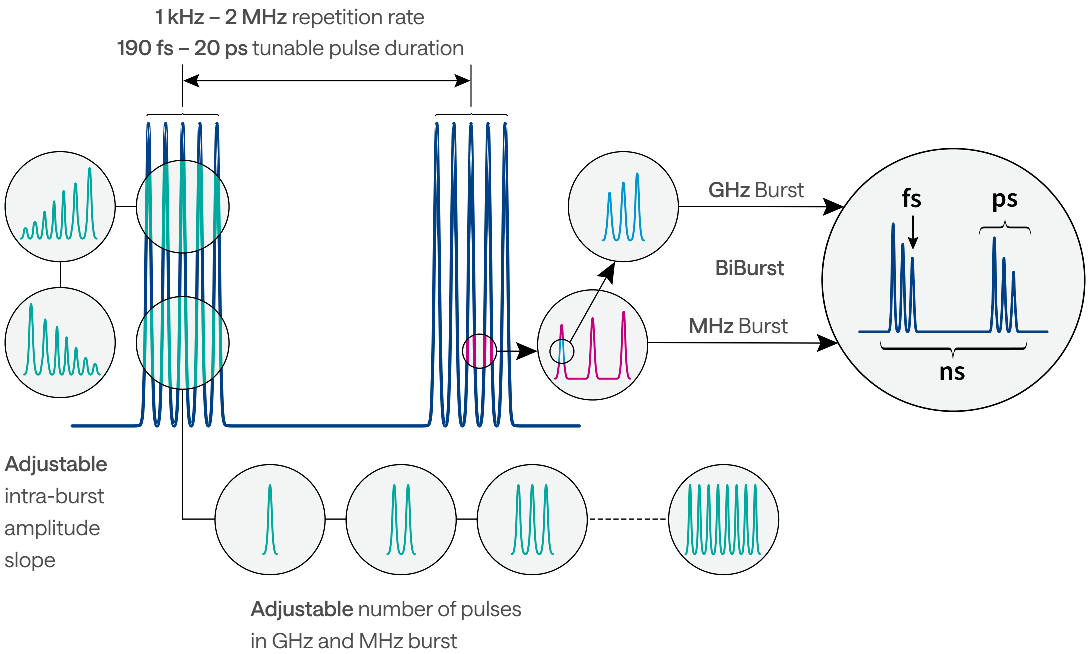
Applications:

- Brittle material drilling and cutting
- Deep engraving
- Selective ablation
- Volume modification of transparent materials
- Hidden marking
- Surface polishing
- Functional surface structuring

Specifications

Model		CARBIDE-CB3	PHAROS
GHz Burst	Intra burst pulse period [1]	440 ± 40 ps	200 ± 40 ps
	Number of pulses, P [2]	1 – 10 [3]	1 – 25
MHz Burst	Intra burst pulse period	≈ 15 ns	
	Number of pulses, N	1 – 10	1 – 9 (7 with FEC [4])

[1] *Custom spacing is available upon request.*
[2] *The maximum number of pulses in a burst depends on the laser repetition rate and energy.*
[3] *A custom number of pulses (up to 400) is available upon request.*
[4] *Fast energy control option. Enables the formation of any pulse envelope at the laser pulse repetition rate.*

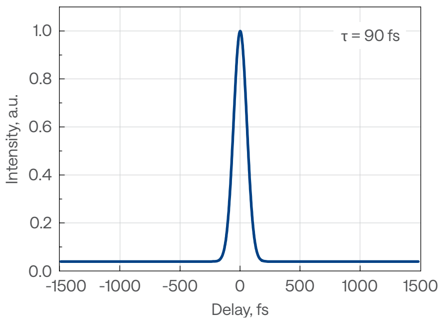


PHAROS

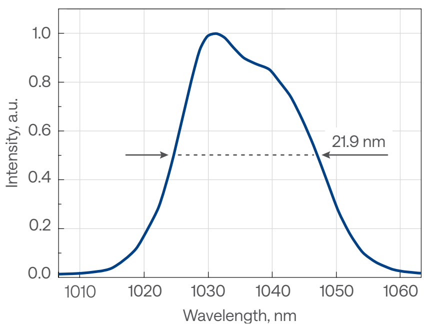
Modular-Design Femtosecond Lasers for Industry and Science

- Maximum pulse energy of up to 4 mJ
- Down to < 100 fs right at the output
- Tunable pulse duration, 100 fs – 20 ps
- Pulse-on-demand and BiBurst for pulse control
- Automated harmonics up to the 5th or tunable extensions
- CEP stabilization or repetition rate locking
- Thermally-stabilized and sealed design

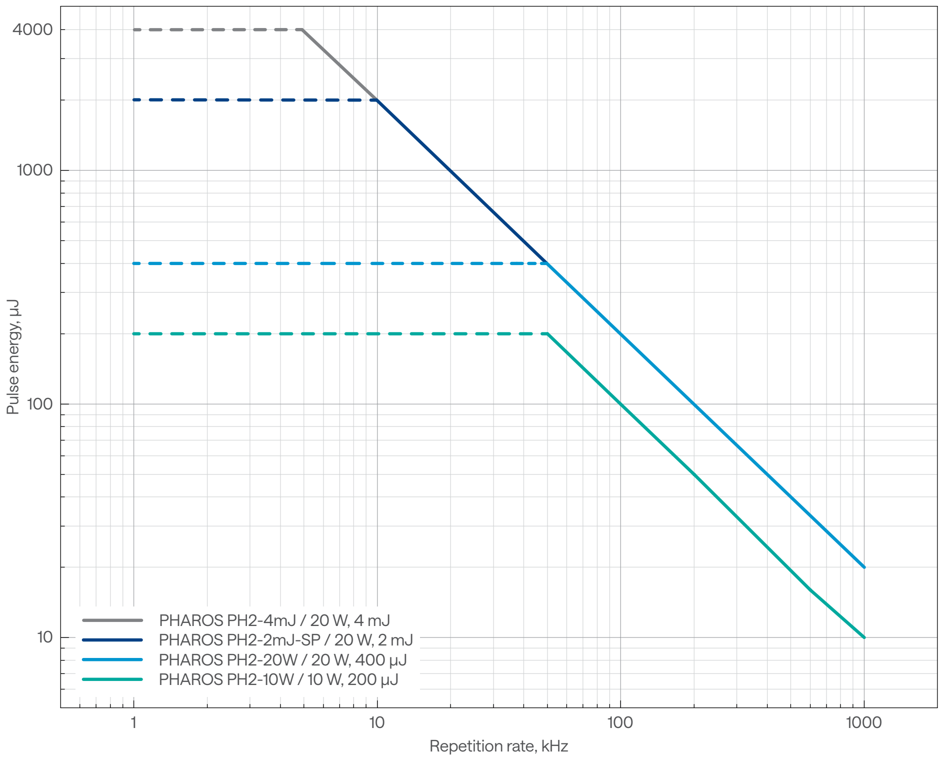
PHAROS-PH2-UP
Typical pulse duration



PHAROS-PH2-UP
Typical spectrum



PHAROS
Pulse energy vs fundamental repetition rate



Specifications

NEW

Model	PH2-10W	PH2-SP			PH2-4mJ	PH2-UP	

OUTPUT CHARACTERISTICS

	PH2-10W	PH2-SP			PH2-4mJ	PH2-UP	
Center wavelength [1]	1030 ± 10 nm						
Maximum output power	10 W	20 W					
Pulse duration [2]	< 290 fs	< 190 fs			< 450 fs [3]	< 100 fs	
Pulse duration tuning range	290 fs – 10 ps (20 ps on request)	190 fs – 10 ps (20 ps on request)			450 fs – 10 ps	100 fs – 10 ps	
Maximum pulse energy	0.2 mJ	0.4 mJ	1 mJ	2 mJ	4 mJ	0.4 mJ	1 mJ
Repetition rate	Single-shot – 1 MHz						
Pulse selection	Single-shot, pulse-on-demand, any fundamental repetition rate division						
Polarization	Linear, horizontal						
Beam quality, M²	< 1.2		< 1.3			< 1.2	
Beam diameter [4]	3.3 ± 0.5 mm	4.0 ± 0.5 mm	4.5 ± 0.5 mm	6.8 ± 0.7 mm		4.5 ± 0.5 mm	6 ± 0.5 mm
Beam pointing stability	< 20 µrad/°C						
Pre-pulse contrast	< 1 : 1000						
Post-pulse contrast	< 1 : 200						
Pulse-to-pulse energy stability, 24 h [5]	< 0.5%						
Long-term power stability, 100 h [5]	< 0.5%						

MAIN OPTIONS

Oscillator output [6]	1 – 7 W, 50 – 250 fs, ≈ 1035 nm, ≈ 76 MHz
Harmonic generator [7]	515 nm, 343 nm, 257 nm, or 206 nm; *see page 23*
Optical parametric amplifier [8]	UV – MIR; *see page 30*
BiBurst option	Tunable GHz and MHz burst with burst-in-burst capability; *see page 13*
CEP stabilization	*See page 17*
Repetition rate locking	

PHYSICAL DIMENSIONS

	PH2-10W, PH2-SP	PH2-4mJ	PH2-UP
Laser head (L × W × H) [9]	730 × 419 × 230 mm	827 × 492 × 250 mm	770 × 419 × 230 mm
Chiller (L × W × H)	590 × 484 × 267 mm		
24 V DC power supply (L × W × H) [9]	280 × 144 × 49 mm		

ENVIRONMENTAL & UTILITY REQUIREMENTS

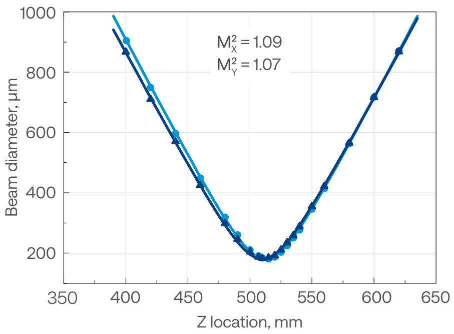
Operating temperature		15 – 30 °C (air conditioning recommended)
Relative humidity		< 80% (non-condensing)
Electrical requirements	Laser	100 V AC, 12 A – 240 V AC, 5 A, 50 – 60 Hz
	Chiller	100 – 230 V AC, 50 – 60 Hz
Rated power	Laser	1000 W
	Chiller	1400 W
Power consumption	Laser	600 W
	Chiller	1000 W

1) *Precise wavelengths for specific models are available upon request.*
2) *Assuming a Gaussian pulse shape.*
3) *Pulse duration can be reduced to < 250 fs if a pulse peak intensity of > 50 GW/cm² is tolerated by the customer setup.*
4) *FW 1/e², measured at laser output, using maximum pulse energy.*
5) *Under stable environmental conditions. Expressed as normalized root mean squared deviation (NRMSD).*
6) *Available simultaneously. Contact sales@lightcon.com for more details or customized solutions.*
7) *Integrated. For an external harmonic generator, refer to HIRO.*
8) *Integrated. For more details and stand-alone OPAs, refer to wavelength-tunable sources.*
9) *Dimensions depend on laser configuration and integrated options.*

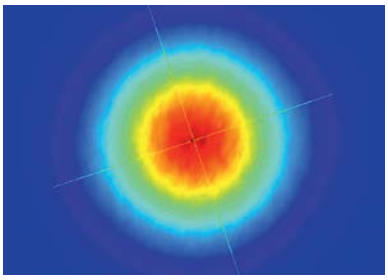
DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

Beam properties

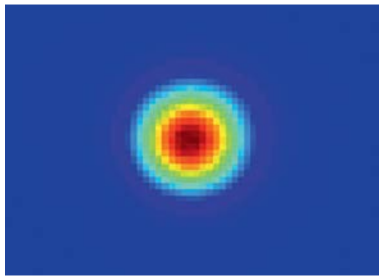
PHAROS
Typical M² measurement data



PHAROS
Typical near-field beam profile

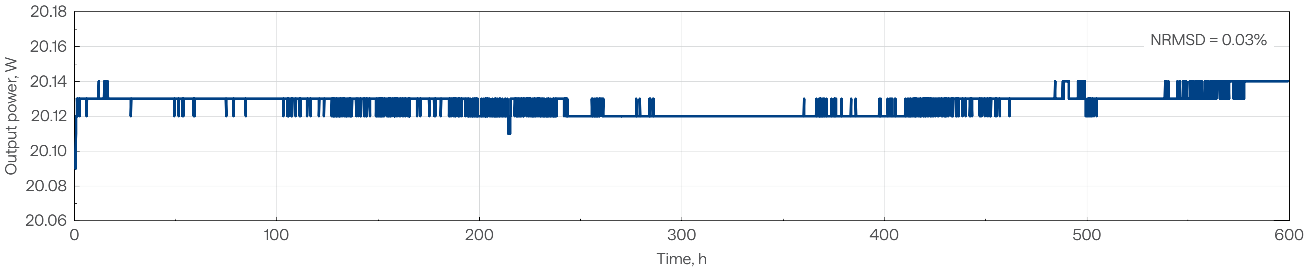


PHAROS
Typical far-field beam profile

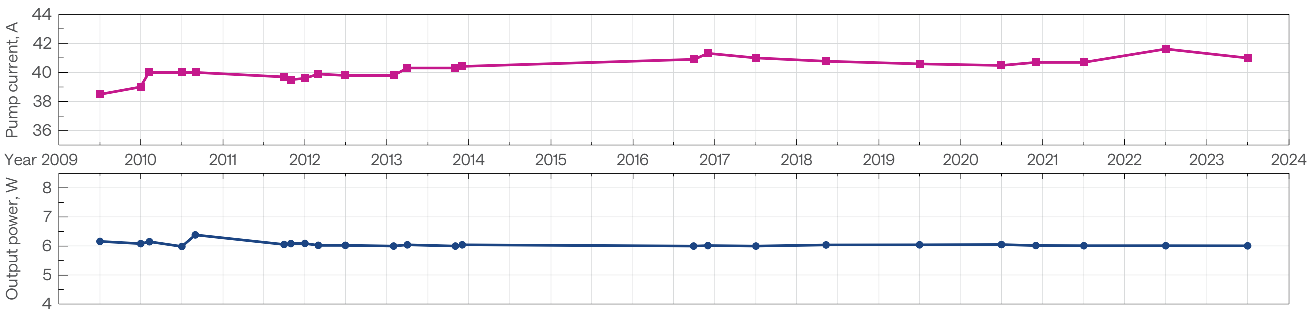


Stability measurements

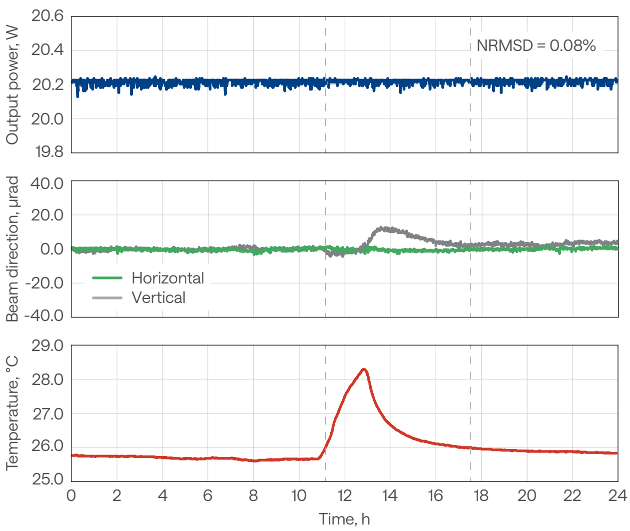
PHAROS
Long-term power stability



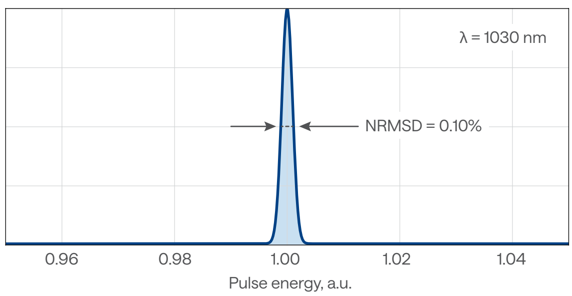
Output power of industrial-grade **PHAROS** lasers operating 24/7 and the current of the pump diodes over the years



PHAROS output power and beam pointing stability with power lock enabled, across varying environmental conditions



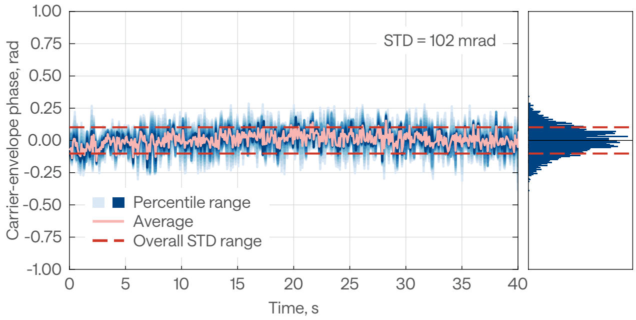
PHAROS
Typical pulse-to-pulse energy stability



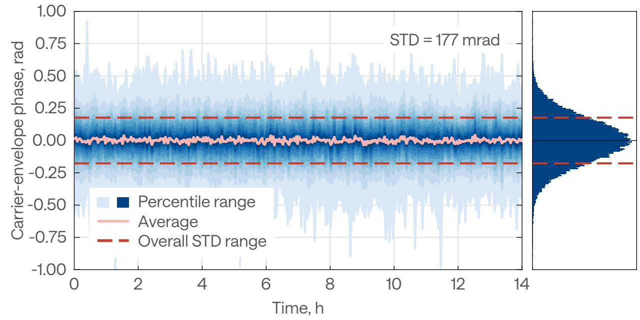
CEP stabilization

PHAROS lasers can be equipped with feedback electronics for carrier-envelope phase (CEP) stabilization of the output pulses. The carrier-envelope offset (CEO) of the **PHAROS** oscillator is actively locked to 1/4th of the repetition rate with a < 100 mrad standard deviation. The CEP stable pulses from the synchronized amplifier have a < 350 mrad standard deviation. The CEP drift occurring inside the amplifier and the user's setup can be compensated with an out of loop f-2f interferometer, which is a part of the complete **PHAROS** active CEP stabilization package.

PHAROS
Short-term CEP stability operating at 200 kHz repetition rate



PHAROS
Long-term CEP stability operating at 200 kHz repetition rate

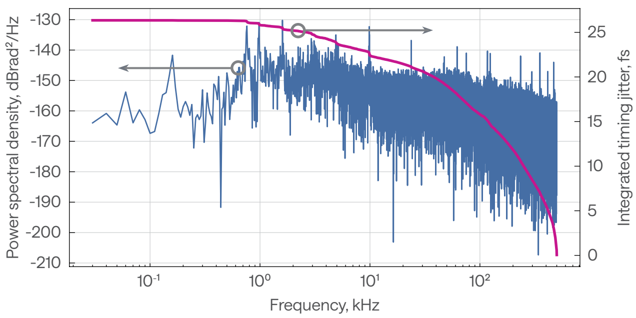


Repetition rate locking

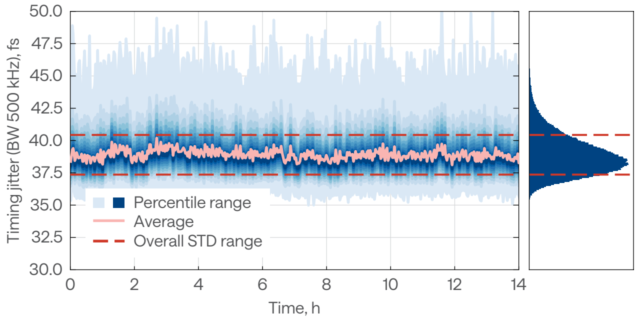
The oscillators in **PHAROS** lasers can be customized for repetition rate locking applications. Coupled with the necessary feedback electronics, the oscillator's repetition rate can be synchronized to an external RF source using the two piezo stages installed within the cavity.

The repetition rate locking system ensures an integrated timing jitter of less than 200 fs for RF reference frequencies above 500 MHz. Additionally, continuous phase shifting is available upon request.

Phase noise data of **PHAROS** oscillator
locked to a 2.8 GHz RF source

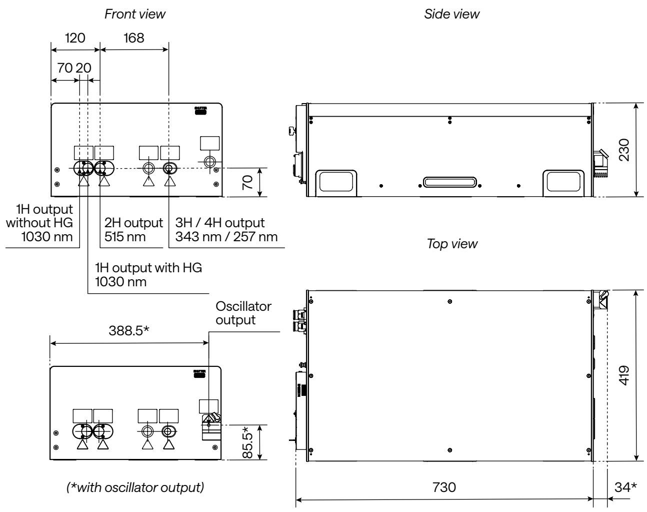


Timing jitter stability over 14 h
PHAROS oscillator locked to a 2.8 GHz RF source

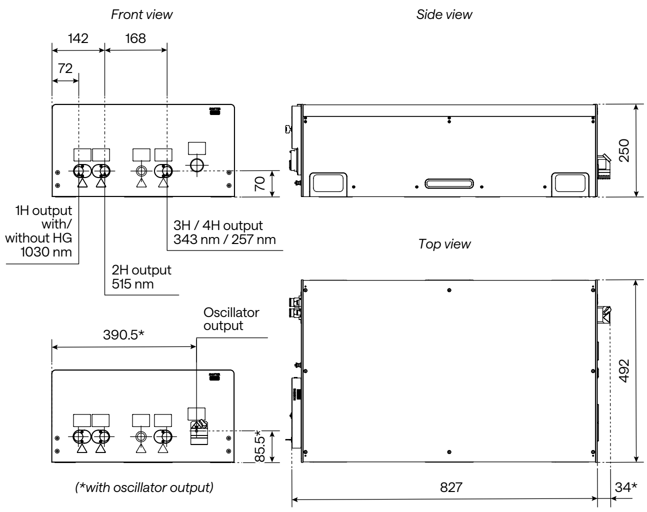


Drawings

PHAROS-PH2-730
-10W or -20W-SP with a FEC or BiBurst option, or a harmonic generator



PHAROS-PH2-827
-10W with an -HE harmonic generator option, or -4mJ



The drawings depend on the exact configuration. If crucial for integration, please contact sales@lightcon.com.

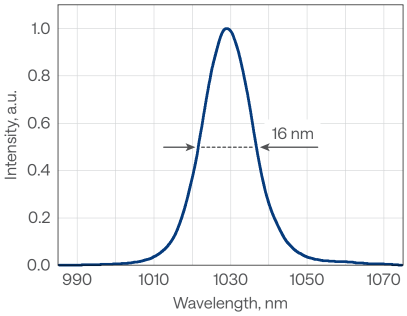
FLINT

High-Repetition-Rate Lasers

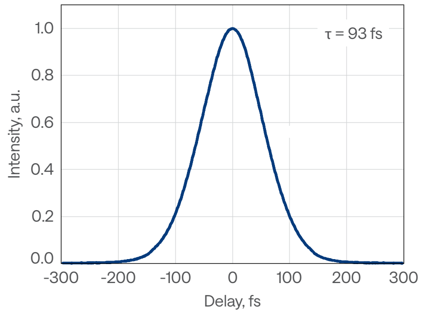
FLINT-FL1

- High-power models, up to 20 W
- High-energy energy models, up to 0.5 µJ
- 10 – 100 MHz repetition rate
- Down to 50 fs pulse duration
- Industrial-grade design for high output stability
- CEP stabilization or repetition rate locking

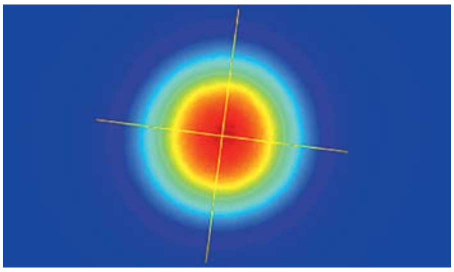
FLINT-FL1
Typical spectrum



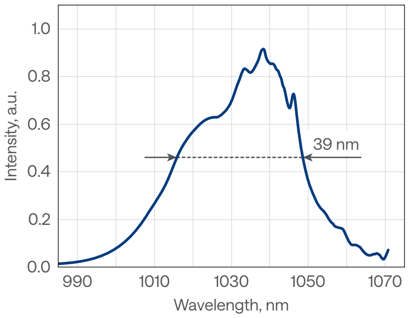
FLINT-FL1
Typical pulse duration



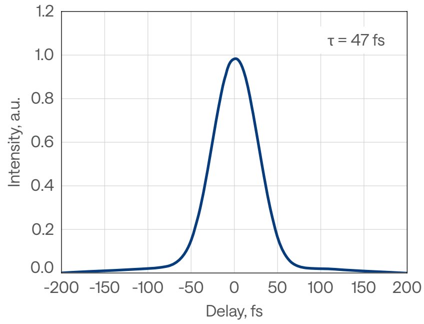
FLINT-FL1
Typical beam profile



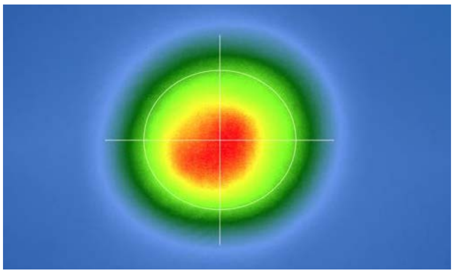
FLINT-FL2-SP
Typical spectrum



FLINT-FL2-SP
Typical pulse duration



FLINT-FL2-SP
Typical beam profile



Specifications

Model	FL1			FL2-SP	FL2		
Key feature	CEP	RRL	Compact	Short pulse	High power and high energy		
Pulse duration	< 100 fs		< 120 fs	< 50 fs	< 120 fs	< 170 fs [1]	
Repetition rate	60 – 100 MHz [2]			10 MHz	10 MHz	40 MHz	80 MHz
Maximum output power	0.5 W	1 W	8 W	4 W	5 W	20 W	
Maximum pulse energy	6 nJ [3]	12.5 nJ [3]	100 nJ [3]	0.4 µJ	0.5 µJ		0.25 µJ
Center wavelength	1035 ± 10 nm			1030 ± 10 nm	1030 ± 10 nm		
Polarization	Linear, horizontal						
Beam quality, M^2	< 1.2			< 1.3	< 1.2		
Beam pointing stability	< 10 µrad/°C						
Long-term power stability, 100 h [4]	< 0.5%						
Integrated 2H generator [5]	n/a				Optional; conversion efficiency > 30% [6]; *see page 21*		
External 2H, 3H, or 4H generator [5]	Optional; *see page 24*						
Integrated attenuator	n/a			Included			

PHYSICAL DIMENSIONS

	FL1	FL2-SP, FL2
Laser head (L × W × H)	448 × 206 × 115 mm	543 × 322 × 146 mm
Power supply and chiller rack (L × W × H)	642 × 553 × 540 mm	642 × 553 × 673 mm
Chiller	Different options available. Contact sales@lightcon.com	

ENVIRONMENTAL AND UTILITY REQUIREMENTS

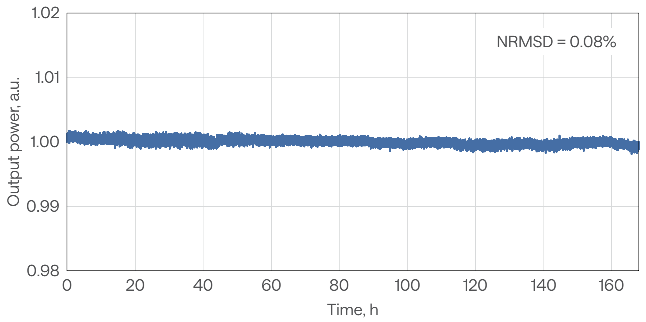
		FL1	FL2-SP, FL2
Operating temperature		15 – 30 °C (air conditioning recommended)	
Relative humidity		< 80% (non-condensing)	
Electrical requirements		100 V AC, 7 A – 240 V AC, 3 A; 50 – 60 Hz	100 V AC, 12 A – 240 V AC, 5 A; 50 – 60 Hz
Rated power		200 W	
Power consumption	Laser	100 W	150 W
	Chiller	600 W	1000 W

1) *For 20 W output power. Lower power models: 8 W and 12 W, are available upon request.*
2) *Standard repetition rate is 80 MHz; custom repetition rate can be factory preset from the given range.*
3) *Depends on the repetition rate. Values are given for 80 MHz.*
4) *With enabled power-lock, under stable environmental conditions. Expressed as normalized root mean squared deviation (NRMSD).*
5) *For external 2H, or even 3H and 4H generation, refer to HIRO for FLINT.*
6) *Conversion efficiency specified at maximum power.*

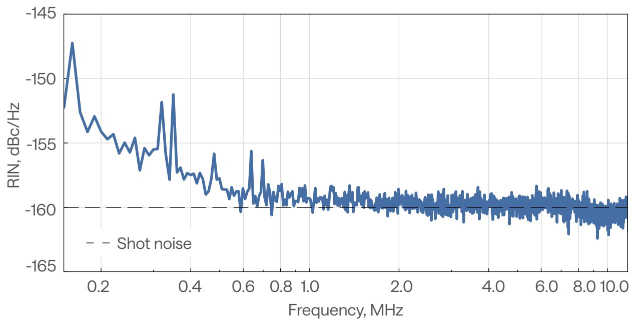
DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

Stability

FLINT-FL2 (20 W) output power stability under harsh environmental conditions over 7 days



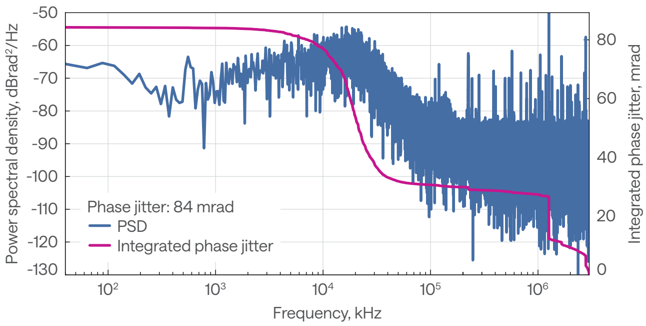
FLINT oscillator relative intensity noise (RIN), shot-noise limited at -160 dBc/Hz above 1 MHz



CEP stabilization

FLINT oscillators can be equipped with feedback electronics for carrier-envelope phase (CEP) stabilization of the output pulses. The carrier-envelope offset (CEO) of the oscillator is actively locked to 1/4th of the repetition rate with a < 100 mrad standard deviation.

CEP-locked **FLINT** oscillator phase noise data

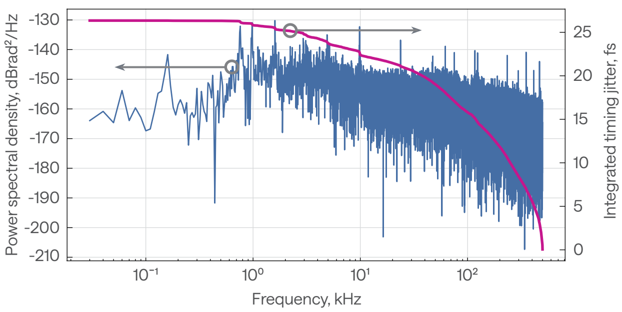


Repetition rate locking

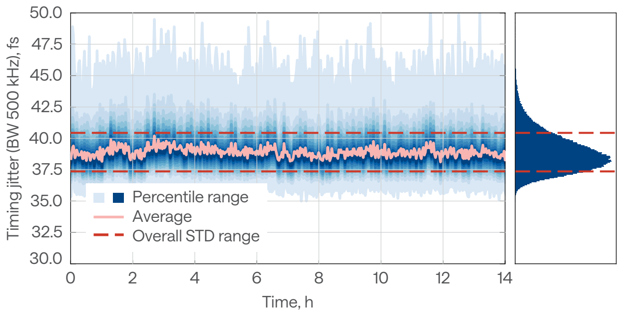
FLINT oscillators can be customized for repetition rate locking applications. Coupled with the necessary feedback electronics, the oscillator's repetition rate can be synchronized to an external RF source using the two piezo stages installed within the cavity.

The repetition rate locking system ensures an integrated timing jitter of less than 200 fs for RF reference frequencies above 500 MHz. Additionally, continuous phase shifting is available upon request.

FLINT oscillator phase noise data
locked to a 2.8 GHz RF source

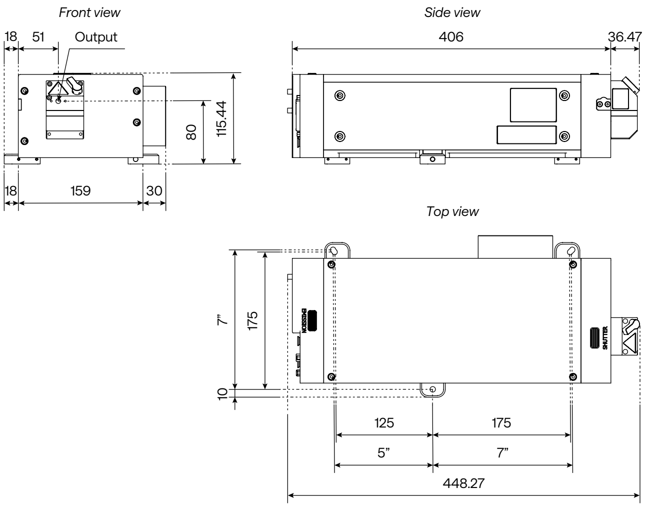


Timing jitter stability over 14 h
FLINT oscillator locked to a 2.8 GHz RF source

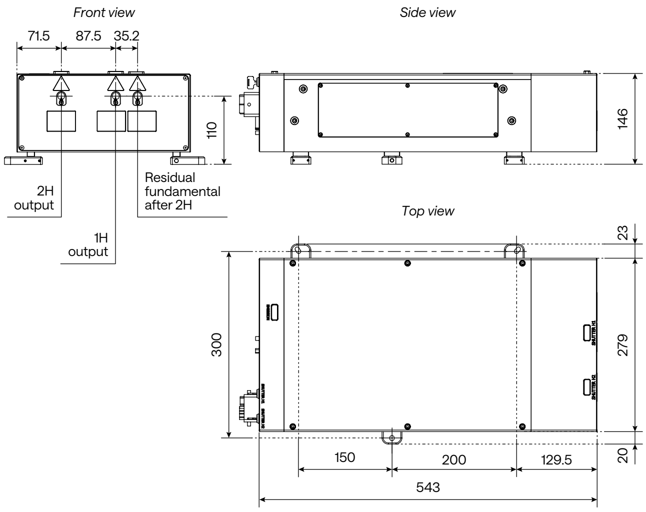


Drawings

FLINT-FL1 drawing



FLINT-FL2 drawing



HG | FLINT

Second Harmonic Generator

FLINT-FL2 with integrated HG

- 515 nm output
- Automated harmonic selection
- Integrated into the housing
- Industrial-grade design

Specifications

Model	FL1	FL2-SP	FL2		
Available harmonic	Refer to HIRO; *see page 24*	Refer to HIRO; *see page 24*	2H		
Pump repetition rate			10 MHz	40 MHz	80 MHz
Maximum pump power			5 W	20 W	
Center wavelength			515 ± 10 nm		
Conversion efficiency [1]			> 30%		
Polarization			Linear, horizontal		

[1] *Conversion efficiency specified at maximum power.*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

Integrated Harmonic Generators

CARBIDE-CB3 with a 2H-3H module

- 515 nm, 343 nm, 257 nm, or 206 nm output
- Automated harmonic selection
- Mounted directly on the laser head
- Industrial-grade design
- 50 W UV model

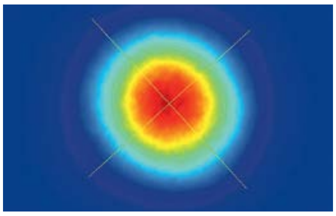
Specifications

Model		2H	2H-3H	2H-4H	2H-5H	30W UV [1]	50W UV [1]
Output wavelength [2] (automated selection)		1030 nm 515 nm	1030 nm 515 nm 343 nm	1030 nm 515 nm 257 nm	1030 nm 515 nm 206 nm	1030 nm 515 nm 343 nm	1030 nm 515 nm 343 nm
Pump pulse energy		20 – 2000 µJ	50 – 2000 µJ	20 – 2000 µJ	100 – 1500 µJ	80 – 400 µJ	120 – 400 µJ
Pump pulse duration		< 300 fs				≈ 500 fs	
Conversion efficiency / Output power		> 50% (2H)	> 50% (2H) > 25% (3H)	> 50% (2H) > 10% (4H) [3]	> 50% (2H) > 5% (5H) [4]	30 W (3H)	50 W (3H)
Beam quality, M^2, typical values	≤ 400 µJ pump	< 1.15 (2H)	< 1.15 (2H) < 1.2 (3H)	< 1.15 (2H) n/a (4H)	n/a	< 1.3 (3H)	< 1.3 (3H)
	> 400 µJ pump	< 1.2 (2H)	< 1.2 (2H) < 1.3 (3H)	< 1.2 (2H) n/a (4H)	n/a		

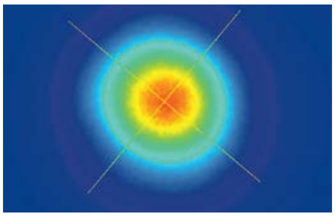
1) *Refer to CARBIDE-CB3-UV for more details.*
2) *Depends on the pump laser model. Up to the 5th harmonic available; contact sales@lightcon.com for more details.*
3) *Maximum output power of 5 W.*
4) *Maximum output power of 0.2 W.*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

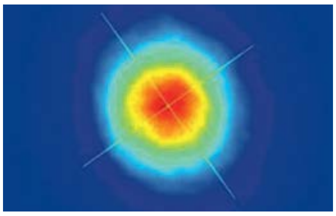
CARBIDE-CB5 (100 kHz, 6 W)
Typical 1H beam profile



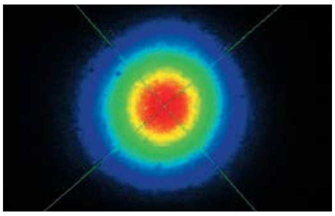
CARBIDE-CB5 (100 kHz, 3.4 W)
Typical 2H beam profile



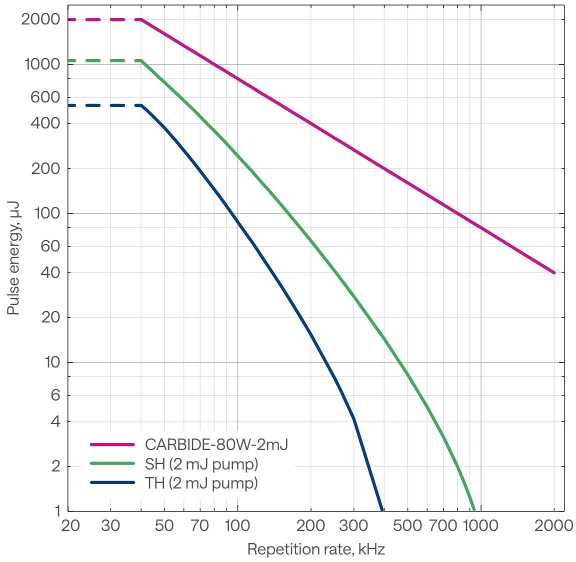
CARBIDE-CB5 (100 kHz, 2.2 W)
Typical 3H beam profile



CARBIDE-CB5 (100 kHz, 100 mW)
Typical 4H beam profile

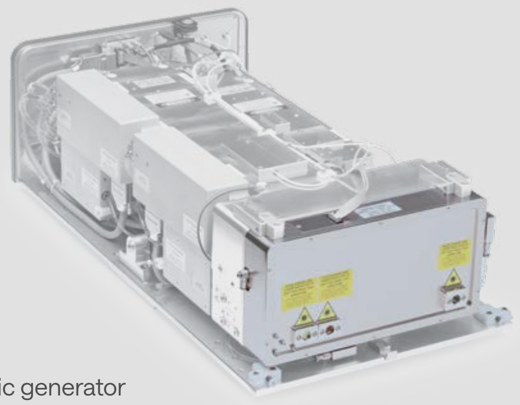


CARBIDE-CB3-80W with a harmonic generator
Pulse energy vs repetition rate



HG | PHAROS

Integrated Harmonic Generators



PHAROS with a harmonic generator

- 515 nm, 343 nm, 257 nm, or 206 nm output
- Automated harmonic selection
- Industrial-grade design

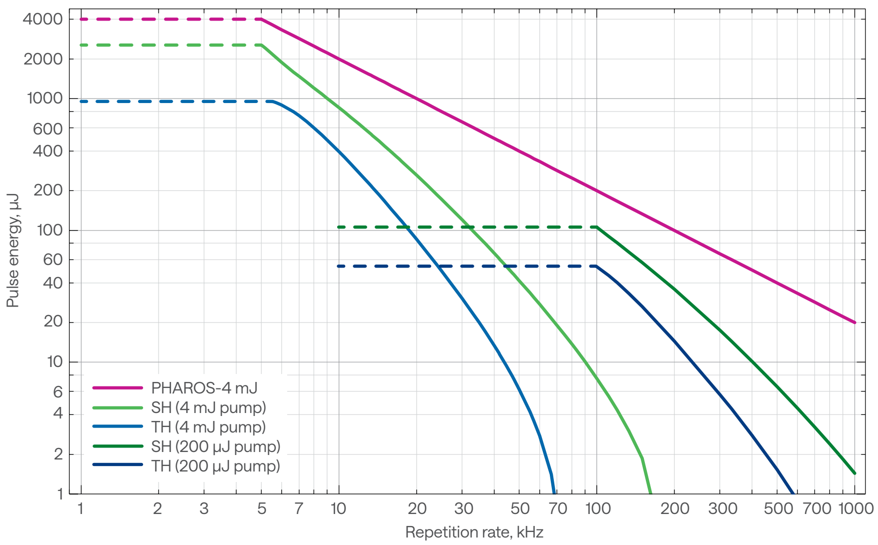
Specifications

Model		2H (-HE)	2H-3H (-HE)	2H-4H (-HE)	4H-5H
Output wavelength [1] (automated selection)		1030 nm 515 nm	1030 nm 515 nm 343 nm	1030 nm 515 nm 257 nm	1030 nm 257 nm 206 nm
Pump pulse energy		20 – 4000 µJ	50 – 4000 µJ	20 – 4000 µJ	200 – 1000 µJ
Pump pulse duration		100 – 500 fs			
Conversion efficiency		> 50% (2H)	> 50% (2H) > 25% (3H)	> 50% (2H) > 10% (4H) [2]	> 10% (4H) [3] > 5% (5H) [4]
Beam quality, M², typical values	≤ 400 µJ pump	< 1.15 (2H)	< 1.15 (2H) < 1.2 (3H)	< 1.15 (2H) n/a (4H)	n/a
	> 400 µJ pump	< 1.2 (2H)	< 1.2 (2H) < 1.3 (3H)	< 1.2 (2H) n/a (4H)	

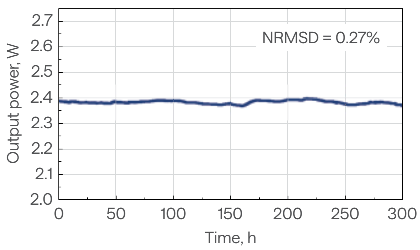
[1] *Depends on the pump laser model.*
[2] *Maximum output power: 2 W at 20–1000 µJ pump energy, or 1 W at 1000–4000 µJ pump energy.*
[3] *Maximum output power of 1 W.*
[4] *Maximum output power of 150 mW.*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

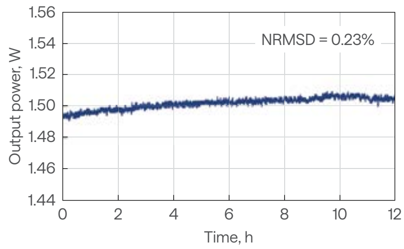
PHAROS with a harmonic generator
Pulse energy vs repetition rate



3H output power stability



4H output power stability



HIRO

External Harmonic Generator

- 515 nm, 343 nm, 257 nm, and 206 nm outputs
- Simple selection of the active harmonic
- Simultaneous or switchable outputs
- Standalone harmonics module for PHAROS, CARBIDE and FLINT

HIRO for PHAROS / CARBIDE

Model	HIRO	HIRO-HP	HIRO-HE
Maximum pump power	20 W	80 W	
Pump pulse energy	8 – 400 μJ	200 – 1000 μJ	1000 – 4000 μJ
Available outputs [1] [2]	Up to 4H [3]	Up to 5H	
Conversion efficiency [1] [4]	> 50% (2H) > 25% (3H) > 10% (4H) [5] > 5% (5H) [6]		
Polarization [7]	Linear, horizontal (2H, 5H) Linear, vertical (3H, 4H)		

PHYSICAL DIMENSIONS

Dimensions (L × W × H)	487 × 176 × 180 mm	552 × 320 × 170 mm

1) *For harmonic combinations and simultaneous outputs, contact sales@lightcon.com.*
2) *Residual fundamental output available upon request.*
3) *White light continuum output available upon request.*
4) *Percentage of pump power, for repetition rate of up to 200 kHz.*
5) *Maximum output power of 1 W.*
6) *Maximum ouput power of 150 mW. Only for HIRO-HP/HE.*
7) *Different polarization is available upon request.*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

HIRO for FLINT

Model	HIRO
Available harmonic [1]	Up to 4H
Maximum pump power	4 W
Conversion efficiency [2]	> 35% (2H) > 5% (3H) > 1% (4H)

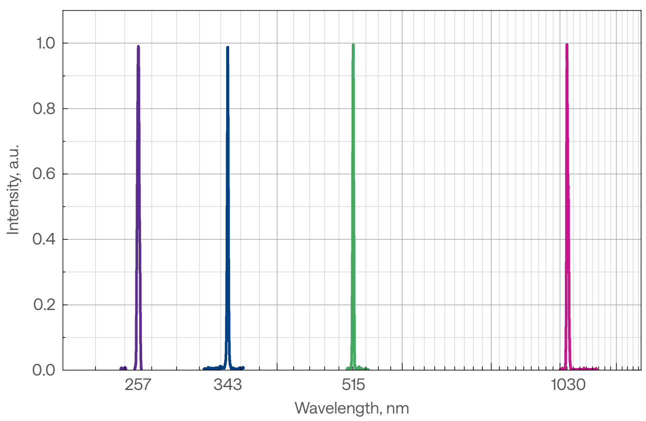
PHYSICAL DIMENSIONS

Dimensions (L × W × H)	487 × 176 × 180 mm

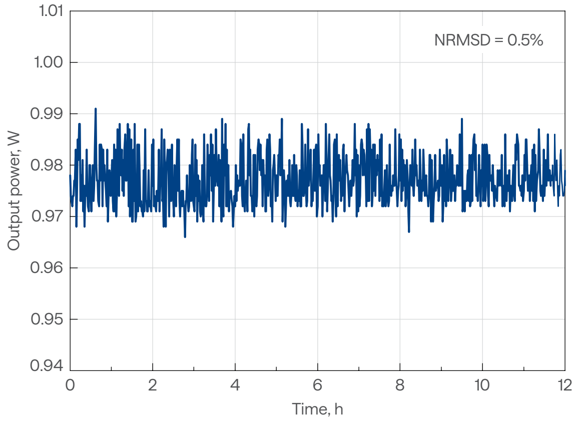
[1] *For high power 2H, refer to HG for FLINT.*
[2] *For pump power of > 500 mW.*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

HIRO outputs

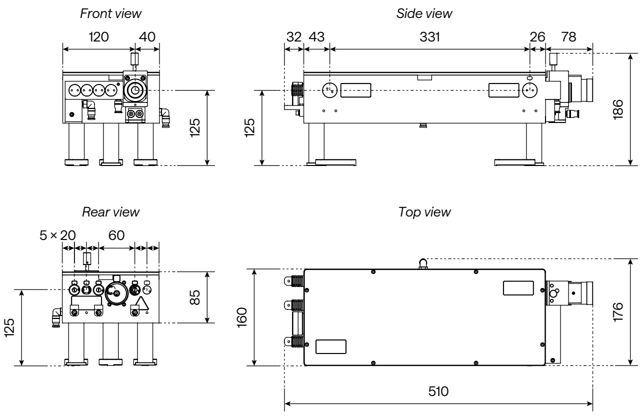


4H output power stability

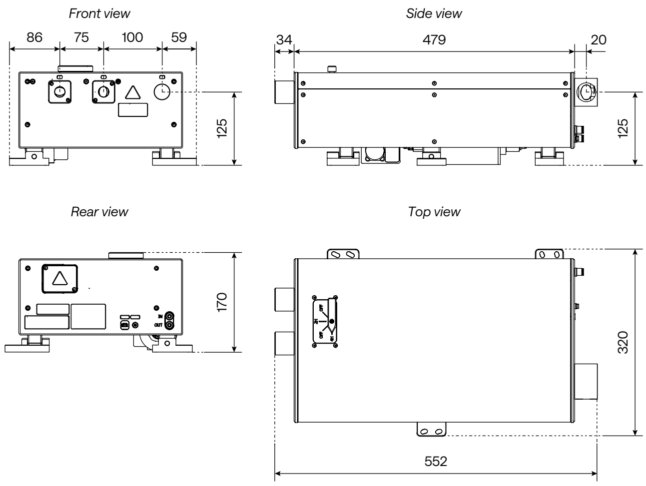


Drawings

HIRO



HIRO-HP/HE



SHBC

Second Harmonic Bandwidth Compressor

- Narrowband 515 nm output
- Picosecond pulses from a femtosecond pump
- < 10 cm^{-1} or < 2 cm^{-1} spectral bandwidth
- Compact footprint

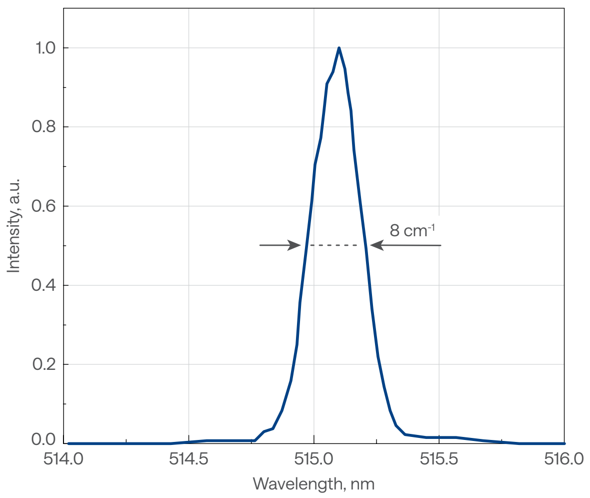
Specifications

Model	SHBC-515	SHBC-NB
OUTPUT CHARACTERISTICS		
Output wavelength [1]	515 nm ± 5 nm	
Conversion efficiency	> 30%	> 6% @ 3 – 6 μJ pump > 10% @ 6 – 30 μJ pump > 15% @ 30 – 200 μJ pump
Spectral bandwidth	< 10 cm^{-1} [2]	< 2 cm^{-1}
Pulse duration	2 – 4 ps [2) 3)]	50 – 100 ps
PUMP LASER REQUIREMENTS		
Pump laser	PHAROS or CARBIDE with uncompressed output [4]	PHAROS or CARBIDE [4]
Repetition rate	Single-shot – 1 MHz	
Pump pulse energy	40 μJ – 4 mJ	3 – 200 μJ
Maximum pump power	40 W	10 W
DIMENSIONS		
Housing (L × W × H)	426 × 351 × 119 mm	400 × 195 × 187 mm
Input height	70 mm	125 mm
Output height	80 mm	125 mm

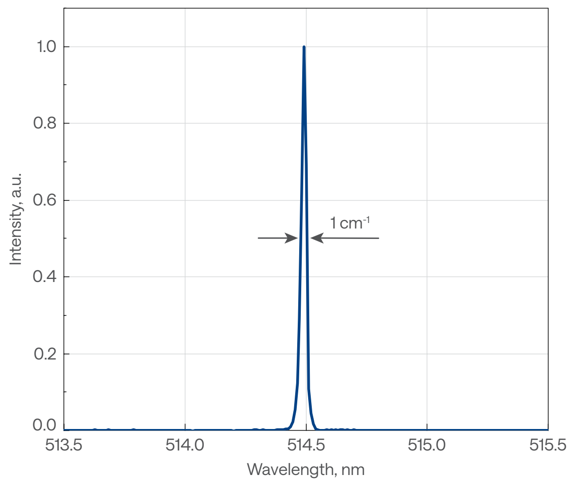
1) *Depends on the pump laser model.*
2) *SHBC-515 can be adjusted to shorter pulse durations at the expense of spectral bandwidth.*
3) *When paired with ORPHEUS-PS, the spectral width and pulse duration are optimized for the best OPA performance.*
4) *Not compatible with PHAROS-UP.*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

SHBC-515 typical output spectrum

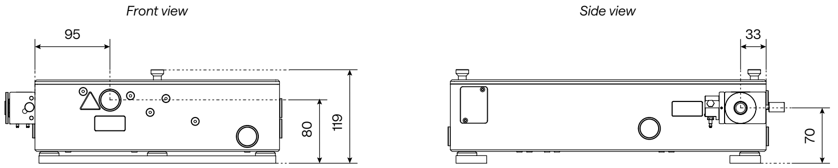


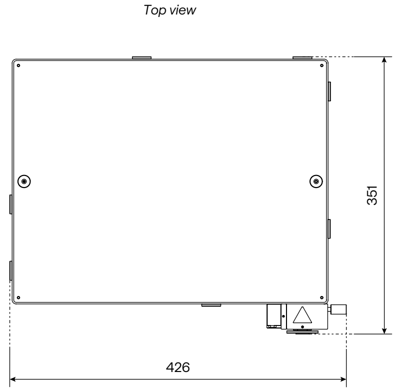
SHBC-NB typical output spectrum



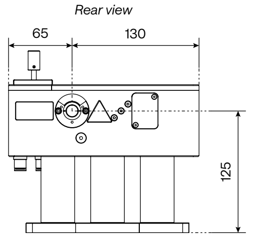
Drawings

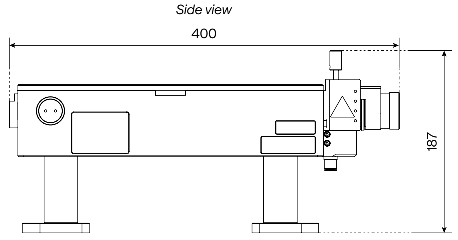
SHBC-515

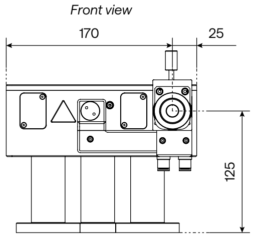


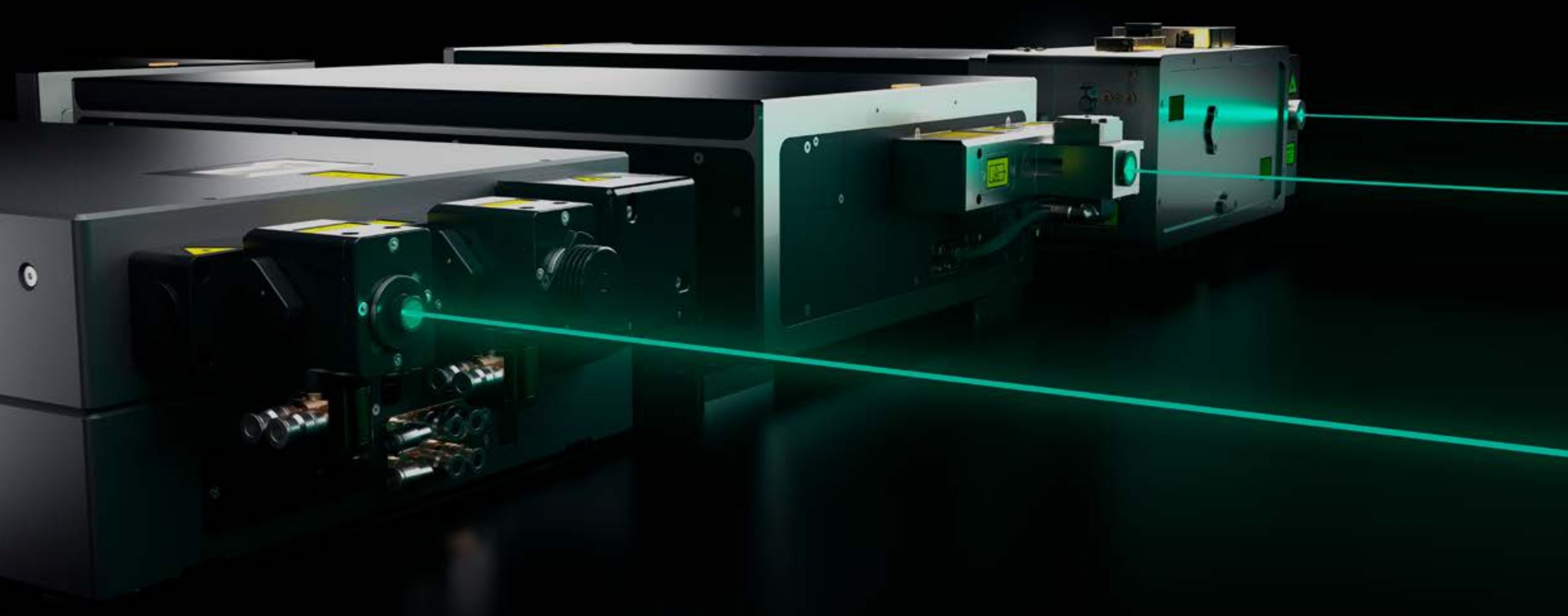


SHBC-NB









Wavelength-Tunable Sources

Coupled with femtosecond lasers, these OPAs provide an invaluable source for ultrafast spectroscopy, nonlinear microscopy, and a variety of other scientific applications.

I-OPA	The only industrial-grade commercial OPA, combining wavelength tunability with robust design.
ORPHEUS | NEO	Next-generation OPA featuring exceptional stability and multiple detectors for continuous power monitoring and diagnostics.
ORPHEUS	A classic OPA platform that many are familiar with – simple to use yet offers an extensive range of parameters.
TOPAS	Classic OPAs for Ti:Sapphire lasers.

Continuous wavelength tunability from UV to MIR

Pulse durations from tens of femtoseconds to a few picoseconds

Leading OPA manufacturer for more than 30 years

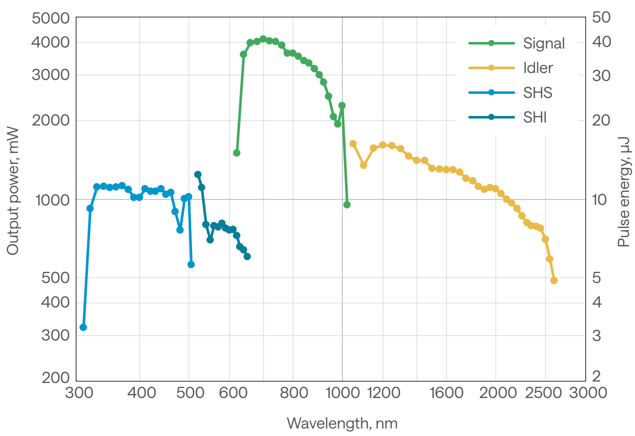
I-OPA

Industrial-Grade Optical Parametric Amplifier

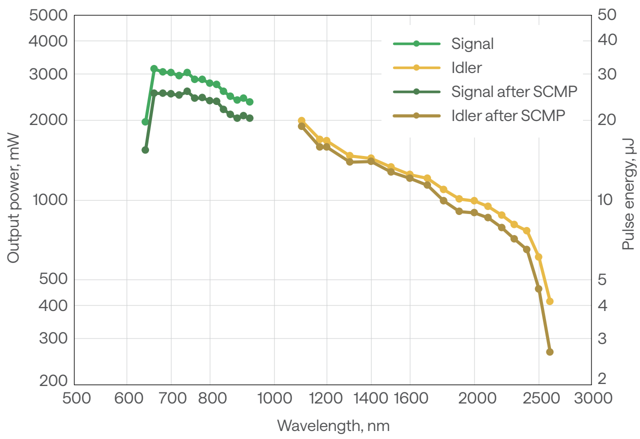
I-OPA-TW on air-cooled CARBIDE-CB5

- Wavelength tunability in an industrial design
- Single-box solution
- Tunable or fixed-wavelength models
- Plug-and-play installation and robust performance
- The most compact OPA in the market

I-OPA-HP typical tuning curves
Pump: 40 W, 400 μJ, 100 kHz



I-OPA-F typical tuning curves
Pump: 40 W, 400 μJ, 100 kHz



Optics Toolbox

Specifications

Model	I-OPA-HP	I-OPA-F	I-OPA-ONE
Configuration	ORPHEUS	ORPHEUS-F	ORPHEUS-ONE
Pump power	Up to 40 W		
Pump pulse energy	20 – 400 µJ		
Repetition rate	Up to 2 MHz		
Tuning range [1]	640 – 1010 nm (signal) 1050 – 2600 nm (idler)	650 – 920 nm (signal) 1200 – 2500 nm (idler)	1350 – 2000 nm (signal) 2100 – 4500 nm (idler)
Conversion efficiency	> 7% @ 700 nm (40 – 400 µJ pump; up to 1 MHz)		> 9% @ 1550 nm (40 – 400 µJ pump; up to 1 MHz)
	> 3.5% @ 700 nm (20 – 40 µJ pump; up to 2 MHz)		> 6% @ 1550 nm (20 – 40 µJ pump; up to 2 MHz)
Spectral bandwidth [2]	80 – 220 cm^{-1} @ 700 – 960 nm	200 – 1000 cm^{-1} @ 650 – 920 nm 150 – 1000 cm^{-1} @ 1200 – 2000 nm	60 – 150 cm^{-1} @ 1450 – 2000 nm
Pulse duration [2] [3]	120 – 250 fs	< 55 fs @ 800 – 920 nm < 70 fs @ 650 – 800 nm < 100 fs @ 1200 – 2000 nm	100 – 300 fs
Long-term power stability, 8 h [4]	< 1% @ 800 nm		< 1% @ 1550 nm
Pulse-to-pulse energy stability, 1 min [4]	< 1% @ 800 nm		< 1% @ 1550 nm
Wavelength extension options	320 – 505 nm (SHS) [5] 525 – 640 nm (SHI) [5]	Contact sales@lightcon.com	4500 – 10 000 nm (DFG)
Pulse compression options [2]	n/a	SCMP (signal pulse compressor) ICMP (idler pulse compressor) GDD-CMP (compressor with GDD control)	n/a

PUMP LASER REQUIREMENTS

Pump laser	PHAROS or CARBIDE
Center wavelength	1030 ± 10 nm
Maximum pump power	40 W
Maximum repetition rate	Up to 2 MHz
Pump pulse energy	20 – 400 µJ
Pulse duration	180 – 300 fs

ENVIRONMENTAL & UTILITY REQUIREMENTS

Operating temperature [6]	19 – 25 °C (air conditioning recommended)
Relative humidity [6]	20 – 70% (non-condensing)
Electrical requirements	n/a [7]

[1] *In the case of a fixed wavelength (FW), a single wavelength can be selected from the signal or idler range. The signal may have an accessible idler pair, and vice versa.*

[2] *I-OPA-F broad-bandwidth pulses are compressed externally. Typical pulse duration before compression: 120 – 250 fs, after compression: 25 – 70 fs @ 650 – 900 nm, 40 – 100 fs @ 1200 – 2000 nm.*

[3] *Output pulse duration depends on the selected wavelength and the pump laser pulse duration.*

[4] *Expressed as normalized root mean squared deviation (NRMSD).*

[5] *Conversion efficiency is 1.2% at peak; specified as a percentage of pump power.*

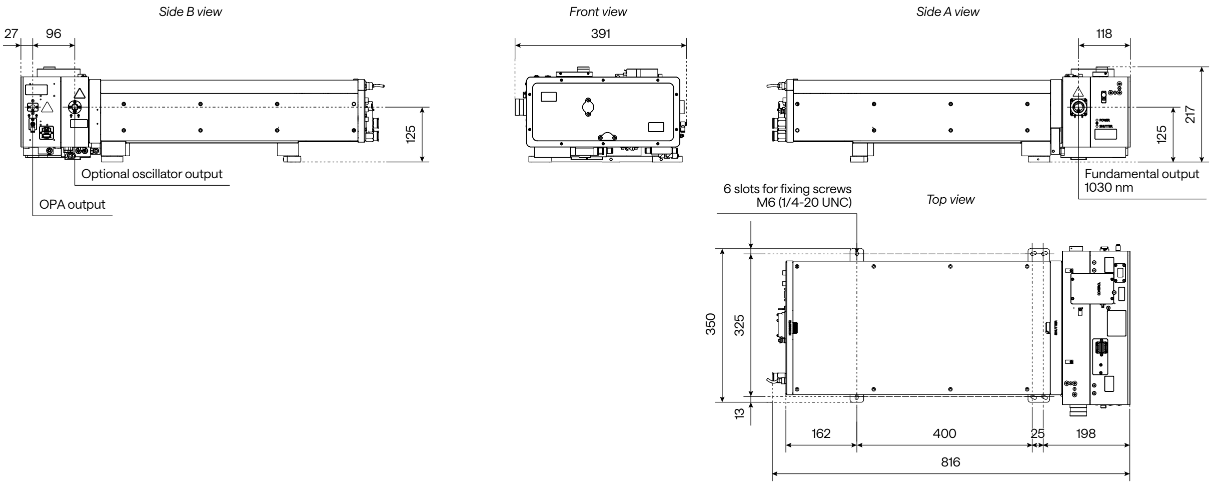
[6] *Specifications are guaranteed for a maximum temperature variation of ± 1 °C and humidity variation of ± 10%.*

[7] *I-OPA is powered by the same electrical source as the pump laser. Thus, refer to the pump laser electrical requirements.*

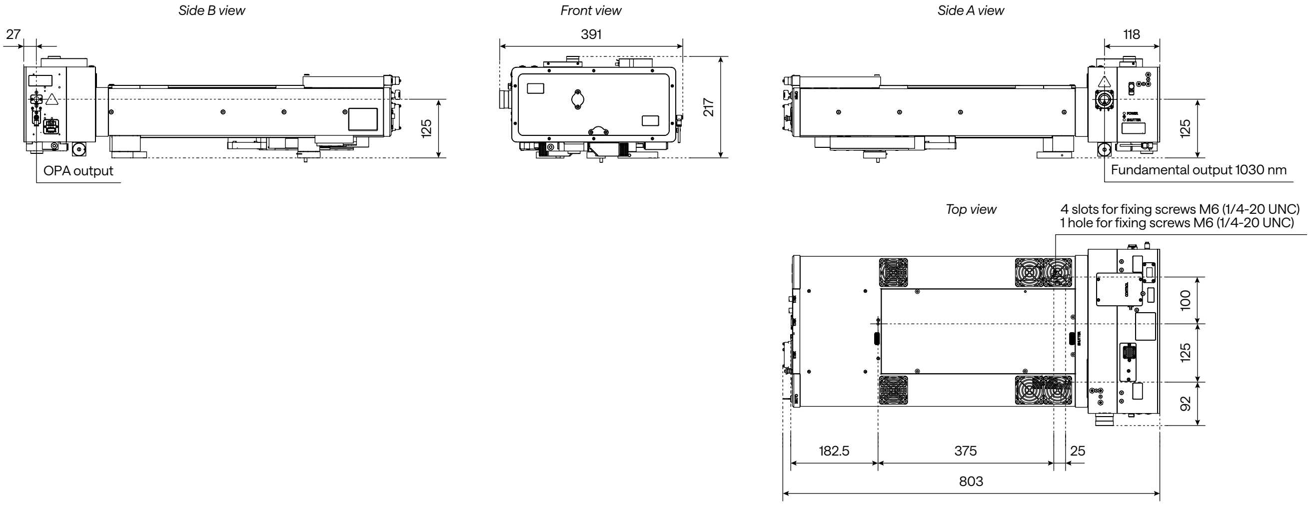
DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

Drawings

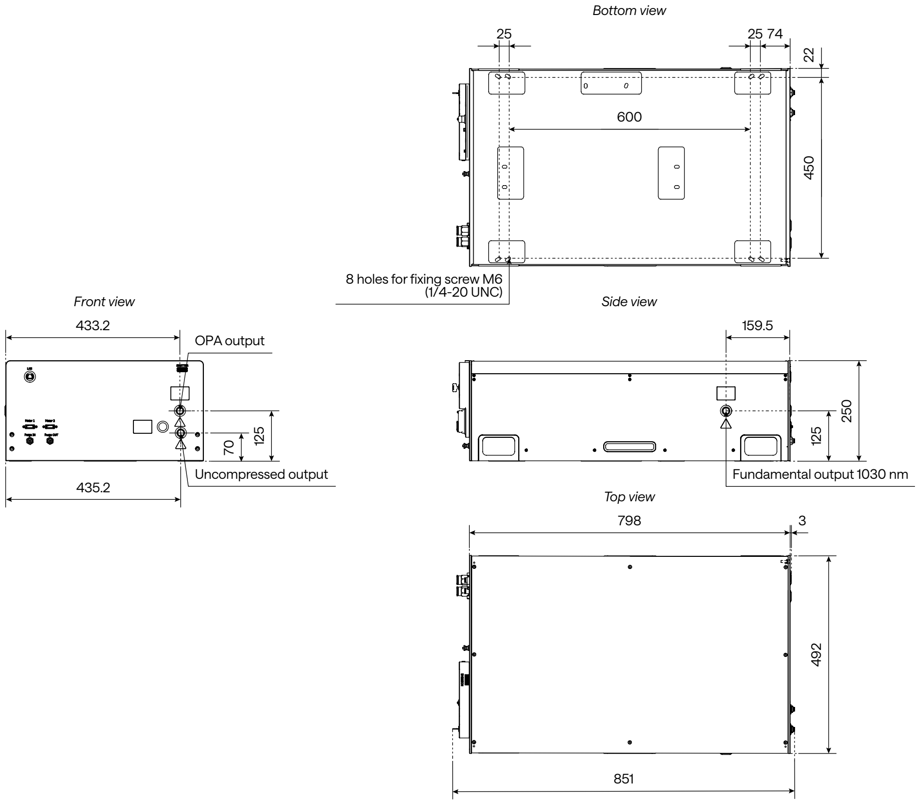
CARBIDE-CB3 with I-OPA-HP



CARBIDE-CB5 with I-OPA-HP



PHAROS-PH2 with I-OPA-HP



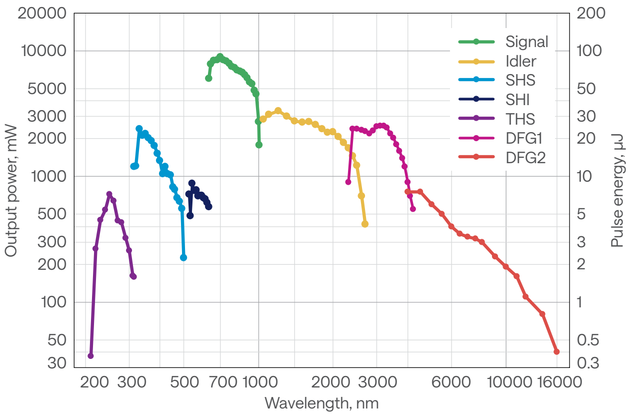
The drawings depend on the exact configuration. For more options, refer to www.lightcon.com.

ORPHEUS | NEO

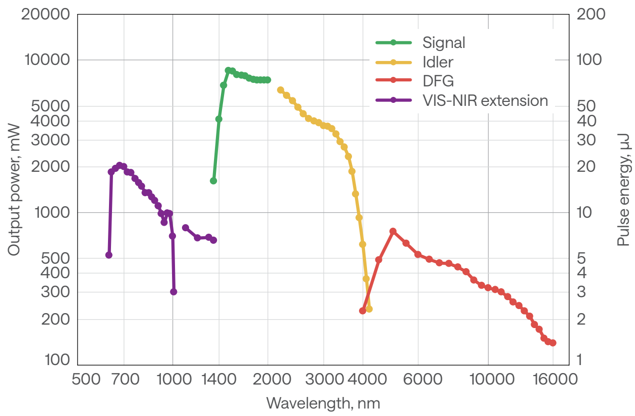
Next-Generation
Optical Parametric Amplifier

- Wavelength range from UV to MIR, 210 – 16 000 nm
- Continuous power monitoring and diagnostics
- Pumped by PHAROS-UP for ultrashort pulses
- Supports up to 80 W, 800 µJ pump at 2 MHz
- Fully integrated wavelength extensions
- Exceptional output stability

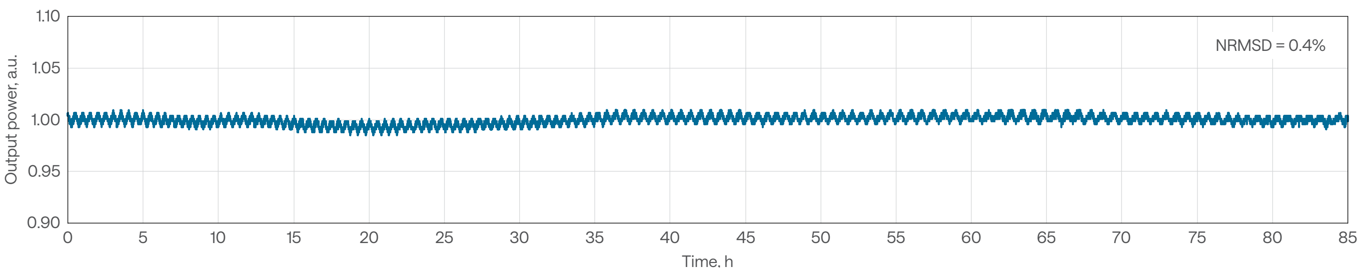
ORPHEUS-NEO typical tuning curves in HP configuration
Pump: 80 W, 800 µJ, 100 kHz



ORPHEUS-NEO-ONE typical tuning curves in ONE configuration
Pump: 80 W, 800 µJ, 100 kHz



ORPHEUS-NEO typical long-term power stability at 800 nm



ORPHEUS-NEO specifications

Model	ORPHEUS-NEO	ORPHEUS-NEO-ONE
Configuration	ORPHEUS	ORPHEUS-ONE
Pump power	Up to 80 W	
Pump pulse energy	20 – 800 µJ	
Repetition rate	Up to 2 MHz	
Tuning range	640 – 1000 nm (signal) 1050 – 2600 nm (idler)	1400 – 2000 nm (signal) 2100 – 4200 nm (idler)
Conversion efficiency	> 7% @ 700 nm (40 – 800 µJ pump; up to 1 MHz)	> 9% @ 1550 nm (40 – 800 µJ pump; up to 1 MHz)
	> 3.5% @ 700 nm (20 – 40 µJ pump; up to 2 MHz)	> 6% @ 1550 nm (20 – 40 µJ pump; up to 2 MHz)
Spectral bandwidth	60 – 220 cm^{-1} @ 700 – 960 nm	50 – 150 cm^{-1} @ 1450 – 2000 nm
Pulse duration [1]	120 – 400 fs	100 – 400 fs
Beam quality, M^2	< 1.3 @ 800 nm	< 1.3 @ 1550 nm
Beam diameter [2]	2.1 ± 0.6 mm @ 800 nm	2.1 ± 0.6 mm @ 1550 nm
Beam divergence (full-angle)	< 2 mrad @ 800 nm	< 4 mrad @ 1550 nm
Long-term power stability, 8 h [3]	< 1% @ 800 nm	< 1% @ 1550 nm
Pulse-to-pulse energy stability, 1 min [3]	< 1% @ 800 nm	< 1% @ 1550 nm
Wavelength extension options; conversion efficiency	210 – 320 nm (THS); > 0.4% @ 250 nm	640 – 1000 nm and 1050 – 1350 nm (VIS–NIR); > 1% @ 700 nm
	320 – 500 nm (SHS) and 525 – 640 nm (SHI); > 1.2% @ 350 nm	
	2500 – 4200 nm (DFG1); > 3% @ 3000 nm	4000 – 16 000 nm (DFG); > 0.3% @ 10 000 nm (for > 40 µJ pump)
	4000 – 16 000 nm (DFG2); > 0.2% @ 10 000 nm	

PUMP LASER REQUIREMENTS

Configuration	PHAROS or CARBIDE
Center wavelength	1030 ± 10 nm
Maximum pump power	80 W
Maximum repetition rate	2 MHz
Pump pulse energy	20 – 800 µJ
Pump pulse duration	180 – 500 fs

ENVIRONMENTAL & UTILITY REQUIREMENTS

Operating temperature [4]	19 – 25 °C (air conditioning recommended)
Relative humidity [4]	20 – 70% (non-condensing)
Electrical requirements	100 – 240 V AC, 4.5 A; 50 – 60 Hz
Rated power	280 W
Power consumption	Standby: 20 W Max during wavelength tuning: 200 W

[1] *Output pulse duration depends on the selected wavelength and the pump laser pulse duration.*

[2] *FW 1/e², measured at laser output, using maximum pulse energy.*

[3] *Expressed as normalized root mean squared deviation (NRMSD).*

[4] *Specifications are guaranteed for a maximum temperature variation of ± 1 °C and humidity variation of ± 10%.*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

ORPHEUS-NEO-UP specifications

Model	ORPHEUS-NEO-UP	ORPHEUS-NEO-ONE-UP
Configuration	ORPHEUS	ORPHEUS-ONE
Pump power	Up to 20 W	
Pump pulse energy	20 – 400 μJ	
Repetition rate	Up to 1 MHz	
Tuning range	640 – 1000 nm (signal) 1050 – 2600 nm (idler)	1450 – 2000 nm (signal) 2100 – 4500 nm (idler)
Conversion efficiency	> 7% @ 700 nm	> 9% @ 1550 nm
Spectral bandwidth	120 – 300 cm^{-1} @ 700 – 2600 nm	150 – 300 cm^{-1} @ 1500 – 1900 nm & 2200 – 3500 nm [1]
Pulse duration [2]	< 100 fs @ 700 – 1000 nm < 120 fs @ 1060 – 2000 nm	< 120 fs @ 1500 – 1900 nm
Beam quality, M^2	< 1.3 @ 800 nm	< 1.3 @ 1550 nm
Beam diameter [3]	2.1 ± 0.6 mm @ 800 nm	2.1 ± 0.6 mm @ 1550 nm
Beam divergence (full-angle)	< 2 mrad @ 800 nm	< 4 mrad @ 1550 nm
Long-term power stability, 8 h [4]	< 1% @ 800 nm	< 1% @ 1550 nm
Pulse-to-pulse energy stability, 1 min [4]	< 1% @ 800 nm	< 1% @ 1550 nm
Wavelength extension options; conversion efficiency	210 – 320 nm (THS); > 0.2% @ 250 nm	640 – 1000 nm and 1050 – 1450 nm (VIS–NIR); > 1% @ 700 nm
	320 – 500 nm (SHS) and 525 – 640 nm (SHI); > 1.2% @ 350 nm	
	2500 – 4500 nm (DFG1); > 3% @ 3000 nm	4500 – 14 000 nm (DFG); 0.2% @ 10 000 nm
	4500 – 14 000 nm (DFG2); > 0.1% @ 10 000 nm	

PUMP LASER REQUIREMENTS

Configuration	PHAROS-UP
Center wavelength	1030 ± 10 nm
Maximum pump power	20 W
Maximum repetition rate	1 MHz
Pump pulse energy	20 – 400 μJ
Pump pulse duration	80 – 100 fs

ENVIRONMENTAL & UTILITY REQUIREMENTS

	Refer to www.lightcon.com

[1] *Spectral bandwidth is equal to 150 – 250 cm^{-1} @ 5000 – 12 000 nm.*

[2] *Output pulse duration depends on the selected wavelength and the pump laser pulse duration.*

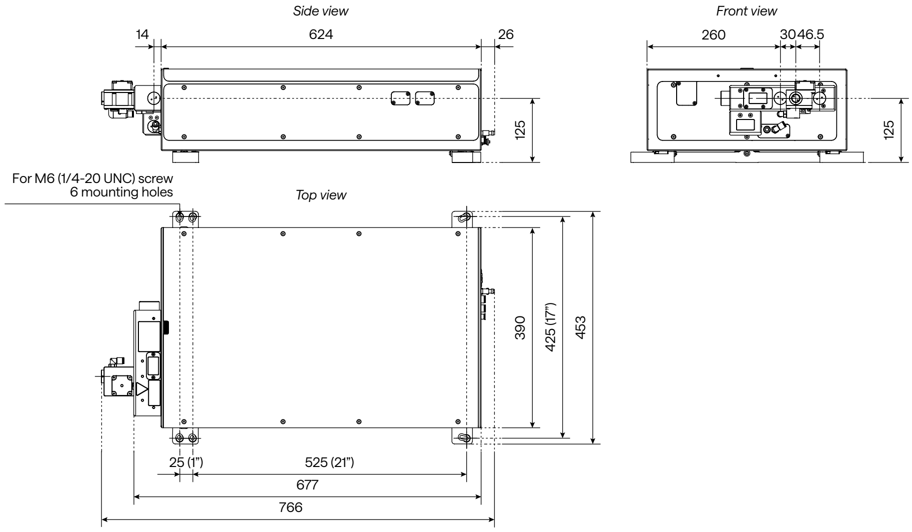
[3] *FW $1/e^2$, measured at laser output, using maximum pulse energy.*

[4] *Expressed as normalized root mean squared deviation (NRMSD).*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

Drawings

ORPHEUS-NEO / ORPHEUS-NEO-UP

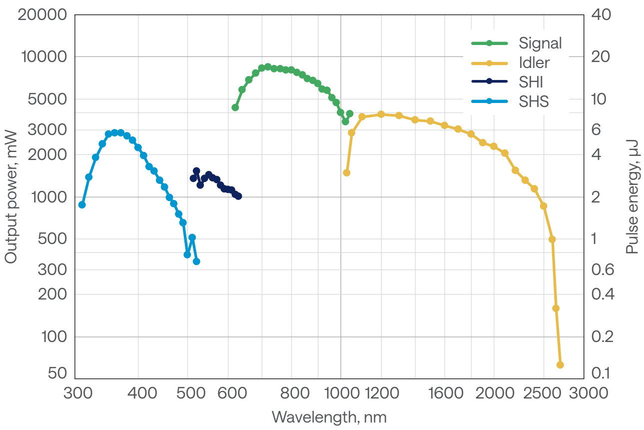


ORPHEUS

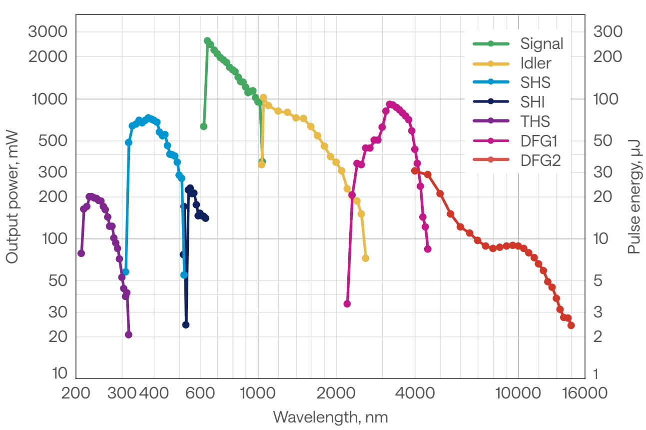
Collinear Optical Parametric Amplifier

- Continuous tunability from UV to MIR, 190 – 16 000 nm
- High energy and high power models
- Single-shot – 2 MHz repetition rate
- Up to 80 W pump power
- Up to 2 mJ pump pulse energy

ORPHEUS-HP typical tuning curves
Pump: 80 W, 160 µJ, 500 kHz



ORPHEUS-HE typical tuning curves
Pump: 20 W, 2 mJ, 10 kHz



Optics Toolbox

Specifications

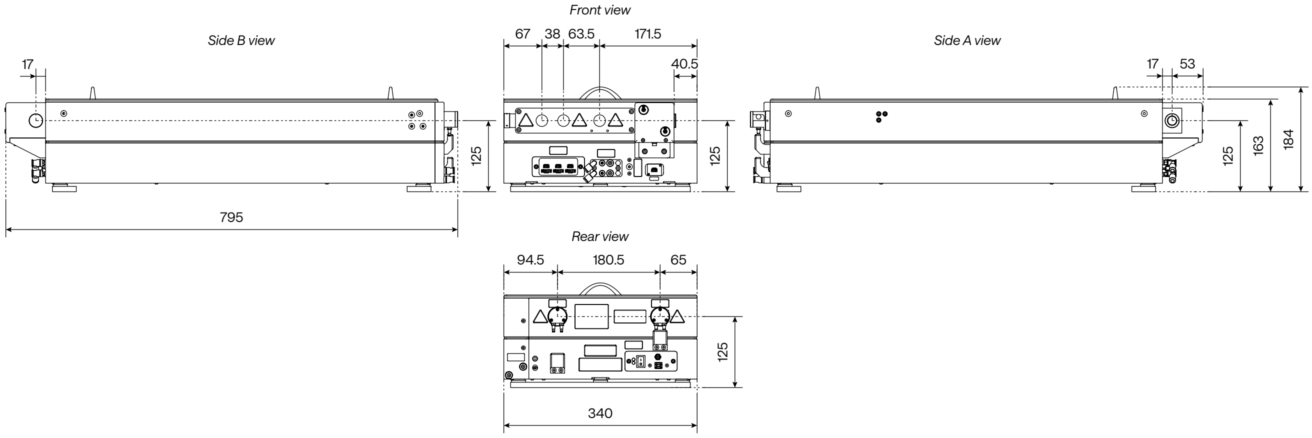
Model	ORPHEUS-HP		ORPHEUS-HE
MAIN OUTPUT (630 – 2600 nm)			
Tuning range	630 –1030 nm (signal) 1030 – 2600 nm (idler)		
Maximum pump power	80 W		
Pump pulse energy	8 – 20 µJ	20 – 400 µJ	400 – 2000 µJ
Conversion efficiency at peak	> 4.5% (signal) > 2% (idler)	> 9% (signal) > 4% (idler)	
Pulse duration	120 – 400 fs		
Spectral bandwidth @ 700 – 960 nm	60 – 220 cm^{-1}		
Long-term power stability, 8 h 1)	< 2% @ 800 nm		
Pulse-to-pulse energy stability, 1 min 1)	< 2% @ 800 nm		
WAVELENGTH EXTENSIONS (190 – 16 000 nm)			
Pump pulse energy	8 – 20 µJ	20 – 400 µJ	400 – 2000 µJ
315 – 630 nm (SHS/SHI)	> 1.2% @ 350 nm	> 2.4% @ 350 nm	
210 – 315 nm (THS)	> 0.4% @ 250 nm 2)	> 0.8% @ 250 nm 2)	
190 – 215 nm (DUV)	n/a	> 0.3% @ 200 nm 3)	Contact sales@lightcon.com
2200 – 4200 nm (DFG1)	> 1.5% @ 3000 nm	> 3% @ 3000 nm	
4000 – 16 000 nm (DFG2)	> 0.1% @ 10 000 nm	> 0.2% @ 10 000 nm	
PUPM LASER REQUIREMENTS			
Pump laser	PHAROS or CARBIDE		
Center wavelength	1030 ± 10 nm		
Maximum pump power	80 W		
Maximum repetition rate	2 MHz		200 kHz
Pump pulse energy	8 – 400 µJ		400 – 2000 µJ
Pump pulse duration 4)	180 – 500 fs		
ENVIRONMENTAL & UTILITY REQUIREMENTS			
	Refer to www.lightcon.com		

1) *Expressed as normalized root mean squared deviation (NRMSD).*
2) *Maximum output power of 400 mW.*
3) *DUV conversion efficiency is specified for pump power up to 10 W and frequencies up to 200 kHz. In case of higher pump power, conversion efficiency decreases. The maximum output power is 40 mW at 200 nm.*
4) *Full width at half maximum (FWHM), assuming a Gaussian pulse shape.*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

Drawings

ORPHEUS-HP

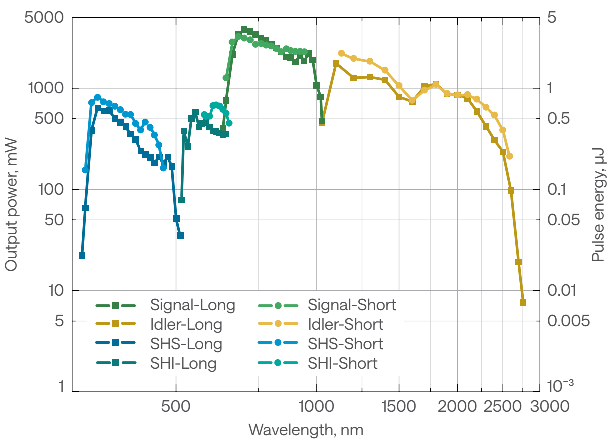


ORPHEUS | F

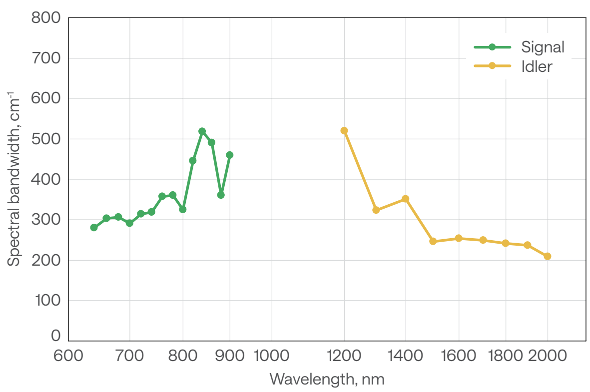
Broad-Bandwidth Hybrid Optical Parametric Amplifier

- Combines the best features of collinear and non-collinear OPAs
- Ultrashort pulses in NIR, 650 – 900 nm and 1200 – 2500 nm
- Single-shot – 2 MHz repetition rate
- < 100 fs pulse duration
- Adjustable spectral bandwidth
- Optional long pulse mode for gap-free tunability

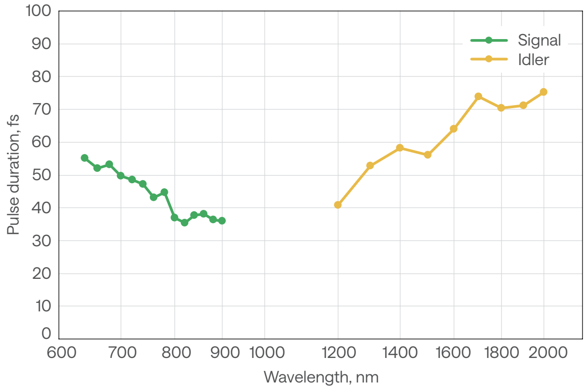
ORPHEUS-F typical tuning curves
Pump: 40 W, 40 μJ, 1000 kHz



ORPHEUS-F typical spectral bandwidth



ORPHEUS-F pulse duration after compression



Optics Toolbox

Specifications

MAIN OUTPUT (650 – 900 nm and 1200 – 2500 nm)

Mode of operation	Short pulse mode [1]	Long pulse mode
Tuning range	650 – 900 nm (signal) 1200 – 2500 nm (idler)	650 – 1010 nm (signal) 1050 – 2500 nm (idler)
Maximum pump power	80 W	
Pump pulse energy	10 – 400 µJ	
Conversion efficiency [2]	> 7% @ 700 nm	
Integrated 2H (515 nm) generation efficiency [3]	> 35%	
Pulse duration before compression [1]	< 290 fs	
Spectral bandwidth	200 – 750 cm^{-1} @ 650 – 900 nm	60 – 220 cm^{-1} @ 650 – 900 nm
Pulse duration after compressor [1]	< 55 fs @ 800 – 900 nm < 70 fs @ 650 – 800 nm < 100 fs @ 1200 – 2000 nm	n/a
Compressor transmission	> 65% @ 650 – 900 nm > 80% @ 1200 – 2000 nm	
Long-term power stability, 8 h [4]	< 2% @ 800 nm	
Pulse-to-pulse energy stability, 1 min [4]	< 2% @ 800 nm	

WAVELENGTH EXTENSION OPTIONS (325 – 15 000 nm) [5]

325 – 450 nm (SHS)	> 1%	n/a
325 – 505 nm (SHS)	n/a	> 1%
525 – 650 nm (SHI)		> 0.5%
600 – 650 nm (SHI)	> 0.5%	n/a
210 – 252 nm (FHS)	n/a	> 0.1%
263 – 325 nm (FHI)		
2500 – 15 000 nm	See ORPHEUS-MIR; *page 42*	

PUMP LASER REQUIREMENTS

Pump laser	PHAROS or CARBIDE
Center wavelength	1030 ± 10 nm
Maximum pump power	80 W
Repetition rate	Single-shot – 2 MHz
Pump pulse energy	10 – 400 µJ
Pump pulse duration [6]	180 – 500 fs

ENVIRONMENTAL & UTILITY REQUIREMENTS

Refer to www.lightcon.com

[1] *In short pulse mode, broadband pulses are compressed externally. Typical pulse duration before compression: 120 – 250 fs, after compression: 25 – 70 fs @ 650 – 900 nm, 40 – 100 fs @ 1200 – 2000 nm.*

[2] *Specified as a percentage of pump power, before the compressor. Conversion efficiency at peak is 10% for signal and idler combined.*

[3] *At the designated output port; not simultaneous to OPA output.*

[4] *Expressed as normalized root mean squared deviation (NRMSD).*

[5] *For > 15 µJ pump pulse energy.*

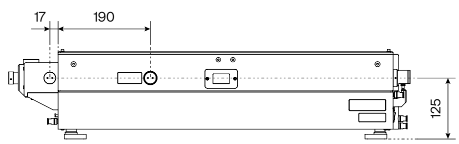
[6] *Full width at half maximum (FWHM), assuming a Gaussian pulse shape.*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

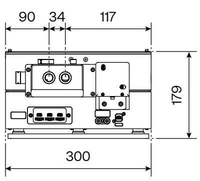
Drawings

ORPHEUS-F

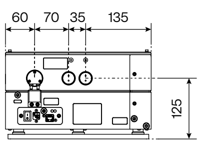
Side B view



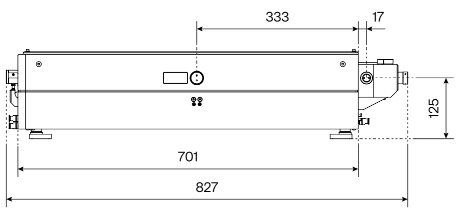
Front view



Rear view



Side A view



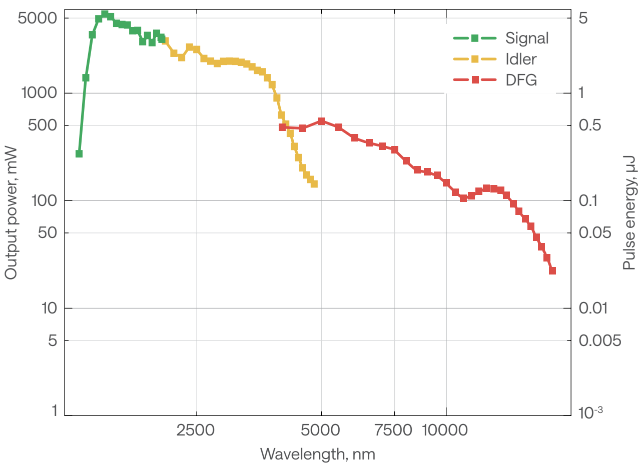
For layout configurations involving compressors, visit toolbox.lightcon.com or contact sales@lightcon.com.

ORPHEUS | ONE

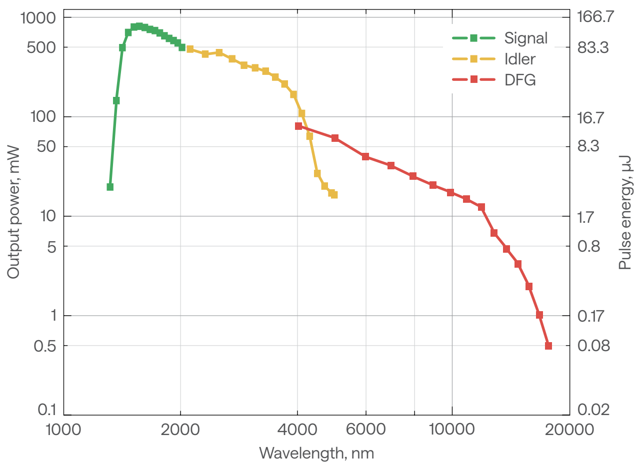
Mid-Infrared Collinear Optical Parametric Amplifier

- High conversion efficiency in MIR, 1400 – 16 000 nm
- High energy and high power models for all needs
- Single-shot – 2 MHz repetition rate
- Supports up to 80 W, 2 mJ pump

ORPHEUS-ONE-HP typical tuning curves
Pump: 40 W, 40 μJ, 1000 kHz



ORPHEUS-ONE-HE typical tuning curves
Pump: 6 W, 1 mJ, 6 kHz



Optics Toolbox

Specifications

Model	ORPHEUS-ONE-HP	ORPHEUS-ONE-HE
MAIN OUTPUT		
Tuning range	1400 – 2000 nm (signal) 2100 – 4200 nm (idler)	
Maximum pump power	80 W	
Pump pulse energy	12 – 400 µJ	400 – 2000 µJ
Conversion efficiency [1] @ 1550 nm	> 9%, 30 – 2000 µJ pump > 6%, 12 – 30 µJ pump	
Spectral bandwidth	50 – 150 cm^{-1} @ 1450 – 2000 nm	
Long-term power stability, 8 h [2]	< 2% @ 1550 nm	
Pulse-to-pulse energy stability, 1 min [2]	< 2% @ 1550 nm	
WAVELENGTH EXTENSION (MIR)		
Tuning range	4000 – 16 000 nm (DFG)	
Conversion efficiency [1]	> 0.3% @ 10 000 nm, 30 – 2000 µJ pump > 0.2% @ 10 000 nm, 12 – 30 µJ pump	
Spectral bandwidth	50 – 120 cm^{-1} @ 5000 – 8000 nm	
PUMP LASER REQUIREMENTS		
Pump laser	PHAROS or CARBIDE	
Center wavelength	1030 ± 10 nm	
Maximum pump power	80 W	
Maximum repetition rate	2 MHz	200 kHz
Pump pulse energy	12 – 400 µJ	400 – 2000 µJ
Pump pulse duration [3]	180 – 500 fs	
ENVIRONMENTAL & UTILITY REQUIREMENTS		
Operating temperature [4]	19 – 25 °C (air conditioning recommended)	
Relative humidity [4]	20 – 70% (non-condensing)	
Electrical requirements	100 – 240 V AC, 1.4 A; 50 – 60 Hz	
Rated power	120 W	
Power consumption	Standby: 10 W Max during wavelength tuning: 100 W	

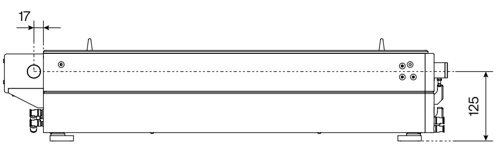
1) *Specified as a percentage of pump power.*
2) *Expressed as normalized root mean squared deviation (NRMSD).*
3) *Full width at half maximum (FWHM), assuming a Gaussian pulse shape.*
4) *Specifications are guaranteed for a maximum temperature variation of ± 1 °C and humidity variation of ± 10%.*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

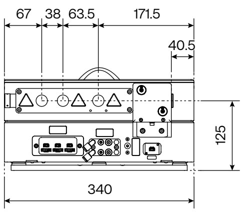
Drawings

ORPHEUS-ONE-HP / HE

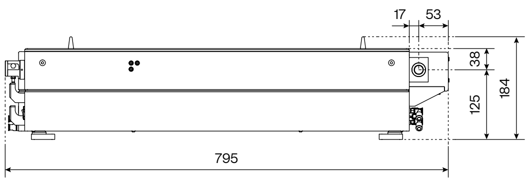
Side B view



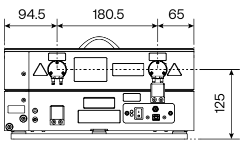
Front view



Side A view



Rear view

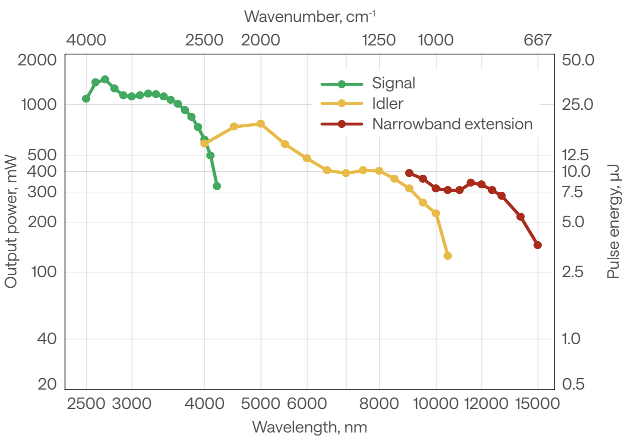


ORPHEUS | MIR

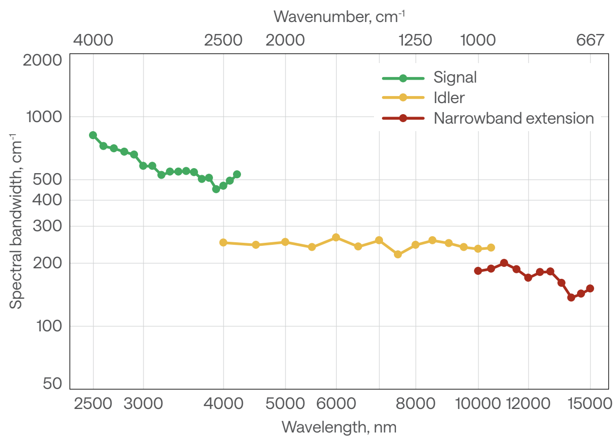
Broad-Bandwidth Mid-Infrared Optical Parametric Amplifier

- Broad-bandwidth mid-IR pulses at high repetition rates
- Continuously tunable from 2500 to 15 000 nm
- Short-pulse high-energy auxiliary output at 2000 nm
- Pumped by industrial-grade lasers for high stability
- CEP-stable option

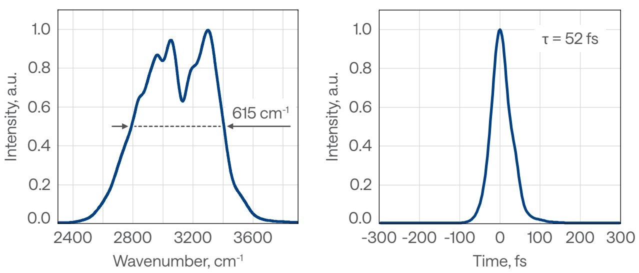
ORPHEUS-MIR typical tuning curves
Pump: 80 W, 2 mJ, 40 kHz



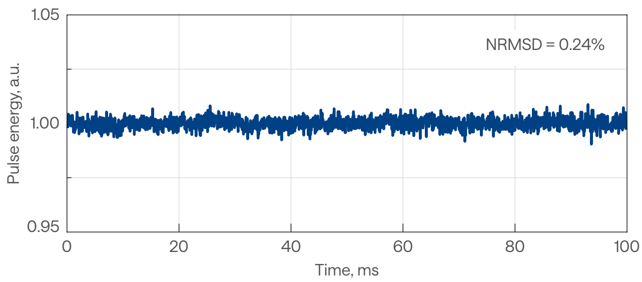
ORPHEUS-MIR typical spectral bandwidth



ORPHEUS-MIR typical output spectrum (left) and pulse duration (right) measured at ≈ 3000 nm



ORPHEUS-MIR pulse-to-pulse energy stability measured at ≈ 3000 nm



Specifications

MAIN OUTPUT (2500 – 10 000 nm)

Mode of operation	Non-collinear	Collinear [1]
Tuning range	2500 – 4000 nm (signal) 4000 – 10 000 nm (idler)	2500 – 4500 nm (signal) 4500 – 10 000 nm (idler)
Maximum pump power	80 W	
Pump pulse energy	200 µJ – 3 mJ	
Maximum repetition rate	100 kHz	
Pulse duration	< 100 fs	< 400 fs (< 100 fs with dispersion compensation) [1]
Conversion efficiency [2]	> 1.2% @ 3000 nm > 1.0% @ 3500 nm > 0.6% @ 5000 nm > 0.3% @ 9000 nm	
Spectral bandwidth [3]	> 300 cm^{-1} @ 3000 – 4000 nm > 200 cm^{-1} @ 4000 – 10 000 nm	
Long-term power stability, 8 h [4]	< 2% @ 5000 nm	
Pulse-to-pulse energy stability, 1 min [4]	< 2% @ 5000 nm	

AUXILIARY OUTPUT (2000 nm)

Output wavelength [5]	2000 ± 100 nm
Pulse duration	< 50 fs
Conversion efficiency [2]	> 8%
Spectral bandwidth	> 350 cm^{-1}

WAVELENGTH EXTENSION (10 000 – 15 000 nm)

Tuning range [6]	10 000 – 15 000 nm	n/a
Conversion efficiency [2]	> 0.2% @ 12 000 nm	
Spectral bandwidth	> 100 cm^{-1}	

PUMP LASER, ENVIRONMENTAL & UTILITY REQUIREMENTS

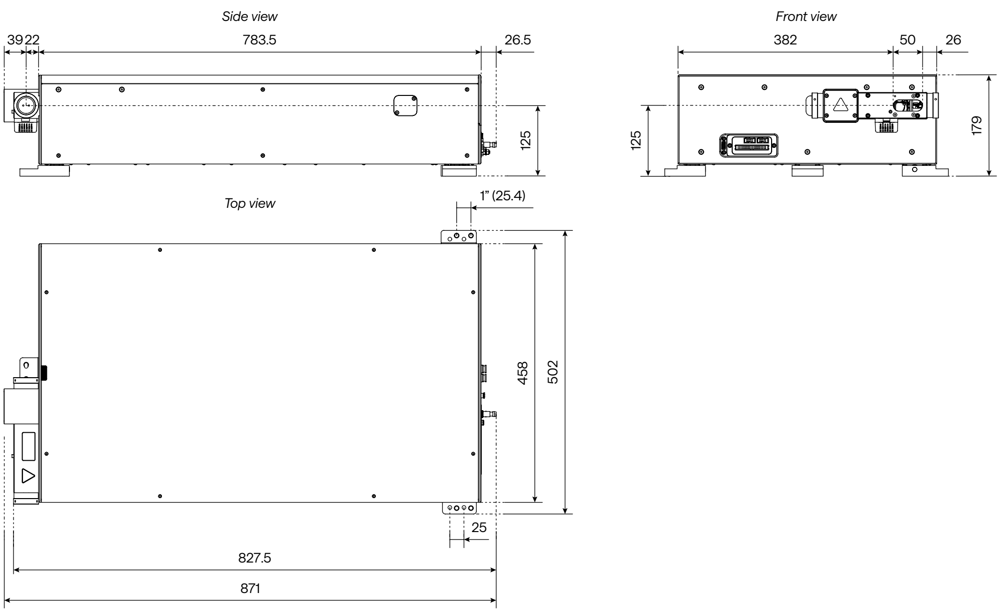
Refer to www.lightcon.com

1) *Collinear mode is achieved with an additional external separator box. Dispersion compensation is optional.*
2) *Specified as a percentage of pump power.*
3) *Full width at half maximum (FWHM).*
4) *Expressed as normalized root mean squared deviation (NRMSD).*
5) *Not tunable, optimized for best overall performance. Not simultaneous to OPA output.*
6) *Not available in collinear-output configuration.*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

Drawings

ORPHEUS-MIR

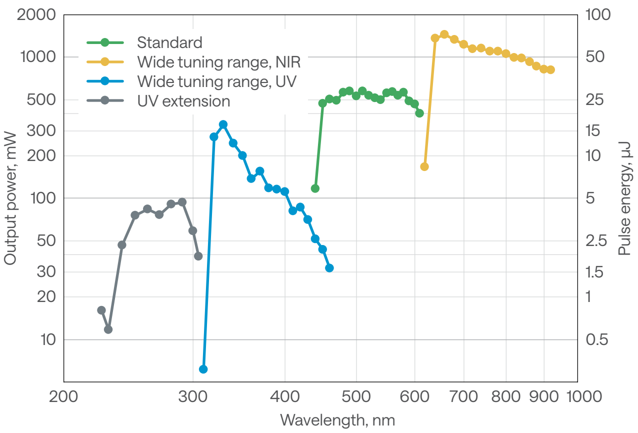


ORPHEUS | VIS

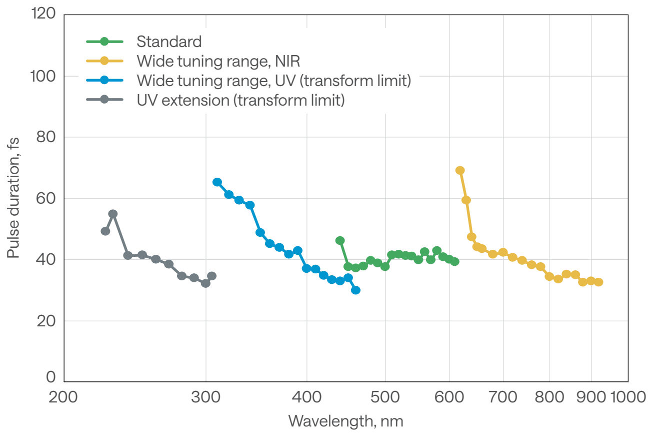
Ultrashort-Pulse VIS Optical Parametric Amplifier

- Ultrashort UV – VIS – NIR pulses
- < 50 fs pulse duration at 500 nm
- Up to 100 kHz repetition rate
- Up to 20 W, 1 mJ pump
- Optional UV extension down to 250 nm

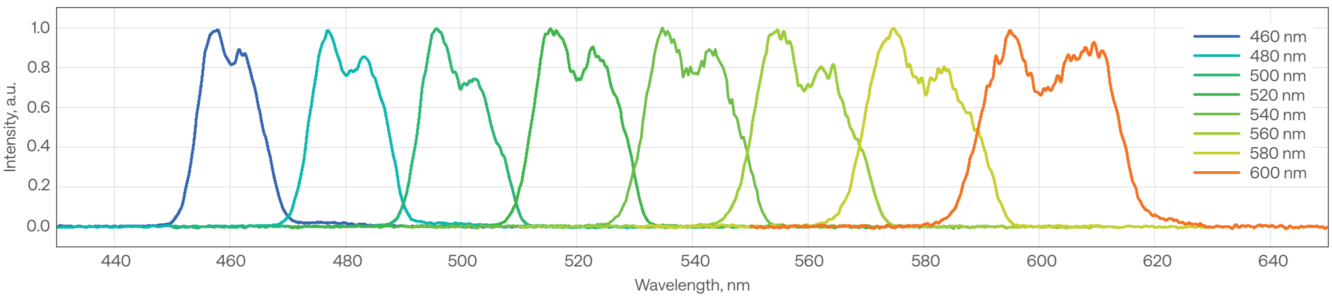
ORPHEUS-VIS tuning curves
Pump: 20 W, 1 mJ



ORPHEUS-VIS typical pulse duration



ORPHEUS-VIS standard configuration's typical spectra set



Specifications

MAIN OUTPUT

Configuration	Standard	Wide tuning range
Tuning range	450 – 600 nm	320 – 900 nm
Maximum pump power	20 W	
Pump pulse energy	200 – 1000 µJ	
Conversion efficiency [1]	> 1.5 % @ 500 nm	> 1.5% @ 500 nm > 5.0% @ 660 nm > 0.5% @ 350 nm
Pulse duration	< 50 fs @ 500 – 600 nm	< 50 fs @ 500 – 600 nm < 55 fs @ 800 – 900 nm < 70 fs @ 650 – 800 nm
Spectral bandwidth [2]	200 – 700 cm^{-1}	
Long-term power stability, 8 h [3]	< 2% @ 500 nm	

OPTIONAL EXTENSION (UV)

Tuning range	250 – 300 nm
Conversion efficiency [1]	> 0.15% @ 280 nm
Spectral bandwidth [2]	200 – 600 cm^{-1}

PUMP LASER REQUIREMENTS

Pump laser	PHAROS or CARBIDE
Center wavelength	1030 ± 10 nm
Maximum pump power	20 W
Maximum repetition rate	100 kHz
Pump pulse energy	200 – 1000 µJ
Pump pulse duration [4]	200 – 350 fs

ENVIRONMENTAL & UTILITY REQUIREMENTS

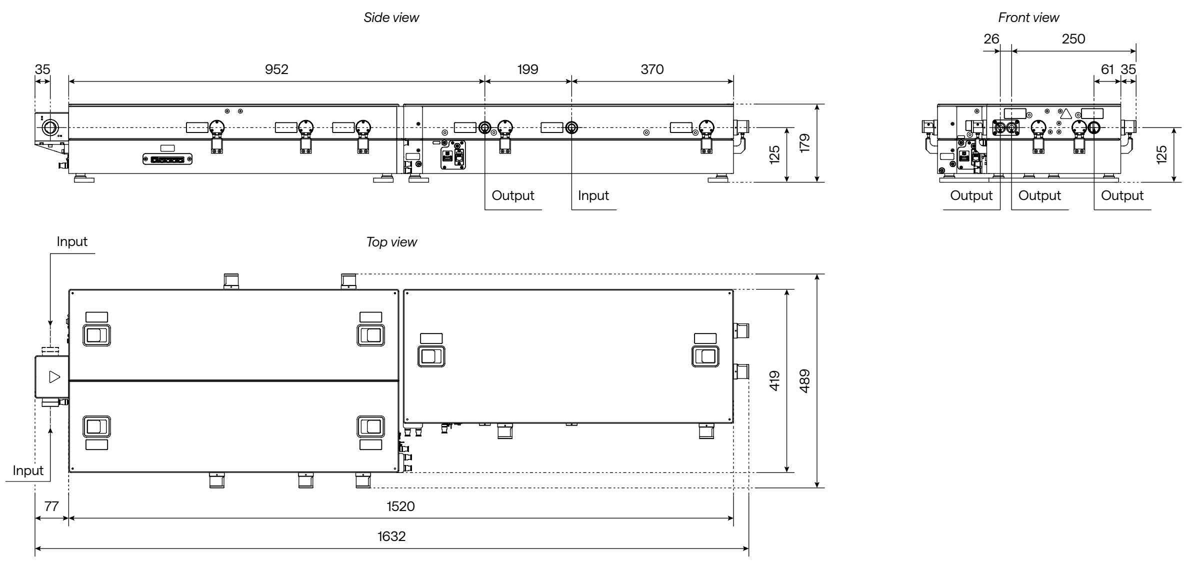
Operating temperature [5]	19 – 25 °C (air conditioning recommended)
Relative humidity [5]	20 – 70% (non-condensing)
Electrical requirements	100 – 240 V AC, 1.4 A; 50 – 60 Hz
Rated power	120 W
Power consumption	Standby: 10 W Max during wavelength tuning: 100 W

1) *Specified as a percentage of pump power.*
2) *Full width at half maximum (FWHM).*
3) *Expressed as normalized root mean squared deviation (NRMSD).*
4) *FWHM, assuming a Gaussian pulse shape.*
5) *Specifications are guaranteed for a maximum temperature variation of ± 1 °C and humidity variation of ± 10%.*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

Drawings

ORPHEUS-VIS

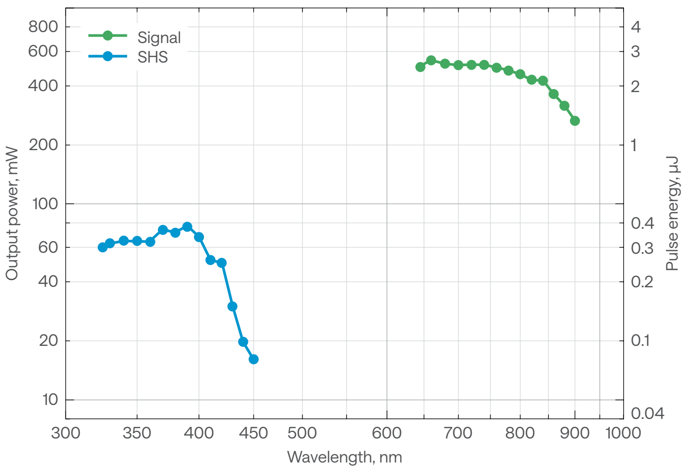


ORPHEUS | N

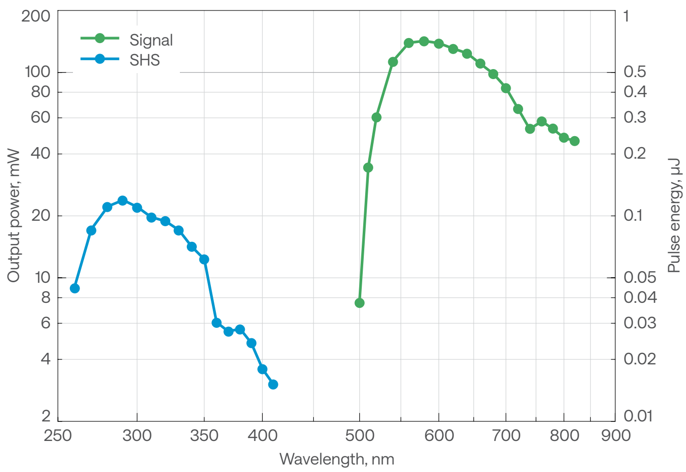
Non-Collinear Optical Parametric Amplifier

- NOPA for the shortest tunable pulses
- Pulse duration down to < 30 fs
- Integrated prism compressor
- Adjustable spectral bandwidth and pulse duration
- Wavelength feedback with an internal spectrometer

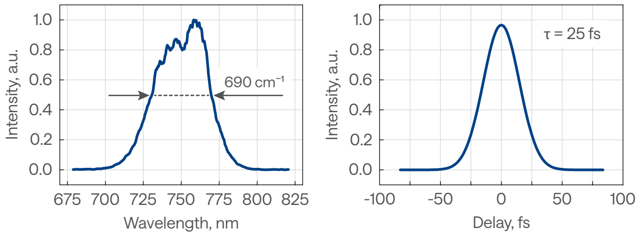
ORPHEUS-N-2H typical tuning curves
Pump: 6 W, 30 μJ, 200 kHz



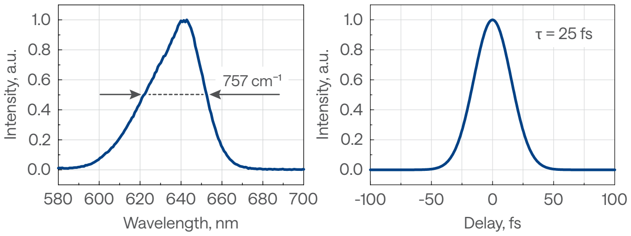
ORPHEUS-N-3H typical tuning curves
Pump: 6 W, 30 μJ, 200 kHz



ORPHEUS-N-2H typical output



ORPHEUS-N-3H typical output



Specifications

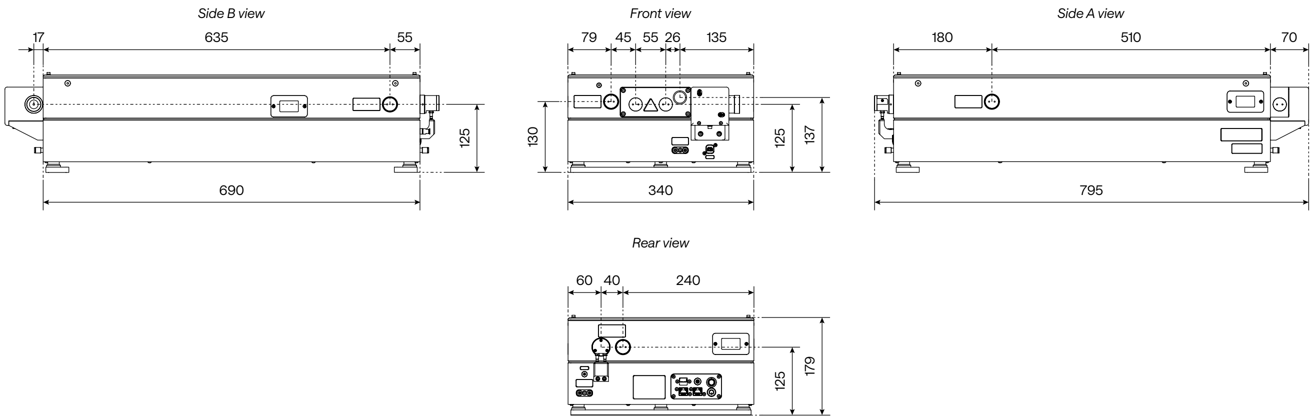
Model	ORPHEUS-N-2H	ORPHEUS-N-3H
MAIN OUTPUT		
Tuning range	650 – 900 nm (signal)	520 – 900 nm (signal)
Maximum pump power	8 W	
Pump pulse energy	10 – 200 μJ	12 – 200 μJ
Conversion efficiency	> 7% @ 700 nm > 5% @ 800 nm	> 1.3% @ 580 nm > 0.7% @ 700 nm > 0.3% @ 800 nm
Integrated 2H / 3H generation efficiency [1]	> 35% (515 nm)	> 25% (343 nm)
Pulse duration after compressor	< 30 fs @ 700 – 850 nm	< 30 fs @ 540 – 660 nm < 70 fs @ 660 – 800 nm
Long-term power stability, 8 h [2]	< 2% @ 800 nm	< 2% @ 580 nm
Pulse-to-pulse energy stability, 1 min [2]	< 2% @ 800 nm	< 2% @ 580 nm
WAVELENGTH EXTENSIONS		
Tuning range (SHS)	325 – 450 nm	260 – 450 nm
Conversion efficiency	> 0.7% @ 350 nm	> 0.15% @ 290 nm
PUMP LASER REQUIREMENTS		
Pump laser	PHAROS or CARBIDE	
Center wavelength	1030 ± 10 nm	
Maximum pump power	8 W	
Repetition rate	Single-shot – 800 kHz	Single-shot – 600 kHz
Pump pulse energy	10 – 200 μJ	12 – 200 μJ
Pump pulse duration [3]	180 – 500 fs	
ENVIRONMENTAL & UTILITY REQUIREMENTS		
Operating temperature [4]	19 – 25 °C (air conditioning recommended)	
Relative humidity [4]	20 – 70% (non-condensing)	
Electrical requirements	100 – 240 V AC, 1.4 A; 50 – 60 Hz	
Rated power	120 W	
Power consumption	Standby: 10 W Max during wavelength tuning: 100 W	
Purging requirements	Nitrogen purge – optional	Nitrogen purge – required, 1 – 3 liters per minute

1) *Not simultaneous to NOPA output.*
2) *Expressed as normalized root mean squared deviation (NRMSD).*
3) *Full width at half maximum (FWHM), assuming a Gaussian pulse shape.*
4) *Specifications are guaranteed for a maximum temperature variation of ± 1 °C and humidity variation of ± 10%.*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

Drawings

ORPHEUS-N



ORPHEUS | TWINS

Dual Optical Parametric Amplifier

- Two simultaneous independently tunable outputs
- 210 – 16 000 nm tuning range
- Single-shot – 2 MHz repetition rate
- Up to 60 W, 0.5 mJ pump
- CEP-stable option

Specifications

MAIN OUTPUT

Tuning range	Choice between ORPHEUS, ORPHEUS-F, and ORPHEUS-ONE configurations
Output pulse energy	Depends on the configuration, see the specifications of the chosen models
Spectral bandwidth	Depends on the configuration, 100 – 750 cm^{-1}
Pulse duration	Depends on the configuration, down to < 50 fs
Repetition rate	Single-shot – 2 MHz

PUMP LASER REQUIREMENTS

Pump laser	PHAROS or CARBIDE
Center wavelength	1030 ± 10 nm
Maximum pump power	60 W
Repetition rate	Single-shot – 2 MHz
Pump pulse energy	16 – 500 µJ
Pump pulse duration [1]	180 – 300 fs

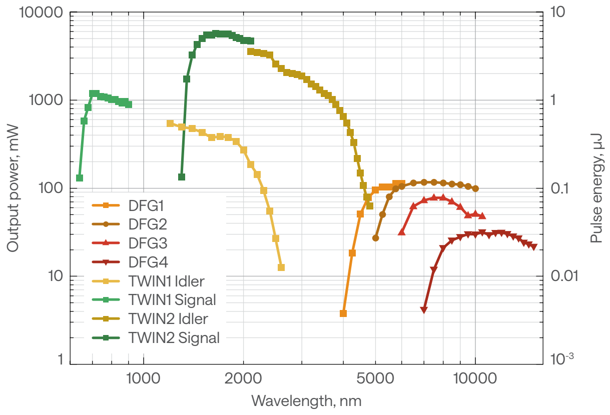
ENVIRONMENTAL & UTILITY REQUIREMENTS

Operating temperature [2]	19 – 25 °C (air conditioning recommended)
Relative humidity [2]	20 – 70% (non-condensing)
Electrical requirements	100 – 240 V AC, 4.5 A; 50 – 60 Hz
Rated power	280 W
Power consumption	Standby: 20 W Max during wavelength tuning: 200 W

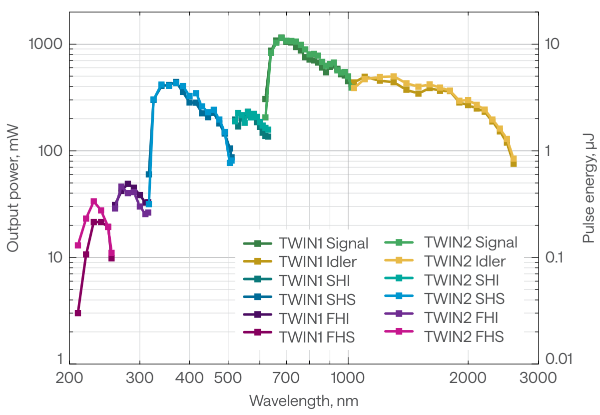
[1] *Full width at half maximum (FWHM), assuming a Gaussian pulse shape.*
[2] *Specifications are guaranteed for a maximum temperature variation of ± 1 °C and humidity variation of ± 10%.*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

ORPHEUS-TWINS (-ONE/-F configuration) tuning curves
Pump: 40 W, 40 μJ, 1000 kHz



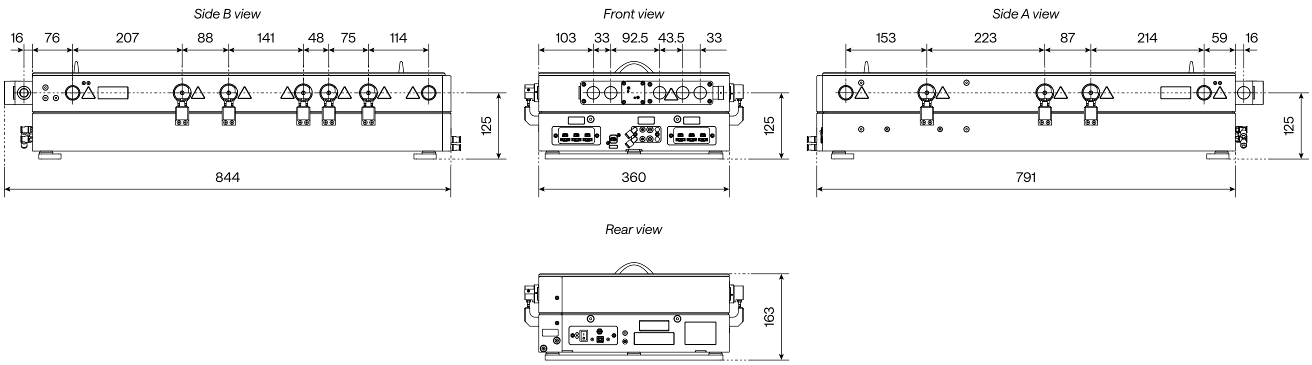
ORPHEUS-TWINS (ORPHEUS / ORPHEUS configuration) tuning curves
Pump: 20 W, 20 μJ, 100 kHz



Optics Toolbox

Drawings

ORPHEUS-TWINS

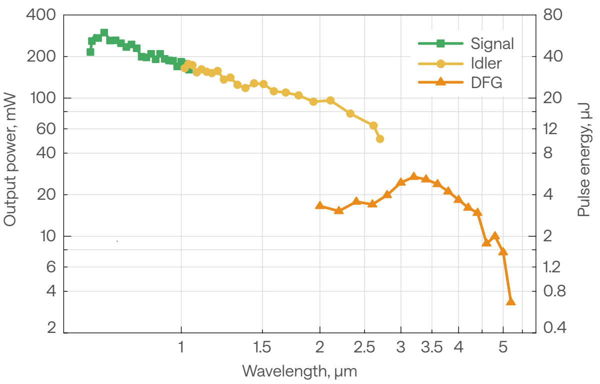


ORPHEUS | PS

Narrow-Bandwidth Optical Parametric Amplifier

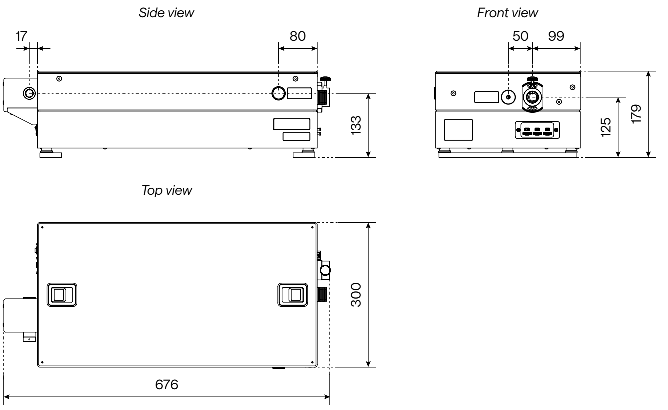
- Picosecond pulses from a femtosecond pump
- 210 – 4800 nm tuning range
- 800 fs – 3 ps pulse duration
- < 20 cm^{-1} spectral bandwidth
- Up to 100 kHz repetition rate
- High output stability

ORPHEUS-PS tuning curves
Pump: 5 W, 1000 μJ, 5 kHz from **PHAROS-20W-SP**

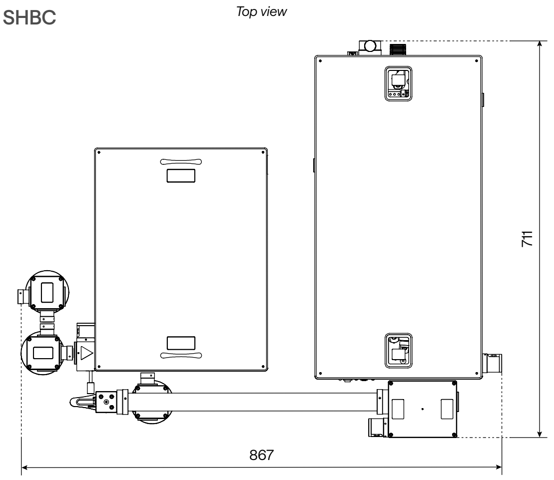


Drawings

ORPHEUS-PS



ORPHEUS-PS with **SHBC**



Specifications

MAIN OUTPUT

Tuning range [1]	640 – 1000 nm (signal) 1060 – 2600 nm (idler)
Conversion efficiency	> 6% @ 700 nm
Pulse duration	800 fs – 3 ps
Spectral bandwidth	< 20 cm^{-1} @ 800 nm
Pulse-to-pulse energy stability [2]	< 2% @ 800 nm

AUXILIARY OUTPUT 1 (515 nm)

Center wavelength [3]	515 nm ± 5 nm
Generation efficiency [4]	> 15%

AUXILIARY OUTPUT 2 (1030 nm)

Center wavelength [5]	1030 ± 10 nm
Pulse duration	< 300 fs
Pulse energy	> 5 µJ

WAVELENGTH EXTENSION

SH package 320 – 500 nm (SHS), 530 – 640 nm (SHI)	> 3% @ 350 nm
FH package 210 – 250 nm (FHS), 265 – 320 nm (FHI)	> 0.3% @ 230 nm
2400 – 4800 nm (DFG)	> 0.25% @ 3200 nm [6]
4500 – 1600 nm (DFG3)	Available, contact sales@lightcon.com

PUMP LASER REQUIREMENTS

Pump laser [7]	PHAROS or CARBIDE with uncompressed output option [8]
Center wavelength	1030 ± 10 nm
Repetition rate	Single-shot – 100 kHz
Maximum pump power	20 W
Pump pulse energy	100 µJ – 3.2 mJ

ENVIRONMENTAL & UTILITY REQUIREMENTS

Operating temperature [9]	19 – 25 °C (air conditioning recommended)
Relative humidity [9]	20 – 70% (non-condensing)
Electrical requirements	100 – 240 V AC, 1.4 A; 50 – 60 Hz
Rated power	120 W
Power consumption	Standby: 10 W Max during wavelength tuning: 100 W

1) *For a single wavelength (515 nm) picosecond output, refer to SHBC.*
2) *Expressed as normalized root mean squared deviation (NRMSD)*
3) *Direct SHBC output, not simultaneous to OPA; see more details in SHBC specifications.*
4) *Specified as a percentage of pump pulse energy.*
5) *Compressed pump output.*
6) *For > 200 µJ pump pulse energy.*
7) *The pump laser is first paired with the SHBC module, then the SHBC output is used to pump the OPA. The parameter requirements are for the pump laser.*
8) *Not compatible with PHAROS-PH2-UP.*
9) *Specifications are guaranteed for a maximum temperature variation of ± 1 °C and humidity variation of ± 10%.*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

TOPAS

Optical Parametric Amplifiers for Ti:Sapphire Lasers

- Tuning range 1160 – 2600 nm, extendable to 189 nm – 20 µm
- Conversion efficiency of > 25%
- Wavelength extensions and high-energy upgrades
- Nearly bandwidth- and diffraction-limited output
- CEP stabilization of idler, 1600–2600 nm
- High output stability

Comparison table

Product [1]	Pump pulse energy	Pump pulse duration	Tuning range	Extended tuning range	Output pulse duration	Upgrades	Features
TOPAS-PRIME	0.15 – 6 mJ [2]					HE-STAGE	Motorized wavelength control, hands-free operation
TOPAS-PRIME-HE	2 – 60 mJ [2]		1160 – 2600 nm	189 nm – 20 µm	30 – 150 fs	n/a	High energy, high conversion efficiency
TOPAS-TWINS [3]	0.3 – 6 mJ [2]	20 – 200 fs				HE-STAGE	Two independently tunable CEP- stable outputs
SHBC	0.3 – 5 mJ		≈ 400 nm	240 nm –2.4 µm	1 – 5 ps	TOPAS-SHBC-400	
TOPAS-SHBC-400	0.2 – 2.5 mJ		480 – 2400 nm			n/a	Narrow bandwidth, picosecond output, generated from broadband femtosecond pump pulses
TOPAS-PS-800	0.2 – 5 mJ	1 – 2 ps	1160 – 2600 nm	240 nm – 20 µm	0.7 – 2 ps	HE-STAGE	

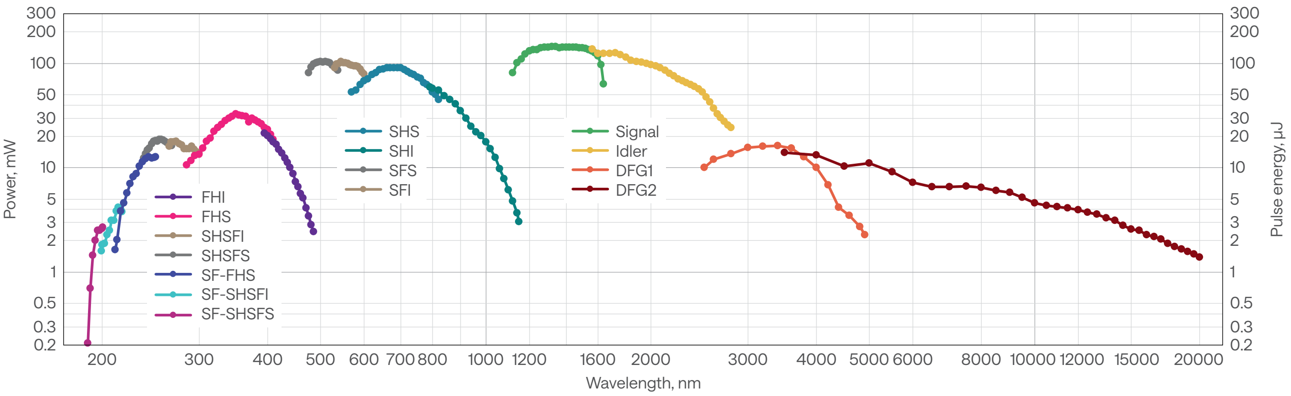
[1] *Custom solutions are available, contact sales@lightcon.com for more details.*

[2] *Maximum pump pulse energy depends on pump pulse duration.*

[3] *TWINS consists of two OPAs, seeded by the same white light source. Specifications and upgrades are applicable for each output.*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

TOPAS-PRIME tuning curves. Pump: 1 mJ, 100 fs, 800 nm



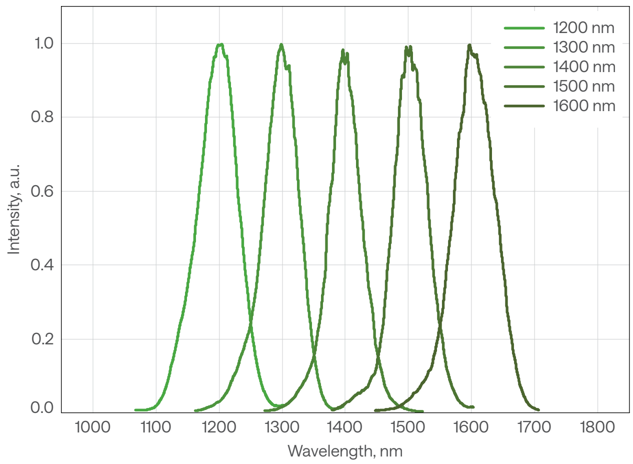
Wavelength extensions and upgrades

Product	Tuning range	Features
HE-STAGE	1160 – 2600 nm	High-energy upgrade for TOPAS-PRIME, TOPAS-TWINS, or TOPAS-PS-800 for 4 – 60 mJ pump
NIRUVIS	240 – 2600 nm	Motorized wavelength tuning, single housing
NIRUVIS-DUV-HE	189 – 2600 nm	High-energy version, broadest tuning range, motorized wavelength tuning, single housing
NIRUVIS-DUV	189 – 2600 nm	Broadest tuning range, motorized wavelength tuning, single housing
NIRUVIS-MW	240 – 2600 nm	Fully automated version, the same output port for the entire wavelength range, motorized wavelength tuning, single housing
NDFG	2600 nm – 20 μm	Noncolinear generator for background-free mid-IR pulses
External crystal stages	240 nm – 20 μm	Cost-efficient separate crystal stages (1, 2, or 3, depending on the tuning range)
SIG-SIG NDFG	4500 nm – 16 μm	Noncolinear generator for CEP-stable mid-IR pulses used with TOPAS-TWINS, CEP slow drift compensation-ready [1]

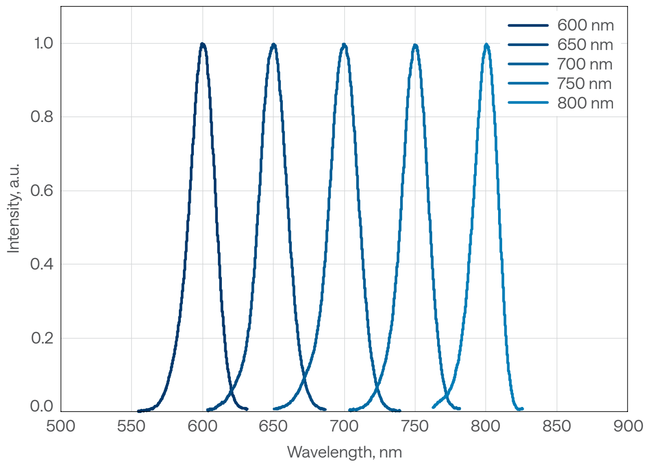
[1] *CEP slow drift is available upon request.*

Performance

TOPAS-PRIME typical signal spectra set



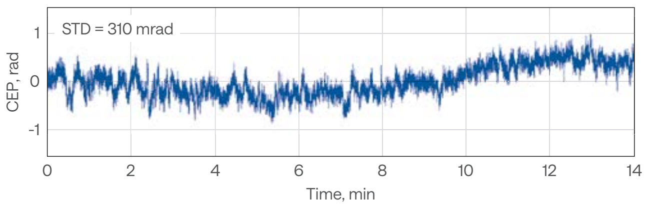
TOPAS-PRIME SHS typical signal spectra set



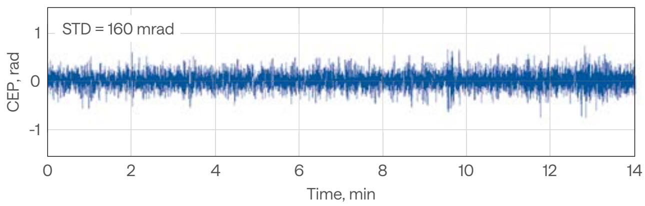
CEP stabilization of idler

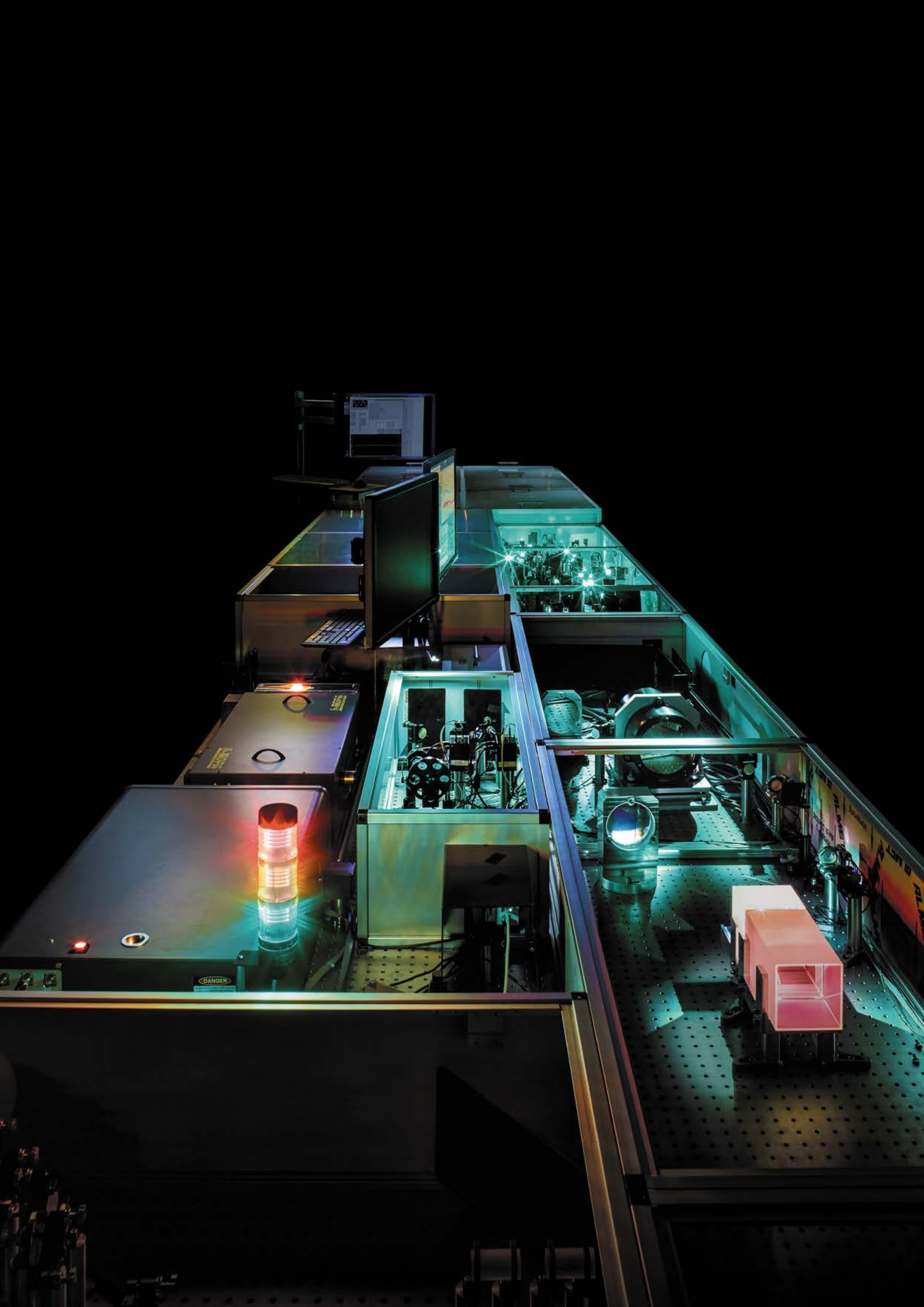
TOPAS idler (1600 – 2600 nm) is passively CEP locked due to a three-wave interaction. However, a slow CEP drift may persist because of changes in pump beam pointing or environmental conditions. Such a drift can be compensated by employing an f-2f interferometer and a feedback loop controlling the temporal delay between the seed and pump in the power amplification stage of **TOPAS-PRIME** and **TOPAS-PRIME-HE**.

CEP stability of idler over 14 min
(a) without drift compensation



(b) with drift compensation with a slow loop




DANGER

OPCPA Systems

Optical parametric chirped-pulse amplification is currently the only laser technology that can simultaneously provide high peak and average power with a few-cycle pulse duration, required for the most demanding scientific applications.

ORPHEUS | OPCPA	Delivers few-cycle, high-contrast, CEP-stable pulses at a chosen wavelength within the 800 – 2000 nm range in a package as compact as our standard parametric amplifiers.
OPCPA | HE	High-energy OPCPA systems scalable to multi-TW peak powers at kHz repetition rates maintain few-cycle pulse durations, meeting the most demanding requirements with stability and reliability unprecedented for systems of this scale.

From tabletop systems to extreme light infrastructures

High peak and average power with few-cycle pulse durations

State-of-the-art CEP and pulse energy stability

ORPHEUS | OPCPA

Compact, Few-Cycle, CEP-Stable OPCPA Systems

- Few-cycle pulses in a compact footprint
- Industrial-grade pump: up to 480 W, 20 mJ
- High repetition rate, up to MHz
- High-contrast variable-bandwidth seed source for CPA and OPCPA systems
- CEP stabilization option

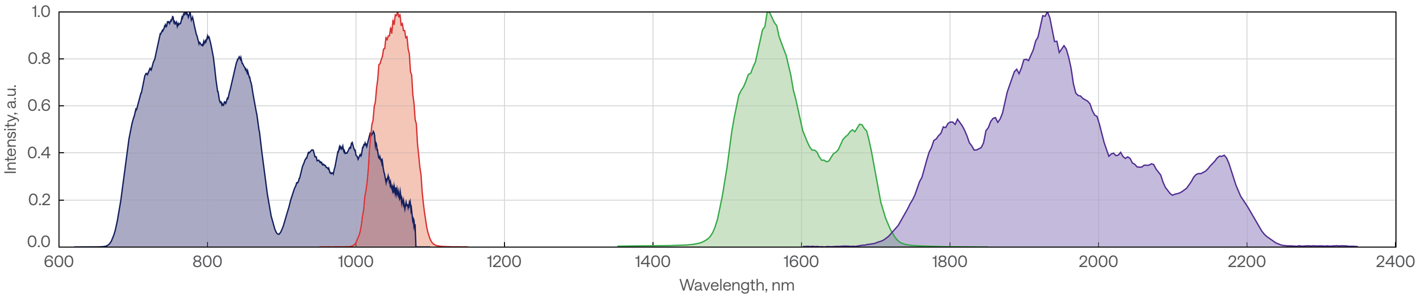
Specifications

		NEW		
Center wavelength (other wavelengths are available) [1]	800 nm	1050 nm	1600 nm	2000 nm
Pump source	PHAROS / CARBIDE			
Pump power	20 – 480 W			
Pump pulse energy	0.2 – 20 mJ			
Repetition rate	1 kHz – 1 MHz			
Conversion efficiency [1]	> 7%	> 6%	> 10%	> 9%
Pulse duration [1)2)]	< 10 fs / < 15 fs	< 40 fs / < 300 fs	< 40 fs	< 25 fs
CEP stability, 1 h [1)3)]	< 250 mrad			
Temporal contrast	$\geq 10^{10}$: 1 from −500 to −50 ps; $\geq 10^{9}$: 1, from −50 to −15 ps; $\geq 10^{6}$: 1, from −15 to −5 ps;		n/a [4]	
Long-term power stability, 8 h [1)5)]	< 1.5%			
Pulse-to-pulse energy stability, 1 min [1)5)]	< 1%			

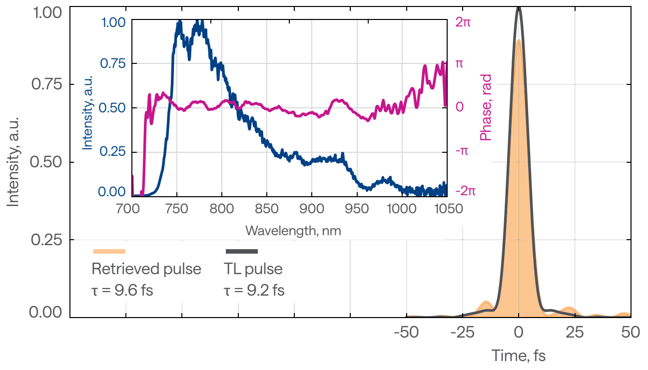
[1] *Typical values. For custom inquiries, contact sales@lightcon.com.*
[2] *Uncompressed pulses available for seeding larger amplifiers.*
[3] *CEP values calculated from unaveraged, single-shot measurements.*
[4] *Although the pulse contrast is not quantified, the identical OPA architecture is already validated at 800 nm and 1050 nm.*
[5] *Expressed as normalized root mean squared deviation (NRMSD).*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

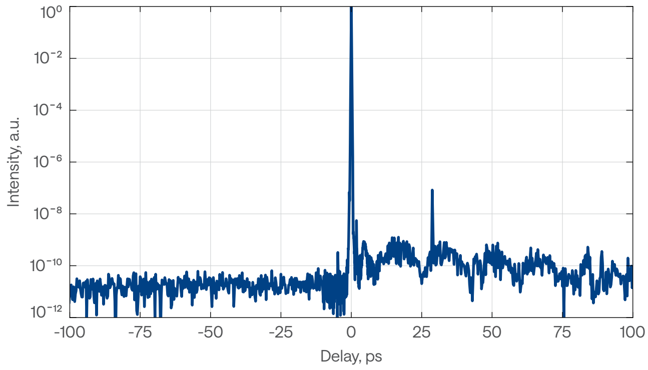
ORPHEUS-OPCPA example spectra of four models



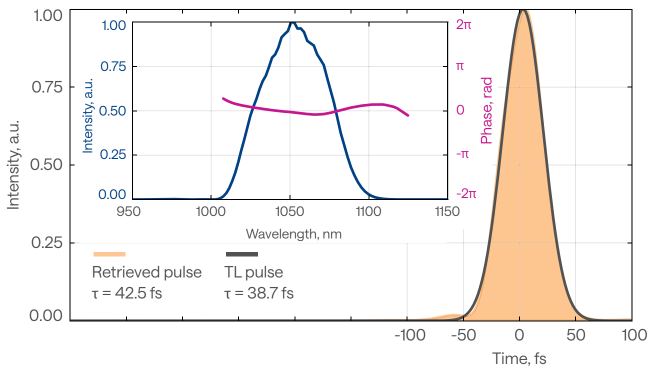
ORPHEUS-OPCPA temporal pulse profile at 800 nm



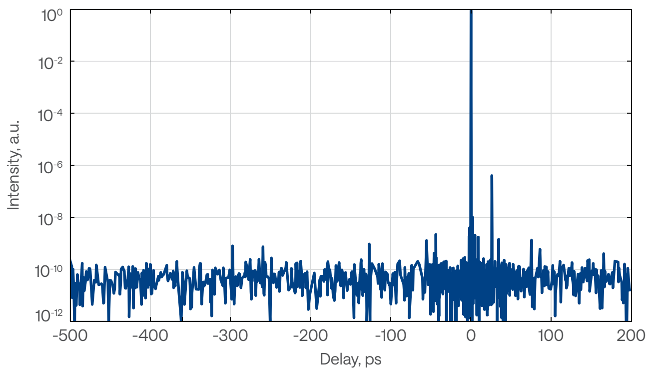
ORPHEUS-OPCPA high-dynamic-range third order autocorrelation measurement system at 800 nm



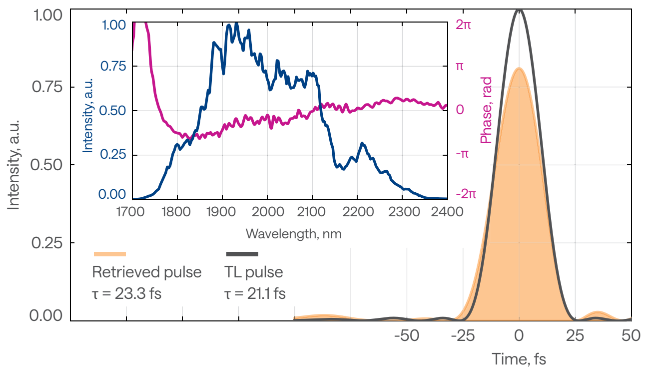
ORPHEUS-OPCPA temporal pulse profile at 1050 nm



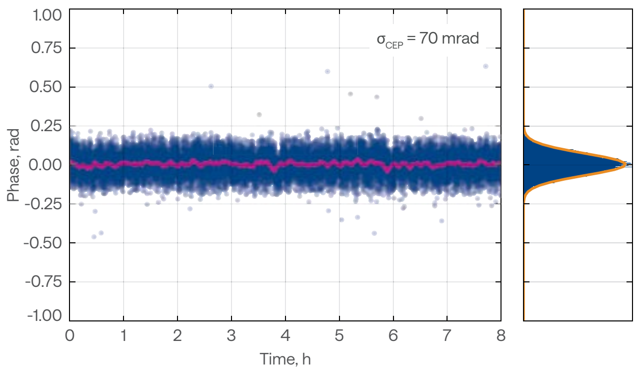
ORPHEUS-OPCPA pulse contrast measurement at 1050 nm



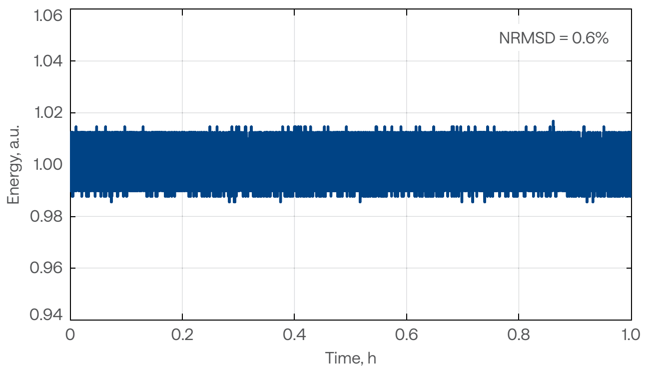
ORPHEUS-OPCPA temporal pulse profile at 2 µm



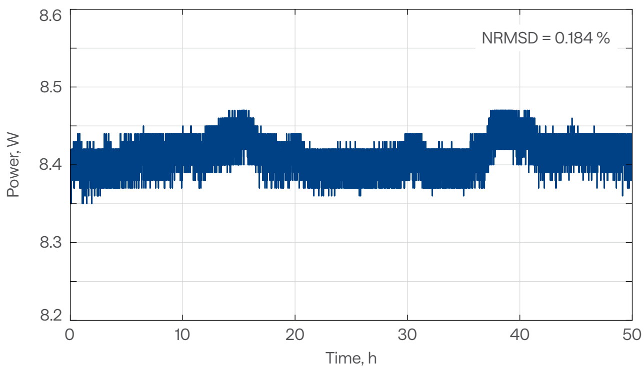
ORPHEUS-OPCPA CEP stability at 2 µm



ORPHEUS-OPCPA pulse-to-pulse energy stability at 2 µm



ORPHEUS-OPCPA long-term output stability at 2 µm



High-Energy OPCPA Systems

Multi-TW peak-power pulses at up to 1 kHz	800 nm, 1600 nm, or 2000 nm output	Few-cycle pulse duration and high pre-pulse contrast
Dual output option	Exceptional CEP and pulse energy stability	Spectral-temporal pulse shaping options

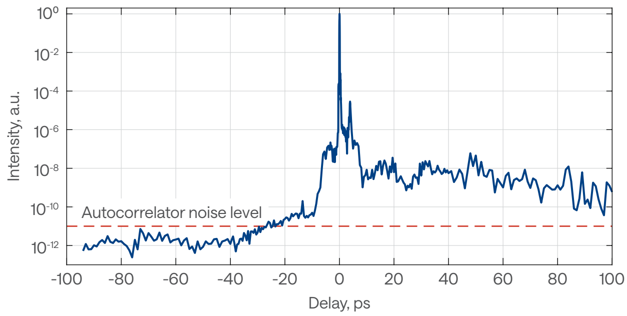
Specifications

Center wavelength	800 nm	1600 nm	2000 nm
Pump source	Picosecond Nd:YAG lasers, seeded by ORPHEUS-OPCPA		
Repetition rate	10 Hz – 1 kHz		
Maximum output pulse energy [1]	250 mJ	100 mJ	50 mJ
Pulse duration [1]	< 9 fs	< 50 fs	< 30 fs
CEP stability, 1 h [1][2]	< 250 mrad		
Long-term power stability, 8 h [1][3]	< 1.5%		
Pulse-to-pulse energy stability, 1 min [1][3]	< 1.5%		

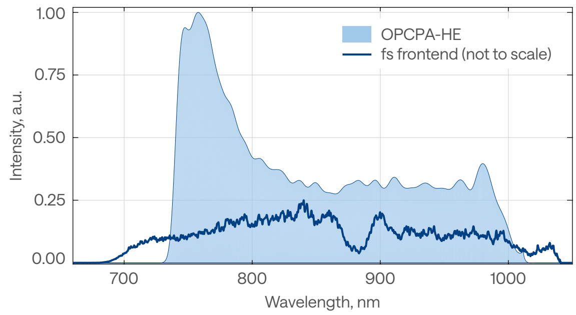
[1] *Typical values. For custom inquiries, contact sales@lightcon.com.*
[2] *CEP values calculated from unaveraged, single-shot measurements.*
[3] *Expressed as as normalized root mean squared deviation (NRMSD).*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

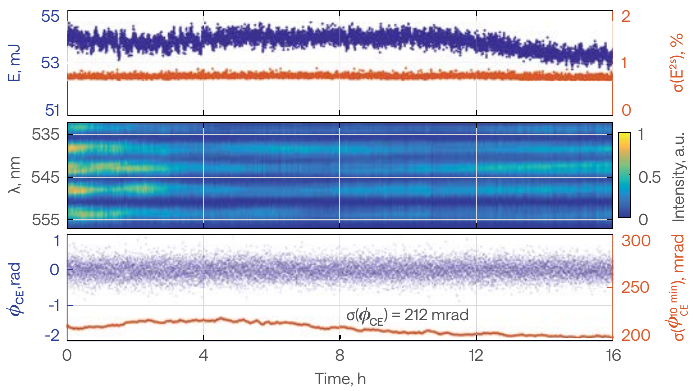
OPCPA-HE system high-dynamic-range third order autocorrelation measurement



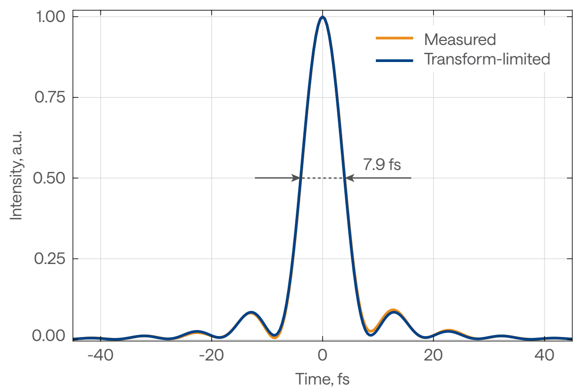
OPCPA-HE output spectrum



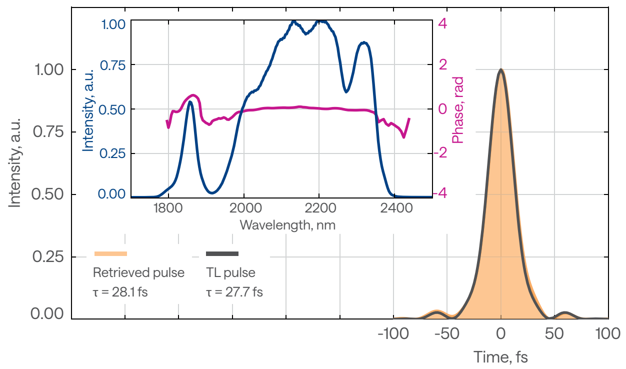
OPCPA-HE pulse energy, f-2f interferogram and CEP stability measured over 16 h



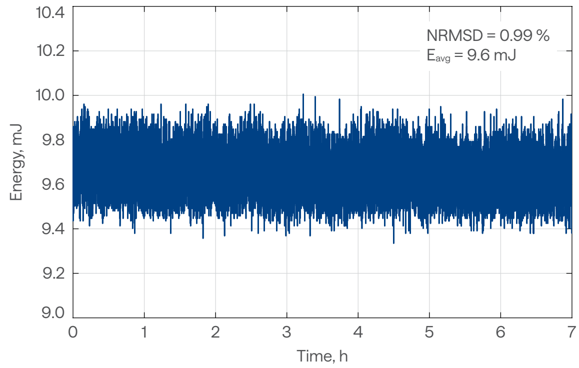
OPCPA-HE output pulses' temporal profile measured with a self-referenced spectral interferometry device

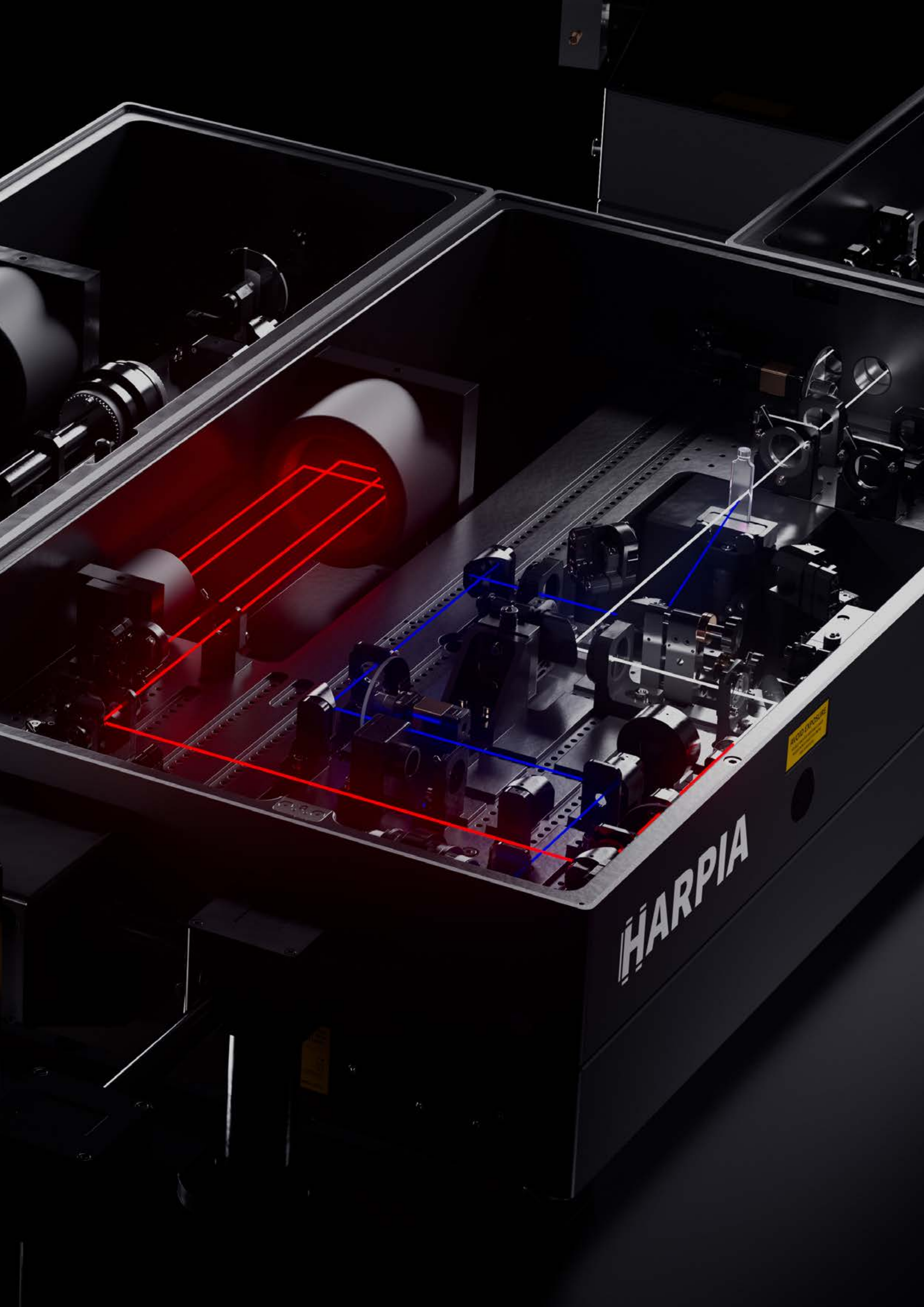


OPCPA-HE output pulses' temporal profile at 2 µm



OPCPA-HE pulse-to-pulse energy stability at 2 µm




HARPIA

Spectroscopy Systems

HARPIA ultrafast spectrometers perform a variety of sophisticated time-resolved measurements within a compact footprint. With an intuitive user experience and easy day-to-day operation, they meet the demands of modern scientific applications.

HARPIA | TA

The system, built around the transient absorption spectrometer, can be expanded with additional modules, including time-correlated single-photon counting, Kerr gate and fluorescence upconversion, and third beam delivery.

HARPIA | LIGHT NEW

The transient absorption spectroscopy system, classified as a Class 1 laser product, combines accessibility, versatility, and unparalleled performance in a compact, single-box design.

Complete single-supplier solutions for sophisticated measurements

Compact and robust systems, powered by industrial-grade lasers

High-level automation and software control

HARPIA | TA

Ultrafast Spectroscopy System

Layout example

- Excellent performance at high repetition rates
- Measurement range from UV to MIR
- Market-leading sensitivity
- Modules for time-resolved, and multi-pulse experiments
- High-level automation in a compact footprint

Specifications

Configuration	UV-VIS	UV-VIS-NIR	MIR
Probe spectral range	350 – 1100 nm [1]	350 – 1600 nm [1]	2000 – 13 000 nm [2]
Pump range	240 – 2200 nm [2]		450 – 2200 nm [3]
Delay range (resolution)	8 ns (8.3 fs)		4 ns (4.2 fs)
Temporal resolution	≤ laser pulse duration or better		
Laser repetition rate	1 – 100 kHz		
Maximum data acquisition rate	3850 Hz		100 kHz
Modes	Reflection and transmission		

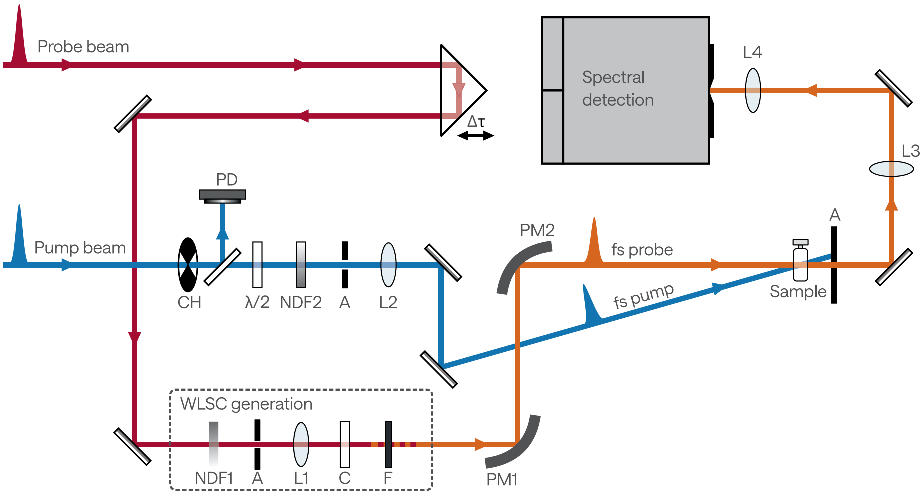
[1] *Pump-probe measurements using Yb-based laser systems may exhibit blind spots at 515 nm and 1030 nm, corresponding to the second harmonic and fundamental wavelength of the laser, where strong pump scattering can interfere with accurate detection.*

[2] *The range is determined by the OPA's output spectrum.*

[3] *The wavelength range is configurable to 240 – 700 nm. Contact sales@lightcon.com for more details.*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

HARPIA-TA optical layout for pump-probe experiments



A – aperture
C – crystal
CH – chopper
F – filter
L – lens
PD – photodiode
PM – parabolic mirror
NDF – neutral density filter
WLSC – white light supercontinuum
Δτ – delay
λ/2 – half-wave plate

HARPIA | TF Time-Resolved Fluorescence Module

Time-resolved fluorescence spectroscopy provides valuable insights into molecular processes occurring in the excited states. The **HARPIA-TF** module combines different measurement modes, enabling the observation of fluorescence dynamics across different time scales. By employing high-repetition-rate **PHAROS** or **CARBIDE** lasers, fluorescence dynamics can be measured while exciting the samples with pulse energies as low as several nanojoules.

Kerr gate

Ideal for femtosecond fluorescence measurements. Simpler alignment and maintenance. The entire spectrum is measured at once.

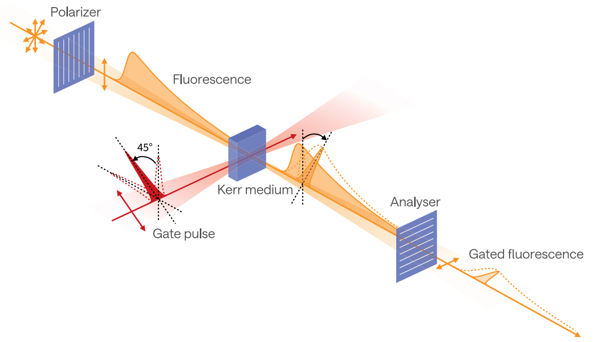
Fluorescence upconversion (FU)

Better temporal resolution for measuring fast fluorescence events.

Time-correlated single-photon counting (TCSPC)

Fluorescence lifetime measurements are extendible to measure phosphorescence signals.

Principle of Kerr gate spectroscopy



Specifications

Module	HARPIA-TF		
Measurement technique	Kerr gate	Fluorescence upconversion	TCSPC
Spectral range	380 – 1000 nm	330 – 820 nm [1) 2)]	220 – 820 nm [3)]
Pump range	240 – 2200 nm [4)]		
Temporal resolution	≥ 1 ps	≤ 1.4 x laser pulse duration	< 180 ps or < 50 ps
Delay range (resolution)	8 ns (8.3 fs)		5 μs [5)]
Compatible with	TCSPC		Kerr gate or fluorescence upconversion
Detector	CCD	PMT	
Modes	Transmission		Reflection and transmission

1) *The fluorescence detection range is extendable up to 1600 nm. Contact sales@lightcon.com for more details.*

2) *Fluorescence detection may exhibit blind spots at 343 nm, 515 nm, and 1030 nm due to harmonic overlap.*

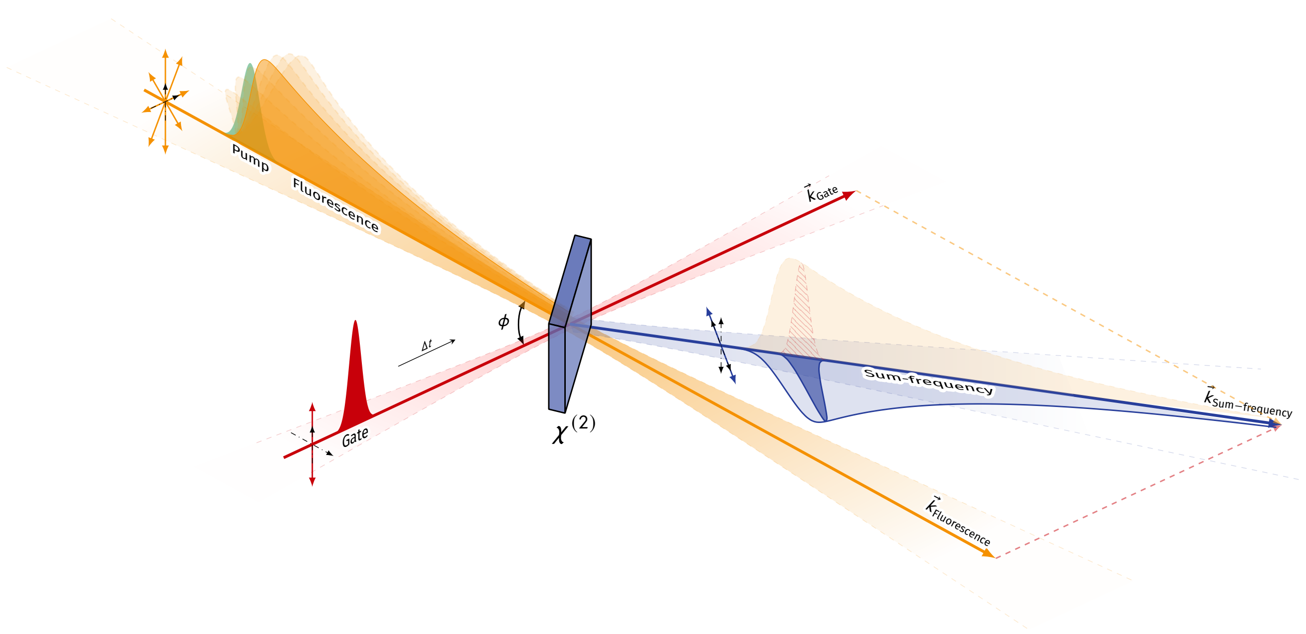
3) *The spectral range is extendable with an additional NIR detector (measurement range 1000 – 1700 nm). Contact sales@lightcon.com for more details.*

4) *The range is determined by the OPA's output spectrum.*

5) *Using FIFO-based acquisition, the temporal window can be extended up to ~1 s for monitoring longer-timescale processes.*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

Principle of fluorescence upconversion measurements



HARPIA | TA-FP Flash Photolysis – Nanosecond TA Module

The flash photolysis experiment is designed to measure the long-lived states of molecular systems. Its principle is analogous to the femtosecond transient absorption (TA) experiment but with a delay in the nanosecond to millisecond range.

In femtosecond transient absorption, the delay between pump and probe pulses is controlled by moving a mechanical delay stage. In contrast, flash photolysis employs a delayed probe pulse generated by an electronically triggered external probe laser – a broadband nanosecond photonic crystal fiber (PCF) laser.

Specifications

Module	HARPIA-TA-FP		HARPIA-TA-FP-UV	
HARPIA-TA configuration	UV-VIS	UV-VIS-NIR	UV-VIS	UV-VIS-NIR
Probe spectral range [1]	450 – 1100 nm	450 – 1600 nm	350 – 1100 nm	350 – 1600 nm
Pump range	240 – 2200 nm [2]			
Delay range	up to 485 μs [3]			
Temporal resolution	2 ns		1 ns	
Probe laser repetition rate	1850 Hz			
Maximum data acquisition rate	3850 Hz			
Modes	Reflection and transmission			

[1] *Pump–probe measurements using nanosecond laser systems may exhibit blind spots at 1064 nm, corresponding to the fundamental wavelength of the laser.*

[2] *The range is determined by the OPA's output spectrum.*

[3] *A longer delay range is possible with the HARPIA-TA-FP configuration (up to 8 ms). Contact sales@lightcon.com for more details.*

HARPIA | TB Third Beam Delivery Module

When standard spectroscopy tools are not enough to unravel the intricate ultrafast dynamics of photoactive systems, multi-pulse time-resolved spectroscopic techniques can be utilized to yield additional insight.

The **HARPIA-TB** module includes a Berek compensator for polarization control, a continuously variable neutral density filter for automated intensity control, and a delay line with a range of up to 4 ns.

Femtosecond stimulated Raman scattering (FSRS)

Delivering frequency-narrowed picosecond pulses enables FSRS measurements, a relatively recent yet increasingly adopted time-resolved spectroscopy technique for observing changes in the vibrational structure of optically excited molecular systems.

Multi-pulse time-resolved transient absorption

Enables control over photochemical reactions and access to higher excited states. Precisely timed pulse sequences can initiate a photoreaction and perturb it at defined moments during its evolution. In some cases, an additional pump pulse can re-excite molecules, with the delay between several pump pulses influencing the reaction's outcome.

Specifications

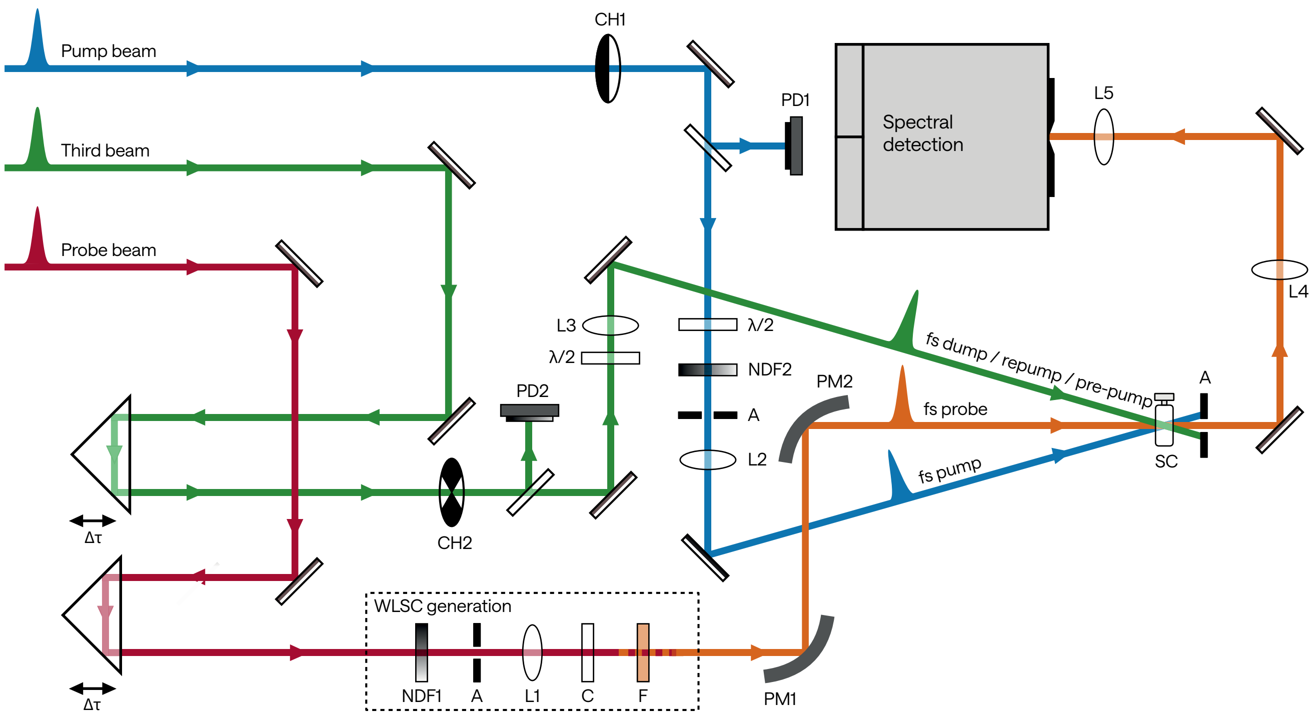
Module	HARPIA-TB	
Measurement technique	FSRS [1]	Pump for multi-pulse experiments
Probe spectral range	350 – 1100 nm [2]	Depends on the HARPIA-TA configuration
Raman spectral range	700 - 2000 cm^{-1}	-
Acceptable wavelength range	450 – 2200 nm [3]	
Delay range (resolution)	4 ns (4.2 fs)	
Modes	Transmission	

[1] *The results were obtained using a specific system configuration: a PHAROS femtosecond laser, an ORPHEUS-HE OPA, and an SHBC combined with an ORPHEUS-PS OPA. Measurements were performed at a 10 kHz repetition rate with a 540 nm actinic pump and a 450 nm Raman pump. β-carotene was used as the sample. Contact sales@lightcon.com for more details.*

[2] *The system may exhibit blind spots at 515 nm and 1030 nm, corresponding to the second harmonic and fundamental wavelength of the laser, where strong pump scattering can interfere with accurate detection.*

[3] *The wavelength range is configurable to 240 – 700 nm. Contact sales@lightcon.com for more details.*

HARPIA-TB optical layout for multi-pulse experiments.



A – aperture
C – crystal
CH – chopper
F – filter
L – lens
PD – photodiode
PM – parabolic mirror
NDF – neutral density filter
WLSC – white light supercontinuum
Δτ – delay
λ/2 – half-wave plate

Options

Cryostat Mounting

HARPIA-TA supports cryostats that can be mounted externally or internally.

Sample Stirrer

Liquid samples are mixed up to avoid overexposure and ensure fresh samples.

Motorized Pump Mirror

Used to automatically optimize pump and probe overlap.

External Beam Steering

To lock the optical beam paths for OPA wavelenghts (350 – 1100 nm).

Beam Profiler

For checking beam shape/size at any position before/after measurement inside **HARPIA**.

Software

HARPIA Service App

Control and data acquisition software

A single software solution for all measurement modes, featuring:

- A user-friendly interface
- Measurement presets
- Measurement noise suppression
- Diagnostics and data export
- Continuous support and updates
- An API for remote experiment control using third-party software (LabVIEW, Python, MATLAB)

Data analysis software

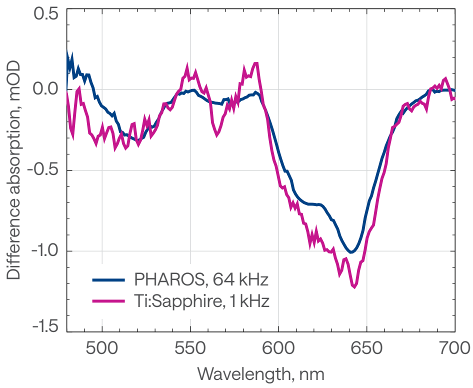
An ultrafast spectroscopy data analysis software, featuring:

- Advanced data wrangling: slicing, merging, cropping, smoothing, fitting, etc.
- Advanced global and target analysis
- Probe spectral chirp correction, calibration and deconvolution
- Support for 3D data sets (2D electronic spectroscopy, fluorescence lifetime imaging)
- Publication-ready figure preparation and data export

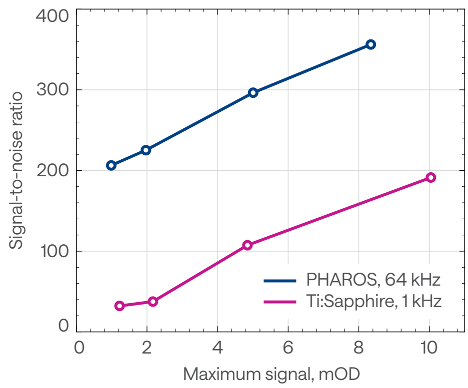
Performance at high repetition rates

The **HARPIA** spectroscopy system achieves an excellent signal-to-noise ratio at high repetition rates and low energy excitation conditions. The graphs below compare the signal-to-noise ratio (SNR) of difference absorption spectra obtained with a Ti:Sapphire laser operating at 1 kHz and a **PHAROS** laser operating at 64 kHz with the same acquisition time.

Measured difference absorption spectra of CdSe/ZnS quantum dots using low- and high-repetition rate lasers with 5 s acquisition time

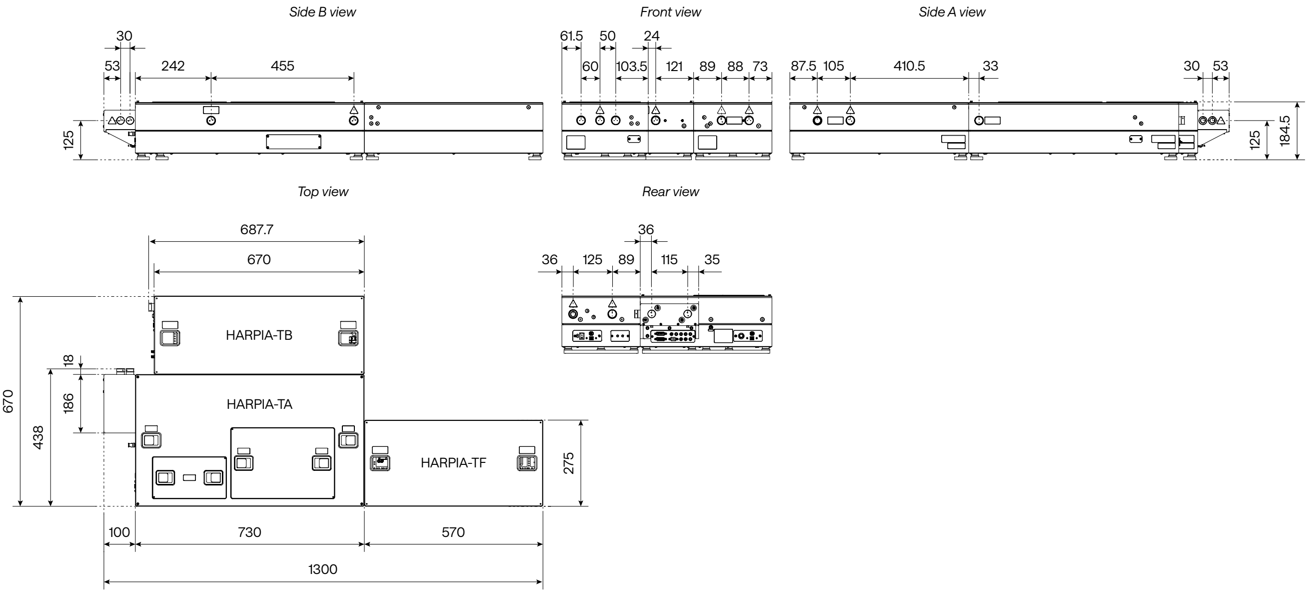


Best-effort SNRs, achieved with **HARPIA-TA** spectrometer driven by a Ti:Sapphire laser at 1 kHz (magenta) and a **PHAROS** laser at 64 kHz (blue)



Drawings

HARPIA system with **HARPIA-TB** and **HARPIA-TF** modules



HARPIA | LIGHT

NEW

Tabletop Transient Absorption Spectroscopy System

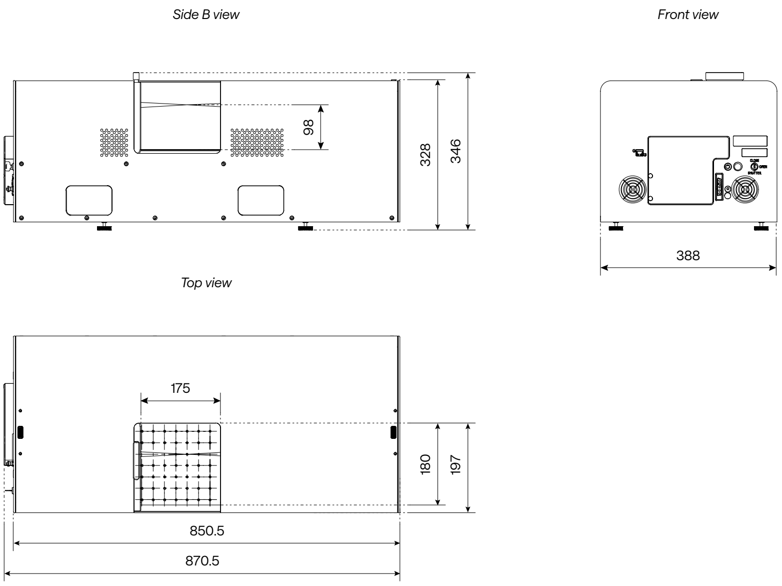
- Class 1 laser product
- Maintenance-free single-box solution
- Plug-and-play installation
- Intuitive measurement and data analysis
- Femto-to-nanosecond temporal resolution

Specifications

Modes	Transmission and reflection
Probe spectral range	460 – 910 nm
Probe polarization control	Linear (0 – 180°)
Pump wavelengths	515 nm, 343 nm
Delay range (resolution)	7.5 ns (10 fs)
Temporal resolution	≤ 290 fs
Laser repetition rate	60 kHz, any fundamental repetition rate division
Maximum data acquisition rate	3850 Hz
Dimensions	870.5 × 388 × 346 mm

Drawings

HARPIA-LIGHT



CLASS 1 LASER PRODUCT


CRONUS
LIGHT
CONVERSION
CRONUS
LIGHT
CONVERSION

Microscopy Sources

CRONUS femtosecond lasers cover applications in functional neuroimaging, optogenetics, and deep imaging, using medium-repetition-rate three-photon (3P) excitation and fast high-repetition-rate two-photon (2P) imaging, as well as widefield and holographic excitation.

CRONUS | 2P

A three-channel laser with a high repetition rate for simultaneous 2P excitation of multiple fluorescent probes, calcium indicators, opsins, or CARS and SRS.

CRONUS | 3P

A turnkey laser source with μJ-level pulses, covering the biological transparency windows at 1300 and 1700 nm for 3P microscopy, and 1030 nm for optogenetic stimulation.

Optimized for advanced multiphoton microscopy

Plug-and-play functionality with automated wavelength and dispersion control

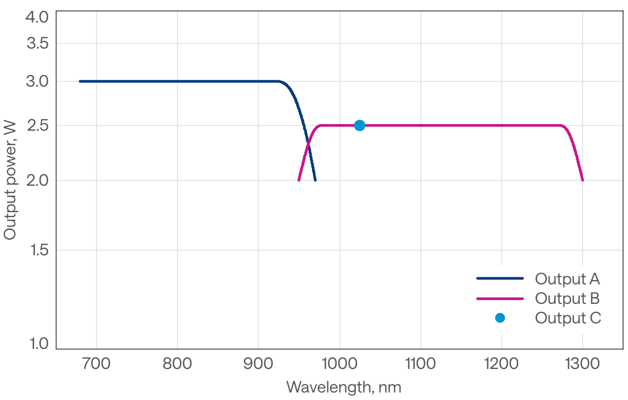
Excellent long-term power and pulse-to-pulse stability

CRONUS | 2P

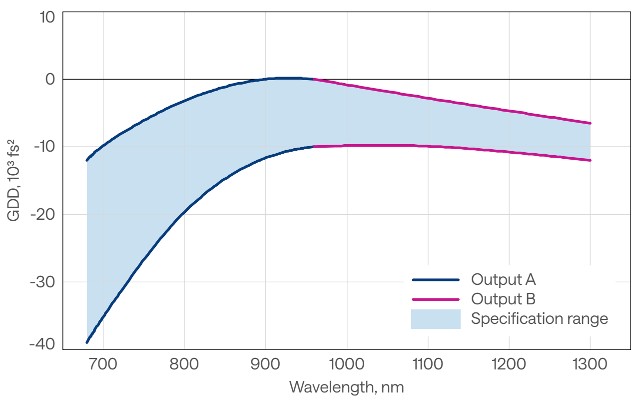
Three-Channel Wavelength-Tunable Femtosecond Laser

- Watt-level output at high repetition rates for fast imaging
- Two tunable and one fixed output for simultaneous multibeam excitation
- Automated GDD control for shortest pulses at the sample
- Feedback-based output power and wavelength stabilization
- Beam steering & power locking

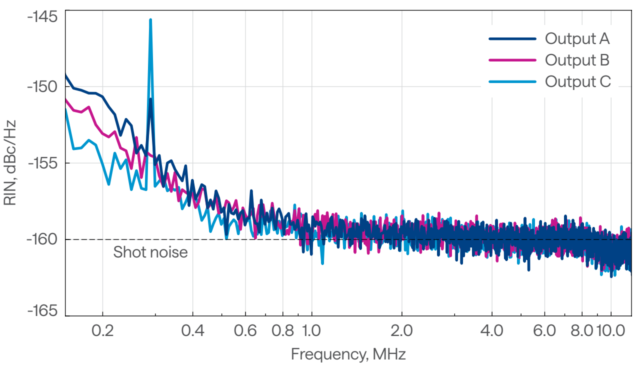
CRONUS-2P tuning curve



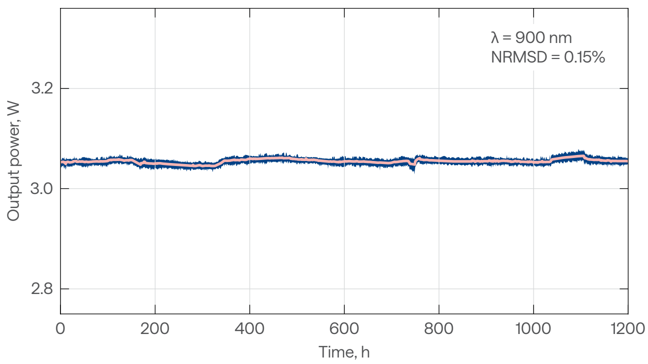
CRONUS-2P GDD control range



CRONUS-2P relative intensity noise (RIN)



CRONUS-2P typical output power stability at 900 nm



Specifications

Model	CRONUS-2P		
	Output A	Output B	Output C
Tuning range [1]	680 – 960 nm	940 – 1300 nm	1025 ± 10 nm (fixed)
Output power [2) 3)]	> 3 W @ 920 nm	> 2.5 W @ 1100 nm	> 2.5 W
Pulse duration [4) 5)]	< 160 fs		
Repetition rate	77 ± 1 MHz		
Beam quality, M^2 [3) 4)]	< 1.2		
Polarization	Linear, horizontal		
Beam divergence, full angle	< 1 mrad		< 1.5 mrad
Beam diameter [4)] (1/e²)	3.0 ± 0.4 mm	3.2 ± 0.4 mm	2.8 ± 0.4 mm
Beam ellipticity [4)]	> 0.8		
Beam astigmatism [4)]	< 20%		
Beam pointing stability [6)]	< 200 µrad		n/a
Long-term power stability, 24 h [4) 7)]	< 1%		
GDD control range	–10 000 to –35 000 fs² @ 700 nm –3000 to –20 000 fs² @ 800 nm 0 to –10 000 fs² @ 920 nm	0 to –10 000 fs² @ 960 nm –3000 to –10 000 fs² @ 1100 nm –8000 to –12 000 fs² @ 1300 nm	n/a

OPTIONAL POWER CONTROL

Tuning range [1)]	680 – 960 nm	940 – 1300 nm	1025 ± 10 nm (fixed)
Output power [8)]	> 2 W @ 920 nm	> 2 W @ 1100 nm	> 1.5 W
Rise/fall time [9)]	< 300 ns		
Contrast ratio	1000:1		
GDD control range	0 to –6500 fs² @ 920 nm	0 to –10 000 fs² @ 1100 nm	n/a

OPTIONAL WAVELENGTH EXTENSIONS (UV – VIS)

Second harmonic tuning range	340 – 480 nm [10)]	480 – 650 nm [11)]	n/a
Conversion efficiency at peak	> 30%		

ENVIRONMENTAL REQUIREMENTS & DIMENSIONS

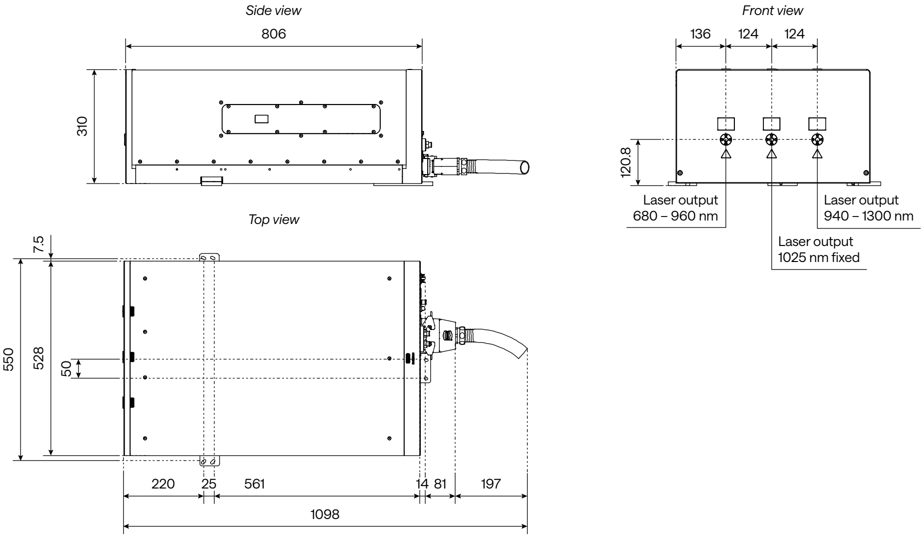
Refer to www.lightcon.com

1) *Configurations with either dual-output A or dual-output B are also available.*
2) *Simultaneous mode: > 1 W @ 920 nm, > 1 W @ 1100 nm, and > 2.5 W @ 1025 nm.*
3) *Power control using AOM is applicable, specifications below.*
4) *Speficied at 920 nm, 1100 nm, and 1025 nm, respectively.*
5) *IR pulse duration determined assuming sech2 shape.*
6) *Beam pointing deviation over the entire tuning and GDD control range.*
7) *Expressed as normalized root mean squared deviation (NRMSD); with less than ±1 °C temperature change after 1 h warm up.*
8) *Simultaneous mode: > 0.7 W @ 920 nm, > 0.7 W @ 1100 nm, and > 1.5 W @ 1025 nm.*
9) *Specified from 5% to 95%.*
10) *Multiple second harmonic configurations available. For more information contact sales@lightcon.com.*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

Drawings

CRONUS-2P

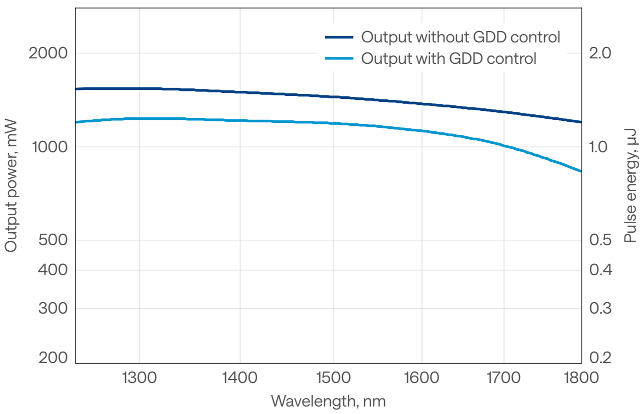


CRONUS | 3P

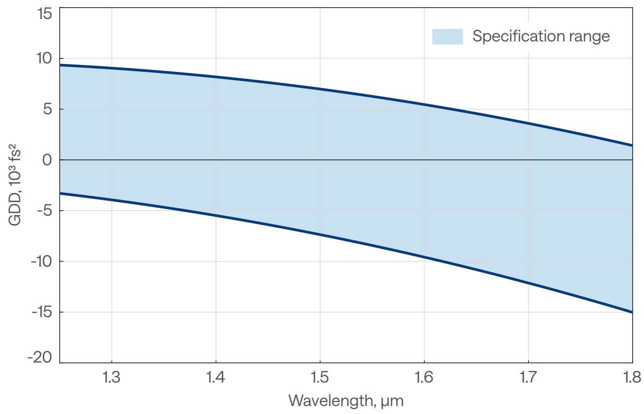
Laser Source for Advanced Nonlinear Microscopy

- High pulse energy for deep imaging
- 1250 – 1800 nm tuning range for 3P imaging
- Down to 50 fs pulse duration for high peak power
- Automated wavelength and GDD control for optimal signal
- Maintenance-free single-box solution

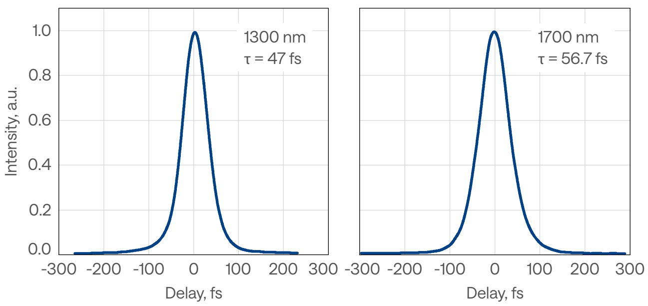
CRONUS-3P output power and pulse energy vs wavelength, at 1 MHz



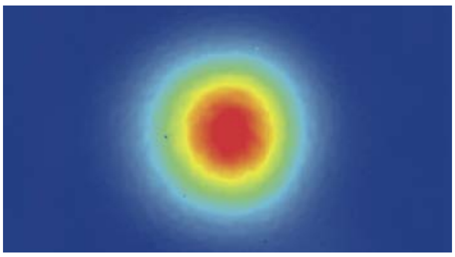
CRONUS-3P GDD control range



CRONUS-3P typical pulse duration at 1300 nm and 1700 nm



CRONUS-3P beam profile at 1300 nm



Specifications

Model	CRONUS-3P		CRONUS-3P with power control	
Tuning range	1250 – 1800 nm			
Repetition rate [1]	Single-shot – 1 MHz or 2 MHz			
	1300 nm	1700 nm	1300 nm	1700 nm
Pulse duration	< 50 fs	< 65 fs	< 50 fs	< 65 fs
Output power	> 1100 mW @ 1 MHz > 800 mW @ 2 MHz	> 800 mW @ 1 MHz > 500 mW @ 2 MHz	> 1000 mW @ 1 MHz > 700 mW @ 2 MHz	> 700 mW @ 1 MHz > 400 mW @ 2 MHz
GDD control range [2]	–4000 to +9000 fs^2	–12 000 to +3500 fs^2	–4000 to +9000 fs^2	–12 000 to +3500 fs^2
Beam diameter [3]	2 – 4 mm			
Beam quality, M^2	< 1.2			
Beam ellipticity	> 0.8			
Beam divergence	< 1 mrad			
Beam pointing stability	< 100 µrad			
Long-term power stability, 24 h [4]	< 1%			
Pulse-to-pulse energy stability, 1 min [4]	< 1%			

MAIN OUTPUT WITHOUT GDD CONTROL

Output power [5]	> 1500 mW @ 1 MHz > 1000 mW @ 2 MHz	> 1050 mW @ 1 MHz > 700 mW @ 2 MHz	n/a

ADDITIONAL OUTPUTS

Auxiliary 1030 nm amplifier output	1030 ± 10 nm, up to 40 W, up to 2 MHz, < 250 fs
Optional 680 – 920 nm amplifier output	680 – 920 nm, > 1500 mW @ 1 MHz or > 1000 mW @ 2 MHz (@ 920 nm), < 290 fs (compressible to < 50 fs) [6]
Optional 1030 nm oscillator output	1030 ± 10 nm, up to 500 mW, ≈ 65 MHz, ≈ 200 fs

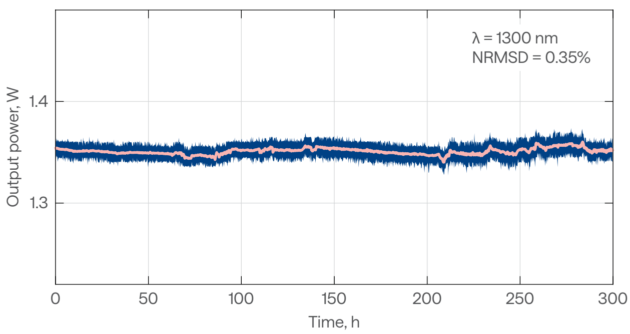
ENVIRONMENTAL REQUIREMENTS & DIMENSIONS

Refer to www.lightcon.com

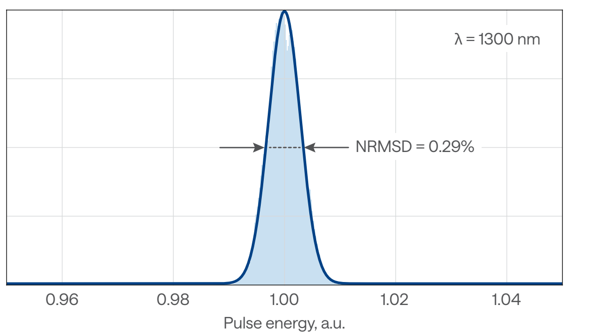
[1] *Lower repetition rate with a higher pulse energy option available.*
[2] *Continuous dispersion control; –4000 fs^2 compensates a microscope with +4000 fs^2.*
[3] *$1/e^2$, measured at compressor output.*
[4] *Expressed as normalized root mean squared deviation (NRMSD).*
[5] *Available only for v1. Contact sales@lightcon.com for more details.*
[6] *With external compressor without GDD control, < 70% transmission at 920 nm.*

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT, REFLECTED OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

CRONUS-3P typical long-term power stability at 1300 nm

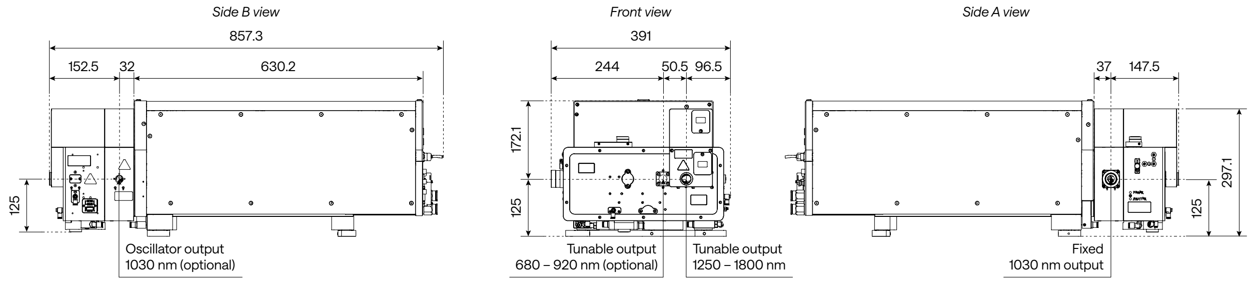


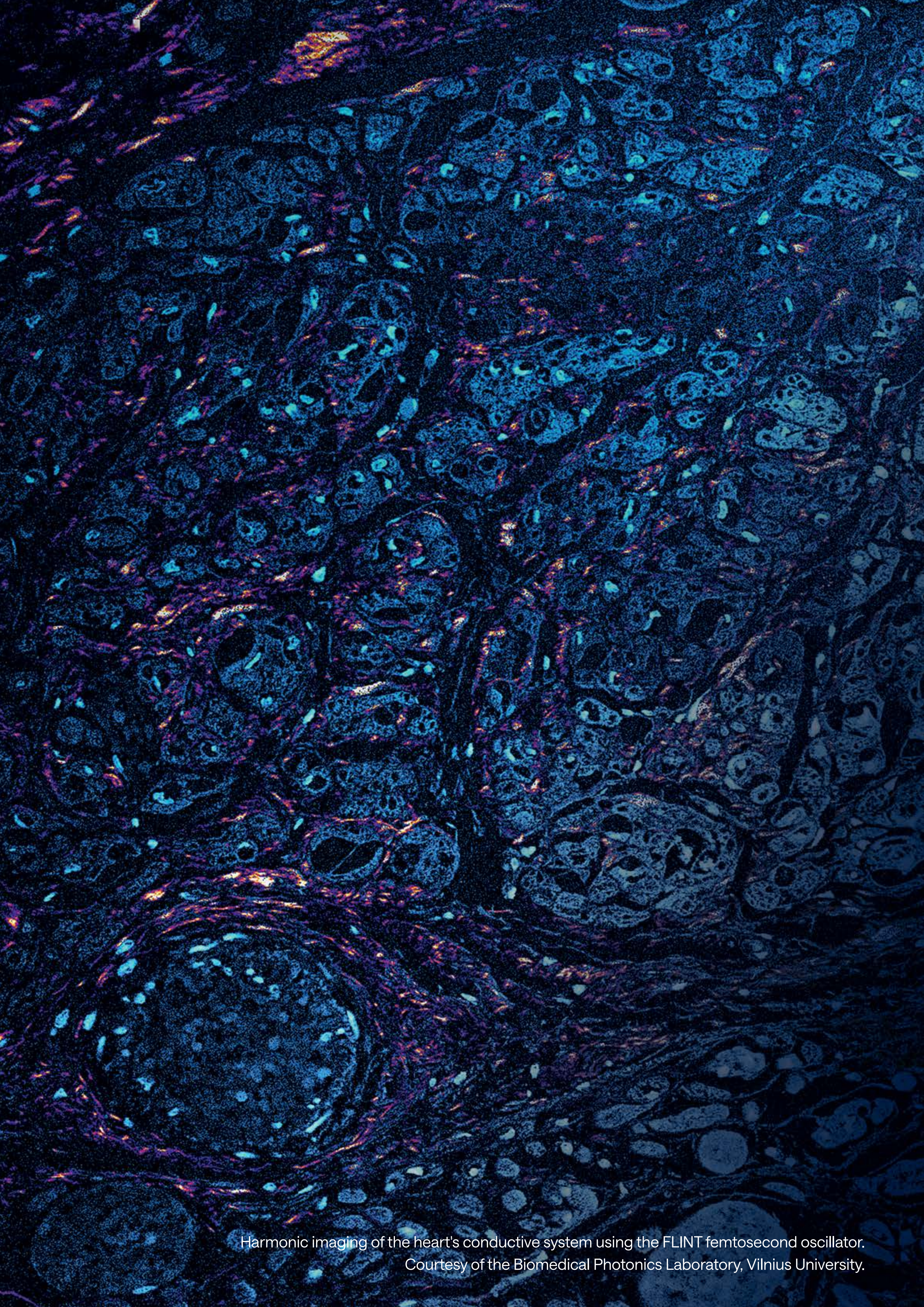
CRONUS-3P typical pulse-to-pulse energy distribution at 1300 nm



Drawings

CRONUS-3P





Harmonic imaging of the heart's conductive system using the FLINT femtosecond oscillator.
Courtesy of the Biomedical Photonics Laboratory, Vilnius University.

Applications

LIGHT CONVERSION delivers best-in-class lasers and laser systems for today's most demanding applications.

This section presents application examples - starting with micromachining, moving through ultrafast spectroscopy, and concluding with nonlinear microscopy - each driven by ultrafast light–matter interactions.

Micromachining Transparent Materials

Selective laser etching

3D selective laser etching in fused silica.

Source: Femtika.

Color marking in glass

Source: Workshop of Photonics.

Glass cutting

Structure fabricated in fused silica.

Glass cutting

Bottom-up glass cutting with GHz bursts: a map of Lithuania cut from 4,8 mm-thick glass.

Source: M. Mackevičiūtė *et al.*, Fast and efficient bottom-up cutting of soda-lime glass using GHz bursts of short laser pulses, Opt. Lasers Eng. 183 (2024).

Metals

Conical drilling

A hole array produced in a 100 μm-thick stainless steel sheet at a rate of 1 ms per hole.

Nozzle drilling

Precision drilling of the nozzle holes.

Source: Posalux SA.

Selective ablation

Selective ablation of tungsten carbide.

Cutting and welding

Cut and welded parts from brass using a single laser system.

Surface texturing

Moon-like surface texturing on a watch bezel.

Source: LASEA.

Micromachining

Semicon Industry

Silicon carbide dicing

Single-pass (300 mm/s) dicing of a 500 µm-thick 4H-SiC wafer.

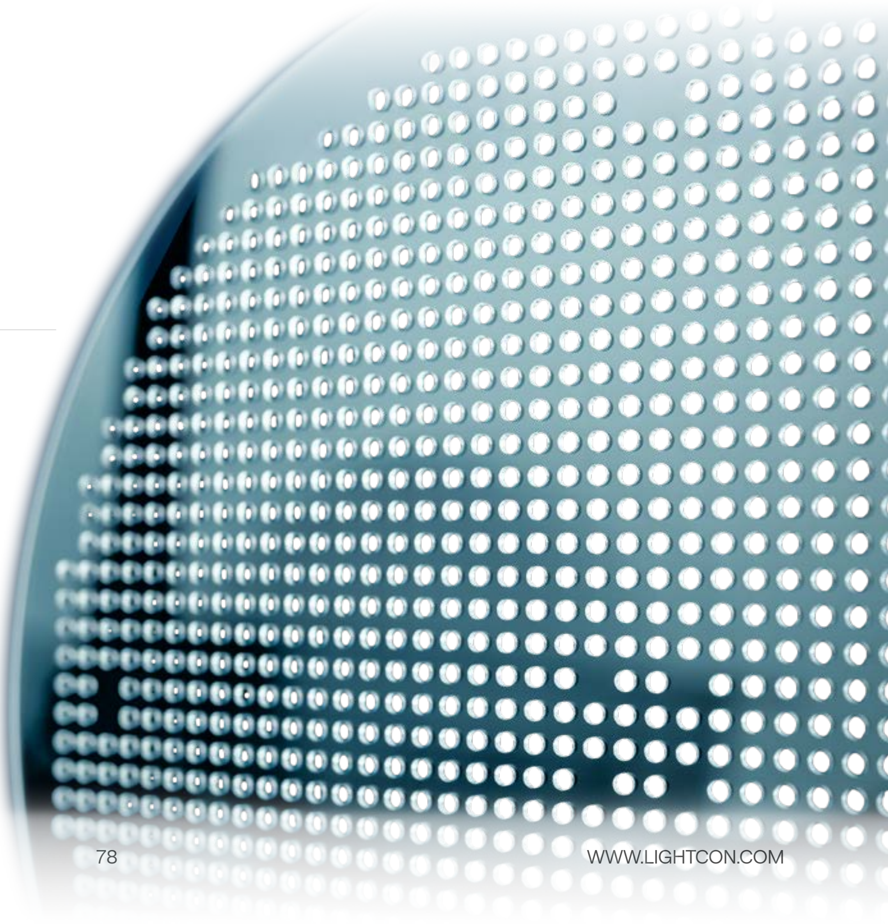
Silicon dicing

Precise dicing of a silicon wafer.

Through Glass Via drilling

Example of glass drilling with densely packed holes.

Source: Workshop of Photonics.



Medical Industry

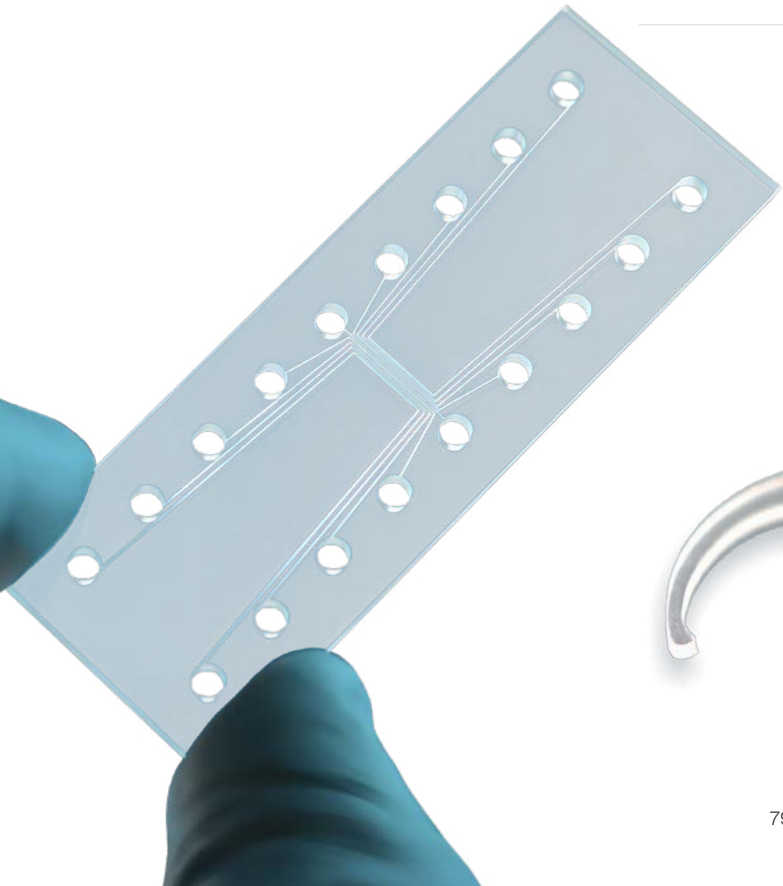
Nitinol stent cutting

Source: Lighteum.

High-contrast marking

Corrosion-free black-and-white marking on a stainless steel hemostatic clamp using the BiBurst option.

Stainless steel stent cutting



Glass ablation and welding

Microfluidic chip manufacturing with channel sealing.

Source: Workshop of Photonics.

Intraocular lens cutting

Source: Lasea.

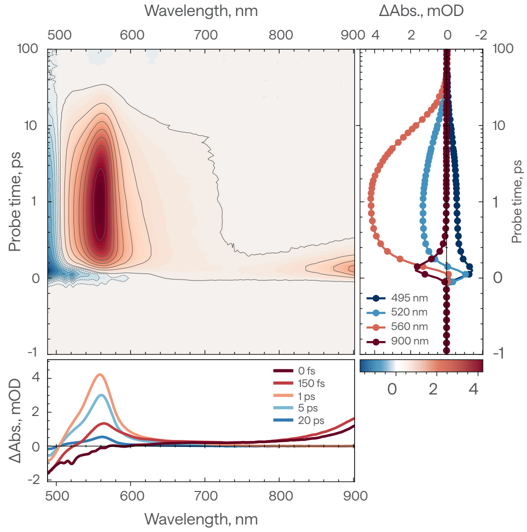
Ultrafast Spectroscopy

HARPIA | TA

Femtosecond pump-probe

Spectral dynamics of β-carotene in solution, acquired using **HARPIA-TA**.

MEASUREMENT CONDITIONS
Pulse repetition rate: 100 kHz
Pump wavelength: 490 nm
Pump pulse energy: < 10 nJ
Acquisition time: 13 s per spectrum
(per delay point)

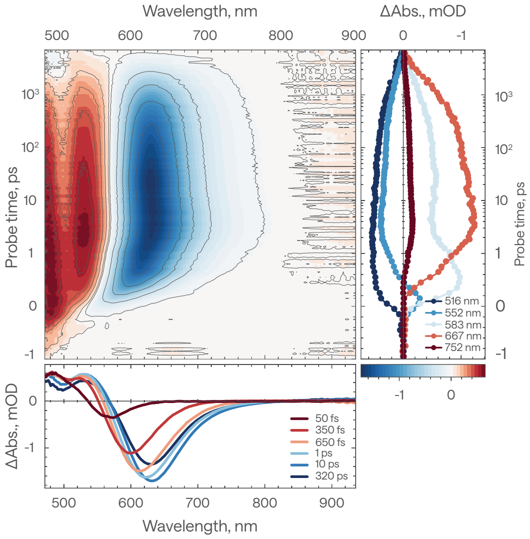


HARPIA | LIGHT

Femtosecond pump-probe

Spectral dynamics of DCM laser dye in solution, acquired using **HARPIA-LIGHT**.

MEASUREMENT CONDITIONS
Pulse repetition rate: 60 kHz
Pump wavelength: 343 nm
Acquisition time: 3 s per spectrum
(per delay point)

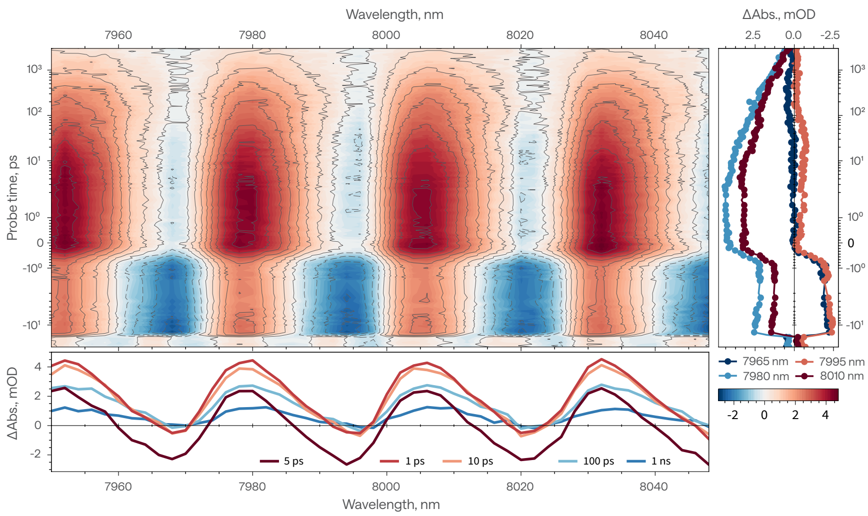


HARPIA | TA

IR femtosecond pump-probe

Pump-probe dynamics of a GaAs wafer in the IR, acquired using signal and reference single-channel detectors of **HARPIA-TA**.

MEASUREMENT CONDITIONS
Pulse repetition rate: 75 kHz
Pump wavelength: 700 nm
Acquisition time: 1 s per point



HARPIA | TF

Time-resolved fluorescence spectroscopy

Kerr gate measurements

Kerr gate measurements in DCM illustrate the method's ability to probe fluorescence evolution with a sub-picosecond temporal resolution.

Fluorescence upconversion

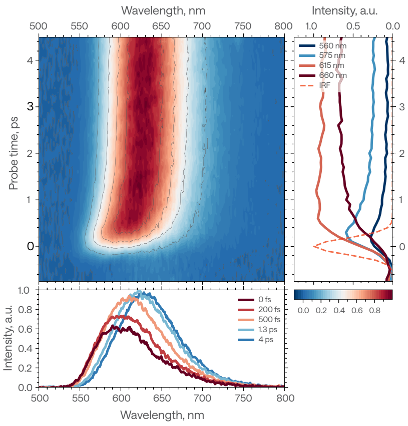
Fluorescence dynamics of DCM laser dye in solution, acquired using **HARPIA-TF** in fluorescence upconversion mode.

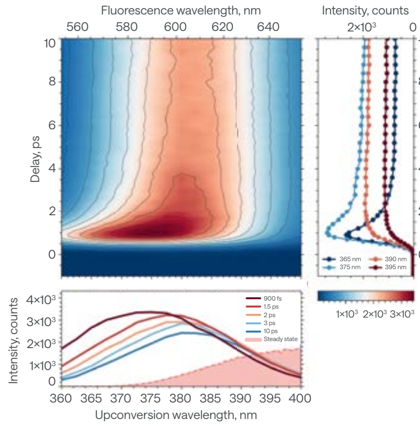
MEASUREMENT CONDITIONS
Repetition rate: 100 kHz
Pump wavelength: 430 nm

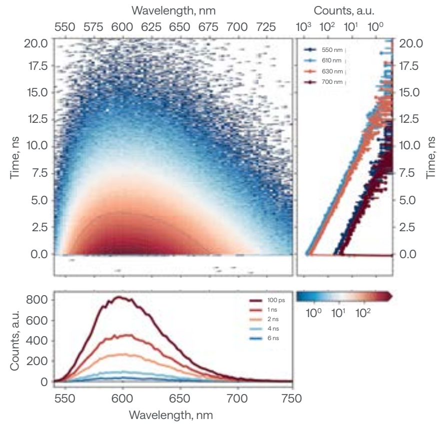
TCSPC

Fluorescence dynamics of DCM laser dye in solution, acquired using **HARPIA-TF** in TCPSC mode.

MEASUREMENT CONDITIONS
Repetition rate: 100 kHz
Pump wavelength: 430 nm





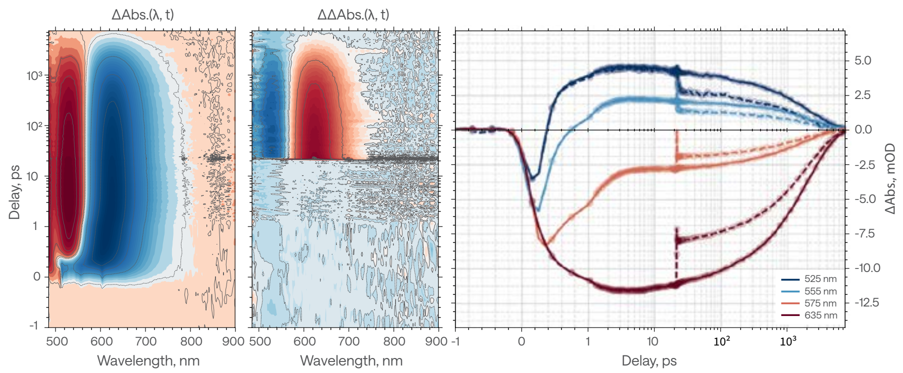


HARPIA | TB

Femtosecond pump-dump-probe

Pump-dump-probe dynamics of DCM laser dye, measured using **HARPIA-TB** with the dump pulse resonant to the emission band of DCM.

MEASUREMENT CONDITIONS
Pulse repetition rate: 50 kHz
Pump wavelength: 515 nm
Dump wavelength: 700 nm
Dump delay: 21 ps
Pump pulse energy: 90 nJ
Dump pulse energy: 190 nJ

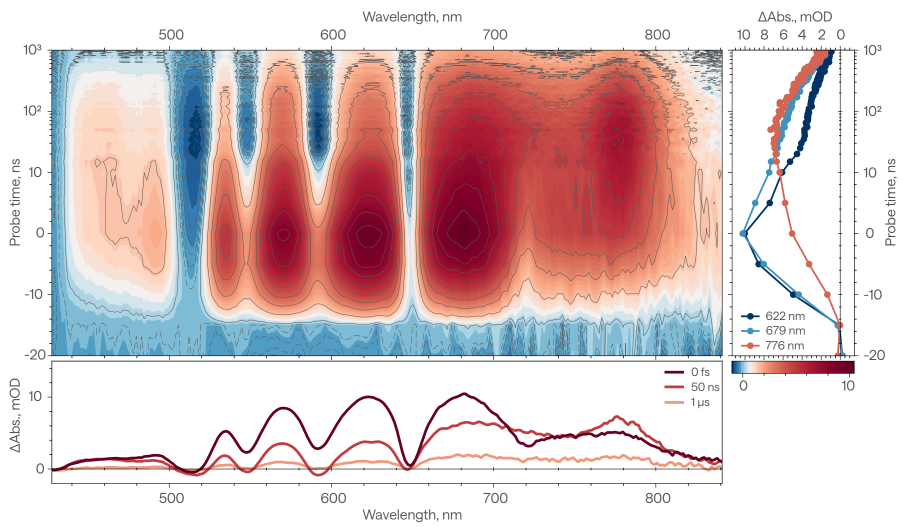


HARPIA | TA-FP

Flash photolysis

Nanosecond spectral dynamics of meso-Tetraphenylporphine in solution, acquired using **HARPIA-TA-FP**.

MEASUREMENT CONDITIONS
Pulse repetition rate: 1.8 kHz
Pump wavelength: 343 nm
Pump pulse energy: 5.4 μJ

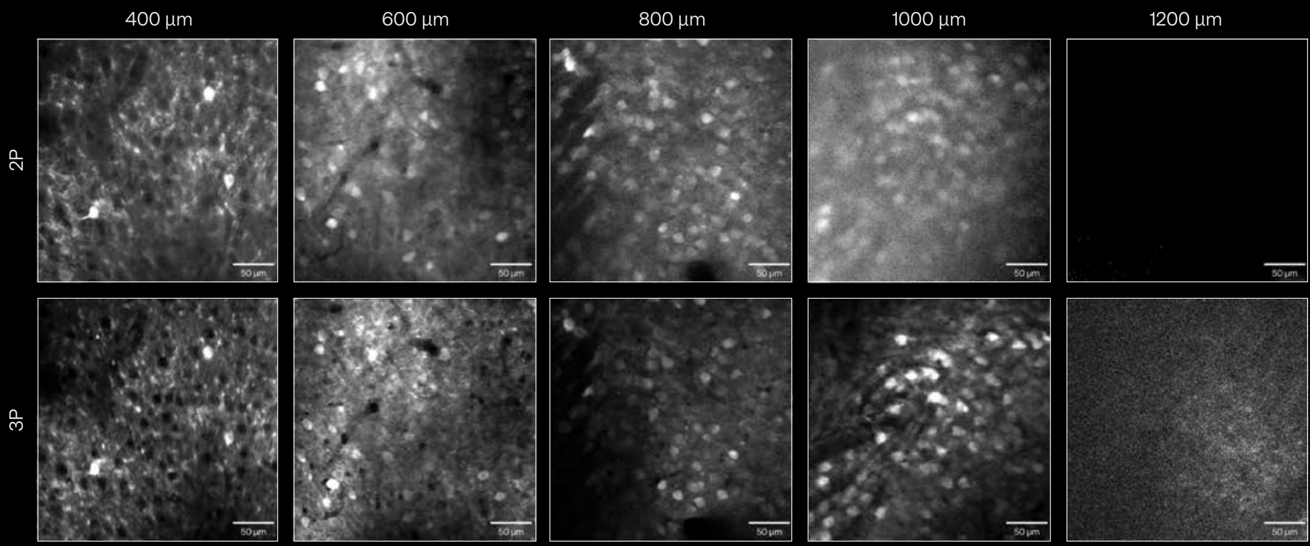


Nonlinear Microscopy

Calcium Imaging

Recording real-time single-neuron activity in deep brain layers of awake animals is crucial for understanding behavior, brain connectivity, and function. These applications have been advanced by neuron imaging and stimulation using high-power, high-pulse-energy, medium-repetition-rate lasers tunable in the SWIR range, which includes the biological transparency windows at 1.3 µm and 1.7 µm. Three-photon microscopy has been shown to provide higher image contrast at greater depths. **CRONUS-2P**, **CRONUS-3P**, and **ORPHEUS** OPA are state-of-the-art choices for two- and three-photon-excited fluorescence (2PEF, 3PEF) and harmonic-generation (SHG, THG) imaging in deep tissues.

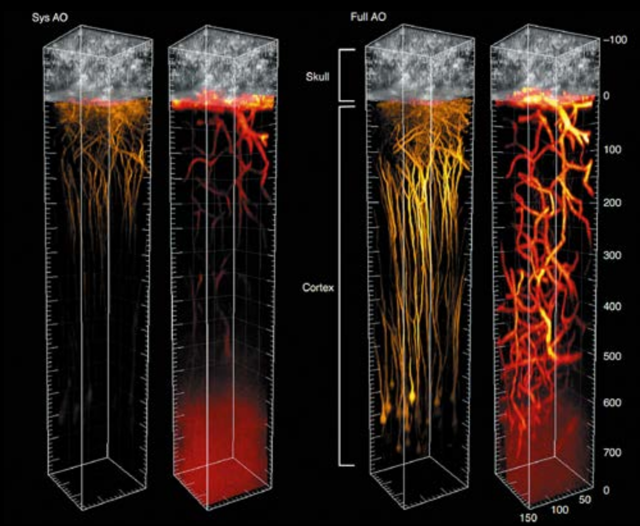
2P and 3P calcium imaging at depth in the mouse brain



Comparison of in vivo 2P and 3P calcium imaging of mouse visual cortex GCaMP neurons on a Thorlabs Bergamo II microscope using a typical 2P laser and Light Conversion's **CRONUS-3P** laser at 920 nm and 1300 nm, respectively.

Courtesy of CSHL ISFNS 2024 school organizers, Willis Broden Jr. and Sergey Matveev (Thorlabs).

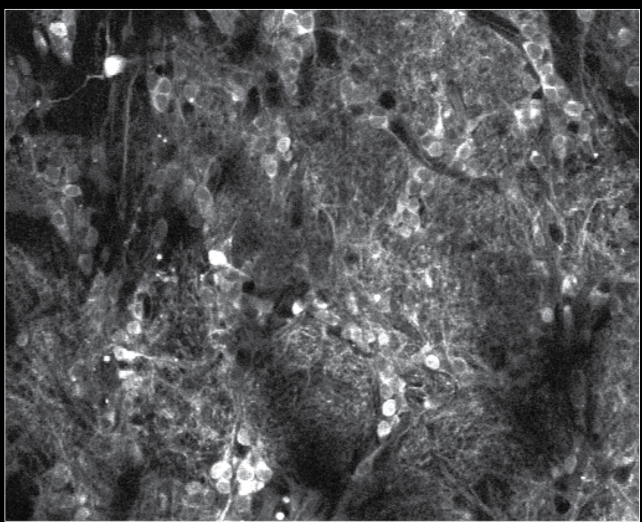
3P AO brain imaging through the intact skull



ORPHEUS-F excitation at 1300 nm enabled imaging up to 1.1 mm below the pia within the intact brain.

Courtesy of Jianan Y. Qu group, the Hong Kong University of Science and Technology. Source: Zh. Qin *et al.*, Deep tissue multi-photon imaging using adaptive optics with direct focus sensing and shaping, Nature Biotechnology 40 (2022).

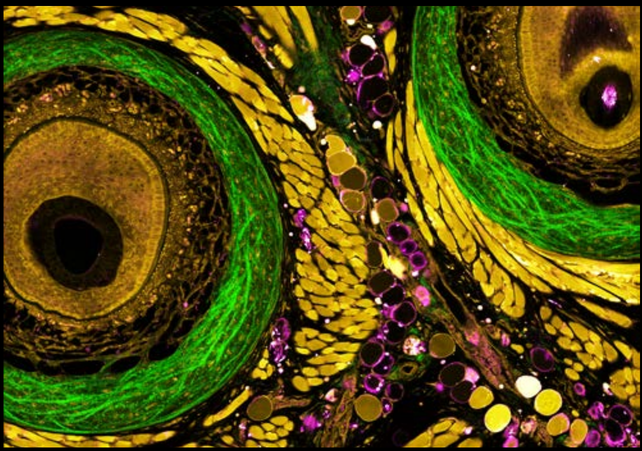
3P anatomical imaging of the mouse olfactory bulb



Mouse olfactory bulb with inhibitory cells labelled with GCaMP8s. Anatomical Z-stack imaged in 3P at 1300 nm.

Courtesy of Fred Marbach, Andreas Schaefer lab, The Francis Crick Institute.

Label-Free In Vivo Imaging

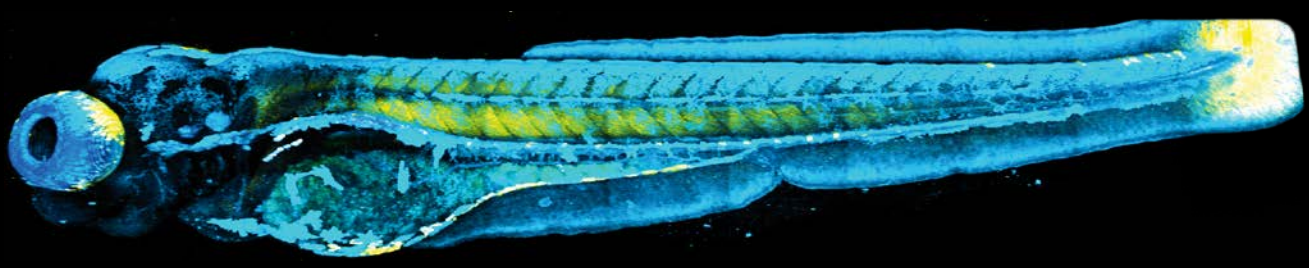


Understanding biological complexity requires minimally disruptive imaging tools capable of providing multiplexed molecular contrasts. To address this need, S. You's laboratory at the Massachusetts Institute of Technology is developing a non-invasive, label-free microscopy approach using **CRONUS-3P** to visualize biosystems.

As part of a study on neuropathic pain, the image reveals the rich microenvironment of an unprocessed, intact mouse whisker pad: collagen capsule (green), comprising the follicle with muscles (yellow) supporting it, adipocytes (purple), stromal cells, and immune cells.

Courtesy of Sixian You group, Massachusetts Institute of Technology.

Multimodal 3D in vivo imaging of zebrafish



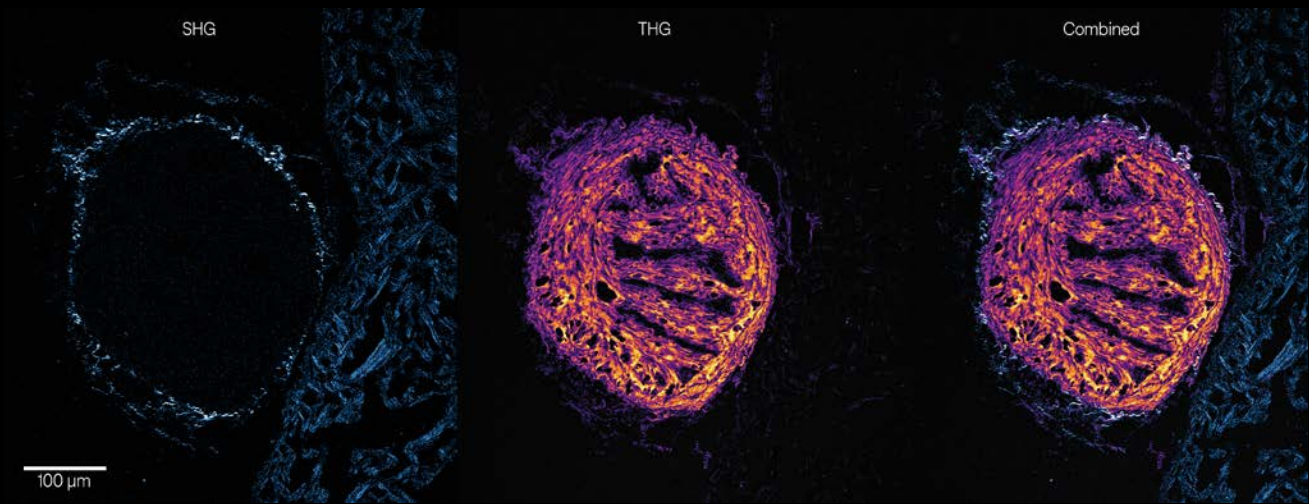
Multimodal 3D label-free imaging of a live 4dpf zebrafish embryo. The embryo was healthy after imaging.
3PF: green, SHG transmission: yellow, THG epi: dark blue, THG transmission: cyan.
Excitation: 1300 nm, XY pixel size: 0.39 μm/px, Z stack: 522 μm range, 1 μm step, Mosaic: 11 x 2 of 400 x 400 μm tiles, Total imaging time: 12 h.

Courtesy of Luigi Bonacina group, University of Geneva.

Combined SHG and THG imaging

Adult zebrafish heart ventricle section from a scar formation study. The brightfield image is stained with Masson's trichrome (MT), connective tissue is blue, muscle is red/brown.

SHG and THG images reveal collagen and muscle structure at the periphery of bulbus arteriosus, while MT-stained elastin is visualized in the center in THG.

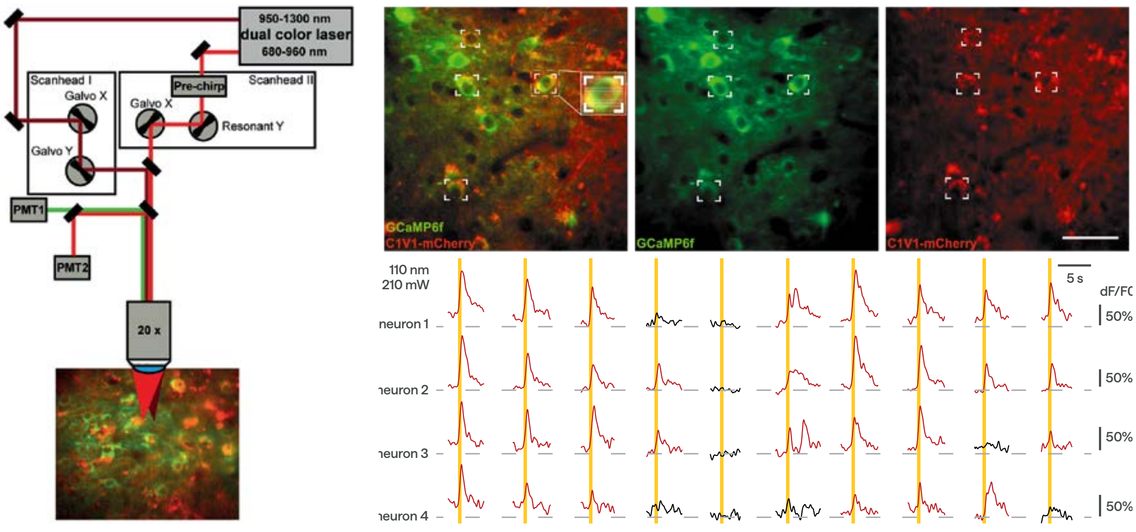


Adult zebrafish heart ventricle section imaged using the **FLINT** femtosecond oscillator.

Samples courtesy of Justas Lazutka, Vilnius University Life Sciences Center.
Imaging courtesy of Virginijus Barzda group, Vilnius University Faculcy of Physics.

2P Photostimulation

Despite the advances in 3-photon excitation sources providing longer wavelengths and higher pulse energies, certain imaging challenges are still better addressed by tunable high-repetition-rate oscillator-based lasers. This is especially true when imaging speed is the primary factor. For these applications, the **CRONUS-2P** laser offers the ultimate solution with its optically synchronized three outputs, two of which are independently tunable. A three-beam source enables a variety of multiphoton excitation pathways, many of which are inaccessible using traditional single- and two-beam solutions. Furthermore, the independent tunability of the two beams enables new coherent Raman scattering modalities.

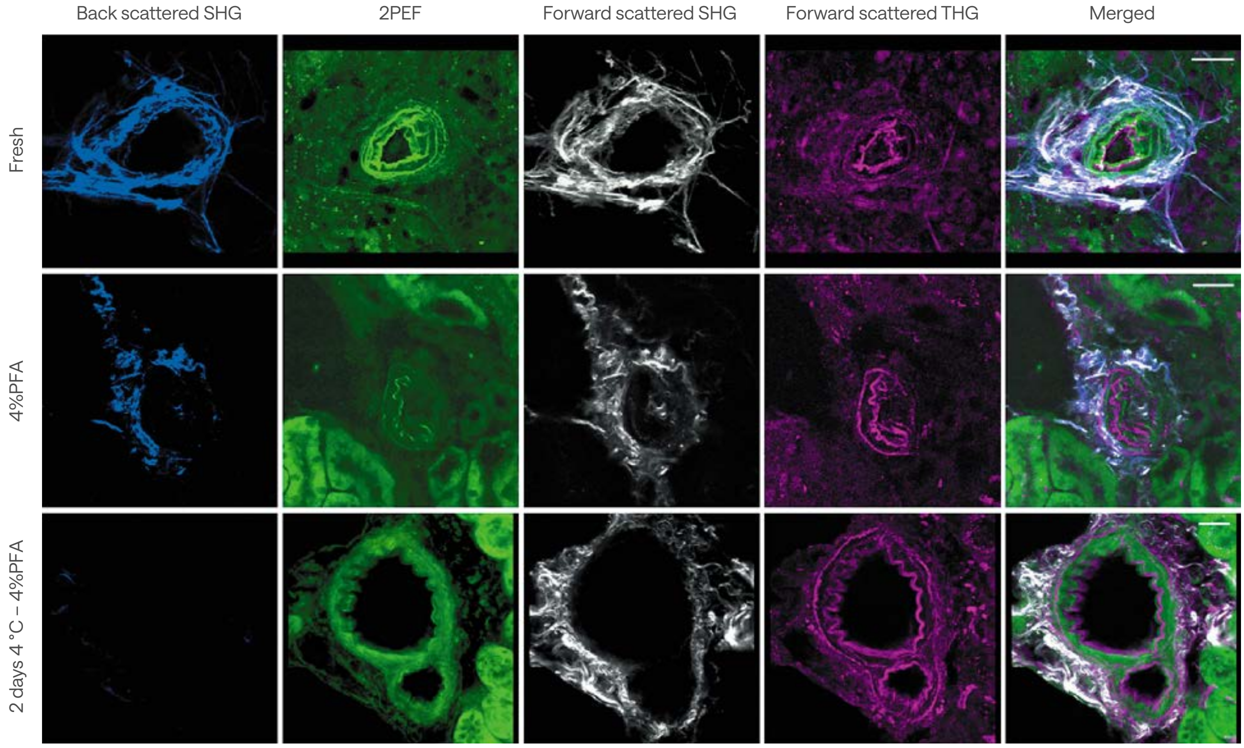


2P optogenetic stimulation of individual neurons using **CRONUS-2P**.

Courtesy of Albrecht Stroh group, University Medical Center Mainz and Leibniz Institute for Resilience Research. Source: T. Fu *et al.*, Exploring two-photon optogenetics beyond 1100 nm for specific and effective all-optical physiology, iScience 24 (2021).

SHG, THG, and 2P Imaging

Fixation methods, such as formalin, are commonly used to preserve tissue and keep its structure as close as possible to the native condition. However, fixatives chemically interact with tissue molecules and may modify their structure. Taking advantage of the SHG and THG emission capabilities of such components, nonlinear 2P microscopy and the **CRONUS-2P** femtosecond laser were used to evaluate the effect that preservation methods, such as chemical fixatives, have on the nonlinear capabilities of protein components within mouse tissues.



SHG signals from collagen, 2PEF and THG signals from elastin in vibratome sections of mouse kidney after different treatments, acquired using the **CRONUS-2P** femtosecond laser source.

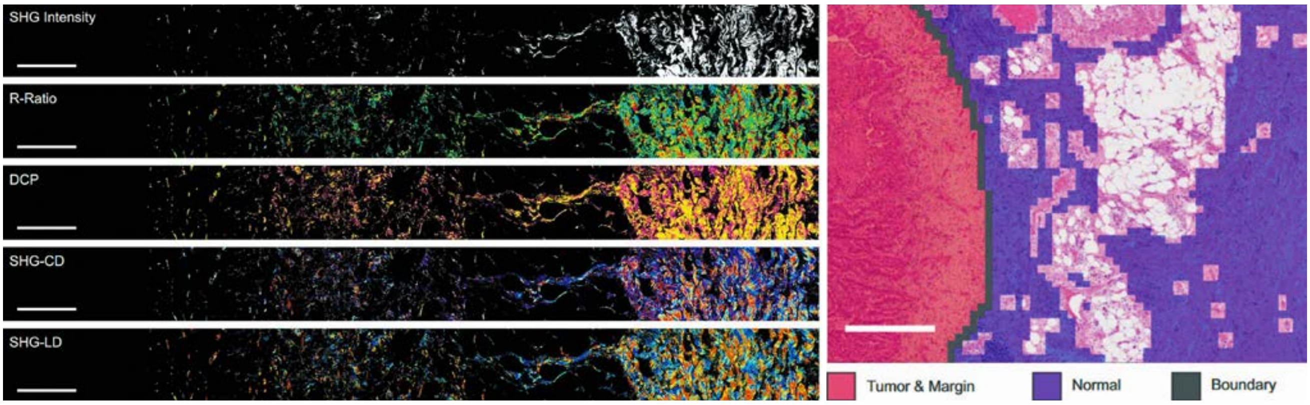
Courtesy of Frauke Alves and Fernanda Ramos-Gomes, Max-Planck Institute for Multidisciplinary Sciences, Germany.

Nonlinear Histopathology

Widefield polarimetric SHG microscopy

Cancer diagnosis and surgical treatment rely on imaging techniques that demand specificity and high throughput. Polarization-resolved second-harmonic generation (P-SHG) microscopy shows potential for visualizing structural changes in collagen networks and the extracellular matrix associated with tumor development. Moreover, P-SHG imaging is label-free and compatible with live tissue imaging at depth. However, traditional raster scanning methods are too slow for clinical applications, and interpreting the structural sensitivity of P-SHG can be challenging.

Nonlinear widefield microscopy addresses these limitations by utilizing amplified femtosecond lasers to increase imaging throughput and field of view. Additionally, machine learning (ML) techniques enable data-driven analysis, facilitating tasks such as automating tumor margin delineation and scoring. By leveraging **PHAROS** and **CARBIDE** lasers in conjunction with ML-augmented widefield microscopy, we can potentially extend the benefits of nonlinear microscopy to the scale required for biomedical and clinical applications.

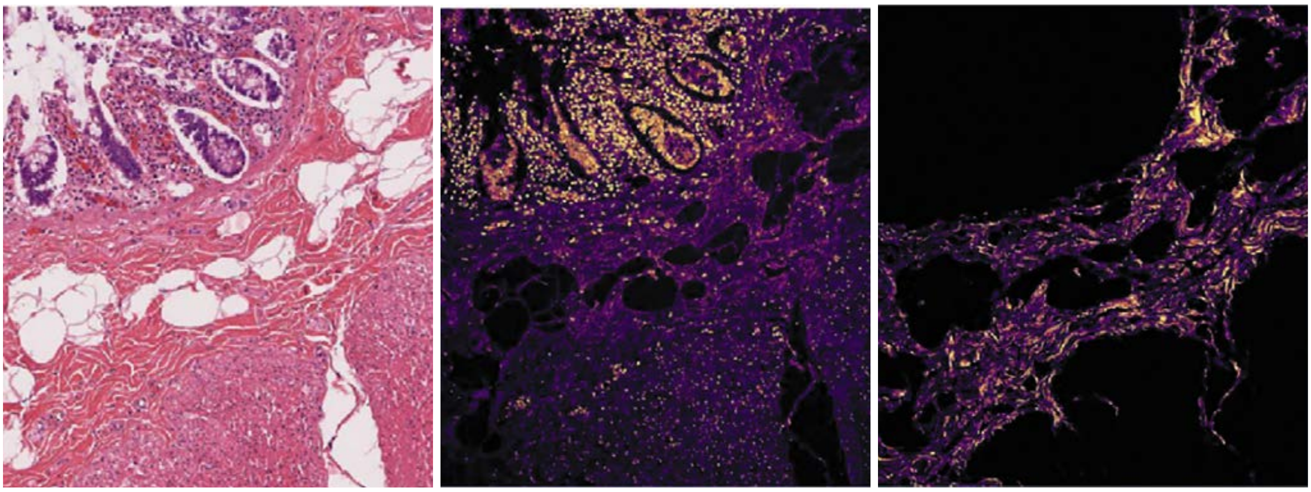


Large-area widefield P-SHG microscopy of human lung tissue tumor margins conducted using the **PHAROS** laser. Image parameters, including SHG intensity, R-ratio, and degree of circular polarization, as well as SHG circular and linear dichroism, are employed in unsupervised ML algorithms to determine the tumor boundary.

Courtesy of Virginijus Barzda group, University of Toronto, and Brian C. Wilson group, Princess Margaret Cancer Centre. Source: Mirsanaye *et al.*, Unsupervised determination of lung tumor margin with widefield polarimetric second-harmonic generation microscopy, Scientific Reports 12 (2022).

Raster-scanning SHG/THG microscopy

For applications requiring a fixed-wavelength femtosecond laser, such as multiphoton-driven fluorescence, excited at 1 µm, and harmonic-generation (SHG, THG) microscopy, the **FLINT** oscillator is a high-performance solid-state source in a proven, industrial-grade package and a compact footprint, providing a stable 24/7 operation with excellent noise performance.



SHG and THG images of H&E-stained colon using the **FLINT** femtosecond oscillator.

Courtesy of Virginijus Barzda group, Vilnius University.

Global Representative Network

AUSTRALIA NEW ZEALAND
Lastek Pty Ltd.
Adelaide, Australia
Phone: +61 8 84 438 668
ricardas@lastek.com.au
www.lastek.com.au

BELGIUM, NETHERLANDS, LUXEMBOURG
Laser 2000 Benelux C.V.
Vinkeveen, Netherlands
Phone: +31 297 266191
info@laser2000.nl
www.laser2000.nl

BRAZIL
Photonics Ltda
São Paulo, Brazil
Phone: +55 11 2839 3209
info@photonics.com.br
www.photonics.com.br

CHINA
Light Conversion China
Shenzhen, China
Phone: +86 189 4874 5558
sales.china@cn.lightcon.com

Beijing Light-Quantum Technology Co., Ltd.
Beijing, China
Phone: +86 10 8290 0415
sales@light-quantum.cn
www.light-quantum.cn

Genuine Optronics Limited
Shanghai, China
Phone: +86 21 64 325 169
jye@gen-opt.com
www.gen-opt.com

CZECH REPUBLIC, SLOVAKIA
Femtonika s.r.o.
Zbýšov, Czech Republic
Phone: +420 792 417 400
info@femtonika.cz
www.femtonika.cz

FRANCE, SWITZERLAND, BELGIUM
Jean-François Poisson
Industrial Market Development Manager
Phone: +33 674 48 0778
jf.poisson@lightcon.com

FRANCE, SWITZERLAND
Frédéric Berthillier
Scientific Market Development Manager
Phone: +33 745 014 410
frederic.berthillier@lightcon.com

GERMANY, AUSTRIA, SWITZERLAND
Ulrich Höchner
Industrial Market Development Manager
Phone: +49 157 8202 5058
u.hoechner@lightcon.com

Christian Hellwig
Scientific Market Development Manager
Phone: +49 174 204 9053
christian.hellwig@lightcon.com

Stefan Piontek
Scientific Market Development Manager
Mobile +49 176 8345 7119
stefan.piontek@lightcon.com

INDIA
Anatech Laser Instruments Pvt. Ltd.
Mumbai, India
Phone: +91 22 4121 0001 / 02 / 03
sales@anatechlaser.com
www.anatechlaser.com

ISRAEL
ROSH Electroptics Ltd.
Netanya, Israel
Phone: +972 (0)9 862 7401
info@roshelop.co.il
www.roshelop.co.il

ITALY
Optoprim S.r.l.
Vimercate, Italy
Phone: +39 039 834 977
info@optoprim.it
www.optoprim.it

JAPAN
Phototechnica Corp.
Saitama, Japan
Phone: +81 48 871 0067
voc@phototechnica.co.jp
www.phototechnica.co.jp

KOREA
Light Conversion Korea
Daejeon, Korea
Phone: +82 42 368 1010
jungsik.seo@lightcon.com

POLAND
Amecam
Warszawa, Poland
Phone: +48 602 500 680
amecam@amecam.pl
www.amecam.pl

SINGAPORE
Acexon Technologies Pte Ltd.
Singapore
Phone: +65 6565 7300
sales@acexon.com
www.acexon.com

SPAIN, PORTUGAL
Innova Scientific S.L.
Las Rozas de Madrid, Spain
Phone: +34 91 710 56 50
rafael.pereira@innovasci.com
www.innovasci.com

SWITZERLAND
GMP SA
Renens, Switzerland
Phone: +41 21 633 21 21
info@gmp.ch
www.gmp.ch

TAIWAN
Alaser Co. Ltd.
Taipei, Taiwan
Phone: +886 2 2377 3118
alexfu@alaser.com.tw
www.alaser.com.tw

TURKEY
Innova Teknoloji Ltd.
İstanbul, Turkey
Phone: +90 216 315 03 36
eryetistir@innova-teknoloji.com
www.innova-teknoloji.com

UNITED KINGDOM
Photonic Solutions Ltd.
Edinburgh, United Kingdom
Phone: +44 (0) 131 664 8122
ben.agate@photonicsolutions.co.uk
www.photonicsolutions.co.uk

USA, CANADA
Light Conversion-USA, Inc.
Bozeman, MT, USA
Phone: +1 833 685 2872
saleslc@lightcon-usa.com