

PHAROS



Modular-Design Industrial-Grade Femtosecond Lasers

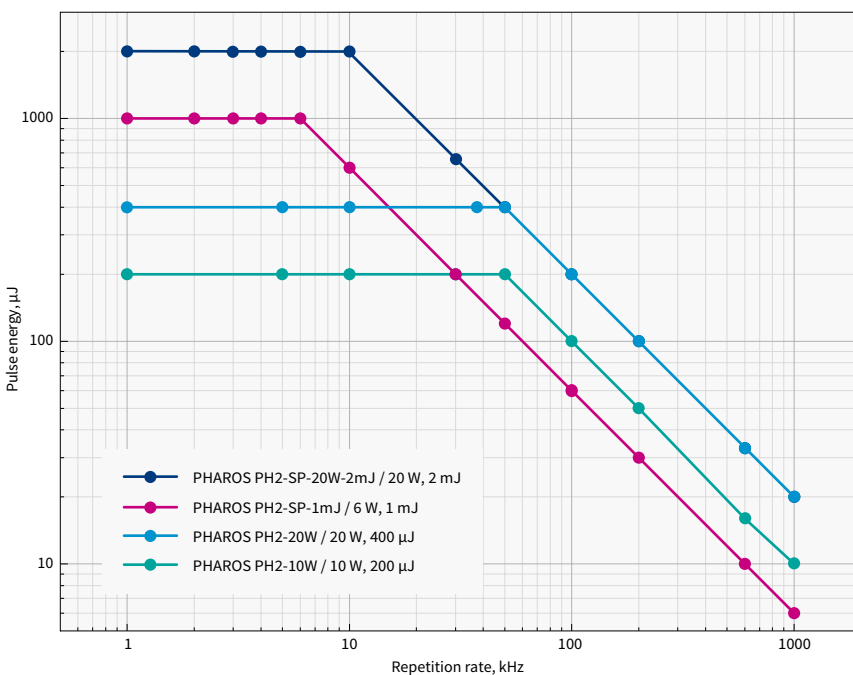
FEATURES

- 190 fs – 20 ps tunable pulse duration
- 2 mJ maximum pulse energy
- 20 W maximum output power
- Single-shot – 1 MHz repetition rate
- Pulse picker for pulse-on-demand mode
- Industrial-grade design
- Optional automated harmonic generator
- Optional CEP stabilization
- Optional repetition rate locking to an external source

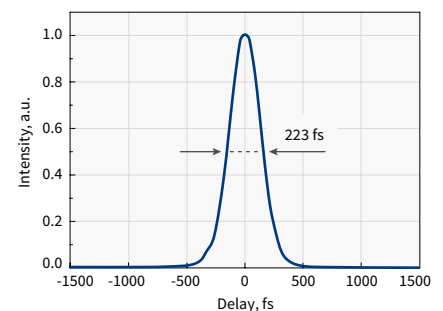


PHAROS is a series of femtosecond lasers combining millijoule pulse energy and high average power. PHAROS features a mechanical and optical design optimized for both scientific and industrial applications. A compact, thermally-stabilized, and sealed design enables PHAROS integration into various optical setups and machining workstations. Diode-pumped Yb medium significantly reduces maintenance costs and provides a long laser lifetime, while the robust optomechanical design enables stable operation in varying environments.

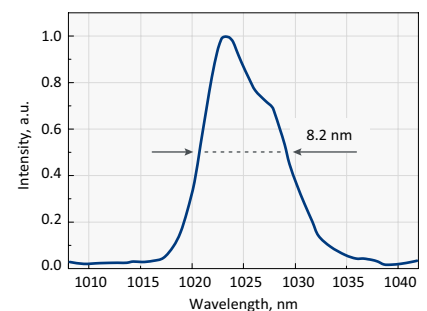
The tunability of PHAROS allows the system to cover applications normally requiring multiple different laser systems. Tunable parameters include pulse duration (190 fs – 20 ps), repetition rate (single-shot – 1 MHz), pulse energy (up to 2 mJ), and average power (up to 20 W). A pulse-on-demand mode is available using the built-in pulse picker. The versatility of PHAROS can be extended by a variety of optional modules.



Pulse energy vs fundamental repetition rate of PHAROS



Typical pulse duration of PHAROS



Typical spectrum of PHAROS

SPECIFICATIONS

| Model ¹⁾ | PH2-10W | PH2-15W | PH2-20W | PH2-SP-1mJ | PH2-SP-20W-2mJ |
|---------------------|---------|---------|---------|------------|----------------|
|---------------------|---------|---------|---------|------------|----------------|

OUTPUT CHARACTERISTIC

| | | | | | |
|---|--|------|------|--|--------|
| Maximum output power | 10 W | 15 W | 20 W | 10 W | 20 W |
| Pulse duration ²⁾ | < 290 fs | | | < 190 fs | |
| Pulse duration tuning range | 290 fs – 10 ps (20 ps on request) | | | 190 fs – 10 ps (20 ps on request) | |
| Maximum pulse energy | 0.4 mJ | | | 1 mJ | 2 mJ |
| Repetition rate | Single-shot – 1 MHz | | | | |
| Pulse selection | Single-shot, pulse-on-demand, any fundamental repetition rate division | | | | |
| Center wavelength ³⁾ | 1030 ± 10 nm | | | | |
| Polarization | Linear, horizontal | | | | |
| Beam quality | TEM ₀₀ ; M ² < 1.2 | | | TEM ₀₀ ; M ² < 1.3 | |
| Beam diameter ⁴⁾ | 2.5 mm | | | 2.9 mm | 4.3 mm |
| Pulse-to-pulse energy stability ⁵⁾ | RMS deviation ⁶⁾ < 0.5% over 24 h | | | | |
| Long-term power stability | RMS deviation ⁶⁾ < 0.5% over 100 h | | | | |
| Beam pointing stability | < 20 μrad/°C | | | | |
| Pre-pulse contrast | < 1 : 1000 | | | | |
| Post-pulse contrast | < 1 : 200 | | | | |

OPTIONAL EXTENSIONS

| | | | | | |
|--|---|--|--|--|--|
| Oscillator output | Optional. Contact sales@lightcon.com for more details or customized solutions | | | | |
| Typical output | 1 – 6 W, 50 – 250 fs, ≈ 1035 nm, ≈ 76 MHz; available simultaneously | | | | |
| Harmonic generator | Integrated, optional (see page 8) | | | | |
| Output wavelength | 515 nm, 343 nm, 257 nm, or 206 nm | | | | |
| Optical parametric amplifier | Integrated, optional (see page 15) | | | | |
| Tuning range | 320 – 10000 nm | | | | |
| BiBurst option | Tunable GHz and MHz burst with burst-in-burst capability, optional (see page 9) | | | | |
| GHz-Burst | | | | | |
| Intra burst pulse period ⁷⁾ | 200 ± 40 ps | | | | |
| Number of pulses, P ⁸⁾ | 1 ... 25 | | | | |
| MHz-Burst | | | | | |
| Intra burst pulse period | ≈ 15 ns | | | | |
| Number of pulses, N | 1 ... 9 (7 with FEC) | | | | |

PHYSICAL DIMENSIONS

| | |
|--|--------------------|
| Laser head (L × W × H) ⁹⁾ | 780 × 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 | 100 V AC, 12 A – 240 V AC, 5 A; 50 – 60 Hz |
| Rated power | 1000 W |
| Power consumption | 600 W |
| Electrical requirements (chiller) | 100 – 230 V AC; 50 – 60 Hz |
| Rated power (chiller) | 1400 W |
| Power consumption (chiller) | 1000 W |

¹⁾ More models are available on request.

²⁾ Assuming Gaussian pulse shape.

³⁾ Precise wavelengths for specific models are available on request.

⁴⁾ FWHM, measured at laser output, using maximum pulse energy.

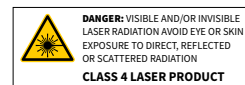
⁵⁾ Under stable environmental conditions.

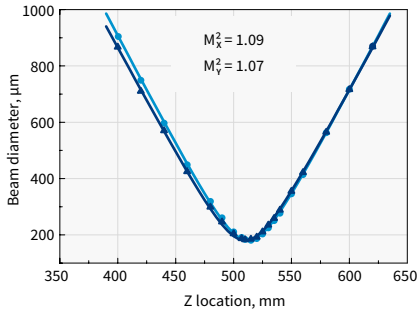
⁶⁾ Normalized to average pulse energy, NRMSD.

⁷⁾ Custom spacing is available on request.

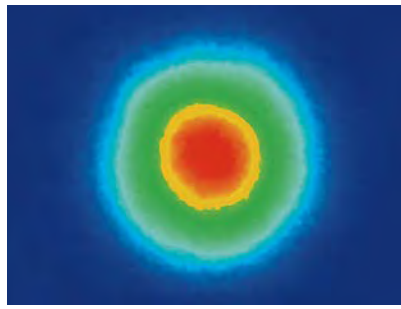
⁸⁾ Maximum number of pulses in a burst depends on the laser repetition rate. Custom number of pulses are available on request.

⁹⁾ Dimensions might increase for the lasers with integrated optional modules.

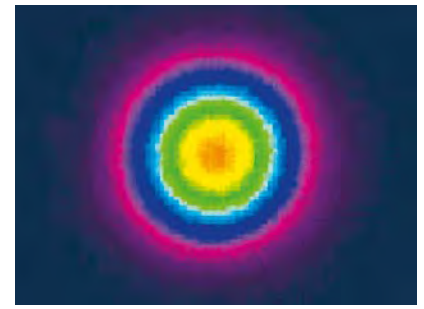




Typical M^2 measurement data of PHAROS

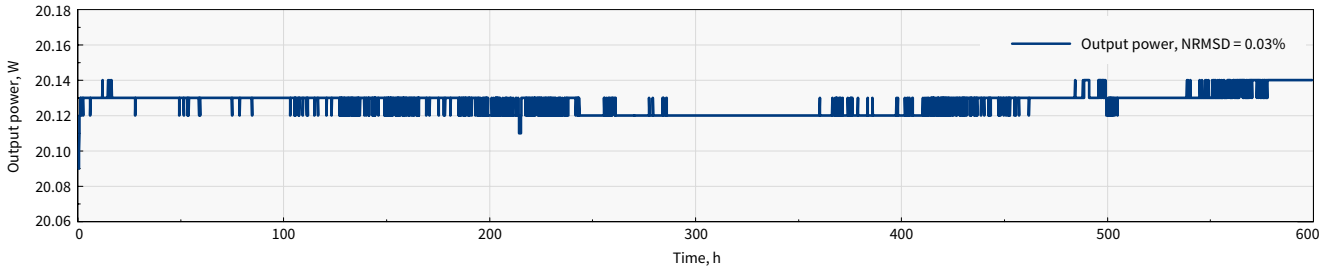


Typical near-field beam profile of PHAROS at 200 kHz

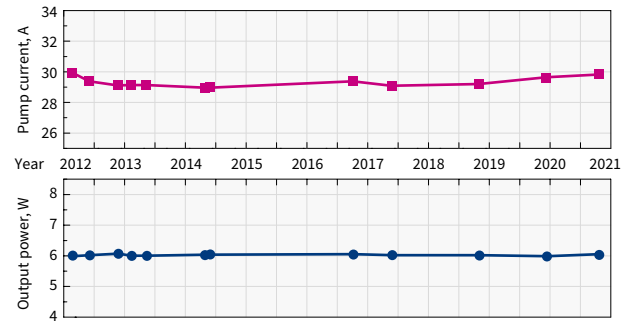
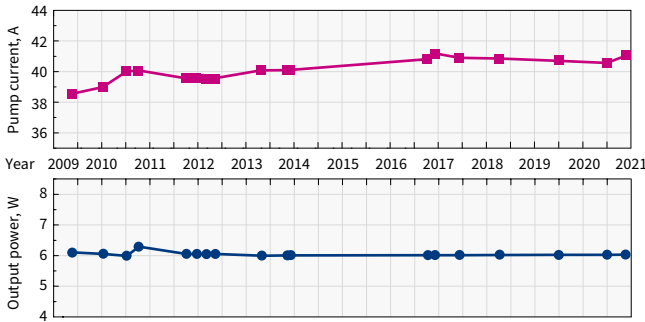


Typical far-field beam profile of PHAROS at 200 kHz

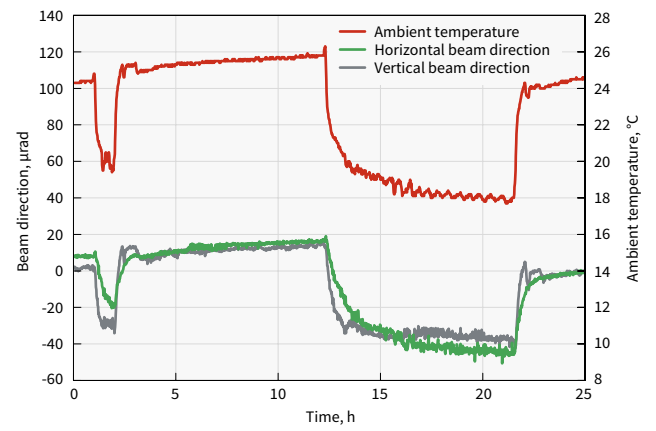
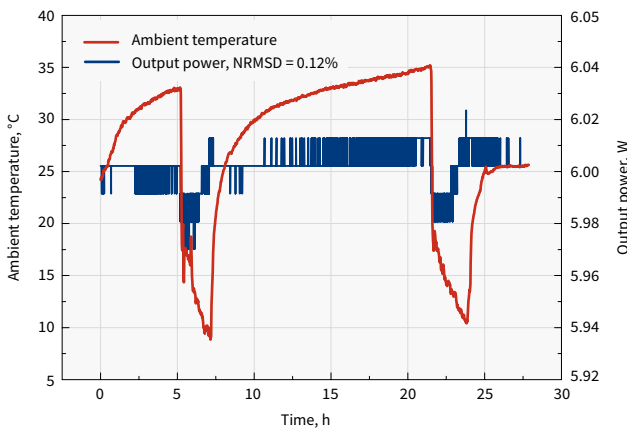
STABILITY MEASUREMENTS



Long-term power stability of PHAROS

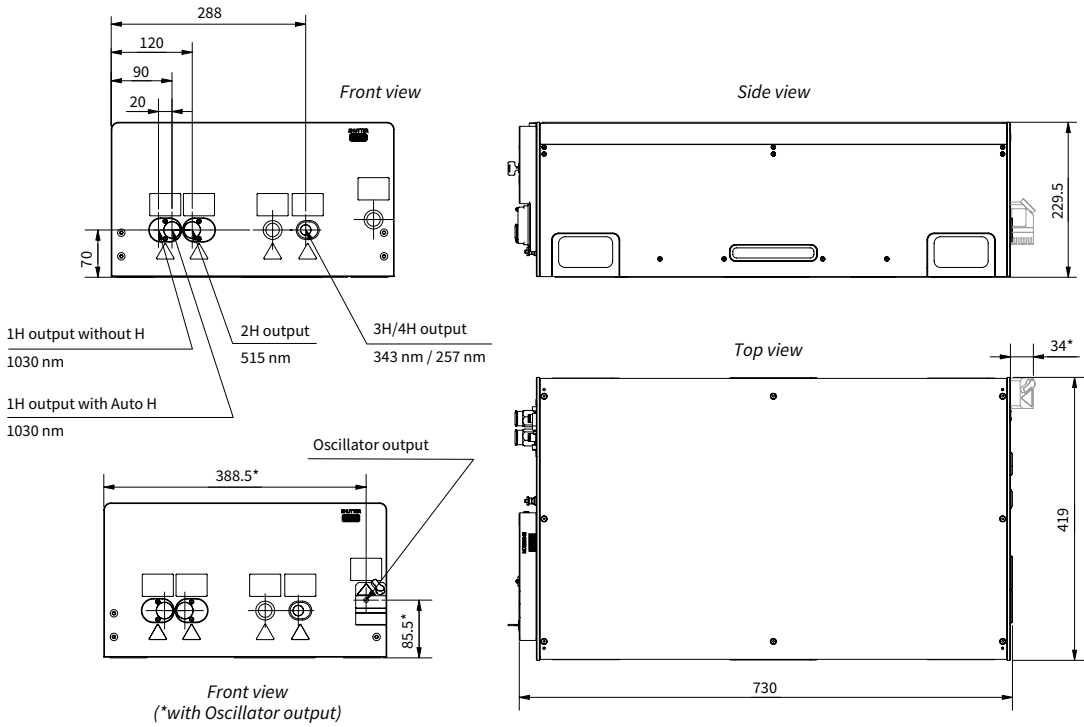


Output power of industrial-grade PHAROS lasers operating 24/7 and current of pump diodes during the years



PHAROS output power and beam direction with power lock enabled, under harsh environmental conditions

DRAWINGS



PHAROS-PH2 laser PH2-730 housing drawing


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HG | PHAROS

Automated Harmonic Generators

FEATURES

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



Harmonic generator attached to PHAROS

PHAROS lasers equipped with automated harmonic generators (HGs) provide a selection of fundamental (1030 nm), second (515 nm), third (343 nm), fourth (257 nm), or fifth (206 nm) harmonic outputs using software control.

HGs are perfect for industrial applications that require a single-wavelength output. Modules, mounted directly at the output of the laser, are fully integrated into the system.

SPECIFICATIONS

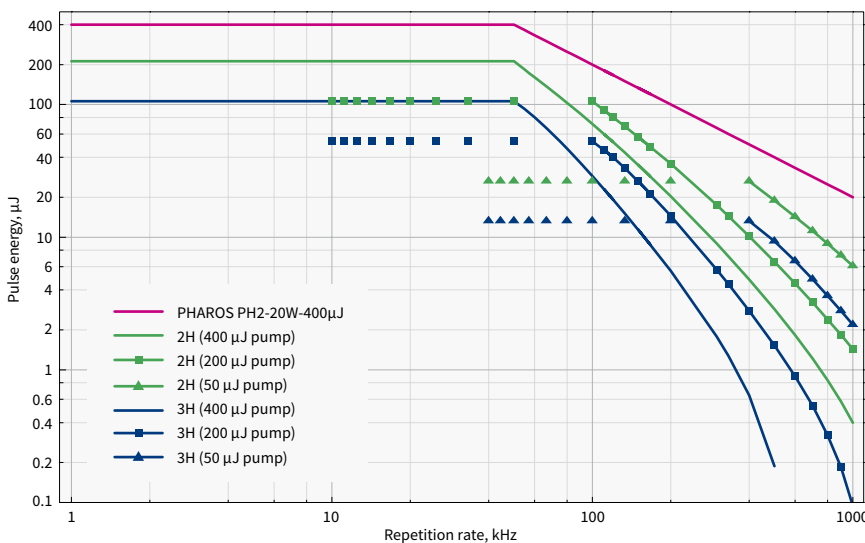
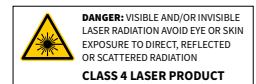
| Model | | 2H (-HE) | 2H-3H (-HE) | 2H-4H (-HE) | 4H-5H |
|--|---------------|----------------------------|---|--|---|
| Output wavelength ¹⁾ (automated selection) | | 1030 nm 515 nm | 1030 nm 515 nm 343 nm | 1030 nm 515 nm 257 nm | 1030 nm 257 nm 206 nm |
| Pump pulse energy | | 20 – 2000 μJ | 50 – 2000 μJ ²⁾ | 20 – 2000 μJ ²⁾ | 200 – 1000 μJ |
| Pump pulse duration | | 190 – 300 fs | | | |
| Conversion efficiency | | > 50% (2H) | > 50% (2H) > 25% (3H) | > 50% (2H) > 10% (4H) ³⁾ | > 10% (4H) ³⁾ > 5% (5H) ⁴⁾ |
| Beam quality (M ²) | ≤ 400 μJ pump | < 1.3 (2H), typical < 1.15 | < 1.3 (2H), typical < 1.15 < 1.4 (3H), typical < 1.2 | < 1.3 (2H), typical < 1.15 n/a (4H) | n/a |
| | > 400 μJ pump | < 1.4 (2H) | < 1.4 (2H) < 1.5 (3H) | < 1.4 (2H) n/a (4H) | |

¹⁾ Depends on pump laser model.

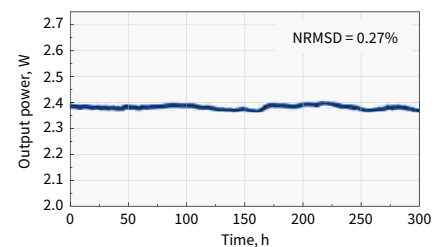
²⁾ High energy versions are available, contact sales@lightcon.com for specifications.

³⁾ Maximum output power of 1 W.

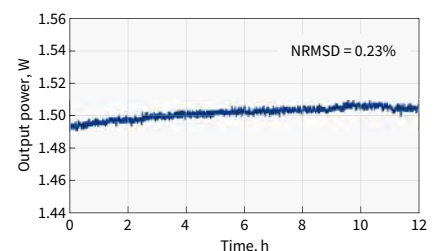
⁴⁾ Maximum output power of 0.15 W.



Pulse energy vs repetition rate of PHAROS with HG



3H output power stability



4H output power stability

BiBurst option

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

PHAROS and CARBIDE (CB3) lasers have an option for tunable GHz and MHz burst with burst-in-burst capability – called BiBurst.

In standard mode, a single pulse is emitted at some fixed frequency. In burst mode, the output consists of pulse packets instead of single pulses. Each packet consists of a certain number of equally separated pulses. MHz-Burst contains N pulses with a nanosecond period, GHz-Burst contains P pulses with a picosecond period. If both bursts are used, the equally separated pulse packets contain sub-packets of pulses (burst-in-burst, BiBurst).

PHAROS and CARBIDE lasers with the BiBurst option bring new capabilities to high-tech manufacturing industries such as consumer electronics, integrated photonic chip manufacturing, future display manufacturing, and quantum technologies. The applications include:

- brittle material drilling and cutting
- deep engraving
- selective ablation
- volume modification of transparent materials
- hidden marking
- surface polishing
- surface functionalization

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 | 1 ... 25 |
| MHz-Burst | Intra burst pulse period | ≈ 15 ns | |
| | Number of pulses, N | 1 ... 10 | 1 ... 9 (7 with FEC) |

¹⁾ Custom spacing is available on request.

²⁾ Maximum number of pulses in a burst depends on the laser repetition rate. Custom number of pulses is available on request.

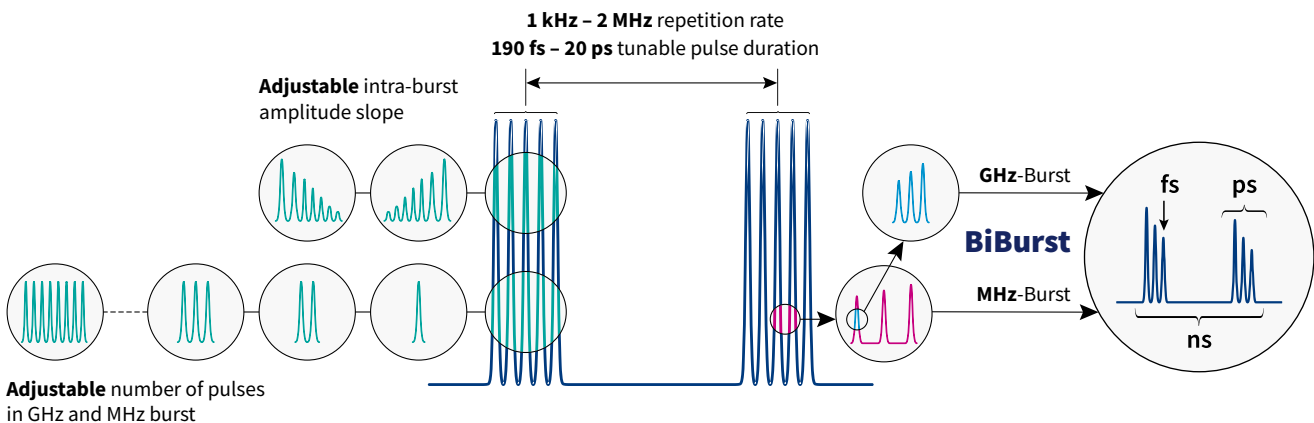


PHOTO
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