

# HARPIA | TA

## Ultrafast Transient Absorption Spectrometer



Layout example

Excellent performance at a high repetition rate

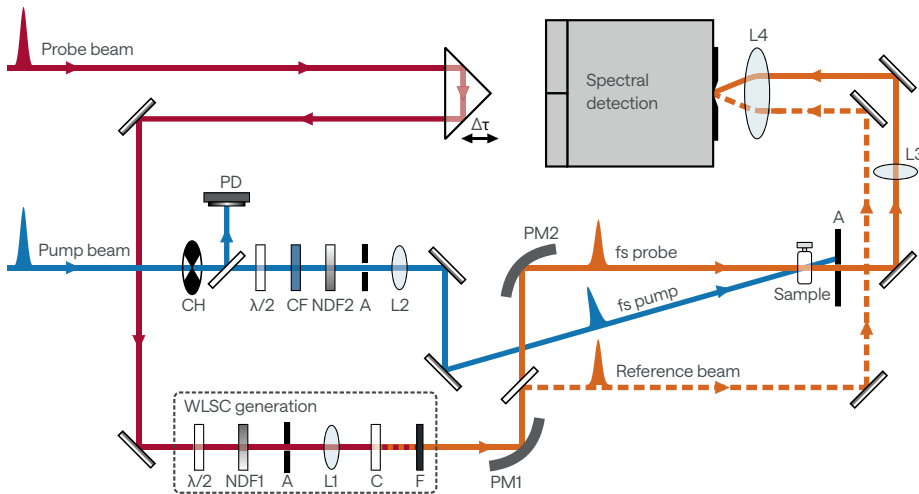
Measurement range from UV to MIR

Market-leading sensitivity

Modules for time-resolved, and multi-pulse experiments

High-level automation in a compact footprint

HARPIA-TA optical layout for pump-probe experiments

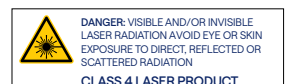


- A – aperture
- C – crystal
- CF – spectral filter
- CH – chopper
- F – filter
- L – lens
- PD – photodiode
- PM – parabolic mirror
- NDF – neutral density filter
- WLSC – white light supercontinuum
- $\Delta\tau$  – delay
- $\lambda/2$  – half-wave plate

### Specifications

Configuration	UV-VIS	UV-VIS-NIR	MIR
Probe spectral range	350 – 1100 nm	350 – 1600 nm	2000 – 13000 nm
Pump range	240 – 2200 nm		450 – 2200 nm <sup>1)</sup>
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		Laser repetition rate
Modes	Reflection and transmission		

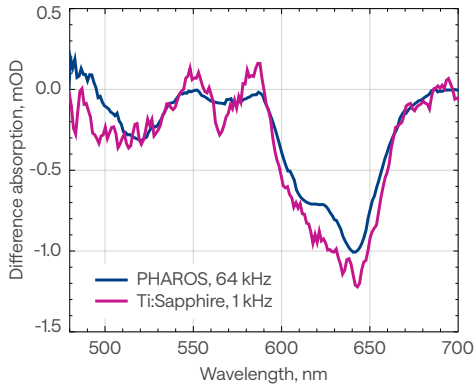
<sup>1)</sup> Wavelength range is configurable to 240 – 700 nm.  
Contact [sales@lightcon.com](mailto:sales@lightcon.com) for more details.



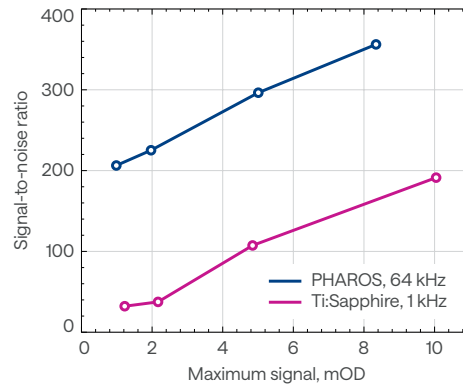
## Performance at high repetition rates

The **HARPIA** spectroscopy system achieves an excellent signal-to-noise ratio at a high repetition rate 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)



## Software

### **HARPIA** Service App

#### Control and data acquisition software

A single software solution for all measurement modes, featuring:

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

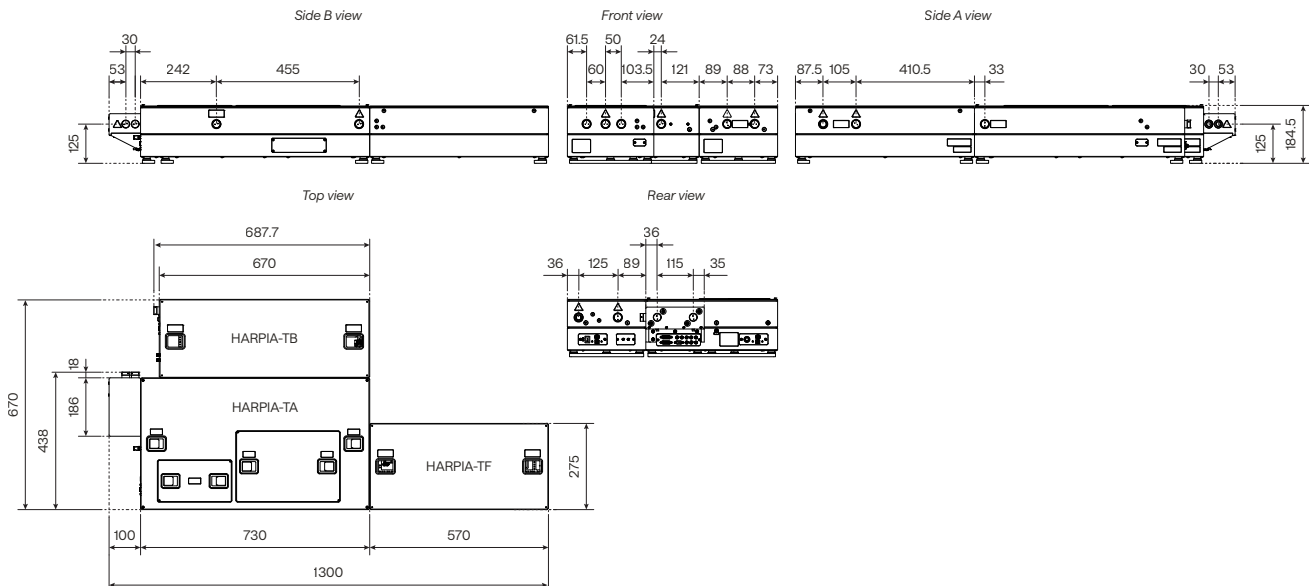
#### Data analysis software

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

## Drawings

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



# HARPIA | TF Time-Resolved Fluorescence Module

Time-resolved fluorescence spectroscopy carries information on the molecular processes in the excited states. HARPIA-TF combines different measurement modes, thus allowing the observation of fluorescence dynamics at different time scales.

Using a high-repetition-rate PHAROS or CARBIDE laser, the fluorescence dynamics can be measured while exciting the samples with pulse energies down to several nanojoules.

### Kerr gate

Easy to use. Simpler alignment and maintenance. The entire spectrum is measured at once.

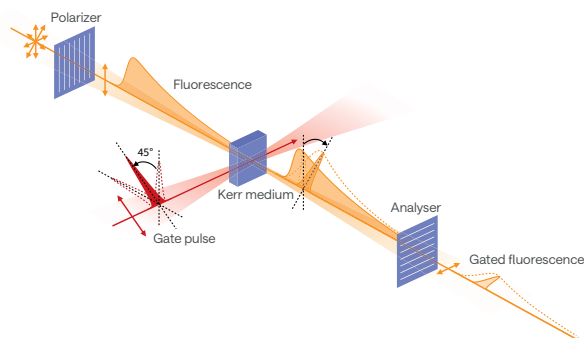
### Fluorescence upconversion (FU)

Better temporal resolution for measuring fast fluorescence events.

### Time-correlated single-photon counting (TCSPC)

Fluorescence lifetime measurements are extendible to measure phosphorescence signals.

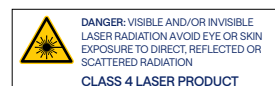
Principle of Kerr gate spectroscopy



## Specifications

Module	HARPIA-TF		
Measurement technique	Kerr gate	Fluorescence upconversion	TCSPC
Spectral range	250 – 1100 nm	330 – 820 nm	220 – 820 nm <sup>1)</sup>
Pump range	240 – 2200 nm		
Temporal resolution	400 – 500 fs	≤ laser pulse duration or better	< 180 ps or < 50 ps
Max measurement range	8 ns		5 μs
Delay resolution	8.3 fs		n/a
Gate (probe) beam requirements	25 – 30 μJ		n/a
Compatible with	TCSPC		Kerr gate or fluorescence upconversion
Modes	Transmission		

<sup>1)</sup> Spectral range is extendable with an additional NIR detector (measurement range 1000 - 1700 nm); contact sales@lightcon.com for more details.



# HARPIA | TA-FP Flash Photolysis – Nanosecond TA Module

The flash photolysis experiment is designed to measure the long-lived states of molecular systems.

The principle of flash photolysis is analogous to the femtosecond transient absorption (TA) experiment but with a delay in a nanosecond–millisecond range.

## 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	450 – 1100 nm	450 – 1600 nm	350 – 1100 nm	350 – 1600 nm
Pump range	240 – 2200 nm			
Delay range	up to 8 ms		up to 500 μs	
Delay resolution	100 ps			
Temporal resolution	2 ns		1 ns	
Probe laser repetition rate	1850 Hz			
Maximum data acquisition rate	3850 Hz			
Modes	Reflection and transmission			

# 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.

## Femtosecond stimulated Raman scattering (FSRS)

Delivering frequency-narrowed picosecond pulses allows to perform FSRS measurements. It is a time-resolved spectroscopy technique for observing changes in the vibrational structure of optically excited molecular systems.

## Multi-pulse time-resolved transient absorption

Multi-pulse time-resolved spectroscopic techniques are a way to manipulate the reactions and access new regions of the higher excited states.

## Specifications

Module	HARPIA-TB	
Configuration	Pump for multi-pulse experiments	NIR probe
Acceptable wavelength range	450 – 2200 nm <sup>1)</sup>	1600 – 2600 nm
Delay range (resolution)	4 ns (4.2 fs)	
Modes	Transmission	

<sup>1)</sup> Wavelength range is configurable to 240 – 700 nm. Contact [sales@lightcon.com](mailto:sales@lightcon.com) for more details.

## 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 wavelengths (350 – 1100 nm).



### Beam Profiler

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

**PHOTO  
TECHNICA** [www.phototechnica.co.jp](http://www.phototechnica.co.jp)  
フォトテクニカ株式会社  
〒336-0017 埼玉県さいたま市南区南浦和 1-2-17  
TEL:048-871-0067 FAX:048-871-0068  
e-mail:voc@phototechnica.co.jp



## Transient Grating Spectrometer



Carrier diffusion coefficient in a matter of minutes

Non-invasive measurement technique

Fully automated and computer controlled

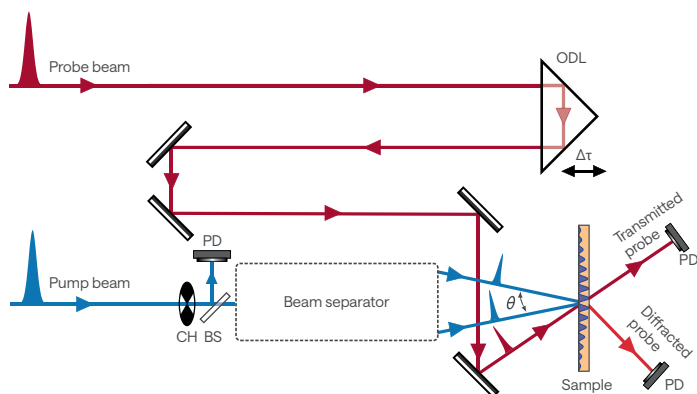
Continuous setting of grating period

Sensitivity down to  $\mu\text{J}/\text{cm}^2$  excitation level

Advanced measurement and analysis software

Photoluminescence (PL) measurement option

### HARPIA-TG principal scheme



BS – beam splitter  
CH – chopper  
PD – photodiode

ODL – optical delay line  
PM – parabolic mirror

$\theta$  – intersection angle  
 $\Delta\tau$  – delay

### Specifications

Measurement mode	Transmission	Reflection
Grating recording wavelength <sup>1)</sup>	340 – 560 nm	
Probe wavelength <sup>2)</sup>	1030 nm	
Grating period <sup>3)</sup>	1.05 – 12.5 $\mu\text{m}$	1.5 – 4.5 $\mu\text{m}$
Pulse duration	< 290 fs	
Delay range	Up to 8 ns	

### MEASUREMENT RANGES

Diffusion coefficient	$\geq 0.1 \text{ cm}^2/\text{s}$
Carrier lifetime	3 ps – 8 ns

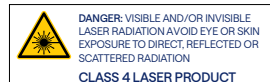
### DIMENSIONS

Physical dimensions (L x W x H)	730 x 420 x 188 mm
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<sup>1)</sup> Extendable to 750 nm by applying different physical gratings. Contact sales@lightcon.com for more details.

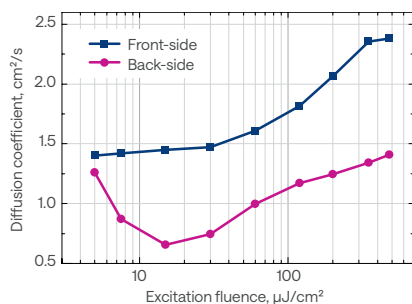
<sup>2)</sup> OPA-based probe is available upon request. Contact sales@lightcon.com for more details.

<sup>3)</sup> Depends on the pump wavelength.

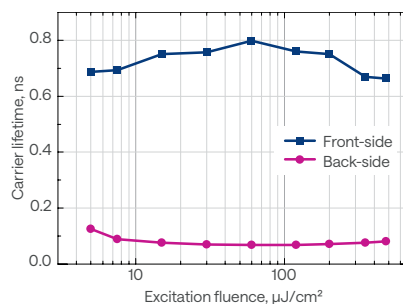


### Performance

Diffusion coefficient of GaN as a function of fluence



Carrier lifetime of GaN as a function of fluence



Diffusion length of GaN as a function of fluence

