

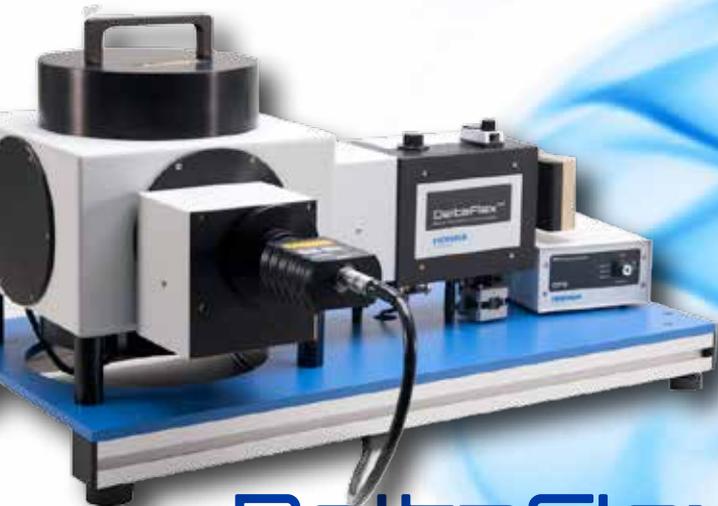
# HORIBA

Scientific

# fluorescence

# REINVENTED!

# lifetime



## DeltaFlex



## DeltaPro

ELEMENTAL ANALYSIS

FLUORESCENCE

GRATINGS &  
OEM SPECTROMETERS

OPTICAL COMPONENTS

FORENSICS

PARTICLE CHARACTERIZATION

RAMAN

SPECTROSCOPIC ELLIPSOMETRY

SPR IMAGING



## Why measure fluorescence lifetimes?

Fluorescence is an ideal nanoscale probe, as it takes place on the nanosecond timescale and can be influenced by molecular processes occurring on the nanometer range. The emission lifetime of a fluorophore can be highly influenced by its environment or the presence of other interacting molecules.

### Thus fluorescence lifetime is useful in measuring:

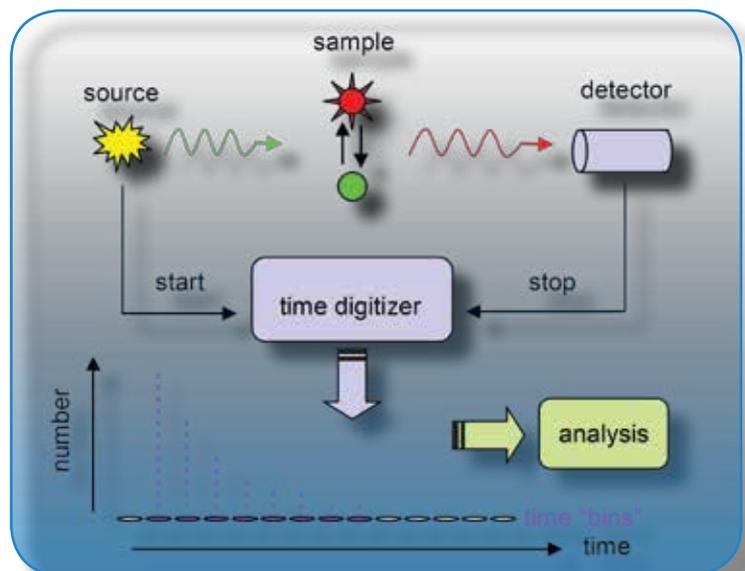
- Changes in the nanoenvironment (viscosity, pH, polarity, solvation)
- Size and shape of molecules
- Molecular interactions
- Inter- and intramolecular distances
- Kinetic and dynamic rates
- Resolution of molecular mixtures

The extra specificity of the fluorescence lifetime allows easy discrimination against scattered excitation and background fluorescence. For example, determination of Förster resonance energy transfer (FRET) is simpler using the fluorescence lifetime, as are quenching and fluorescence anisotropy measurements, allowing more parameters to be recovered. Unlike steady-state, lifetime is also an absolute measurement and is independent of sample concentration, label loading/binding uniformity, and fluctuations in excitation intensity.

## Why use Time Correlated Single Photon Counting (TCSPC) to measure lifetime?

TCSPC has always been the most sensitive method for measuring fluorescence lifetimes. However, the Delta series also makes TCSPC:

- Fast
- Easy to use
- Compact
- AFFORDABLE



# The Delta Series



**From the simplest, easiest to use  
TCSPC system to the most  
flexible and versatile**



The new Delta series of fluorescence TCSPC lifetime systems are the fastest, most flexible, and most affordable lifetime solutions available. The Delta series includes the DeltaPro, the very affordable and simple to use filter-based lifetime system with performance that rivals most high end systems. For the ultimate flexibility and upgradability, DeltaFlex, our modular system, seamlessly integrates monochromators, polarizers, the widest array of sources (LEDs, laser diodes, supercontinuum lasers) and detectors (including NIR). This enables lifetimes from 25 ps to 1 sec, over wavelengths spanning the UV to NIR, to be measured.

The culmination of over 40 years of lifetime experience, Delta series highlights include: the fastest sources (up to 100 MHz), the widest lifetime ranges (ps to sec), virtually unlimited configurability with our new F-Link plug-and-play architecture and advanced lifetime analysis software. The Delta series is truly the next generation of fluorescence lifetime systems.

## Delta Series Features

- **Fast...**acquisition times from one millisecond
- **Sensitive...**uses single-photon counting detection
- **Accurate...**crystal locked timing circuits never require recalibration
- **Wide range...**resolves lifetimes from 25 ps to 1 second
- **Modular...**easily reconfigured as measurement requirements evolve
- **Compact...**desktop dimensions
- **Convenient...**single USB 2.0 connection to PC
- **Two configurations:** DeltaPRO - very cost effective and simple TCSPC  
DeltaFlex - ultimate flexibility and performance

## DeltaPro™

The DeltaPro is a remarkably affordable, easy to use filter-based lifetime system that still offers capabilities found in far more expensive and complex systems. DeltaPro's simplicity makes it the ideal system for a multi-user facility with researchers who need to measure lifetimes, or a combined research/ teaching lab. But don't let the price and approachability fool you. The DeltaPro is a serious research instrument capable of picosecond lifetime measurements. With the addition of SpectraLED excitation sources it instantly becomes a phosphorimeter. Our proprietary optimized performance optics, sources and detectors mean that measurement of weakly emitting samples becomes routine. Finally, the DeltaPro is supported by our analysis software that gives you access to the same full array of lifetime analysis modules as our most sophisticated systems.



## DeltaFlex™

The DeltaFlex is our fully configurable, most flexible and powerful lifetime system that offers unmatched capabilities. Using our proprietary F-Link, the DeltaFlex is easily upgradable and can be expanded to incorporate additional monochromators, NIR detectors, third party lasers, cryostats and more. DeltaFlex's versatility makes it the ultimate tool for users performing state-of-the-art lifetime research. The DeltaFlex is also supported by our powerful acquisition and analysis software that gives you direct control of all the motorized accessories connected to the system, as well as the same full array of lifetime analysis capabilities.



# Measurement types and examples

The Delta series includes configurations ideal for all modes of lifetime measurements, including kinetics, anisotropy and TRES (Time-resolved emission spectra), for all lifetime applications such as FRET, measurement of physical constants (such as local viscosity), binding studies and photophysical characterization of molecular interactions.

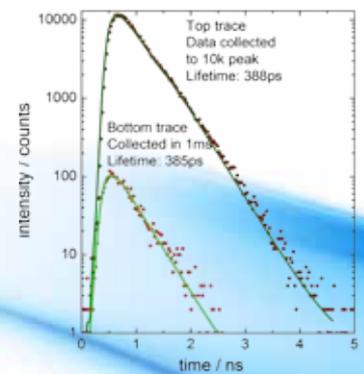
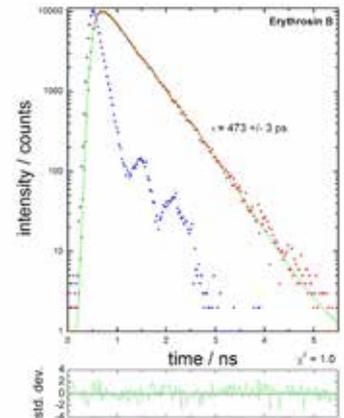


## Lifetime

- from 25 ps to 1 s
- acquire data in as little as 1 ms

### Useful for...

- molecular interactions
- LRET / FRET
- determination of parameters
- understanding photophysical processes

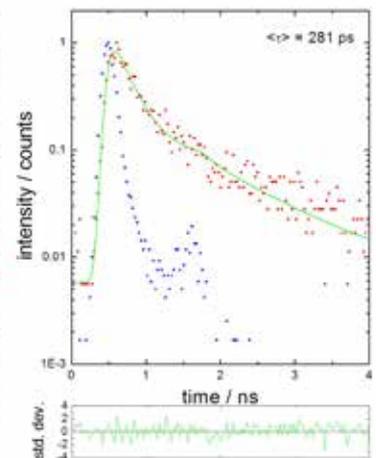
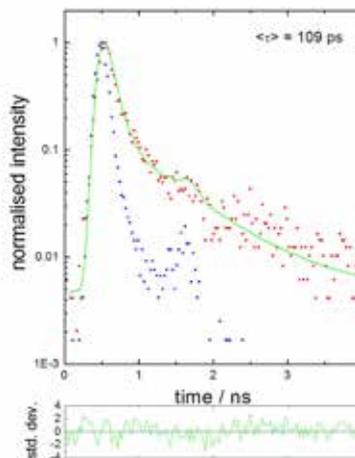
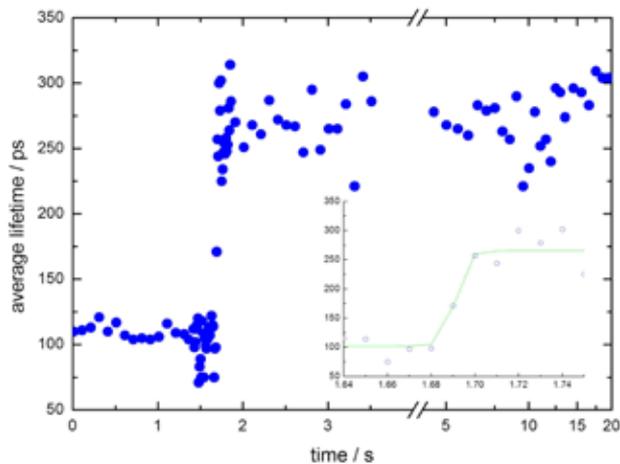
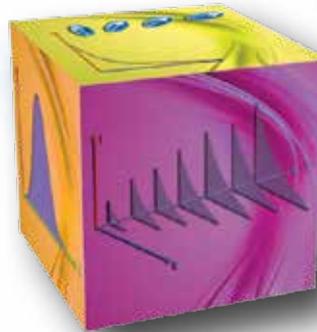


## Kinetic TCSPC

- collect up to 10,000 decays sequentially
- acquisition times from 1 ms to 1 minute

### Useful for...

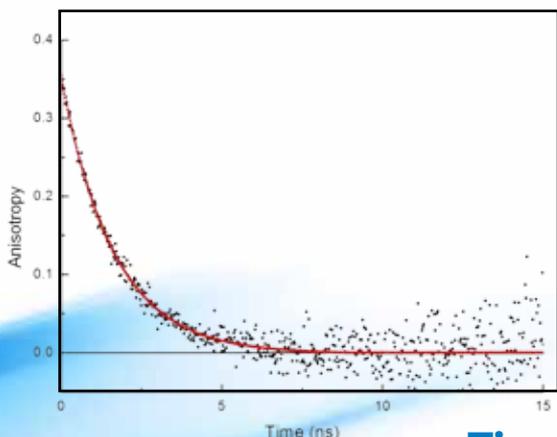
- kinetic studies
- binding information
- molecular interactions
- monitoring changes in local environment



# Measurement types and examples (continued)

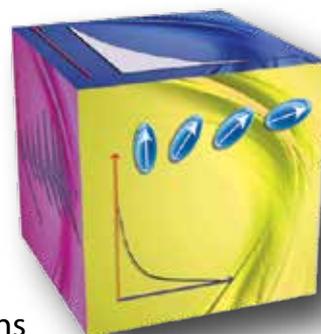
## Anisotropy

- fluorescence and phosphorescence timescales
- reconvolution to determine short correlation times



### Useful for...

- molecular interactions
- changes in local viscosity
- determinations of molecular size
- energy depolarization processes

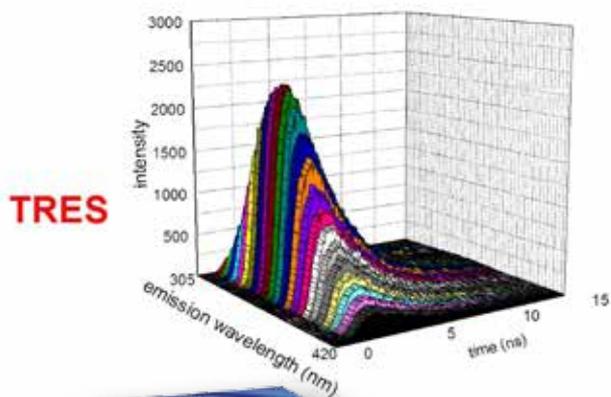
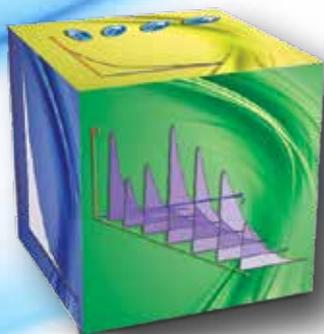


## Time-resolved emission spectra (TRES)\*

- create intensity, wavelength, time surfaces
- fluorescence and phosphorescence timescales
- time slice spectral data
- global analysis of up to 100 wavelength dependent decays
- enables determination of decay associated spectra

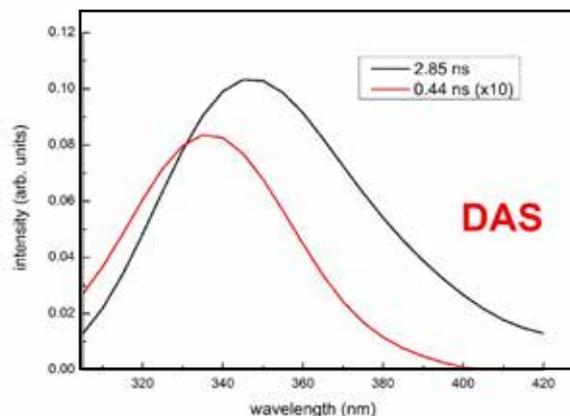
### Useful for...

- resolving spectra from a mixture of fluorophores
- monitoring time dependent emissions
- molecular interactions

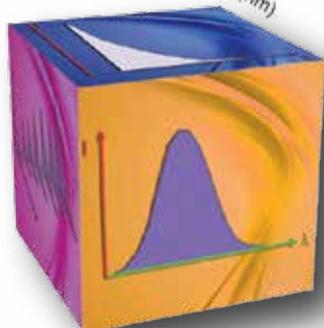


TRES

global analysis



DAS



## Steady-state\*

### Useful for...

- determination of emission wavelength using TCSPC excitation source

\*Requires a monochromator

# Delta series components:

## Delta series excitation sources

From UV to NIR, all excitation sources are software controlled, with the repetition rate automatically adjusted to suit the time range.



### DeltaDiodes

Utilize laser diode and LED technology to generate short optical pulses over a very wide range of repetition rates and wavelengths.

#### Features:

Optical pulses as short as 40 ps for laser diode-based sources

Repetition rates up to 100 MHz (20MHz for LEDs)

Wavelengths 250-1310 nm

(See website for full range and specifications)

CW available on most laser diode versions

Plug-n-play compatible within DeltaDiode range

### NanoLEDs

Can generate pulses with repetition rates up to 1MHz.

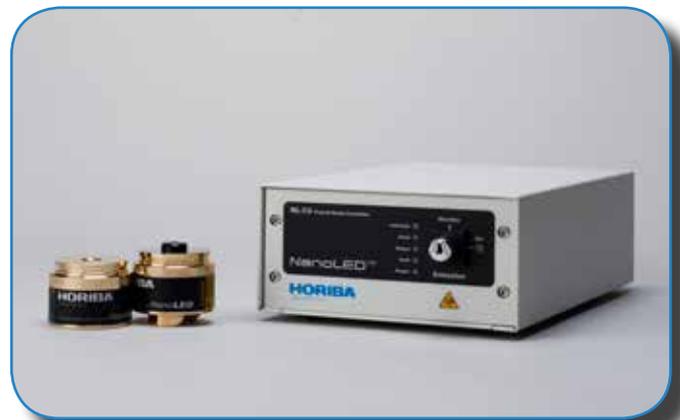
#### Features:

Wavelengths from 250-1310 nm (See website for full range)

Plug-n-play compatible within NanoLED range

Laser diode based sources generate pulses <100 ps

LEDs generate pulses ~1 ns



### SpectraLEDs

Longer pulsed excitation sources designed specifically for phosphorescence lifetimes.

#### Features:

Pulses range from microseconds to milliseconds

Wavelengths range from UV to NIR

Plug-n-play compatible in SpectraLED range

Unique to HORIBA Scientific



## Delta series detectors

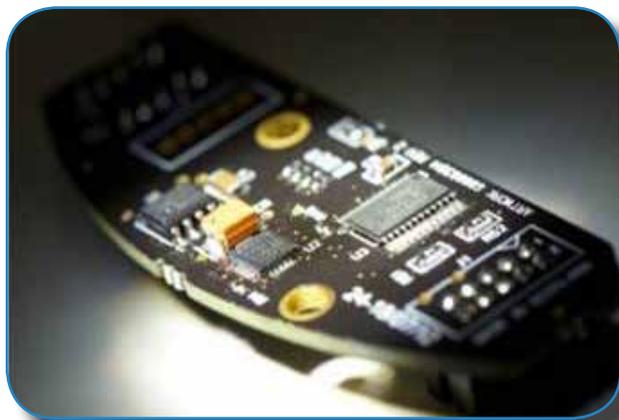


PPD detectors are compact and include all electronics required to detect single photons with picosecond accuracy. The module contains a wide bandwidth GHz pre-amplifier, picosecond timing constant fraction discriminator and regulated high voltage supply all in one compact, fully integrated package.

NIR detectors are also available. These can extend the wavelength range up to 1700 nm. For detectors whose wavelength response starts at 950 nm, it is also possible to couple both a NIR detector and PPD to the same monochromator using a selectable mirror block.

The heart of the Delta series is the DeltaHub timing module. This features an ultra-short dead time of only 10ns that is perfectly matched to our high repetition diode light sources and high speed detectors. This unique combination of technologies achieves near lossless photon counting, making the Delta series both accurate and fast.

- Ultra-low deadtime (<10 ns)
- Counts virtually every photon
- Measures lifetimes from picoseconds to seconds
- USB interface – no PCI cards



## DeltaHub timing electronics

- High throughput photon counting



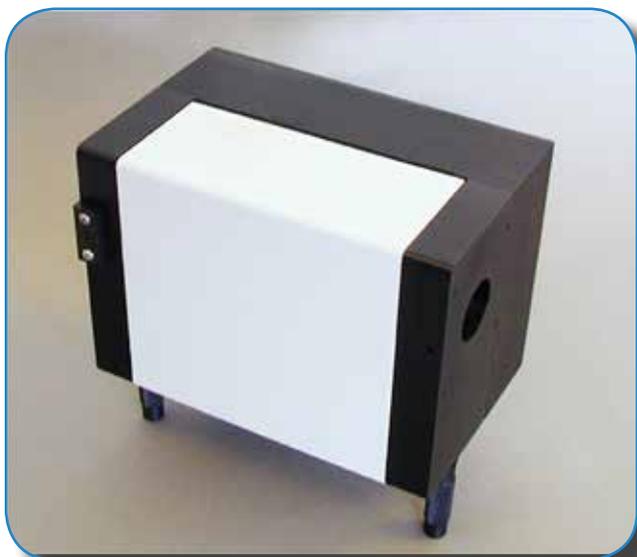
## F-link hardware communication

- Intelligent components and robust communication

F-link is an internal bus that is used in the Delta series to link the various components together. For example, the sample compartment lid is interlocked via F-link to protect the detector and optionally switch off the laser. Other new accessories such as motorized polarizers also come with F-link. Since each F-link "node" is intelligent, whenever an F-link component is added to the system, it is auto-detected, and the configuration automatically updates without relying on troublesome registry settings.

## Time-domain monochromators

Give excellent stray light rejection and a time dispersion of 0.13 ps/nm. They are designed with a Seya-Namioka geometry and feature an integral safety shutter interlocked to the sample compartment and computer-controlled adjustable slits and wavelength drive.



## Sample holders

- Standard with stirrer and temperature sensor
- Front face, able to accept cuvettes for concentrated samples
- Front surface for use with solid samples

Temperature control and 4 position turret optional

# Simple yet powerful acquisition and analysis software

Allows control over the hardware and data collection plus a complete suite of data analysis modules making use of our proprietary hybrid search algorithm.

Analysis for up to 5 exponentials

Exciplex kinetics

Lifetime distribution

Top-hat

Non-extensive decay (NED)

Exponential series

Förster energy transfer

Yokota-Tanimoto energy transfer

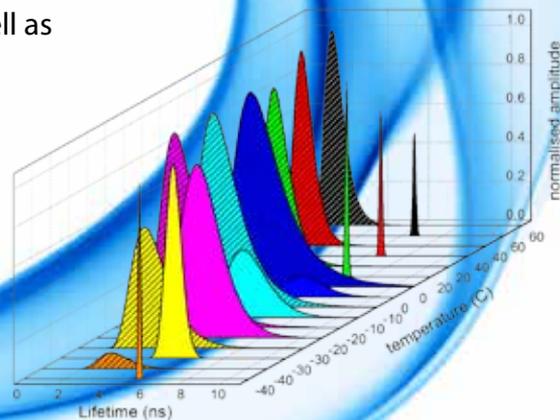
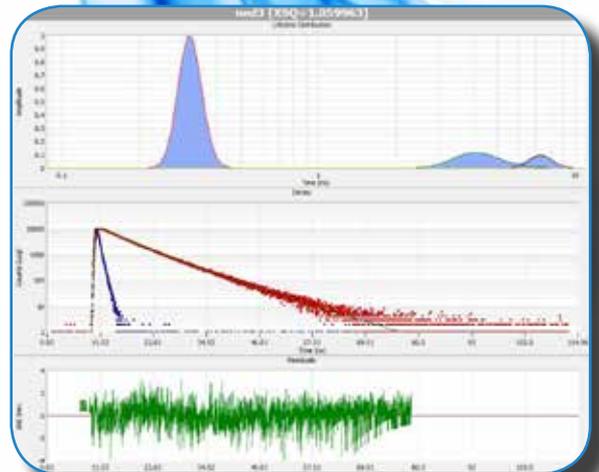
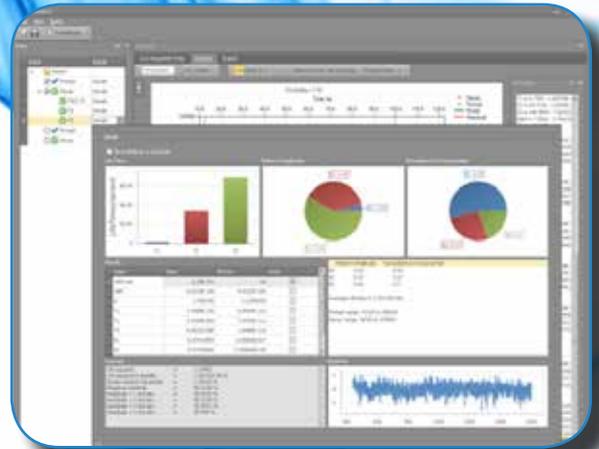
Micellar quenching

Anisotropy analysis (including reconvolution to resolve short correlation times)

Batch exponential analysis

Global exponential analysis

These modules include our proprietary NED distribution analysis. This is a form of analysis based on the gamma function distribution, which is the most probable form of distribution for positive lifetimes. Unlike “model free” analyses, such as exponential series method (ESM) and the maximum entropy method (MEM), it starts with a defined number of distributions. This constraint means that it is less likely to produce artifacts, and is a simpler method to fit both complex, as well as purely discrete exponential decays.



## DeltaPro Specifications

	DeltaPro-DD	DeltaPro-NL
Minimum lifetime	25 ps with laser-diode source	30 ps with laser-diode source
Shortest acquisition time	1 millisecond*	100 milliseconds*
Diode controller	DeltaDiode and SpectraLED	NanoLED and SpectraLED
Repetition rates	10 kHz–100 MHz with DeltaDiode* 0.1 Hz–2.6 kHz with SpectraLED	10 kHz–1 MHz with NanoLED 0.1 Hz–2.6 kHz with SpectraLED
Prompt FWHM	<200 ps FWHM with PPD and laser diode (405 nm)	
Dead time	10 ns	
Time ranges	10 ns–11 s	100 ns–11 s
Wavelength selection	Interchangeable filters (filters purchased separately from HORIBA or others)	
Detector response	250–650 nm standard; 250–850 nm and 300–900 nm optional	
PC interface	USB 2.0. PC not included. Requires Windows® XP or Windows® 7, 32/64-bit English language ver.	
System footprint	75 cm × 45 cm nominal excluding PC (depending on options)	

## DeltaFlex Specifications

Minimum lifetime	25 ps with laser-diode source*		
Shortest acquisition time	1 millisecond*		
Diode controller	DeltaDiode-C1, SpectraLED		
Repetition rates	10 kHz–100 MHz with DeltaDiode*; 0.1 Hz–2.6 kHz with SpectraLED		
Prompt FWHM	<200 ps FWHM with laser diode (405 nm)		
Dead time	10 ns		
Time ranges	10 ns–11 s		
Wavelength selection	Emission monochromator 200–800 nm standard; 300–1200 nm and 400–1600 nm optional Excitation and second emission monochromators also available		
Detector options	<i>PPD modules</i> PPD-650: 250–650 nm (standard) PPD-850: 250–850 nm optional PPD-900: 300–900 nm optional	<i>Near-IR options</i> H10330 series 950–1200/1400/1700 nm R5509 series 300–1400/1700 nm NIR detectors may be mounted to emission monochromator simultaneously as PPD	<i>MCP-PMT options</i> See FluoroCube UltraFast series
Automation	<i>Standard:</i> Lenses, sample stirrer, monochromator (wavelength and slits), diode controllers. <i>Optional:</i> Polarizers, sample turret, sample temperature.		
PC interface	USB 2.0. PC not included. Requires Windows® XP or Windows® 7, 32/64-bit English language ver.		
System footprint	75 cm × 55 cm nominal excluding PC (DeltaFlex-01)		

\*Dependent on sample and system configuration



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Lifetime  
Microspectroscopy

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