

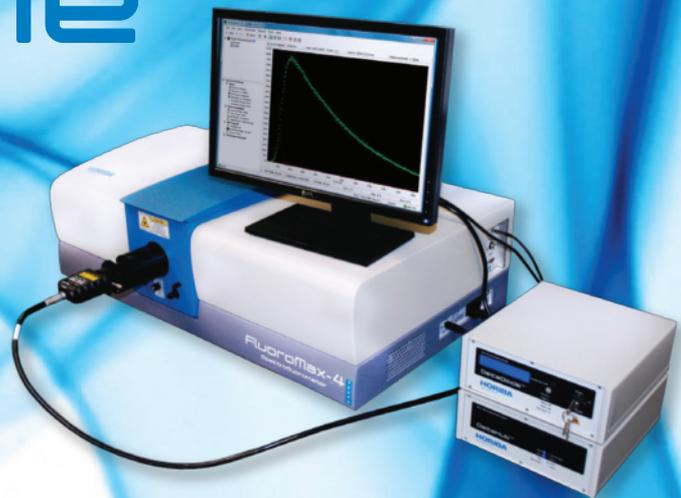
# HORIBA

Scientific



## DeltaTime

- Add a new dimension to your fluorescence
- Add the power of fluorescence lifetime spectroscopy to our steady-state fluorimeters



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:

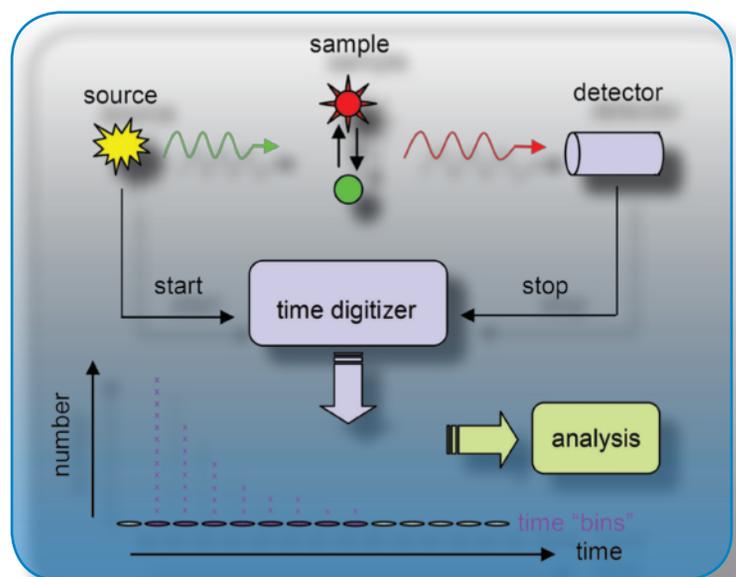
- Changes in the nanoenvironment (viscosity, pH, polarity, solvation)
- Size and shape of molecules
- Molecular interactions
- Inter- and intramolecular distances
- Kinetic and dynamic rates
- Resolution of molecular mixtures

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



# DeltaTime



Make the most sensitive and flexible  
fluorimeters even more versatile  
by adding lifetime capability



The DeltaTime TCSPC lifetime plug-in offers acquisition speed, flexibility, and affordability unavailable in any other hybrid fluorescence solution available. DeltaTime seamlessly integrates monochromators, polarizers, and other accessories with the widest array of sources (LEDs, laser diodes, supercontinuum lasers) and detectors (including NIR), providing lifetime coverage from 25ps to 1sec over wavelengths spanning the UV to NIR. The culmination of over 40 years of lifetime experience, DeltaTime highlights include: the fastest sources (up to 100 MHz), the widest lifetime ranges (ps to sec), virtually unlimited configurability and advanced lifetime analysis software. DeltaTime is part of our Delta series...truly the next generation of fluorescence lifetime systems.

## DeltaTime Features:

- Fast...lifetime acquisition times from one millisecond
- Sensitive...uses single-photon counting detection
- Accurate...crystal locked timing circuits never require recalibration
- Wide range...resolves lifetimes from 25ps to 1 second
- Modular...easily reconfigured as measurement requirements evolve
- Compact...desktop dimensions
- Convenient...single USB 2.0 connection to PC

# Measurement types and examples

The Delta series include 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.

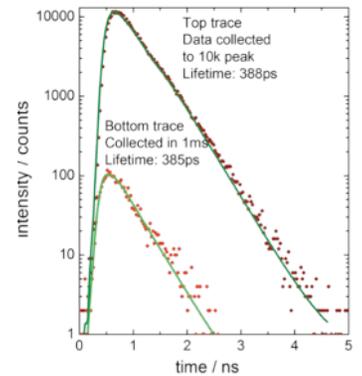
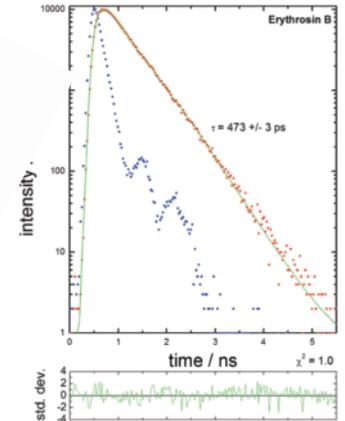


## Lifetime

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

### Useful for...

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

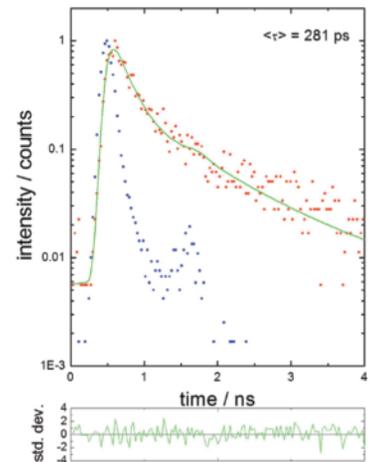
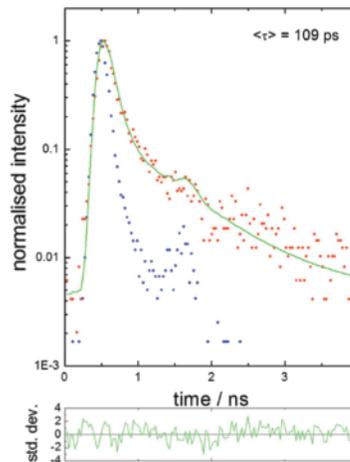
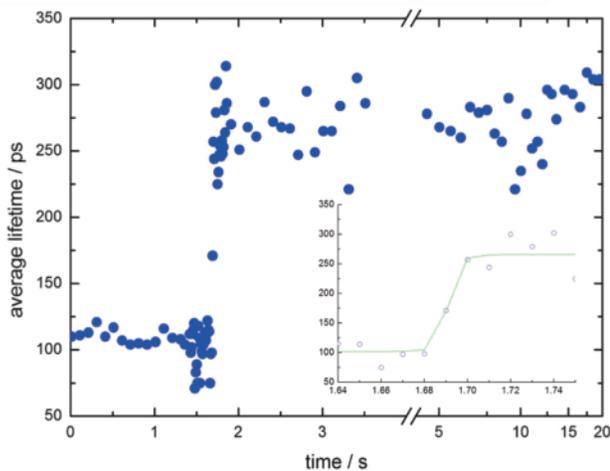
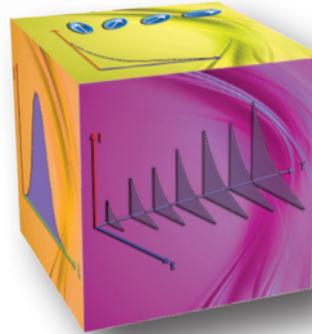


## Kinetic TCSPC

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

### Useful for...

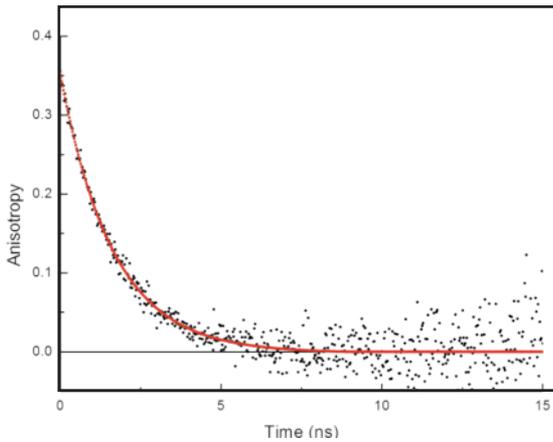
- kinetic studies
- binding information
- molecular interactions
- monitoring changes in local environment



# Measurement types and examples (continued)

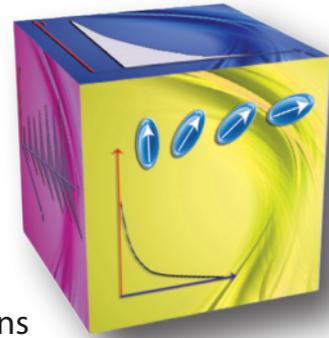
## Anisotropy

- 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

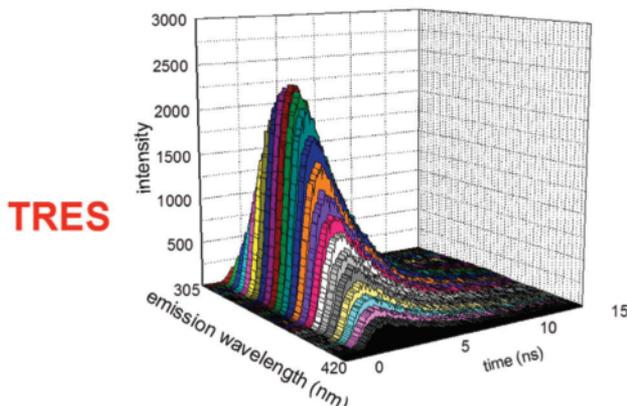
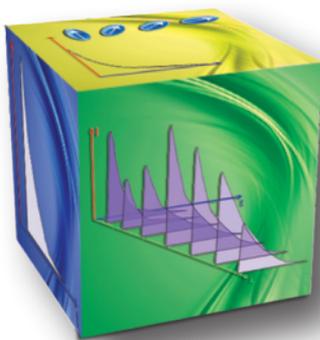


## Time-resolved emission spectra (TRES)\*

- 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

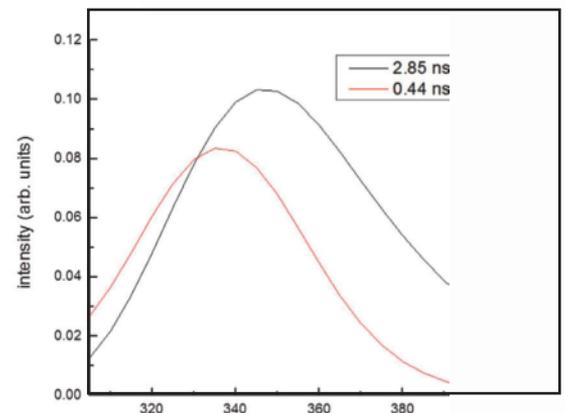
### Useful for...

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



TRES

global analysis



# 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

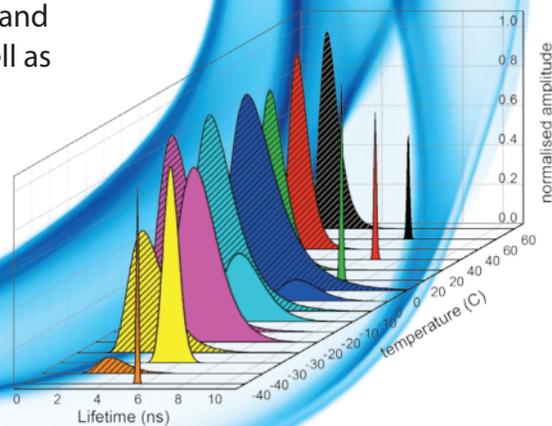
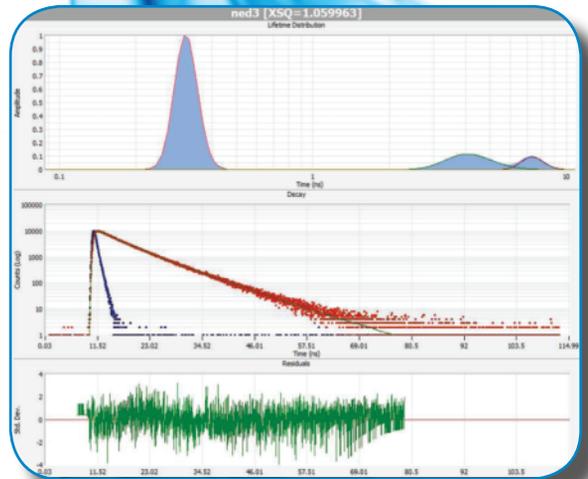
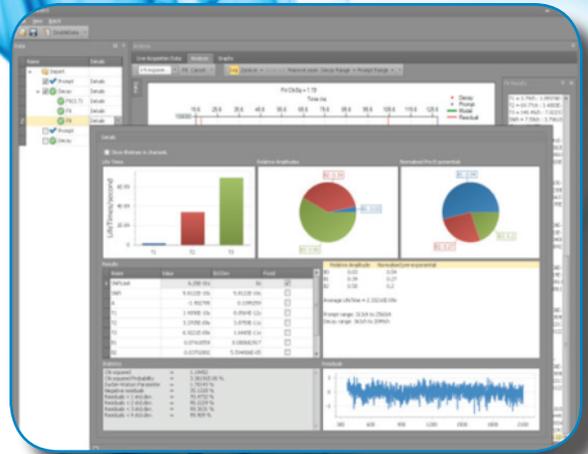
Micellar quenching

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.



# DeltaTime components:

## DeltaTime 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 40ps for laser diode based sources

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

Wavelengths 250-1310nm

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

Plug-n-play compatible within NanoLED range

Laser diode-based sources generate pulses <100ps

LEDs generate pulses ~1ns

High intensity laser diodes generate <1ns pulses and ~20x more power than standard versions



### 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



## DeltaTime detectors

DeltaTime can use existing PMT detectors included in the steady-state system, or, in the case of the Fluorolog modular series, also detectors optimized for lifetime measurements. Our 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.

## DeltaHub timing electronics

### • High throughput photon counting

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



## DeltaTime Specifications

	DeltaTime-DD	DeltaTime-NL
Minimum lifetime	25 ps with laser-diode source & PPD detector 150 ps with standard detector	30 ps with laser-diode source & PPD detector 150 ps with standard detector
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–10 kHz with SpectraLED	10 kHz–1 MHz with NanoLED 0.1 Hz–10 kHz with SpectraLED
Prompt FWHM	<200 ps FWHM with PPD and laser diode	
Dead time	10 ns	
Time ranges	10 ns – 11 s	100 ns – 11 s
Lifetime-optimized detector options (Fluorolog only)	<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 near-IR detectors may be mounted to emission monochromator simultaneously with PPD
PC interface	USB 2.0. PC not included. Requires Windows® XP or Windows® 7, 32/64-bit English language ver.	
DeltaTime footprint	23 cm × 25 cm nominal (added to existing system)	

\*Dependent on sample and system configuration



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