

FluoTime 200

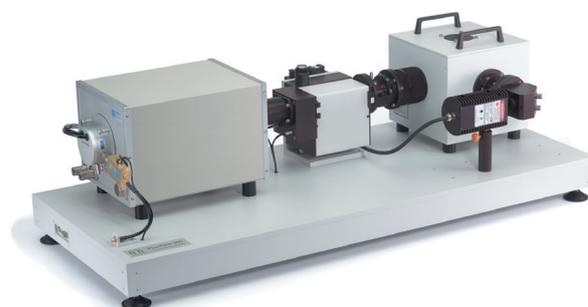
High Performance Fluorescence Lifetime Spectrometer

- Modular and flexible design
- Picosecond time resolution
- Time-Correlated Single Photon Counting (TCSPC) via USB
- Laser injection optics
- Optional prism polarizers
- Advanced data analysis software



Applications

- Time-resolved fluorescence spectroscopy
- Fluorescence anisotropy decay analysis
- Ultra sensitive analysis
- Photochemistry
- Solar cell research
- Singlet oxygen
- Material research



Configuration and Standard Components

The FluoTime 200 spectrometer is a high performance fluorescence lifetime system featuring modular construction, single photon timing sensitivity and research flexibility. It contains the complete optics and electronics for recording fluorescence decays by means of Time-Correlated Single Photon Counting (TCSPC). The system can be used with femtosecond or picosecond lasers, like the picosecond diode lasers from PicoQuant. With the FluoTime 200, decay times down to a few picoseconds can be resolved. The system allows operation at laser repetition rates as high as 85 MHz and count rates up to several million counts/sec.



Laser coupling module

The laser coupling module consists of an iris, a beam steering mirror, an optional replaceable polarizer module and a focusing lens. The iris allows precise adjustment of the excitation intensity and prevents the penetration of room light into the sample chamber. The beam is directed towards the sample by an adjustable steering mirror. An optional prism polarizer selects the desired polarization plane of the non-polarized radiation. Finally, the beam is focused onto the sample by an adjustable lens.



Sample chamber

The sample chamber contains a versatile sample holder (standard: cuvette, optional: front face) and a mechanism to protect the detector from excessive light exposition. Temperature control of the cuvette holder is possible by attaching an external thermostat (tubing for the circulating fluid is pre-installed) or by replacing the standard cuvette holder with a peltier-cooled holder. Later upgrades to T- or X-geometry or motorized sample holders are possible.



Detector

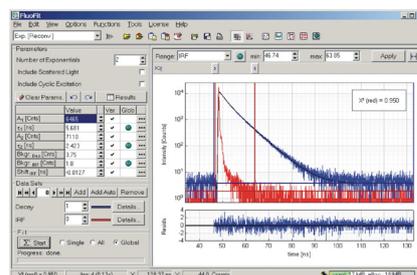
The PMA detector unit, based on the Hamamatsu H5783 series photosensor module, is recommended for the majority of applications. The unit has a built-in high voltage power supply, signal pre-amplifier and a gold plated iron housing for optimal timing performance and maximum shielding. With this detector unit, an Instrument Response Function (IRF) as short as 200 ps can be achieved. Cooling is available for both detector types to reduce the number of dark counts.

Monochromator

For spectral filtering of the emitted light, a small monochromator is chosen. The standard single monochromator, with a 100 mm focal length, features low time dispersion, an f/3.2 aperture and externally adjustable slits with bandwidths of 4, 8 and 16 nm.

Data analysis

Numerical analysis of the raw data is an integral part of the TCSPC method. FluoFit is a Windows™ based global decay analysis software with an easy to use graphical user interface and presentation-ready numerical and graphical output. It implements an iterative reconvolution fitting routine with nonlinear error minimization. Various exponential decay models (up to fourth order) or rate constant distribution models can be fitted to the observed decay. FluoFit supports fitting of calculated anisotropy data as well. Running FluoFit simultaneously with the measurement software allows for parallel data analysis.



TCSPC data acquisition

The data acquisition module contains the complete timing electronics for Time-Correlated Single Photon Counting (TCSPC). The system works in forward start-stop mode, still operating at the full repetition rate of modern pulsed excitation sources. Several million photon events per second can be processed. Consequently, TCSPC acquisition times shorter than 1 second can be utilized. All functions of the TCSPC module are controlled by easy to use Windows™ based software. These functions include loading and saving experimental data as well as setting and storing measurement parameters. Optionally available is a data acquisition board for lower time resolution (phosphorescence decays).

Specifications

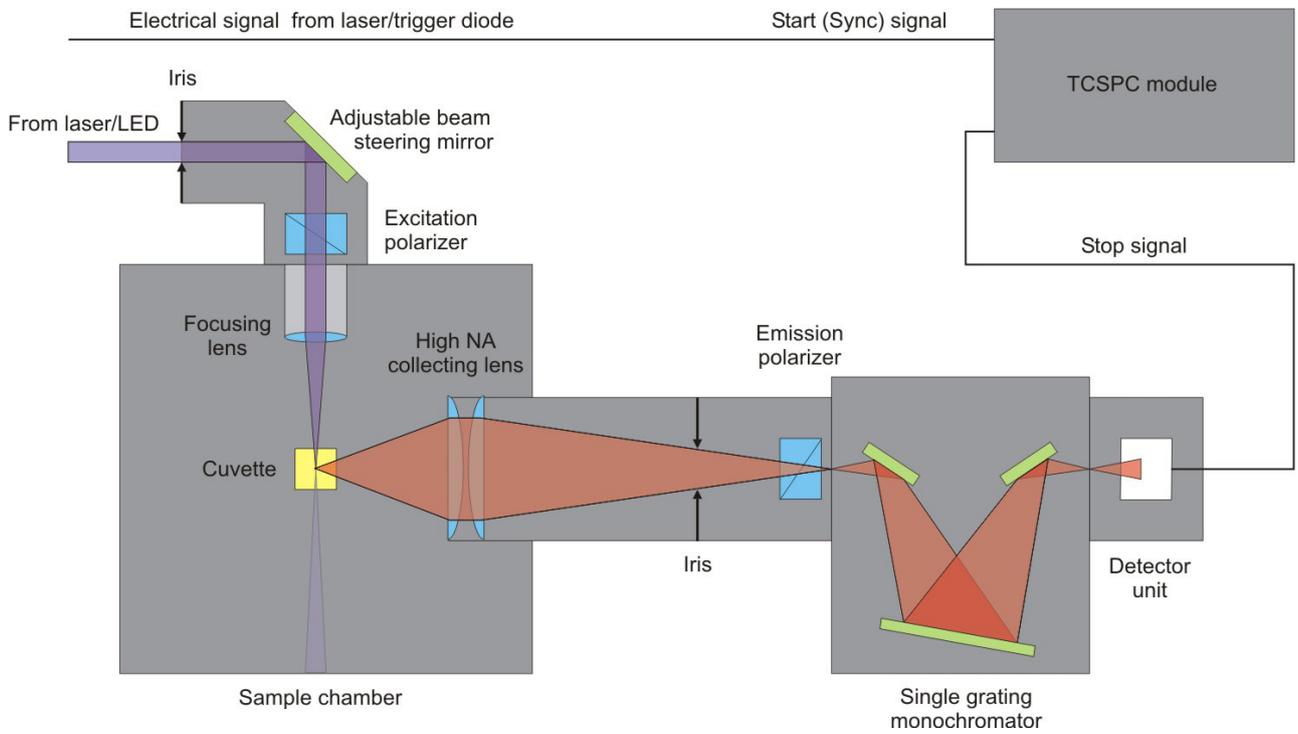
System	
Optical configuration	L-Geometry (standard), T- or X-Geometry available
Mode of operation	Time-Correlated Single Photon Counting (TCSPC), Multichannel Scaling (MCS) ¹⁾
Monochromators	
Type	single
Focal length and aperture	100 mm F/3.2
Stray light rejection	$1 \cdot 10^{-5}$
Gratings	1200 l/mm (standard)
Step size (min)	0.5 nm
Resolution	4 nm, 8 nm and 16 nm
Wavelength accuracy	0.3 nm
Wavelength repeatability	0.5 nm

Excitation Sources			
Light source	Pulsed LEDs (PLS Series)	Laser Diode Heads (LDH Series)	Ti:Sa Lasers
Wavelengths	245-600 nm	375-510, 530, 635-1550 nm	240-950 nm ²⁾
Pulse width	400 ps - 1 ns	60-500 ps	20-200 fs
Repetition rate	up to 40 MHz	up to 40 MHz (optional 80 MHz)	up to 84 MHz
Detectors			
Type ³⁾	PMT (PMA Series)	MCP-PMT	NIR-PMT
Spectral range	185-700 nm, 185-820 nm, 300-900 nm	160-650 nm, 160-850 nm	950-1400 nm
Dark counts* (uncooled)	< 50 cps < 900 cps < 6000 cps	< 50 cps < 500 cps	---
Dark counts* (cooled)	--- < 50 cps < 900 cps	< 10,000 cps	
Data Acquisition Unit			
Type	PicoHarp 300	NanoHarp 250	
Time resolution (bin width)	4 ps	4 ns, 32 ns	
Count depth	16 bit	18 bit	
Dead time	< 95 ns	8 ns	
Lifetime resolution	< 10 ps	< 10 ns	
Time channels per curve	up to 65536	1024 to 262144	
Differential non-linearity	< 1 % rms, < 5 % pp.	< 0.1 % rms, < 1 % pp.	
Discriminator level, zero cross adjust	software adjustable		
Collection time	1 ms - 10 h		

Data Analysis Software	
Type	FluoFit Pro
Analysis possibilities	exponential decay, lifetime distribution, anisotropy, global analysis
Operation	
Operating system	Windows™ 2000/XP/Vista/7
Electrical and Dimensional	
Power requirements	220/240 or 110/120 VAC, 50/60 Hz
Dimensions (standard)	800 × 400 × 300 mm (w × d × h)

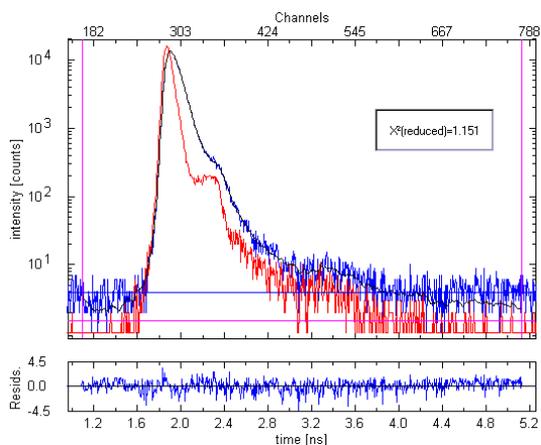
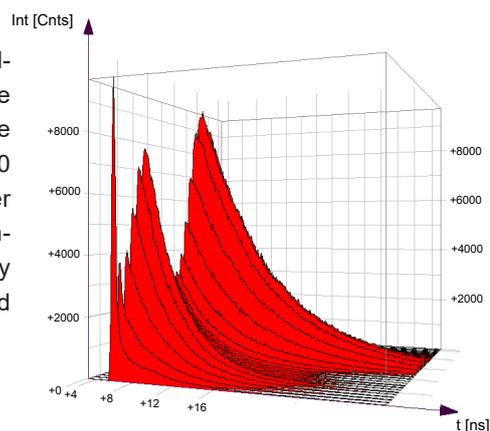
¹⁾ with a different photon counting board, ²⁾ incl. harmonics, ³⁾ other detectors and cooling available upon request, *typ. value at 20 °C ambient temperature

Optical Layout



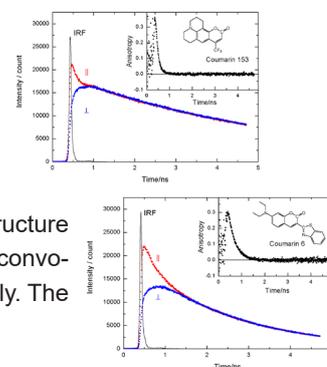
Measurement Examples

Spectral dependence of the fluorescence decay kinetics (i.e. time-resolved fluorescence spectra) of an ethanol solution of Phenoxazon 9 (Nile Red) containing a trace amount of Coumarin 152. 32 decay curves were recorded (from 450 to 750 nm in 10 nm steps) using a FluoTime 200 with motorized monochromator. The decay curves show that, at longer times, the spectra are dominated by the Nile Red emission due to its longer lifetime. This measurement mode of the FluoTime 200 is particularly useful for studying solvation dynamics, excimer or exciplex formation and related phenomena.



Time-resolved fluorescence measurement of DASPI (10^{-6} molar in Ethanol) using a FluoTime 200 equipped with a MCP-PMT and the PicoHarp 300. The sample was excited with a LDH-P-C-405 picosecond diode laser with a 70 ps FWHM pulse width at 20 MHz repetition rate. Fluorescence response at 590 nm was detected through a single monochromator. The plot shows the measured Instrument Response Function (red), the sample decay (blue) and the fitted decay (black). The fitted fluorescence lifetime is 65 ± 5 ps.

The example on the right shows a time-resolved anisotropy measurement of Coumarin 153 (C153) and Coumarin 6 (C6) in dimethyl sulfoxide (DMSO) at a temperature of 290 K. The sample was excited with a LDH-P-C-405 diode laser and the emission at 500 nm was monitored with an MCP-PMT. The FluoTime 200 was equipped with Glan-Taylor prism polarizers. The figures show the recorded polarized decays, the IRF of the measurement and the calculated fluorescence anisotropy decay together with a structure of the compounds. Fitting the anisotropy decay to a single exponential model without reconvolution yields a 110 ps and 330 ps rotational correlation time for C153 and C6, respectively. The results reflect the prolonged molecular shape of C6, in comparison to C153.



Options

Prism polarizers

For fluorescence anisotropy measurements a 15 mm aperture Glan-Laser polarizer can be provided. It features an excellent transmission range of 230-2700 nm and an extinction ratio of 10^{-5} .

Microchannel plate PMT

Detector based on the Hamamatsu R3809 series microchannel plate photomultiplier tube (MCP-PMT) to achieve the highest possible time resolution with the TCSPC method. With fast laser sources the IRF is less than 50 ps.

NIR-PMT

Detector based on the Hamamatsu H10330 series photomultiplier tube for fluorescence detection in the infrared up to 1400 nm (1700 nm as an option).

Solea supercontinuum laser

The wavelength tunability and the variable repetition rates of the supercontinuum laser Solea, combined with the short pulse widths allows to perform excitation scans as well as fluorescence lifetime measurements over a broad spectral and temporal range with only a single laser.

Versatile sample holder

The standard sample holder accommodates 1 cm (or smaller) path length cuvettes. Temperature control of the sample is made possible by circulating liquid and the tubing is pre-installed. An additional external thermostat (optional) can be attached. The cuvette holder can be optionally replaced with a peltier cooled cuvette holder or replaced with a simple front face sample holder.



Cryostat options

The Oxford Instruments Optistat™ series cryostat allows for low temperature photoluminescence measurements. Precise control of the sample temperature is possible with various cryostat types, ranging from 2.3 to 500 K.

Multichannel scaler

For slow luminescence decays, the NanoHarp 250 multiscaler board can be added.

Further options

Electrical stirrer, multi-pass sample holder, DLLs for custom programming, ...

Further PicoQuant Systems

FluoTime 300 "EasyTau"

Automated fluorescence lifetime spectrometer



MicroTime 100

Upright time-resolved fluorescence microscope



MicroTime 200

Inverse time-resolved fluorescence microscope



LSM Upgrade Kit

Compact lifetime & FCS upgrade kit for Laser Scanning Microscopes



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