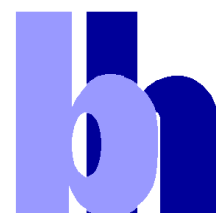


Becker & Hickl GmbH

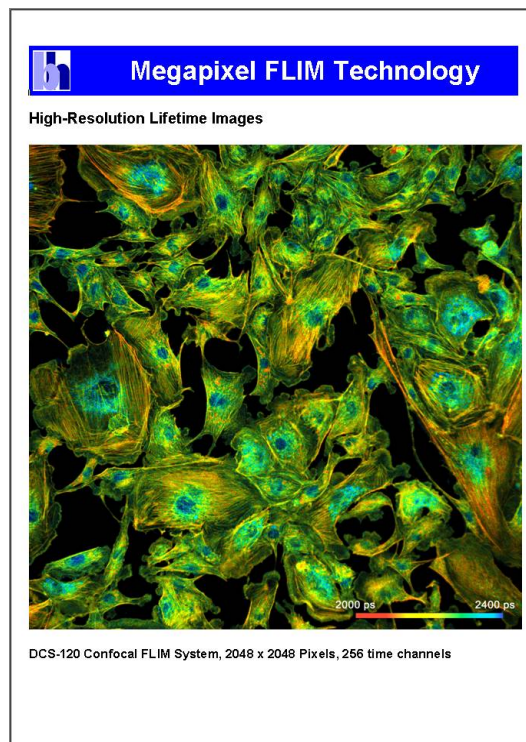
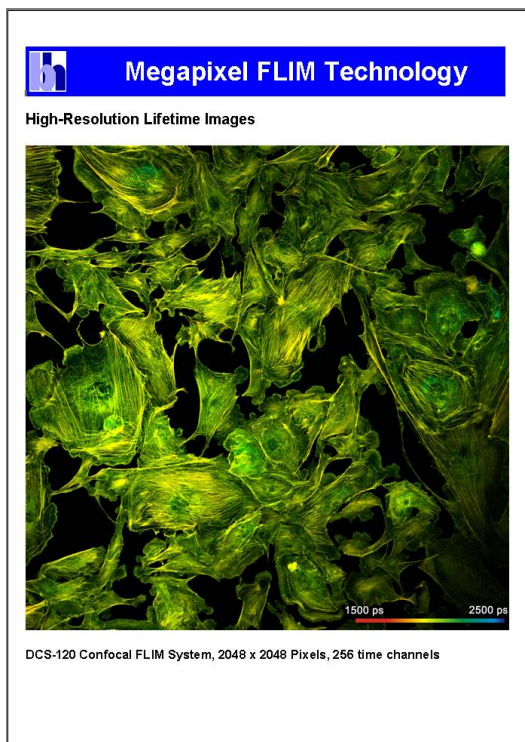
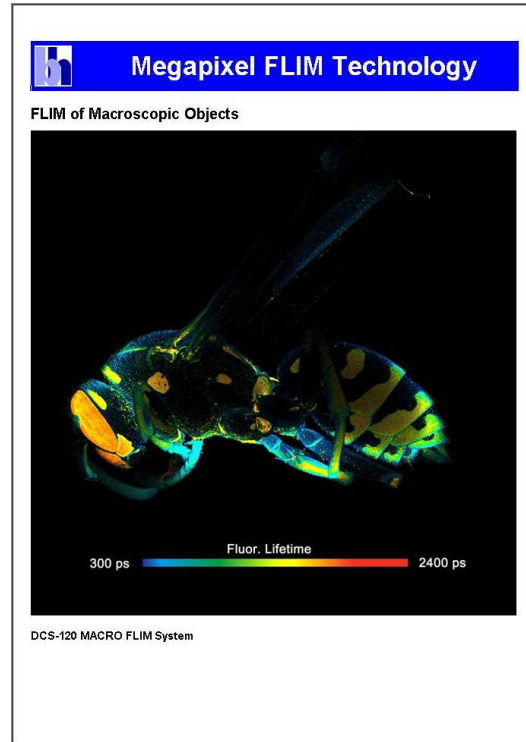
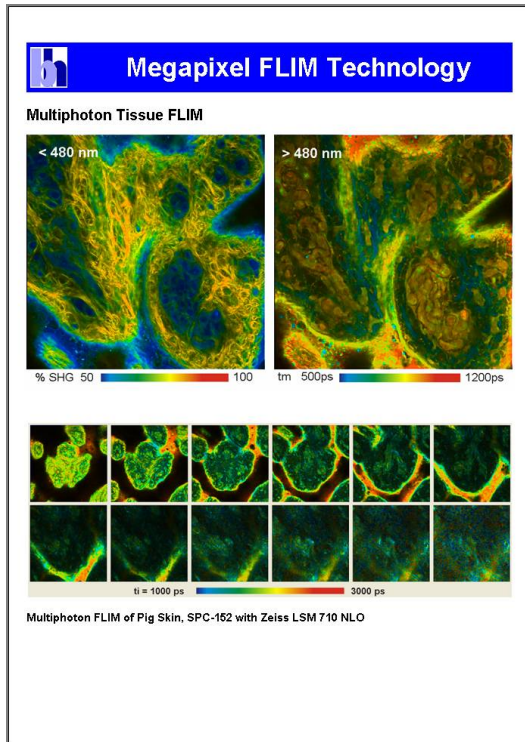
Poster Catalog

2018



bh Poster Catalog

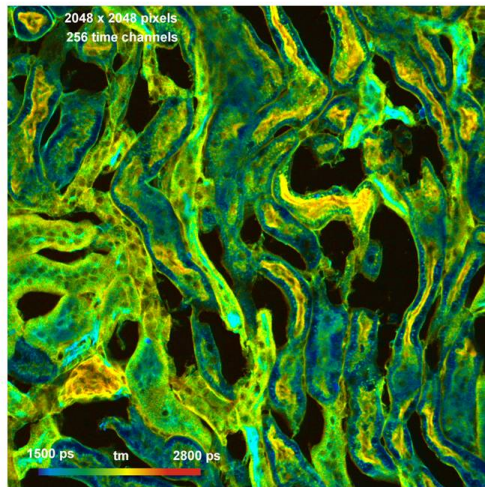
Hard copies of all posters are available from bh. Size is A0, or 84 x 120 cm. Price is EURO 20 plus shipping cost. Please contact info@becker-hickl.com, use subject 'Posters'. Specify desired poster by page and position in page. Example: *Page 3, upper right*.





Megapixel FLIM Technology

High-Resolution Lifetime Images

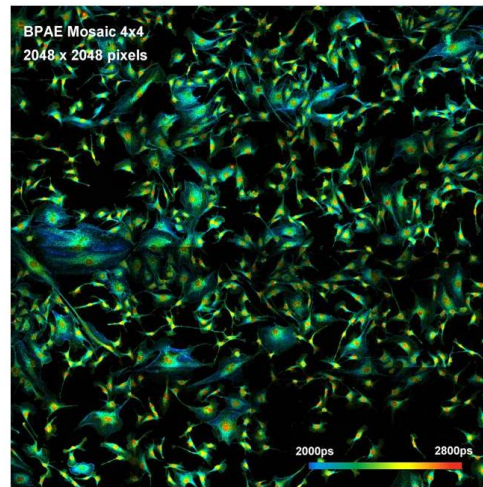


DCS-120 Confocal FLIM System, 2048 x 2048 Pixels, 256 time channels



Megapixel FLIM Technology

High-Resolution Lifetime Mosaic Images

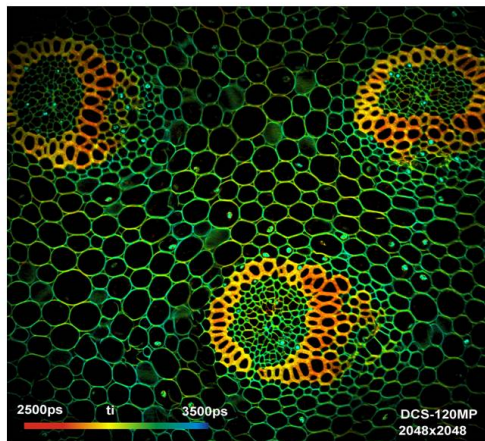


DCS-120 Multiphoton FLIM System, 2048 x 2048 Pixels, 256 time channels



Megapixel FLIM Technology

High Resolution Multiphoton Lifetime Images

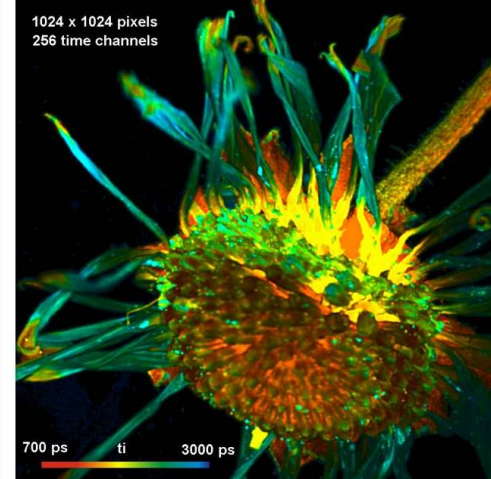


DCS-120 Multiphoton FLIM System, 2048 x 2048 Pixels, 256 time channels



Megapixel FLIM Technology

FLIM of Macroscopic Objects

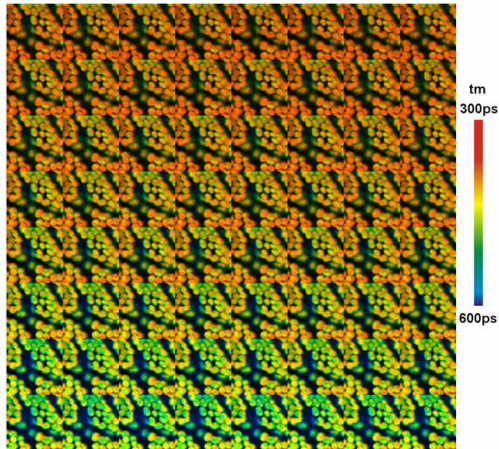


DCS-120 MACRO FLIM System



Megapixel FLIM Technology

Temporal Mosaic FLIM - Recording of Chlorophyll Transients

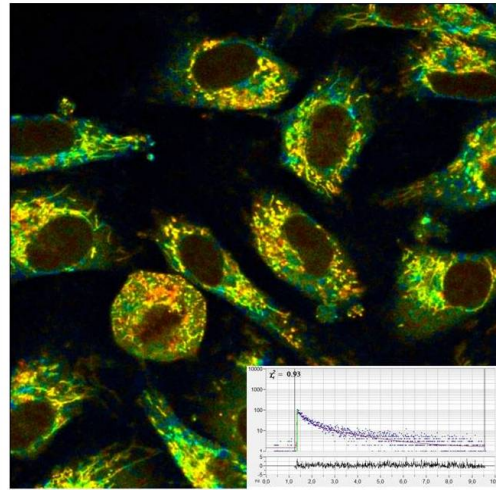


DCS-120 System



Megapixel FLIM Technology

NADH FLIM with Ultra-Fast Detectors

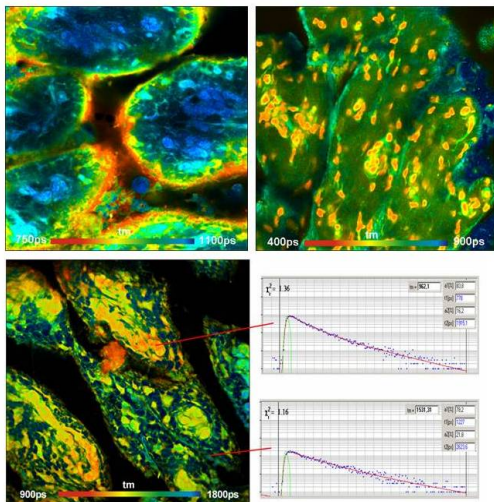


SPC-150NX, HPM-100-06 Hybrid Detector, Zeiss LSM 880 NLO



Megapixel FLIM Technology

Near Infrared FLIM - Deep-Tissue Imaging at Affordable Price

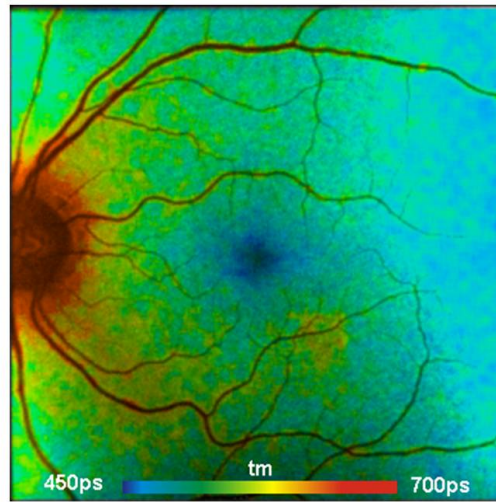


SPC-150, HPM-100-50 Hybrid Detector



Megapixel FLIM Technology

Clinical FLIM of the Human Eye

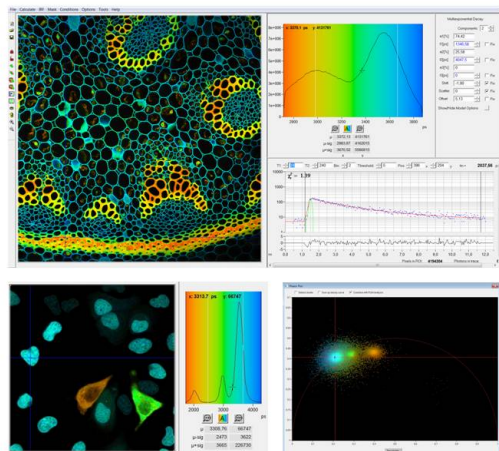


SPC-150 TCSPC FLIM module with Heidelberg Engineering FLIO Scanner



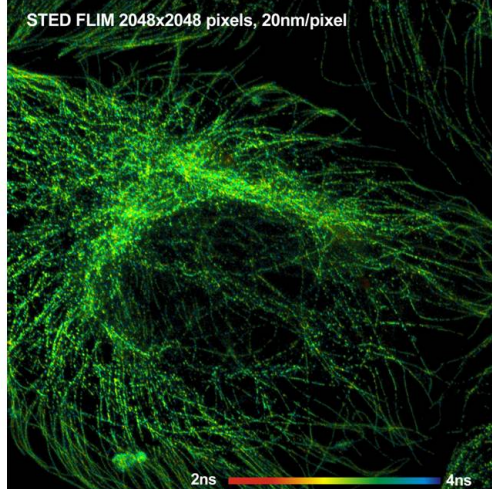
Megapixel FLIM Technology

SPCImage - The Gold Standard in FLIM Data Analysis



Megapixel FLIM Technology

STED FLIM at 20 nm Resolution

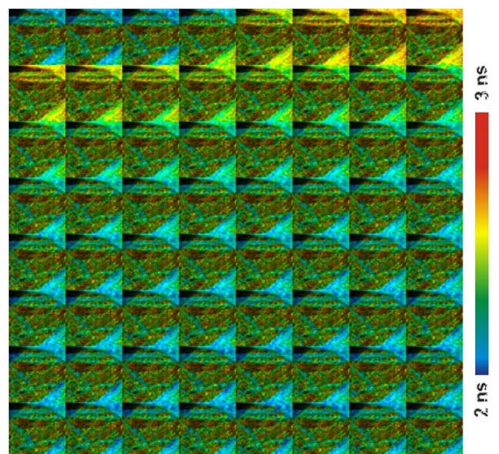


SPC-150 with Abberior STED Microscope



Megapixel FLIM Technology

Temporal Mosaic FLIM - Recording of Ca²⁺ Transient in Live Neurons

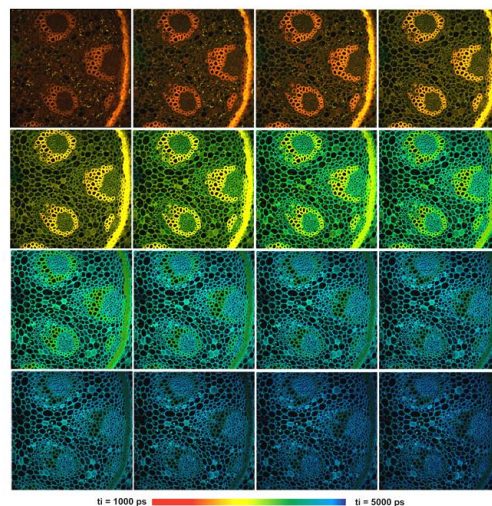


Resolution of Sequence 38 ms / Image
SPC-150 TCSPC FLIM Module, Zeiss LSM 7 MP



Megapixel FLIM Technology

Multi-Wavelength FLIM

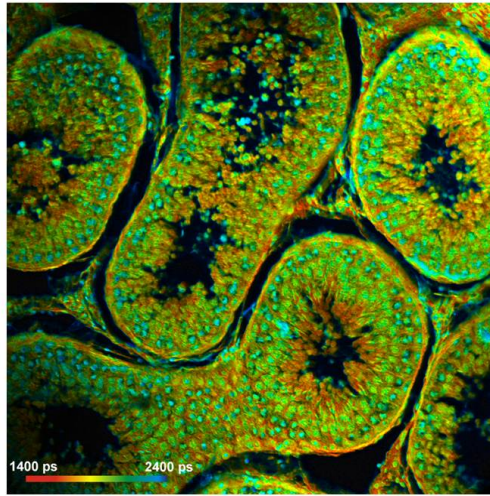


DCS-120 Confocal FLIM system, PML-16 GaAsP Multi-Wavelength Detector



Megapixel FLIM Technology

High-Resolution Lifetime Images

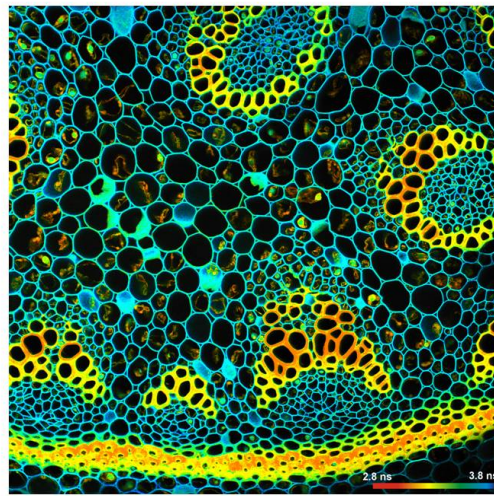


Rabbit Tissue, bh DCS-120 Confocal FLIM System



Megapixel FLIM Technology

High-Resolution Lifetime Images

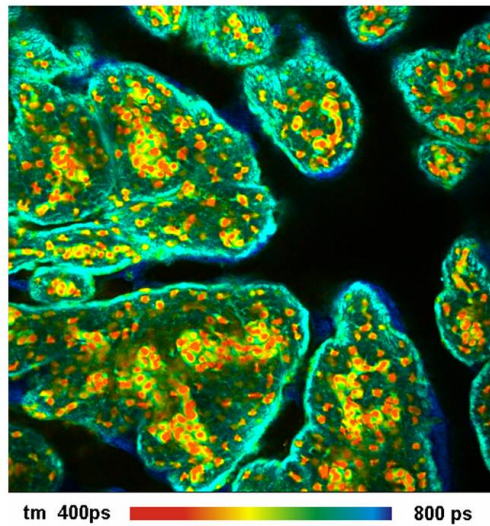


Convallaria Sample, bh DCS-120 Confocal FLIM System



Megapixel FLIM Technology

Two Photon FLIM at 1300 nm Excitation Wavelength

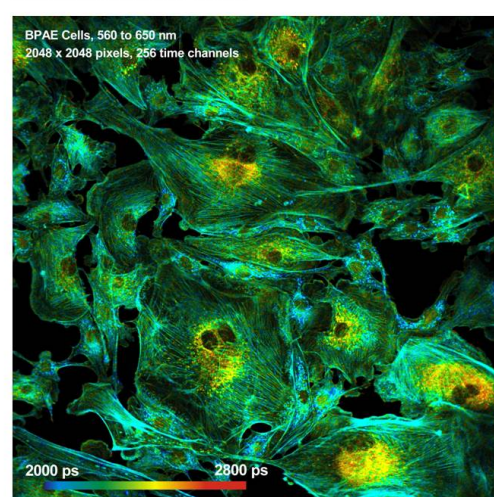


Zeiss LSM 710 OPO FLIM System, Pig Skin with Methylen Blue



Megapixel FLIM Technology

High-Resolution Lifetime Images

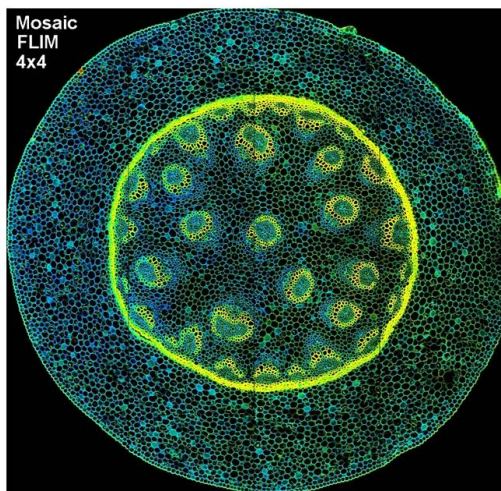


DCS-120 Confocal FLIM System, 2048 x 2048 Pixels, 256 time channels



Megapixel FLIM Technology

Lateral Mosaic FLIM

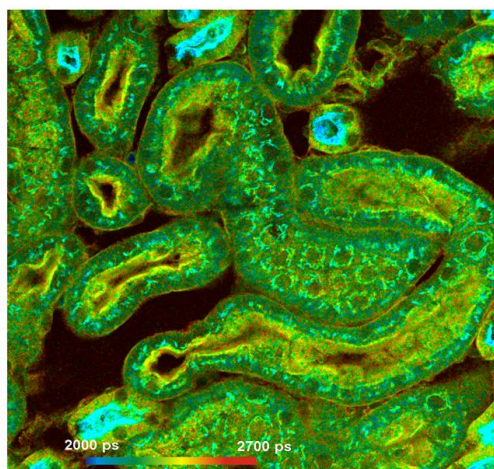


Zeiss LSM 710 FLIM System, 2048 x 2048 Pixels, 256 time channels



Megapixel FLIM Technology

High-Resolution Lifetime Images

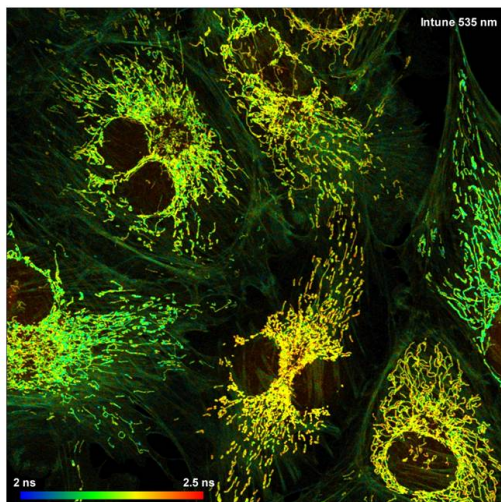


Mouse Kidney Sample, Nikon A1 with bh Simple-Tau 152 FLIM system



Megapixel FLIM Technology

High-Resolution FLIM

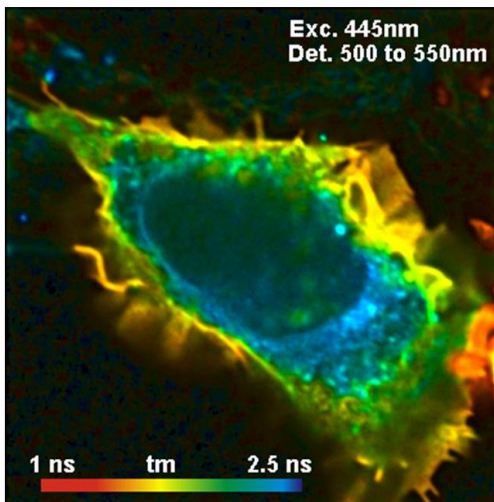


Zeiss LSM 710 Intune FLIM System, BPAE Cells



Megapixel FLIM Technology

Quantitative FRET



Zeiss LSM 710 FLIM System, Interacting Proteins in Cell Membrane



Principle of TCSPC

TCSPC detects single photons of a periodic light signal and determines the times of the photons after the excitation pulses

The pulse repetition rate of the signal is much higher than the photon detection rate. Therefore, the detection of several photons per signal period is extremely unlikely. Only a single photon per signal period needs to be considered. The time of this photon can be determined at extremely high resolution.

From the times of the individual photons TCSPC builds up the distribution of the photons over the time after the excitation pulse

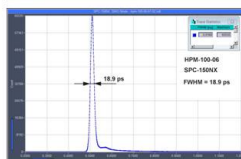
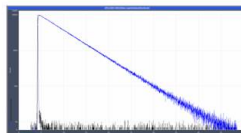
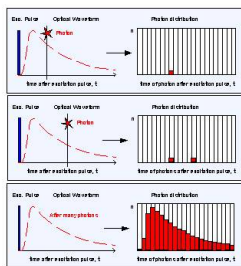
Every photon seen by the detector contributes to the buildup of the photon distribution. Therefore, the recording process works at near ideal efficiency.

The photon distribution represents the waveform of the optical signal

TCSPC is able to cover an extremely large dynamic range. Unlike analog techniques, TCSPC is not limited by the linearity range of the detector. A fluorescence decay function (shown right) can be followed over more than three orders of magnitude.

TCSPC yields an extremely high time resolution

The time resolution of TCSPC is given by the transit time jitter of the detector, not by the width of the detector response. With bh TCSPC modules and bh detector an instrument response of less than 20 ps full width at half maximum can be achieved. The time-channel width can be made as short as 400 fs.



Literature: W. Becker, The bh TCSPC Handbook. Electronic version available at www.becker-hickl.com. For printed copies please contact info@becker-hickl.com



Multidimensional TCSPC

TCSPC detects single photons of a periodic light signal and determines the times of the photons after the excitation pulses plus one or several additional parameters which are associated to the individual photons

The parameter can be any physical value that can be determined for the individual photons. Examples are wavelength, direction of polarisation, location within an image area, time from a stimulation of the sample, excitation wavelength, and many others which can either be measured or controlled in the experiment setup.

From the times of the individual photons and the parameter values TCSPC builds up a multi-dimensional distribution of the photons over the time after the excitation pulse and the parameter values

As for classic TCSPC, every photon seen by the detector contributes to the buildup of the photon distribution. Since there is no rejection of photons the recording process works at near ideal efficiency.

Example 1: Multi-Wavelength TCSPC

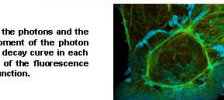
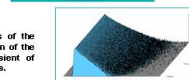
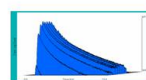
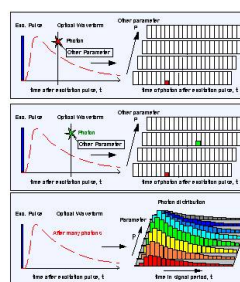
TCSPC build up a photon distribution over the times and the wavelength of the photons

Example 2: Accumulation of ultra-fast time series

TCSPC build up a photon distribution over the times of the photon after the excitation pulses and after a stimulation of the sample. The example shows the photochemical transient of chlorophyll in a plant. Time per curve is 100 microseconds.

Example 3: FLIM

TCSPC builds up a photon distribution over the times of the photons and the position of the laser spot in a scanning area in the moment of the photon detection. The result is a pixel array with a fluorescence decay curve in each pixel. FLIM data are displayed as colour-coded images of the fluorescence lifetime or another parameter of the fluorescence decay function.



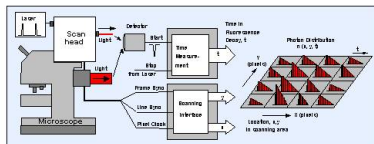
Literature: W. Becker, The bh TCSPC Handbook. Electronic version available at www.becker-hickl.com. For printed copies please contact info@becker-hickl.com



TCSPC FLIM

TCSPC FLIM builds up a photon distribution over the times of the photons in the laser pulse period and the coordinates of a two-dimensional scan

TCSPC FLIM scans the sample by a high-repetition rate pulsed laser beam and detects single photons of the fluorescence signal from the sample. Each photon is characterised by its time in the laser pulse period and the coordinates of the laser spot in the scanning area in the moment of its detection. The recording process builds up a photon distribution over the photon times and the scan coordinates. The result is an array of pixels, each containing photon numbers for consecutive times after the excitation pulses in a large number of time channels.



TCSPC FLIM combines single-photon sensitivity, ultra-high time resolution, and capability to resolve multi-exponential decay profiles with high spatial resolution, optical sectioning capability, suppression of out-of-focus light, and suppression of lateral and longitudinal scattering.

FLIM Images

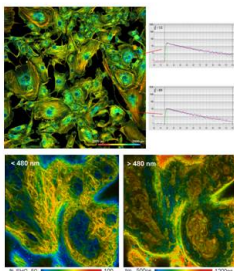
In each pixel, TCSPC-FLIM results contain a full fluorescence decay curve with a large number of data points. FLIM data are displayed as colour-coded images of the fluorescence lifetime, of lifetimes or amplitudes of the components of a multi-exponential decay, or of the ratio of the lifetimes or amplitudes of several decay components.

Multiphoton FLIM

TCSPC FLIM combines favourably with multiphoton excitation. Multiphoton FLIM images deliver high-contrast and high-resolution from deep tissue layers.

Advanced TCSPC FLIM Techniques

TCSPC FLIM can be extended for multi-spectral detection, simultaneous FLIM-PLIM, Z-stack FLIM, mosaic imaging, an recording of dynamic effects in biological objects down to the millisecond range.



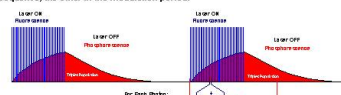
Literature: W. Becker, The bh TCSPC Handbook. Electronic version available at www.becker-hickl.com. For printed copies please contact info@becker-hickl.com



Simultaneous FLIM-PLIM

FLIM-PLIM simultaneously builds up two photon distributions, one over the scan coordinates and the times of the photons in the laser pulse period, the other over the scan coordinates and the times of the photons in the period of an additional modulation of the laser.

The excitation laser is periodically turned on and off at a period in the microsecond range. In the laser-on phases fluorescence is excited, and triplet population is built up. In the laser-off phases fluorescence stops and phosphorescence is emitted from the triplet state. For every photon, the TCSPC module measures two times - one in the laser pulse sequence, the other in the modulation period.



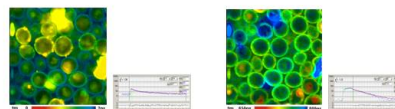
bh's FLIM-PLIM process simultaneously builds up two photon distributions. The distribution over the scan coordinates and the times in the laser pulse period is the FLIM image. The distribution over the scan coordinates and the times in the modulation period is the PLIM image.



The bh FLIM-PLIM technique is extremely sensitive (FLIM is excited by many pulses, not only by one), works at extremely low phosphor concentration (phosphorescence dyes are potentially toxic), exploits the advantages of scanning (out-of-focus signals are suppressed, optical sectioning is available), and is compatible with two-photon excitation.

Simultaneous FLIM-PLIM is used to probe the metabolic state of cells and tissue and simultaneously track the oxygen concentration

The metabolic state is derived from the fluorescence decay function of NADH, oxygen concentration from the phosphorescence decay time of a phosphorescent dye.

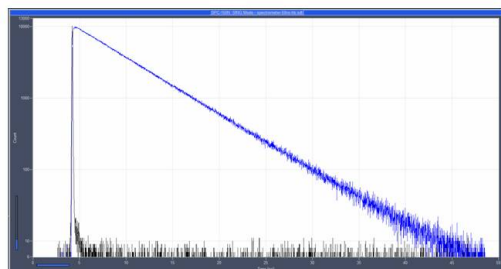


Literature: W. Becker, The bh TCSPC Handbook. Electronic version available at www.becker-hickl.com. For printed copies please contact info@becker-hickl.com

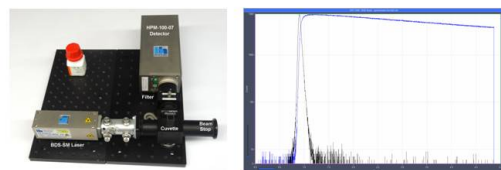


Multi-Dimensional TCSPC

Ultra-Fast Fluorescence Decay Recording - IRF Width < 30 ps

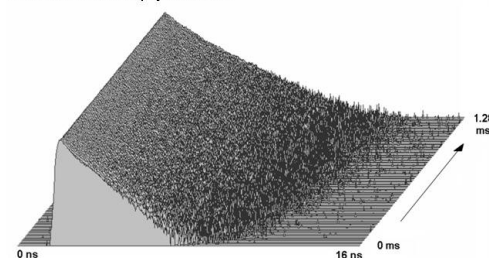


Makes Decay of Fluorescein Look Like Phosphorescence

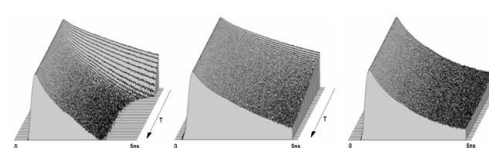


Multi-Dimensional TCSPC

Dynamic Effects Resolved at μ s and ms Resolution
Photochemical Chlorophyll Transient



Non-Photochemical Chlorophyll Transient



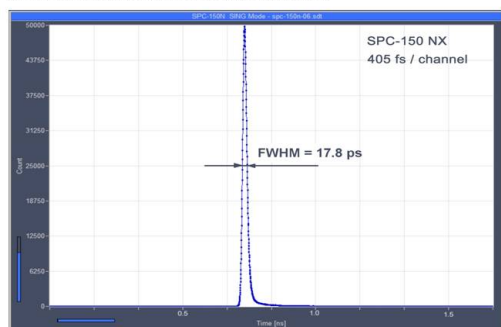
SPC-130 TCSPC Module, bh ps Diode Laser



Multi-Dimensional TCSPC

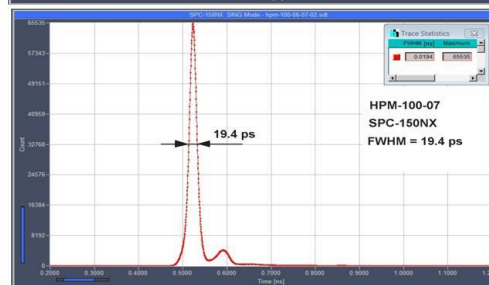
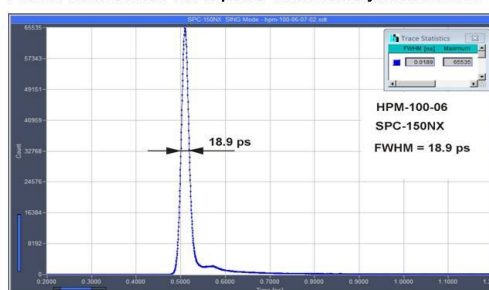
World Record in TCSPC Time Resolution

bh SPC-150NX TCSPC Module with SCONTEL NBN Detector



Multi-Dimensional TCSPC

Fastest on the Planet: Sub-20ps IRF Width from Hybrid Detectors





Poster Catalog

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