HARPIA | TF

Femtosecond Fluorescence Upconversion and TCSPC Module

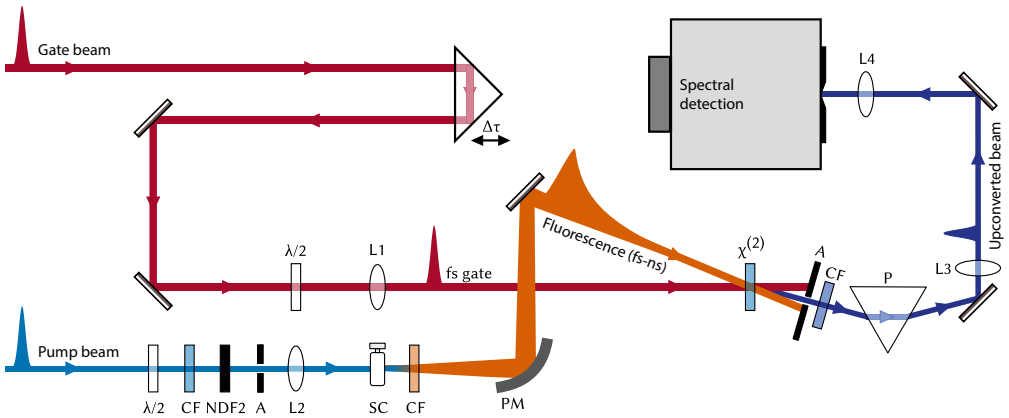
FEATURES

- Combined femtosecond upconversion and TCSPC measurement in a small footprint
- Straightforward operation and easy day-to-day maintenance
- Works as an add-on to a HARPIA-TA or as a standalone unit
- Easy switching between fluorescence upconversion and TCSPC modes
- Compatible with PHAROS and CARBIDE series lasers running at 50 – 1000 kHz
- Analog PMT detector option for fluorescence upconversion
- Automated spectral scanning and calibration of upconversion crystal and prism
- Measurement of fluorescence dynamics in the femtosecond to microsecond range
- Full control over the following parameters of the pump beam:
  - Polarization (using a Berek polarization compensator)
  - Intensity (using manual or automated continuously variable neutral density filters)
  - Gate delay (using an optical delay line)
- Spectrally-resolved fluorescence detection using a monochromator
- When combined with a HARPIA-TA main unit, a single monochromator can be used for both time-resolved absorption and fluorescence measurements with no detector swapping necessary. Other monochromator options are available, such as a double subtractive monochromator for higher TCSPC time resolution

The HARPIA-TF is a time-resolved fluorescence measurement module which combines fluorescence upconversion and TCSPC techniques. In fluorescence upconversion, the signal from the sample is mixed in a nonlinear crystal with a gating femtosecond pulse to achieve high temporal resolution, which is limited by the duration of the gate pulse and is in the range of 250 fs. For fluorescence decay times exceeding 150 ps, the instrument can be used in time-correlated single-photon counting (TCSPC) mode to measure kinetic traces in the 200 ps – 2 µs range. The HARPIA-TF module supports Becker&Hickl TCSPC devices and detectors.

The combination of these two time-resolved fluorescence techniques enables the measurement of spectrally-resolved fluorescence decay in the femtosecond to microsecond range.

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



HARPIA optical layout for fluorescence upconversion measurements

LIGHT CONVERSION

SPECIFICATIONS

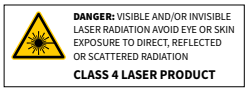
TCSPC MODE

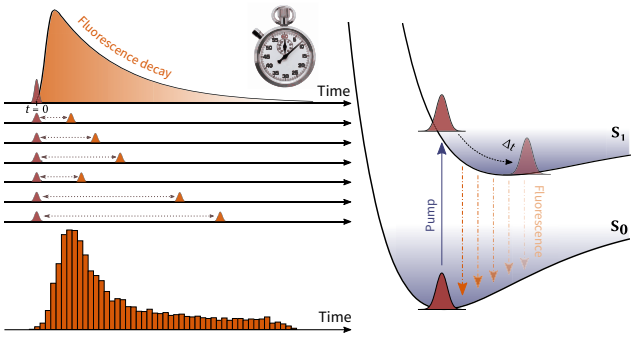
TCSPC module	Becker&Hickl SPC 130 [1)]
Photomultiplier	Becker&Hickl PMC-150 or HPM-100
Emission wavelength range	300 – 820 nm
Intrinsic time resolution	<200 ps
Time resolution with monochromator	<1.2 ns [2)]
SNR	< 100 : 1, assuming 5 s averaging per trace [3)]

UPCONVERSION MODE

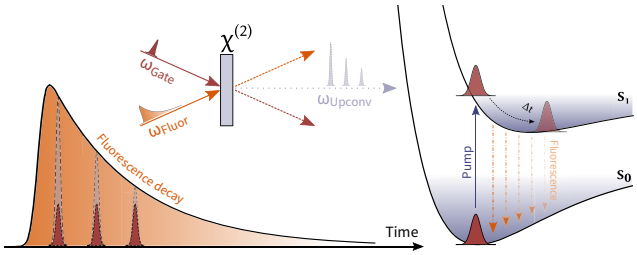
Wavelength range	300 – 1600 nm [4)]
Wavelength resolution	Limited by the bandwidth of the gating pulse, typically around 100 cm^{-1}
Delay range	4 ns, 6 ns or 8 ns
Delay resolution	4.2 fs, 6.3 fs or 8.3 fs
Time resolution	< 1.4× of the pump or probe pulse duration, whichever is longer, 420 fs with a PHAROS laser [5)]
SNR	65:1, assuming 0.5 s averaging per point [6)]

1) *Visit www.becker-hickl.de for specifications.*
2) *Estimated as the FWHM of the upconverted white-light supercontinuum generated in the sample.*
3) *Estimated by fitting a kinetic trace measured in Rhodamine 6G solution at 580 nm with multiple exponents, subtracting the fit from the data and taking the ratio between the standard deviation of the residuals and the 0.5 × maximum signal value. Laser repetition rate 250 kHz. Not applicable to all samples and configurations.*
4) *Depending on the gating source, full range covered with different nonlinear crystals.*
5) *Estimated as the FWHM of the upconverted white-light supercontinuum generated in the sample or the derivative of the rise of the upconversion signal.*
6) *Estimated as the standard deviation of a set of 100 points at 50 ps intervals measured in Rhodamine 6G dye at an upconverted wavelength of 360 nm using a PHAROS laser running at 150 kHz repetition rate. Not applicable to all samples and configurations.*





Principle of time-correlated single-photon counting (TCSPC)



Principle of time-resolved fluorescence upconversion