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Contributors

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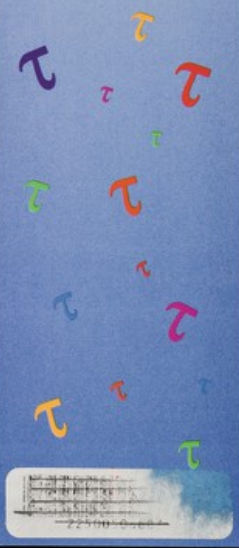
FLUOROLOG - τ 2

FLUORESCENCE LIFETIME AND
STEADY-STATE SPECTROFLUOROMETER

Time Resolved Spectroscopy

Use the Fluorolog-τ2 to study

- *Physical properties of novel fluorophores*
- *Binding sites in proteins, DNAs and RNAs*
- *Local and Global molecular motion, molecular size and shape*
- *Inter- and intra-molecular distances*
- *Excited state reactions*
- *Energy transfer and charge transfer*
- *Fluorescence quenching and diffusion constants*
- *Overlapping species in HPLC*



FLUOROLOG-τ2

A Fluorescence Lifetime AND Steady-State Spectrofluorometer

Whether your work involves protein folding, novel drug delivery or new laser materials, it's about time you discovered the advantages of fluorescence dynamics plus static measurements – **All in One Instrument.**

ONLY Fluorolog-τ2 delivers:

- Highest Sensitivity – even with xenon source
- Expensive lasers are not required
- Flattest frequency response over the full frequency range
- Fast selection of lifetime or CW operation
- Update ANY Fluorolog-2 to lifetime capability

A Total Fluorescence Laboratory in One Complete System

The Fluorolog-τ2 answers the need for a complete, uncompromising array of fluorescence capability in a single, flexible instrument package.

Starting with the proven performance of a Fluorolog-2, the most sensitive, steady-state spectrofluorometer in the world, we added the unique optical and electronic components for frequency domain measurements – from picoseconds to microseconds. This union of static and dynamic fluorescence features was achieved while retaining the proven sensitivity and resolving power of the Fluorolog-2. These high-quality SPEX optics also provide the precise collimation necessary to take maximum advantage of the cw source.

And you can switch from picosecond lifetimes to steady-state in just seconds.

A major τ2 feature is that there's no realignment required when switching between modes of operation. In addition, a built-in laser port encourages exciting weak fluorescent signals with the twist of a knob.

Frequency Domain-the Right Choice

The time decay of fluorescence can be studied in either the time domain, using a pulsed excitation beam, or in the frequency domain, by exciting with a sinusoidal-modulated light beam. We chose the frequency domain because of:

- High sensitivity provided by continuous illumination
- The superb precision resulting from heterodyning (cross-correlating high to low frequencies)
- The ease of use

For example, high sensitivity lifetime measurements can be performed in a few seconds using the standard cw xenon arc lamp that is also used for steady-state measurements.

MHz Modulation

In the frequency domain, excitation light is sinusoidally modulated, usually in the MHz range. The modulated beam excites a sample which emits fluorescence at the same frequency, but phase shifted and demodulated by the average fluorescence lifetime of the sample. These two independent measurements – phase shifted and demodulation – when accumulated at several frequencies, can accurately characterize the time behavior of heterogeneous samples.

Frequency Response

τ2's wide, smooth frequency response ranges from 1 MHz to 250 MHz in 0.1 MHz steps. You select the upper and lower frequency, along with either linear, log, or custom coverage. The computer then automatically steps through the frequencies while measuring the sample response. The unknown and a standard sample are alternately measured by means of a motorized sample holder. This differential method produces the highest precision and accuracy. Up to four samples can be measured in one experiment. The data file is plotted and stored as the measurements progress and can be simultaneously monitored on the CRT.

On-Line Modeling in the Frequency Domain

Analysis of the phase and modulation frequency response of an unknown requires fitting the data to a model by the well-established non-linear least-squares method. With the Fluorolog-τ2 you finally have the power and computing speed to implement and test multiple models while the experiment is in progress. The benefits include:

- Increase the time you spend on real experiments
- Maximize your data production by eliminating unneeded measurements
- Move on more quickly to new samples.

Some On-Line Capabilities Include

- Lifetime Heterogeneity – resolve lifetimes and contributions of various species
- Distributed Fluorescence Decays – distributions of lifetimes in a single sample.
- Anisotropy Decays – time-dependent polarization

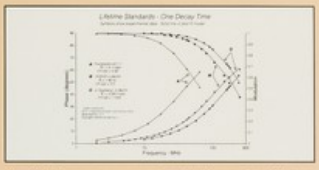


Figure 1: Lifetime range, accuracy and precision demonstrate the ultimate potential of a Fluorescence instrument. These three frequency response curves prove the superior performance of the SPEX Fl- τ2. Note the ability to scan the full frequency range using the cw xenon arc lamp.

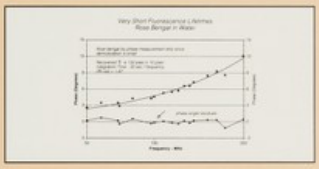


Figure 2: Complex systems like excited-state reactions and quenching experiments place extreme demands on the high-frequency response of an instrument. Here Rose Bengal in water shows how the Fl-τ2 easily penetrates to the sub-nanosecond region.

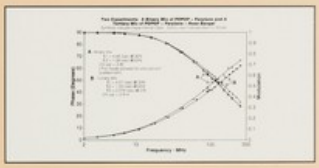


Figure 3: Heterogeneity analysis lets you resolve multiple lifetimes in a single sample – a necessity for real-world problems. Here two mixtures are resolved , one with two probes, the other with three, one in the psec range.

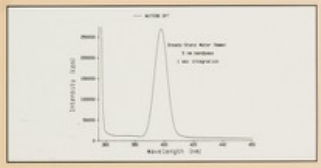


Figure 4: In the steady-state mode, the Fluorolog-τ2's photon-counting detection maintains the highest sensitivity. The high signal-to-noise ratio on the Raman line of water sets the new standard in Lifetime spectrofluorometers – performance no others can match.

Technical Specifications

Each Fluorolog-τ2 is an addition to a Fluorolog-2 spectrofluorometer. The Fluorolog-τ2 can be purchased as a complete, turnkey lifetime and CW spectrofluorometer, or as an upgrade to an existing Fluorolog-2. A Fluorolog-τ2 consists of an integrated optical module and electronics rack that includes the following components: frequency synthesizers, RF amplifiers, modulator compartment with laser input port, electronics control modulator.

1. **Lifetime Range**
   10 picosecond to 2 microseconds.*
2. **Lifetime Resolution**
   ±5 picoseconds (for subnanosecond lifetimes).
3. **Frequency Range**
   1MHz to 250 MHz**
4. **Acquisition Modes**
   Frequency Domain . . . for direct measurement of fluorescence dynamics.
   Photon-Counting . . . . . for steady-state measurements.
5. **Source**
   Xenon lamp (150W or 450W) with integral air-cooled housing, regulated power supply, and x, y, z external focusing adjustments.
6. **Spectrometers**
   0.22m Czerny-Turner with f/4 aperture and all-reflective optics: range 0 to 1000 nm, minimum step size 0.02 nm, accuracy ±0.5 nm. The gratings are kinematically mounted and interchangeable for optimization from the UV to IR region.
7. **Sampling Turret**
   Automated, motorized, four-position, thermostatted cuvette holder with magnetic stirrer. Temperature ranges from -20 degrees to 80 degrees (circulating water bath required).
8. **Sensitivity**
   Fluorolog-2 sensitivity, in CW mode, can be measured from the Raman band of water.
   Lamp = 450W, Bandpass = 5 nm, Excitation = 350 nm, Integration Time = 1 sec.
   Model FL111 = 200,000 cps
   Model FL112 = 225,000 cps
   Model FL212 = 250,000 cps
9. **Software**
   Complete DM3000F Spectroscopy Software plus a frequency domain lifetime package including instrument control, acquisition, and data processing

* These limits are sample dependent and reflect the ability to detect a 1 degree phase shift at 250 MHz and a 0.10 modulation at 1 MHz.

** Contact a SPEX representative for information concerning other freqaency ranges.

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