Configurations and Applications of Transient Absorption Instruments

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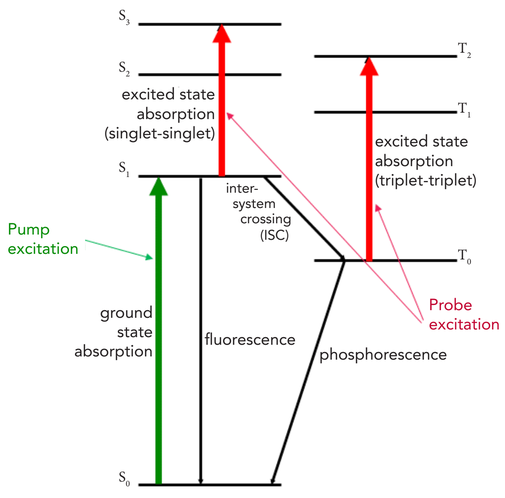
Introduction

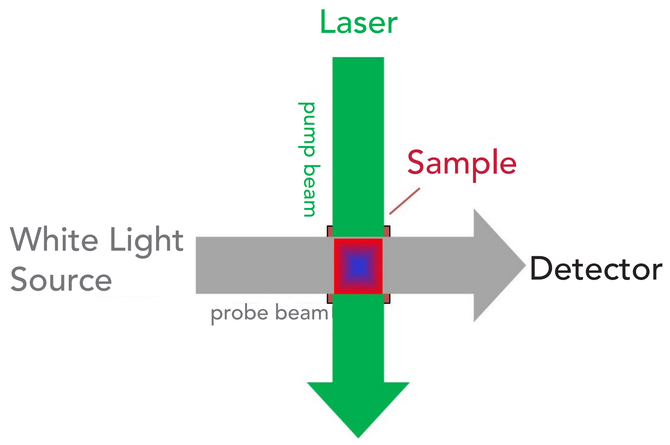
Transient Absorption (TA) in the nanosecond-second range is a pump-probe spectroscopic technique for studying light-induced processes:

- **Excited State Lifetimes**
- **Short-Lived Intermediates**
- **Reaction Kinetics**

Applications in **Materials Science**, **Photochemistry** and **Photobiology**



Example: Excited State Detection



Cross Beam Configuration

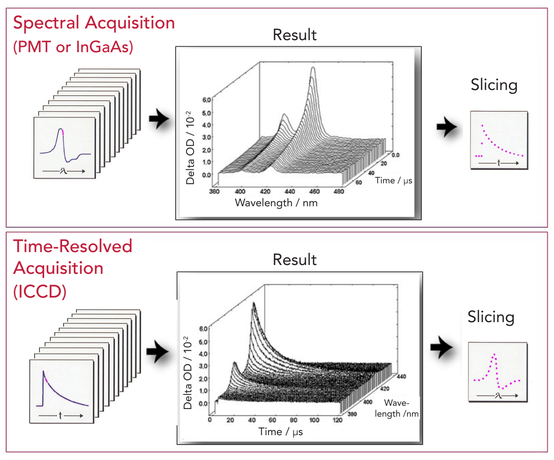
Edinburgh Instruments Transient Absorption spectrometers can be configured with a wide range of accessories. The choice of components is guided by the end application:

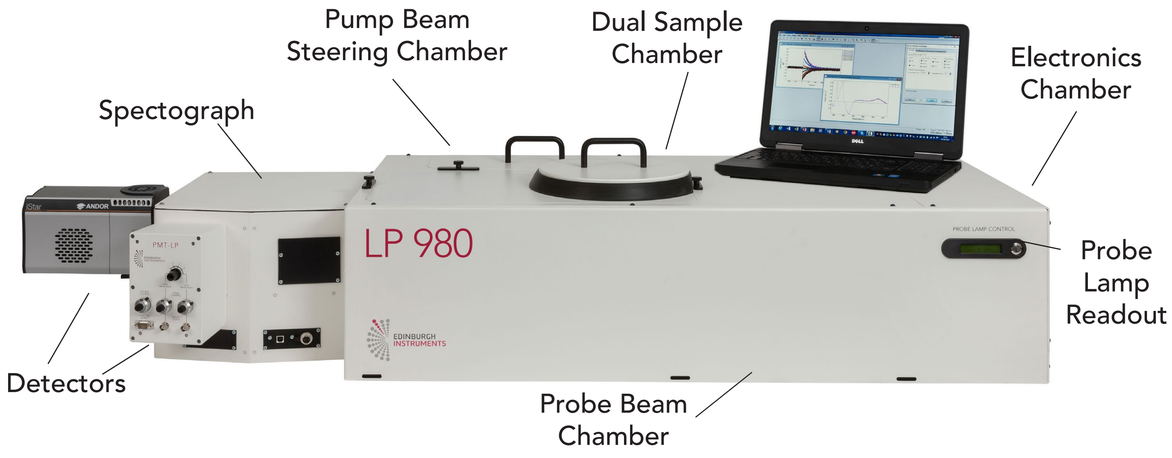
- **Pump laser** – How much power is needed? Wavelength tuning needed?
- **Probe lamp** – Pulsed or continuous? What spectral range?
- **Detector(s)** – Spectral or Time-Resolved? Visible or NIR range?
- **Sample holder(s)** – Solid, liquid, or powder samples? Are they transparent? What is the concentration?

This poster presents common application examples and the recommended instrument configuration for each case.

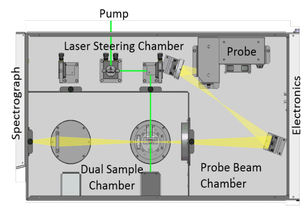
LP980 Transient Absorption Spectrometer

The LP980 can be configured with two detectors for wavelength and time-resolved acquisition:

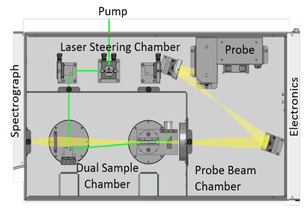




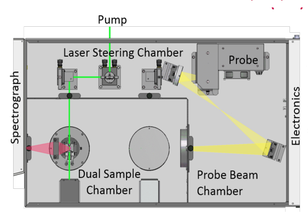
Standard Transient Absorption (TA)



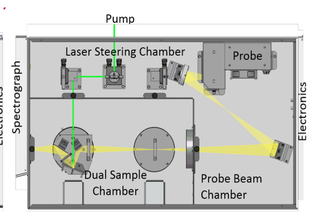
Quasi-Collinear TA



Laser-Induced Fluorescence (LIF)



Diffuse Reflectance

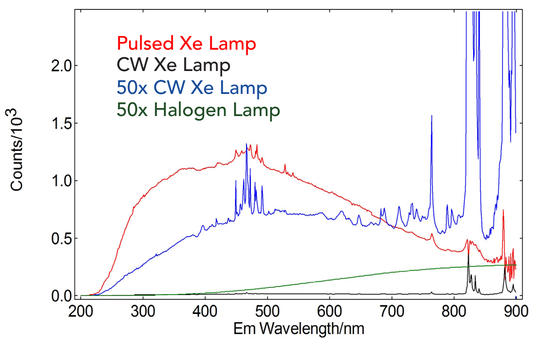


Millisecond - Seconds Range

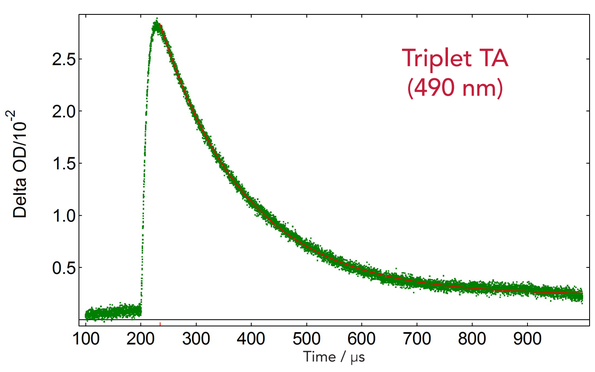
High stability probe lamp and multiple outputs in PMT provide optimal signal-to-noise ratio for long kinetic decays.

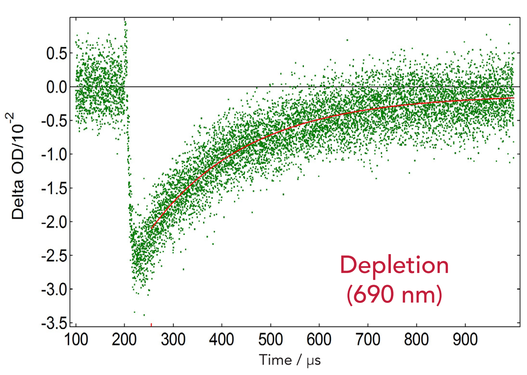
Tungsten-Halogen Lamp: High stability CW probe option recommended for decays longer than 10 ms.

	Xe Lamp	Halogen Lamp
Spectral Range	230 – 900 nm	300 – 900 nm
Power	150 W	50 W
Pulsed Option	Yes (0.2 ms to 6 ms)	No



Low Bandwidth Output: The standard PMT-LP detector has a low bandwidth option for improved signal-to-noise ratio at long lifetimes. It features four gain positions from 1 (10 µs lifetime) to 1000 (10 ms lifetime).





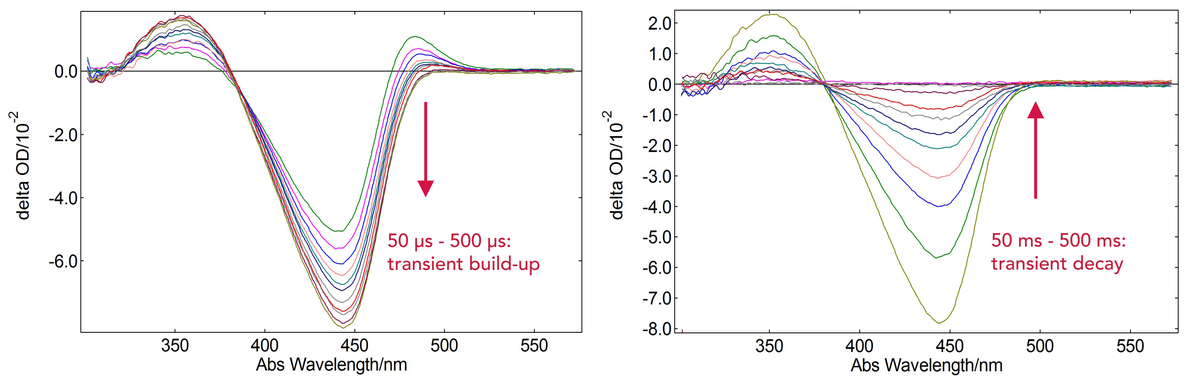
Triplet state TA and ground state depletion of zinc phthalocyanine (ZnPc) photosensitiser.
Sample provided by Prof. Tebello Nyokong (Rhodes University)

Photosensitive Samples

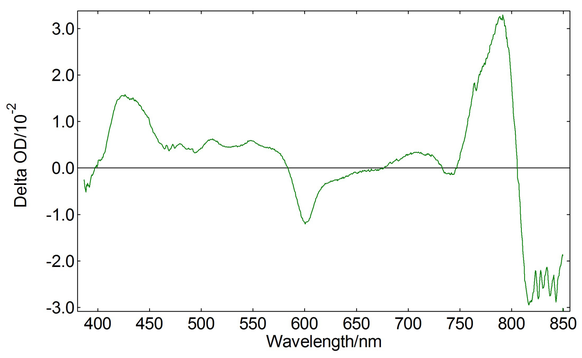
Light-sensitive samples such as biological compounds benefit from reduced measurement time and photobleaching monitoring.

Internal Energy Meters: This accessory monitors the energy of the pump beam before and after the sample to check for photodegradation.

ICCD Detector: Acquires the full transient spectrum in a single shot. Recommended for faster measurements and unstable samples.



Photoactive Yellow Protein (PYP) Dynamics
Measured in LP980 with ICCD detector

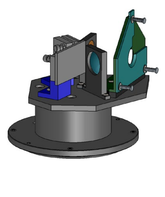


TA spectrum of Photosynthetic Reaction Centres (PRC)

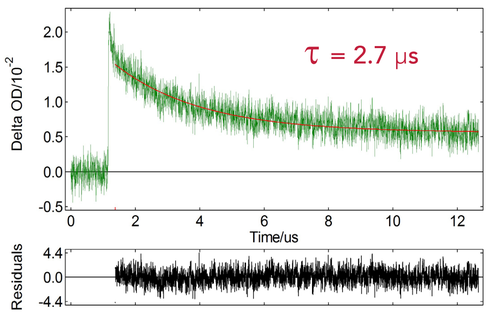
Pump-probe delay = 0 ns, ICCD gate width = 1 ms
Sample provided by Prof. Richard Cogdell (University of Glasgow)

Solid or Gaseous Samples

Diffuse Reflectance Holder: Recommended for solid opaque samples.

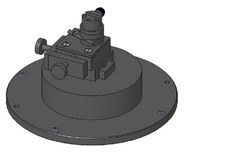


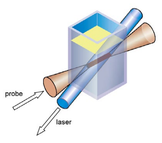
Film Sample Holder: Recommended for solid transparent samples.



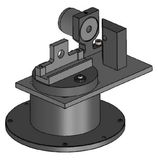
TA decay of BiVO4 film

Measured in film sample holder and fitted to an exponential decay in L900 software.





Quasi Collinear Holder: Recommended for gas cells or dilute liquid samples.

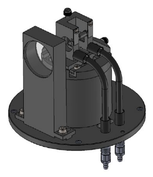


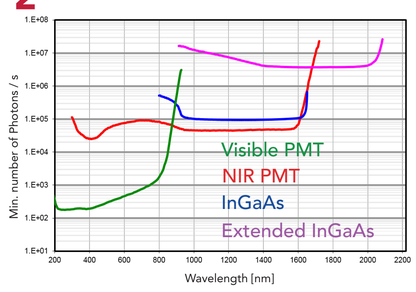
NIR Range and $^1O_2$ Detection

Analogue InGaAs Detector: Recommended for kinetic TA measurements in 870 nm – 1650 nm range.

Photon-Counting Module + NIR PMT: Recommended for luminescence decays in 950 nm - 1700 nm range; e.g. singlet oxygen.

LIF Sample Holder: Recommended for high-quality photoluminescence decays. Increases signal-to-noise ratio in $^1O_2$ detection.





$^1O_2$ luminescence

Rose Bengal in ethanol as photosensitiser
Measured in LP980 with photon-counting NIR PMT and LIF sample holder