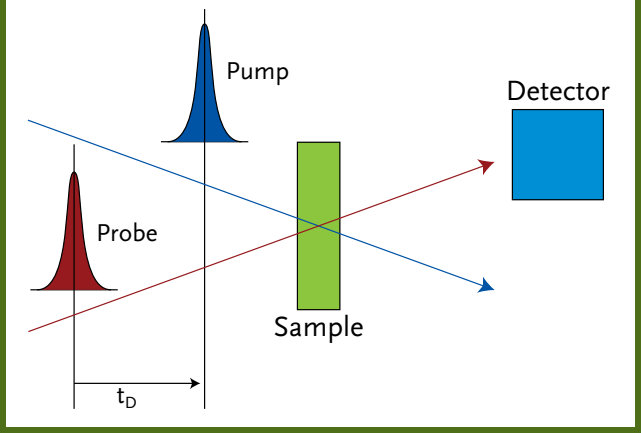
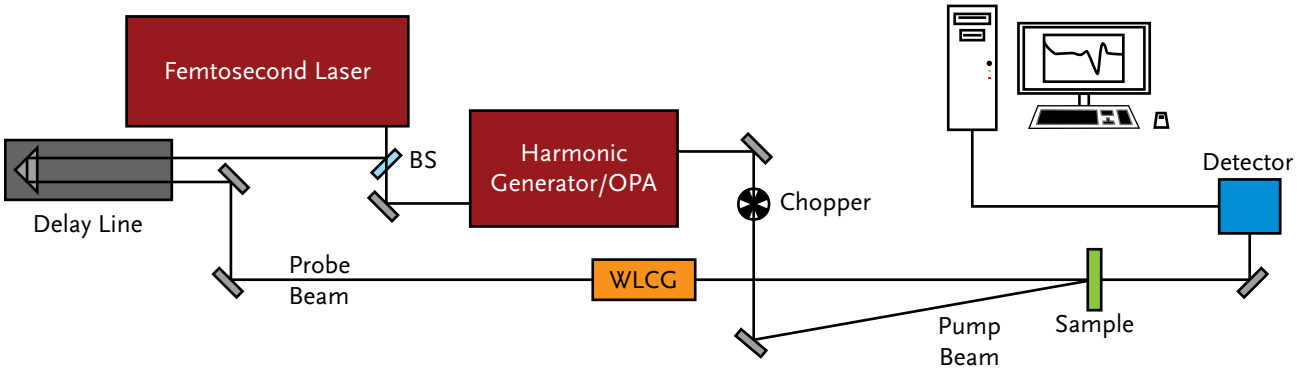
Hatteras Ultrafast Spectrometer

Time Resolved Femtosecond Spectroscopy

Ultrafast spectroscopy is a field of research that provides information on the mechanistic and kinetic details of chemical events. Femtosecond transient absorption (TA) spectroscopy represents the natural evolution of laser flash photolysis since the introduction of ultrashort laser sources. With pulse durations of 100 fs it is now possible to get information about the dynamics occurring in the excited electronic states. Thereby, the time resolved pump-probe technique is the most convenient method for conducting ultrafast spectroscopy experiments. This technique allows observation of fast chemical and biological reactions, investigate energy and electron transfer, and watch the evolution of the electronic and vibrational energy redistribution. Broad spectral and temporal ranges can be probed. Provides detailed information on the decay mechanism of the excited states of a material and determine luminescence lifetimes.



For time resolved pump-probe experiments two independently tunable and synchronized pulses are needed.



An amplified pulse is divided into two parts with relative intensities chosen depending on the experiment. A relatively strong pump beam is used for sample excitation by sending it through a harmonic generator or an optical parametric amplifier (OPA). The remaining portion of the beam is sent through a computer-controlled delay line and then focused in to a sapphire plate to generate a white light continuum. A weak probe pulse subsequently measures the transmission (the absorption of the excited sample) as a function of the time delay between the pump and probe pulses.

The difference between the two probe pulse measurements corresponds to the transient absorption changes accompanying the reaction initiated with the pump pulse.

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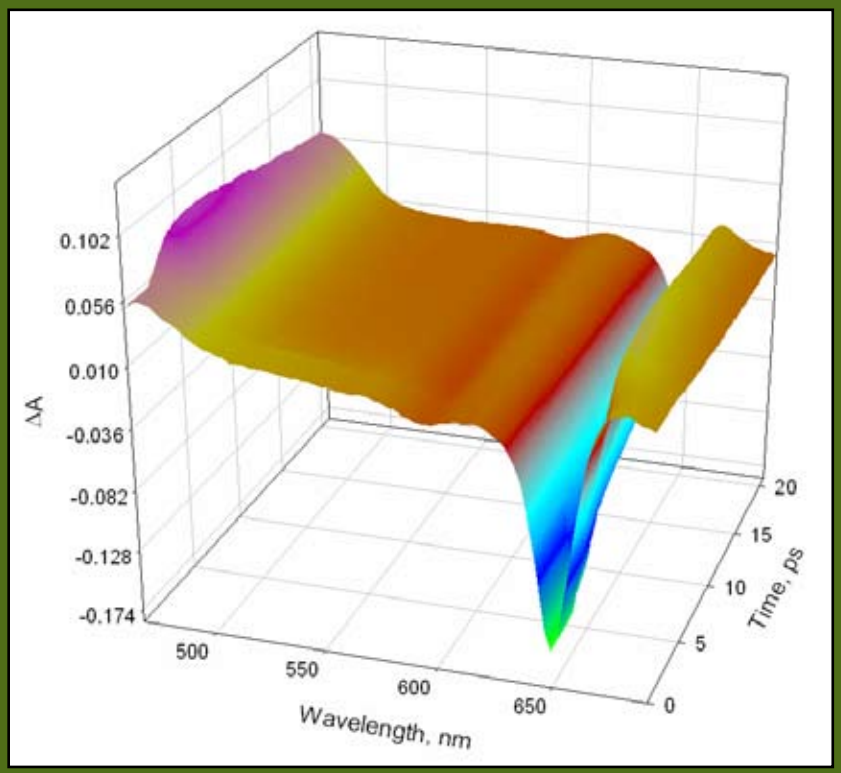
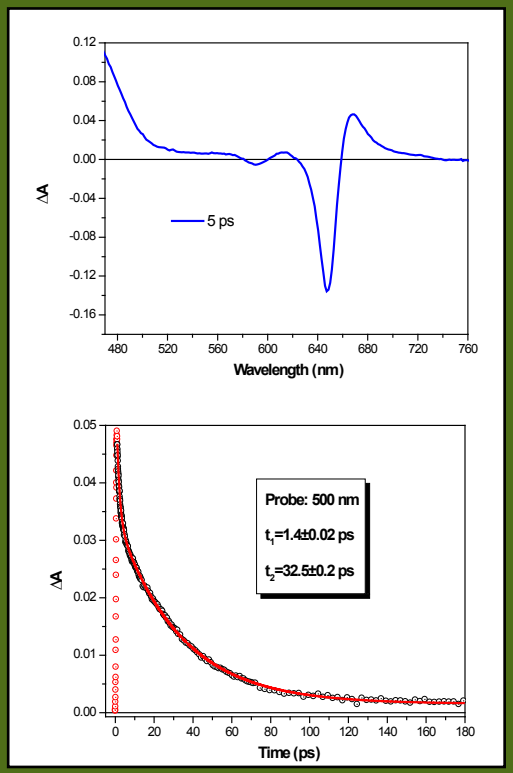
	Standard	Optional
Spectral Range	450-900 nm	350-750 nm
Spectral Resolution	1.5 nm	
Dynamic Range	1600 ps	3200 ps
Temporal Scale	3.5 fs	7 fs
Temporal Resolution	< 140 fs	
Footprint	100 (L) x 35 (W) x 25 (H) cm	

Information about the temporal evolution of the excited state population is collected by varying the temporal overlap between the pump and probe pulses via the delay stage and measuring the time averaged transmission of the sample at each position of the delay. The result is a set of data that can be plotted time delay vs. absorption/transmission for the wavelengths present in the white light continuum.

There are a variety of detectors for collecting transient data, though a CCD spectrometer is typically better suited for transient spectroscopy. A CCD spectrometer allows the acquisition of the whole spectrum while being compact and easy to align.



Three-dimensional diagram depicting time-resolved transient absorption for Ni(II) tetraphenyltetrabenzoporphyrin (NiTPTBP) in benzene.



Transient spectrum at 5 ps. (Top) Kinetic profile at 500 nm. (Bottom)

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