LEHIGH UNIVERSITY

Center for Optical Technologies

All Optical Network thrust

Nonlinear Optical Time-Resolved Spectroscopy and Wave Mixing

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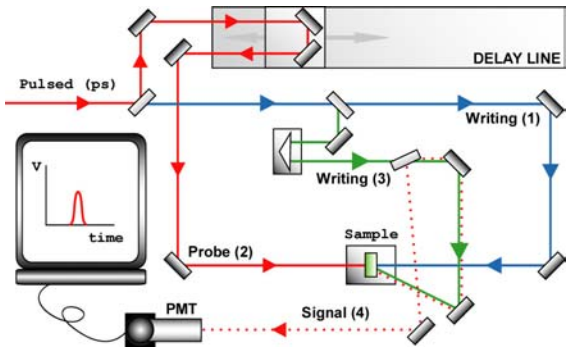
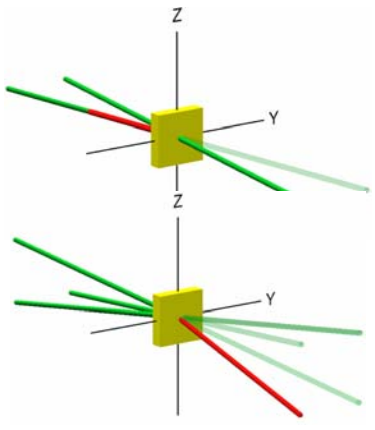
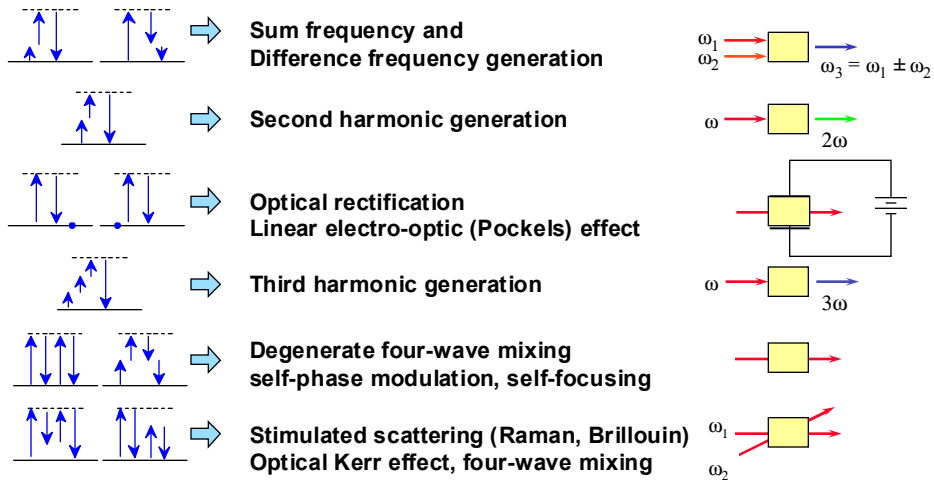
Experimental principles

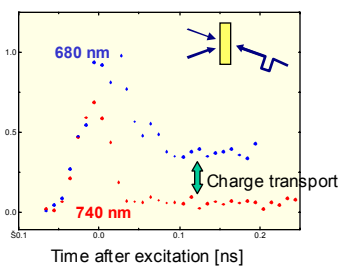




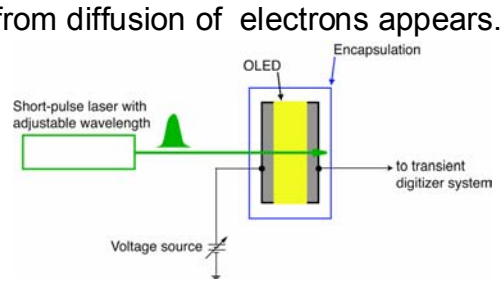
The input beams of light sketched in green interact to produce the red beam



Charge Transport



Four-wave mixing in an organic crystal: at the shorter wavelength a signal from diffusion of electrons appears.



Time dynamics of short-pulse induced photoconductivity reveals carrier life-time and charge transport efficiency.

Multi-photon interactions for fundamental studies and future optical neworking gear

Short pulses with adjustable wavelength

Excitation and detection of charge transport

- **New insights on transport in complex molecular and polar materials**

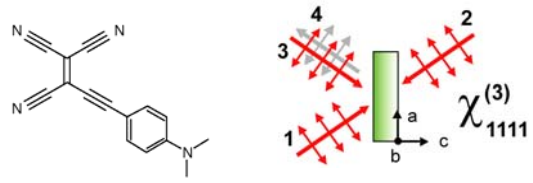
Second order nonlinear optical effects

- **Investigation of symmetry breaking**
- **New materials for modulators and frequency conversion**

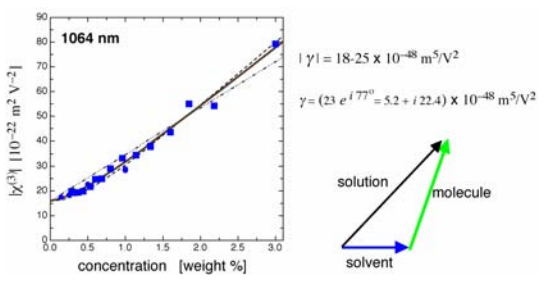
Third order nonlinear optical effects

- **Spectral dependence of the nonlinear response**
- **Structure-propety relationship in new organic molecules**
- **New materials for optical transistors and other all-optical processors.**

New materials for optical switching

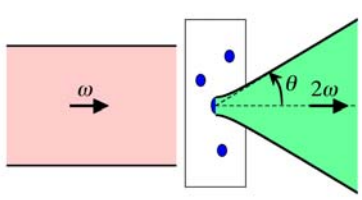


An organic molecule such as the one on the left can have an extraordinary nonlinear respone to light.
Simultaneous three-photon inter-actions can reveal information on its optical switching capabilities. This molecule has large two-photon effects at 1200 nm with good susceptibilities in the telecom spectral range.



The dependence of the nonlinearity of a solution from the concentration of the molecule reveals the molecular properties.
In this case the molecular nonlinearity γ is complex and adds vectorially to the nonlinearity of the solution. The values of both its imaginary and real parts are extraordinarily large for a molecule of this size.

Second harmonic generation and material symmetries



Only non-centrosymmetric materials can double the frequency of the light. This can be used to detect ferroelectric nanoparticles and to analize molecular orientation in supramolecular self-assembled films.