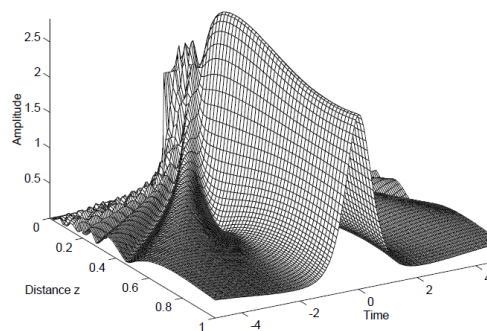


# Ultrafast Optical Physics II

Nils Huse & Franz X. Kärtner — SoSe 2014 — STiNE 66-370

*Understanding ultrafast optics, lasers, & their applications in science*

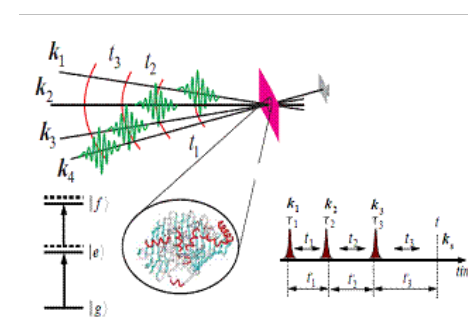
- Linear & nonlinear pulse propagation: Optical solitons & pulse compression
- Laser dynamics: Single-mode, multi-mode, Q-switching, mode locking
- Pulse characterization: Autocorrelation, FROG, SPIDER and 2DSI
- Noise in mode-locked lasers and frequency combs
- Laser oscillators & conventional and parametric amplifiers
- High-harmonic generation & attosecond pulse generation
- Nonlinear polarizations in matter: understanding perturbative expansions
- Ultrafast Fourier-transform spectroscopy: two and more dimensions
- From GHz to the ultraviolet: investigating transient states of matter with light
- More ways to see: Raman, CARS & fluorescence - also good for imaging
- Soft and hard X-ray sources: synchrotrons, table-top lasers, X-ray lasers
- Ultrafast X-ray science: femtosecond molecular movies @ atomic resolution



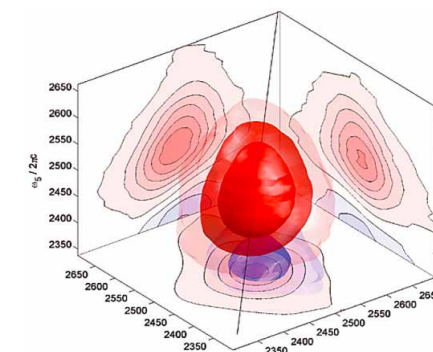
Soliton-like pulse shaping in mode-locked lasers.



High repetition rate Kerr-Lens Mode-locked Ti:sapphire laser.



Nonlinear Spectroscopy: separating quantum pathways in space.



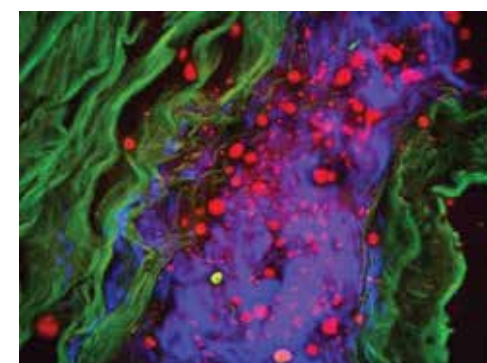
Femtosecond 3DFT vibrational spectroscopy with infrared light.



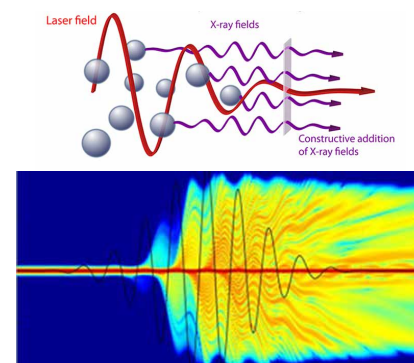
Superfluorescence cone in optical parametric amplifiers.



Methane-stabilized HeNe-Laser in a molecular optical clock.



SHG-CARS-Fluorescence overlay-image using FT-spectromicroscopy.



High harmonic generation: new sources for ultrafast X-ray science.

Lectures: Fr. 08.30-10.00  
 Exercises: Fr. 10.30-12.00  
 Start: 4. April. 2014

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*Understanding ultrafast optics, lasers, & their applications in science*

1	04.04.2014	Introduction to ultrafast optics & linear pulse propagation
2		Nonlinear Pulse Propagation
3	11.04.2014	Laser Dynamics: Two-level systems and optical Bloch equations
4		Laser Dynamics: single-mode, multi-mode, and Q-switching
	18.04.2014	GOOD FRIDAY
5	25.04.2014	Active Modelocking
6		Passive Modelocking
7	05.05.2014 <i>MONDAY</i>	Pulse Characterization: autocorrelation, FROG
8		SPIDER and 2DSI
9	09.05.2014	Noise in Modelocked Lasers
10		Femtosecond laser frequency combs
11	16.05.2014	Laser amplifiers
12		Parametric amplifiers
13	23.05.2014	High harmonic generation and attosecond pulse generation
14		Free-Electron Lasers

15	02.06.2014 <i>MONDAY</i>	Two-level systems and the density operator
16		Perturbation theory and nonlinear optics
17	06.06.2014	Lineshapes and correlation functions
18		Nonlinear spectroscopy techniques
	13.06.2014	MID-TERM BREAK
19	20.06.2014	Applications: from the THz to the Infrared
20		Applications: visible and UV laser spectroscopy
21	27.06.2014	Stimulated Raman, CARS, and fluorescence upconversion
22		Ultrafast nonlinear imaging techniques
23	04.07.2014	Applications of high harmonic radiation (ARPES)
24		XUV spectroscopy
25	11.07.2014	Ultrafast X-ray science: atoms, molecules, & condensed matter
26		X-rays vs. Electrons: atomically-resolved scattering & imaging
27	18.07.2014	Lab Tours: Ultrafast Optics and X-rays Division Ultrafast Molecular Dynamics Group
28		