

Ultrafast Optical Physics II

SoSe 2017

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Lectures: Fr 08.30-10.00 SemRm IV, BLDG 99

Recitations: Fr 10.30-12.00 SemRm IV, BLDG 99

Start: 07.04.2017

Content:

Linear and nonlinear pulse propagation: Optical solitons and pulse compression.

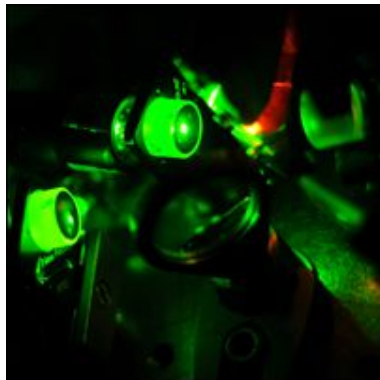
Laser dynamics: Single-mode, multi-mode, Q-switching, mode locking.

Pulse characterization: Autocorrelation, FROG, SPIDER and 2DSI.

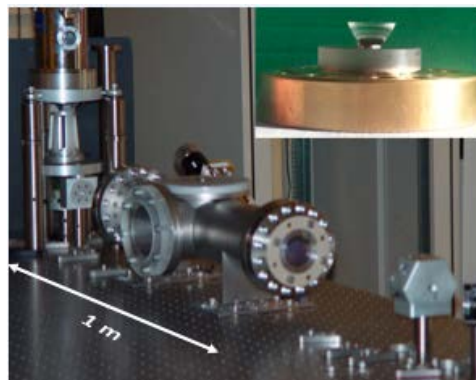
Noise in mode-locked lasers and frequency combs.

Laser amplifiers and parametric amplifiers and oscillators.

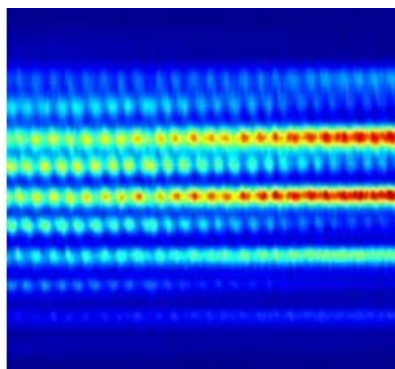
Soft and hard X-ray sources including attosecond pulse generation.



High repetition-rate Kerr-lens
Mode-locked Ti:sapphire laser



High energy cryogenically-cooled
laser



FROG-CRAB characterization of
an attosecond pulse train



Single-cycle pulse synthesizer

Required Textbook:

Class notes will be distributed in class.

Recommended Textbook:

Ultrafast Optics, Andrew M. Weiner, Hoboken, NJ, Wiley (2009).

Additional References:

Waves and Fields in Optoelectronics, H. A. Haus, Prentice Hall, NJ (1984).

Ultrashort laser pulse phenomena: fundamentals, techniques, and applications on a femtosecond time scale, J.-C. Diels and W. Rudolph, Academic Press (2006).

Few-Cycle Laser Pulse Generation and Its Applications, Ed. F. X. Kärtner, Topics in Applied Physics Vo. 95, Springer Verlag (2004).

Principles of Lasers, O. Svelto, Plenum Press, NY (1998).

Optical Resonance and Two-Level Atoms, L. Allen and J. H. Eberly, J. Wiley & Sons NY (1975).

Elements of Quantum Optics, P. Meystre, M. Sargent III, Springer-Verlag, NY, (2007).

Requirements:

8 Problem Sets and Term Paper

Collaboration on problem sets is encouraged.

Course Policy:

Collaboration: Collaboration on problem sets is permitted. However, you must list who you collaborated with when you hand in your problem sets.

Groups may discuss the problems, strategies for solutions, etc. However, each person is expected to do all of the problems independently. You may not copy the problem solutions from other members in your group. Evidence of copying will be considered cheating.

Plagiarism: Direct copying of text from other sources (books, review articles etc.) on the term papers will be considered plagiarism. Reproduction of figures or data is permitted provided that the reference is cited.

Tentative Schedule:

1	Noah Chang 07/04/2017	Introduction to Ultrafast Optics
2		Optical Pulses and Dispersion
	14/04/2017	No Class
3	Noah Chang 21/04/2017	Linear Pulse Propagation (I) <i>Problem Set 1 Out</i>
4		Linear Pulse propagation (II)

5	Noah Chang 28/04/2017	Nonlinear Schrödinger Equation (NLSE) <i>Problem Set 1 Due, Problem Set 2 Out</i>
6		Soliton Perturbation Theory
7	Noah Chang 05/05/2017	Pulse Compression and Dispersion Compensation Techniques
8		Review of Quantum Mechanics
9	Noah Chang 08/05/2017	Two Level System and Maxwell-Bloch Equations <i>Problem Set 2 Due, Problem Set 3 Out</i>
10		Laser Rate Equations
11	Noah Chang 12/05/2017	Laser CW-Operation <i>Problem Set 3 Due, Problem Set 4 Out</i>
12		Q-Switching: Active and Passive <i>Distribute Term Paper Proposals</i>
	19/05/2017	No Class
13	Franz Kärtner 29/05/2017	Master Equation <i>Problem Set 4 Due, Problem Set 5 Out</i>
14		Active Mode-Locking
15	Franz Kärtner 02/06/2017	Passive Mode-Locking with Saturable Absorbers <i>Problem Set 5 Due, Problem Set 6 Out</i>
16		Semiconductor Saturable Absorbers
	09/06/2017	No Class
17	Franz Kärtner 16/06/2017	Kerr-Lens Mode-Locking <i>Problem Set 6 Due, Problem Set 7 Out</i>
18		Pulse Characterization I – Autocorrelation
19	Franz Kärtner 23/06/2017	Pulse Characterization II – FROG <i>Term Paper Proposal Due</i>
20		Noise in Mode-Locked Lasers
21	Franz Kärtner 30/06/2017	Femtosecond Laser Frequency Combs <i>Problem Set 7 Due</i>
22		Pulse Amplification
23	Franz Kärtner 07/07/2017	Second-Order Nonlinear Effects <i>Problem Set 8 Out</i>
24		Optical Parametric Amplification
25	Franz Kärtner 14/07/2017	High Harmonic Generation and Ultrafast X-Ray Sources <i>Problem Set 8 due</i>
26		Ultrafast Optics Group Lab Tour