

Ultrafast Optical Physics II

SoSe 2020

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Lectures: Fr 08:30-10:00 and 10:15-11:00, Online Course using Zoom and Slack

Recitations: Fr 11:15-12:00, Online Course using Zoom and Slack

Start: April 24, 2020 with link:

<https://uni-hamburg.zoom.us/j/98827301468?pwd=jKoaR96ZJODXeneor2G3HOSgB85jWw>

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.

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

Required Textbook:

Class notes can be downloaded

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).

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

Fundamentals of Attosecond Science, Z. Chang, CRC Press, (2011).

Nonlinear Optics, R. Boyd, Elsevier, Academic Press, (2008).

Requirements:

5 Problem Sets and Short Interactive Presentations during class, Term Paper and Presentation substitute final. Collaboration on problem sets is encouraged.

Course Policy:

Collaboration: When collaborating on problem sets, all contributors to the solution need to be listed. However, each person is expected to hand in the solution independently and should be able to present the solution in the recitations. Not being able to present the solution will result in 0 points for the specific problem.

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	Kärtner 24/04/2020	Introduction to Ultrafast Optics
2		Optical Pulses and Dispersion
	1/05/2020	Labor Day, No Classes
3	Kärtner 8/05/2020	Linear Pulse Propagation <i>Problem Set 1 Out</i>
4		Nonlinear Pulse Propagation
5	Kärtner 15/05/2020	Review of Quantum Mechanics <i>Problem Set 1 Due, Problem Set 2 Out</i>
6		Two-Level Systems and Maxwell-Bloch Equations
	22/05/2020	Pentecost Break, No Classes
7	Kärtner 29/05/2020	Laser Rate Equations and CW-Operation <i>Problem Set 2 Due, Problem Set 3 Out</i>
8		Q-Switching
9	Kärtner 05/06/2020	Nonlinear Schrödinger Equation (NLSE) <i>Problem Set 3 Due, Problem Set 4 Out</i>
10		Pulse Compression and Dispersion Compensation Techniques <i>Distribute Term Paper Proposals</i>
11	Kärtner 12/06/2020	Master Equation <i>Problem Set 4 Due, Problem Set 5 Out</i>
12		Active Mode-Locking
13	Kärtner 19/06/2020	Passive Mode-Locking with Saturable Absorbers <i>Problem Set 5 Due</i>
14		Noise in Mode-Locked Lasers
15	Kärtner 26/06/2020	Femtosecond Laser Frequency Combs <i>Short presentations</i>
16		Laser Amplifiers
17	Kärtner 03/07/2020	Optical Parametric Amplifiers <i>Short presentations</i>
18		Autocorrelation, FROG, SPIDER, 2DSI
19	Kärtner 10/07/2020	High Harmonic Generation and Attosecond Science <i>Short presentations</i>
20		Ultrafast X-Ray Sources <i>Tour through Labs of Ultrafast Optics and X-rays Group</i>

Term Paper Presentations will be scheduled during the summer break