Nonlinear Optics

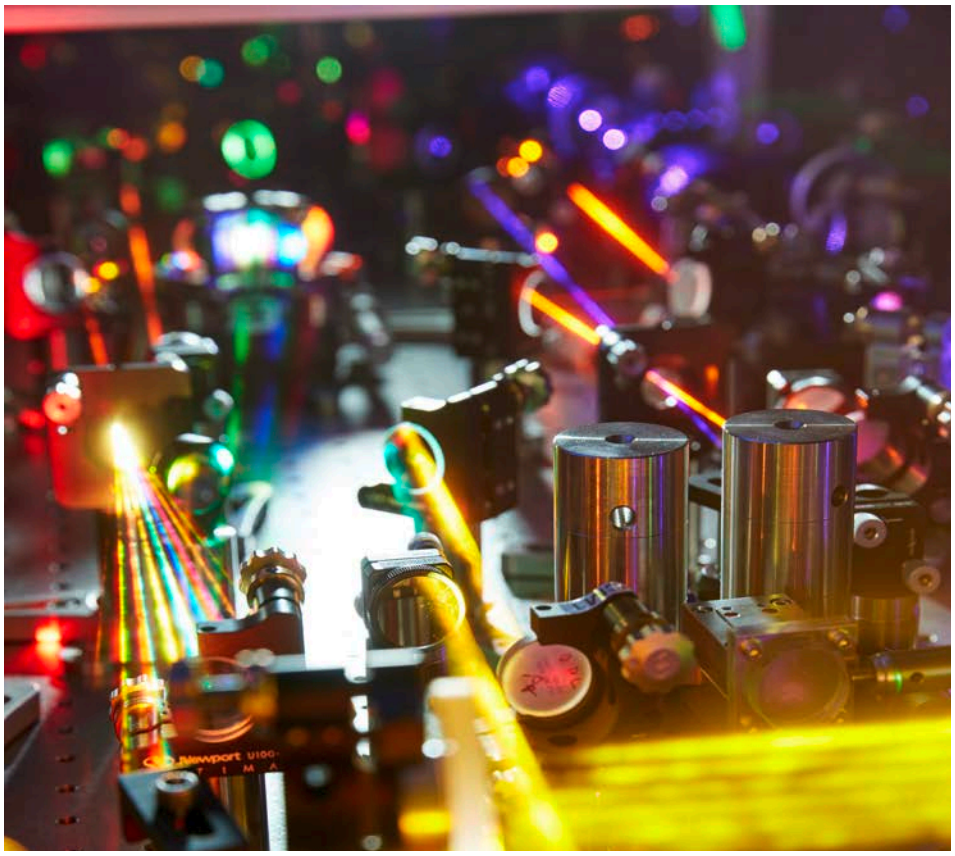
WiSe 2017-2018

Prof. Franz X. Kärtner & Dr. Oliver D. Mücke, Bldg. 99, Room O3.097 & O3. 115
Email & phone: franz.kaertner@cfel.de, 040 8998 6350
oliver.muecke@cfel.de, 040 8998 6355

Lectures: Tue 16.00-17.30, SR V (O1.109), CFEL bldg. 99, Bahrenfeld campus
Lecture & Recitations: Thu 16.00 -17.30 SR V (O1.109), CFEL bldg. 99
Start: October 17, 2017

Content:

Nonlinear optical susceptibilities and symmetries, nonlinear wave equation, second-harmonic generation, phase matching, quasi-phase matching, optical rectification, Manley-Rowe relations, sum- and difference-frequency generation, THz generation, optical parametric amplification, ultrashort-pulse optical parametric (chirped-pulse) amplification, third-order nonlinear effects: third-harmonic generation, Kerr effect, self-phase modulation, self-focusing, stimulated Raman- and Brillouin-scattering, optical solitons, extreme nonlinear optics: carrier-wave Rabi flopping, Bloch oscillations, dynamical Franz-Keldysh effect, strong-field physics in solids, high-order harmonic generation, attosecond science.



Required Textbook: Class notes will be distributed in class.
Recommended Textbook: R. W. Boyd, Nonlinear Optics.

Additional References:

1. The Principles of Nonlinear Optics, Y. R. Chen, J. Wiley & Sons NY (1984).
2. The Elements of Nonlinear Optics, P. N. Butcher & D. Cotter, Cambridge Studies in Modern Optics 9, (1990).

3. Nonlinear Fiber Optics, G. P. Agrawal, Academic Press (1998).
4. Solitons: an introduction, P. G. Drazin & R. S. Johnson, Cambridge Texts In Applied Mathematics, NY (1989).

Requirements:

9 Problem Sets and a 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	Franz Kärtner 17/10/2017	**Introduction to Nonlinear Optics**
2	Franz Kärtner 19/10/2017	**Important Nonlinear Optical Processes Overview**
3	Oliver Mücke 24/10/2017	**Nonlinear Optical Susceptibilities** *Problem Set 1 Out*
4	Franz Kärtner 26/10/2017	**Susceptibility Tensors**
5	Franz Kärtner 31/10/2017	**Nonlinear Wave Equation** *Problem Set 1 Due, Problem Set 2 Out*
6	Franz Kärtner 2/11/2017	**Second-Harmonic Generation**
7	Oliver Mücke 7/11/2017	**Frequency Doubling of Pulses, Quasi-Phase Matching** *Problem Set 2 Due, Problem Set 3 Out*
8	Oliver Mücke 9/11/2017	**Optical Parametric Oscillation/Amplification, Difference Frequency Generation**
9	Franz Kärtner 14/11/2017	**Electro-Optic Effect and Modulators** *Problem Set 3 Due, Problem Set 4 Out*
10	Franz Kärtner 16/11/2017	**Acousto-Optic Modulators and Bragg Cells**
11	Oliver Mücke 21/11/2017	**Third-Order Nonlinear Effects** *Problem Set 4 Due, Problem Set 5 Out*
12	Oliver Mücke 23/11/2017	**Self-Phase Modulation and Self-Focusing**
13	Franz Kärtner 28/11/2017	**Raman and (Stimulated) Brillouin Scattering** *Problem Set 5 Due, Problem Set 6 Out; Distr. Term Paper Proposals*
14	Franz Kärtner 30/11/2017	**Optical Solitons**

15	Oliver Mücke 5/12/2017	**Ultrashort-Pulse Optical Parametric Amplification** *Problem Set 6 Due, Problem Set 7 Out*
16	Oliver Mücke 7/12/2017	**Ultrashort-Pulse Optical Parametric Chirped-Pulse Amplification**
17	Franz Kärtner 12/12/2017	**High-Energy Few-Cycle Parametric Sources I** *Problem Set 7 Due, Problem Set 8 Out*
18	Franz Kärtner 14/12/2017	**High-Energy Few-Cycle Parametric Sources II: NOPA, OPCPA, passive CEP stabilization in OPA**
19	Oliver Mücke 19/12/2017	**Nonlinear Optics with Two-Level Systems** *Problem Set 8 Due, Term Paper Proposal Due*
20	Oliver Mücke 21/12/2017	**Carrier-Wave Rabi Flopping**
21	Franz Kärtner 9/1/2018	**Ultrafast Terahertz (THz) Sources** *Problem Set 9 Out*
22	Franz Kärtner 11/1/2018	**Applications of Ultrafast Terahertz (THz) Sources**
23	Oliver Mücke 16/1/2018	**High-Harmonic Generation** *Problem Set 9 Due*
24	Oliver Mücke 18/1/2018	**Attosecond Science**
25	Oliver Mücke 23/1/2018	**Strong-Field Physics in Solids I**
26	Oliver Mücke 25/1/2018	**Strong-Field Physics in Solids II**
27	06/02/2018	**Lab tour**
28	08/02/2018	**Term Paper Presentation**