Nonlinear Optics

WiSe 2015/2016

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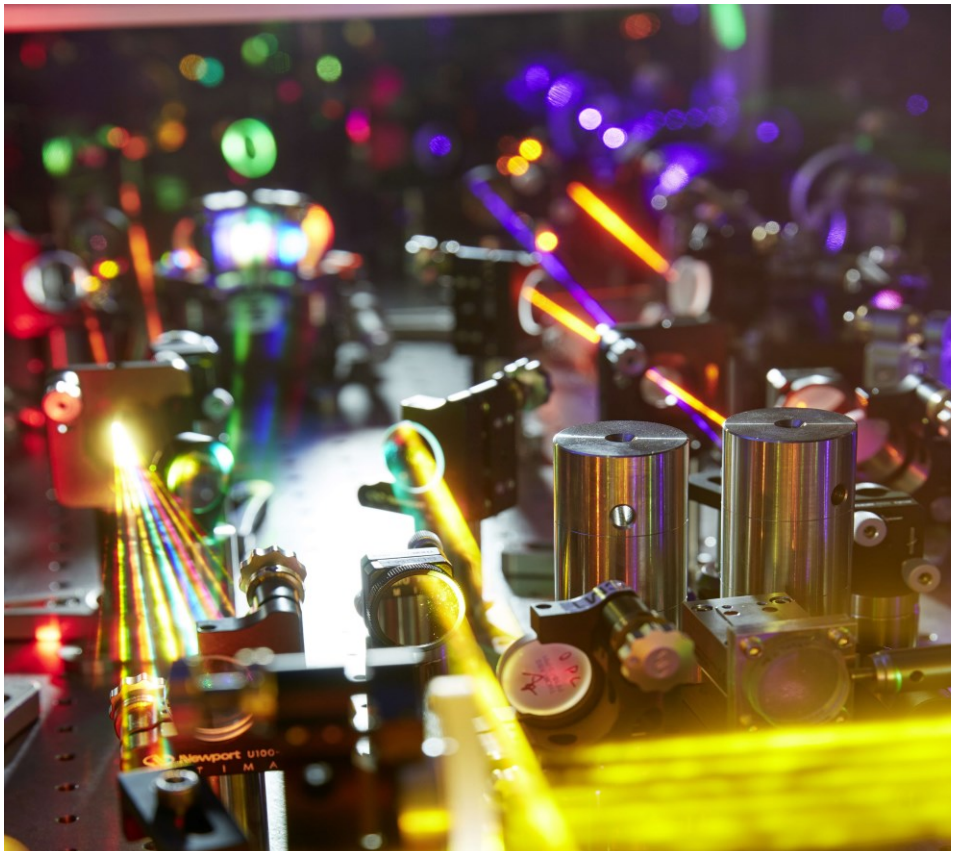
Lectures: Fr 08.30-10.45 SemRm 4, Jungiusstrasse 9
Recitations: Fr 11.15-12.00 SemRm 4, Jungiusstrasse 9
Start: October 16, 2015

Content:

Nonlinear optical susceptibilities and symmetries, nonlinear wave equation, second-harmonic generation, phase matching, quasi-phase matching, optical rectification, Manly-Rowe relations, sum- and difference-frequency generation, THz generation, optical parametric amplification, ultrafast optical parametric 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, 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:

10 Problem Sets and Term Paper
Collaboration on problem sets is encouraged.

Course Policy:

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.

Schedule:

1	Franz Kärtner 16/10/2015	**Introduction to Nonlinear Optics**
2		**Important Nonlinear Optical Processes Overview**
3	Oliver Mücke 23/10/2015	**Nonlinear Optical Susceptibilities** *Problem Set 1 Out*
4		**Susceptibility Tensors**
5	Franz Kärtner 30/10/2015	**Nonlinear Wave Equation: Second-Harmonic Generation** *Problem Set 1 Due, Problem Set 2 Out*
6		**Phase Matching**
7	Oliver Mücke 06/11/2015	**Electro-Optic Effect and Modulators** *Problem Set 2 Due, Problem Set 3 Out*
8		**Acousto-Optic Modulators and Bragg Cells**
9	Franz Kärtner 13/11/2015	**Third-Order Nonlinear Effects** *Problem Set 3 Due, Problem Set 4 Out*
10		**Self-Phase Modulation and Self-Focusing**

11	Franz Kärtner 20/11/2015	**Raman and Brillouin Scattering** *Problem Set 4 Due, Problem Set 5 Out*
12		**Optical Solitons** *Distribute Term Paper Proposals*
13	Franz Kärtner 27/11/2015	**Optical Parametric Amplification** *Problem Set 5 Due, Problem Set 6 Out*
14		**Ultrafast Optical Parametric Amplification**
15	Oliver Mücke 04/12/2015	**Design of High-Energy Few-Cycle Parametric Sources** Problem *Set 6 Due, Problem Set 7 Out*
16		**Mid-IR and Terahertz (THz) Ultrafast Sources** *Term Paper Proposal Due*
17	Oliver Mücke 11/12/2015	**Quantum Theory of Nonlinear Optical Susceptibility** *Problem Set 7 Due, Problem Set 8 Out*
18		**Electromagnetically Induced Transparency**
19	Oliver Mücke 18/12/2015	**Nonlinear Optics with Two-Level Systems** *Problem Set 8 Due, Problem Set 9 Out*
20		**Carrier-Wave Rabi Flopping**
21	Franz Kärtner 08/01/2016	**High-Harmonic Generation** *Problem Set 9 Due, Problem Set 10 Out*
22		**Attosecond Science**
23	Oliver Mücke 15/01/2016	**Strong-Field Physics in Solids I** *Problem Set 10 Due, Term Papers Due*
24		**Strong-Field Physics in Solids I**
25	Franz Kärtner 22/01/2016	**Ultrafast X-ray Sources I** *Problem Set 10 Due, Term Papers Due*
26		**Ultrafast X-ray Sources II**
27	29/01/2016	**Term Paper Presentation** *Problem Set 10 Due, Term Papers Due*
28		**Term Paper Presentation**