

Ultrafast Optics

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The lecture is intended to deliver fundamental insight into the rapidly growing field of short laser pulse techniques and their applications.

With the ultrafast optics technology, the femtosecond and recently also attosecond time scale processes became available for researchers, not only in physics, but also chemistry, biology and material engineering. I will start with the basic concepts behind ultrashort pulse generation and amplification, then will cover a range of techniques used in ultrafast metrology (pulse diagnostics) and finally present the most spectacular application in science and technology, ranging from pump-probe molecular spectroscopy (Nobel 1999) to the optical frequency combs (Nobel 2005).

The lecture may be of interest not only for students of experimental optics, but also to solid state physicists, chemists and biologists using ultrafast measurement techniques in their research.

The preliminary lecture plan (2 hours per week) is as follows:

1. Introduction
2. Ultrashort laser pulses
3. Pulse Generation
4. Amplifiers – regenerative and parametric
5. Dispersion in ultrafast optics
6. Nonlinear Optics – second- and third-order effects.
7. Autocorrelation
8. FROG
9. Ultrafast Interferometry – SPIDER
10. Pulse Shaping
11. Ultrafast Spectroscopy
12. Coherent Control
13. Applications I – Ultrafast Imaging
14. Applications II – Ultrafast Micro-Machining and 3D Photolithography
15. Applications III – Optical Frequency Combs
16. HHG and attosecond pulses