Topics in Modern Optics, PHYC 581 005

Instructor: Jean-Claude Diels

The class is tentatively scheduled on Tuesdays and Thursdays from 14:00 to 15:15 in PANDA room 5. This may change to accommodate the wishes of the class.

The main topic of this class will be interaction of intense pulses of light with matter, and their linear and nonlinear propagation through various media, including air. The type of light waveform being considered range from single pulse, picosecond to femtosecond pulse trains or frequency combs, to attosecond pulses.

This will be partly covering nonlinear optics for short pulses. A semi-classical quantum mechanical treatment of the interaction of atoms or molecules with a classical field covers practically all phenomena from saturation to harmonic generation to nonlinear propagation. In most practical instances, a generalized "Bloch Vector Model" can be used to get a physical feeling for the type of interaction, and how the physical situation can be exploited to optimize the desired result.

The various interactions properties will be applied to the creation and manipulation of ultrashort pulses, and sources of frequency combs.

Applications covered range from propagation of intense pulses in the atmosphere, air lasing, and new techniques of sensing. Quantum effects will play an important role in the last topic. The Schrödinger equation applies to several families of laser sensor, hence tools of Quantum mechanics can be applied to their description. There is a quantum limit to the uncertainty in measurements, which can be broken by squeezing techniques applied to solitons.

Parts of this course is covered in *Ultrashort Laser Pulse Phenomena* J.-C. Diels and W. Rudolph, Academic Press (first edition out of print, second edition too expensive, third edition not done yet – hopefully completed this fall). In lieu of an expensive textbook, you will have access to all material as pdf and ppt files. Hopefully, at the end of the semester, the whole third edition will be accessible as a pdf file.

Some lectures will serve as introductory material to Optics seminars and Physics colloquia this semester.

Your activity: Occasional homework and a presentation on related publication or research.
Grading: Trust my objectivity and subjectivity.