FSK3810 Femtochemistry 8.0 credits

Femtokemi

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

Course syllabus for FSK3810 valid from Spring 2010

Grading scale

G

Education cycle

Third cycle

Specific prerequisites

Quantum physics for F4 (SI2170) or Laser spectroscopy for F4 (SK2800), or corresponding knowledge.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

The course aims to give basic knowledge about the use of femtosecond lasers regarding ultrafast events in chemical dynamics, physical chemistry, molecular physics and chemical

physics. The students will follow the field of ultrafast dynamics and penetrate frontline research within femtochemistry. After the course the student will be able to:

- solve problems concerning short pulse propagation
- solve problems about the density matrix and time-evolution of wave-packets
- explain how non-linear effects can be used in operating femtosecond lasers
- explain the pump-probe method in femtochemistry
- differences in linear and non-linear response
- give examples of femtosecond processes in the condensed phase and to compare with the gas phase
- perform calculations applying the Franck-Condon approximation
- to be able to use search engines to gather scientific information and find scientific literature in a systematic way
- be able to explain breakthrough areas such as femtochemistry, ultra-fast spectroscopy and coherent control.

Course contents

Lasers in Femtochemistry. Introduction. Radiation-matter interaction. Lasers. Short pulse production. Non-linear phenomena. Short pulse characterization. Short pulse propagation effects. Time-resolved spectroscopy. Quantum mechanics in Hilbert Space. Quantum mechanics in Liouville Space. Density-matrix, time-evolution, pump-probe spectroscopy. Linear and non-linear response. Double Feynman diagrams. Liouville pathways. Condon approximation. Pump-probe, doorway, window wave packets. Wigner functions. Application to three level systems, ICN. Wave packets. NaI, I2, I3. Condensed phase processes. CPA-2000 erbium fiber oscillator, stretched pulse amplification, regenerator. Femtochemistry at KTH. Ultra-fast spectroscopy. Gas phase, molecular beams, solution chemistry. Coherent control.

Course literature

Handouts. Lars-Erik Berg

Examination

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

INL1 - Assignments, 8.0 credits, grade scale: P, F

Other requirements for final grade

Homework assignments (INL1; 8 credits, grade P/F).

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.