Quantum Dynamics: FBB3130

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Abstract

Quantum dynamics is the background of molecular and optical physics, which has impact in different fields, from molecular dynamics and light propagation to different applications like quantum computing, molecular electronics and material sciences. The QD is the front page of modern physics and chemistry due to ultrashort laser infra-red and optical sciences pulses (from femtosecond to attosecond time domains). Femtosecond x-ray pulses are already available in FLASH (Hamburg) and Stanford Linear Accelerator Center. This new source of ultra-short x-ray pulses opens unique opportunity to map molecular dynamics with the ngstrm resolution which of crucial importance in material sciences and biology. "Quantum dynamics" gives students important concept of the dynamics of different physical chemical processes. The course is intended for anyone who wishes to learn the current state of ultrafast phenomena in chemistry and physics.

This course has been developed in parallel with the fast-advancing multidisciplinary research and technological developments related to the ultrafast molecular dynamics, and addresses three main topics: Part 1: fundamental quantum mechanics of light-matter interaction /quantum molecular dynamics and dynamics of light propagation Part 2 time-dependent spectroscopies Part 3: dynamics of propagation of ultra-short light pulses.

PACS numbers:

Room RB 15, Roslagstullsbacken 15 (Albanova University Center)

Points: 7.5 hp

10.00 -18 October (Monday)

10.00 -22 October (Friday)

10.00 -25 October (Monday)

10.00 -27 October (Wednesday)

10.00 -1 November (Monday)

10.00 -5 Novemberr (Friday)

10.00 -8 November (Monday)

10.00 -12 November(Friday)

10.00 -15 November (Monday)

10.00 -19 November (Friday)

10.00 -22 November (Monday)

10.00 -29 November (Monday)

Lectures (about 10):

1) Stationary Schrdinger equation. Born-Oppenheimer approximation. Electronic and nuclear degrees of freedom

2) Time-dependent Schrdinger equation. Harmonic oscillator. Dissociation.

3) General properties of the wave-packet: Quantum versus classical dynamics. Revival phenomenon

4) Dynamics of the Interaction between photons and molecules. Fermi Golden rule. Franck-Condon principle

5) Mechanisms of the relaxation of excited electronic state. Dynamics of photoabsorption and fluorescence. Mechanisms of the spectral line broadening.

6) Dynamics of the Raman scattering and Kramers-Heisenberg equation. Duration of the light scattering.

7) Numerical computations.

8) Dynamics of the molecules in strong laser field. Density matrix formalism and Maxwell's equations

9) Radiative damage. Multi-photon ionization and dissociation of molecules.

10) Dynamics of pulse propagation. Area theorem.

11) Self-seeded Stimulated Raman scattering.

Four-wave mixing. Slowdown and compression of the pulse. Numerical computations.

12) Time-resolved structure determination.