



PHYS2750 Theoretical methods of laser-matter interactions

[45h] 6 credits

This course is not taught in 2006-2007

Teacher(s): André Nauts, Bernard Piraux
Language: French
Level: Second cycle

Aims

A: Laser-matter interaction (22.5-0)

Introduction of the main concepts and different theoretical approaches necessary to study the interaction of an electromagnetic field with a quantum system (atom, molecule, etc.)

B: Spectroscopy of atoms and molecules (22.5-0)

Introduction to spectroscopy, oriented towards spectra of vibration-rotation of molecules, or towards the electronic spectra of atoms and molecules.

C: Theoretical treatments of atomic collisions (22.5-0)

Study of collision processes, particularly those related to astrophysics and controlled thermonuclear fusion.

Main themes

A : Description of the electromagnetic field and interaction Hamiltonian.

perturbative methods (time -dependent and -independent). Non-perturbative methods (Floquet methods, dressed atom, essential states). Coupling of a bound state to a continuum of states.

B : Two possible orientations, presented in alternance :

Vibration-Rotation spectra:

Rovibrational Hamiltonian of polyatomic molecules, the rotation and vibration to any order, vibrational and rotational resonances, rotational and vibration spectra, Stark molecular effect.

Electronic spectra:

Introduction to rovibronic spectroscopy of simple molecules. Quantum defect theory. Feshbach resonances and perturbations in spectra. Predissociation of molecules.

C : Quantum theory of electron-atom scattering (elastic and inelastic collision).

General theory of collisions and theoretical approaches (perturbative methods, "Close-coupling" method, R-matrix)

Heavy particle collisions: semi-classical treatment of excitation, electron transfert, concept of diabatic state, Landau-Zener model, resonances.

Laser assisted collisions.