UCL Université catholique de Louvain

# LPHY2140

*2015-2016*

# Photons, atoms and molecules

| 5.0 credits | 30.0 h | 1q |
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| Teacher(s) : | Nauts André ; Urbain Xavier ; |
| Language : | Français |
| Place of the course | Louvain-la-Neuve |
| Main themes : | - Laser-atom interaction Phemenological models Perturbative approach 2-state model : Rabi oscillations, adiabatic rapid passage, Bloch vector, Ramsey fringes, saturated absorption 3-state Model : optical pumping, AC-stark shift, 2-photon spectroscopy, STIRAP, induced electromagnetic transparency, slow light - Cold atoms, atom traps and Bose-Einstein condensates Slowing down atoms with light : Doppler and sub-Doppler cooling, cooling beyond the recoil limit, the Zeeman slower Trapping atoms in electromagnetic fields : magneto-optical trap or MOT, magnetostatic trap and evaporative cooling, reactive force and dipole trap Bose-Einstein condensation : statistical mechanics of boson condensation, wave function and properties of the condensate, fermion condensates and atom lasers Applications of cold atoms to metrology : atomic clocks, atomic fountains, cold ions in a Paul trap, Lamb-Dicke regime and quantum jumps, atomic qubits - Introduction to the principles of Nuclear Magnetic Resonance (NMR) and Magnetic Resonance Imaging (MRI) Magnetic Bloch equations , spin echoes, Fourier Transform NMR Principles and basic pulse sequences in MRI - Entanglement and quantum non-locality Einstein-Podolsky-Rosen paradox (EPR) Bell's inequalities , Bell states , quantum teleportation Experimental tests , Aspect experiments,... |
| Aims : | The purpose of this course is to present the theoretical basis of some recent topics in atomic and molecular physics, with particular emphasis on the laser-atom interactions. The course is illustrated with the description of outstanding experiments. The main objective is the understanding of the physical concepts.<br>*The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".* |
| Other infos : | Students must have followed and passed at least the following exams: PHY1322 " Quantum physics 2 ". |
| Faculty or entity in charge: | PHYS |

| Programmes / formations proposant cette unité d'enseignement (UE) | | | | |
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| Intitulé du programme | Sigle | Credits | Prerequis | Acquis d'apprentissage |
| Master [120] in Physics | PHYS2M | 5 | - | |
| Master [60] in Physics | PHYS2M1 | 5 | - | |
| Master [120] in Physical Engineering | FYAP2M | 5 | - | |