UCL Université catholique de Louvain

LPHY2120

2015-2016

Quantum Field Theory

4.0 credits	22.5 h	1q

Teacher(s) :	Gérard Jean-Marc ;
Language :	Français
Place of the course	Louvain-la-Neuve
Main themes :	This course provides a general introduction to the concept and techniques of Quantum Field Theory. Emphasis is given to the connection to Classical and Quantum Mechanics and its applications to different fields, from Optics to Condensed Matter and Particle Physics. The Syllabus is complementary to Relativistic Quantum Mechanics and Quantum Field Theory II and lays out the mathematical formalism used in Elementary Particle Physics, Fundamental Interactions, as well as in the more advanced optional courses. P { margin-bottom: 0.21cm; } Introductory topics 1.1 Motivation. Historical perspective. 1.2 Many-Particle Classical and Quantum Mechanics. 1.3 Classical Field Theory. 1.4 Second Quantization. Non-relativistic Quantum Field Theory. 1.5 Relativistic Classical Field Theory. The Klein'Gordon field. 2. Field quantization 2.1 Canonical Quantization. Scalar field theory. 2.2 The Electromagnetic Field: classical equations. Normal modes. 2.3 The Electromagnetic Field: Canonical Quantization. Polarization. Coherent states. 2.4 Field Quantization in the presence of charges. Interactions. Quantum Electrodynamics. Single'photon events. 3. Applications 3.1 Quantum effects in the vacuum. Casimir effect. Lamb shift. 3.2 Anomalous magnetic moments. 3.3 Scattering of light. 3.4 Atomic transitions. Spontaneous and stimulated emission. Lasers. 4. More advanced topics 4.1 Aspects of symmetry. The Brout'Englert'Higgs mechanism. 4.2 Topological solutions.
Aims :	*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".*
Evaluation methods :	P { margin-bottom: 0.21cm; } -- Weekly assigment (60%) ' one problem sheet to be worked out and delivered within a week. -- Final project & mp; oral presentation (40%). -- The final grade can be lifted to reflect class participation, improvement and effort.

Bibliography :	P { margin-bottom: 0.21cm; }A:link { } Classical textbooks -- W. Greiner, Field Quantization: Berlin, Springer Verlag 1996. -- P. Lambropoulos, D. Petrosyan, Fundamentals of Quantum Optics and Quantum Information: Springer Science & mp; Business Media, 2007. -- F. Mandl, G. Shaw, Quantum Field Theory: John Wiley & mp; Sons, 2013. -- M. Peskin, D. Schroeder, An introduction to Quantum Field Theory: Addison-Wesley Publishing Company, 1995. -- M. Srednicki, Quantum Field Theory, Cambridge University Press, 25 Jan 2007. -- A. Zee, Quantum Field Theory in a Nutshell : Princeton University Press, 1 Feb 2010. -- S. Weinberg, The Quantum Theory of Fields Vols. I,II : Cambridge University Press, 1996. ' Lecture notes -- L. Alvarez-Gaume, A. Vazquez-Mozo, Introductory lectures on Quantum Field Theory -- P. Riseborough, Advanced Quantum Mechanics -- D. Steck, Classical and Modern Optics -- A. Wipf, Selected topics in Quantum Field Theory
Faculty or entity in charge:	PHYS

Programmes / formations proposant cette unité d'enseignement (UE)

Intitulé du programme	Sigle	Credits	Prerequis	Acquis d'apprentissage
Master [120] in Physics	PHYS2M	4	-	
Master [60] in Physics	PHYS2M1	4	-	
Master [120] in Physical Engineering	FYAP2M	4	-	