UCLouvain

lphy2120

2018

Quantum Field Theory

4 credits	22.5 h	Q1

Teacher(s)	Gérard Jean-Marc ;
Language :	French
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. 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	• Weekly assigment (60%) ' one problem sheet to be worked out and delivered within a week. • Final project & oral presentation (40%). • The final grade can be lifted to reflect class participation, improvement and effort.

Bibliography	<u>Manuels classiques</u> - W. Greiner, Field Quantization: Berlin, Springer Verlag 1996. - P. Lambropoulos, D. Petrosyan, Fundamentals of Quantum Optics and Quantum Information: Springer Science & Business Media, 2007. - F. Mandl, G. Shaw, Quantum Field Theory: John Wiley & 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. - S. Weinberg, The Quantum Theory of Fields Vols. I,II : Cambridge University Press, -Zee, Quantum Field Theory in a Nutshell : Princeton University Press, 1 Feb 2010. 1996. <u>Notes de course</u> -L. Alvarez-Gaume, A. Vazquez-Mozo, Introductory lectures on Quantum Field Theory, hep-th:0510040 - P. Riseborough,Advanced Quantum Mecanics, https://math.temple.edu/ prisebor/Advanced.pdf - D. Steck, Classical and Modern Optics, http://atomoptics.uoregon.edu/ dsteck/teaching/optics/optics-notes.pdf. Pour les etudiants avec des inter^ets plut^ot mathematiques . . . - R. Ticciati, Quantum Field Theory for Mathematicians: Cambridge University Press, 1999 - A. Wipf, Selected topics in Quantum Field Theory, https://www.tpi.uni-jena.de/qfphysics/homepage/wipf/lecturenotes.html
Faculty or entity in charge	PHYS

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Aims
Master [120] in Physical Engineering	FYAP2M	4		
Master [120] in Physics	PHYS2M	4		
Master [60] in Physics	PHYS2M1	4		