UCLouvain

lphys2234

2019

Quantum field theory 2

In view of the health context linked to the spread of the coronavirus, the methods of organisation and evaluation of the learning units could be adapted in different situations; these possible new methods have been - or will be - communicated by the teachers to the students.

5 credits	30.0 h	Q2

This biannual learning is being organized in 2019-2020

Teacher(s)	Govaerts Jan ;
Language :	English
Place of the course	Louvain-la-Neuve
Main themes	- S matrix and correlation functions : asymptotic theory, Källen-Lehmann representation, LSZ reduction, time-ordered n point functions and perturbation theory. - Renormalized perturbation theory to all orders, and renormalization schemes ; i) Feynman diagrams approach ; ii) Functional integral and methods approach. - Perturbative and non-perturbative functional methods in quantum field theory ; effective quantum action and potential. - Selected topics in advanced quantum field theory, depending on the interests of each year's target audience, one of which being the topic of a personal project.
Aims	**a. Contribution of the teaching unit to the learning outcomes of the programme (PHYS2M and PHYS2M1)** AA1 : A1.1, A1.2, A1.6 AA2 : A2.1, A2.5 AA3 : A3.1, A3.2, A3.3, A3.4 AA4 : A4.1, A4.2 AA5 : A5.1, A5.2, A5.3, A5.4 AA6 : A6.1, A6.2 AA7 : A7.1, A7.3, A7.4 AA8 : A8.1 1 **b. Specific learning outcomes of the teaching unit** By the end of this teaching unit, the student will be able to : 1. implement renormalised perturbation theory of theories with quantum scalar and spinorial fields, possibly even vector and gauge fields ; 2. understand the roles of regularization and of renormalization points in a perturbative renormalization scheme ; 3. explain the occurrence of masses and interaction coupling constants which are running functions of renormalization scales ; 4. further the study of a specific topic of advanced quantum field theory ; 5. relate the contents of the course to current developments in quantum field theory at the interface of the fundamental quantum interactions and of the gravitational interaction. - - - - *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	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** Written examination with exercises combined with an individual oral exam based on a personal project report.
Teaching methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** Traditional lectures in class. Integrative personal project - subject left to the student's choice. Reading portofolio for personal study.
Content	- S matrix and correlation functions: asymptotic theory, Källen-Lehmann representation, LSZ reduction, time-ordered n point functions and perturbation theory. - Renormalized perturbation theory to all orders, and renormalization schemes :

	i) Feynman diagrams approach ; ii) Functional integral and methods approach. - Perturbative and non perturbative functional methods in quantum field theory ; effective quantum action and potential. - Selected themes of advanced quantum field theory, depending on the interests of each year's target audience, one of which being the topic of a personal project, as for instance : a) non perturbative and topological methods and contributions (anomalies, instantons, monopoles, ...) ; b) quantisation of gauge theories and BRST symmetry ; c) renormalization group equations ; d) supersymmetry and supergravity ; e) quantum field theory on curved space-time ; f) quantum entanglement ; g) etc.
Bibliography	- M. E. Peskin and Daniel S. Schroeder, *An Introduction to Quantum Field Theory* (Westview Press, Perseus Books, 1995). - Cl. Itzykson and J.-B. Zuber, *Quantum Field Theory* (MacGraw-Hill, New York, 1980). - P. Ramond, *Field Theory: A Modern Primer* (Benjamin Cummings, Reading, 1981). Ainsi que d'autres ouvrages et documents de référence en fonction des sujets choisis d'année en année. As well as other reference books and documents depending on the chosen topics from one year to the next.
Faculty or entity in charge	PHYS

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Aims
Master [60] in Physics	PHYS2M1	5		
Master [120] in Physics	PHYS2M	5		