PHYS-432 **Quantum field theory II**

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Cursus	Sem.	Type
Ing.-phys	MA2, MA4	Opt.
Physicien	MA2, MA4	Opt.

Language of teaching	English
Credits	6
Session	Summer
Semester	Spring
Exam	Oral
Workload	180h
Weeks	14
Hours	**5 weekly**
Lecture	3 weekly
Exercises	2 weekly
Number of positions	

Summary

The goal of the course is to introduce relativistic quantum field theory as the conceptual and mathematical framework describing fundamental interactions such as Quantum Electrodynamics.

Content

7. Gauge invariance, the electromagnetic field and its coupling to charged fields. Quantized electromagnetic field. Massive vector field. Polarization vectors. Representation of the Lorentz group on single particle states.
8. Causality in classical and quantum field theory
9. Discrete symmetries: parity (P), charge conjugation (C), time reversal (T) and their action of fields and states. CPT theorem.
10. Interacting fields. Formal theory of relativistic scattering. Asymptotic states. Lippmann-Schwinger equation. S-matrix and its symmetries. S-matrix in perturbation theory and Feynman diagrams. Cross sections and decay-rates.
11. Quantum electrodynamics: Feynman rules, elementary processes, Ward identities.
12. The Standard Model: non-abelian gauge theory, the field content and the lagrangian of the SM, the Higgs mechanism.

Learning Prerequisites

Required courses

Classical Electrodynamics, Quantum Field Theory I, Quantum Mechanics I and II, Analytical Mechanics, Mathematical Physics

Recommended courses

Quantum Mechanics III and IV, General Relativity, Cosmology

Learning Outcomes

By the end of the course, the student must be able to:

- Expound the theory and its phenomenological consequences
- Formalize and solve the problems

Transversal skills

- Use a work methodology appropriate to the task.

Teaching methods

Ex cathedra and exercises in class

Assessment methods

Oral exam, based on one theoretical question and one exercise picked through a random choice. The candidate is allowed 1 hour to prepare and 20 minutes to present and discuss the handwritten results.

Resources

Virtual desktop infrastructure (VDI)

Yes

Bibliography

- "An introduction to quantum field theory / Michael E. Peskin, Daniel V. Schroeder". Année:1995. ISBN:0-201-50397-2
- "The quantum theory of fields / Steven Weinberg". Année:2005. ISBN:978-0-521-67053-1
- "Quantum field theory / Claude Itzykson, Jean-Bernard Zuber". Année:1980. ISBN:0-07-032071-3
- "Relativistic quantum mechanics / James D. Bjorken, Sidney D. Drell". Année:1964
- "A modern introduction to quantum field theory / Michele Maggiore". Année:2010. ISBN:978-0-19-852074-0
- "Théorie quantique des champs / Jean-Pierre Derendinger". Année:2001. ISBN:2-88074-491-1
- Quantum Field Theory / Marc Srenedicki". Année:2007. ISBN:9780521864497
- Quantum Field Theory and the Standard Model / Matthew D. Schwartz". Année:2014. ISBN:1107034736

Ressources en bibliothèque

- Relativistic quantum mechanics / Bjorken
- Quantum field theory / Itzykson
- An introduction to quantum field theory / Peskin
- Théorie quantique des champs / Derendinger
- A modern introduction to quantum field theory / Maggiore
- The quantum theory of fields / Weinberg
- Quantum Field Theory and the Standard Model / Schwartz
- Quantum Field Theory / Srenedicki

Notes/Handbook

Lecture Notes for QFT-I and QFT-II

Websites

- https://www.epfl.ch/labs/lptp/

Moodle Link

- https://go.epfl.ch/PHYS-432

Prerequisite for

Theoretical Particle Physics