EPFL

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

- Quantisation of fields and massive particles with spin and the relevance of symmetries in fundamental physics (Poincaré group, little groups, irreducible representations ...);
- Quantisation of massless particles with spin-1 (photons);
- Introduction to Quantum electrodynamics (QED);
- Discrete spacetime symmetries (P, C, T and CPT);
- Causality and statistics;
- Classical predictions of QED;
- Higher order calculations and quantum corrections.

Time permitting: more advanced topics such as the Higgs mechanism, electroweak interactions and non-abelian gauge theories, path integral...

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

Exam: oral, consisting of one theoretical question and one exercise, picked randomly and for which the candidate is allowed a 45 minute preparation

Resources

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 and the Standard Model / Matthew D. Schwartz". Année:2014. ISBN:1107034736

• Quantum Field Theory / Marc Srenedicki". Année:2007. ISBN:9780521864497

• "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

Ressources en bibliothèque

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

Websites

• https://www.epfl.ch/labs/lptp/wp-content/uploads/2022/05/NewQFTLectureNotes.pdf

Moodle Link

• https://go.epfl.ch/PHYS-432

Prerequisite for

Prerequisite for Theoretical Physics