PHYS-432 **Relativistic quantum fields II**

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

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	Oral
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Summary

The goal of the course is to introduce relativistic quantum field theory as the framework to describe fundamental interactions.

Content

1. Introduction
Conceptual foundations. Overview of particle physics. Units of measure in high energy physics.
2. Classical Field Theory
Lagrangian and Hamiltonian formulation. Noether's theorem.
3. Symmetry Principles
Elements of group theory and group representations. Lie groups. Lie Algebras. Lorentz and Poincaré groups. Parity, time reversal and charge conjugation.
4. Free Quantum Fields
Canonical quantization. Creation and annihilation operators. Fock space. Free relativistic particles. Bosons and Fermions. Symmetries in the quantum theory. Causality.
5. Classification of quantum fields
Real and complex scalar fields. Spinor field. Quantized electromagnetic field. Massive vector field.
6. Interacting fields
Formal theory of relativistic scattering. Asymptotic states. Lippmann-Schwinger equation. S-matrix and Feynman diagrams. Cross sections and decay-rates.
7. Fundamental interactions
Quantum electrodynamics. The weak force and parity violation. The strong force. Overview of the Standard Model.

Learning Prerequisites

Recommended courses

Electrodynamics, Special relativity, Quantum Mechanics I and II, Mathematical Physics strongly recommended

Learning Outcomes

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

- Expound the theory and its phenomenological consequences
- 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

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 / 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

- Théorie quantique des champs / Derendinger
- Relativistic Quantum Mechanics / Drell
- A Modern Introduction to Quantum Field Theory / Maggiore
- Quantum Field Theory / Itzykson
- The Quantum Theory of Fields/ Weinberg
- An Introduction to Quantum Field Theory / Peskin

Websites

- http://itp.epfl.ch/page-60688-en.html