GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2020-2021

Quantum Field Theory (C001747)

Due to Covid 19, the education and evaluation methods may vary from the information displayed in the schedules and course details. Any changes will be communicated on Ufora.

Course size *(nominal values; actual values may depend on programme)*

Credits	6.0	**Study time**	180 h	**Contact hrs**	52.5 h

Course offerings and teaching methods in academic year 2020-2021

A (semester 1)	Dutch	Gent	lecture	40.0 h
			seminar: coached exercises	12.5 h
			online seminar: coached exercises	0.0 h
			online lecture	0.0 h

Lecturers in academic year 2020-2021

Verschelde, Henri	WE05	lecturer-in-charge
Mertens, Thomas	WE05	co-lecturer

Offered in the following programmes in 2020-2021	crdts	offering
Master of Science in Teaching in Science and Technology (main subject Mathematics)	6	A
Master of Science in Teaching in Science and Technology (main subject Physics and Astronomy)	6	A
Master of Science in Physics and Astronomy	6	A
Master of Science in Mathematics	6	A

Teaching languages

Dutch

Keywords

Quantum field theory, elementary particle physics

Position of the course

Theoretical: thorough study of modern relativistic quantum field theory based on the path integral formalism and applied to elementary particle physics and solid state physics.
Practical: calculation of probabilities of particle processes in the Weinberg-Salam-model and quantum chromodynamics. Modern introduction to relativistic quantum field theory and elementary particle physics based on the path integral formalism. The emphasis is on physical concepts and their relation with the mathematical model.

Contents

Elementary particles are the quanta of their underlying particle field. Therefore, quantum field theory is at the basis of elementary particle physics. The particle aspect of a quantum field can be elegantly extracted in the path integral formalism. A perturbative expansion of the path integral can be pictorially represented with Feynman diagrams of the particle processes. Elementary particles also have internal symmetries and Yang-Mills theories with local gauge invariance demand special precaution to define the path integral properly. This entails the introduction of the so-called Faddeev-Popov ghosts, particles without physical meaning but which have to be introduced for mathematical consistency (conservation of probability). A further technical question is the problem of renormalisation: quantum fluctuations at very small distances generate divergences. Amodern view of renormalisation is given through the renormalization group. Applications of Yang-Mills theories are the Weinberg-Salam model of electroweak interactions and quantum chromodynamics (Q.C.D.), the theory of quarks and gluons which describes strong interactions. As an application of the renormalisation group, the asymptotic freedom of quarks is considered in some detail. Also, some aspects of the quark confinement problem are treated. The course ends with GUTS (Grand Unified Theories) and string theory.

Initial competences

End competences of Relativity Theory and Quantum Mechanics are sufficient.

Final competences

The student has a working knowledge of particle physics and field theory and is prepared for research in quantum field theory, elementary particle physics and theoretical physics in general (for ex: theoretical solid state physics).

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Lecture, seminar: coached exercises, online lecture, online seminar: coached exercises

Extra information on the teaching methods

The excercises are guided and are based on Feynman diagrams.

Learning materials and price

Syllabus. Cost: 12 EUR

References

An introduction to quantum field theory. M. Peskin and D. Schroeder, Addison Wesley (1995)

Course content-related study coaching

Support orally or via email by teacher and collaborators.

Evaluation methods

end-of-term evaluation

Examination methods in case of periodic evaluation during the first examination period

Oral examination

Examination methods in case of periodic evaluation during the second examination period

Written examination with open questions, oral examination

Examination methods in case of permanent evaluation

Possibilities of retake in case of permanent evaluation

not applicable

Extra information on the examination methods

Theory: orally and written.
Exercises: written.The emphasis is on the understanding of physical concepts and their relation with the mathematical model.

Calculation of the examination mark

1/2(theory)+1/4(oral)+1/4(excercises)