

PHYS-702

**Advanced Quantum Field Theory**

Rattazzi Riccardo

| <b>Cursus</b> | <b>Sem.</b> | <b>Type</b> |
|---------------|-------------|-------------|
| Physics       |             | Obl.        |

|                            |           |
|----------------------------|-----------|
| Language of teaching       | English   |
| Credits                    | 4         |
| Session                    |           |
| Exam                       | Multiple  |
| Workload                   | 120h      |
| <b>Hours</b>               | <b>56</b> |
| Courses                    | 28        |
| Exercises                  | 28        |
| <b>Number of positions</b> |           |

**Frequency**

Every year

**Remark**

Next time: Fall

**Summary**

The course builds on the two previous courses on the subject. The main subject is the study of quantum field theories at the loop level. The course introduces the concept of loop divergences and renormalization. Non abelian gauge theories are also discussed in depth.

**Content**

Skills developed in the course include the use of the Path integral formalism, methodologies to perform loop calculations and renormalization.

- 1) Path integral approach to QFT
- 2) Regularization and renormalization
  - applications to scalar fields with a quartic interaction
  - application to Yukawa theory
  - application to Quantum Electrodynamics
- 3) Non-abelian gauge theories
  - BRST quantization
  - renormalization at 1- loop
- 4) The renormalization group
  - Callan Symanzik equation
  - asymptotic freedom
  - fixed points
- 5) Anomalies

**Keywords**

Path integral formalism, divergences renormalization, Gauge theories  
Renormalization group, Anomalies

### Learning Prerequisites

#### Required courses

Quantum mechanics 1,2 - Quantum Field theory 1,2

#### Recommended courses

Conformal Field theory and gravity  
Gauge theories and the Standard Model

### Expected student activities

Study a quantum field theory at quantum level.  
Understanding and interpreting loop effects in a quantum field theory.  
Performing loop calculations in gauge theories.

### Resources

#### Bibliography

An introduction to Quantum Field Theory, by Peskin and Schroeder  
The quantum theory of Fields, Vol 1,2 by Weinberg

#### Ressources en bibliothèque

- [An introduction to Quantum Field Theory / Peskin, Schroeder](#)
- [The quantum theory of fields / Weinberg . Vol2](#)
- [The quantum theory of fields / Weinberg . Vol1](#)