Universidad Zaragoza

Academic Year/course: 2023/24

68358 - Quantum field theory

Syllabus Information

Academic year: 2023/24
Subject: 68358 - Quantum field theory
Faculty / School: 100 - Facultad de Ciencias
Degree: 628 - Master's Degree in Physics of the Universe: Cosmology, Astrophysics, Particles and Astroparticles
ECTS: 6.0
Year: 01
Semester: First semester
Subject type: Optional
Module:

1. General information

Quantum Field Theory (QFT) occupies a unique place in physics since it combines and makes compatible two great findings of physics: quantum theory and relativity. This theory is the basis of the Standard Model of particle physics. In addition, QFT provides essential tools for nuclear physics, atomic physics, condensed matter physics and astrophysics.

Together with **Electrodynamics: Interaction of Radiation and Matter**, **Theory and Phenomenology of the Standard Model of Particle Physics and Particle Physics beyond the Standard Model, it forms the Particle Physics subject.**

These approaches and objectives are aligned with the following Sustainable Development Goals (SDGs) of the Agenda 2030: 4-Quality education.

2. Learning results

Upon completion of this subject, the student will be able to:

- Master the basic concepts of quantum field theory as the fundamental theoretical framework of the physics of particles and astroparticles.
- Analyze the deduction of a theory and the connection with experimental data.
- Calculate cross sections and decay widths for processes relevant to particle physics and astroparticles.
- Handle the Feynman Diagrams technique.
- Understand the role of symmetries in quantum field theories.
- Know the essential pieces that will constitute the Standard Model.

3. Syllabus

1. Scalar field.
2. Dirac field.
3. Lagrangian of electrodynamics and quantization.
4. Feynman's rules and elementary processes.
5. Divergences, regularization, renormalization.
6. Symmetries and quantization: spontaneous breaking, abelian Higgs mechanism, anomalies.
7. Non-Abelian gauge theories.
8. Lattice regularisation.

4. Academic activities

1. Participation in and attendance to lectures.
2. Case analysis, sharing and debate on the contents of the subject.
3. Solving problems related to the contents of the subject.
4. Writing and submission of works.
5. Production and oral presentation of works.

6. Tutoring.
7. Individual study.
8. Written or oral assessment tests
9. Discussions in discussion forum.

5. Assessment system

The student must demonstrate that they has achieved the intended learning results through the following assessment activities:

- Assessment of case analysis, problem solving, questions and other activities: 20%.
- Assessment of reports and written work: 20%.
- Assessment of oral presentations of work: 20%.
- Assessment of the evaluation tests: 40%.

The final grade will be obtained according to the percentage assigned to each assessment activity.
In order to pass the subject, this final grade must be equal or higher than 5.

The subject has been designed primarily for students who attend lectures during the term.
However, there will also be an assessment test for students who are unable to attend these lectures or who have not completed or have not passed the assessment activities.
This global assessment test will take place on the dates established by the Faculty of Sciences.