Universidad Zaragoza

Academic Year/course: 2024/25

26950 - High Energy Physics

Syllabus Information

Academic year: 2024/25
Subject: 26950 - High Energy Physics
Faculty / School: 100 - Facultad de Ciencias
Degree: 447 - Degree in Physics
ECTS: 5.0
Year:
Semester: Second semester
Subject type: Optional
Module:

1. General information

The general objective of this subject is to introduce the basic concepts of high energy physics, and more specifically of the Physics of elementary particles and their interactions. At the theoretical level, to understand the relationship between particles and their interactions and relativistic field theory. At the phenomenological level, to identify the characteristics of the different interactions and the associated processes. At the experimental level, to understand the different ways of performing experiments or observations at the microscopic level.

It is recommended to have taken Nuclear and Particle Physics and/or Quantum Mechanics, and to have passed Quantum Physics I and II.

2. Learning results

The stated learning results should demonstrate that the student has achieved the following results:

- To understand the concepts of relativistic kinematics, particles and interactions.
- To understand the essential ingredients in the modern understanding of interactions between elementary particles: fields, gauge invariance, coupling constants, exchange bosons, virtual particles, Feynman diagrams, etc.
- To understand the relevance of symmetries for each type of fundamental interaction.
- To know the fundamental properties of interactions.
- To know the Feynman rules of QED. To calculate simple Feynman diagrams (tree level) and relate them to the effective section of a process.
- To know the experimental tools used in high energy physics: accelerators and detectors.
- To know the role of the Higgs mechanism in giving mass to exchange bosons.

3. Syllabus

1. Previous concepts: units. Elementary particles. Relativistic kinematics. Brief historical introduction.
2. Experimental methods. Particle accelerators and particle detection. Cosmic radiation.
3. Classical field theory. Symmetries and conservation laws. Electrodynamics and gauge symmetry.
4. Electromagnetic interaction. QED, Feynman diagrams, effective sections.
5. Weak, electroweak and strong interactions. Basic notions.
6. Higgs mechanism, standard model precision tests. Basic ideas.

4. Academic activities

The program offers the students help to achieve the expected results and comprises the following activities:

- Master classes where the topics to be covered in the subject are presented.
- Resolution of exercises proposed individually and in work groups.
- Problem solving.

Classes: 4 hours per week.

5. Assessment system

The student must demonstrate achievement of the intended learning results through the following assessment activities:

- Continuous evaluation of learning by solving problems and exercises proposed throughout the term and other activities proposed by the teacher of the subject (40% of the final grade). The evaluation grade will reflect the quality of the solutions to the proposed exercises/problems, personal work and active participation in the subject.
- Completion of a final theoretical-practical test (60% of the final grade).

If the grade of the final theoretical-practical test is lower than 4 out of 10, this will be the final grade of the subject

A minimum of 5 points in the final grade is required to pass the subject

Passing the subject by means of a single global test

In the event that the student chooses not to carry out the activities proposed by the teacher mentioned above, there will be a single global test at the end of the term on the dates published by the Faculty of Sciences.

6. Sustainable Development Goals

4 - Quality Education