SUBJECT TEACHING GUIDE

G71 - Physics of Elementary Particles

Double Degree in Physics and Mathematics
Degree in Physics

Academic year 2021-2022

1. IDENTIFYING DATA					
Degree	Double Degree in Physics and Mathematics Degree in Physics			Type and Year	Optional. Year 5 Optional. Year 4
Faculty	Faculty of Sciences				
Discipline	Subject Area: Physics of Elementary Particles Mention in Fundamental Physics				
Course unit title and code	G71 - Physics of Elementary Particles				
Number of ECTS credits allocated	6	Term		Semester based (1)	
Web					
Language of instruction	Spanish	English Friendly	Yes	Mode of delivery	Face-to-face

Department	DPTO. FISICA MODERNA
Name of lecturer	PABLO MARTINEZ RUIZ DEL ARBOL
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Office	
Other lecturers	JORGE DUARTE CAMPDERROS CELIA FERNANDEZ MADRAZO

3.1 LEARNING OUTCOMES

- Understanding the basics of the Standard Model
Knowing the importance of a model of Elementary Particles to understand the microscopic world.
Understand the characteristics of the elemental forces and properties of the particles.
Identify the processes of interaction of a particle passing through a physical medium.
Knowing detection techniques employed and the relevant instrumentation.
Knowing how to handle simple detectors and some conventional analysis techniques.
Understand the basic ideas used in particle accelerators.
To know the basic experimental results which supports the Standard Model
Know and use the basic tools of calculation of processes between elementary particles.
Current lines of development in relation to the proposed theoretical models.

4. OBJECTIVES

1- Know the Standard Model of elementary particles, and fundamental forces.
2- Know the tools of calculation processes of interaction between particles.
3- Understand the detection techniques and key technologies. Application in current experiments.
4- Knowing the current research lines in the field.

6. COURSE ORGANIZATION

CONTENTS	
1	Introduction Reminder of basic concepts. Dirac Equation for spin 1/2 particles. Solutions of the equation for particles and antiparticles. Physics interpretation.
2	Experimental techniques. Particle detectors. Accelerators.
3	Physics observable Cross sections and decays Interaction by exchange of particles
4	Electromagnetic interaction Electron-positron annihilation Tools for the evaluation of matrix elements Weak interaction. Weak interaction as a Gauge model: Weinberg-Salam model. Experimental evidences.
5	QCD, jets and gluons. Strong interaction as an interchange of gluons. Strong coupling constant. Asymptotic freedom. Confinement. Beyond the Standard Model. QCD, jets and gluons Strong interaction: gluon exchange Strong coupling constant Asymptotic freedom and confinement

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Exercises to be solved/defended along the course + Partial Exams + Final exam (theory+practical exercise)	Written exam	Yes	Yes	50,00
Practice on the measurement of the Z mass	Activity evaluation with Virtual Media	No	No	25,00
Practice on particle detection methods.	Laboratory evaluation	No	No	25,00
TOTAL				100,00

Observations

The evaluation will be done as follows:

1.- Exams consisting of both theoretical questions and resolution of exercises.

+ 25% of the grade -> First exam
+ 25% of the grade -> Second exam
+ There is the possibility to redo the exams in a final exam. In this case the highest grade will be kept.
+ It will be needed to score at least 3/10 to allow averaging with the practical sessions.
+ The realization of proposed exercises and its exposition in class will score 1 additional point over the final grade of the exams.

2.- Practical sessions

+ 25% of the final grade -> Practice 1
+ 25% of the final grade -> Practice 2
+ Each practice will require the elaboration of a report. The final grade will be the average of the student activity in the lab and the report. The absence of the report means that the practice will not be evaluated. If both reports are missing the student will not be evaluated.

The dedication to the evaluation is as follows:
4 hours dedicated to the exam an its correction (2 hours exam + 2 hours of correction)
4 hours dedicated to the correction of practices.
2 hours dedicated to the evaluation of problems carried out by the students along the course.

Observations for part-time students

As much as possible the professor will help to follow the course

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

Modern Particle Physics, Mark Thomson, Cambridge Univ. Press

Particle Physics, BR Martin & G. Shaw, Ed Wiley,