26929 - Nuclear and Particle Physics

Información del Plan Docente

Academic Year	2017/18
Faculty / School	100 - Facultad de Ciencias
Degree	447 - Degree in Physics
ECTS	6.0
Year	4
Semester	First semester
Subject Type	Compulsory
Module	---

1.General information

1.1.Introduction

In this course, students are introduced to nuclear and particle physics, their theoretical and experimental foundations, their most important applications and their relationship with other fields. This course will provide the students with a basic, rigorous and practical knowledge that will allow them to go in-depth autonomously.

1.2.Recommendations to take this course

It is advised to have passed Quantum Physics I and Quantum Physics II.

1.3.Context and importance of this course in the degree

In Quantum Physics I and Quantum Physics II the students acquire basic knowledge about the quantum structure of atoms and molecules. In the present course, they will go from atoms to nuclei and from the latter to elementary particles, the quarks and leptons

1.4.Activities and key dates

Classes will start and finish in the dates indicated by the Faculty of Sciences.

Evaluation sessions: To be decided by the Faculty of Sciences and to be announced well in advance.

2.Learning goals

2.1.Learning goals

1 The student is capable of estimating nuclear masses and sizes.

2 The student is able to determine nuclear instability for the different decay processes

3 The student knows when each nuclear model can be applied and is able to apply it to simple cases

4 The student is able to associate the deuteron experimental data with the properties of nuclear forces

5 The student is able to calculate the spin, parity and magnetic moment of different nuclei using the nuclear shell model

6 The student is able to identify/classify the fundamental interactions according to cross sections and decay widths.

7 The student handles correctly tables of radioactive isotopes and tables of particles.

8 The student is able to measure a beta decay spectrum and to calculate the corresponding Kurie plot

9 The student is capable to apply relativistic and non-relativistic kinematics to nuclear and particle reactions and decays.

10 The student knows the most important processes of nuclear fusion in stars and nuclear fission in nuclear reactors.

2.2.Importance of learning goals

This course will enable students to understand the theoretical and experimental foundations of nuclear and particle physics. They will be able to know and predict properties of nuclei and elementary particle. They will also know the fundamental interactions and the Standard Model of Particle physics.

3.Aims of the course and competences

3.1.Aims of the course

Nuclear and Particle Physics are two subjects born in the twentieth century that have an enormous relevance in in the evolution of the society and share the instrumentation and methodology.

3.2.Competences

1 Understand subatomic physical phenomena.

2 Understand and apply nuclear models

3 Understand the Standard Model of Particle Physics and Fundamental Interactions

4 Understand and apply conservation laws and selection rules in nuclear and particle processes

4.Assessment (1st and 2nd call)

4.1.Assessment tasks (description of tasks, marking system and assessment criteria)

1 A continued evaluation (**A mark**), solving problems and questions during the classes, with a duration previously established, will take into account the personal work of the students throughout the course. The maximum score will be 10 points.

2 The course will also comprise practical sessions in the laboratory with elaboration of written reports (**L mark**). The maximum score will be 10 points. Reports must be delivered not later than 15 days before the theoretical-practical examination.

3 Theoretical-practical examination the date established by the Faculty of Sciences (**P mark**). It is mandatory. The maximum score will be 10 points. Students that have not delivered the practical report on time will have to do an additional examination in the laboratory that will be their L mark.

The final mark will be the greatest of

N=0.1*A+0.1*L+0.8*P or N=0.1*L+0.9*PN

A minimum of N=5 points is necessary to pass the course.

5.Methodology, learning tasks, syllabus and resources

5.1.Methodological overview

The course is organized by combining theoretical and practical lessons. In order to achieve the intended goals the strategy chosen by the teaching staff consists of using lectures for presenting to the students the basic knowledge required to face the problem solving and laboratory work. Interactive problem resolution classes and laboratory sessions will be conveniently intertwined.

5.2.Learning tasks

The 6 ECTS assigned to the planned learning activities are as following:

- Theoretical lectures (4.0 ECTS): 40 hours

- Interactive problem resolution classes (1.5 ECTS): 15 hours

- Laboratory work (0.5 ECTS): 5 hours

5.3.Syllabus

1 Nuclear global properties: phenomenology, nuclear mass, binding energy, nuclear sizes.

2 Nuclear forces and models: two-body system in nuclear physics, the deuteron, the nuclear shell model, collective models.

3 Nuclear decay modes: radioactivity, alpha, beta and gamma decay, nuclear fission.

4 Nuclear reactions: resonances, nuclear fusion, nuclear astrophysics, nucleosynthesis.

5 Elementary particle physics: historical introduction, particle accelerators, particle detectors.

6 The fundamental interactions: leptons, hadrons and quarks, the standard model.

5.4.Course planning and calendar

The course is organized in three training activities:

Theoretical lectures (4 ECTS); interactive problem resolution clasess (1.5 ECTS). The theoretical-practical examination will take aprox 3 hours.

Laboratory work (0.5 ECTS). Laboratory reports must be delivered not later than 15 days before the theoretical-practical examination.

Lectures of theory and problems: 4 sessions / week. Dates to be decided by the Faculty of Science.

Lab classes: They will be announced by the professor at the beginning of the course.

Evaluation sessions: To be decided by the Faculty of Sciences and to be announced well in advance.

5.5.Bibliography and recommended resources

- BB Burcham, W.E.. Nuclear and particle physics / W.E. Burcham and M. Jobes . 1st ed. Harlow [etc.] : Prentice Hall : Pearson Education, 1995
- BB Ferrer Soria, Antonio. Física nuclear y de partículas / Antonio Ferrer Soria . 2ª ed., corr. y ampl. Valencia : Universitat de València, 2006
- BB Heyde, Kris. Basic ideas and concepts in nuclear physics : an introductory approach / K. Heyde . 2nd ed. Bristol [etc.] : Institute of physics, 1999
- BB Particles and nuclei : an introduction to the physical concepts / Bogdan Povh... [et al.] ; translated by Martin Lavelle . Berlin [etc.] : Springer, cop. 1995
- BB Williams, W.S.C.. Nuclear and particle physics / W.S.C. Williams . 1st ed., repr. with corrections and data updates Oxford : Clarendon Press, 1995
- BC Cottingham, W.N.. An introduction to nuclear physics / W. N. Cottingham and D. A. Greenwod . 2nd ed Cambridge : Cambridge University Press, 2001
- BC Krane, Kenneth S.. Introductory nuclear physics / Kenneth S. Krane . New York [etc.] : Wiley & Sons, cop. 1988
- BC Martin, B. R.. Particle physics / B. R. Martin, G. Shaw . 2nd. ed., [3rd] repr. Chichester [etc.] : John Wiley & Sons, 2003