Universidad Zaragoza

Academic Year/course: 2022/23

60037 - Interaction of radiation and matter

Syllabus Information

Academic Year: 2022/23
Subject: 60037 - Interaction of radiation and matter
Faculty / School: 100 - Facultad de Ciencias
Degree: 538 - Master's in Physics and Physical Technologies
589 - Master's in Physics and Physical Technologies
ECTS: 5.0
Year: 1
Semester: First semester
Subject Type: Optional
Module:

1. General information

1.1. Aims of the course

Interaction of Radiation and Matter is a master course of physics that provides the basis for understanding numerous phenomena in advanced Physics and Astrophysics. It is devoted to provide the basis of the radiation mechanisms based on quantum and relativistic principles.

The subject and its expected outcomes respond to the following approaches and goals: to understand the classical and quantum nature of electromagnetic interactions, together with more recent developments associated with new materials, as well as applications to other branches of physics. At the end of the course the student should be able to use and apply their knowledge to solve current problems of radiation detection, particle physics, astrophysics and cosmology. These approaches and objectives are aligned with the following Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda (https://www.un.org/sustainabledevelopment/es/), in such a way that the acquisition of the results of subject learning provides training and competence to contribute to some extent to its achievement. In particular with Objective 4: Quality education. Goal 5: Gender equality, Goal 9: Industry, innovation and infrastructure and Goal 13: Climate action.

2. Learning goals

2.1. Competences

After the course, the student will be more competent to:

- Understand the basic concepts and physical phenomena related to relativistic interactions of light and matter,
- and compute their effects.
- Analyze and interpret physical phenomena that involve the emission or absorption of radiation.
- Integrate knowledge and consolidate the basic skills and interrelationships between the different fields of
- particle physics and astrophysics.
- Analyze, treat and interpret the experimental data.
- Understand how theory applies to new materials.

2.2. Learning goals

To pass this course, the student needs demonstrate the following results:
? Know the fundamentals and practical consequences of the relativistic aspects of radiation.
? Being able to analyze the different physical phenomena that involve emission or absorption of electromagnetic radiation.
? Know the radiation detection techniques.
? Know the basic rules of the interaction of light with matter.

2.3. Importance of learning goals

The interest in the electromagnetic phenomena at short distances has increased in recent decades due to their fundamental properties and new physical phenomena associated with the quantum nature of radiation-matter interaction. A solid knowledge of these phenomena and the development of new analytical tools will allow the students to apply them in solving advanced problems in this field. The course will also allow students to acquire and develop the analytical skills necessary to work in a theoretical or experimental research group in the future. The course will also serve to familiarize the student with the objectives of sustainable development.

3. Assessment (1st and 2nd call)

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

A continued evaluation will take into account the personal work of the students throughout the course. The students will provide solutions to a series of problems proposed at the end of the different sections of the course. The evaluation of the quality of their written answers to these problems will comprise 50% of the final mark. A special problem or selected article will be assigned to each student. It will account for the 20% of the final mark. An evaluation test at the end of the course on different aspects covered in the subject will represent 30% of the final grade.

The course has been primarily designed for students who are able to attend the lectures on site, and carry out the evaluation activities described above. However, there will also be an evaluation test for those students who are either unable to attend these lectures or who fail in their first evaluation. This global test will be carried out on the dates established by the Faculty of Sciences and will consist of an evaluation of the same learning results as in the continuous evaluation tests.

Honors degree qualification
The honors degree will be awarded to students who achieve the maximum grades, as long as it is above 9.0.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The methodology followed in this course is oriented towards achievement of the learning objectives. It favors the acquisition of a theoretical specialization in the interactions between radiation and matter. The main activities training course include: lectures, problem solving and discussions (4+2 ECTS); study and presentation of selected articles from the field (1 ECTS).
These activities allow students to actively participate in the learning process as well as acquire the desired knowledge in theory and applications of the interaction of radiation with the matter and become familiar with problem-solving skills.

4.2. Learning tasks

The course includes the following learning tasks:

- Lectures on the theory of radiation and matter
- Tutorial sessions for problem solving and discussion
- Study, oral presentations and discussion of selected articles
- Student autonomous work

4.3. Syllabus

The course will address the following topics:

1. Relativistic electrodynamics.
2. Lorentz symmetry and spin.
3. Radiation classical theory.
4. Synchrotron radiation.
5. Cerenkov Effect.
6. Astrophysical applications.
7. Quantum electrodynamics.
8. Quantum electromagnetic radiation.
9. Fermi golden rule. Compton effect.
10. Photons in astrophysics

4.4. Course planning and calendar

The dates will be established and announced by the teachers at the beginning of the course.

Classes will begin and end on the dates indicated by the Faculty of Sciences.

Theory classes: 4 sessions per week. Dates to be decided.
Assessment sessions: dates to be decided.

4.5. Bibliography and recommended resources

http://biblos.unizar.es/br/br_citas.php?codigo=60037&year=2019