Universidad Zaragoza

Academic Year/course: 2024/25

26953 - Quantum Mechanics

Syllabus Information

Academic year: 2024/25
Subject: 26953 - Quantum Mechanics
Faculty / School: 100 - Facultad de Ciencias
Degree: 447 - Degree in Physics
ECTS: 5.0
Year:
Semester: First semester
Subject type: Optional
Module:

1. General information

To know some basic aspects of non-relativistic and relativistic Quantum Mechanics. Relativistic results, besides their intrinsic interest, serve as an introduction to the second cuatrimester course "High energy physics" (26950)

2. Learning results

Upon completion of the subject, students will be able to:

- Understand the postulates of quantum mechanics
- Distinguish a pure state from a mixed state in terms of the density matrix, quantify the entanglement of bipartite states and understand its relevance to the measurement process.
- Know the mechanisms used in quantum encryption, understand its inviolability and other properties, such as the impossibility of cloning.
- Know the quantum logic gates and understand the most used algorithms in the programming of the quantum computers. Be able to develop some simple quantum programs.
- Understand the notion of symmetry in Quantum Mechanics and the notion of representation of a group.
- Understand the notion of particle as an irreducible representation of the Poincaré group
- Know Klein-Gordon and Dirac equations and understand their main properties.

3. Syllabus

The program offered to the student to help them achieve the expected results comprises the following activities

1. Introduction to Hilbert spaces
2. The postulates of Quantum Mechanics.
3. Coherent states of the harmonic oscillator. Ladder operators and number operators.
4. Density matrices. Pure and mixed states.
5. Composed systems and entanglement.
6. Markovian quantum systems
7. Elements of quantum information. Quantum cryptography.
8. Quantum computation. Algorithms. Physical implementations.
9. Symmetry groups and representations
10. Irreducible representations of the Poincaré group.
11. Klein-Gordon equation
12. Dirac equation

4. Academic activities

Schedule of classroom sessions and presentation of papers

The schedule of the face-to-face sessions will be established by the Faculty of Science and will be announced in advance.

Evaluation sessions: the continuous evaluation will be carried out throughout the semester through a global written test. These sessions are determined by the Dean's Office of the Faculty of Sciences and published each year on its website.

The classes are taught during the first semester (September-December) of the Degree in Physics.

5. Assessment system

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

Resolution of problems and proposed works (60% of the final grade).

Subject exam (40% of the final grade).

Passing the subject by means of a single global test

This global test will consist of a global exam of the subject.

6. Sustainable Development Goals

4 - Quality Education