Universidad Zaragoza

Academic Year/course: 2024/25

26937 - Gravity and Cosmology

Syllabus Information

Academic year: 2024/25
Subject: 26937 - Gravity and Cosmology
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

In general, the objective of the Gravitation and Cosmology subject is that the student acquires the capacity for analysis, abstraction and adequate synthesis and learns to express scientific concepts with the necessary rigor. In addition, this subject should provide students with the basic mathematical techniques necessary to study and solve the relativistic Einstein equations. Within these general objectives, the subject of Gravitation and Cosmology presents an application of the mathematical techniques of Differential Geometry to the study and resolution of the equations that govern gravitational phenomena. We will begin by studying the physical reasons that require an extension of the Newtonian formulation of gravitational phenomena, making them compatible with Special Relativity. Subsequently the Einstein equations for the gravitational field will be justified and solved in two situations. On the one hand, the geometry generated by the sun. In this case, the planetary orbits and the curvature of the light rays when passing through the solar system will be determined. On the other hand, the geometry of the expanding Universe. The evolution of the Universe from its beginnings will be addressed , reviewing the most important milestones in its development.

2. Learning results

- To understand the physical premises on which the Theory of General Relativity is based by deriving Einstein's equations from the principle of general covariance.
- To be able to solve the equations of the gravitational field in simple cases that will have been developed throughout the term, distinguishing coordinate singularities from physical singularities..
- To determine the relativistic corrections to the planetary orbits and compare with the observations appreciating the fit between the two.
- To analyse the structure and composition of the Universe, its history and recent measurements, as well as the kinematic origin of large-scale homogeneity .
- To apply Einstein's equations to the Universe as a whole and find the energy composition of the Universe that best reproduces the observations.
- To discuss the dependence of the evolution of the Universe on cosmological parameters.

3. Syllabus

- Current observations.
- Review of Newtonian Gravitation.
- Description of the theory of General Relativity.
- The geometry of the Solar System.
- Motion of the planets and curvature of light.
- The standard cosmological model.
- History of the Universe.
- Background radiation decoupling.
- Primordial nucleosynthesis.
- Primary inflation.
- The current accelerated expansion.
- Formation of structures.
- The big bang and quantum gravity.

4. Academic activities

- Theoretical and practical classes: 3/4 hours per week
- Classes to solve proposed problems: 1 hour per week for approximately 4 weeks.
- Study and personal work: 60 hours.
- Assessment tests. 6 hours.

5. Assessment system

Continuous evaluation of the student by means of the resolution of exercises proposed to the students (50% of the final grade).

Theoretical-practical test (50% of the final grade).

Passing the subject by means of a single global test: it will be possible to obtain the highest grade by taking a single final exam that will cover all the contents seen in the subject.

6. Sustainable Development Goals

4 - Quality Education
5 - Gender Equality