UAB
Universitat Autònoma de Barcelona

# Introduction to the Physics of the Cosmos

Code: 44078
ECTS Credits: 6

2025/2026

| Degree | Type | Year |
|---|---|---|
| High Energy Physics, Astrophysics and Cosmology | OB | 0 |

## Contact

Name: Álvaro Sánchez Monge

Email: alvaro.sanchez.monge@uab.cat

## Teachers

Francisco Javier Castander Serentill

Alessandro Patruno

Andrea Wulzer

Oriol Pujolas Boix

Lluis Galbany Gonzalez

## Teaching groups languages

You can view this information at the end of this document.

## Prerequisites

None

## Objectives and Contextualisation

The course is intended to provide students with a complete and thorough introductory course to Particle Physics, Astrophysics and Cosmology, who should be able to use such knowledge as a solid basis for the following more specialized courses.
Since it is a transversal course for all students who choose the specific programs on High Energy Physics, Astrophysics and Cosmology, it provides basic knowledge on the alternative itinerary the student has not chosen.
Finally, since students come from different academic backgrounds, this course tends to unify and balance out the students' academic skills and abilities.

## Competences

- Continue the learning process, to a large extent autonomously
- Understand the basics in the main areas of high energy physics, astrophysics and cosmology
- Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
- Use mathematics to describe the physical world, select the appropriate equations, construct adequate models, interpret mathematical results and make critical comparisons with experimentation and observation.

## Learning Outcomes

1. Understand the basics of astrophysics: coordinates, distances, magnitudes.
2. Understand the basics of astrophysics: structure and evolution of stars and galaxies.
3. Understand the basics of cosmology: distance ladder, expansion of the universe.
4. Understand the basics of cosmology: large scale structure.
5. Understand the basics of particle physics: cross sections, relativistic kinematics.
6. Understand the basics of particle physics: symmetries and interactions.
7. Use group theory to understand the SU(2) and SU(3) symmetries in hadrons.
8. Use online, English bibliographic tools to get more detailed information about the content of the course.

## Content

General outline of the Course
General concepts of Astrophysics and Cosmology
Structure and evolution of stars and planetary systems
Structure and evolution of galaxies
Introduction to Cosmology
Introduction to General Relativity
General introduction to particle physics
Relativistic quantum field theory
Simmetries and interactions
Electromagnetic interactions
Strong interaction and hadrons
Electroweak interaction and Higgs

## Activities and Methodology

| Title | Hours | ECTS | Learning Outcomes |
|---|---|---|---|
| Type: Directed | | | |
| Theory Lectures | 45 | 1.8 | 2, 3, 5, 1, 8 |
| Type: Supervised | | | |
| Study of theoretical foundations | 45 | 1.8 | 2, 3, 5, 1, 8 |
| Type: Autonomous | | | |
| Discussion, work groups, group exercises | 45 | 1.8 | 2, 3, 5, 1, 8 |

Theory lectures and exercises.

Class-work and Homework

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

## Assessment

## Continous Assessment Activities

| Title | Weighting | Hours | ECTS | Learning Outcomes |
|---|---|---|---|---|
| Homework Astrophysics and Cosmology | 25% | 6 | 0.24 | 4, 2, 3, 1, 8 |
| Homework on High Energy Physics | 25% | 6 | 0.24 | 6, 5, 8 |
| Written exam (multiquestion test) | 50% | 3 | 0.12 | 4, 6, 2, 3, 5, 1, 7 |

One exam on High Energy Physics and on Astrophysics/Cosmology (fifty fifty weighted)

One homework on High Energy Physics

One homework on Astrophysics/Cosmology

This subject/module does not foresee the single assessment system.

Whoever fails the course with the continuous evaluation, and has attended at least two thirds of the evaluation actions, may take a recovery exam on the syllabus of the entire course.

## Bibliography

"An introduction to modern astrophysics"; D A Ostlie and B W Carroll, Ed. Pearson International Edition

"Astrophysics for physicists"; A R Choudhuri, Ed. Cambridge

"Stellar structure and evolution"; R Kippenhahn, A Weigert and A Weiss, Ed. Springer

"Physical Foundations of Cosmology"; V Mukhanov, Ed. CUP 2005

"Cosmology"; P Coles and F Lucchin, Ed. Wiley

"Particle Physics" - Third Edition; B R Martin and G Shaw, Ed. Wiley and Sons 2008

"Introduction to paticle and astroparticle physics"; A de Angelis and M Pimenta, Ed. Springer 2018

"Quantum Field Theory in a Nutshell"; A Zee, Ed. Princeton University Press 2003

"The Standard Model: A Primer"; C P Burgess and G. D. Moore, Ed. CUP 2007

"An Introduction to Quantum Field Theory"; M E Peskin and D V Schroeder, Ed. Addison-Wesley 1995

## Software

None

## Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

| Name | Group | Language | Semester | Turn |
|---|---|---|---|---|
| (TEm) Theory (master) | 1 | English | first semester | morning-mixed |