Universitat Autònoma de Barcelona

# Introduction to the Physics of the Cosmos

2016/2017

Code: 42862
ECTS Credits: 9

| Degree | Type | Year | Semester |
|---|---|---|---|
| 4313861 High Energy Physics, Astrophysics and Cosmology | OB | 0 | 1 |

## Contact

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## Use of languages

Principal working language: english (eng)

## External teachers

Enrique Gaztañaga

Francisco J. Castander

Josep M. Trigo-Rodriguez

Oriol Pujolas

## 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.

## Skills

- 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

- Outline of the Course General
- Introduction to Particle Physics: mass, spin and Poincaré group
- Relativistic kinematics
- Interaction amplitudes and cross sections
- Discrete symmetries
- Continuous symmetries
- Hadrons and the Quark Model
- General concepts of Astronomy
- Structure and evolution of stars
- Planets and planetary systems
- Structure and evolution of galaxies
- Introduction to General Relativity
- Introduction to Cosmology
- Introduction to Astrobiology

## Methodology

Theory lectures and exercises.

Classwork and Homework.

## Activities

| Title | Hours | ECTS | Learning outcomes |
|---|---|---|---|
| **Type: Directed** | | | |
| Theory Lectures | 52 | 2.08 | |
| **Type: Supervised** | | | |
| Study of theoretical foundations | 52 | 2.08 | |
| **Type: Autonomous** | | | |
| Discussion, work groups, group exercises | 52 | 2.08 | |

## Evaluation

One exam and one homework on High Energy Physics.

One exam on Astrophysics and Cosmology and five homeworks on Cosmology, Galaxies, Stellar Physics, Planetary Systems and Astrobiology.

## Evaluation activities

| Title | Weighting | Hours | ECTS | Learning outcomes |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Exam on High Energy Physics | 25 | 2 | 0.08 | 5, 6, 8 |
| Exam on Astrophysics and Cosmology | 25 | 2 | 0.08 | 1, 2, 3, 4, 8 |
| Homework on Astrobiology | 5 | 10 | 0.4 | 2, 3, 4 |
| Homework on Cosmology | 5 | 10 | 0.4 | 3, 4, 8 |
| Homework on Galaxies and Galactic Evolution | 5 | 10 | 0.4 | 2, 3, 8 |
| Homework on High Energy Physics | 25 | 15 | 0.6 | 5, 6, 7, 8 |
| Homework on Planetary Systems | 5 | 10 | 0.4 | 2 |
| Homework on Stellar Physics | 5 | 10 | 0.4 | 1, 2 |

## Bibliography

"An Introduction to Modern Stellar Astrophysics", B. W. Carroll & D.A. Ostlie, Addison-Wesley

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

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

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

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

"Extragalactic Astronomy and Cosmology", P. Schneider, Springer

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

"Planets and Planetary Systems" S. Eales, Wiley

"Extrasolar planets & Astrobiology", C. A. Schaf

"Astrobiology: A very short introduction", D.C. Catling