Universitat Autònoma de Barcelona

Standard Model: Fundamentals and Phenomenology — 2016/2017

Code: 42864
ECTS Credits: 9

Degree	Type	Year	Semester
4313861 High Energy Physics, Astrophysics and Cosmology	OT	0	1

Contact

Name: Rafel Escribano Carrascosa

Email: Rafel.Escribano@uab.cat

Use of languages

Principal working language: english (eng)

External teachers

Aurelio Juste

Imma Riu

Prerequisites

It is recommended to have followed the course Introduction to the Physics of the Cosmos, and to follow, in parallel, the course Introduction to Quantum Field Theory.

Objectives and Contextualisation

The main purpose of this course is to give an overview of the Standard Model of particle physics starting from the fundamentals and finishing with the phenomenology.

Skills

- Apply the main principles to specific areas such as particle physics, astrophysics of stars, planets and galaxies, cosmology and physics beyond the Standard Model.
- Understand the bases of advanced topics selected at the frontier of high energy physics, astrophysics and cosmology and apply them consistently.
- Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
- Use critical reasoning, analytical capacity and the correct technical language and formulate logical arguments.

Learning outcomes

1. Analyzing the concept of spontaneous breaking of symmetry .
2. Apply chromodynamics of quantum to strong elementary processes .
3. Apply the Weinberg- Salam theory to electroweak elementary processes.
4. Recognize the basics of Weinberg- Salam theory of electroweak interactions
5. Understand the basics of the theory of the Standard Model and its phenomenology.

Content

Fundamentals of the Standard Model:

1. Difficulties of the pre-gauge theory
2. Global and local gauge invariance
3. Spontaneous symmetry breaking, Goldstone bosons and the Higgs mechanism
4. The Standard Model of electroweak interactions
5. Electroweak phenomenology
6. Flavour dynamics
7. Electromagnetic interactions of leptons and hadrons
8. An introduction to Quantum Chromodynamics (QCD)

Phenomenology of the Standard Model:

1. QCD in electron-proton collisions
2. QCD in electron-positron collisions
3. Jet algorithms
4. QCD in hadron-hadron collisions
5. Monte Carlo event generators
6. Top physics
7. Higgs physics
8. Heavy flavor physics
9. Neutrino physics

Methodology

Theory Lectures and Exercises.

Classwork and Homework.

Activities

Title	Hours	ECTS	Learning outcomes
Type: Directed			
Theory Lectures	68	2.72	1, 2, 3, 4, 5
Type: Autonomous			
Discussion, Work Groups, Group Exercises	68	2.72	1, 2, 3, 4, 5
Study of Theoretical Foundations	68	2.72	1, 2, 3, 4, 5

Evaluation

One exam and one homework of Fundamentals of the SM, and one exam and one homework of Phenomenology of the SM.

Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Exam Fundamentals	25%	1.5	0.06	1, 3, 4, 5
Exam Phenomenology	25%	1.5	0.06	2, 3, 5

Homework Fundamentals	25%	9	0.36	1, 3, 4, 5
Homework Phenomenology	25%	9	0.36	2, 3, 5

Bibliography

Fundamentals of the Standard Model:

- D. Griffiths, Introduction to Elementary Particles, Wiley-VCH 2008
- F. Halzen and A. D. Martin, Quarks & Leptons: An Introductory Course in Modern Particle Physics, Wiley 1984
- C. Quigg, Gauge Theories of the Strong, Weak and Electromagnetic Interactions, Princeton University Press 2013
- T. Cheng and L. Li, Gauge Theory of Elementary Particle Physics, Oxford University Press 1988
- J. F. Donoghue, E. Golowich and B. R. Holstein, Dynamics of the Standard Model, Cambridge University Press 2014

Phenomenology of the Standard Model:

- F. Halzen and A. D. Martin, Quarks & Leptons: An Introductory Course in Modern Particle Physics, Wiley 1984
- R. K. Ellis, W. J. Stirling and B. R. Webber, QCD and Collider Physics, Cambridge University Press 2003
- D. H. Perkins, Introduction to High Energy Physics, Cambridge University Press 2000
- D. Green, High Pt Physics at Hadron Colliders, Cambridge University Press 2009