



INSTITUTO DE FÍSICA
FACULTAD DE FÍSICA

COURSE	: DATA ANALYSIS IN PARTICLE PHYSICS
TRANSLATION	: ANÁLISIS DE DATOS EN FÍSICA DE PARTÍCULAS
NUMBER	: FIM4040
CREDITS	: 15 UC / 9 SCT
MODULES	: 2
REQUISITES	: NO REQUIREMENTS
RESTRICTIONS	: 030401 Y 030501
CHARACTER	: OPTATIVE
FORMAT	: THEORETICAL LECTURES
QUALIFICATION	: STANDARD
FORMATIVE LEVEL	: DOCTORATE
DISCIPLINE	: PHYSICS

I. COURSE DESCRIPTION

Study of experimental Particle Physics through data analysis. Characteristics of the Standard Model particles will be reviewed to explain how they can be measured and observed in the experiment. Advanced "big data analysis" techniques will be covered.

II. LEARNING OUTCOMES

- Learn to extract physical characteristics from experimental measurements in Particle Physics
- Acquire an understanding of the statistical and computational tools necessary for data analysis

III. CONTENT

- 1 Introduction to the Standard Model of Particles
2. Production and decay of particles
3. Luminosity and number of events
4. Event generators
- 5 the Monte Carlo method
6. Reconstruction and Hadronization
- 7 colliders and detectors
8. Introduction to the ROOT tool
9. Probabilities
- 10 examples of probability functions
11. Statistical tests
- 12 systematic errors
13. Estimation of parameters: general concepts
14. The "maximum likelihood" method
- 15 the method of least squares
16. Estimation of statistical intervals
- 17 Modeling of probability functions and parameter estimation using RooFit
18. Analysis of "multi-variables" using "Machine Learning"

IV. METHODOLOGICAL STRATEGIES

- Theoretical lectures
- Project

V. EVALUATIVE STRATEGIES

- Partial exam (30%)
- Individual work (30%)



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-Final project exhibition (40%)

VI. BIBLIOGRAPHY

REQUIRED

M. Thompson, *Modern Particle Physics*, Cambridge
R. Brun and F. Rademakers, *ROOT - An Object Oriented Data Analysis Framework*
W. Verkerke and D. P. Kirkby, *The RooFit toolkit for data modeling*
G. Cowan, *Statistical Data Analysis*, Clarendon Press, Oxford

OPTIONAL

D. Griffiths, *Introduction to Elementary Particles*, Wiley-VCH
R. J. Barlow, *A Guide to the Use of Statistical Methods in the Physical Sciences*,
John Wiley