

SUBJECT TEACHING GUIDE

285 - ANALYSIS TOOLS IN PARTICLE PHYSICS

Master's Degree in Particle Physics and the Cosmos

Academic year 2024-2025

1. IDENTIFYING DATA					
Degree	Master's Degree in Particle Physics and the Cosmos			Type and Year	Optional. Year 1
Faculty	Faculty of Sciences				
Discipline	SPECIALIZATION IN PARTICLE PHYSICS Specialisation Module				
Course unit title and code	285 - ANALYSIS TOOLS IN PARTICLE PHYSICS				
Number of ECTS credits allocated	6	Term	Semester based (2)		
Web					
Language of instruction	Spanish	English Friendly	Yes	Mode of delivery	Face-to-face

Department	DPTO. FISICA MODERNA
Name of lecturer	ROCIO VILAR CORTABITARTE
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Office	IFCA - Edificio Juan Jordá. Planta: - 1. DESPACHO - CONTRATADOS/PROFESORADO FORMACION (S101)
Other lecturers	ALICIA CALDERON TAZON PEDRO JOSE FERNANDEZ MANTECA LARA LLORET IGLESIAS

3.1 LEARNING OUTCOMES

- the students will be able to know the different analysis techniques used to reconstruct the particles that leave tracks in the detector and select triggers .
- the students will know the physics object reconstruction in the physic analysis
- The student will be able to evaluate the data composition (signal and backgrounds) of the sample. List the different parts needed for the analysis in order to get the result (efficiencies, physics objects, systematic and statistical errors, etc) and be able to calculate them and set an strategy to obtained the physics result.
- Student should be able to know different MonteCarlos to simulate signal and backgrounds and its main characteristics . Be able to tell which is more appropriate for the process under studied.
- The student will now different machine learning techniques to extract physics results.

4. OBJECTIVES

- To get a clear idea of all the ingredients and different components needed to get physics results out of the data taken by the experiment
- To get a feeling of the best way to handle the problem to get the answer . Make sure the analysis done to obtain the answer is solid and robust.
- Manage different analysis techniques ; from simple to complicate, be able to compare them and choose the most adecquate one.
- Undestand the systematics and statistical uncertainties.
- Interpret the results obtained under different theoretical hypothesis and be critical with the results.

6. SUBJECT PROGRAM

CONTENTS

1	The student will be able to do a particle physics analysis with the data collectes in a detector. The student will desing an analysis that includes the relevant parts needed to obtain a result, this includes data composition (signal and backgrounds), MontaCarlos, efficiencies, aceptances, physics objects, data selection, data analysis strategy, background estimation, uncertainties, signal extraction, statistical analysis, etc.
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7. ASSESSMENT METHODS AND CRITERIA				
Description	Type	Final Eval.	Reassessn	%
Presentation of project. The student's project, which include written and oral presentaaion, will be evaluated. In case this project won't fulfil the minimal requirements, feedback will be provided and the student will have another chance to present it	Work	No	Yes	50,00
Assignments. The teacher will give different assignments to be done by the students, they will have to presente them. They will repeat assignment correctly written and oral. The assignments will be provided by the teacher at the lecture, will be done by the	Others	No	Yes	30,00
Labs . Done during lectures. During the labs lectures, the teacher will interact with the students and do different exercises that will be evaluated by the professor. During the labs the students will be given a set of assignments that will be then evalua	Laboratory evaluation	No	No	10,00
Work at class. Done during the lectures. Since the evaluation will be mostly based on a continuous assessment, the students will be asked questions during the lectures. Their answers and active participation will be evaluated by the professor.	Others	No	No	10,00
TOTAL				100,00
Observations				
It is very important the continuous work throught the attitude the students show at the lectures, labs, and different assignmentss provide to them. They need to be present at lectures and labs. These assignments, exercises and questions will have to do either by themselves or in groups. They will have to present the different tasks we assigned them				
Observations for part-time students				
It would be a continuous evaluation throught the work they do at the lectures they need to be present and they work they do by themselves				

8. BIBLIOGRAPHY AND TEACHING MATERIALS
BASIC
https://onlinelibrary.wiley.com/doi/book/10.1002/9783527677320
http://www.hep.caltech.edu/~NarskyPorter/
https://www.springer.com/la/book/9783319628394
http://admin.cambridge.org/academic/subjects/physics/particle-physics-and-nuclear-physics/data-analysis-techniques-high-energy-physics-2nd-edition?format=PB#0VIKIwlr0Rvw0wp.97
https://www.springer.com/gp/book/9783540572800