

COURSE OF STUDY *Physics (LM-17)*
ACADEMIC YEAR 2024-2025

ACADEMIC SUBJECT *Rare Events Physics*

General information	
Year of the course	2ns
Academic calendar (starting and ending date)	1st semester: September - December 2024
Credits (CFU/ECTS):	3
SSD	FIS/04
Language	English
Mode of attendance	Compulsory

Professor/ Lecturer	
Name and Surname	Giovanni Francesco Ciani
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Telephone	0805443191
Department and address	Physics, Room R40
Virtual room	
Office Hours (and modalities: e.g., by appointment, on line, etc.)	To be agreed with the professor

Work schedule			
Hours			
Total	Lectures	Hands-on (laboratory, workshops, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
75	16	15	44
CFU/ECTS			
3	2	1	

Learning Objectives	Main features of Rare events physics and background reduction techniques
Course prerequisites	Particle detector, nuclear and particle physics

Teaching strategie	Lessons with proposal and discussion of cases of study. Guided analysis of made-available tables.
Expected learning outcomes in terms of	
Knowledge and understanding on:	<p>Underground Laboratories all over the world.</p> <p>Background reduction in Underground Laboratories</p> <p>Direct dark matter research and various experimental techniques used in Underground Laboratories (dual-phase argon Time Projection Chamber, cryogenic scintillators)</p> <p>Double beta decay neutrinoless: basic theoretical aspects and experimental techniques used in Underground Laboratories (HPGe detectors, Bolometric Scintillators)</p> <p>Nuclear Astrophysics in Underground Laboratories</p> <ul style="list-style-type: none"> o Data Analysis Tools in Rare Events Physics (Pulse Shape Discrimination, Feldman Cousin Approach,)

Applying knowledge and understanding on:	o Rare events physics and background reduction techniques
Soft skills	<p>Knowledge and understanding: Main branch of Rare event physics (Dark matter research, double beta decay neutrinoless, nuclear astrophysics) and importance of measurements in underground laboratories.</p> <p>Applied knowledge and understanding: The student is able to extract useful information about the study of rare events and how crucial it is to install experiments in underground laboratories.</p> <p>Judging autonomy: Students are encouraged to deepen each argument reading focused manuscript</p> <p>Communicative Skills: Preparation, exposure and discussion of a presentation</p> <p>o Learning Skills: Know how to extract operational information for case studies from formal texts and manuscripts.</p>
Syllabus	
Content knowledge	In order to go beyond the standard model and to explore new frontiers (Direct dark matter research, double beta decay neutrinoless, nuclear physics in the region of interest of stellar evolution), it is mandatory to measure tiny signals with an extremely low event rate. In this course the contribution on Physics in Underground Laboratories all over the world (and mainly in Laboratori Nazionali del Gran Sasso) will be explained
Texts and readings	Papers and review manuscripts;
Notes, additional materials	slides
Repository	<i>Please ask to Professor</i>

Assessment	
Assessment methods	Presentation and discussion on the argument chosen
Assessment criteria	<ul style="list-style-type: none"> ● knows the basic principles of Rare event Physics ● knows the main source of natural background and how reduce it ● knows the main technique to measure Rare Events in Physics ● knows how to realize a presentation. <ul style="list-style-type: none"> o knows how to present the results of a structural analysis in written and oral forms;
Final exam and grading criteria	Results of the final presentation (50%), presentation and discussion (50%)
Further information	
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