



General information	
Academic subject	Rare Events Physics in Underground Laboratories
Degree course	Physics
Academic Year	2022/20233
European Credit Transfer and Accumulation System (ECTS)	
Language	English
Academic calendar (starting and ending date)	2nd semester
Attendance	Not compulsory

Professor/ Lecturer	
Name and Surname	Giovanni Francesco Ciani
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Telephone	
Department and address	Physics
Virtual headquarters (Microsoft Teams code)	
Tutoring (time and day)	To be defined with the teacher

Syllabus	
Learning Objectives	Main features of Rare events physics and background reduction techniques
Course prerequisites	Particle detector, nuclear and particle physics
Contents	In order to go beyond the standard model and to explore new frontiers (Direct dark matter research, double beta decay neutrinoless, nuclear physics in region of interest of stellar evolution), it is mandatory to measure tiny signals with a 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
Books and bibliography	Papers and review manuscripts; slides
Additional materials	slides

Work schedule			
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
Hours			
75	18	13	44
ECTS			
3	2	1	

Teaching strategy	
	Lessons with proposal and discussion of cases of study. Guided analysis of made-available tables.

Expected learning outcomes	
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"> ○ Data Analysis Tools in Rare Events Physics (Pulse Shape Discrimination, Feldman Cousin Approach,)



Applying knowledge and understanding on:	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 study of rare event and how crucial is to install experiment 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>Learning Skills: Know how to extract operational information for case studies from formal texts and manuscripts.</p>

Assessment and feedback	
Methods of assessment	Presentation and discussion on the argument chosen
Evaluation 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">○ knows how to present the results of a structural analysis in written and oral forms;
Criteria for assessment and attribution of the final mark	Results of the final presentation (50%), presentation and discussion (50%)
Additional information	