COURSE OF STUDY *Physics (LM-17)*
ACADEMIC YEAR *2023-2024*
ACADEMIC SUBJECT *Higgs Physics*

General information	
Year of the course	2nd
Academic calendar (starting and ending date)	1st semester: September - December 2023
Credits (CFU/ECTS):	3
SSD	FIS/01
Language	English
Mode of attendance	Optional

Professor/ Lecturer	
Name and Surname	Rosamaria Venditti
E-mail	rosamaria.venditti@uniba.it
Telephone	
Department and address	Dipartimento di Fisica, Room 136
Virtual room	MS Teams code: tfekvar
Office Hours (and modalities: e.g., by appointment, on line, etc.)	Tuesday 15.00-17.00 with booking by email

Work schedule			
Hours			
Total	Lectures	Hands-on (laboratory, workshops, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
75	24		45
CFU/ECTS			
3	3		

Learning Objectives	This course aims to illustrate to the student the main phenomenological aspects of the physics of the Higgs boson. The course presents the theoretical aspects related to the properties of the Higgs boson (mass, width, spin, coupling with particles, self coupling) and describes in detail the measurement techniques at LHC and future colliders. The course aims to provide the students with specific high-level training on the subject and at the same time allow them to acquire general skills on data analysis techniques in particle physics.
Course prerequisites	Basic knowledge of physics of fundamental interactions, elementary particle physics and particle detectors.

Teaching strategy	Live class
Expected learning outcomes in terms of	
Knowledge and understanding on:	Knowledge and understanding of • basic aspects of the theory and phenomenology of the Higgs boson • state of the art of experimental measurements • prospects for future measurements
Applying knowledge and understanding on:	Ability to apply knowledge and understanding • Role of the Higgs boson in the Standard model and phenomenology

	• Experimental techniques developed over the last 20 years to arrive at the discovery • Recognize the problems related to experimental measurements
Soft skills	• *Making informed judgments and choices:* the student will learn how scientific theories are born, from the observation of a phenomenon to the development of hypotheses, to the rigorous process of verifying hypotheses through experimental tests and data analysis. The student will acquire critical thinking, creativity and analytical skills. • *Communicating knowledge and understanding: t*he student will be able to express himself using appropriate technical-scientific language, fully communicating the concepts learned. Furthermore, we aim to introduce the student to the writing of scientific articles through the critical reading of some of them related to the physics of the Higgs boson examined during the course. • *Capacities to continue learning:* The student must demonstrate that he has acquired the tools to enrich his knowledge also through the consultation of scientific papers as Illustrated during the course.
Syllabus	
Content knowledge	Standard model and mass problem, Higgs mechanism (theoretical background). Coupling with SM particles. Mass, width, and spin Higgs: theoretical predictions, hierarchy problem and introduction to experimental measurements. Production of Higgs at hadronic colliders (LHC, HL-LHC, TeVatron) and lepton (future accelerators and hints at LEP). Higgs decays in fermions and bosons (including self-coupling). Overview of the main channels of discovery at LHC and high-priority searches for Run3 and HL-LHC (supported by critical reading of the papers, with practical examples/application of the techniques of background estimation, background/signal separation and MVA analysis). Combination of the results of all channels (with hints of statistics). Notes on measures of differential distributions. Open issues and physics beyond the standard model.
Texts and readings	1. The Higgs boson discovery at the Large Hadron collider (R. Wolf, Springer Tracts in Modern Physics) 2. Higgs Hunter's guide (Jhon Gunion et al)
Notes, additional materials	Slides of the lectures
Repository	

Assessment	
Assessment methods	Oral exam
Assessment criteria	An excellent grade is the result of meeting most of the following evaluation criteria: Knowledge and understanding: The student must demonstrate knowledge of the role of the Higgs boson in the standard model and the phenomenology related to its properties. Ability to apply knowledge and understanding: The student is asked to apply the knowledge acquired in the course, identifying the limits of existing measures and critically commenting on the design of measures for future colliders, with the guidance of the teacher. -Ability to explain concepts clearly and completely -Ability to analyze / criticize the measures presented in the course and propose additional / alternative solutions.
Final exam and grading criteria	The final grade is awarded out of thirty. The exam is considered passed when the grade is greater than or equal to 18; the maximum mark is 30 cum laude. To achieve a high evaluation, the student must have developed independent judgment and adequate argumentation and presentation skills.

Further information	
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