UNIVERSITÀ DI PAVIA

Anno Accademico 2018/2019

THEORY OF FUNDAMENTAL INTERACTIONS

Enrollment year	2017/2018
Academic year	2018/2019
Regulations	DM270
Academic discipline	FIS/02 (THEORETICAL PHYSICS, MATHEMATICAL MODELS AND METHODS)
Department	DEPARTMENT OF PHYSICS
Course	
Curriculum	Fisica teorica
Year of study	2°
Period	1st semester (01/10/2018 - 18/01/2019)
ECTS	6
Lesson hours	48 lesson hours
Language	Italian
Activity type	ORAL TEST
Teacher	MONTAGNA GUIDO (titolare) - 6 ECTS
Prerequisites	The course of Quantum Electrodynamics of the M.Sc. in Physical Sciences and basic knowledge of particle physics, as obtained for instance in the course Introduction to Subnuclear Physics of the Bachelor in Physics. Knowledge of particular Quantum Field Theory topics (e.g. renormalization) is welcome but not compulsory.
Learning outcomes	The course is an introduction to modern gauge theories, with the task of illustrating the basic theoretical concepts of the Standard Model of electroweak and strong interactions. At the end of the course, the student should have acquired at least the basic theoretical notions for a M.Sc. thesis in elementary particle physics, both theoretical and experimental.
Course contents	Quantum Electrodynamics as an abelian gauge theory. Non-abelian gauge invariance: Yang-Mills theories. Spontaneous symmetry breaking:

	the Goldstone theorem and the Higgs mechanism. Electrowek unified theory: Lagrangian and main phenomenological implications. The Lagrangian of Quantum ChromoDynamics (QCD): exact and approximate symmetries, main phenomenological aspects. One-loop perturbative effects: vacuum polarization in QED and QCD, asymptotic freedom in QCD. Neutrino physics.
Teaching methods	Lectures aimed at providing an illustration of all the conceptual and mathematical aspects inherent to each topic. Examples from recent and current experiments will be given during the lectures, in order to emphasize the link between theoretical predictions and experimental tests.
Reccomended or required readings	C. Quigg - Gauge Theories of the Strong, Weak and Electromagnetic Interactions - ©1983, 1997, Addison Wesley Longman, Inc. C.M. Becchi, G. Ridolfi – An Introduction to Relativistic Processes and the Standard Model of Electroweak Interactions, Springer. F. Mandl and G. Shaw - Quantum Field Theory - ©1994, John Wiley & Sons.
Assessment methods	Oral exam. The student will have to show to be acquainted with the formalism of gauge invariance and how it is applied in the construction of the modern theories of fundamental interactions. Also, he will have to show familiarity with the main phenomenological implications of gauge theories.
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Sustainable development goals - Agenda 2030	$lbl_legenda_sviluppo_sostenibile