UNIVERSITÀ DEGLI STUDI DI BARI ALDO MORO

DIPARTIMENTO INTERUNIVERSITARIO DI FISICA

General information		
Academic subject	Advanced quantum field theory	
Degree course	Physics	
Academic Year	II	
European Credit Transfer and Accumulation System (ECTS)		3
Language	English	
Academic calendar (starting and ending date)	October-December 2022	
Attendance	Free willig	

Professor/ Lecturer	
Name and Surname	Alessandro Mirizzi
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Telephone	
Department and address	Dipartimento Interateneo di Fisica, Via Amendola 173
Virtual headquarters	
Tutoring (time and day)	On request. In presence or online

Syllabus	
Learning Objectives	Knowledge of the most advances methods of quantum field theory
Course prerequisites	Basics of quantum field theory
Contents	1. *Quantum field theory in condensed matter.* Many body theory. Superfluidity. Quasi-particles. Superfluid Lagrangian. Superconductivity. BCS Theory. 2. *Symmetries and Symmetry Breaking.* Spontaneous symmetry breaking. Goldstone theorem. Higgs mechanism in condensed matter and particle physics. 3. *Topological objects in quantum field theory.* Solitons. Monopoles. Instantones. 4. *Phonons and their interactions.* Quantization of free phonon field. Interactions and interaction scheme. Phonon propagator. Perturbation theory. Feynman diagrams. 5. *Fractional statistics.* Topology. Anyons. Chern-Simons action. Integer and fractional quantum Hall effect. Elements of dual theories. 6. *Renormalization.* Introduction to renormalization and renormalization group.
Books and bibliography	1. A. Zee, *"Quantum Field Theory in a Nutshell,"* Princeton University Press. 2. Chetan Nayak, Dispense su *"Quantum Condensed Matter Physics".*

	3. Gerard't Hooft *"Monopoles, Instantons and Confinement"*, arXiv:hep-th/0010225.
Additional materials	

Work schedule			
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
Hours			
117	16	15	86
ECTS			
3	2	1	

Teaching strategy	Lectures/exercise classes in the classroom
Expected learning outcomes	
Knowledge and understanding on:	○ Consolidation of the knowledge in Quantum Field Theory and of the applications in particle physics and in condensed matter.
Applying knowledge and understanding on:	○ Ability in modelling phenomena in particle physics and in condensed matter through techniques of advanced quantum field theory.
Soft skills	• *Making informed judgments and choices* ○ Development of a critical spirit to distinguish the relevant aspects from the marginal ones in the problems studied. Verify assumptions and approximations • *Communicating knowledge and understanding* ○ Development of adequate skill in communicating scientific topics • *Capacities to continue learning* ○ Ability is searching bibliographical references, in using (online) databases, and online material

Assessment and feedback	
Methods of assessment	Oral exams on topic treated during the lectures
Evaluation criteria	• *Knowledge and understanding* ○ Knowledge of advanced theoretical foundation of quantum field theory • *Applying knowledge and understanding* ○ Use the acquired knowledge to solve problems of advanced quantum field theory • *Autonomy of judgment* ○ Developing physical and mathematical tools to properly model physical problems relative to complex quantum systems • *Communicating knowledge and understanding* ○ Express in a proper way physical and mathematical concepts characterizing advanced quantum field theory • *Communication skills* ○ Acquire an appropriate rigorous language to communicate science • *Capacities to continue learning*

	○ Develop mathematical and physical tool to model physical problems
Criteria for assessment and attribution of the final mark	Clarity in the oral exposition of the physical concepts.
Additional information	