COURSE OF STUDY *Physics (LM-17)*

ACADEMIC YEAR *2024-2025*

ACADEMIC SUBJECT *Heavy Ion Physics*

General information	
Year of the course	1st
Academic calendar (starting and ending date)	2nd semester: March – May 2025
Credits (CFU/ECTS):	3
SSD	FIS/01
Language	English
Mode of attendance	Recommended, not compulsory

Professor/ Lecturer	
Name and Surname	Giacomo Volpe
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Department and address	Dipartimento Interateneo di Fisica “M. Merlin”, Campus Universitario via Amendola 173 - 70125 Bari, ground floor, room 49
Virtual room	
Office Hours (and modalities: e.g., by appointment, on line, etc.)	By appointment

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	Basic notions of ultra-relativistic heavy ion collisions
Course prerequisites	Notions of nuclear and sub-nuclear physics, quantum mechanics, thermodynamic, particle detectors

Teaching strategie	Class lectures
Expected learning outcomes in terms of	
Knowledge and understanding on:	Basic knowledge of ultra-relativistic nucleus-nucleus collisions physics and the state of art of the experimental measurements.
Applying knowledge and understanding on:	Ability to autonomously recognize the main features of the phenomenology of heavy ion collisions and of QGP
Soft skills	● *Making informed judgments and choices* o In discussing and comparing the main heavy ion physics results and their interpretation in term of the quark-gluon plasma properties ● *Communicating knowledge and understanding*

	○ ability to present and to discuss ultra-relativistic nucleus-nucleus collisions results in a complete way and with an appropriate scientific language. ● *Capacities to continue learning* ○ Ability to approach the specialist literature and to work in an international and multidisciplinary context.
Syllabus	
Content knowledge	Quantum Chromodynamics and the Phase Transition in Strongly Interacting Matter. The Quark Gluon Plasma (QGP). Relativistic Kinematics. Cross Section and Collision Geometry. Global properties of heavy-ion collisions. Space-time evolution of the QGP. Soft probes: Thermal photons and lepton pairs, particle multiplicity, collective flow and correlations, statistical model. Hard probes: Jet quenching. Quarkonia and Heavy Quark. Sources of relativistic and ultra-relativistic nuclei. Experimental apparatus: the ALICE experiment. Connections to other fields of physics: nuclear physics, particle physics, statistical physics, relativistic fluid dynamics, astrophysics.
Texts and readings	Material provided by the professor
Notes, additional materials	
Repository	One drive folder

Assessment	
Assessment methods	
Assessment criteria	● *Knowledge and understanding* ○ of the basic aspects of the ultra-relativistic nucleus-nucleus collisions. ● *Applying knowledge and understanding* ○ Ability to autonomously recognize the main features of the evolution of the system created in a heavy-ion collisions ● *Autonomy of judgment* ○ Ability to evaluate the conceptual accuracy of the physics equations and models. ● *Communicating knowledge and understanding* ○ Ability to discuss one's knowledge with appropriate scientific language ● *Communication skills* ○ Ability to discuss the properties of the quark-gluon plasma using a professional language ● *Capacities to continue learning* ○ Ability to deepen specific topics of heavy ion physics autonomously starting from the knowledge and methods acquired during the course.
Final exam and grading criteria	It will be evaluated the ability to explain the various concepts and the level of understanding of the same will be positively evaluated.
Further information	
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