COURSE OF STUDY *Physics (LM-17)*

ACADEMIC YEAR *2023-2024*

ACADEMIC SUBJECT *Cosmology*

General information	
Year of the course	2nd
Academic calendar (starting and ending date)	1st semester: September - December 2023
Credits (CFU/ECTS):	3
SSD	FIS/02
Language	English
Mode of attendance	Recommended, not compulsory

Professor/ Lecturer	
Name and Surname	Luigi Tedesco
E-mail	Luigi.tedesco@ba.infn.it
Telephone	0805443213
Department and address	Dipartimento di Fisica di bari
Virtual room	
Office Hours (and modalities: e.g., by appointment, on line, etc.)	Contact via email to make an appointment (generally Monday and Friday afternoon)

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	The Cosmology training unit aims to introduce the student to the study of the general laws that regulate the Universe under geometric, relativistic, thermodynamic and particle aspects.
Course prerequisites	A prerequisite is knowledge of some aspects of basic General Relativity.

Teaching strategie	Frontal lessons on the blackboard
Expected learning outcomes in terms of	
Knowledge and understanding on:	
Applying knowledge and understanding on:	
Soft skills	
Syllabus	***Descrittore di Dublino 1****:* Basic knowledge of the concepts acquired ***Descrittore di Dublino 2:*** Ability to analyze the methods of solving the Schroedinger equation from both a theoretical and computational point of view

	***Descrittore di Dublino 3**:* autonomy of judgement Understand the methodologies and logic of quantum mechanics. Ability to analyze and describe phenomena. Ability to analyze data and correctly interpret experimental results. ***Descrittore di Dublino 4**:* communication skills At the end of the course the student must be able to have a minimum autonomy in re-elaborating the concepts acquired ***Descrittore di Dublino 5**:* o Ability to learn independently Analysis of the concepts acquired and interpretation of the data
Content knowledge	Reviews of general relativity and elements of Riemannian geometry: tensor calculus, covariant derivative, geodesics and curvature tensor. Einstein equations with cosmological constant. Dynamic energy-momentum tensor and its covariant conservation. Examples: scalar field and perfect fluids. Exact solutions with maximally symmetric subspaces: spatially homogeneous and isotropic geometry. Comoving coordinate system: synchronous paper, cosmic time and conformal time. Conformably flat metrics. Polar coordinates and Friedmann-Lemaitre-Robertson-Walker metric. Kinematic properties: spectral shift of signals, particle horizon and event horizon. Gravitational sources as perfect barotropic fluids. Friedman equations. Solutions dominated by matter and radiation. Statistical and thermodynamic properties of the primordial radiation fluid. The standard cosmological model. Luminosity distance and apparent magnitude. The distance modulus and the brightness-redshift diagram. Hubble's law and cosmic acceleration. Standard model problems: missing mass and dark matter, acceleration and dark energy, cosmological constant, singularity, flatness and horizons. Primordial black holes as a possible form of dark matter (outlines). Inflationary problem solving. Example: the de Sitter model. Exponential expansion and geodesic completeness
Texts and readings	*M. Gasperini – Cosmology* *S. Weinberg - Cosmology*
Notes, additional materials	lesson notes
Repository	

Assessment	
Assessment methods	Oral examination. Analysis and discussion of the phenomena described in class and through the ability to correctly use the language of quantum mechanics and rigorously describe also in relation to computational methods
Assessment criteria	• Making judgements: evaluating oneself and others after a discussion • Communication skills: comparing seemingly unrelated topics • Ability to learn: through classroom discussion and exercises to carry out
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 18/30 Votes: From 1 to 17 → Students are unable to provide a basic description of the concepts being analyzed. From 18 to 24 → Students are able to provide a basic description of the concepts acquired. From 25 to 27 → Students are able to provide a good description of theoretical concepts.

	From 28 to 30 cum laude→ Students are able to provide an advanced description of the concepts under discussion with a critical re-elaboration of knowledge.
Further information	
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