UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Introduction To Cosmology

2627-1-F1703Q013

Aims

Knowledge and understanding (DdD1)

Acquisition of a basic knowledge of the structure of the Universe and of the main stages of the cosmic history, from the big bang to the growth of structures.

Applying knowledge and understanding (DdD2)
Ability to derive analitically or numerically the evolution of the main cosmological quantities (e.g. redshift, scale factor, luminosity and angular distances, cosmological horizon) starting from the density of the different components (e.g. relativistic and non relativistic matter, dark energy) permeating the Universe;
Ability to use cosmological and astrophysical observations to solve the inverse problem, i.e. to determine the values of the cosmological parameters from the information on the distributions of cosmological observables, as, for example, the distributions of redshift and luminosity distance pairs.

Contents

Classical cosmology, Friedman models. Cosmic microwave background. Cosmological nucleosynthesis. Inflation. Structure formation and growth.

Detailed program

Large scale homogeneity and isotropy of the Universe. The Hubble law. The Robertson Walker metric. The Friedmann Equation and Friedmann models. Measures of the cosmological parameters. Problems in the standard Big bang model and the inflation solution. Cosmic nucleosynthesis. Recombination. Cosmic

microwave background. Gravitational instability in an expanding Universe. Differences in the distribution of structures in presence of hot or cold dark matter.

Prerequisites

Mathematics and Physics for undergraduates. A basic knowledge of general relativity allows for a more complete comprehension of the class, but such knowledge is not necessary to fruitfully follow the class.
The first part of the course will include an introduction to the concepts of general relativity required.

Teaching form

All the lectures will be in presence.

3 CFU will consist of traditional lectures ("didattica erogativa", DE), with 21 hours splitted in 10 lectures of 2 hours each and 1 lecture of 1 hour.

The remaining 3 CFU will consist of interactive teaching ("didattica interattiva" - DI), with 16 lectures of 2 hours and 1 lecture of 1 hour on the construction and solution of cosmological models and on the estimation of the cosmological parameters.

I will frequently propose during the lectures (not evaluated) questions and problems to be solved individually or in group, to allow for a check of the effective learning progress of the class.

Textbook and teaching resource

The main text of the class is: B. Ryden, “Introduction to cosmology”.

Some lectures, in particular on the structute formation topic, will be based on:

1. Binney and Tremaine "Galactic dynamics"
2. Longaire "Galaxy formation"

Semester

First semester.

Assessment method

The final exam is an oral assessment (viva) covering the topics discussed in class. there are no intermediate exams.

The exam consists of three equally weighted parts: the discussion of an an argument selected by the student, the analysis of a multicomponent Friedmann model, and a broader discussion to assess the student's understanding of the remaining topics covered during the course.

Evaluation is based on three equally important criteria:
Depth of understanding of the topics
Ability to apply this knowledge to derive the large-scale properties of the Universe
Clarity and conciseness in presentation

Office hours

Wednesday 16:00-18:00

Sustainable Development Goals

QUALITY EDUCATION