



UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Modern Cosmology and Galaxy Formation

2324-1-F5802Q022

Aims

Acquire basic knowledge and develop a "big picture" grasp of major topics in Modern Cosmology and Galaxy Formation in the early Universe. Build a Master-level foundation for understanding current ongoing theoretical research and observational efforts in the field. Develop practical research skills and tools, the ability to formulate meaningful questions and hypotheses, and devise strategies to test them.

Contents

The transformation of cold neutral intergalactic hydrogen into a highly ionized warm plasma marks the end of the cosmic dark ages and the beginning of the age of galaxies. The details of this process reflect the nature of the early sources of radiation and heat, the statistical characteristics of the large-scale structure of the Universe, the thermodynamics and chemistry of cosmic baryons, the nature of dark matter, and the histories of star formation and black hole accretion. A number of massive data sets from new ground- and space-based instruments and facilities over the next decade are poised to revolutionize our understanding of primeval galaxies, the reionization photon budget and timeline, the physics and the fine-grained properties of gas in the "cosmic web". In this course, we survey key aspects of galaxy formation in the early Universe and larger-scale structure modeling, and describe the diverse range of observational and theoretical techniques and tools currently available in this exciting area of research.

Detailed program

Smooth Homogeneous Universes, Cosmic Dynamics, Observational Tools in Cosmology, Early Universe and Dark Matter, Gravitational Instability in the Linear and Nonlinear Regimes, the Clumpy Universe, Dark Ages and the Epoch of First Light, Formation of Dark Matter Halos, Gas Cooling and Baryonic Structures, Quasars and High-

Redshift Objects, Cosmic History of Star Formation, Probes of Reionization and the Lyman-alpha Forest, First Results from the James Webb Space Telescope.

Prerequisites

Mathematics and Physics for students of the bachelor's degree. Basic knowledge of electromagnetism, gravitation, relativity, particle and atomic physics, statistical physics and thermodynamics. It is useful (but not required, as the course is largely self-contained) to take this class after the first-semester courses of the Astrophysics and Space Physics Master.

Teaching form

The lectures (6 CFU, 42 hours) will be held in English. I will frequently propose during the lectures questions and problems (not graded) to be solved individually or in groups. All the material will be made available online, but class attendance and active participation are integral parts of the teaching-learning process.

Textbook and teaching resource

There is no official textbook for this course. However, you will find most of the topics we cover in these books:

Peebles, Peebles Principles of Physical Cosmology. ISBN: 0691019339

Longair, Galaxy Formation. ISBN: 978-3-540-73477-2

Mo, van den Bosch, & White, Galaxy Formation and Evolution. ISBN: 9780511727726

Padmanabhan, Theoretical Astrophysics Volume III. ISBN:0521566304

The instructors notes will be made available on the e-learning page of the course.

Semester

Second Semester.

Assessment method

Final exam is based on oral discussion on the concepts and practices of the courses. The examination will last between 30 and 40 min, and it is composed of a 15-20 min presentation by the candidate on a selected subject (previously agreed between the student and the instructor) of cosmology/galaxy formation, making use of slides and/or the blackboard. The second part consists of questions and discussions that will test the student qualitative and quantitative understanding of key concepts, and her/his ability to perform analytical calculations.

Office hours

By appointment (via email).

Sustainable Development Goals

QUALITY EDUCATION | INDUSTRY, INNOVATION AND INFRASTRUCTURE
