UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Introduction To Galaxies

2526-1-F5803Q024

Aims

Provide the background knowledge of current theories and observations of galaxy formation and evolution. Provide the background knowledge and skills for the analysis and interpretation of observational datasets, of the techniques and outputs of numerical simulations and of galaxy formation models.

At the end of the course, students will be able to:

- Demonstrate knowledge and understanding of key concepts in the astrophysics of galaxies.
- Understand and apply investigative methods and experimental approaches used in astrophysics.
- Make use of mathematical and statistical tools specific to astrophysics, with particular emphasis on the study of galaxy populations.
- Apply the scientific method and modeling strategies to analyze and solve astrophysical problems.

Contents

Theories, observations and numerical simulations of galaxy formation and evolution:

1. Elements of structure and galaxy formation;
2. The baryon physics in galaxies;
3. Inflows, Outflows, and the Baryon cycle;
4. Environmentally driven galaxy evolution.

Detailed program

The following topics will be presented:

1) Elements of structure and galaxy formation

- From the CMB to halos
- Growth of density perturbations
- Collapse of DM haloes

2) The baryon physics in galaxies

- Hot haloes in hydrostatic equilibrium
- Gas accretion and cooling
- Formation of gaseous disks
- Star Formation in Galaxies
- Stellar population Syntesis models of galaxies
- Estimates of Stellar mass and ages
- Estimates of Gas mass and Star Formation Rates
- Dust absorption and emission
- Spectral Diagnostics (Metallicity, Density, Temperature, Ionization source)

3) Inflows, Outflows, and the Baryon cycle

- Outflows from SN Feedback
- AGN feedback
- Galaxy Evolution with redshift
- Galaxy equilibrium models, semi-analytic models, numerical simulations
- Galaxy morphology and Kinematics
- The circum galactic medium

4) Environmentally driven galaxy evolution

- Galaxy evolution in groups and clusters, star formation quenching
- Physical mechanisms effective in dense environments

Prerequisites

Undergraduate degree in physics, knowledge of elementary atomic physics.

Teaching form

This is an 8 CFU course. Lectures will cover the main theoretical concepts (21 hours 35%, traditional lectures). Each set of lectures will be followed by hands-on sessions on specific datasets or numerical techniques to practice the background concepts, through work done individually or in small groups (40 hours 65%, interactive teaching).

Attendance in presence to the hands-on sessions is highly recommended.

All activities will be in English.

Textbook and teaching resource

Houjun Mo, Frank van den Bosch, Simon White; Galaxy Formation and Evolution; 2010 Cambridge University Press.

Handouts provided by the teachers via the e-learning platform.

Relevant papers from the literature will be suggested to deepen the knowledge of the topics.

Semester

First semester.

Assessment method

Written report on the results of two of the hands-on sessions (chosen by the student) and oral exam on the lectures and practical sessions.
The evaluation will include:

- the knowledge of the content of the lectures and the ability to link topics and to solve problems (weight 70%),
- the clarity of the oral exposition, the use of the appropriate technical language and the ability to formulate and present coherent arguments on the topics of the course (weight 15%),
- the technical skills and data analysis metolodogies acquired during the hands-on sessions (weight 15%).

Office hours

By appointment (via email).

Sustainable Development Goals

QUALITY EDUCATION