UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Stellar Astrophysics

2223-1-F5802Q002

Aims

The aim of this course is at providing tools for understanding the physics of stars, their formation and evolution through cosmic ages. Stellar astrophysics is key for understnding galaxies, their colors and formation history. Recently this dicipline finds new applications in the field of gravitational wave astrophysics.

Contents

Introduction to stellar astrophysics: formation, structure and evolution.

Detailed program

- Stellar equilibria, the virial theorem and stability
- Stellar timescales
- Light from stars: black body radiation, opacity and radiative transport
- Classical and quantum gases
- Nuclear reactions: quantum tunneling: Gamov's energy, synthesis of the heavy elements.
- Stars on the main sequence: scaling relations, maximum and minimum mass
- Degenerate stars: Chandrasekhar limiting mass.
- Stellar evolution beyond the main sequence: red giant phase, planetary nebulae, AGB and supernovae.
- Gravitational collapse: neutrino emission and deleptonisation.
- Compact objects as relics of stars: white dwarfs, neutron stars and black holes.
- Stellar evolution in binary systems.
- Dynamics of black holes and neutron stars in star clusters.
- Star formation: Jean's mass, proto-stars, initial mass function.

- Population III stars. Black hole seeds. Supermassive stars.

Prerequisites

Calculus, Classical Mechanics, Electromagnetism, Condensed Matter, Quantum Mechanics

Teaching form

Frontal Lectures.

Textbook and teaching resource

Books:

Prialnik, “Stellar structure and evolution”
Phillips, “The Physics of Stars”
Kippenhahn and Weigert, “Stellar structure and evolution”
Stahler and Palla, “The formation of stars”
Shapiro and Teukolsky, “Black holes, white dwrafs and neutron stars”
Selected reviews and selected papers provided during the lectures.
Selection of recorded lectures.

Semester

First semester

Assessment method

Oral exam: extended test on the level of knowledge of the contents of the course by the student and attention on the degree of clarity in the exposition. The first question will focus on one of the most fundamental concepts of stellar physics highlighted during the course. A short slide-presentation by the student on a selected topic of stellar evolution/star formation.

Office hours

Upon appointment via email

Sustainable Development Goals