UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Radiative Processes

2526-1-F5803Q011

Aims

Radiative processes are crucial in astrophysics because they govern how electromagnetic energy is sourced and transferred through space in order to infer information about cosmic objects. This course is an introduction to the radiative processes fundamental for the description of high-energy astrophysical sources. It offers tools to infer the physical properties of cosmic sources based on the radiation they emit and enables modeling of their spectral properties.

Contents

- The electromagnetic spectrum
- Thermal plasma - Black body - Bremsstrahlung
- Elements of special relativity
- Relativistic beaming
- Synchrotron emission and self-absorption
- Direct Compton and Inverse Compton
- Theory of accretion onto black holes and spectral emission
- Active Galactic Nuclei
- Pulsars
- X-ray binaries

Detailed program

- The electromagnetic spectrum and the spectral decomposition of electromagnetic fields
- The radiative transport equations; black body radiation; application to line emission and line absorption; line

shift and broadening
- Reionization and Strömgren sphere from UV sources
- Bremsstrahlung emission
- Special relativity: aberration, beaming and superluminal sources
- Synchrotron: relativistic dynamics of charges in magnetic fields; total power emitted by the single electron; characteristic frequencies of the emitted spectrum. Self-absorption
- Thomson scattering: Inverse Compton; total power emitted by a single electron and spectral properties; spectra from non thermal electrons
- Bondi model for accretion and the Shakura Sunyaev accretion disc around black holes
- Active Galactic Nuclei: phenomenology; relativistic iron line emission line; broad and narrow optical emission lines; unification schemes
- Pulsars in the P-Pdot diagram; X-ray binaries

Prerequisites

Classical mechanics, classical electro-magnetism.

Teaching form

30 hours of frontal lectures, mostly at the blackboard, occasionally with the support of slides; 12 hours of supporting activities and exercises.

Lectures are in English.

Recorded lectures from previous years are available for students who may be unable to attend classes in person.

Textbook and teaching resource

Reference book
Rybicki and Lightman, “Radiative Processes in Astrophysics” - Chapters 1,3,4,5,6,7

Other books
Ghisellini, "Radiative processes in high energy astrophysics"
Longair, “High Energy Astrophysics”

Selected reviews and selected papers provided during the lectures

Semester

First Semester

Assessment method

The oral exam will start with the presentation of a topic selected by the student on a radiative procces. Thereafter, the teacher will verify knowledge on the main themes treated in the course. Later, the student will discuss a selected class of sources on his/her choice.

Evaluation is based on three equally important criteria:

Depth of Understanding
? Demonstrate a comprehensive grasp of the subject matter.
? Show ability to connect concepts and apply knowledge in context.
Analytical Thinking
? Successfully perform analytical derivations.
? Pose relevant, thoughtful, and probing questions.
Clarity and Conciseness of Presentation
? Present ideas in a clear and logically structured manner.
? Use precise language and appropriate visual aids

Office hours

Upon email appointment

Sustainable Development Goals

QUALITY EDUCATION