UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Astronomical Instrumentation

2122-1-F5802Q010

Aims

Let the student be familiar with the functioning of the modern astronomical instrumentation so that she/he can understand the scientific literature related to instrumentation and be aware of the specific characterisitcs of the instruments getting the data she/is asked to analyze during her/his thesis.

Contents

Introduction to the physical principles of operation of telescopes and detectors of electromagnetic, gravitational and particle radiation (cosmic rays).

Detailed program

Geometrical optics recals.

Principles of gaussian optics.
Electromagnetic wave polarization: Stokes parameters.

Telescopes:

- main optical schemes
- mountings
- angular resolution
- atmospheric absorption

- seeing

Radio Astronomy:

- single antenna telescopes
- interferometers
- riceivers
- spectrometers
- polarimeters

Millimetric and Sub-millimetric Astronomy:

- telescopes
- etherodyne receivers SIS
- bolometric receivers
- TES
- mKIDS

Infrared Astronomy:

- telescopes
- adaptive/active optics
- infrared arrays

Optical Astronomy:

- telescopes
- CCD cameras
- photometric systems
- spectroscopes

Ultraviolet Astronomy:

- Normal and grazing incidence telescopes
- UV CCD
- Micro-Channel Plates
- Avalanche Photo Diodes

X ray Astronomy:

- grazing incidence telescopes
- coded mask telescopes

- collimators

Gamma ray Astrnomy

- Cerenkov Telescopes
- Showers detectors

Inonizing radiation detectors:

- ionization chambers
- proportional chambers
- Geiger
- scintillators
- photomultipliers
- semiconductor detectors

Gravitational antennas

- Strain Ratio, sensitivity

- Weber Resonators
- Interferometers
    - LIGO
    - VIRGO
    - LISA

Cryogenerators

Heat transfer: conductivity, convectivity, radiation
T>180K fridges
T<180K fridges

- "wet"/"dry"
- ^{3}He fridge
- Dilution fridge
- Adiabatic Demagnetization Refrigerator

Astronomical Coordinates

- Local Coordinates (alt-azi)

- Equatorial Coordinates
- Galactic Coordinates

Detailed analysis of some next generation ground based instrument or space mission suggested by the students

Prerequisites

Physics 1, Physics 2, Physics 3, Structure of Matters

Teaching form

Frontal lessons, eventually in streaming. In any case the lessons are recorded and published on the e-learning page.

Textbook and teaching resource

Video files of the lessons.

Forum for every lessons.

Lesson presentations.

Textbook:

“Electronic Imaging in Astronomy”, McLean, Springer 2008

suggested books:

"Radio Astronomy", John D. Kraus, Cygnus Quasar Books

"Radiation Detection and Measurements", Glenn Knol, Weyley

"Observational Astrophysics", Pierre Lenà, Springer

Semester

Second Semester.

Assessment method

Oral exam consisting of two short seminars about contemporary instruments or space missions.

Office hours

Every day by appointment.