



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## COURSE SYLLABUS

### Astronomical Instrumentation

2425-1-F5802Q010

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#### 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 characteristics of the instruments getting the data she/is asked to analyze during her/his thesis.

#### Contents

Introduction to the principles of functioning of the telescopes and electromagnetic, gravitational and particle radiation detectors.

#### Detailed program

Optics review:

- Geometrical optics
- Concepts of Gaussian optics
- Electromagnetic wave polarization: Stokes parameters.

Astronomical Coordinates

- Local Coordinates (alt-azi)
- Equatorial Coordinates
- Galactic Coordinates

## Telescopes:

- main optical schemes
- mountings
- angular resolution
- atmospheric absorption
- seeing
- active/adaptive optic

## Radio Astronomy:

- single antenna telescopes
- interferometers
- receivers
- spectrometers
- polarimeters

## Millimetric and Sub-millimetric Astronomy:

- telescopes
- heterodyne 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 Astronomy

- Cerenkov Telescopes
- Shower 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
- $T > 180\text{K}$  fridges
- $T < 180\text{K}$  fridges
- "wet"/"dry"
- $^3\text{He}$  fridge
- Dilution fridge
- Adiabatic Demagnetization Refrigerator

Educational trip to a national observational facility (possible destinations are the INAF radio telescopes, the EGO/VIRGO observatory, the Asiago observatory, an aerospace/high-tech industry that has an instrument or payload in advanced development)

## Prerequisites

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

This course is recommended to students wishing to follow an observational/experimental track during their studies

## Teaching form

Frontal lessons (**traditional form**), eventually in streaming if there are students attending from remote because of visa problems.

## Textbook and teaching resource

Lesson slides.

Textbook:

"Electronic Imaging in Astronomy", McLean, Springer 2008

suggested books:

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

"Radiation Detection and Measurements", Glenn Knol, Wyley

"Observational Astrophysics", Pierre Lenà, Springer

## **Semester**

Second Semester.

## **Assessment method**

Oral exam consisting of two short seminars about contemporary instruments or space missions agreed with the teacher.

## **Office hours**

Any day by appointment (email).

## **Sustainable Development Goals**

QUALITY EDUCATION | INDUSTRY, INNOVATION AND INFRASTRUCTURE | PARTNERSHIPS FOR THE GOALS

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