UAB
Universitat Autònoma de Barcelona

Observational Techniques

Code: 42866
ECTS Credits: 6

2025/2026

Degree	Type	Year
High Energy Physics, Astrophysics and Cosmology	OT	0

Contact

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Teachers

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

No specific prerequisites are set for this course, but it is advisable to possess basic knowledge of Astronomy and Physics.

Objectives and Contextualisation

The objective of this course is to familiarize the student with the various techniques for observations as used in Astronomy. The student will be required to comprehend basic concepts, nomenclature and unit systems that are commonly employed in astronomical work. Detection techniques and instrumentation will be described as a function of wavelength, including the entire particle and electromagnetic spectrum: neutrino astronomy, high-energy (gamma-rays and X-rays), UV-optical, near infrared and radio astronomy. For all these regimes, which use different methodologies, data reduction and analysis techniques will be covered. The final goal is that the student acquires sufficient basic knowledge to be able to plan, execute and analyze observations in all branches of Astronomy thus enabling him/her to perform scientific research. We take into account the role of women in the development of the observational techniques in astronomy.

Competences

- Apply the main principles to specific areas such as particle physics, astrophysics of stars, planets and galaxies, cosmology and physics beyond the Standard Model.
- Formulate and tackle problems, both open and more defined, identifying the most relevant principles and using approaches where necessary to reach a solution, which should be presented with an explanation of the suppositions and approaches.
- Understand the bases of advanced topics selected at the frontier of high energy physics, astrophysics and cosmology and apply them consistently.
- Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
- Use critical reasoning, analytical capacity and the correct technical language and formulate logical arguments.

Learning Outcomes

1. Apply the optical principle of the conceptual design of astronomical cameras and telescopes.
2. Make a comparative analysis of the different observation techniques (optical astronomy, radioastronomy, etc.).
3. Plan an optical observation of a series of astronomical objects.
4. Understand the basics of astronomical observations.
5. Understand the basics of optical and infrared astronomy.
6. Understand the basics of radioastronomy.

Content

Basic concepts of astronomy (atmospheric windows, position astronomy, magnitude systems)

Solar observation

UV, optical and infrared astronomy:

- Telescopes: optical and mechanical designs, adaptive optics, observation planning
- Detectors: CCDs, near IR detectors
- Reduction of astronomical images
- Photometry and photometric systems
- Spectroscopy

High-energy astrophysics:

- Detection principles
- Instrumentation
- Data analysis

Radioastronomy:

- Detection principles
- Radiointerferometry
- Data analysis

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			

Practical labs	6	0.24	3
Theory lectures	39	1.56	2, 1, 6, 5, 4
Type: Supervised			
Practical labs	5	0.2	3
Essay	5	0.2	6, 5, 3
Type: Autonomous			
Discussion, team work	38	1.52	2, 1, 6, 5, 4, 3
Homework	28	1.12	2, 1, 6, 5, 4

Theory lectures and exercises.

Classwork and homework.

Preparation of an essay for oral presentation and preparation of lab reports.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Oral presentation and discussion of a topical essay	27.5%	4	0.16	2, 1, 6, 5, 4, 3
Resit Essay and Presentation	55%	3	0.12	2, 1, 6, 5, 4, 3
Written report of a topical essay	27.5%	12	0.48	2, 1, 6, 5, 4, 3
Written report on practical lab on optical observations.	15%	3.4	0.14	1, 5, 4, 3
Written report on practical lab on X-ray astrophysics	15%	3.3	0.13	1, 4
Written report on practical lab radiastronomy	15%	3.3	0.13	6, 4

The evaluation is composed of an oral presentation and discussion of a topical essay with 27.5% weight (individual), a written report of a topical essay with 27.5% weight (individual), and the reports from three practical labs on data reduction and analysis with 15% weight each (in small groups or individual).

There will be a resit exam for those who fail the course.

This subject/module does not foresee the single assessment system.

Bibliography

- Astrophysical Techniques (CRC Press), C.R. Kitchin, 2013 (6th ed)
- The Design and Construction of Large Optical Telescopes (Springer), Pierre Y. Bely (editor), 2002
- The Sun. An introduction (Springer), Michael Stix, 2002
- Observational Astrophysics (Springer), Pierre Léna et al., 2012 (3rd ed)
- Handbook of CCD Astronomy (Cambridge), Steve B. Howell, 2006
- Handbook of Infrared Astronomy (Cambridge), I.S. Glass, 1999
- Observational Astronomy: Techniques and Instrumentation (Cambridge), Edmund C. Sutton, 2011
- Radiation Detection and Measurement (Wiley), Glenn F. Knoll, 2010 (4th ed)
- High Energy Astrophysics (Cambridge), Malcom S. Longair, 2011 (3rd ed)
- Exploring the X-ray Universe (Cambridge), Philip A. Charles, Frederick D. Seward, 2010 (2nd ed)
- Lectures on Neutrino Astronomy: Theory and Experiment (Lectures presented at the TASI School), Francis Halzen, 1998 (arXiv:astro-ph/9810368v1)
- Tools of Radio Astronomy (A&A Library, Springer), Kirsten Rohlfs, Thomas L. Wilson, 2009 (5th ed)
- Interferometry and Synthesis in Radio Astronomy (Wiley), A.R. Thompson, J.M. Moran, G.W. Swenson Jr., 2001 (2nd ed)
- An introduction to Radio Astronomy (Cambridge). Bernard F. Burke, Francis Graham-Smith, 2009 (3rd ed)

Software

Preferred working environment (highly recommended): Linux or Mac OS

Software: CARTA, or similar than can read and analyze FITS images

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(TEm) Theory (master)	1	English	first semester	morning-mixed