Astronomical instruments - course description

General information

Course name	Astronomical instruments
Course ID	13.7-WF-FizP-AI-S17
Faculty	Faculty of Physics and Astronomy
Field of study	Physics
Education profile	academic
Level of studies	First-cycle studies leading to Bachelor's degree
Beginning semester	winter term 2018/2019

Course information

Semester	2
ECTS credits to win	4
Course type	obligatory
Teaching language	english
Author of syllabus	• dr hab. Wojciech Lewandowski, prof. UZ

Classes forms

The class form	Hours per semester (full-time)	Hours per week (full-time)	Hours per semester (part-time)	Hours per week (part-time)	Form of assignment
Lecture	30	2	-	-	Exam
Class	30	2	-	-	Credit with grade

Aim of the course

The necessary concepts of optics and physics of electromagnetic wave needed to understand the principles of operation and construction of optical telescopes. Description of the construction of optical receivers used in astronomy. Construction and operation of the basic types of optical telescopes. Introduction of the concepts of electrodynamics and the physics of electromagnetic waves, that are necessary for understanding of the development of radio-astronomical telescopes and receivers. Description of basic receiver types used in radio astronomy. Description of basic radio-telescope types.

Prerequisites

Knowledge of basic physical concepts of optics, electrodynamics and wave physics.

Scope

- Astronomical coordinate systems, siderial time, time-keeping, stellar brightness scale

- Optical telescopes, basic tesescope parameters

- Astronomical light detectors: photometers, CCD cameras, polarimeters, spectrographs, optical filter systems.

- The basic aplications of photometry, spectroscopy and polarymetry

- Radio-telescopes, radio wave detectors and receivers

- Interferometry in radioastronomy (VLA, VLBI, LOFAR, SKA)

- Microwave and infrared telescopes (ALMA)

- X-ray and gamma telescopes, including Cherenkov's telescopes (HESS)

- Cosmic rays: origin and detection

- Detection of astrophysical neutrinos

- Basics of the gravitational wve theory and gravitational wave detectors (VIRGO, LIGO).

Teaching methods

Classic lecture; computational exercises and research project preparation in the class

Learning outcomes and methods of theirs verification

Outcome description	Outcome symbols	Methods of verification	The class form
Student is able to solve simple problems concerning the basics of astrophysics and the designs of astronomical telescopes.		• a draft	• Class

Outcome description	Outcome symbols	Methods of verification	The class form
Student can name and describe basic types of optical telescopes, radio-telescopes, microwave and infrared telescopes. He can explain the idea and structure of Cherenkov telescopes, and the instruments used to detect cosmic rays, neutrinos and gravitational waves. He can describe and explain the astronomical receivers used to detect and measure electromagnetic radiation in all of its regimes: including photometers/radiometers and spectrometers. He knows their design and working principles, and he is able to calculate basic parameters of telescopes and receivers. Student understands the basic ideas of photometry, spectroscopy, polarimetry and their hybrids. He understands the concepts if the air mass, extinction, seeing and scintillation. He is able to use available astronomical databases and extract the information needed. Student has basic knowledge about astronomical sources of electromagnetic radiation, as well as cosmic ray particles, neutrinos and gravitational waves.		• an exam - oral, descriptive, test and other	• Lecture
Student is able to prepare and perform a simple research project concerning astronomical observations		• a project	• Class

Assignment conditions

Lecture: Oral exam, passing condition – positive grade.

Class: written test – solving computational exercises (50% of the grade) and the research project (50%) of the grade

Before taking the examination the student needs to obtain passing grade from the class

Final grade: average of the exam grade and the class grade.

Recommended reading

[1] F. Shu, *Galaktyki, gwiazdy, życie*, Proszyński i S_ka, 2003.

[2] M. Kubiak, *Gwiazdy i materia międzygwiazdowa*, PWN, 1994.

[3] J. M. Kreiner, *Astronomia z astrofizyką*, PWN, 1988.

[4] A. Branicki, *Obserwacje i pomiary astronomiczne*, WUW, 2006.

[5] R. Taylor, *Wstęp do analizy błędu pomiarowego*, PWN, 1999.

[6] K. Rohlfs, T. L. Wilson, *Tools of Radio Astronomy*, Springer, 2006

Further reading

[1] B. D. Warner, *Lightcurve Photometry and Analysis*, Springer 2006.

[2] S. B. Howell, *Handbook of CCD astronomy,* Cambridge Uni. Press, 2006.

[3] E. Budding i O. Demircan, *Introduction to astronomical photometry*, Cambridge Uni. Press, 2007.

[4] J. D. Krauss, *Radio Astronomy,* Cygnus-Quasar Books, 1986.

[5] K. Grupen, I. Buvat (eds), *Handbook of particle detection and imaging*, Springer, 2012.

[6] I. S. Glass, *Handbook of infrared astronomy*, Cambridge Univ. Press, 1999.

[7] J. D. E. Creighton, W. G. Anderson, *Gravitational-Wave Physics and Astronomy: An Introduction to Theory, Experiment and Data Analysis*, Wiley, 2011.

Notes

Modified by dr hab. Piotr Lubiński, prof. UZ (last modification: 01-08-2018 14:38)