

Observational methods and data analysis in astrophysics - course description

General information	
Course name	Observational methods and data analysis in astrophysics
Course ID	13.7-WF-FizP-OMDAA-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 2022/2023

Course information	
Semester	4
ECTS credits to win	6
Available in specialities	Astrofizyka komputerowa
Course type	obligatory
Teaching language	english
Author of syllabus	<ul style="list-style-type: none">dr hab. Jarosław Kijak, prof. UZdr 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	-	-	Credit with grade
Class	30	2	-	-	Credit with grade

Aim of the course

Basic knowledge on the methods of observation and measurement of in radio astronomy. Learning the methods of data analysis, in particular radio wave.

Prerequisites

Computer laboratory I - information technologies, Fundamentals of programming, Electrodynamics, Astronomical instruments

Scope

Astronomical radiation sources and particularly interesting objects. Methods of observation for particular types of objects. Multi-frequency flux measurement - spectrum, spectroscopy, interferometry, pulsars.

Measurement error analysis, the normal distribution (Gaussian), fitting the data to a linear function. Chi-square test, correlation and autocorrelation function. Introduction to Fourier analysis. Types of optical telescopes, the basic parameters of telescopes. Optical radiation receivers used in astronomy: photometers, CCD camera, polarimeters, spectroscopes. Filter systems. Construction and operation of optical receivers and their basic parameters.

Basics of photometry, spectroscopy and polarimetry.

Teaching methods

Conversational lecture:

accounting exercises.

Learning outcomes and methods of theirs verification

Outcome description	Outcome symbols	Methods of verification	The class form
The student is able to characterize research methods and choose appropriate statistical methods for the analysis of measurement data in astronomy	<ul style="list-style-type: none">K1A_W04K1A_K03	<ul style="list-style-type: none">a test	<ul style="list-style-type: none">Lecture
The student is able to interpret simple astronomical observations and based on them estimate the most important physical parameters of astronomical objects	<ul style="list-style-type: none">K1A_U05K1A_U06K1A_U08	<ul style="list-style-type: none">a quizan evaluation test	<ul style="list-style-type: none">Class
Student has a basic knowledge of astronomical sources of radiation.	<ul style="list-style-type: none">K1A_W01	<ul style="list-style-type: none">a test	<ul style="list-style-type: none">Lecture
The student can describe the methods in radio astronomy observations and explain the operation of modern astronomical instruments.	<ul style="list-style-type: none">K1A_W03K1A_W05	<ul style="list-style-type: none">a discussion	<ul style="list-style-type: none">Lecture

Outcome description	Outcome symbols	Methods of verification	The class form
The student can use source literature, including astronomical databases and directories.	<ul style="list-style-type: none"> • K1A_W03 • K1A_U01 • K1A_U05 • K1A_K01 • K1A_K02 	<ul style="list-style-type: none"> • a quiz • an evaluation test 	<ul style="list-style-type: none"> • Class
The students can construct a simple research project and use statistical methods to analyze data.	<ul style="list-style-type: none"> • K1A_U03 • K1A_U04 • K1A_U07 	<ul style="list-style-type: none"> • a project 	<ul style="list-style-type: none"> • Class

Assignment conditions

Lecture: Positive passing of final test (80%) and discussion (20%).

Class: positive completion of homework (50%), solving problems in the class (50%)

Final grade: 50% lecture, 50% class.

Recommended reading

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

[2] J. R. Taylor, Wstęp do analizy błędu pomiarowego, PWN, Warszawa 1999

[3] S. Brandt, Analiza danych (Metody statystyczne i obliczeniowe), Wydawnictwo Naukowe PWN, Warszawa 2002.

[4] Compendium of Practical Astronomy, Instrumentation and Redaction Techniques, SG. D. Roth, Springer-Verlag, Berlin 1994.

[5] T. L. Wilson, K. Rohlfs, S. Huttemeister, Tools of Radio Astronomy, Fifth Edition, Springer-Verlag, Berlin 2009.

[6] J. D. Kraus, Radio Astronomy, 2nd edition, Cygnus-Quasar Books, Powell, OH, 1986.

[7] T. L. Wilson, S. Huttemeister, Tools of Radio Astronomy, Problems and Solutions, Springer-Verlag, Berlin 2005

[8] F. Shu, Galaktyki, gwiazdy, życie, Prószyński i S_ka, 2003.

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

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

Further reading

[1] Single-dish radio astronomy techniques an-NRAO Summer School held at National Astronomy and Ionosphere Center, Arecibo Observatory, Arecibo, Puerto Rico, USA, 10 -15 June 2001.

[2] Interferometry and Synthesis in Radio Astronomy, Second Edition; A. R. Thompson, J. M. Moran, G.W. Swenson Jr., WILEY-VCH Verlag GmbH & Co. KgaA, Weinheim, 2004.

Notes

Modified by dr Marcin Kośmider (last modification: 04-04-2022 20:47)

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