



# Interstellar mediums at various epochs of the evolution of the Universe

## Educational subject description sheet

### Basic information

<b>Study programme</b> Astronomia	<b>Didactic cycle</b> 2023/24
<b>Speciality</b> -	<b>Subject code</b> 04ASTS.25K.02189.23
<b>Organizational unit</b> Faculty of Physics	<b>Lecture languages</b> English
<b>Study level</b> Second-cycle programme	<b>Course type</b> Elective
<b>Study form</b> Full-time	<b>Block</b> Major subjects
<b>Education profile</b> General academic	
<b>Subject coordinator</b>	Michał Michałowski
<b>Lecturer</b>	Michał Michałowski
<b>Periods</b> Semester 1, Semester 3	<b>Activities and hours</b> • Lecture: 30, Exam • Laboratories: 15, Graded credit
	<b>Number of ECTS points</b> 5

### Goals

Code	Goal
C1	To familiarize students with research methods and the current state of knowledge about interstellar medium
C2	Demonstration of the basic steps of interferometric data reduction

### Subject learning outcomes

Code	Outcomes in terms of	Learning outcomes	Examination methods
<b>Knowledge - Student:</b>			
W1	knows the basics of interferometric observations	AST_K2_W04, AST_K2_W06, AST_K2_W07	Project
W2	knows the history of research on interstellar medium	AST_K2_W02, AST_K2_W08	Oral exam
W3	knows the components of interstellar medium	AST_K2_W02, AST_K2_W04	Oral exam
W4	knows the research methods for studying interstellar medium	AST_K2_W02, AST_K2_W04	Oral exam, Multimedia presentation
W5	understands the relationships between the components of interstellar medium	AST_K2_W02	Oral exam, Multimedia presentation
W6	knows the current state of knowledge about interstellar medium	AST_K2_W02, AST_K2_W04, AST_K2_W05, AST_K2_W08	Oral exam, Multimedia presentation
<b>Skills - Student:</b>			
U1	can read and understand literature on interstellar medium	AST_K2_U02, AST_K2_U05, AST_K2_U06, AST_K2_U08	Multimedia presentation
U2	can summarise and present the latest research results on interstellar medium	AST_K2_U02, AST_K2_U04, AST_K2_U05, AST_K2_U06, AST_K2_U07, AST_K2_U08	Multimedia presentation
U3	understands the process of interferometric data reduction	AST_K2_U01, AST_K2_U05, AST_K2_U06	Project
U4	knows how to perform basic reduction of interferometric data	AST_K2_U01, AST_K2_U02, AST_K2_U03, AST_K2_U05	Project
<b>Social competences - Student:</b>			
K1	can critically evaluate scientific publications	AST_K2_K01	Multimedia presentation

## Study content

No.	Course content	Subject learning outcomes	Activities
1.	Basics of interferometry	W1, W4, U3, U4	Lecture, Laboratories
2.	Components of interstellar medium	W2, W3, W5	Lecture
3.	Dust emission	W2, W4, U1, U2, K1	Lecture
4.	Gas emission and spectral lines	W2, W4, U1, U2, K1	Lecture
5.	Star formation process	W2, W5, U1, U2, K1	Lecture

No.	Course content	Subject learning outcomes	Activities
6.	Dusty galaxies and the history of star formation in the Universe	W6, U1, U2, K1	Lecture
7.	The dustiest galaxies in the Universe	W6, U1, U2, K1	Lecture
8.	Dust production	W5, W6, U1, U2, K1	Lecture
9.	Gas accretion and star formation	W5, W6, U1, U2, K1	Lecture
10.	Reduction of interferometric data	W1, W4, U3, U4	Laboratories

### Additional information

Activities	Teaching and learning methods and activities
Lecture	Lecture with a multimedia presentation of selected issues, Discussion
Laboratories	Solving tasks (e.g. computational, artistic, practical), Project method, Work in groups

Activities	Credit conditions
Lecture	Knowledge and ability to discuss topics discussed during the lecture
Laboratories	Correct performance of data reduction

### Literature

#### Obligatory

1. Physics of the Interstellar and Intergalactic Medium, Bruce T. Draine, Princeton University Press, 2011, ISBN: 978-0-691-12214-4
2. Scientific publications: Astrophysical Journal, Astronomy and Astrophysics, Monthly Notices of the Royal Astronomical Society Nature, Science
3. <https://astro.uni-bonn.de/~uklein/teaching/ISM/InterstellarMedium.pdf>

#### Optional

1. <https://ay201b.wordpress.com/>

### Calculation of ECTS points

Activities	Activity hours*
Lecture	30
Laboratories	15
Preparation for classes	30
Reading the indicated literature	20
Preparation of a multimedia presentation	25

Preparation of a project	30
<b>Student workload</b>	<b>Hours</b> 150
<b>Number of ECTS points</b>	<b>ECTS</b> 5

\* academic hour = 45 minutes

## Efekty uczenia się dla kierunku

Kod	Treść
AST_K2_K01	The graduate is ready to critical evaluation of gained knowledge and received content
AST_K2_U01	The graduate can use the gathered knowledge to plan and carry out studies and observations regarding cognitive issues in the scope of astronomy, with the use of proper methods and tools
AST_K2_U02	The graduate can The graduate can formulate and test hypotheses regarding simple research problems, evaluate the results of experiments, observations and theoretical calculations critically and discuss the measurement errors
AST_K2_U03	The graduate can collaborate with other people as part of team work and take a leading role in teams, including team management
AST_K2_U04	The graduate can communicate with various audiences and present in an accessible manner the results of astronomical discoveries, including those in areas lying on the borderline of related scientific disciplines
AST_K2_U05	The graduate can plan and carry out learning independently, understands the need of lifelong learning and is able to inspire and organise the process of learning of other people
AST_K2_U06	The graduate can independently search for professional information and astronomical data, knows the most important astronomical journals and databases, which allows proper selection of sources and information from these sources used to solve complex and unusual research problems
AST_K2_U07	The graduate can prepare various pieces of written work and oral presentations in Polish and English languages, regarding problems in the scope of astronomy and is able to conduct a debate
AST_K2_U08	The graduate can use language skills in astronomy - according to requirements specified for the level B2+ of the Common European Framework of Reference for Languages
AST_K2_W02	The graduate knows and understands in depth selected problems in the scope of advanced astrophysics
AST_K2_W04	The graduate knows and understands in depth modern tools, techniques and methods of observational astronomy
AST_K2_W05	The graduate knows and understands the main development directions and the most recent discoveries in astronomy
AST_K2_W06	The graduate knows and understands in depth the methods of advanced mathematics used in astronomy sufficiently enough for quantitative description, understanding and modelling of phenomena, as well as solving problems in astronomy
AST_K2_W07	The graduate knows and understands calculation methods, information techniques and selected professional software packages used to solve complex astronomical problems and to process and interpret modern astronomical observations
AST_K2_W08	The graduate knows and understands fundamental dilemmas of modern civilisation, legal and ethical conditions regarding scientific activity and teaching in astronomy, including copyright protection rules