

Course Specifications

Valid as from the academic year 2024-2025

Early Universe Cosmology (C003829)

Course size	(nominal values; actual values may depend on programme)				
Credits 6.0	Study time 180 h				
Course offerings in aca	demic year 2024-2025				
A (semester 2)	English	Gent			
Lecturers in academic	year 2024-2025				
Craps, Ben		VUB lecturer-in-charge		large	
Hertog, Thomas			KUL	co-lecturer	
Offered in the following programmes in 2024-2025				crdts	offering
Master of Science in Teaching in Science and Technology(main subject Physics and Astronomy)				6	А
Master of Science	in Physics and Astronomy			6	А

Teaching languages

English

Keywords

Position of the course

Contents

- 1 The Expanding Universe
 - Kinematics and dynamics of expanding universe (cosmic evolution, Hubble law, Friedmann eqs)
 - Propagation of light and horizons (geodesics, conformal diagrams, luminosity, redshift, distance)
 - composition of the universe, status cosmological observations
- 2 The Early Hot Universe
 - Thermal history
 - Cosmological nucleosynthesis
- 3 Structure formation
 - Gravitational Instability in Newtonian theory (Jeans theory)
 - Gravitational Instability in General Relativity (cosmological perturbation theory, halo formation,...)
- 4 Inflation
 - Three puzzles (flatness, horizon, monopoles)
 - Slow-roll inflation
- Inflation as origin of cosmological fluctuations
- 5 Anisotropies in the Microwave Sky
 - Generalities
 - Temperature fluctuations: scalar and tensor modes
 - Polarization
 - Observations
- 6 Quantum cosmology: which universe and why?

Initial competences

Before taking this course, the student should be familiar with physics as a whole on a bachelor level and he/she should master the standard tools of calculus. In addition, the student should be familiar with the basics of general relativity and quantum field theory.

Final competences

- 1 The student becomes acquainted with the general theory of modern, relativistic cosmology and its observational vindication. This includes the thermal and nuclear history of our expanding universe, as well as the formation of large-scale structures like galaxies from seeds generated in a primordial era of inflation.
- 2 The student learns to appreciate the development of relativistic cosmology in the historical context of 20th century physics.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Lecture, Independent work

Extra information on the teaching methods

The 60 hours "self study" refer to the estimated time spent on homeworks. The 8 hours taught by Ben Craps normally take place in Brussels, the 18 hours taught by Thomas Hertog normally take place in Leuven.

Study material

None

References

Course content-related study coaching

Assessment moments

end-of-term and continuous assessment

Examination methods in case of periodic assessment during the first examination period

Oral assessment

Examination methods in case of periodic assessment during the second examination period

Oral assessment

Examination methods in case of permanent assessment

Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is not possible

Calculation of the examination mark

Oral exam with written preparation (67% of the final score). During the semester the students will be evaluated through take-home tasks, for which they can earn points that will be taken into account for 33% in the final score.

The points from the take-home tasks will be transferred to the second exam period. Only the regular examination can be repeated.