

## Cosmology and Galaxy Formation (C002512)

**Course size** *(nominal values; actual values may depend on programme)*

**Credits 6.0**

**Study time 180 h**

**Course offerings and teaching methods in academic year 2024-2025**

A (semester 1)

Dutch

Gent

seminar

lecture

**Lecturers in academic year 2024-2025**

De Rijcke, Sven

WE05

lecturer-in-charge

**Offered in the following programmes in 2024-2025**

**crdts**

**offering**

Master of Science in Teaching in Science and Technology(main subject Mathematics)

6

A

Master of Science in Teaching in Science and Technology(main subject Physics and Astronomy)

6

A

Master of Science in Mathematics

6

A

Master of Science in Physics and Astronomy

6

A

Master of Science in Physics and Astronomy

6

A

**Teaching languages**

Dutch

**Keywords**

Galaxies, cosmologie, Friedman-Lemaitre models, dark matter, dark energy, cosmic structure, background radiation, concordance model, quintessence, inflation theory

**Position of the course**

The aim of this course is to give a thorough treatment of the large scale dynamics of the universe (i.e. its accelerating expansion), of the formation of cosmic structure (clusters, voids, galaxies), and of the physics of the cosmic microwave background fluctuations. This course builds on the compulsory courses "Relativity theory and introduction to elementary particle physics" and "Introduction to astronomy". The students should have followed successfully these courses or have acquired their competences in another way. This course is complementary to the optional course "Nuclear astrophysics" in which Big Bang nucleosynthesis and the thermal evolution of the universe are treated.

**Contents**

The course starts with an overview of the phenomenology of galaxies and of cosmological observations (large-scale distribution of galaxies, the Hubble expansion, the accelerating universe, ...). Friedman-Lemaitre models for the dynamics of the universe. Evolution of cosmic structure, from the primordial density fluctuations left over after inflation to the formation of virialised objects, such as galaxies. Effects due to cold and/or hot dark matter. Numerical simulations of structure formation. Recent observations of the power spectrum of the microwave background temperature fluctuations. Determination of the cosmological parameters and the concordance model. Shortcomings of this model and possible alternatives.

**Initial competences**

This course builds on the compulsory courses "Relativity theory and introduction to elementary particle physics", "Introduction to astronomy", "Extragalactic astronomy" and "Physics of galaxies". The students should have followed successfully these courses or have acquired their competences in another way.

**Final competences**

1 Learn to apply the astronomical research method, which is usually based on observations and not on experiments, to this specific topic.

- 2 Learn how to calculate certain observable quantities within the context of a simple cosmological model.
- 3 Know how to apply methods drawn from other physical theories (e.g. general relativity or particle physics) to cosmological theories.
- 4 Gain insight in the limitations of current cosmological theories.
- 5 Learn to appreciate and communicate the philosophical and social importance of the subject.

#### **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**

Seminar, Lecture

#### **Extra information on the teaching methods**

all students are expected to attempt to solve the exercises at the end of each chapter. Each time, 2-3 students will be appointed to present their solutions during the upcoming exercise class. This way, students can hone their presentation skills before a friendly audience, they are encouraged to learn from each other and to compare different approaches to the problems.

#### **Study material**

Type: Syllabus

Name: Syllabus'

Indicative price: Free or paid by faculty

Optional: no

Additional information: Dutch syllabus, downloadable as a .pdf from Ufora. For students who don't know Dutch, a book will be provided as a substitute for the syllabus.

#### **References**

#### **Course content-related study coaching**

Active support via Ufora and personally on appointment

#### **Assessment moments**

end-of-term assessment

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

Oral assessment, Written assessment, Assignment

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

Oral assessment, Written assessment, Assignment

#### **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

#### **Extra information on the examination methods**

PE

Theory: partly written, partly oral

Exercises: the students can use the syllabus for this part of the exam

Programming project in Python with written report

#### **Calculation of the examination mark**

theory: 8/20

exercises : 7/20

programming project: 5/20