GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2024-2025

Theoretical and Numerical Astrophysics (C004505)

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

Credits 6.0 **Study time 180 h**

Course offerings in academic year 2024-2025

A (semester 1) English Gent

Lecturers in academic year 2024-2025

Baes, Maarten 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 Physics and Astronomy)	6	A
Master of Science in Physics and Astronomy	6	A
Master of Science in Physics and Astronomy	6	A
Exchange Programme in Physics and Astronomy (Master's Level)	6	A

Teaching languages

English

Keywords

Astrophysics, stellar dynamics, galaxy formation and evolution, gravity, hydrodynamics

Position of the course

Galaxies are extremely complex objects and understanding their formation and evolution is one of the main challenges in modern astrophysics. Students starting the MSc in Physics and Astronomy should have a solid understanding of the structure and the different components of galaxies and their position in the large-scale structure of the Universe. The main goals of the present course are (1) providing a thorough theoretical treatment of fundamental aspects that shape galaxies throughout their cosmic evolution, and (2) exploring the numerical methods used by astrophysicists to study galaxy evolution in a cosmological context.

Contents

1 Gravity: stellar dynamics
2 Gravity: systems of particles
3 Cosmological N-body simulations
4 Hydrodynamics
5 Baryonic physics for cosmological hydrodynamics simulations
6 Cosmological hydrodynamics simulations of galaxy formation

Initial competences

Successful completion of the BSc courses Galaxies (C004214) and Structure of the Universe (C004221) or having acquired the necessary competences in another way. Students are assumed to have a good working knowledge of Python, at the level acquired in the BSc course Python for Scientists (C004212).

Final competences

1 Understand potential theory and the theory of stellar dynamics.
2 Derive the different numerical schemes that are at the basis of astrophysical N-body and hydrodynamic simulations.
3 Understand the advantages and disadvantages of the different simulation techniques for specified astrophysical problems.

4 Explain the structure, dynamics and evolution of dark matter haloes and galaxies
5 Understand the fundamental ingredients at work in galaxy evolution and link their effect of observational properties.

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

The theory is thoroughly explained during the lectures. The exercises are in the form of supervised Python exercises.

Study material

Type: Syllabus

Name: syllabus
Indicative price: € 15
Optional: no

References

- Cimatti et al. (2019), Introduction to Galaxy Formation and Evolution: From Primordial Gas to Present-Day Galaxies (ISBN 1107134765)
- Bodenheimer et al. (2006), Numerical methods in Astrophysics, An Introduction (ISBN 0750308834)
- Binney & Tremaine (2010), Galaxy Dynamics (ISBN 1400828724)

Course content-related study coaching

The material is thoroughly explained during the lectures. The lecturer and teaching assistent(s) are available for additional coaching.

Assessment moments

end-of-term and continuous assessment

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

Written assessment with open-ended questions

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

Written assessment with open-ended questions

Examination methods in case of permanent assessment

Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is possible

Calculation of the examination mark

Theory: 50%
Programming project: 50%

Facilities for Working Students

All the presentations are available online for students that cannot attend the classes, and the lecturers are available for additional explanations.