GHENT UNIVERSITY

Course Specifications

Valid in the academic year 2023-2024

Nuclear Astrophysics (C000064)

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 2023-2024

A (semester 2)	Dutch	Gent	lecture
			seminar

Lecturers in academic year 2023-2024

Jachowicz, Natalie	WE05	lecturer-in-charge

Offered in the following programmes in 2023-2024	**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

Teaching languages

Dutch

Keywords

Astrophysics, astronomy, stellar evolution, cosmology, big-bang, nuclear reactions, nucleosynthesis, elements, abundances.

Position of the course

A minimal knowledge of astronomy and nuclear physics is desirable.
The objectives are: (a) Explain the energy production in the sun and in other stars in all phases of the stellar evolution by means of the corresponding nuclear processes. (b) Understand the nuclear processes leading to the observed abundances of elements and isotopes in nature under various astrophysical conditions.

Contents

- Relevant aspects of astronomy : observed abundances of elements ; Hertzsprung-Russell diagram; Hubble law; cosmic radiation, telescopes.
- Elements of nuclear physics: nuclear processes relevant to astrophysics, relevant experiments, neutrinos and oscillations, the MSW effect.
- Basic principles of stellar structure.
- Big Bang nucleosynthesis.
- Nucleosynthesis in stars : principles; stellar reaction rates and their determination; thermonuclear reactions, including H, He, C, Ne, O and Si burning; nucleosynthesis beyond iron: mechanism, s-, r- and p-process ; Stellar evolution. Supernovae: observation and mechanism. Nuclear reactions in the sun: the standard solar model; the problem of the solar neutrinos.
- Galactic chemical evolution. Nucleocosmochronology.

Initial competences

A knowledge of basic physics is required; an elementary knowledge of the principles of quantum mechanics and nuclear physics is desirable.

Final competences

1 Describe the main mechanisms for nucleosynthesis in the universe.
2 Show clear understanding of the role of the interplay between nuclear structure and reactions on one hand and stellar structure and evolution on the other, in stellar nucleosynthesis.
3 Interpret and explain the results of numerical nucleosynthesis simulations.

4 Show insight in the principles of galactic chemical evolution and cosmochronology and apply them in problems.
5 Apply basic skills form different subdomains of physics and astronomy to solve nucleosynthesis-related problems.

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

When required by the COVID19 situation adapted education methods may be rolled out.

Learning materials and price

An Introduction to Nuclear Astrophysics. R.N. Boyd, The University of Chicago Press, Chicago (2008), ISBN-13 978-0-226-06971-5.
Estimated Cost: 50 EUR

References

- C. Rolfs and W. Rodney, Cauldrons in the Cosmos, University of Chicago Press, Chicago (1988) ISBN 0-226-72456-5.
- A. Phillips, The physics of stars, J. Wiley & Sons, Chichester, UK (1994) ISBN 0 471 94155 7

Course content-related study coaching

On appointment.

Assessment moments

end-of-term assessment

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

Oral assessment, Written assessment with open-ended questions

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

Oral assessment, 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

Extra information on the examination methods

- Continous assessment : Presentation, homework. Details to be announced on UFORA.
- Examination : Oral and written test of the theoretical knowledge and the familiarity with the field (closed book).
- Examination : Written test of the problem solving capacities of the student via selected exercises (open book).

Calculation of the examination mark

Periodic evaluation: 75%, permanent evaluation 25%.