Faculty of Science

FYST54, Physics: Advanced Nuclear Physics, 7.5 credits

Fysik: Avancerad kärnfysik, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2021-12-08 to be valid from 2021-12-08, autumn semester 2022.

General Information

The course is an advanced level elective course for a Bachelor or Master's Degree in physics.

Language of instruction: English

Main field of studies	*Depth of study relative to the degree requirements*
Physics	A1N, Second cycle, has only first-cycle course/s as entry requirements

Learning outcomes

The course covers theoretical models for the structure and reactions of atomic nuclear, as well as experiments in nuclear physics and their scientific applications. The course also includes computer and experiment laboratory exercises in order to introduce the students to methods used in modern nuclear physics. The purpose of the course is to enhance the student's knowledge of theoretical and experimental nuclear physics.

Knowledge and understanding

On completion of the course, the students shall be able to:

- explain the structure of atomic nuclei with quantum mechanical models
- explain various types of nuclear reactions and transitions
- explain models of atomic nuclei and experimental methods used to study them and describe their limitations
- clarify the connection of theoretical and experimental methods used in nuclear physics.

Competence and skills
On completion of the course, the students shall be able to:

- use quantum mechanical descriptions of atomic nuclei and their properties
- clarify and describe current nuclear physics research
- identify key experiments to investigate selected nuclear phenomen.

Judgement and approach
On completion of the course, the students shall be able to:

- show an ability to assess the applicability and limitations of physical models of nuclear structure and reaction
- independently evaluate and assess the need to acquire and assess the need for further knowledge
- analyze nuclear data and carry out computer programming relevant for such work
- evaluate experimental methods, configurations and results
- relate nuclear physics to other areas of physical sciences.

Course content

The course covers theoretical models for nuclear structure and reactions, as well as experimental set-ups for the study of atomic nuclei, according to the following summary:

- the connection between microscopic and macroscopic properties of atomic nuclei, e.g., shell structure and modes of deformation,
- definitions of, and calculations using, operators for different nuclear transitions,
- experimental methods to probe nuclear properties, e.g., with gamma-ray spectroscopy,
- relations between reaction cross sections and the properties and internal structure of atomic nuclei,
- descriptions of nuclear reactions, such as transfer and knockout reactions, and experimental set-ups to study atomic nuclei with these,
- the application of nuclear structure and reaction models, and related experimental results, in adjacent fields, in particular, nuclear astrophysics and the creation of the elements.

Course design

The teaching consists of plenary lectures, group tuition, and supervision in connection with laboratory sessions and associated computer exercises. The lectures are mainly devoted to an overview of the theoretical content, experimental set-ups and results, including topics relevant for the laboratory sessions, and presentation of contemporary research. The lectures are accompanied by group tuition and compulsory individual problem-sheet hand-ins. The laboratory sessions involve preparatory meetings, laboratory work, computer exercises, feedback sessions, and written reports. Participation in experimental and theoretical laboratory work, and associated activities, is compulsory.

Assessment

The examination consists of theoretical hand-ins and laboratory reports during the course, and an oral examination at the end of the course. The oral examination is only offered to those students that have passed the written assignments.

Students who do not pass an assessment will be offered another opportunity for assessment soon thereafter.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Subcourses that are part of this course can be found in an appendix at the end of this document.

Grades

Marking scale: Fail, Pass, Pass with distinction.
Passing the entire course requires an approved examination, passed laboratory reports, theoretical hand-ins and participation in all compulsory parts according to the following:

- 2 credits experimental laboratory and reports, graded Pass, Fail
- 2 credits computer laboratory and hand-ins, graded Pass, Fail
- 3.5 credits oral exam, graded Fail, Pass, Pass with distinction.

The final grade of the course is decided by the oral exam, considering as well the laboratory sessions, reports and hand-ins.

Entry requirements

To be admitted to the course, students must have 75 credits in physics and 45 credits in mathematics, alternatively a bachelor degree in physics is required – in both cases having a knowledge corresponding to FYSB22 Basic Quantum Mechanics, 7.5 credits and FYSC22 Nuclear Ohysics, 7.5 credits as well as English 6/B.

Further information

The course is given together with FKFN40 Advanced Nuclear Physics, 7,5 credits, which is coordinated by LTH.

Subcourses in FYST54, Physics: Advanced Nuclear Physics

Applies from H22

2201 Oral exam, 3,5 hp
Grading scale: Fail, Pass, Pass with distinction
2202 Laboratory Exercises and Reports, 2,0 hp
Grading scale: Fail, Pass
2203 Computer exercises and assignments, 2,0 hp
Grading scale: Fail, Pass