FACULTY OF SCIENCE

Physics, Master's Programme, 120 credits

Physics, Master Program, 120 högskolepoäng

Programme code: N2PHY

Second cycle / Avancerad nivå

1. Confirmation

This programme syllabus was confirmed by the Faculty of Science on 17-10-2006 (g) and was last revised on 10-10-2022 (GU 2022/2616) by the Dean of the Faculty to be valid from 10-10-2022, Autumn semester 2023.

Responsible Department/equivalent: Department of Physics

2. Purpose

The master program in Physics is a modern physics program that includes both fundamental physics and modern physics with close research connections. A wide range of areas within theoretical physics, computational physics, materials physics, biological physics, as well as astrophysics are represented. The program contains modern methods with applications outside of academic research, and with its training in creative problem solving it provides an excellent foundation for all types of technical and engineering occupations.

3. Entry requirements

A Bachelor's degree or the equivalence to 180 Swedish credit points (p) or 180 ECTS credits at an accredited university. At least 90 credits physics (including quantum mechanics), 30 credits maths (including linear algebra and analysis), and programming. Applicants must prove their knowledge of English: English 6/English B from Swedish Upper Secondary School or the equivalent level of an internationally recognized test, for example TOEFL, IELTS.

4. Higher education qualification and main field of study

This programme leads to a Degree of Master of Science (120 credits) with a major in Physics (Naturvetenskaplig masterexamen med huvudområdet Fysik).

5. Outcomes

General outcomes for Degree of Master (120 credits)

Knowledge and understanding

For a Degree of Master (120 credits) the student shall

- demonstrate knowledge and understanding in the main field of study, including both broad knowledge of the field and a considerable degree of specialised knowledge in certain areas of the field as well as insight into current research and development work, and
- demonstrate specialised methodological knowledge in the main field of study.

Competence and skills

For a Degree of Master (120 credits) the student shall

- demonstrate the ability to critically and systematically integrate knowledge and analyse, assess and deal with complex phenomena, issues and situations even with limited information
- demonstrate the ability to identify and formulate issues critically, autonomously and creatively as well as to plan and, using appropriate methods, undertake advanced tasks within predetermined time frames and so contribute to the formation of knowledge as well as the ability to evaluate this work
- demonstrate the ability in speech and writing both nationally and internationally to clearly report and discuss his or her conclusions and the knowledge and arguments on which they are based in dialogue with different audiences, and
- demonstrate the skills required for participation in research and development work or autonomous employment in some other qualified capacity.

Judgement and approach

For a Degree of Master (120 credits) the student shall

- demonstrate the ability to make assessments in the main field of study informed by relevant disciplinary, social and ethical issues and also to demonstrate awareness of ethical aspects of research and development work
- demonstrate insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used, and
- demonstrate the ability to identify the personal need for further knowledge and take responsibility for his or her ongoing learning.

Local outcomes

The main learning outcomes of the programme are to give the students:

1. A broad general knowledge of the basic aspects of the field of fundamental physics, that builds on the understanding acquired at the Bachelor level, but deepens it so that it can be applied independently in a new context.

2. A more specialized knowledge in a chosen subfield that can be used for problem solving connected to an area of current research.

3. Training in constructing mathematical models that capture essential aspects of physical phenomena and critically examining their consistence and domain of validity.

4. Training in using the scientific literature and giving oral and written scientific and popular presentations.

5. The skills necessary for continued individual studies and research in the field of fundamental physics and related areas.

6. Content and structure

The program contains a mix of theoretical and experimental courses. The first year of the programme is devoted to course work. In the first quarter there are three recommended courses that will set the stage for the rest of program, namely a quantum mechanics course, a data analysis and big data course containing modern tools such as Monte Carlo methods and machine learning, and a project course aimed at getting exposed to different topics.

After this the student is free to set up his or her own programplan from a large selection of courses. There are five different specializations; theoretical-, computational-, materials-, biological physics and astronomy and astrophysics.

The master thesis (30, 45, or 60 credit points) typically includes both literature studies and independent work, and may be done at the University or at company. It is presented in a seminar and a written report.

Recommended courses in the first quarter

- Learning from data
- Quantum mechanics + Project course

Recommended elective courses.

- Computational Physics
- Modern astrophysics
- Spectroscopy
- Statistical physics
- Symmetry
- Biological and biotechnical physics
- Computational materials and molecular physics
- Condensed matter physics
- Fundamentals of hard and soft materials
- Gravitation and cosmology
- Stellar physics
- Symmetry
- Computational continuum physics
- Interstellar medium and star formation
- Optical materials physics

- Quantum field theory
- Galaxies and observational cosmology
- High performance computing
- Materials imaging and microanalysis
- Physics and materials in medicin
- Plasma physics and applications
- Standard model of particle physics
- Surface and nanophysics
- Advanced condensed matter
- Advanced simulation and machine learning
- Astrophysical dynamics
- Functional energy materials
- Quantum computing
- Radio astronomy
- Science, innovation and entrepreneurship
- String theory

7. Guaranteed admission

Student as in mandatory rate follow the programme has guaranteed admission.

8. Other information

The study programme will be followed up and evaluated in accordance with the applicable *Policy för kvalitetssäkring och kvalitetsutveckling av utbildning vid Göteborgs universitet* (Policy for the Quality assurance and Quality Development of Education at the University of Gothenburg).