

Description of the PhD programme in physics

Description of the academic programme

The Ph.D. programme in physics aims to educate independent researchers at a high international level in cooperation with national and international research communities.

The programme aims to fulfil both current and future requirements for competence in research, development, and dissemination at the university, other public and private institutions, companies, and organizations.

The physics department covers a broad range of research subjects. We have a particular responsibility for fundamental research, as well as applications of knowledge within the development of industry and society.

The study programme yields generic and analytical competence that can be utilized in industry, research, or education. A person holding a Ph.D. in physics has a thorough and broad physics background, with special competence at a high international level within his or her field. The candidate is equipped with the skills and knowledge required to meet continual and demanding changes in today's research.

Candidates will also have the general competence common to all Ph.D. programmes at NTNU.

Subject areas

The programme provides opportunities for various specializations within the field of physics, including condensed matter physics, astro- and particle physics, quantum field theory, numerical physics, statistical physics, biological physics, optics, energy and environmental physics, and physics of complex systems.

For a more detailed description of research areas, see the department website:

<http://www.ntnu.no/fysikk>

Overall learning goals

The Ph.D. programme aims to train the candidates in producing and publishing new knowledge, strengthen the professional expertise in the specific and general fields, and enable the candidates to contribute to the advancement of the field.

Learning outcome

A candidate who has completed the Ph.D. programme in physics should have the following learning outcomes defined in terms of knowledge, skills, and general competence:

Knowledge

The candidate:

- is at the forefront of knowledge within his or her field of physics
- has a broad physics background, to allow for future flexibility in the field

- can evaluate the expediency and application of different methods and processes in research and scholarly development projects
- can contribute to the development of new knowledge, new theories, methods, interpretations, and forms of documentation in the field

The knowledge is gained through:

- *formal training of 30 credits*
- *reading and keeping up to date on the literature within the field*
- *writing the summary of the thesis, where the candidate independently writes an introduction giving the background for the work, discusses and justifies the choice of methods, and sets the results in an international context*

Skills

The candidate:

- can formulate problems for, plan and carry out research and scholarly development work
- can use the research methods of the field to create new knowledge, new theories and methods
- can carry out research and scholarly research work of a high international standard
- can handle complex academic issues and challenge established knowledge and practice in the field

The skills are achieved through:

- *guidance and own research*
- *publications, submissions to international journals, and experience with referee statements*
- *the thesis*
- *presentation of results at national and international meetings and conferences*

General competence

The candidate:

- can identify new relevant ethical issues and carry out his or her research with scholarly integrity
- can assess the risks involved in the work, and safeguard HSE
- can manage complex interdisciplinary assignments and projects
- can communicate research and development work through recognized international channels
- can participate in debates in the field in international forums
- can quickly acquire new knowledge
- can establish academic networks

General competence is acquired through:

- *guidance and own research*
- *work with publications and the thesis*
- *a trial lecture on an assigned topic, prepared in a short time*

Requirements for admission, from § 5 and 7.3 in the regulations

To be admitted to the Ph.D. programme a broad background in biophysics and other relevant fields is required. A Master of Physics or equivalent is required. At least 150 credits in physics and physics related topics at university or college level are required.

In accordance with the regulations' requirement of a "strong academic background" it is required

that both the previous bachelor studies (equivalent to the first three years of the technology programme) and the master studies (equivalent to the final two years of the technology programme) are completed with satisfactory results. Normally an average grade of C or better is required for the bachelor degree (or equivalent) and B or better for the master degree (or equivalent).

The aim of the programme is to enable Ph.D. candidates in physics from NTNU to have a broad background in physics which enables subsequent flexibility in the field. For this to be possible within a short time-frame, it is assumed that candidates who are admitted have, in addition to training in basic topics in classical and modern physics, an education that has given experience with both theoretical and experimental physics, and which mainly covers key areas such as quantum mechanics, statistical mechanics, and electromagnetic theory. If the previous education has not covered these central subjects, the candidate may be required to take additional examinations in certain subjects prior to being admitted, or during the doctoral programme, preferably during the first three semesters of study. This coursework cannot be included in the formal course requirements of the Ph.D. programme, and examination in such courses must be passed with a grade of C or better for each of the mandatory courses.

Finances

Funding for the studies must be available before admission to the Ph.D. programme in physics.

Required courses

The course part of the programme is equivalent to one full semester of courses (30 credits). The main goals of this part are to give the candidate a general, scientific background in physics, and to give the theoretical background required to perform the work.

Normally, a minimum of 22.5 credits should be within physics courses.

In his or her future career the Ph.D. candidate will come in contact with broader scientific issues. It is important that the candidate acquires a broad background in physics which enables subsequent flexibility in the field. It is therefore recommended that the courses in the training component of the Ph.D. programme are chosen to provide the candidate with a good overview of diverse topics in physics.

The Faculty provides training in ethics, HSE and innovation, through a mandatory introduction program for PhD candidates. In addition, the course XX Doing Science: Methods, Ethics and Dissemination constitutes a compulsory part of the training component.

Ph.D. courses at the Department of physics:

Code	Title	Semester	Credits
FY8102	Elektronmikroskopi og diffraksjon <i>Electron Microscopy and Diffraction</i>	H16	7,5
FY8104	Anvendelse av symmetri grupper i fysikken <i>Application of Symmetry Groups in Physics</i>	H15	7,5
FY8201	Polymerfysikk <i>Polymer Physics</i>	H15	7,5
FY8203	Myke materialers fysikk <i>Soft Condensed Matter</i>	V16	7,5
FY8302	Kvanteteorien for faste stoffer <i>Quantum Theory of Solids</i>	H15	7,5
FY8303	Faseoverganger og kritiske fenomener <i>Phase Transitions and Critical Phenomena</i>	V16	7,5
FY8304	Matematiske approksimasjonsmetoder i fysikken <i>Mathematical Approximation Methods in Physics</i>	H16	7,5
FY8305	Funksjonalintegralmetoder i kondenserte fasers fysikk <i>Functional Integral Methods in Condensed Matter Physics</i>	H16	7,5
FY8306	Videregående kvantefeltteori <i>Advanced quantum field theory</i>	H15	7,5
FY8403	Biopolymergeler og nettverk <i>Biopolymer Gels and Networks</i>	V17	7,5
FY8408	Innføring i MR-avbildning <i>Introduction to MR imaging</i>	H15	4,0
FY8409	Klinisk fysikk for stråleterapi <i>Radiation Therapy Physics</i>	H15	4,0
FY8410	Avansert kraft- og lysmikroskopi <i>Light and Force Based Molecular Imaging</i>	H15	5,0
FY8502	Avansert biofysikk <i>Advanced Biophysics</i>	H/V	7,5
FY8503	Avansert teoretisk fysikk <i>Advanced Theoretical Physics</i>	H/V	7,5
FY8504	Avansert eksperimentell fysikk <i>Advanced Experimental Physics</i>	H/V	7,5
FY8902	Atmosfærefysikk og klimaendringer <i>Atmospheric Physics and Climate Change</i>	V16	7,5
FY8903	Gravitasjon og kosmologi <i>Gravitation and Cosmology</i>	V17	7,5
FY8904	Numerisk fysikk <i>Computational Physics</i>	V16	7,5
FY8905	Materialfysikk <i>Materials Physics</i>	H15	7,5
FY8906	Biofysiske mikroteknikker <i>Biophysical Micromethods</i>	H15	7,5
FY8907	Klassisk transportteori <i>Classical Transport Theory</i>	V17	7,5
FY8908	Kvanteoptikk <i>Quantum Optics</i>	H15	7,5
FY8909	Nanofysikk <i>Nano Physics</i>	V16	7,5
FY8910	Ikkelinær dynamikk <i>Non-linear dynamics</i>	H16	7,5
XX	Naturvitenskap i praksis: Metode, etikk og formidling <i>Doing Science: Methods, Ethics and Dissemination</i>	??	??