

Description of the PhD programme in Physics

Description of the academic programme

The PhD programme in physics aims to educate independent researchers at a high international level in cooperation with national and international research communities, thereby fulfilling both current and future requirements for competence in research, development, and dissemination at universities, other public and private institutions, companies, and organizations.

Subject areas

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.

Our PhD programme provides opportunities for specializations within various fields, including condensed matter physics, physics of porous media, astrophysics, particle physics, quantum field theory, quantum spintronics, numerical physics, optics, energy and environmental physics, and physics of complex systems.

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

<https://www.ntnu.edu/physics>

Overall learning goals

The PhD 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 PhD 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.

The knowledge is gained through:

- *formal training of 30 ECTS credits;*
- *reading and keeping up to date on the literature within the field.*

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, 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;
- can evaluate the expediency and application of different methods and processes in research and scholarly development projects.

The skills are achieved through:

- *formal training of 30 ECTS credits;*
- *guidance and own research;*
- *preparing publications, submitting them to international journals, and gaining experience with referee reports;*
- *writing the thesis and placing the results in a broader context.*

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 national and 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:

- *various courses, especially the compulsory course Doing Science: Methods, Ethics and Dissemination;*
- *a basic training in ethics, HSE and innovation;*
- *own research;*
- *working with publications and writing the thesis;*
- *presenting results at national and international meetings and conferences;*
- *giving a trial lecture on an assigned topic.*

Requirements for admission, from § 5 in the regulations

To be admitted to the PhD programme, a candidate should have a solid background in physics and other relevant fields. We require:

- a Master of Physics (or equivalent);
- at least 150 ECTS credits in physics and physics-related topics at university or college level.

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) should have been completed with satisfactory results. Normally an average grade of B or better is required for the master degree (or equivalent).

It is further 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 covered key areas such as quantum mechanics, statistical mechanics, and electromagnetic theory. If the previous education did not include such central subjects, the candidate may be required to take additional exams 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 PhD programme, and examination in such courses must be passed with a grade of C or better.

Finances

Funding for the studies must be available before admission to the PhD programme in Physics.

Required courses

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

Normally, a minimum of 22.5 credits should be within physics or physics-related courses. It is recommended that these courses are chosen such as to provide a diverse overview of topics in physics, thus developing the candidate's flexibility in the field.

The Faculty provides training in ethics, HSE and innovation, through a mandatory introduction programme for PhD candidates. In addition, the course MN8000 Doing Science: Methods, Ethics and Dissemination constitutes a compulsory part of the training component.