NTNU

Norwegian University of Science and Technology
Faculty of Natural Sciences

DIPLOMA

Tom Doekle Vethaak
born 25 March 1993

has 20 December 2016 been awarded the degree
Master of Science in Physics

Programme of Study: Physics

Thesis Title: Non-equilibrium quantum effects in hybrid structures of ferromagnets and superconductors

Average Degree Grade: B

The diploma is issued 20 March 2017.

Dean of Faculty

Faculty Officer

Originalvitnemålet er stemplet og signert av NTNU. The authentic academic diploma is stamped and signed by NTNU.

General information about the degree
Master of Science in Physics is awarded in accordance with the Regulations on Degrees and Titles Protected by Law of 16 December 2005 (No. 1574).
The nominal length of study for the degree is 2 years and it comprises 120 ECTS credits. One completed year of study has nominally 60 ECTS credits.
Master of Science in Physics is a qualification that is part of second cycle/level 7 in the Norwegian Qualifications Framework for Lifelong Learning, approved by the Ministry of Education and Research on 15.12.2011.

Objectives, content and organisation of the programme of study
- The Master's Degree Programme in Physics provides graduates with research-based, specialised knowledge and, through practical projects, helps attain skills and general competence at an advanced level. The graduate acquires the skills to qualify for a broad range of positions in research, industry, consultancy, education and public administration, or for further education in a doctoral program.
- The programme consists of 60 credits of compulsory and elective courses, including Experts in Teamwork (common to all master's students at NTNU), and a master's thesis with a work load of 60 credits. The Master's thesis is usually carried out within one of the following areas: Astro and particle physics and modern field theory, biophysics and medical physics, energy and environmental physics, optics and condensed matter physics.
- Throughout their studies, the graduate experiences various teaching and working methods including lectures, theoretical and practical exercises including laboratory work, project work, oral and written presentations, and laboratory journal and scientific report writing. The graduate also obtains experience in both independent and group work. The Master's thesis is normally integrated into on-going research projects. It is a written report, based on independent scholarly work, accomplished under the guidance of an academic supervisor.

The candidate's learning outcomes
A graduate who has completed his or her qualification should achieve the following learning outcomes defined in terms of general competence, knowledge and skills:

General competence
The Master graduate in Physics
- understands the role of physics in society and has the background to consider ethical problems.
- knows the historical development of physics, its possibilities and limitations, and understands the value of life-long learning.
- is able to gather, assess, and make use of new information.
- has the ability to successfully carry out advanced tasks and projects, both independently and in collaboration with others, as well as across disciplines.
- has an adequate background for pursuing pedagogic education.
- has an international perspective on their discipline.

Knowledge
The Master graduate in Physics
- has substantial knowledge in physics, solid knowledge in mathematics, and knowledge in supported fields like computer science.
- has research experience within a specific field of physics, through a supervised project (the master's thesis).
- has advanced knowledge in specialised areas in physics.
- is familiar with contemporary research within various fields of physics.

Skills
The Master graduate in Physics
- has the background and experience required to model, analyse, and solve advanced problems in physics.
- is able to apply advanced theoretical and/or experimental methods, including the use of numerical methods and simulations.
- can combine and use knowledge from several disciplines.
- can critically and independently assess and evaluate research methods and results.
- has the ability to develop and renew scientific competence - independently, through courses or PhD studies in physics, or related disciplines.
- is able to enter new problem areas that require an analytic and innovative approach.
- can disseminate subject matter and results to both specialists and a broader audience.

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Transcript of Records

Norwegian University of Science and Technology

Name: **Vethaak, Tom Doekle**
Degree: Master of Science in Physics
Study programme: Physics

Date of birth: 1993-03-25
Received: 2016-12-20

Course		Semester	Credits	Grade	Grade distribution [1] A B C D E
FY3403	Particle Physics	2014 autumn	7.5	C	
TFY4205	Quantum Mechanics II	2014 autumn	7.5	C	
TFY4230	Statistical Physics	2014 autumn	7.5	B	
TFY4300	Energy and Environmental Physics	2014 autumn	7.5	B	
TFY4305	Nonlinear Dynamics	2014 autumn	7.5	C	
TFE4850	Experts in Teamwork - Space Technology	2015 spring	7.5	C	
TFY4220	Solid State Physics	2015 spring	7.5	C	
TFY4340	Nanophysics	2015 spring	7.5	C	
FY3900	Master Thesis in Physics *Non-equilibrium quantum effects in hybrid structures of ferromagnets and superconductors*	2016 autumn	60	B	

Total: 120.0

20 March 2017

Tone Haug
Executive Officer

1) For an explanation of the grade distribution, see the last page.

NTNU
NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY
Student and Academic Division

Transcript of Records

Norwegian University of Science and Technology

Name: **Vethaak, Tom Doekle**
Degree: Master of Science in Physics
Study programme: Physics

Date of birth: 1993-03-25
Received: 2016-12-20

Credit system and grading

The academic year normally runs from mid-August to mid-June and lasts for 10 months. Courses are measured in "studiepoeng", considered equivalent to the European Credit Transfer System standard (ECTS credits). The full-time workload for one academic year is 1500 - 1800 hours of study / 60 "studiepoeng".

The Norwegian grading system consists of two grading scales: one scale with the grades pass or fail and one graded scale from A to E for pass and F for fail. The graded scale has the following qualitative descriptions:

A	Excellent	An excellent performance, clearly outstanding. The candidate demonstrates excellent judgement and a very high degree of independent thinking.
B	Very good	A very good performance. The candidate demonstrates sound judgement and a high degree of independent thinking.
C	Good	A good performance in most areas. The candidate demonstrates a reasonable degree of judgement and independent thinking in the most important areas.
D	Satisfactory	A satisfactory performance, but with significant shortcomings. The candidate demonstrates a limited degree of judgement and independent thinking.
E	Sufficient	A performance that meets the minimum criteria, but no more. The candidate demonstrates a very limited degree of judgement and independent thinking.
F	Fail	A performance that does not meet the minimum academic criteria. The candidate demonstrates an absence of both judgement and independent thinking.

The assessment is criterion referenced.

Grade distribution

The distribution of grades is shown by the percentage for courses using the graded scale A – F. Fail (F) is not included in the distribution. All results from the last five years are included in the calculation. The distribution is also shown for courses that have been active for less than five years. There has to be at least 10 approved results during the period.

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Diploma Supplement

Norwegian University of Science and Technology

This Diploma Supplement model was developed by the European Commission, Council of Europe and UNESCO/CEPES. The purpose of the supplement is to provide sufficient independent data to improve the international 'transparency' and fair academic and professional recognition of qualification (diplomas, degrees, certificates etc.). It is designed to provide a description of the nature, level, context, content and status of the studies that were pursued and successfully completed by the individual named on the original qualification to which this supplement is appended. It should be free from any value judgements, equivalence statements or suggestions about recognition. Information in all eight sections should be provided. Where information is not provided, an explanation should give the reason why.

1 INFORMATION IDENTIFYING THE HOLDER OF THE QUALIFICATION

1.1	Family name(s):	Vethaak
1.2	Given name(s):	Tom Doekle
1.3	Date of birth *(day/month/year)*:	25-03-1993
1.4	Student identification number or code:	754831

2 INFORMATION IDENTIFYING THE QUALIFICATION

2.1 Name of qualification and (if applicable) title conferred (in original language):
Master of Science in Physics
The title master is protected by law in Norway.

2.2 Main field(s) of study for the qualification:
Physics

2.3 Name and status of awarding institution (in original language):
Norges teknisk-naturvitenskapelige universitet, a public university. The quality assurance system was evaluated and approved by the Norwegian Agency for Quality Assurance in Education in 2014.

2.4 Name and status of institution administering studies:
See section 2.3

2.5 Language(s) of instruction/examination:
English

3 INFORMATION ON THE LEVEL OF THE QUALIFICATION

3.1 Level of qualification:
Second Cycle/Level 7, Norwegian Qualifications Framework for Lifelong Learning

3.2 Official length of the programme:
2 years in full-time mode (120 ECTS credits)

3.3 Access requirements:
Bachelor's degree (3 years - 180 ECTS credits) or equivalent education, with an average grade of C or better, and a relevant main profile. The specific academic qualifications that are required for the admission to the Master's programme, is described in the curriculum. Applicants must compete for a given number of places.

4 INFORMATION ON THE CONTENTS AND RESULTS GAINED

4.1 Mode of study:
Full-time.

4.2 Programme requirements:
The programme consists of 120 credits of compulsory and elective courses including:
- Courses at a master's level, amounting to 60 credits, where some credits are for compulsory courses and some for elective courses that allow graduates to specialise in their chosen topics of interest.

- A master's thesis providing a total of 60 credits. The thesis is a written report of a piece of independent scholarly work, accomplished under the guidance of an academic supervisor.

See the diploma for more information about the programme of study and the candidate's learning outcomes.

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4.3 Programme details:

Name: Tom Doekle Vethaak

Course		Semester	Credits	Grade	Grade distribution A B C D E
FY3403	Particle Physics	2014 autumn	7.5	C	
TFY4205	Quantum Mechanics II	2014 autumn	7.5	C	
TFY4230	Statistical Physics	2014 autumn	7.5	B	
TFY4300	Energy and Environmental Physics	2014 autumn	7.5	B	
TFY4305	Nonlinear Dynamics	2014 autumn	7.5	C	
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TFY4220	Solid State Physics	2015 spring	7.5	C	
TFY4340	Nanophysics	2015 spring	7.5	C	
FY3900	Master Thesis in Physics *Non-equilibrium quantum effects in hybrid structures of ferromagnets and superconductors*	2016 autumn	60	B	

Total: 120.0

Credit system and grading

The academic year normally runs from mid-August to mid-June and lasts for 10 months. Courses are measured in "studiepoeng", considered equivalent to the European Credit Transfer System standard (ECTS credits). The full-time workload for one academic year is 1500 - 1800 hours of study / 60 "studiepoeng".

The Norwegian grading system consists of two grading scales: one scale with the grades pass or fail and one graded scale from A to E for pass and F for fail. The graded scale has the following qualitative descriptions:

A	Excellent	An excellent performance, clearly outstanding. The candidate demonstrates excellent judgement and a very high degree of independent thinking.
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F	Fail	A performance that does not meet the minimum academic criteria. The candidate demonstrates an absence of both judgement and independent thinking.

The assessment is criterion referenced.

Grade distribution

The distribution of grades is shown by the percentage for courses using the graded scale A – F. Fail (F) is not included in the distribution. All results from the last five years are included in the calculation. The distribution is also shown for courses that have been active for less than five years. There has to be at least 10 approved results during the period.

4.4 Grading scheme and, if available, grade distribution guidance:
See section 4.3
The Norwegian scale of grades is based on the European ECTS grading scale, with letters from A to F or Passed/Failed. There is only one grade for failed, F. This is different from the ECTS grading scale that has two grades for failed. Some assignments, field work or similar work may be graded Completed/Not completed. The percentages are only used for conversion to letter-based grades in single courses.

Norwegian grades - Equivalent percentages:
A: Excellent. An impressive and truly distinguished achivement - 89-100 %
B: Very good. An achievement definitely above average - 77-88 %
C: Good. An average achievement without essential discrepancies - 65-76 %
D: Satisfactory. An acceptable achievement but with some discrepancies - 53-64 %
E: Sufficient. A just acceptable achievement with major discrepancies - 41-52 %
F: Failed. A non-acceptable achievement - 0-40 %

In Norway, A should be the grade for an excellent performance, and C should be the average grade over any large population and a long period of time. There is no demand for a statistical distribution of grades in a specified population or class. All grades are to be used equally at all levels of the education, which means that C should be the average grade both at bachelor's and master's levels.

MSc theses handed in for evaluation no later than 31st of March 2014 have been and will still be evaluated according to a grading practice within which mainly the upper part of the grading scale is used. Theses handed in for evaluation after 31st of March 2014 will now be evaluated according to a new practice where the whole grading scale, A - F, is used.

4.5 Overall classification of the qualification (in original language):
Average Degree Grade: B

5 INFORMATION ON THE FUNCTION OF THE QUALIFICATION

5.1 Access to further study:
The Master of Science degree provides a foundation for application to PhD degree programmes within or related to the field of study (i.e. relevant for third cycle studies). According to the regulations for access to PhD programmes at NTNU, an average grade of A or B is required for the last 120 ECTS credits in the Master's degree programme.

5.2 Professional status:
The Master of Science degree provides opportunities for employment in both private and public sectors, e.g. research, industry, consultancy, education and public administration. The degree entitles the graduate to exercise professional work in numerous fields that require knowledge and experience in academic and scientific approaches within the specific field of study.

6 ADDITIONAL INFORMATION

6.1 Additional information:
Not applicable.

6.2 Further information sources:
Norwegian University of Science and Technology: http://www.ntnu.edu/
NOKUT - Norwegian Agency for Quality Assurance in Education: http://www.nokut.no/en/

7 CERTIFICATION OF THE SUPPLEMENT

7.1 Date: 20 March 2017
Date of original qualification: 20 December 2016

7.2 Signature: Tone Haug

7.3 Capacity: Tone Haug
Higher Executive Officer

7.4 Official stamp

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8. INFORMATION ON THE NATIONAL HIGHER EDUCATION SYSTEM

Higher education in Norway

The Ministry of Education and Research has the overall responsibility for higher education in Norway. Higher education is offered by four types of higher education institutions: university *(universitet)*, specialized university institution *(vitenskapelig høyskole)*, accredited university college *(akkreditert høyskole)*, and university college with accredited study programmes *(høyskole med akkrediterte studier)*. The differences between the types of higher education institutions are related to their self-accrediting authority.

All public and private higher education in Norway is subject to the Act Relating to Universities and University Colleges (Lov 2005-04-01 nr 15)[1]. An institution's right to award specific degrees and the prescribed lengths of study are codified in Regulations on Degrees and Titles protected by Law (FOR 2005-12-16 nr 1574). The awarding of master's degrees is regulated by the Regulations on requirements for awarding a master's degree (FOR 2005-12-01 nr 1392).

Since 2002 Norway has adhered to the objectives of the Bologna Process in the European Higher Education Area. Most of the elements have been implemented through the reform of the Norwegian higher education system carried out in 2003. Central to the reform has been a transition from the former degree system to the bachelor's, master's and doctoral degree structure, with a few exceptions.

Norwegian higher education qualifications make up the levels from 6 to 8 of the Norwegian Qualifications Framework for Lifelong Learning (NQF) from 2011, which is the national overarching qualifications framework[2]. It describes the levels of qualifications as defined by the total learning outcomes in terms of the knowledge, skills and general competence that graduates at various levels should have achieved[3]. NQF was referenced to the European Qualifications Framework (EQF) in 2014.

Quality assurance and accreditation of institutions and programmes

The Norwegian Agency for Quality Assurance in Education (NOKUT) is an autonomous governmental agency which provides external supervision and control of the quality of Norwegian higher education, as well as of all tertiary vocational education[4]. NOKUT accredits new study programmes, controls the existing ones, and provides a cyclic evaluation of the institutions' quality assurance systems for educational provision.

An accredited higher education institution is granted the right to offer educational provision, without having to apply to NOKUT for specific programme accreditation, in accordance with the authority that its institutional category implies. Universities may without external accreditation establish study programmes at all levels. Accredited university colleges have to apply for the accreditation of programmes at master and doctoral levels. In those fields where specialized university institutions and accredited university colleges have the right to award doctorates or corresponding degrees, they may themselves decide which study programmes and disciplines the institution shall provide.

University colleges without institutional accreditation must apply to NOKUT for accreditation of study programmes at all levels.

Lists of all accredited institutions, as well as of all accredited study programmes at the university colleges without institutional accreditation are available on www.nokut.no

[1] In brackets are written the official codes of each act, published in Norwegian in the online database Lovdata, www.lovdata.no
[2] National generic learning outcomes descriptions' levels for the bachelor's, master's and doctoral degrees were defined by the Instructions on the Norwegian Qualifications Framework for Higher Education in 2009.
[3] Learning outcomes for a specific NQF level show the minimum of what each learner should know, understand and be able to do after completing a learning process.
[4] Tertiary vocational education (TVE), level 5 in the NQF (EQF), is provided by *fagskoler*, which are considered as tertiary vocational education institutions. TVE is based on upper secondary education and training or equivalent competence. Courses have duration of from 6 months to 2 years. All provisions must be accredited by NOKUT.

Admission requirements and progression

The Higher Education Entrance Qualification is the successful completion of Norwegian upper secondary education with some specified courses. The Certificate of Upper Secondary Education and Training *(Vitnemål for videregående opplæring)* is based on 13 years of schooling. Admission may also be gained by means of other qualifications recognized as being on a par with the Higher Education Entrance Qualification, such as recognition of prior learning and work experience. Some fields of study have additional entrance requirements.

Degrees and qualifications

All Norwegian higher education institutions use a system of credits *(studiepoeng)* for measuring study activities, considered equivalent to the European Credit Transfer and Accumulation System (ECTS). 60 ECTS credits *(studiepoeng)* are allocated to the workload of a full year of academic study, equivalent to 1500-1800 hours of study. 30 ECTS credits are normally allocated to one semester's full-time study. The academic year normally lasts for 10 months and runs from August to June.

NQF (EQF) Level 6: Bachelor (1st cycle)
The bachelor's degree is awarded after three years of full-time study (180 ECTS). Some bachelor's degrees, in the field of music and performing arts, consist of four-year bachelor's programmes (240 ECTS). Teacher education for primary and lower secondary school, years 1-7 and years 5-10 is a four-year professional programme (240 ECTS).

University college graduate *(høyskolekandidat)* is a two-year degree (120 ECTS), a short cycle degree within the first cycle. Holders of this degree may in some cases continue their studies in a bachelor programme and thus obtain a bachelor's degree.

NQF (EQF) Level 7: Master (2nd cycle)
The master's degree is normally obtained after two years of study (120 ECTS), following the completion of a bachelor's degree. A master's degree programme includes independent work (normally a thesis) of between 30 and 60 ECTS. Some experience-based master's degrees have a scope of 90 or 120 ECTS (including independent work of at least 20 ECTS).

One-tier (integrated/long-term) master's degree is a five-year study programme (300 ECTS) which results in a master's degree, with no intermediate bachelor's degree. An exception is the Master of Architecture programme at the Oslo School of Architecture and Design, which has a scope of 330 ECTS.

In the fields of medicine, psychology and theology, professionally oriented degrees/qualifications of six years' duration (360 ECTS) are awarded; in the field of veterinary science - after 5 ½-6 years. They have retained the title *candidata/candidatus* from the former degree system.

NQF (EQF) Level 8: Doctoral degree/PhD (3rd cycle)
Doctoral degree, PhD *(philosophiae doctor, ph.d.)*, is awarded after three years of study, following the completion of a master's degree or a five to six-year professionally oriented degree/qualification.

Doctor philosophiae *(dr. philos.)* is conferred on graduates who have qualified for a doctoral degree on their own, without formal research training.

Diploma, artistic research fellowships programme *(kunstnerisk utviklingsprogram)* is a three-year programme in the field of creative and performing arts. It is offered as a parallel to other research-oriented provisions organized as academic PhD programmes.

Descriptions of the educational qualifications can be found in the Norwegian Qualifications Framework for Lifelong Learning at www.nokut.no/NKR.

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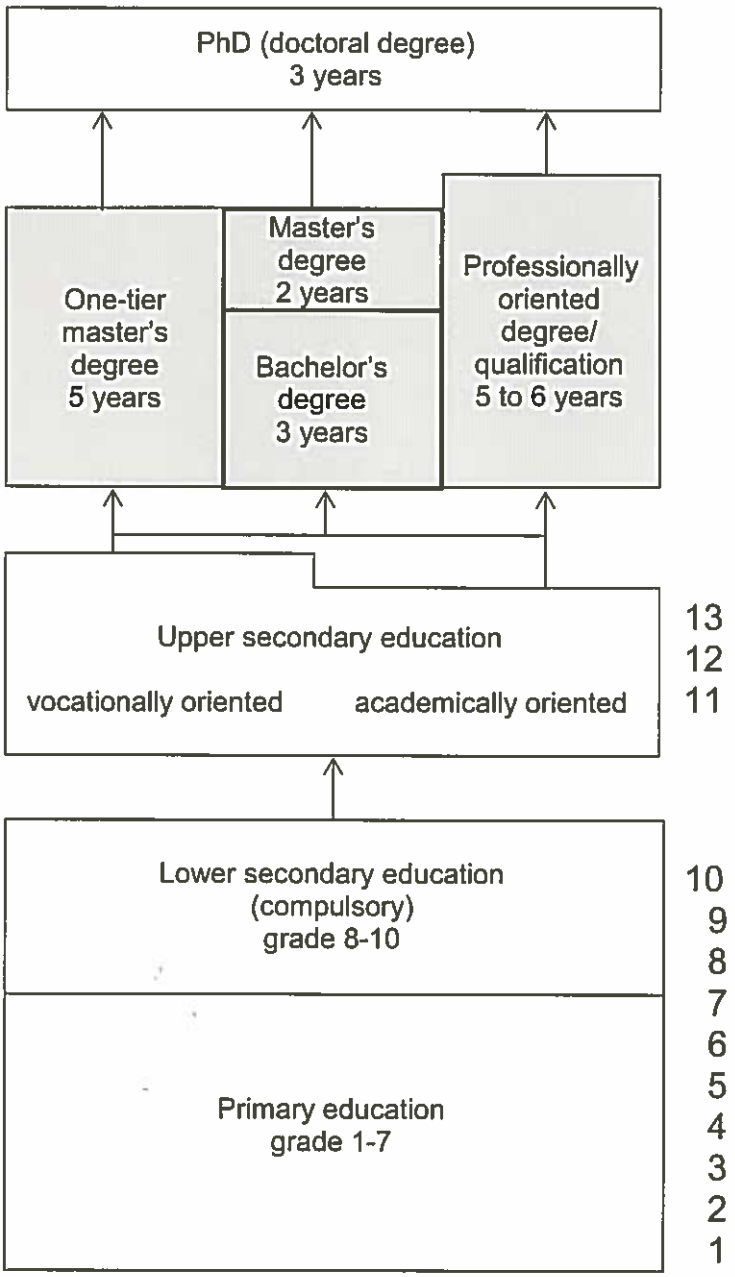
General structure of the Norwegian educational system



Higher education degrees and qualifications not included in the chart*:

- Master's degree in Architecture from Oslo School of Architecture and Design: 5 ½ years
- Experienced-based master's degree: 1 ½ or 2 years
- Bachelor's degree of 4 years' duration (music)
- Primary and lower secondary teacher education programmes for years 1-7 and years 5-10: 4 years
- University college graduate degree: 2 years

* In addition, Norway has a system of **tertiary vocational education** ***(fagskole)***, which is not considered higher education. It is based on upper secondary education and training or equivalent competence. Course duration is from six months to 2 years. Holders of some 1 and 2 year *fagskole*-qualifications can after individual assessment continue their studies in some bachelor programs, for example in the fields of engineering and marketing.

Transcript of Records

Norwegian University of Science and Technology

Tom Doekle Vethaak

Moholt Alle 20-64
7050 TRONDHEIM

Name: **Vethaak, Tom Doekle** Date of birth: 1993-03-25

The student has completed the following examinations at the Norwegian University of Science and Technology:

Course		Semester	Credits	Grade	Grade distribution [1] A B C D E
[redacted]					
FY8302	Quantum Theory of Solids	2015 autumn	7.5	Passed	

Total: 75.0

Trondheim, 17 December 2015 _____
signature

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Student and Academic Division

1) For an explanation of the grade distribution, see the last page.

An official transcript must be signed and stamped by the Norwegian University of Science and Technology