Physics and Astronomy

Faculty of Science,
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This report was finalized on 19 February 2014.

Report on the bachelor's degree programme Physics & Astronomy and the master's degree programme Physics and Climate Science of Utrecht University

This report takes the NVAO's Assessment framework for limited programme assessments as a starting point.

Administrative data regarding the programmes

Bachelor's programme Physics & Astronomy

Name of the programme:	Natuur- en Sterrenkunde
CROHO number:	56984
Level of the programme:	bachelor's
Orientation of the programme:	academic
Number of credits:	180 EC
Specializations or tracks:	none
Location(s):	Utrecht
Mode(s) of study:	full time
Expiration of accreditation:	31-12-2014

Master's programme Physics and Climate Science

Name of the programme:	Natuurkunde en Meteorologie & Fysische Oceanografie
CROHO number:	60705
Level of the programme:	master's
Orientation of the programme:	academic
Number of credits:	120 EC
Specializations or tracks:	Theoretical Physics; Particle Physics; Meteorology, Physical Oceanography and Climate; Nanomaterials: Chemistry and Physics
Location(s):	Utrecht
Mode(s) of study:	full time
Expiration of accreditation:	31-12-2014

The visit of the assessment committee Physics and Astronomy to the Faculty of Science of Utrecht University took place from November 12th till 14th.

Administrative data regarding the institution

Name of the institution:	Utrecht University
Status of the institution:	publicly funded institution
Result institutional quality assurance assessment:	positive

Quantitative data regarding the programmes

The required quantitative data regarding the programmes are included in Appendix 5.

Composition of the assessment committee

The committee that assessed the bachelor's degree programme Physics & Astronomy and the master's degree programme Physics and Climate Science consisted of:

- Prof. dr D. Lenstra is professor emeritus in Electrical Engineering (Delft University of Technology) and fellow of the Eindhoven University of Technology.
- Prof. dr G. Borghs is professor emeritus in Physics at the KU Leuven (BE) and senior fellow of the Inter-university Micro Electronics Centre (imec).
- Prof. dr T. Theuns is reader Astrophysics at Durham University (UK) and part-time professor Astrophysics University of Antwerp (BE).
- Dr H.P. Blok, retired associate professor at VU-university, Amsterdam;
- Dr J. Hoogenraad is owner of Spoorgloren BV.
- J.J.T. Wagenaar MSc, student member, is PhD-student in Physics, Leiden University.

extended with an expert on the subject Meteorology, Physical Oceanography and Climate:
- Prof. dr J. Pietrzak is professor in Physical Oceanography at Delft University of Technology.

The committee was supported by dr. J. Corporaal and dr. B.M. van Balen, who acted as secretaries.

Appendix 1 contains the curricula vitae of the members of the committee.

Working method of the assessment committee

Preparation
The committee held a preliminary meeting on October 8, 2013. During this meeting the committee was instructed about the accreditation framework and the programme of the upcoming assessments. A vice-chair for each visit was appointed and the Domain Specific Framework for Physics and Astronomy was set.
To prepare the contents of the site visits, the coordinator first checked the quality and completeness of the Critical Reflections prepared by the programmes. After establishing that the reports met the demands, they were forwarded to the participating committee members. The committee members read the reports and formulated questions on their contents.

As well as the Critical Reflection, each committee member read a selection of eighteen bachelor theses and twenty-five master theses. These theses were randomly chosen from a list of graduates of the last two completed academic years within a range of grades.

Site visit
A preliminary programme of the site visit was made by the coordinator and adapted after consultation with the coordinator of the Faculty of Science. The timetable for the visit in Utrecht is included as Appendix 6.

Prior to the site visit the committee asked the programmes to select representative interview partners. During the site visit, meetings were held with panels representing the faculty management, the programme management, alumni, the Educational Committee, the Educational Subcommittee, and the Board of Examiners. Meetings were also held with representatives of the students and teaching staff.

During the site visit, the committee examined material it had requested; an overview of this material is given in Appendix 7. The committee gave students and lecturers the opportunity – outside the set interviews – to speak informally to the committee during a consultation hour. No requests were received for this option.

The committee used the final part of the visit for an internal meeting to discuss the findings. The visit was concluded with a public oral presentation by the chair of the committee of the preliminary impressions and general observations.

Report
Based on the committee's findings, the coordinator prepared a draft report. This report was presented to the committee members involved in the site visit. After receiving approval, the draft report was sent to the Faculty with the request to check it for factual inaccuracies. The comments received from the Faculty were discussed with the committee chairman. The final version of the report was sent to the committee members for a final check. Subsequently the definitive report was approved and sent to Utrecht University.

Decision rules
In accordance with the NVAO's Assessment Framework for Limited Programme Assessments (as of 22 November 2011), the committee used the following definitions for the assessment of both the standards and the programme as a whole.

Generic quality
The quality that can reasonably be expected in an international perspective from a higher education bachelor's or master's degree programme.

Unsatisfactory
The programme does not meet the current generic quality standards and shows serious shortcomings in several areas.

Satisfactory
The programme meets the current generic quality standards and shows an acceptable level across its entire spectrum.

Good
The programme systematically surpasses the current generic quality standards across its entire spectrum.

Excellent
The programme systematically well surpasses the current generic quality standards across its entire spectrum and is regarded as an (inter)national example.

Summary judgement

Bachelor's degree programme Physics & Astronomy

Standard 1
The bachelor's degree programme Physics & Astronomy aims at providing students with a broad, basic knowledge of physics, mainly to prepare them to successfully enrol in a master's (research) programme. There are no separate tracks. Students choose from one of six study paths, which prepare them for one of the four master's programmes within the Utrecht University master's degree programme Physics and Climate Science, or a physics or astronomy master's degree programme elsewhere.

The committee has expressed its concern about the lack of adequate job orientation and about the number of changes the programme recently has gone through. It urges the management to focus on stability and contents now, rather than trying to attract students by, for instance, new name changes. Since the previous assessment committee also concluded that more attention should be paid to job orientation (especially outside research), the committee urges the programme management to critically reflect on how job orientation can get a more secure and prominent place in the curriculum. Also, it encourages the programme to formulate which skills students acquire and how these can be valued and put into use in a research or corporate environment.

The committee has studied the intended learning outcomes of the programmes and concludes that they are in line with the domain specific framework of reference and meet international standards.

Standard 2
The bachelor's degree programme Physics & Astronomy consists of 180 EC, evenly divided over three years. The curriculum of the bachelor's degree programme is composed of three parts: a mandatory part (90 EC), an elective set of courses within the programme (45 EC) and a so-called 'optional course profile' (45 EC). All bachelor's courses (except for the bachelor's research project) account for 7.5 EC, allowing students to follow two courses next to each other and to take eight courses a year (60 EC).

There are no official tracks within the bachelor's degree programme. However, by choosing certain mandatory and elective courses, there are six study paths preparing for a master's programme in Physics & Astronomy. These study paths are: (1) Theoretical Physics, (2) Experimental Physics, (3) Nanomaterials, (4) Climate Physics, (5) History and Philosophy of Science, and (6) Astrophysics. To better prepare students for their study path, a new mandatory course will commence in 2013/2014. In their second year, students will choose 'structure of matter' or/and 'fluid dynamics'.

The committee concludes that the content and design of the bachelor's degree programme ensure that students are able to obtain the intended learning outcomes. The programme is well-structured, cohesive and varied, and offers ample opportunity to students to pursue personal interests and talents. There is a clear connection between the aims of the courses and the learning aims of the programme. Excellency programs (the TWIN programme and the bachelor honours programme) guarantee that talented students are sufficiently challenged. The committee advises the programme management to make sure that the various study paths and learning lines do not create a too complicated structure. Finally, the committee underlines the importance of a basic knowledge of astronomy for all bachelor students of physics. The committee is of opinion that the management should be very clear about the position of astronomy in the programme.

The committee concludes that there is an adequate system of study guidance in place. It is pleased to hear that students generally feel well supported in scheduling their programme. Completion rates of the programme are low, mainly because of a delay during the research project at the end of the bachelor's degree programme. Appropriate solutions are being implemented to reduce this delay. The committee is confident that these solutions will improve the completion rates and urges the management to actively keep trying to attract more female students and female staff.

The committee is very impressed with the academic staff delivering the programme. The educational policy of Utrecht University encourages lecturers to obtain not only a basic, but also a senior teaching qualification (SKO in addition to BKO). Almost half of the academic staff has obtained this qualification. This shows that the programme is very much dedicated to the quality of teaching.

The committee concludes that the teaching facilities are adequate, but dated. It is happy to learn that the programme will move into a new building, probably in 2015. The new set-up of the physics labs sets high demands on the technical and support staff, which has been reduced in size. To avoid future problems, the committee advises the programme management to evaluate the new set-up of the physics labs with the teachers and technical staff concerned and implement changes if necessary.

The committee concludes that the Education Advisory Committee functions well and that students are generally well involved in the shaping and evaluation of the programme. Nevertheless, two changes are necessary. Firstly, the committee thinks that students in the Educational Committee (and preferably also in the Educational Advisory Committee) should be elected, so as to guarantee that they can function as spokespersons for the student population that they represent. Secondly, the committee stresses the need for the programme management to try and improve the response rates to course evaluations and involve alumni in the process of evaluating the programme as a whole.

Standard 3
The committee finds the system of testing adequate. The examinations in the bachelor's degree programme match the learning objectives of the courses. Exams are of a high quality and the management is working hard to improve the quality assessment cycle concerning testing. Students are well informed about assessment procedures. The introduction of new assessment forms, provided by the *Undergraduate School* for the assessment of the thesis project, should lead to more clarity on what the final grade is based on. According to the committee this form needs to be better implemented and better formalized.

The committee finds the structure of two Boards of Examiners and one Sub Board of Examiners Physics & Astronomy complicated and stresses that it should be clear to students what the division of responsibilities is. It is impressed by the initiatives taken by the Assessment Advisory Board. Finally, it suggests that the quality of exams should not only be checked afterwards, but could already be improved beforehand by making it custom to have exams checked by a second reader.

To assess the level achieved by the students, the committee examined a range of bachelor's theses. In general, it agrees with the marks that have been given and concludes that the final level of the theses matches with what can be expected of a graduate of an academic bachelor's degree programme. It urges the programmes not to tolerate students taking longer over their bachelor's research project in order to get a higher grade. In this respect, the committee is hopeful that the recently adopted Research Project Application Form will also help students to finish their theses in time. Finally, the committee is of the opinion that a cum laude rate of around 5% would be much more realistic than the current 30%.

The committee assesses the standards from the Assessment framework for limited programme assessments in the following way:

Bachelor's degree programme Physics & Astronomy :

Standard 1: Intended learning outcomes	**satisfactory**
Standard 2: Teaching-learning environment	**satisfactory**
Standard 3: Assessment and achieved learning outcomes	**satisfactory**
General conclusion	**satisfactory**

Master's degree programme Physics and Climate Science

Standard 1

The master's degree programme Physics and Climate Sciences is research oriented, and consists of four programmes (1) Theoretical Physics (TP), (2) Particle Physics (PP), (3) Meteorology, Physical Oceanography and Climate (MPOC) and (4) Nanomaterials: Chemistry & Physics (NMCP). This last track has been assessed previously and therefore was not evaluated by this assessment committee.

The committee has expressed its concern about the lack of adequate job orientation and about the amount of changes the programme recently has gone through. It urges the management to focus on stability and contents now, rather than trying to attract students by, for instance, changing the name of the master's degree programme. Since the previous assessment committee also concluded that more attention should be paid to job orientation (especially outside research), the committee urges the programme management to critically reflect on how job orientation can get a more secure and prominent place in the curriculum. Also, it encourages the programme to formulate which skills students acquire and how these can be valued and put into use in a research or corporate environment.

The committee has studied the intended learning outcomes of the programme and concludes that they are in line with the domain specific framework of reference and meet international standards. According to the committee, the MPOC-programme could benefit from painting a clearer picture of its position in comparison with similar programmes outside the Netherlands.

Standard 2

The master's degree programme consists of 120 EC, divided over two years. The didactical concept underlying the programme is that of learning by doing. The first year is devoted to theoretical courses, the second year to setting up and carrying out a research project at one of the faculty's research groups or at an affiliated research institute. The programme works with three categories of courses (mandatory courses, primary electives and secondary electives), and holds the principle that there is no set order in which courses have to be taken. The mandatory courses focus on core aspects of the specific research field. The primary electives are designed to further specify within the research field of choice. The secondary electives allow students to follow personal interests. They can be filled in outside or within the discipline.

The committee concludes that the content and design of the master's degree programme ensure that students are able to obtain the intended learning outcomes. The programme is well structured, cohesive and varied and offers ample opportunity to students to pursue personal interests and talents. There is a clear connection between the aims of the courses and the learning aims of the programme. An excellency programme (Theoretical Physics and Mathematical Sciences honours programme, leading to a double major in Physics and Mathematics) guarantees that talented students in this programme are sufficiently challenged.

The committee advises the programme management to make sure that mandatory and elective courses do not create a too complicated structure. Also, it finds that the management should inform students better about changes in the curricula, as master's students of Particle Physics proved to be underinformed about the contents of the new Experimental Physics programme.

The committee concludes that there is an adequate system of study guidance in place. It is satisfied to hear that students generally feel that they are well supported in scheduling their programme. However, completion rates are low, mainly because of a delay during the research project at the end of the master's degree programme. Appropriate solutions are being implemented to reduce this delay. The committee is confident that these solutions will improve the completion rates. It urges the management to actively keep trying to attract more female students and female staff.

The committee is very impressed with the academic staff delivering the programme. The educational policy of Utrecht University encourages lecturers to obtain not only a basic, but also a senior teaching qualification (SKO in addition to BKO). Almost half of academic staff has obtained this qualification. This shows that the programme is dedicated to the quality of teaching.

The teaching facilities, the committee concludes, are adequate, but dated. It is happy to learn that the programme will move into a new building, probably in 2015.

The committee concludes that the Education Advisory Committee functions well and that students are generally involved well in the shaping and evaluation of the programme. Nevertheless, two changes are necessary. Firstly, the committee is of the opinion that students in the Educational Committee (and preferably also in the Educational Advisory Committee) should be elected, so as to guarantee that they can function as a spokesperson for the student population which they represent. Secondly, the committee stresses the need for the programme management to try and improve the response rates to course evaluations and involve alumni in the process of evaluating the programme as a whole.

Standard 3
The committee finds the system of testing adequate. The examinations in the programme match the learning objectives of the courses. Exams are of a high quality and the management is working hard to improve the quality assessment cycle concerning testing. Students are well informed about assessment procedures. The introduction of new assessment forms, provided by the *Graduate School of Natural Sciences* for the assessment of the thesis project, should lead to

more clarity on what the final grade is based on. These forms, the committee concludes, need to be better implemented and better formalized.

The committee finds the structure of two Boards of Examiners and one Sub Board of Examiners Physics & Astronomy complicated and stresses that it should be clear to students what the division of responsibilities is. It is impressed by the initiatives taken by the Assessment Advisory Board. Finally, it suggests that the quality of exams should not only be checked afterwards, but could already be improved beforehand by making it custom to have exams checked by a second reader.

To assess the level achieved by the students, the committee examined a range of master's theses. In general, it agrees with the marks that have been given and concludes that the final level of the theses matches with what can be expected of a graduate of an academic master's research programme. It urges the programmes not to tolerate students taking longer over their final research project in order to get a higher grade. In this respect, the committee is hopeful that the recently adopted Research Project Application Form will also help students to finish their theses in time. Finally, the committee thinks that a cum-laude rate of around 5% would be much more realistic than the current 30%.

The committee assesses the standards from the Assessment framework for limited programme assessments in the following way:

Master's degree programme Physics and Climate Science:

Standard 1: Intended learning outcomes	**satisfactory**
Standard 2: Teaching-learning environment	**satisfactory**
Standard 3: Assessment and achieved learning outcomes	**satisfactory**
General conclusion	**satisfactory**

The chair and the secretary of the committee hereby declare that all members of the committee have studied this report and that they agree with the judgements laid down in the report. They confirm that the assessment has been conducted in accordance with the demands relating to independence.

Date: 19 February 2014

prof. dr D. Lenstra

dr. B.M. van Balen

Description of the standards from the Assessment framework for limited programme assessments

Standard 1: Intended learning outcomes

The intended learning outcomes of the programme have been concretised with regard to content, level and orientation; they meet international requirements.

Explanation:
As for level and orientation (bachelor's or master's; professional or academic), the intended learning outcomes fit into the Dutch qualifications framework. In addition, they tie in with the international perspective of the requirements currently set by the professional field and the discipline with regard to the contents of the programme.

Findings

In this paragraph the findings of the committee with regard to the Domain Specific Framework of Reference and intended learning outcomes, the level and orientation of the two programmes are described. After considering the findings the committee comes to a conclusion on Standard 1. Firstly, some attention will be paid to the organizational embedding and reorganization of the programmes.

1.1 Organizational embedding
The bachelor's degree programme Physics & Astronomy is one of seven bachelor's degree programmes situated in the Science Faculty. It is embedded in the faculty-wide Undergraduate School. The master's degree programme Physics and Climate Science at Utrecht University is one of nine master's degree programmes under the responsibility of the Graduate School of Natural Sciences, one of three graduate schools in the Faculty of Science. The *Schools* are responsible for the organization and quality of the programme. The department is responsible for employing academic staff delivering the programmes. Most lecturers are active in research groups.

Since the last assessment in 2007 both programmes have witnessed two major reorganizations and are still in the process of reshaping their curricula. Quite a few further changes (for instance, redesigning of the bachelor and master research projects, more emphasis on job orientation activities, clearer labelling of scientific writing and presenting skills, (possible) name changes of the bachelor's degree programme and the MA Particle-Physics programme) have been just set in place, are announced in the self-assessment reports or have been brought up in the meetings with the assessment committee during the site visit. For example, in order to attract more female students, the management expressed the thought that a name change of the bachelor's degree programme might be beneficial (for instance, from 'Physics and Climate Science' to 'Physics & Health').

1.2 Profile

Bachelor Physics & Astronomy
The bachelor's degree programme primarily aims at preparing students for a (research) master's programme in the field of physics and astronomy. Therefore it has an introductory function and focuses on providing students with a 'thorough and broad basic knowledge of the discipline physics & astronomy'.

Distinctive features of the programme are the didactical vision of Utrecht University, which can be summed up in four points:

- The bachelor's phase aims at providing a broad knowledge of the discipline, rather than specialization, which is reserved for the master's phase.
- In comparison, students have a lot of room to set their own study path. Over half of the programme is filled with optional courses within and outside the discipline.
- It is the aim of the programme to offer personal and activating courses and good study guidance.
- To ensure the quality of teaching, Utrecht University pays a lot of attention to the staff's teaching qualifications.

Key words in the programme management's vision on the degree programme are 'depth by elective courses', 'inspiration from staff research', 'differentiation in excellence' (for excellent students, there are a double major and an honours programme, see Standard 2) and 'flexibility in choice'. There are no official tracks within the bachelor's degree programme, but students are encouraged to choose one of four study paths that prepare them for one of four master's programmes within the master's degree programme Physics and Climate Science. In addition, by choosing certain elective courses, there is a fifth path preparing for the master's programme History and Philosophy of Science and a sixth path for a master's programme Astrophysics at another university. Finally, students can obtain a second degree teaching qualification by following a so-called 'Education minor', which is no part of this assessment.

Master Physics and Climate Science
As stated in the self-assessment report, the overall aim of the master's degree programme Physics and Climate Science is 'to educate students to be optimally prepared for conducting top level research, both in a disciplinary and interdisciplinary environment, at universities, research institutes, as well as in business and industry.' By choosing one of four programmes, students specialize in a particular field within Physics and Climate Science. Each track has specific aims and intended learning outcomes. In the self-assessment report the programme management explains that Utrecht University chooses to position itself with the programmes within the degree programmes, rather than with the umbrella degree programmes in which students are registered. Students opt for either: (1) Theoretical Physics (TP), (2) Particle Physics (PP – which will be replaced by 'Experimental Physics' from 2013/2014 onwards), (3) Meteorology, Physical Oceanography and Climate (MPOC) or (4) Nanomaterials: Chemistry & Physics (NMCP). This last programme has been assessed previously as part of the assessment of all programmes within Chemical Sciences. The main goals of the remaining three programmes are summed up briefly as follows:

The master's programme Theoretical Physics (TP) focuses on the two research themes of the research institute. It is linked to (Institute for Theoretical Physics): (1) Quantum Gravity, Strings and Elementary Particles and (2) Condensed Matter Theory, Statistical and Computational Physics. Together with sister institutes at Leiden University and Amsterdam University, it forms the Delta Insitute for Theoretical Physics, which offers courses as a joint effort.

The master's programme Particle Physics (PP) trains students 'on all aspects of the Standard Model of Particle Physics, which describes the building blocks of matter and the forces between them'. This programme is offered in collaboration with Amsterdam University, VU-university, Amsterdam, and the National Institute for Subatomic Physics, NIKHEF. The programme has links with research groups at these institutes as well as with researchers at CERN-Geneva (European Organization for Nuclear Research).

The master's programme Meteorology, Physical Oceanography and Climate (MPOC) focuses on 'fundamental physical, dynamical and chemical processes that make up the Earth's climate system', in particular the theory of geophysical fluid dynamics. The programme is linked with the Institute for Marine and Atmospheric research Utrecht (IMAU), which works with five focal points (Ice and Climate, Atmospheric Dynamics, Oceans and Climate, Coastal and Shelf Sea Dynamics, Atmospheric Physics and Chemistry). These are reflected in the programme, both in courses and research projects.

1.3 Intended Learning Outcomes

The objectives of the degree programmes are translated into programme-specific aims and learning outcomes (see Appendix 3) using the Dublin descriptors. Both programmes have based their learning outcomes on the Domain Specific Framework of Reference (Chamber of Physics, VSNU 2013).

The bachelor's degree programme Physics & Astronomy has formulated four general aims and seven exit qualifications, divided in two categories: discipline related and generic academic skills. The relation between these exit qualifications and the courses in which they are addressed is made clear in a matrix provided in the self-assessment report. For instance, learning outcome 2 ('*Basale problemen in een geïsoleerde context op het gebied van de natuurkunde, sterrenkunde of mfo met wiskundige of numerieke hulpmiddelen op te lossen dan wel daarover op een experimentele of observationele wijze informatie te vergaren en deze te interpreteren.*') is attributed to all courses except for the two optional courses: '*Filosofie en Grondslagen van de Natuurkunde'* and '*Geschiedenis van de modern natuurkunde*', whereas learning outcome 3a ('Individual research, integrating new and existing knowledge and skills') comes to the foreground in two courses only ('Statistische fysica' and Bachelor Research Project).

The master's degree programme Physics and Climate Science has formulated fourteen specific learning outcomes for each programme. These are more or less evenly divided over the five Dublin descriptors 'knowledge and understanding', 'applying knowledge and understanding', 'making judgements', 'communication' and 'learning skills'. According to the self-assessment report, the first year of the master's programme 'is devoted to acquiring deep knowledge about physical theories, while the second year focuses on research.' The research focus of the programmes is reflected in the learning aims, for example in learning outcome 4 of the Theoretical Physics programme: ('Is able, possible guided by a staff member, to translate a problem of modern theoretical physics into a research question'), in learning outcome 4 of the Particle Physics programme ('Is able to conduct research in the field of particle physics under supervision of a scientific staff member and report on it in a manner that meets the customary standards of the discipline') and in learning outcome 4 of the MPOC-programme ('Is able to define a scientific problem in the field of climate science and design a basic strategy to solve this problem'). The committee has studied the intended learning outcomes in relation with the domain specific framework of reference. It concludes that the intended learning outcomes of the bachelor's degree programme are broadly defined and geared towards enrolling in a master's degree programme, and that those of the master's degree programme are more specific and geared towards starting a PhD-trajectory. The committee is of the opinion that the intended learning outcomes are in line with the domain specific requirements and meet international standards.

Considerations

During the site visit, the committee had a lot of attention for the changes in the programmes and the implications these changes have for the profile and unique position of the programmes, both on a national and international scale. It foremost notes that the organization is fully in motion. From the changes announced, it also concludes that the variety of educational programs has not found its definite form yet. It was for instance unclear to the committee how the new programme Experimental Physics will relate to the current programme Particle Physics. It urges the programme management to maintain the current high standard of the Particle Physics programme.

The committee was asked to give their advice on a name change of the bachelor's program ('Physics' instead of 'Physics and Astronomy') as a result of the departure of the Institute of Astronomy. This shift has had its implications for the place of astronomy in the programme. The committee has some content-related concerns about the astronomy courses, which will be dealt with in Standard 2. Here, it urges the programme to be very clear in its communication to future students about the place of astronomy in the bachelor degree programme. Furthermore, the committee advises the programme management to consider new changes, such as yet again changing the name of the bachelor's degree programme, very carefully. It stresses that the programme should now focus on building in some kind of stabilization by focusing on content rather than labeling.

The committee has discussed the profile, level and orientation of both degree programmes. From talking to the students, it concludes that both bachelor's and master's students highly appreciate the flexibility that is offered to them in the composition of the programme. This flexibility allows them to choose their own study path. The academic orientation of the bachelor's and master's degree programme is adequate and it is in line with what can be expected from a scientific bachelor's and master's degree program from an international perspective. Due to its unique character in the Netherlands, the assessment committee feels that the MPOC-programme could benefit from making clearer its position and unique selling point from an international perspective.

Despite earlier suggestions of the previous visitation committee, and despite recurrent criticism from students, the focus of both programmes is much research-dominated. The committee concludes that both the *bachelor's degree programme Physics & Astronomy* and the master's degree programme *Physics and Climate Science* lack adequate orientation on possibilities outside research. The programme management is aware of this problem and is planning to take action. However, the programme management at the same time states (in the self-assessment report of the bachelor degree programme) that 'the bachelor diploma is not a suitable exit qualification for finding work in university research, research institutes or industry'. Although the programme management recognized that this was formulated too strongly, the committee stresses that the programme should fulfill the legal requirements that a bachelor degree programme must pay attention to the prospects of students who will not proceed their career in research. After all, only the very best students will be able to continue research after a PhD-trajectory and the programme should take all students' interests into account. The committee also stresses the need for a positive, rather than a negative formulation. In its opinion, the programmes should pay explicit attention in their profiles to what students *are* qualified to do after graduating from either the bachelor's or the master's programme and what their options are, both in a research and/or a business environment. The committee is of the opinion that both programmes need to make job orientated activities more visible in their curricula, as well as their respective connection with the work field. The programme states that contact with lecturers/researchers is also a form of job orientation, which the committee can appreciate, with the restriction that the teaching staff represent the research field, but not (necessarily) the corporate world. The committee urges the programme management to substantially improve on job orientation within the curriculum.

Conclusion

Bachelor's degree programme Physics & Astronomy : the committee assesses Standard 1 as 'satisfactory'.
Master's degree programme Physics and Climate Science: the committee assesses Standard 1 as 'satisfactory'.

Standard 2: Teaching-learning environment

The curriculum, staff and programme-specific services and facilities enable the incoming students to achieve the intended learning outcomes.

Explanation:
The contents and structure of the curriculum enable the students admitted to achieve the intended learning outcomes. The quality of the staff and of the programme-specific services and facilities is essential to that end. Curriculum, staff, services and facilities constitute a coherent teaching-learning environment for the students.

Findings

The committee has studied the curricula of both programmes, has seen the course material, the digital learning environment and results of course evaluations. In this standard the findings of the committee concerning the content, orientation and structure of the programmes (2.1), intake and study load (2.2) teaching staff (2.3) and facilities (2.4) are discussed.

2.1 Programmes and coherence of the curricula

The bachelor's degree programme Physics & Astronomy consists of 180 EC, evenly divided over three years. The master's degree programme Physics and Climate Science consists of 120 EC, divided over two years. Each year is further divided into four parts of approximately ten weeks each. An overview of both degree programmes can be found in appendix 4.

2.1.1 Bachelor's degree programme Physics & Astronomy

The curriculum of the bachelor's degree programme is composed of three parts: a mandatory part (90 EC), an elective set of courses within the programme (45 EC) and a so-called 'optional course profile' (45 EC). All bachelor's courses (except for the bachelor's research project) account for 7.5 EC, allowing students to follow two courses next to each other and to take eight courses a year (60 EC). Each course has a level-indication (1=introductory, 2=deepening and 3=advanced). At least 45 EC of the physics & astronomy courses must be at level 3.

- The mandatory part consist of nine courses (ten from 2013/2014 onwards) and the bachelor research project (15 EC). Mandatory courses are, for example, those on '*Relativistische en Klassieke Mechanica*', '*Golven & Optica'* and '*Kwantummechanica*'. Six courses are at an introductory level, three are indicated as 'level 2' (to be extended with a fourth course from next year onwards). The bachelor research project is at an advanced level. It is supervised by a member of staff and carried out at one of the research groups of the department (or at an affiliated Dutch research institute).
- The elective part ('major elective') consists of a set of seven courses (six from 2013/2014 onwards, as one elective course will be replaced by a new mandatory course, see below) which students have to take within the Physics & Astronomy programme.
- The 'optional course profile' is composed of 45 EC (six courses) which students can either fill with courses within or outside physics & astronomy.

There are no official tracks within the bachelor's degree programme. However, by choosing certain mandatory and elective courses, there are six study paths: (1) Theoretical Physics, (2) Experimental Physics, (3) Nanomaterials, (4) Climate Physics, (5) History and Philosophy of Science, and (6) Astrophysics. To better prepare students for choosing a study path, a new mandatory course will commence in 2013/2014. In their second year, students will choose 'structure of matter' or/and 'fluid dynamics'.

The bachelor's degree programme Physics & Astronomy offers two options for talented students. They can either follow the TWIN-programme (a double major programme in physics & astronomy and mathematics) or be invited to participate in the faculty's honours programme. About 40% and 10% of all bachelor's students respectively make use of these two options.

As mentioned before, the curriculum of the bachelor's degree programme is currently being reorganized. Recently, the four-period system and the 'optional course profile' have been introduced as part of the flexibility policy of the faculty Undergraduate School. Additionally, two further changes are announced and will be implemented in the near future. Firstly, practical work ('physics labs') will take up a bigger part of the programme. Part of these physics labs will be integrated in the courses. Secondly, to further strengthen the relation between the bachelor's degree programme and a master's research programme and to ensure a coherent connection between various courses, a system of six 'learning lines' will be set in place. These are: (1) Classical & Relativistic Mechanics, (2) Statistical Physics & Condensed Matter, (3) Quantum Mechanics, (4) Electromagnetism & Optics, (5) Structure of Matter & Fluid Dynamics and (6) Mathematics.

The committee has studied the bachelor's degree programme Physics & Astronomy. It concludes that the programme is well structured and succeeds in offering a coherent and varied set of courses, with ample opportunity for students to pursue personal interests and talents. There is a clear connection between the aims of the courses and the learning aims of the programme. At the same time, the committee urges the programme management to make sure that the different study paths and learning lines, mandatory and elective courses do not create a too complicated structure. In the opinion of the committee, it should not be possible for a bachelor student to graduate without basic laboratory skills. Therefore, it is enthusiastic about the set-up of the new physics labs with clearly defined aims for each stage of the course (data processing, simple experiments, planning, presenting skills, writing reports) and which become more complicated as the experiments progress.

The committee has discussed the place of astronomy in the bachelor's degree programme quite extensively. During the site visit, it learned that lecturers for the astronomy courses are being brought in from University College Utrecht (UCU). Not all lecturers appear to be active in research, which is a concern for the committee. Another point of concern is the fact that teachers might be less accessible for students because they are based elsewhere. The programme management stresses that, in line with students' wishes, it will maintain to offer astronomy courses in the bachelor's degree programme, as they provide essential knowledge for, for example, a master's degree course in Astroparticle physics. However, the programme management and teachers also stated that if students are *only* interested in astronomy than maybe they should consider studying astronomy at a different university. The committee underlines the importance of a basic knowledge of astronomy for all bachelor's students of physics, and reiterates that the management should be very clear about the position of astronomy in the programme, so that prospective students can make a well-balanced choice between studying astronomy at Utrecht University or elsewhere.

2.1.2 Master's degree programme Physics and Climate Science

The didactical concept underlying the master's degree programme is that of learning by doing. The common structure of all master's programmes is as follows. The first year is devoted to theoretical courses, the second year to setting up and carrying out a research project. The research project is carried out at one of the faculty's research groups or at an affiliated research institute (for instance CERN for Particle Physics) and supervised by at least one member of staff, who serves as a role model. Like all programmes within the Graduate School of Natural Sciences, the master's degree programme Physics and Climate Science works with three categories of courses (mandatory courses, primary electives and secondary electives), and holds the principle that there is no set order in which courses have to be taken (flexibility policy). The mandatory courses focus on core aspects of the specific research field. The primary electives are a set of elective courses to further specialize within the research field of choice. They have to be taken within the own specialization programme. The secondary electives allow students to 'gain knowledge and/or develop skills outside the immediate framework of their master's programme.' They can be filled in within or outside the discipline. However, courses outside the Graduate School of Natural Sciences require permission from the programme director.

Different from the bachelor's degree programme, courses in the various programmes of the master's degree programme vary in size. Those of Theoretical Physics (TP), Particle Physics (PP) and Meteorology, Physical Oceanography and Climate (MPOC) range from 3 EC (the primary electives within PP), 3.75 EC (primary electives within MPOC), to 6, 7.5, 10 and 12 EC. The committee notes that there are also differences in the total build-up of the programme, ranging from 18 to 37.5 EC on mandatory courses (TP versus MPOC) and 45 EC to 55 or even 65 EC on the final research project (TP and MPOC versus PP). When the secondary electives have to be used to remove deficiencies in knowledge or skills, there sometimes is no room to take additional courses outside the specialisation.

Talented master students of the TP programme can join the honours programme Mathematical Science or Theoretical Physics (MSTP, 165 EC), which leads to a double degree in Physics and Mathematics.

As for the bachelor's degree programme, the committee concludes that the master's degree programme Physics and Climate Sciences is well structured and successful in providing a coherent and varied set of courses for each programme, enabling students to optimally prepare for a career in research while having the opportunity to follow personal interests and talents. There is a clear connection between the aims of the courses and the learning aims of each programme.

As mentioned before, the committee had some concerns about the new programme Experimental Physics, which will replace the current Particle Physics programme. Although the new programme will officially start in 2013/2014, it is already offered from 2012 onwards. From talking to the students, the committee concludes that students were well informed about the fact that the programme would change, but did not have a clear idea of the exact changes. One of the students said they would have chosen a different programme within the master's degree programme, had they known what the changes involve. The students also told the committee that they are enthusiastic about the name of the programme (as opposite to Theoretical Physics), and about the set-up of the courses, part of which are followed together with students from different universities (mostly University of Amsterdam). They noticed that courses were already changing due to this cooperation. When asked for possible improvements in the programme, the students told the committee that there could be more practical lab work in the first year of the programme. The committee supports this suggestion. Futhermore, it urges the programme management to keep students better informed when it considers changes to the curriculum.

The committee has paid special attention to the MPOC programme, which is unique in the Netherlands. It concludes that the set-up of the programme is challenging and touches upon all subjects relevant in the discipline. The committee also noticed that the students were very enthusiastic about the programme, which in their opinion is 'applicable to the real world'. Nevertheless, the students found the beginning of the second year a bit unclear. The programme coordinator explained that the second year starts with two project-orientated courses, which function as an introduction to the thesis. Due to the fact that these are no traditional courses, students sometimes only appreciate them in hindsight. To avoid confusion, the committee advises the programme management to make the function of these courses in the curriculum more clear to students.

Finally, the committee concludes that the scientific orientation of the programme is more than sufficiently safeguarded by the fact that courses are taught by staff of the research institutes, who are able to teach students about state of the art research within their discipline (see also 2.3).

2.2 Study load, guidance and rates

Study load

As stated before, the curricula of the three-year bachelor's degree programme Physics & Astronomy and the two-year master's degree programme Physics and Climate Science are divided in four blocks a year of approximately ten weeks each. Students usually follow eight courses a year. The research project takes up one block in the bachelor's degree programme and three to four blocks in the master's degree programme. Dividing the yearly contact hours provided in the self-assessment report of the bachelor degree programme by 40 weeks a year, one arrives at the weekly amount of contact hours. That amount is 18.9 for the first year of the bachelor's degree programme, going down to 17.4 in the second and 13.2 in the last year of the programme. These contact hours account for 50% of the total study load. The committee was unable to find clear numbers regarding contact hours for the different *master's programmes*. The management states that the contact hours in the master's phase form 33% of the total study load and that for an average course (7.5 EC representing a study load of 210 hours), there are approximately 67 contact hours. The management states that students find that some courses have a study load that is not in balance with the course credits, in other words, that some courses are too difficult or too easy. The assessment committee is happy to hear and finds it important that these imbalances will be restored.

Complemented by self-tuition hours, the contact hours lead to a study load of a full-time workweek. The committee finds it plausible that contact hours in the bachelor's phase go down as students' independence increases. The student representatives of the two degree programmes with whom the committee spoke during the site visit were of the opinion that the programmes in their current form are feasible. There are no major stumbling blocks, although bachelor's students did mention that some courses (for instance *quantum mechanics* and *advanced quantum mechanics*) are very challenging as they contain too little mathematical explanation for physics students (as opposed to TWIN-students). The committee is glad to learn that the management is aware of this problem and is planning to pay more attention to the training of mathematical skills in the new learning lines.

Guidance

The programme coordinators support students in their individual choices at the beginning and during their study. Together with the study advisors they keep an eye on the progress of students and their personal circumstances. Additionally, students can contact a study counsellor in case of personal and/or financial problems. The students mentioned that the system of study guidance is adequate. The bachelor's students were enthusiastic about the guidance provided in tutor groups (10-12 first year students) and in the run-up to the research project. According to them, the recently implemented 'research project application form' (a form containing the research objectives, start and end date, et cetera which is signed at the start of the project) works well. The committee is satisfied to hear that students generally feel that they are well supported in scheduling their programme.

Rates
The *bachelor's degree programme Physics & Astronomy* grants direct access to students who hold a Dutch VWO diploma (profile Nature & Technology or Nature & Health) with mathematics B. Around 30% leaves the programme in the first year. According to the programme management these students often lack the skills in mathematics and physics needed for the programme. To ensure a better match between prospective students and the programme, an introduction programme ('Matching') will be organized, consisting of interviews with individual students, a group lecture, participation in a work group and a practical lab assignment. The matching procedure has become effective in the summer of 2013. The committee finds the introduction programme a good initiative, and hopes that the drop-out rate will go down as students obtain a more realistic idea of the programme.

A subject that was raised a few times in the meetings is that of the automatic graduation procedure for the bachelor's degree programme, which entails that students who have obtained 180 credits automatically are signed out of the programme. This policy has been introduced since the bachelor's diploma has become a prerequisite for starting the master's degree programme ('*harde knip*') and enables the programme coordinators to keep a better track of where students are in their studies. The committee concludes that the rule is not always in the interest of bachelor's students, for instance, when they have followed or wish to follow extra courses before graduating. The programme management is aware of the problems the procedure sometimes causes, but also stresses the need to be able to monitor students' progress. In practice, the management states, the rule should not create problems, because the Exam Committee mostly grants permission to students who, after consulting their programme coordinator, want to take additional courses. However, from talking to the students, the committee concludes that students more often turn to their supervisor and ask them not to hand in the final grade yet. The committee concludes that this is a situation that is undesirable and urges the programme management to stress in the study guide that the Exam Committee may grant permission to and make an exception for those students for whom the procedure causes problems.

The *master's degree programme Physics and Climate Science* is aimed at students who have successfully completed a bachelor's degree at a Dutch university in physics or in a related science with a strong component in physics. The programme is also open for students with a foreign university bachelor's degree in physics or students with a Dutch, non-university (HBO) bachelor's degree. All applicants are individually assessed by the Board of Admissions of the Graduate School of Natural Sciences. The specific admission conditions for each programme are specified in the Education and Exam Regulations (OER). The Board of Admissions sometimes asks students to use their secondary electives to remove deficiencies in knowledge or skills. When there is a more substantial gap, applicants complete a five month pre-master before they can enter the programme.

The number of enrolling students for all four programmes fluctuates between 44 (2006/2007), 82 (2009/2010) and 60 (2011/2012) The programme management aims at a student intake of approximately 80 per year, resulting in 20 per programme. It expects that the inflow of the Experimental Physics programme will reach that number as a result of the launch of the new programme. The committee learned that the MPOC programme and the Theoretical Physics programme currently attract most international students (both approximately 53%) and that hardly any non-university degree students enroll in the master's degree programme (only two students from 2006 onwards). 60% of graduates continue their career as a PhD student.

The assessment committee has two critical remarks in regard to both the bachelor and the master's degree programme. Above all the committee is concerned that on average both bachelor's and master's students take too long to graduate. This delay is almost solely caused by the fact that students take too long carrying out their research project at the end of their studies. A large number of students rework their theses to get a higher grade. The committee also noticed that the number of cum laude graduates is high. This issue will be dealt with in standard 3. Both programmes are aware of the delay the research projects cause, and are addressing it by setting stricter deadlines to the bachelor's and master's projects and theses. Furthermore, students are asked to sign a 'research project application form'. The committee thinks that these are appropriate measures. It also ventured the idea to limit the possibility for students to get the cum laude judicium if they have exceeded a certain amount of time.

A final point of concern is the underrepresentation of female staff and students. The committee is happy that the educational programmes see this problem and are trying to address it, for instance by adopting a more gender neutral approach in attracting new students in the bachelor's degree programme. The master's programme Meterology, Physical Oceanography and Climate attracts most female students (approximately 25%). The programme management voiced the expectation that in future this problem will decrease, as there are already more female PhD students. Nevertheless, the committee strongly urges the programme management to actively try and correct this imbalance, for instance when attracting new members of staff.

2.3 Composition of the academic staff

The staff of the bachelor's degree programme Physics & Astronomy and the master's degree programme Physics and Climate Science is attached to the department of Physics. Lecturers teach in both the bachelor's and the master's degree programme. At the time of the site visit, the academic staff of the department of Physics & Astronomy consisted of 54 lecturers (25 of whom hold a position as professor) and a number of PhD-candidates who regularly assist in the teaching process. Of the lecturers, 96% holds a PhD. The student-staff ratio in the bachelor's degree programme is 1:19, that of both degree programmes (BA and MA) is 1:25.7.

Utrecht University pays a lot of attention to its educational policy. Lecturers are required to obtain teaching qualifications. Most members of staff have obtained the *Basis Kwalificatie Onderwijs* (BKO, 83%), 48% have also obtained the *Senior Kwalificatie Onderwijs* (SKO). The committee is pleased to see that the educational staff is given more than sufficient support from the management in further developing their teaching skills.

During the site visit, the committee noted that the students are enthusiastic about the quality of the teachers. This is reflected in the course evaluations, in which the quality of teaching is evaluated well above average. The committee was impressed by the dedication and enthusiasm of which the teaching staff testified, and the good quality of the teaching. It also had the impression that the students have not suffered from all changes, and realizes that this is to a big extent the achievement of the lecturers. Finally, the committee takes into consideration that the research of the department of Physics & Astronomy was recently assessed as very good to excellent. It concludes that the academic staff is more than sufficiently equipped for delivering the programmes. A minor point of criticism is that the committee would find it desirable when teaching assistants (primarily employed in the bachelor's degree programme) would receive some form of didactic training.

2.4 Accommodations & Internal quality assurance

The bachelor's and master's degree programmes share facilities provided by the faculty of Science at the Uithof (Minnaertgebouw, Leuvenlaan 4). During the site visit, the assessment committee was able to get a good impression of the teaching facilities and physics labs. It concludes that the teaching facilities are sufficient, although slightly dated. Students testify that the facilities are adequate. Master students who have reached the research project phase get access to the same facilities as PhD-students and members of staff and are invited to participate in meetings of their department and research group. The committee values this approach.

An issue that came up in various meetings is that of the physics labs. There are three physics lab rooms available for the bachelor's programme. The committee is concerned whether there is sufficient manpower available to run those labs, since the total number of fte has gone down considerably (from 2 to 1.1 fte plus 3 fte technical support, gone down from 5 fte) and since the programme management is making considerable changes to the set-up of the physics labs in the bachelor's degree programme. When confronted with these concerns, the management acknowledged that financial restrictions account here. One way of solving the problem of manpower, the management expects, is to attract teachers of the courses in the designing of the experiments. The committee agrees that this is essential, especially in view of the intended learning line and the integration of the physics labs in the courses, but also stresses the need for the programme management to realize that the physics labs are at a critical level as far as manpower is concerned. It believes that brushing aside the problem might lead to more substantial problems in the future, from which not only the staff involved, but also students would suffer. It advises the programme to evaluate the new set-up of the physics labs with the teachers and technical staff concerned and implement changes if necessary. The physics lab steering committee, which helped to design and develop the new experiments, could play a leading role in this evaluation. Finally, the committee is glad to learn that the faculty will move into a new building in 2015.

The committee has assessed to what extent students and graduates are involved in the shaping and evaluation of the programmes. Both programmes share one Educational Committee (Opleidingscommissie) with other programmes in the Undergraduate School and Graduate School of Natural Sciences. However, the Educational Committee or Educational Council, in which students can play an important role, is hardly mentioned in the bachelor's self-assessment report. Both programmes also have an Educational Advisory Committee (Opleidingsadviescommissie, OAC), an executive committee of the Educational Committee, which exclusively deals with their own degree programme. From talking to the Educational Advisory Committees, the assessment committee concludes that these committees function well and are able to play an active role in the process of quality control. The committee has regular meetings and organizes extra meetings if necessary. Currently, in the bachelor's degree programme it is looking at the implementation of study paths, and in the master's programmes it is advising the management how to go about eventually making all master's courses equal in size (7.5 EC). Both Educational Advisory Committees use the Student Association as a parallel way to collect information. The positive note the assessment committee makes about the Educational Advisory Committee is countered by a critical remark about the Educational Committee. The committee learned that student members of the Educational Committee are not elected, but asked to participate. The assessment committee strongly urges the programme to implement a system in which student members are elected. This can help to guarantee that they can act as a spokesperson for the student population that they represent.

Both the bachelor's degree programme Physics & Astronomy and the master's degree programme Physics and Climate Science make use of an online evaluation system, Caracal (implemented in 2012). At the end of the course, students are asked to fill in a questionnaire in Caracal concerning all educational aspects of the course. The lecturers involved in the courses, as well as the director of education and the Educational Advisory Committee, keep track of the evaluations. The last two parties take action if evaluations show that a class is rated below or above average. The committee asked how the management deals with feedback, for instance when a course is rated extremely low. It learned that the director of education in such a case immediately approaches the course coordinator. This system fails when the director of education is also the course coordinator. The assessment committee advises the programme to set rules as to how to proceed in such a situation.

The committee has noted that the number of students who fill in online evaluations differs considerably per course (between 30-80%). Paper forms that students fill in after an exam have a much higher response rate (80-90%). The Graduate School of GeoSciences has tackled the problem of low response rates by explaining to its students why it is important to fill in the evaluations, after which the rate has gone up. The committee advises the programmes to also adopt this policy and try and improve the response rates.

In addition to Caracal, in the bachelor's degree programme there is a 'course response group', formed by students, which also evaluates courses. It discusses their results with the lecturer and reports to the director of education.

Both degree programmes do not systematically evaluate the curriculum as a whole (although there are some initiatives in the master's degree programme, for example, annual meetings between programme director, coordinator and student representatives). Although the student association holds close ties with graduates, the programme itself does not keep in touch in a systematic way. However, the programme management is planning to set up a system in which alumni will be involved in the assessment of the programme in a more structured way. The committee is confident that such evaluations will lead to identifying potential stumbling blocks in the composition of the programme and to formulating improvement measurements.

Considerations

The committee concludes that the content and design of both the bachelor's and master's degree programme ensure that students are able to obtain the intended learning outcomes. Both programmes are well-structured, cohesive and varied and offer ample opportunity to students to pursue personal interests and talents. There is a clear connection between the aims of the courses and the learning aims of the programmes. Excellency programs (the TWIN programme, the bachelor honours programme and the master's Theoretical Physics honours programme) guarantee that talented students are sufficiently challenged. The fact that a considerable number of students makes use of this possibility, proves that the programmes are well aware of student's capabilities and wishes. The committee advises the programme management to make sure that the different study paths and learning lines, mandatory and elective courses do not create a too complicated structure. Also, it finds that the management should inform students better about changes in the curricula, as master's students of Particle Physics proved to be underinformed about the contents of the new

Experimental Physics programme. Finally, the committee underlines the importance of a basic knowledge of astronomy for all bachelor's students of physics. The committee is of the opinion that the management should be very clear about the position of astronomy in the programme.

The committee concludes that there is an adequate system of study guidance in place. It is pleased to hear that students generally feel that they are well supported in scheduling their programme. Completion rates are low, mainly because of a delay during the research project at the end of the bachelor and master's degree programmes. Appropriate solutions are being implemented to reduce this delay. The committee is confident that these solutions will improve the completion rates. It urges the management to actively keep trying to attract more female students and female staff.

The committee is very impressed with the academic staff delivering the programme. The educational policy of Utrecht University encourages lecturers to obtain not only a basic, but also a senior teaching qualification (SKO in addition to BKO). Almost half of the academic staff have obtained this qualification. This shows that the programmes are dedicated to the quality of teaching.

The teaching facilities, the committee concludes, are adequate, but dated. It is happy to learn that the programmes will move into a new building, probably in 2015. The new set-up of the physics labs puts high demands on the technical and support staff, which has been reduced in size. To avoid future problems, the assessment committee advises the programme management to evaluate the new set-up of the physics labs with the teachers and technical staff concerned and implement changes if necessary.

The committee concludes that the Education Advisory Committees function well and that students are generally involved well in the shaping and evaluation of the programmes. Nevertheless, two changes are necessary. Firstly, the committee thinks that students in the Educational Committee (and preferably also in the Educational Advisory Committee) should be elected, so as to guarantee that they can function as a spokesperson for the student population which they represent. Secondly, the committee stresses the need for the programme management to try and improve the response rates to course evaluations and involve alumni in the process of evaluating the programme as a whole.

Conclusion

Bachelor's degree programme Physics & Astronomy : the committee assesses Standard 2 as 'satisfactory'.
Master's degree programme Physics and Climate Science: the committee assesses Standard 2 as 'satisfactory'.

Standard 3: Assessment and achieved learning outcomes

The programme has an adequate assessment system in place and demonstrates that the intended learning outcomes are achieved.

Explanation:
The level achieved is demonstrated by interim and final tests, final projects and the performance of graduates in actual practice or in post-graduate programmes. The tests and assessments are valid, reliable and transparent to the students.

Findings

This section deals with the assessment policy, the procedures regarding testing and examination and the assessment methods of both programmes. To this end various assessment materials have been evaluated, such as students' exams and essays, assessment keys, assessment forms and research project reports. The assessments and assessment system were also discussed with students, the staff, the Board of Examiners and the programme management.
The committee studied a selection of graduation theses to assess whether graduates have obtained the intended learning outcomes. It also had discussions with students, teachers, and alumni about the qualifications of the graduates and the relation to the requirements of the labour market.

3.1 Assessment system and Board of Examiners

In accordance with statutory regulations, the bachelor's degree programme Physics & Astronomy and the master's degree programme Physics and Climate Science have laid down their assessment system in an 'Education and Examination Regulations' (OER) document. The document provides students with information on, for instance, the admission criteria for tests, exam dates and assessment instruments. The individual assessment procedure for each course is made clear at the beginning of that course and can be found in the study guide. There are two Boards of Examiners, one for the Undergraduate School and one for the Graduate School of Natural Sciences. These Boards of Examiners are responsible for drawing up and enforcing the rules and regulations, and check the quality of assessment within their schools. They have delegated part of their responsibilities to the Sub Board of Examiners Physics & Astronomy. Two members of this Sub Board are also a member of respectively the Board of Examiners of the Undergraduate School and the Board of Examiners of the Graduate School Natural Sciences. Furthermore, all three committees benefit from advice provided by the Assessment Advisory Committee *('toetsadviescommissie')* – established by the Science Faculty in 2011 as a center of expertise regarding assessment and assessment-related didactics. Finally, the bachelor's degree programme wants to start an annual graduation assessment starting from 2013/2014 onwards. Five members of staff will evaluate a number of theses supervised by one of them to check whether students have been given a fair assessment.

The assessment committee has studied the organogram provided in the self-assessment reports and concludes that the quality assessment of testing has a very complicated structure, with two Boards of Examiners and one Sub Board embedded in the Science Faculty, where each Graduate School has its own Board of Examiners. To makes things more confusing, a fourth Sub Board is mentioned in the organogram of the master's self-assessment report (Sub Board of Examiners of Physics and Climate Science) which upon closer examination proved to be identical to the Sub Board of Physics & Astronomy. The programme management assured the committee that responsibilities are well divided and clear. The Sub Exam

Committee deals with individual cases. Because its members are also member of the two Boards of Examiners, students' requests are easily passed over to the Undergraduate or Graduate School Exam Committee. The committee stresses that it should remain clear for students what the division of responsibilities is between the three Boards of Examiners.

Course assessment

Both programmes make use of various types of exams. Written exams are used most often, but students' work is also assessed by means of written reports, oral presentations, online assignments and practical work. The committee concludes that the various test forms tie in well with the intended learning outcomes. The programmes are working on an improvement of the quality assurance system for the tests of individual courses. At the moment, the quality of tests is checked randomly after the test has been taken by an assessment panel. Also, the programmes want to introduce a standard use of a test matrix that shows how the learning aims are being tested. This seems a good idea to the committee. When designing an exam or test, lecturers do not always consult a second person, for instance a colleague, to check whether questions are well-formulated and match the learning aims of the course. The committee advises the programme to adopt this policy, as it will help to further improve the quality of tests and exams. When students do not pass a course, they are allowed to retake the exam if their final mark is at least a 4 (out of 10). The committee discussed this rule with the students who remarked that they find the rule in principle fair, but that it is in practice not maintained, while teachers easily allow exceptions. The committee recommends the management to see to it that rules are clear, unambiguous and fulfilled.

Assessment procedure of the bachelor and master research project

During the site visit, both the bachelor's degree programme Physics & Astronomy and the master's degree programme Physics & Climate Science were in the process of revising the assessment procedure of the bachelor and master research project. The project and theses are assessed by the first supervisor and a second examiner, both members of staff, who give their marks independently. The second assessor has not been involved in the daily work of the student. Students get two marks, one for the thesis and one for the oral presentation. To assess the projects, both programmes make use of an Assessment Form composed by respectively the Undergraduate School and the Graduate School and standardized in the Science Faculty in 2011. As mentioned earlier, both programmes have also recently adapted a research project application form, which is signed by both the student and the supervisor and must be submitted before the start of the project.

To assess the level achieved, the assessment committee has read a selected number of bachelor's and master's theses. When trying to retrieve the supervisor's arguments for giving a certain grade, it learnt that assessment forms were often missing or not filled in properly, resulting in grades for which it is not clear how they have been arrived at. It also noted that the second assessor is not always independent, and, a bigger concern, that in the bachelor's theses there often was no second assessor. From talking to the students, the committee learned that some of them also remember that no assessment form had been used in the assessment of the bachelor's thesis. The academic staff recalls that the form has been put into place a year and a half ago in the master's degree programme. The committee does not understand why the programme has jumped the bus so late and stresses the need to formalize and implement the new assessment procedure as soon as possible. The committee urges the programme management to keep its promise to implement the new assessment procedure in 2014. The forms are available. In addition, the programme should make sure that the second examiner is able to judge the thesis independently.

The assessment committee nevertheless assesses standard 3 as 'satisfactory' because it can see that both programmes are working very hard to improve and formalize the quality control of examination. In the few cases that the assessment forms were used properly, they were of good quality. Also, the committee concludes that the overall quality control is adequate and that the exams are of high quality. The committee sees the Assessment Advisory Committee as a promising new committee and is also satisfied with the attention given to testing in the yearly assessment and job evaluation conversation with the lecturers.

3.2 Academic level achieved

Each member of the assessment committee has read a number of bachelor's and/or master's theses to check whether students have achieved the intended learning outcomes. It concludes that the quality of the theses is good and matches the academic level that may be expected of a bachelor's or master's thesis at academic level. In general, it agrees with the marks assigned to the theses and with the range of the grades, although in some cases the committee members would have given a considerable higher (a 6.5 was given for what seemed an excellent thesis) or lower grade was given, which in the opinion of one of the committee members would have been a 7 (instead of a 9) because the thesis lacked a clear research question. The committee concludes that such differences make the role of a second assessor and the use of an assessment form all the more important. But because assessment forms were missing, the committee found it hard to see what the student's work had been, and what the supervisor's. Finally, the committee concludes that some students take (much) too long to graduate, partly because they aim for a higher grade, as the committee learned.

The number of students graduating with the judicium cum laude is high, around 30%. The management told the committee that they want to decrease this number to around 20%. The committee finds this number still too high, and thinks that a percentage of around 5% is more realistic.

From studying the information provided in the self-assessment report, the committee concludes that graduates have no trouble finding a job, though most often in research. 85% of the bachelor graduates enroll in a master's degree programme, half of them in a Physics programme. Of the master's graduates 60% carries on in a PhD-track, either at Utrecht University or elsewhere. The committee concludes that this shows that graduates have achieved the intended learning outcomes.

Considerations

The committee confirmed that the system of testing is adequate. The examinations in the programme match the learning objectives of the courses. Students are well informed about assessment procedures. The introduction of new assessment forms, provided by the Undergraduate School and Graduate School for the assessment of the thesis project, should lead to more clarity on what the final grade is based on. This form, the committee concludes, needs to be better implemented and better formalized.

The committee finds the structure of two Boards of Examiners and one Sub Board of Examiners Physics & Astronomy complicated and stresses that it should be clear to students what the division of responsibilities is. It is impressed by the positive role and initiatives taken by the Assessment Advisory Board. Finally, it suggests that the quality of tests and exams should not only be checked afterwards, but could already be improved beforehand by making it custom to have tests and exams checked by a second reader.

To assess the level achieved by the students, the committee examined a range of bachelor's and master's theses. In general, it agrees with the marks that have been given and concludes that the level of the theses matches with what can be expected of a graduate of an academic bachelor's and master's degree programme in physics. It urges the programmes not to tolerate students taking longer over their final research project in order to get a higher grade. In this respect, the committee is hopeful that the recently adopted Research Project Application Form will also help students to finish their theses in time. Finally, the committee is of the opinion that a cum laude rate of around 5% would be much more realistic than the current 30%.

Conclusion

Bachelor's degree programme Physics & Astronomy : the committee assesses Standard 3 as 'satisfactory'.
Master's degree programme Physics and Climate Science: the committee assesses Standard 3 as 'satisfactory'.

General conclusion

In the committee's judgement, both the bachelor's degree programme Physics & Astronomy and the master's degree programme Physics and Climate Science at Utrecht University fulfil the criteria for accreditation. It has noted many positive aspects and suggested several points for improvement. Weighing up those points and the individual assessment of each standard, the committee concludes that both programmes 'meet the current generic quality standards and show an acceptable level across its entire spectrum' and consequently can be assessed as 'satisfactory'.

Conclusion

The committee assesses the *bachelor's degree programme Physics & Astronomy* as 'satisfactory'.
The committee assesses the *master's degree programme Physics and Climate Science* as 'satisfactory'.

Appendices

Appendix 1: Curricula vitae of the members of the assessment committee

Prof. dr. D. (Daan) Lenstra studied Physics at the University of Groningen and got his PhD at the Delft University of Technology on the subject 'Polarization effects in gas lasers'. Since 1979 his research is focuses on the broad area of quantum electronics. He was professor at the VU University Amsterdam from 1991-2006. Between 2000 and 2006 he was also professor at Eindhoven University of Technology. From 2004-2006 he was scientific director of the COBRA Research Institute. From November 2006 until his retirement in 2010 he was dean of the Faculty Electrical Engineering, Mathematics and Computer Sciences at Delft University of Technology. Since 2012 he is honorary advisor for the Faculty Electrical Engineering of Eindhoven University of Technology.

Prof. dr G. (Gustaaf) Borghs is professor emeritus at the Department of Physics and Astronomy, Leuven University, Belgium. He received his PhD in Nuclear Science from Leuven University in 1977. Since then he was involved in teaching and research at the Department of Physics and Astronomy, Leuven University, Belgium. He supervised more than 70 doctoral theses.
Since 1984, he is also working at the Inter-university Micro Electronics Centre (IMEC), Belgium.
He was the initiator of the convergence laboratory at imec/University of Leuven/ Life Sciences Research Institute (VIB), Flanders, Belgium in 2004 for researchers of conjugated disciplines of bio-electronics. Since 2008 he is senior fellow at IMEC.

Prof. dr. T. (Tom) Theuns is staff member (reader) at the Institute for Computational Cosmology of Durham University (UK). He teaches courses on astrophysics in year 2 (galactic astronomy) and year 4 (interstellar medium), supervises year 4 students, and six doctorate students have successfully obtained their doctorate theses under his supervision. Theuns was appointed as professor at the University of Antwerp in 2002, where he teaches courses on stellar evolution, galaxy formation and cosmology. He was a member of the doctoral committee of six doctorate students. Since 2008, Theuns has been a fellow of the British Higher Education Academy. This independent organisation supports excellence in the learning process and in teaching at institutes of higher education. Theuns is a member of the Astrosim European Science Foundation steering committee.

Dr. H.P. (Henk) Blok studied Experimental Physics at the VU University Amsterdam. He got his PhD in 1972 at the same university and stayed at this university as assistant professor and PI. He did experimental work with the VU cyclotron and the electronics accelerator of NIKHEF and other places (Boulder, Osaka, Darmstadt, Orsay, JLab, DESY). He taught and supervised undergraduate, graduate and PhD students. Between 1998 and 2004 he occupied the position of programme director Physics and educational director of the Faculty of Sciences at the VU University Amsterdam. He retired in 2005 from these functions but is still active in experimental work and teaching.

Dr. J. (Jan) Hoogenraad did his master's degree in Physics and got his PhD in 1996 at the FOM Institute for Nuclear and Molecular Physics (AMOLF) in Amsterdam. He was Research Scientist of the Philips Natuurkundig Laboratorium (1996-1998), System Engineer, Special Applications division, ASM Lithography (1998-1999), Product Development Manager Software Releases, ASM Lithography (1999-2004) and Manager Test and Quality, Nederlandse Spoorwegen (2003-2009). Since 2009 he has his own company, *Spoorgloren* for change management and quantative services in public transport. He published 20 papers in acknowledged international Physics Journals and is member of the *Nederlandse Natuurkundige*

Vereniging, The Institute of Physics (London), the American Physical Society and INCOSE (Association for Systems Engineering).

J.T.T. (Jelmer) Wagenaar, MSc got his bachelor degree in Physics in 2011 at the University Leiden and his master's degree in 2013 at the same university. During his studies he was teaching assistant for two subjects. During 5 years he was active as member of the educational committee of Physics. At the moment he is PhD student at the University Leiden and teacher Physics and Chemistry for pupils who are preparing themselves for graduation in secondary school.

Prof. dr. Julie Pietrzak became an Antoni van Leeuwenhoek Professor in 2011. She holds the Chair of Physical Oceanography within the Environmental Fluid Mechanics (EFM) Section. Her research in coastal oceanography covers stratified flows in estuaries and Region of Freshwater Influence (ROFI's) and suspended particulate matter dynamics. Much of this is carrying out with state of the art models such as Delft3D. Another key area of her research is next generation unstructured mesh models and developing accurate flood models. She participates in the development of unstructured mesh models and is an active member of the International Workshops on Unstructured Mesh Numerical Modelling of Coastal, Shelf and Ocean Flows, having hosted two events in Delft over the last decade. She has a keen research interest in the processes controlling stratification in coastal systems and the distribution of sediment, and how to accurately model these processes. She has been a member of the TUD-EFM group for over a decade. She has a record of successful multidisciplinary research.

Appendix 2: Domain-specific framework of reference

Bachelor's programme Physics and Astronomy

Uitgangspunten

Het doel van universitaire opleidingen in een vakwetenschap is de studenten voor te bereiden op de zelfstandige beoefening van het vak en de toepassing van de verworven kennis en vaardigheden. Algemeen wordt als uitgangspunt aanvaard dat de Nederlandse universitaire opleidingen in het domein natuur- en sterrenkunde een niveau moeten hebben waarmee de afgestudeerde zich op de internationale markt kan meten met afgestudeerden uit andere landen die gezichtsbepalend zijn voor het onderzoek. Het domeinspecifieke referentiekader bedoelt een maatstaf te geven voor dit uitgangspunt.
Het hier gepresenteerde kader is gebaseerd op het in de onderwijsvisitatie 2007 gebruikte referentiekader. Dat kader leunde sterk op de eindkwalificaties zoals die waren geformuleerd in het document 'Reference points for the design and delivery of degree programmes in physics', geproduceerd in het kader van het Tuning Project. Dit gaf ook de gewenste aansluiting met de Dublin-descriptoren als richtsnoer voor het verschil in niveau tussen Bachelor en Master. Verder is gebruik gemaakt van het meer recente document 'A European Specification for Physics Bachelor Studies' van de European Physical Society (2009). De eindtermen zijn geformuleerd in termen van competenties van de afgestudeerde. Dit leidt tot daarop gebaseerde eisen aan het curriculum: aan welke kennis en vaardigheden in het curriculum moet aandacht worden besteed. Opleidingen met dezelfde naam zijn overigens niet identiek. Naast bijvoorbeeld verschillen die ontstaan door verschil in onderzoeksspecialisatie van de wetenschappelijke staf en keuzemogelijkheden die studenten daardoor geboden worden, is er een meer structureel verschil tussen opleidingen aan algemene en technische universiteiten. Er zijn dan ook meerdere manieren om te voldoen aan de vereisten van het referentiekader. Essentieel is dat de eigen inkleuring past binnen de algemene, internationaal geaccepteerde maatstaven.

Het Referentiekader

Eindkwalificaties
Voor de bacheloropleidingen natuurkunde, sterrenkunde en technische natuurkunde kunnen de eindkwalificaties met de volgende drie types van competenties worden beschreven. Om aansluiting te houden met de eerder genoemde documenten worden deze hier in het Engels omschreven. Binnen de types is de volgorde aangehouden die het Tuning document de 'Rating of Importance Order' noemt.

(a) Discipline-gerelateerde cognitieve competenties.

	Specific competence	**Description. On completion of the degree course, the student should**
1	Problem solving skills	be able to evaluate clearly the orders of magnitude in situations which are physically different, but show analogies, thus allowing the use of known solutions in new problems
2	Knowledge and understanding of Physics	have knowledge of the foundations of modern physics and a good understanding of the important physical theories (logical and mathematical structure, experimental support, physical phenomena described);

	Specific competence	Description. On completion of the degree course, the student should
3	Modelling skills	be able to identify the essentials of a process/situation and to set up a working model of the same; be able to perform the required approximations; i.e. critical thinking to construct physical models
4	Understanding of the Physics culture	be familiar with the most important areas of physics and with those approaches, which span many areas in physics; have acquired a qualitative understanding of current developments at the frontiers of the physics discipline.
5	Familiarity with basic and applied research	acquire an understanding of the nature and ways of physics research and of how physics research is applicable to many fields other than physics, e.g. engineering; be able to design experimental and/or theoretical procedures for: (i) solving current problems in academic or industrial research; (ii) improving the existing results
6	Human / professional skills	be able to develop a personal sense of responsibility, given the free choice of elective/optional courses; be able to gain professional flexibility through the wide spectrum of scientific techniques offered in the curriculum
7	Absolute standards	have become familiar with highly regarded research in the field with respect to physical discoveries and theories, thus developing an awareness of the highest standards

(b) Discipline-gerelateerde praktische vaardigheden.

	Specific competence	Description. On completion of the degree course, the student should
8	Mathematical skills	be able to understand and master the use of the most commonly used mathematical and numerical methods
9	Experimental skills	have become familiar with most important experimental methods and be able to perform experiments independently, as well as to describe, analyse and critically evaluate experimental data; be able to scientifically report the findings
10	Computer skills	be able to perform calculations independently, even when a small PC or a large computer is needed, including the development of software programmes

(c) Discipline-gerelateerde generieke competenties.

	Specific competence	Description. On completion of the degree course, the student should
11	Literature search	be able to search for and use physical and other technical literature, as well as any other sources of information relevant to research work and technical project development; have good knowledge of technical English.
12	Ethical behaviour	appreciate that to fabricate, falsify or misrepresent data or to commit plagiarism constitutes unethical scientific behaviour; be objective, unbiased and truthful in all aspects of their work and recognise the limits of their knowledge.
13	Communication skills	be able to listen carefully and to present difficult ideas and complex information in a clear and concise manner to professional as well as to lay audiences; be able to work in an interdisciplinary team.
14	Foreign language skills	be able to gain command of foreign languages through, usually elective, participation in courses taught in foreign language.

Programma
Voor het programma van een Bacheloropleiding zijn er nog verschillende belangrijke randvoorwaarden waarmee de opbouw van het curriculum rekening moet houden.

Ten eerste is natuurkunde een hiërarchische discipline, die een geordende en gestructureerde kennisoverdracht vereist. Natuurkunde is verder gebaseerd op experimenten en observaties als de basis voor kennis. Ook moet in de huidige maatschappij een natuurkunde curriculum niet alleen studenten kunnen bedienen die voornemens zijn verder te gaan in de richting van universitaire of industriële research; maar ook studenten die een wat bredere maar wel op natuurkunde gebaseerde opleiding zoeken, die hen een goede basis van generieke competenties verschaft, waardoor ze hun eigen talenten optimaal kunnen ontplooien, en ze zich op een veelheid aan posities op de arbeidsmarkt kunnen richten. De kern van het Bachelor-Master systeem is tenslotte dat een Bachelor afgestudeerde niet automatisch door zal willen of hoeven gaan met een Master opleiding in dezelfde discipline of op dezelfde locatie, en opleidingen zullen hier op verschillende manieren een invulling aan willen geven. Tenslotte wordt het ingangsniveau van het Bachelorprogramma bepaald door het Nederlandse vwo, met een profiel Natuur en techniek, dan wel Natuur en gezondheid, met extra wiskunde. Van de opleidingen wordt verwacht dat zij aansluiten bij het eindniveau dat door het vwo feitelijk wordt geboden.

Om aan de eindkwalificaties te voldoen zal een student in elk geval vertrouwd moeten raken met de basisvakken van de natuurkunde, waaronder klassieke mechanica, elektromagnetisme, speciale relativiteitstheorie, kwantummechanica, optica, thermodynamica en statistische fysica. In de bachelorfase horen ook vakken thuis waarin deze basisvakken worden toegepast op de beschrijving van specifieke fysische systemen, zoals atomen, moleculen, atoomkernen, gassen en vaste stoffen. Elke bachelorstudent zal met enkele daarvan vertrouwd dienen te raken. Verder kan er in de bachelorfase in bescheiden mate aandacht gegeven worden aan de algemene relativiteitstheorie, de kwantumveldentheorie en de fysica van elementaire deeltjes. Als gevolg van de wiskundige structuur van natuurkundige theorieën is een behoorlijk pakket aan onderdelen van de wiskunde, mede gericht op het verwerven van analytische en numerieke vaardigheden, onmisbaar evenals aandacht voor modelleren met computersimulaties.. Aangezien waarnemingen en metingen de primaire bron zijn van natuurkundige kennis dient een natuurkundestudent praktische ervaring op te doen met werken aan en met moderne experimentele opstellingen. Hedendaagse methoden van registratie en verwerking van signalen en meetgegevens zijn daarvan een wezenlijk onderdeel. Daarvoor zijn de nodige moderne voorzieningen en apparatuur een vereiste.

In de bacheloropleiding in de technische natuurkunde zal bovendien aandacht moeten zijn voor praktisch werk dat gericht is op ontwerpen dan wel vervaardigen van objecten of apparaten met een praktisch nut, naast het verkrijgen van kennis of inzicht. De eerder genoemde toepassingsgebieden voor de basisvakken kunnen mede gekozen worden op grond van hun technische relevantie.

Doordat de sterrenkunde in haar fysische basis nauw verbonden is met de natuurkunde, is er zeker in het begin van de bacheloropleidingen een aanzienlijke overlap tussen beide vakwetenschappen. Daarbij zal de student Sterrenkunde zich vooral concentreren op die basisvakken van de natuurkunde die in de sterrenkunde belangrijk zijn. Een student zal zich in de bachelorfase ook specifiek astronomische vakken eigen moeten maken, zoals astrofysica, kosmologie, planeetsystemen en de evolutie van sterren en sterrenstelsels. Verder dient er gelegenheid te zijn vertrouwd te raken en ervaring op te doen met astronomische waarnemingstechnieken en meetmethoden. Daardoor zal het practicum in de sterrenkundeopleiding een ander karakter hebben dan in de natuurkundeopleiding.

Een bacheloropleiding in het domein van de natuur- en sterrenkunde kan niet volstaan met onderdelen van de eigen vakwetenschap alleen. Voor alle opleidingen geldt dat een afgestudeerde bachelor een scala van mogelijkheden heeft voor een vervolgopleiding dan wel een start op de arbeidsmarkt. Een vervolgopleiding kan zijn een masteropleiding in een specialisatie binnen het eigen vak. Maar ook masteropleidingen met een breder karakter (levenswetenschappen, nanowetenschappen) of in een andere discipline (scheikunde, wiskunde, bedrijfskunde) zijn toegankelijk voor afgestudeerde bachelors in de natuur- of sterrenkunde. Bovendien moet er mee rekening gehouden worden dat de arbeidsmarkt ruimte gaat bieden aan afgestudeerde bachelors op terreinen waar de verworven kennis en de voor natuur- en sterrenkunde karakteristieke methoden en vaardigheden toegepast kunnen worden. Vanwege deze diversiteit aan vervolgmogelijkheden voor een bachelor moet er tijdens de bacheloropleiding ruimte zijn voor differentiatie, die de student de gelegenheid biedt zich te oriënteren en voor te bereiden op deze keuzemogelijkheden. Daarvoor is een zekere keuzeruimte tijdens de opleiding onontbeerlijk. Ook is het belangrijk dat de opleiding wordt afgesloten met een onderzoeksproject. Daarin kan de student een eerste ervaring opdoen met vragen en methoden van onderzoek, en met de rapportage van resultaten in de vorm van een scriptie en een voordracht. Het niveau van het onderzoek en de mate van oorspronkelijkheid en zelfstandigheid van de student mogen daarbij uiteraard nog bescheiden zijn. Ze dienen aan te sluiten op het ingangsniveau van masteropleidingen. Daarvoor is nodig dat verschillende aspecten van wetenschappelijk onderzoek aan bod komen.

In ieder programma en voor elke student is academische vorming van belang. Daarom behoren training in communicatie in gesproken en geschreven vorm in het onderwijsprogramma aan de orde te komen, en er hoort aandacht te zijn voor wetenschapsethiek, evenals aandacht voor de geschiedenis van het eigen vak en inzicht in de positie van het vak binnen het geheel van wetenschap, cultuur en samenleving.

Tenslotte maakt ook toetsing integraal deel uit van een programma. Verschillende competenties vereisen verschillende manieren van toetsen. Klassieke tentamens en becijfering bijvoorbeeld geven inzicht in het conceptuele begrip, de wiskundige vaardigheden, en het probleemoplossend vermogen van de student. Toetsen binnen een bepaalde tijd of projecten met een afgesproken einddatum leren de student te werken onder druk en zijn werk te organiseren. Verslagen en presentaties maken duidelijk wat de student bereikt heeft onder minder restrictieve omstandigheden, en ten aanzien van communicatie. De toepassing van deze verschillende manieren van toetsen borgt de competenties die door het bachelorprogramma vereist worden.

Master's programme Physics and Climate Science

The descriptors for the master degree programmes can be described with three types of competences, as is done below. The sequence within each category is, with few exceptions, taken from what is called the 'Rating of Importance Order' in the Tuning document.

(a) Discipline-related cognitive competences.

	Specific competence	**Description. On completion of the degree course, the student should**
1	Modelling skills	be able to identify the essentials of a process/situation and to set up a working model of the same; be able to perform the required approximations; i.e. critically think about how to construct physical models.
2	Problem solving skills	be able to evaluate clearly the orders of magnitude in situations which are physically different, but show analogies, thus allowing the use of known solutions in new problems.
3	Knowledge and understanding of Physics	have a good understanding of the important physical theories (logical and mathematical structure, experimental support, physical phenomena described).
4	Familiarity with basic and applied research	acquire an understanding of the nature and ways of physics research and of how physics research is applicable to many fields other than physics, e.g. engineering; be able to design experimental and/or theoretical procedures for: (i) solving current problems in academic or industrial research; (ii) improving the existing results.
5	Frontier research	have a good knowledge of the state of the art in (at least) one of the presently active topics in physics research.
6	Human / professional skills	be able to develop a personal sense of responsibility; be able to gain professional flexibility through the wide spectrum of scientific techniques offered in the curriculum.
7	Physics culture	be familiar with the most important areas of physics and with the common approaches, which span many areas in physics.
8	Absolute standards	have become familiar with highly regarded research in the field thus developing an awareness of the highest standards.

(b) Discipline-related practical skills.

	Specific competence	**Description. On completion of the degree course, the student should**
9	Mathematical skills	be able to understand and master the use of the most commonly used mathematical and numerical methods.
10	Computer skills	be able to perform calculations independently, even when a small PC or a large computer is needed, including the development of software programmes.
11	Experimental skills	have become familiar with most important experimental methods and be able to perform experiments independently, as well as to describe, analyse and critically evaluate experimental data; and to be able to scientifically report the findings.

(c) Discipline-related generic competences.

	Specific competence	Description. On completion of the degree course, the student should
12	Literature search	be able to search for and use physical and other technical literature, as well as any other sources of information relevant to research work and technical project development; have good knowledge of technical English.
13	Learning ability	be able to enter new fields through independent study.
14	Ethical behaviour (relevant to physics)	be able to understand the socially related problems related to the profession, and to comprehend the ethical characteristics of research and of the professional activity in physics and its responsibility to society.
15	Specific communication skills	be able to listen carefully and to present difficult ideas and complex information in a clear and concise manner to professional as well as to lay audiences; be able to work in an interdisciplinary team.
16	Managing skills	be able to work with a high degree of autonomy, even accepting responsibility in (project) planning, and in the managing of structures.
17	Updating skills	enjoy the facility to remain informed of new developments and methods, and be able to provide professional advice on their possible impact or range of applications.
18	Foreign language skills	have improved command of foreign languages through participation in courses taught in foreign language.

Appendix 3: Intended learning outcomes

Bachelor's programme Physics and Astronomy

Aims

In het bachelorprogramma wordt beoogd studenten theoretische en praktische basiskennis en (wiskundige) basisvaardigheden in de discipline (natuurkunde, sterrenkunde, mfo) te geven.

Het bachelorprogramma biedt de student de mogelijkheid een inhoudelijke profilering aan de studie te geven door zich nader te verdiepen in een deelgebied van de discipline of zich te verbreden in een andere wetenschappelijke discipline.

In het bachelorprogramma wordt de student getraind in algemene vaardigheden: mondeling en schriftelijk rapporteren, computergebruik, projectmatig werken, werken in teamverband etc.

In het bachelorprogramma wordt de student de gelegenheid geboden om zich te oriënteren op onderzoeksmasters, maatschappij gerichte masters en communicatie/educatiemasters en/of zich voor te bereiden op de keuze van een verdere (studie)loopbaan.

Exit qualifications

Na afronden van het bachelorprogramma is de student in staat om:

Vakspecifiek:

- De basisconcepten van de discipline (natuurkunde, sterrenkunde, mfo) te benoemen en hun onderlinge fysische en wiskundige relatie te beschrijven.
- Basale problemen in een geïsoleerde context op het gebied van de natuurkunde, sterrenkunde of mfo met wiskundige of numerieke hulpmiddelen op te lossen dan wel daarover op een experimentele of observationele wijze informatie te vergaren en deze te interpreteren.
- Een begin te maken met een zelfstandig afsluitend onderzoek in een onderzoeksgroep van de faculteit of elders. De student is daarbij in staat om
  a. zelfstandig nieuwe vakkennis en vaardigheden te verwerven en deze te integreren met reeds opgedane kennis en vaardigheden, en
  b. bovendien om over zijn/haar werk schriftelijk en mondeling te rapporteren.

Algemene academisch:

- Een visie te ontwikkelen over de plaats en het belang van de discipline in een brede wetenschappelijke, wijsgerige en maatschappelijke context.
- Om te gaan met klassieke en moderne wetenschappelijke bronnen van informatie.
- Projectmatig te kunnen werken en hierover schriftelijk en mondeling te kunnen communiceren.
- Een verantwoorde keuze te maken voor een vervolgopleiding of de arbeidsmarkt.

Master's programmes Physics and Climate Science

The exit qualifications of the master degree programme Physics and Climate Science are identical to those of the domain-specific reference context.

Programme specific learning outcomes:

Theoretical Physics

Students should acquire the amount of knowledge, insight and technical skills in the field of theoretical physics and related disciplines required to work independently at a professional academic level, or to continue their education in a PhD programme.

Knowledge and understanding
1a: Has basic knowledge of field-theoretic and mathematical methods in theoretical physics, and has insight into its use in high-energy physics and/or condensed matter physics and/or statistical physics. 1b: Can employ this knowledge to contribute to ongoing research in one of those areas.
2. Is aware of recent development in theoretical physics, and can put this into perspective of physics as a whole.
3. Is able to understand the international literature on at least one branch of theoretical physics, and to relate this to his/her own research.
Applying knowledge and understanding
4. Is able, possibly guided by a staff member, to translate a problem of modern theoretical physics into a research question.
5. Is able, under supervision of a staff member, to formulate a research plan that meets scientific standards.
6. Is capable to carefully conduct this research, supervised by a staff member, and to analyse and interpret the results obtained.
Making judgements
7. Can discuss the results of this theoretical research with the supervisor and fellow students, and possibly also with other researchers in the research group.
8. Can indicate the meaning and content of this research for the particular branch of theoretical physics.
9. Can critically reflect on this theoretical-physics research.
Communication
10. Can explain the results of this research to an audience of specialists as well as fellow students, both orally and in writing, in English.
11. Can conduct a theoretical-physics research project, supervised by a staff member, possibly as a part of (multidisciplinary) research team.
Learning skills
12. Has obtained the ability to study focused and independently.
13. Has an academic attitude towards the field of theoretical physics, which allows for further growth in this field or outside.
14. Is qualified to be admitted to a PhD research project in the field of theoretical physics, physics in general, and/or mathematics.

Particle Physics

Knowledge and understanding
1a. Has knowledge of modern particle physics with an emphasis on the Standard Model, and 1b. profound knowledge of the physics of strong interactions and/or another special subtopic of relevance in current particle physics research such that the international research literature can be understood.
2. Has knowledge of experimental techniques of particle detection and data analysis in high-energy physics.
Applying knowledge and understanding
3. Is able to identify, formulate, analyse and suggest possible solutions to problems independently in the field of particle physics.
4. Is able to conduct research in the field of particle physics under supervision of a scientific staff member and report on it in a manner that meets the customary standards of the discipline.
5. Is able to apply knowledge and insight in original research projects in the area of particle physics, at the level of international scientific journals. 6. Is able to communicate both orally and written conclusions, as well as the underlying knowledge, grounds and considerations, to an audience composed of specialists or non-specialists in English.
Making judgements
7. Is able to participate critically and constructively in the scientific debate in the research group.
8. Is able to indicate the relevance of his/her research for the advancement of physics.
9. Is able to reflect critically upon his/her own contribution, and that of others.
Communication
10. Has the skills to discuss, in spoken and written English, on the results of research, including the underlying knowledge and background.
11. Is able to work together constructively critical in an international team of experts and use modern means of scientific communication.
Learning skills
12. Has the skills to evaluate his/her own learning and development process and to adjust this process if necessary.
13. Displays a professional and academic work attitude that enables him/her to work in an area related to the research on particle physics.
14a. Has the qualifications to enroll in a PhD programme in particle physics 14b. Is qualified to acquire a research position in a (semi) public or commercial organization.

Meteorology, Physical Oceanography and Climate

Knowledge and understanding
1a. Has knowledge of the physics of the climate system, as is described in the specific aims of the courses of the programme. 1b. Has understanding of the dynamics of atmosphere, ocean and climate and is able to use this knowledge and understanding to contribute to further development and/or application of scientific concepts and methods.
2a. Has knowledge of important developments in the field of global climate models and of process-oriented models. 2b. Is able to state the relevance of these developments for the research field and society.
3. Has knowledge of the scientific literature in one of the five specialised research themes that is covered by the programme and is able to adequately interpret this literature.
Applying knowledge and understanding
4. Is able to define a scientific problem in the field of climate science and design a basic strategy to solve this problem.
5. Is able to develop a numerical model, and to use and improve (parts of) existing numerical models of different degrees of complexity.
6a. Is able to analyse, process and interpret the output of numerical models. 6b. Is able to analyse, process and interpret measured data.
Making judgements
7. Is able to discuss at a professional level about scientific aspects of climate research.
8. Is able to indicate the relevance of fundamental scientific research for finding solutions for problems in the field of climate science.
9. Is able to critically reflect on own results, as well as on published scientific literature in the field of climate science.
Communication
10. Is able to transfer knowledge and results of research in the field of climate science to both a specialised and a more broadly interested audience.
11. Is able to act professionally in a (possibly multi-disciplinary) research team.
Learning skills
12. Has the skills to reflect upon his/her learning and evolution process and, if necessary, adjust this process.
13. Has developed an effective and result-driven working method that enables him/her to function in a self-reliant manner in a competitive labour market.
14. Has acquired sufficient scientific knowledge and skills to conduct independent scientific research, or to conduct other discipline-related work.

Appendix 4: Overview of the curricula

Bachelor's programme Physics and Astronomy

Summary of the bachelor programme

	Level 1	Level 2	Level 3	Total
Major required	45	22,5		67,5
Major elective	7,5	22,5	30	52,5
Research project			15	15
optional course profile	7,5*	22,5*	15*	45
Total	60	60	60	180

*Minimum 15 ec at level 2. Thus, the distribution over the levels may also differ from what is shown. For example, if the optional course profile is taken completely outside Physics & Astronomy, a distribution of 22,5 ects (level 1), 15 ects (level 2), and 7,5 ects (level 3) is more obvious.

Required courses (total 82,5 ec, 75 for twin students).

Course	Level	Physics Lab
Relativistische en Klassieke Mechanica (MERL)	1	
Data Acquisitie en Toegepaste Analyse (DATA)	1	X
Golven & Optica (G&O)	1	X
Electromagnetisme (ELE)	1	
Wiskundige Technieken 1 (WT1)	1	
Wiskundige Technieken 2 (WT2)	1	
Wiskundige Technieken 3 (WT3)	2	
Statistische Fysica (SF)	2	X
Kwantummechanica (QME)	2	
Bachelor Onderzoek (BONZ)	3	

Elective courses

Course	Level
Klimaatverandering in context (O)	1
Atmosfeer- en Oceaandynamica	1
Wetenschappelijke Revolutie	1
Bouw & Ontwikkeling van Sterren	1
Electrodynamica	2
Klimaat & Straling	2
Numerieke Methoden voor fysici en astronomen	2
Geavanceerd Practicum	2
Filosofie en Grondslagen van de Natuurkunde (O)	2
Voortgezette statistische fysica	3
Voortgezette mechanica	3
Voortgezette kwantummechanica	3
Moderne gecondenseerde materie	3

Course	Level
Quantummaterie	3
Klassieke veldentheorie	3
Geofysische stromingsleer	3
Klimaatdynamica	3
Subatomaire fysica	3
Kosmologie	3
Geschiedenis van de Moderne Natuurkunde	3

Appendix 5: Quantitative data regarding the programmes

Data on intake, transfers and graduates

Bachelor's programme Physics and Astronomy

Total intake, including double-major programme (TWIN)

Year	Total	Male	Female
06/07	116	91	25
07/08	96	69	27
08/09	102	87	15
09/10	126	96	30
10/11	142	120	22
11/12	127	107	20
Total	**709**	**570**	**139**

Source: Osiris

Graduated, still registered and stopped

Year	Cohort size	Graduated*	Still registered	Stopped
06/07	116 (35)	68 (24)	6 (0)	42 (11)
07/08	96 (32)	54 (16)	6 (3)	36 (16)
08/09	102 (44)	45 (30)	18 (5)	39 (9)
09/10	126 (48)	24 (15)	52 (16)	50 (17)
10/11	142 (57)	4 (0)	79 (?)	59 (?)
11/12	127 (51)	1 (0)	87 (?)	39 (?)
Total	**709**	**196**	**248**	

Source: Osiris

* including students who switched from the double-major programme (TWIN) to the bachelor's degree programme Mathematics after the first year: 2006 (1), 2008 (1), 2009 (2). Numbers in between brackets refer to TWIN students.

Stopped

Year	Cohort size	After one year (number)	After one year (%)	Total
06/07	116	30	26%	42
07/08	96	25	26%	36
08/09	102	30	29%	39
09/10	126	43	34%	50
10/11	142	49	35%	59
11/12	127	39	31%	39

Source: Osiris

Exams per year / output

06/07	07/08	08/09	09/10	10/11
62	57	86	72	82

Average duration in months

Cohort	Cohort size	Graduated	Duration
06/07	116	68 (24)	49
07/08	96	54 (16)	48
08/09	102	45 (30)	43
09/10	126	24 (15)	37
10/11	142	4 (0)	23
11/12	127	1 (0)	10

Master's programmes Physics and Climate Science

Total intake of the master's programmes

	Own university	Other universities (NL)	HBO	Outside HE (international)	Total
2006/07	35	2	0	7	44 (9)
2007/08	49	5	0	9	63 (11)
2008/09	46	1	1	14	62 (18)
2009/10	53	13	0	16	82 (16)
2010/11	34	3	0	7	44 (5)
2011/12	34	7	0	19	60 (13)

Intake per academic year, including students Nanomaterials-Physics, all intake moments
Numbers between brackets refer to female students

Throughput of the programme Theoretical Physics

Year	Cohort size	From own university		From other universities (NL)		From HBO		From outside HE (internat.)	
		Gra-dua-ted	Still regis-tered	Gra-dua-ted	Still regis-tered	Gra-dua-ted	Still regist-ered	Gra-dua-ted	Still regis-tered
2006/07	28	16	0	-	-	-	-	5	0
2007/08	30	18	1	1	0	-	-	5	0
2008/09	23	11	1	-	-	-	-	5	0
2009/10	31	11	5	0	1	-	-	6	0
2010/11	27	8	8	0	1	-	-	3	4
2011/12	29	1	14	0	2	-	-	0	9
2012/13	30	0	19	0	1	-	-	0	10

Throughput of the programme Particle Physics

Year	Cohort size	From own university		From other universities (NL)		From HBO		From outside HE (internat.)	
		Gra-dua-ted	Still regis-tered	Gra-dua-ted	Still regis-tered	Gra-dua-ted	Still regist-ered	Gra-dua-ted	Still regis-tered
2006/07	7	3	0	-	-	-	-	-	-
2007/08	8	5	0	-	-	-	-	-	-
2008/09	10	4	0	-	-	-	-	0	0
2009/10	8	2	2	-	-	-	-	1	0
2010/11	6	3	0	-	-	-	-	1	1
2011/12	6	0	3	-	-	-	-	0	3
2012/13	4	0	4	-	-	-	-	-	-

Throughput of the programme Meteorology, Physical Oceanography and Climate

Year	Cohort size	From own university		From other universities (NL)		From HBO		From outside HE (internat.)	
		Gra-dua-ted	Still regis-tered	Gra-dua-ted	Still regis-tered	Gra-dua-ted	Still regist-ered	Gra-dua-ted	Still regis-tered
2006/07	6	4	0	1	0	-	-	-	-
2007/08	14	9	0	3	0	-	-	2	0
2008/09	20	13	0	1	0	1	0	2	0
2009/10	26	12	0	9	0	-	-	4	0
2010/11	7	3	1	2	0	-	-	0	0
2011/12	14	0	3	0	3	0	1	0	6
2012/13	23	0	13	0	3	-	-	0	7

Programme performance of the master's programmes Physics and Climate Science

Cohort	Cohort size at 1 October	Yield after 1 year (%)	Yield after 2 years (%)	Yield after 3 years (%)	Yield after 4 years (%)
2006/07	38	3	34	82	89
2007/08	57	12	39	79	86
2008/09	48	8	48	81	85
2009/10	69	7	39	80	
2010/11	41	2	49		
2011/12	53	4			

Output of the master's programmes Physics and Climate Science

Year	From own university		From other universities (NL)		From HBO		From outside HE (internat.)	
	Gradu-ated	Average dura-tion	Gradu-ated	Average duratio n	Gradu-ated	Average duratio n	Gradu-ated	Average duratio n
06/07	7	22	1	31	0	-	7	27
07/08	31	20	0	-	0	-	10	33
08/09	41	23	2	26	0	-	5	40
09/10	40	26	3	30	0	-	11	26
10/11	29	28	3	24	0	-	8	28
11/12	43	29	9	25	1	35	12	31

Teacher-student ratio achieved

Teaching staff quality

Grade	MA	PhD	BKO
Percentage	100%	96%	83%

Source: Human Resources, Faculty of Science

On November 1, 2012, the number of bachelor students Physics and Astronomy was 379 (source: Osiris). (The number of students in the master degree programme Physics and Climate Science was 134 (source: Osiris) , and thus the total number of students was 513.)
The total size of available teaching staff (in fte units) on November 1, 2012, was 20,0 (source: Dpt. of Human Resources). Within the teaching staff no division is made between master and bachelor teaching.

This yields as student-teaching staff ratio: 379/20=19,0, if only bachelor students are counted, or 513/20=25,7 for all (bachelor and master) students.

Ratio	379 students (2012) / 20,0 fte = 19,0 (only bachelor students counted) 513 students (2012) / 20,0 fte = 25,7 (bachelor and master students counted)

Source: Osiris (students) and Human Resources, Faculty of Science (staff)

Average amount of face-to-face instruction per stage of the study programme

	Year 1 (Bachelor) Hours per student in this year	**Year 2 (Bachelor) Hours per student in this year**	**Year 3 (Bachelor) Hours per student in this year**
Lectures	288	270	222
Working classes	324	326	268
Physics Lab	117	72	18
Assessments/exams	28	26	20
Total contact time	**757**	**694**	**528**

The table below shows average number of contact hours for a typical 7.5 EC course

	Number of hours per student
Lectures	32
Tutorials	32
Assessment/exams	3
Total contact time	67
Total time of the course (7.5 EC)	210

Appendix 6: Programme of the site visit

Dag 1: 12 november 2013 – ALLEEN COMMISSIE		
12.30	13.30	Aankomst en lunch commissie
13.30	14.30	Presentatie visitatie aan expertleden en nieuwe commissieleden Uitleg CROHO-labelwijziging
14.30	17.30	Internoverleg en voorbespreking commissie Bestuderen documenten
19.00		Diner (commissie)

Dag 2: 13 november 2013		
8.30	11.00	Voorbereidend overleg commissie + inzage documenten
11.00	12.00	Management 1: - opleidingsdirecteur BA natuur- en sterrenkunde, dr. A.M. Vredenberg - onderwijsdirecteur, prof.dr. G.I. Barkema - programmaleiders: Theoretical physics, prof.dr. R.H.H.G. van Roij Experimental physics, prof.dr. R.J.M. Snellings Meteorology, physical oceanography and climate, prof.dr. W.P.M. de Ruijter
12:00	12:45	Management 2: programmaleiders Science and Business Management (SBM) en Energy science, prof. dr. J.C.M. Smeekens, dr. W. van Sark, onderwijsdirecteur departement IMEW dr. M.C. Bootsma coördinator FBE Master Science and Business Management, prof.dr. A.Buijs 1 programmaleider History and Philosophy of Sciences, prof.dr. L.T.G. Theunissen
12:45	14:30	Lunch
14:30	15:30	Studenten BA: K.I. van der Wijst; R. van der Vaart; J. Smits; T. Figiel Studenten MA THPH: T. Drwesnki; T. Sikkenk Student MA EXP: A. Veen Studenten MA MPOC: F. van der Burgt; E. Lambert
15:30	16:30	Studenten SBM: P.Frijters BSc; A. van Muijden BSc.; R.Ruitenbeek BSc; Studenten ES: A.Boonstra BSc; ing. P. Claassens; D.Klip BSc; Studenten HPS: M. Walker BSc; T. Hagendijk BSc; L. van Zuijlen BSc

Parallelsessie

16:45	17:15	Alumni THPH: E. van der Bijl MSc; I. Lodato MSc EXP: M. Veldhoen MSc; R. Bertens MSc; MPOC: W. Ridderinkhof MSc; E. Tuenter, MSc.	Alumni SBM: M. Schuchardt MSc; N. Thuss MSc; ES: J. Braslawsky MSc; drs. O. Edelenbosch MSc HPS: P. Acuna Luonga MSc; S. Heijnens MSc
17:15	18.00	Intern overleg commissie	
19.00		Diner (commissie)	

Dag 3: 14 november 2013			
8:30	9:30	Examencommissies en studie-adviseur -voorzitter examencommissie Graduate school of Natural Sciences (HPS, MPOC, THPH, EXP): dr. C. De Mello-Donega; - voorzitter examencommissie Undergraduatie School: dr. G.M.H.Engels; - voorzitter examencommissie Graduate School of Life Sciences (SBM): dr. M.L. Zonderland; - voorzitter Graduate School Geosciences (ES): dr. E. Nieuwlaar; - voorzitter van de deelexamencommissie Ba + MA natuurkunde: prof.dr. M. van den Broeke; - voorzitter van de deelexamencommissie HPS; prof.dr. D.G.B.J. Dieks; -studieadviseur BA en MA natuurkunde: prof.dr.H.C. Gerritsen.	
9:30	10:15	Opleidingsadviescommissies BA en MA Natuurkunde: - voorzitter: dr. R. Duine; - lid: dr. G. Blab; - masterstudentlid: S. van der Meijden, BSc; - bachelorstudent: F. Nolet; - voorzitter UGS OC: prof.dr. L.W. Jenneskens.	Opleidingsadviescommissies SBM, ES en HPS: -voorzitter GSLS SBM: prof.dr. J. Boonstra; -student GSLS SBM: L. van der Wal, BSC; -voorzitter MA OC IMEW: dr. A. Ramirez; -student MA OC IMEW B. Vermeer, BSc; - student MA ES: L. Helper, BSc; - voorzitter HPS: drs. L.C.Palm; - student HPS: R.M. Bertnes, BSc.
10:30	11.30	Docenten 1: -BA Natuurkunde: dr. P.J.S. van Capel, dr. A. Imhof; -MA THPH: prof.dr. S.G.J. Vandoren; -MA EXP en MPOC: dr. R.S.W. van der Wal, dr. A.S. von der Heydt, dr. D. van Oosten;	
11.30	12.30	Docenten 2 -MA SBM: prof.dr. J. Wempe, drs. P. van der Meer; - MA ES: dr. M. Junginger, dr. E. Nieuwlaar; - MA HPS: prof.dr. W.Mijnhardt, prof.dr. L.Dorsman.	
12.30	13.00	Open spreekuur/rondleiding	
13.00	15.00	Lunch en voorbereiden eindgesprek	
15.00	15.45	Eindgesprek management 1 met bestuurders -1 opleidingsdirecteur BA Management 1: - opleidingsdirecteur BA natuur- en sterrenkunde, dr. A.M. Vredenberg - onderwijsdirecteur, prof.dr. G.I. Barkema - hoofd afdeling Natuur- en Sterrenkunde: prof.dr. J.I. Dijkhuis - programmaleiders: Theoretical physics, prof.dr. R.H.H.G. van Roij Experimental physics, prof.dr. R.J.M. Snellings Meteorology, physical oceanography and climate, prof.dr. W.P.M. de Ruijter Voorzitter Graduate School Natural Sciences: prof.dr. L.A.C.J. Voesenek; Voorzitter Undergraduate School: prof.dr. H.E. de Swart; dr. G.W. Heil	
15:45	16:30	Eindgesprek management 2 met bestuurders programmaleiders Science and Business Management (SBM) en Energy science, prof. dr. J.C.M. Smeekens, prof. dr. K. Blok, onderwijsdirecteur GEO: dr. M.C. Bootsma; programmaleider History and Philosophy of Sciences, prof.dr. L.T.G. Theunissen; voorzitter Graduate School of Life Sciences: prof.dr. D. Bär; vice-decaan onderwijs Geofaculteit: prof.dr. P. Hoekstra.	

Dag 3: 14 november 2013		
16.30	17.00	Opstellen eerste bevindingen
17.00	17.30	Mondelinge rapportage

Appendix 7: Theses and documents studied by the committee

Prior to the site visit, the committee studied the theses of the students with the following student numbers:

Bachelor's programme Physics and Astronomy

3144097	3345599	3547833	3345556
3245780	3476995	3471047	3230708
3502309	3359778	3251497	3377563
3505014	3355055	3337324	
3060969	3345149	3355349	
3471667			

Master's programmes Physics and Climate Science

3120791	3021068	3319830	3555712
3559998	3021084	3404633	3545849
3220850	3078728	3212939	3437639
3379639	348082	3032183	3023427
3034518	3542785	3137872	
9904697	0134260	3118363	
3118401	3061981	3021076	

During the site visit, the committee studied, among other things, the following documents (partly as hard copies, partly via the institute's electronic learning environment):

- Minutes and reports of relevant committees (Educational Committee, Board of Examinors, Committee of Assessments);
- Tests and assignments with the assessment criteria and standard answers;
- Summary and analysis of evaluation results;
- Regulations and manuals for internships and thesis;
- course material and tests of a selection of courses per year;
- Information and documentation for students.

• Appendix 8: Declarations of independence

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ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: D. LENSTRA

PRIVÉ ADRES: HUIZERWEG 58

1261 AZ BLARICUM

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

DESKUNDIGE

AANGEVRAAGD DOOR DE INSTELLING:

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

1

VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: UTRECHT DATUM: 8 oktober 2013

HANDTEKENING:

2

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ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Gustaaf Borghs

PRIVÉ ADRES: KU Leuven Blok D
Celestijnenlaan 3000 Leuven
België

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

____

____

AANGEVRAAGD DOOR DE INSTELLING:

____

____

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

1

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nederlands - vlaamse accreditatieorganisatie

VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Utrecht DATUM: 8 october 2013

HANDTEKENING:

2

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ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Tom Theuns

PRIVÉ ADRES:

16 Clarendon House, Clayton St West, Newcastle NE1 5EE, UK

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

Natuur en sterrenkunde

AANGEVRAAGD DOOR DE INSTELLING:

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

1

VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Durham

DATUM: 21 November 2013

HANDTEKENING:

2

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ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: H. P. Blok

PRIVÉ ADRES:

Prinses Ireneplantsoen 18
1191 CB Ouderkerk aan de Amstel

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

AANGEVRAAGD DOOR DE INSTELLING:

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

1

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VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Nijmegen

DATUM: 3 nov. 2013

HANDTEKENING: H. P. Blok

2

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ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: J. H. HOOGENRAAD

PRIVÉ ADRES:

POSTBUS 2717

3500 GS UTRECHT

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

AANGEVRAAGD DOOR DE INSTELLING:

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

1

VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: UTRECHT

DATUM: 8 OKTOBER 2013

HANDTEKENING:

2

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ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Jelmer J.T. Wagenaar

PRIVÉ ADRES: Ruysdaelhof 32
2251 JK Voorschoten

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

AANGEVRAAGD DOOR DE INSTELLING:

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

1

VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Utrecht DATUM: 8-10-'13

HANDTEKENING:

2

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nederlands - vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Prof. Dr. Julie D Pietrzak

PRIVÉ ADRES: OUDE DELFT 6, DELFT,
The Netherlands, 2611 CC

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

Natuur en Sterrenkunde (Physics and Climate Science)

AANGEVRAAGD DOOR DE INSTELLING:

UNIVERSITY OF UTRECHT

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

1

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VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Delft DATUM: 10 Feb. 2014

HANDTEKENING:

J Pietrzak

2

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Qu36

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Joke Corporaal

PRIVÉ ADRES: Weerenhof 8207
6536 CA, Nijmegen

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

Natuur- en Sterrenkunde (BA en MA)

AANGEVRAAGD DOOR DE INSTELLING:

Universiteit van Utrecht, Universiteit Twente,
Universiteit van Amsterdam, Vrije Universiteit Amsterdam

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

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VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Nijmegen DATUM: 28/1/'14

HANDTEKENING:

2