Astronomy

Faculty of Science,
Leiden University

Quality Assurance Netherlands Universities (QANU)
Catharijnesingel 56
PO Box 8035
3503 RA Utrecht
The Netherlands

Phone: +31 (0) 30 230 3100
Telefax: +31 (0) 30 230 3129
E-mail: info@qanu.nl
Internet: www.qanu.nl

Project number: Q0436

© 2014 QANU
Text and numerical material from this publication may be reproduced in print, by photocopying or by any other means with the permission of QANU if the source is mentioned.

CONTENTS

This report was finalized on 21 May 2014

Report on the master's programme Astronomy of Leiden University

This report takes the NVAO's Assessment Framework for Limited Programme Assessments as a starting point.

Administrative data regarding the programme

Master's programme Astronomy

Name of the programme:	Astronomy
CROHO number:	60200
Level of the programme:	master's
Orientation of the programme:	academic
Number of credits:	120 EC
Specializations or tracks:	Research in Astronomy; Cosmology; Astronomy and Instrumentation; Science Based Business; Science Communication and Society; Science and Education.
Location(s):	Leiden
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 Leiden University took place on 5 and 6 December 2013.

Administrative data regarding the institution

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

Quantitative data regarding the programme

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

Composition of the assessment committee

The committee that assessed the master's programme Astronomy consisted of:

- Prof. dr. Daan Lenstra, professor emeritus of Electrical Engineering at Delft University of Technology and fellow at Eindhoven University of Technology (chair);
- Prof. dr. Wim de Boer, professor of Physics at the University of Karlsruhe (DE);

- Prof. dr. Elias Brinks, professor of Astrophysics at the University of Hertfordshire (UK);
- Prof. dr. Martin Goedhart, professor Mathematics and Science Education at University of Groningen;
- Dr. Jan Hoogenraad, owner of Spoorgloren BV for change management and quantitative service in public transport;
- Sander Breur MSc, PhD candidate at Nikhef, University of Amsterdam.

The committee was supported by Astrid van Vliet MA, who acted as secretary.

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

Working method of the assessment committee

The assessment of the master's programme Astronomy of Leiden University is part of a cluster assessment. In the context of this cluster visitation, in the time period between November 2013 and April 2014, twenty-eight programmes at nine different institutions were assessed.

The committee Physics and Astronomy is composed of in total sixteen members:

- Prof. dr. Daan Lenstra, professor emeritus of Electrical Engineering at Delft University of Technology and fellow at Eindhoven University of Technology (chair);
- Prof. dr. Wim de Boer, professor of Physics at the University of Karlsruhe (DE);
- Prof. dr. Elias Brinks, professor of Astrophysics at the University of Hertfordshire (UK);
- Prof. dr. Tom Theuns, reader in Astrophysics at Durham University (UK) and part time professor of Astrophysics at the University of Antwerp (BE);
- Prof. dr. Gustaaf Borghs, professor emeritus of Physics at KU Leuven (BE) and senior fellow at the Interuniversity MicroElectronics Centre (IMEC);
- Dr. ir. Jaap Flokstra, retired associate professor at University of Twente;
- Prof. dr. ir. Guido van Oost, full professor Plasma Physics, Department of Applied Physics, Ghent University (BE);
- Dr. Henk Blok, retired associate professor, Faculty of Sciences, VU University Amsterdam;
- Prof. dr. Martin Goedhart, professor Didactics of Mathematics and Natural Sciences at University of Groningen;
- Christianne Vink MSc, didactic coach, educational advisor/trainer and partner of Academic Factory;
- Dr. Jan Hoogenraad, owner of Spoorgloren BV for change management and quantitative service in public transport;
- Dr. ir. Harald Tepper, chief strategy officer at the Dutch Forensic Institute;
- Sander Breur MSc, PhD candidate at Nikhef, University of Amsterdam;
- Lisanne Coenen BSc, master student Applied Physics at Delft University of Technology;
- Carmen van Schoubroeck, student bachelor Mathematics and bachelor Physics and Astronomy, Radboud University Nijmegen;
- Jelmer Wagenaar MSc, PhD candidate in Physics at Leiden University.

To prevent any conflict of interest and based on expertise and availability, a (sub)committee was composed for every visit. Each committee consists of five to seven members. In order to guarantee consistence within the cluster, professor Lenstra attends to all visits, except to Delft and Eindhoven. Project coordinators for this cluster are Liza Kozlowksa MA and Kees-Jan van Klaveren MA, employees of QANU. The project coordinators accommodate on a regular basis with the secretaries of the different visits and they always attend the concluding meeting of the visit.

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 discussed. Appendix 2 contains the framework of reference.

To prepare the contents of the site visits, the secretary 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.

Next to the critical reflection, the committee members read a selection of fifteen master theses. The 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 secretary and adapted after consultation of the contact person at Leiden University. The timetable for the visit in Leiden 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 and the Board of Examiners. Meetings were also held with representatives of the students and teaching staff. Well in advance of the visit, the committee approved a list of the selected interview partners.

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.

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 of the preliminary impressions and general observations by the chair of the committee.

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 Leiden 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 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

The master's programme Astronomy is offered by the 'Sterrewacht Leiden ('Leiden Observatory'), which is part of the Faculty of Science of Leiden University.

Standard 1: Intended learning outcomes
The programme operates within the university concept of 'studying in a research environment'. The master's programme Astronomy offers three disciplinary research tracks: Research in Astronomy, Cosmology, Astronomy and Instrumentation. Furthermore, it offers three combined specializations: Science Based Business, Science Communication & Society and Education.

The committee recognizes the profile of a proud institute which is strongly focused on research. The 'Sterrewacht' has an excellent international reputation. The committee is very positive about this profile.

The committee established that the intended learning outcomes are in line with the domain specific requirements. They are also linked adequately with the Dublin descriptors. The learning outcomes indicate sufficiently that the programme is aiming at a master's degree level However, the committee considers the learning outcomes as being described too generally. It advises to specify the learning outcomes of the programme.

Standard 2: Teaching-learning environment
The master's programme is an English taught two-year programme of 120 EC. Each specialization has its own specific mix of core courses, electives and (research) projects. Each student writes a thesis based on a 30 or 36 EC final research project.

The committee is positive about the thorough and clearly research based profile of the curriculum. It appreciates the direct link the students have with the research groups of the institute. The combined specializations however attract very few students. The committee states that these should be better promoted or integrated with the other specializations in order to attract more students.

The committee found no information on the intended learning outcomes of individual courses and advises management to add this information. Notwithstanding these remarks, the committee is confident that the curriculum in general relates adequately to the intended learning outcomes of the programme and the Dublin descriptors, based on the course descriptions and course materials.

After discussions with students and alumni, the committee concludes that the programme informs them correctly about the intensive study programme. The committee compliments management with the average study duration. The committee is impressed by the commitment, expertise and academic qualities of the staff.

There is an open and direct communication between the education committee and the Director of Teaching. The committee concludes that the education committee plays a good and efficient role in the programme. It advises to organize the education committee in such a way that it also holds meetings without the teaching director, in order to enhance its independence.

Standard 3: Assessment and achieved learning outcomes

The programme makes use of a variety of tests: written exams, oral exams, presentations, short essays, the internship report and the master thesis. In order to assure the quality of the assessments, the Board of Examiners (BoE) assigns the examiners for each course. The BoE verifies that each exam is checked on clarity, length, level and coverage of the course material by a second reader. With regard to the final research project, the BoE also implemented a number of measures to ensure the validity and transparency of each assessment.

The committee concludes that the testing and assessment system is working adequately, but that the BoE should have made more efforts in controlling it. It established that the BoE did not control the quality of tests and assessments within the SBB and SCS specializations. The committee is reassured by the quick repairs the Faculty made by installing a mandated Board of Examiners, but urges the programme to pay more attention to the controls of testing and assessment quality.

The committee studied 15 theses written in the past three academic years. It concludes that those theses reflect scientific research at master level and sound academic work. The committee agrees with the grades given, but urges management to make sure all assessment forms are filled in completely. It also concluded that the internship reports of the SBB specialization show that students obtain the SBB-specific learning outcomes. It is less convinced of the academic level of the internship reports and concludes that some of the grades given were higher than expected.

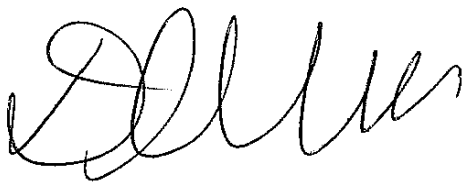
The committee would like to emphasize that the achieved learning outcomes as reflected by the master theses leave no doubt about the quality of the programme. Although the BoE did not control the tests and assessments of all specializations within the programme during the site visit, this omission has now been repaired. The extra check it performed on the SBB internship reports has proven for the committee that the SBB-specific learning outcomes are also obtained. Based on those considerations, the committee concludes that the programme meets all requirements for Standard 3.

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

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: 21 May 2014



Prof. dr. Daan Lenstra

Astrid van Vliet MA

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 profile, the level and orientation of the programme, the Domain Specific Framework of Reference and the intended learning outcomes are described. After considering the findings the committee comes to a conclusion on Standard 1.

Profile
The master's programme Astronomy is offered by the 'Sterrewacht Leiden ('Leiden Observatory'), which is part of the Faculty of Science. The programme operates within the university concept of 'studying in a research environment'. The master's programme enables, according to the critical reflection, the students 'to impart sufficient knowledge, understanding and skills as to enable the graduate to contribute independently, at an academic level and in an original manner to recognizing, coming up with and solving issues in an area of the natural sciences, to discuss this contribution with colleagues, to inform non-specialists in a clear and unambiguous manner on conclusions and considerations that form the foundation of the study, and to successfully follow a PhD programme within the discipline and its marginal areas'. The master's programme Astronomy offers three disciplinary research tracks (Research in Astronomy, Cosmology, Astronomy and Instrumentation) and three combined specializations (Science Based Business, Science Communication & Society and Education).

Students confirm the research-based profile of the programme in an international environment, which they very much appreciate, as well as the small scale of it.

The committee, having read the critical reflection, distils the profile of a proud institute which is strongly focused on research. The 'Sterrewacht' has an excellent international reputation. The committee is very positive about this profile.

Level and orientation

Domain Specific Framework of Reference
The national council of program directors of the Physics and Astronomy programmes has established a Domain Specific Framework of Reference (DSRK) for the assessment of the bachelor's and master's programmes in those disciplines. The program directors revised the Framework that has been written for the assessment of Physics and Astronomy in 2007. That Framework in turn was inspired by the intended learning outcomes as formulated in the European Tuning-project document *'Reference points for the design and delivery of degree programmes in physics'*, which has set an international standard. This document also uses the Dublin

descriptors as guideline for differentiation between bachelor and master level. The current DSRK is furthermore based on the more recent documents *'A European Physics Bachelor Study'* and *'A European Physics Master Study'* (2009) by the European Physics Society. The DSRK for master's programmes can be found in Appendix 2. The committee agrees with the requirements the DSRK sets for the intended learning outcomes of master's programmes in physics and astronomy.

Intended learning outcomes
The critical reflection provides the below listed intended learning outcomes for all specializations (see also Appendix 3):

- theoretical and/or practical skills in more than one specialist area of astronomy, to such an extent that the graduate can carry out research under global supervision;
- the ability to independently analyse astronomical problems, analyse the relevant specialist literature, formulate verifiable hypotheses, design and carry out research to test these hypotheses and critically reflect on these results, as well as those of others;
- the ability to interrelate and integrate various areas of astronomy and areas of physics and astronomy;
- the ability to present clearly, orally as well as in writing, one's own research results, the ability to discuss these results with colleagues and to present these results as a contribution to a conference or as (part of) a scientific publication;
- an understanding of the role of the sciences in society sufficient to be able to reflect upon them and to develop an ethically sound attitude to the practice of science.

The three combined specializations furthermore apply specific outcomes:

Science Based Business specialization:
- knowledge and understanding of science- and research-driven business and introduction into the most relevant business disciplines;
- the ability to make a business plan or a plan for an innovative project in a relevant field;
- experience in performing business activities in an existing company, or directed towards setting up a new company or organization.

Science Communication and Society specialization:
- knowledge and understanding of modern information and communication technology;
- experience in science communication;
- knowledge of ethical, historical and social aspects in the area of the natural sciences.

Education specialization:
- all qualifications necessary for teaching all levels of secondary education and technical and vocational training (for 16-18 year-olds);
- an approach to education/teaching taking into account the relationship between school and society, taking into account the moral values that are accepted in our multiform society.

The committee has studied the intended learning outcomes and concludes that they are in line with the domain specific requirements. They are also linked adequately with the Dublin descriptors. The learning outcomes indicate sufficiently that the programme is aiming at a master's degree level and they surpass the bachelor's level. For instance, active knowledge of the state-of-the-art in one or several areas of astronomy and skills necessary for being a

researcher, such as learning ability and independence. However, the committee considers the learning outcomes to be described too generally. It advices to specify the learning outcomes of the programme.

Considerations

The committee distils the profile of a proud institute which is very much focused on research. The 'Sterrewacht' has an excellent international reputation. The committee is very positive about this profile.

The committee concludes that the intended learning outcomes are in line with the domain specific requirements. They are also linked adequately with the Dublin descriptors. The learning outcomes indicate sufficiently that the programme is aiming at a master's degree level and they surpass the bachelor's level. However, the committee considers the learning outcomes to be described too generally. It advices to specify the learning outcomes of the programme.

Conclusion

Master's programme Astronomy: 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 studied the curriculum of the master's programme Astronomy, the course material, the digital learning environment and results of course evaluations. The committee also had access to the minutes of relevant committees. In this standard the findings of the committee concerning the content and structure of the programme, intake and study load, the teaching staff and internal quality assurance are discussed.

Content and structure
The master programme is an English taught two-year programme of 120 EC. The programme is divided into three research specializations and three combined specializations, as described in the Critical reflection:

- Astronomy Research Master, the core of the master programme. Students are given considerable freedom in putting together their programme. The astronomy coursework of the master consists of core courses, general courses, specialist courses and instrumentation related courses (36 EC in total). The rest of the courses can be selected from master courses in physics, mathematics and computer science (24 EC in total). Given the final qualifications of the graduate in terms of research skills, experience and insight, hands-on research is a key element of the programme. Students carry out two research projects. The first is a minor project (24 EC) of a preparatory nature. The second (36 EC) is the major research project, resulting in the officially recognised MSc thesis.
- Cosmology, a joint endeavour with the Physics Department where both Physics and Astronomy students can enrol. The courses are divided in astronomy courses (36 EC) and physics courses (24 EC). The research projects consist of a minor one (24 EC) in Astronomy and a major one (36 EC) in Cosmology;
- Astronomy and Instrumentation, in collaboration with Delft University of Technology (TUD). It combines astronomy courses (36 EC) and instrumentation-related physics courses (24 EC). The research projects consist of a minor one (24 EC) in Astronomy and a major one (36 EC) in Astronomical Instrumentation.

The three combined specializations: Science Based Business, Science Communication & Society and Education, all consist of astronomy and other courses (30-50 EC), the research project of 30 EC. The other 40-60 EC are devoted to courses and internships focused on the specialization. The combined specializations SBB and SC are organized at faculty level, while the Education specialization is a joint programme of the faculty and ICLON (the Leiden University Graduate School of Teaching).

The teaching methodology is, as described in the critical reflection, modelled on the master-apprentice idea, with much focus on he research projects. Formal knowledge of specialized subjects is taught in classical lecture series, where significant use is made of research literature. Students take part in all activities of the research teams when performing their research

project and are given a workspace at the Observatory. Oral and written presentations are part of the research project.

An overview of all master courses of the curriculum is provided in Appendix 4.

The committee is positive about the curriculum of this programme. The curriculum is thorough and clearly shows the research based profile. The specializations offer a broad and unique palette of choices, partly thanks to the Leiden-Delft collaboration. The committee appreciates the direct link the students have with the research groups of the institute. Students praised the flexibility of the three research specializations. The committee noticed however that the combined specializations attract very few students. The committee states that these should be better promoted or integrated with the other specializations in order to attract more students.

Achievement of the intended learning outcomes
The committee checked whether the students were able to realise the intended learning outcomes through the programme. It studied the curriculum and the study materials available before and during the visit. It also discussed this subject with teaching staff, students and alumni in order to find out whether all elements of the learning outcomes are addressed adequately.

The critical reflection contains a table which relates all competences of the Domain Specific Framework of Reference to teaching components in the programme. The committee states that the relation of individual courses to the intended learning outcomes has not been made explicit in the critical reflection, nor in the description of the courses themselves. The committee advises management to add this information per course, in order to provide students with a better insight in the link between programme and intended learning outcomes.

Notwithstanding these remarks, based on the course descriptions and course materials the committee is confident that the curriculum in general relates adequately to the intended learning outcomes of the programme and the Dublin descriptors.

Feasibility and guidance of the master's programme

Intake and study load
Students holding a BSc degree in Astronomy (or Physics and Astronomy) from any university participating in the Dutch Research School for Astronomy (NOVA) are admitted. The applications of other candidates are judged by a Board of Admissions. Applicants should also show proof of sufficient proficiency in English.

The inflow is stable at about 15 students per year. As a consequence of the increased inflow in the bachelor, management expects the inflow of the master to grow in the coming years. Over the past few years, 35-46 percent of the students completed the programme in two years; completion rates after three years fluctuated between 54 and 100 percent. According to the critical reflection, a persistent completion rate of 90 percent is one of the programme's key goals for the coming years.

Quantitative data are available in Appendix 5.

The committee checked the feasibility of doing two research projects in the three research specializations. Management explained that students are able to learn how to do research first and then apply their know-how in the second project. In general, students appreciated the possibility to explore two fields of interest and be able to develop their research skills first and then apply these. A few alumni preferred one research project, because this would have enabled them to publish the results. The committee values the idea of doing two research projects, which allows students to improve their research skills before starting the final project. However, this model makes it more difficult for students to publish the results of their research project.

After discussions with students and alumni, the committee concludes that the programme informs them correctly about the intensive study programme. Students encounter no obstacles in the study load. The committee finds the completion rate after three years rather low and encourages the programme management to take measures in order to achieve its own goal of a consistent 90 percent completion rate.

Guidance

According to the critical reflection, the study advisor has a key role in the guidance of the students. Given the substantial amount of freedom the students have in putting together their study programme, the study advisor closely monitors them, both in the choices made and in their performance in the course of the programme. The study advisor is member of the Observatory staff. Students prepare a study plan, with courses chosen (in accordance with their specialization) and when they will be taken. The plan is checked for feasibility and signed both by student and study advisor. The choice of the research project and supervisor is part of the study plan. The career preparation is also part of the guidance by the study advisor. Given the research oriented environment this is mainly focussed on taking up a PhD position inside or outside the institute. The guidance of students who study the combined specializations, is somewhat outside the scope of the study advisor, during the time spent on courses and projects that take place on faculty level.

Based on the information available and after discussions with staff, students and alumni the committee concludes that the research environment is a stimulating factor and is very much appreciated by the students. The committee compliments management with the way the students are involved in the research at the Observatory. However, information and guidance for students who do not wish to pursue a PhD, but want to enter the labour market is currently lacking and should be extended. . The committee feels this could partly explain why so few students opt for one of the double specializations. The committee suggests making better use of its alumni database to connect to the labor market for master graduates. Also, the committee found that training in human/professional skills is not formally embedded in the programme, even though these skills are of importance especially for those who enter the labor market with a master's degree. The committee advises management to reconsider this choice. Guidance of students who follow one of the combined specializations needs more attention and involvement of the programme management. There is a risk of study delay for these students, as they are out of view for the programme's study advisor for the duration of a year.

Staff

According to the critical reflection, staff members spend 30% of their work load on education. PhD students spend a total of 10% of their work load on education. 80% of all staff members have obtained their BKO, a basic didactic qualification. Management informs the committee during the visit that university management is discussing the introduction of

the SKO, the senior didactic qualification. PhD students who teach have to follow a course offered by the ICLON. The teaching quality of the PhD students is monitored by the education committee and their supervising staff member is responsible for implementation of adjustments in the case of negative feedback about their teaching.

Students are in general positive about their teachers; they are open, easy to contact and teach well. The committee is impressed by the commitment and academic qualities of the staff and concludes that both the didactic skills and expertise of staff members are of high level.

Programme specific quality assurance
The education committee consists of five teaching staff (including a PhD student) and five students (three bachelor and two master students, including an international student). The critical reflection lists the following activities of this committee:

- Evaluation through the so called semester-response system. There are two evaluations per semester: three weeks after the start and at the end of the semester. These evaluation meetings are plenary and teaching staff attends them. This system allows timely adjustment during and improvements at the end of the semester;
- Three times per year the education committee has a regular plenary meeting;
- Lunch meetings every four weeks (together with representatives of the education committee of Physics) with the Director of Teaching, programme coordinator and study advisor. Day-to-day matters are addressed.

Every course is evaluated by ICLON, using standard surveys. The results of these surveys play a role in the performance evaluations of the staff members.

After discussions with the education committee, the assessment committee concluded that its communication with the programme director is open and direct. Thanks to short lines of communication, it is easy for the education committee to provide the programme director with direct feedback. The committee concludes that the education committee plays a good and efficient role in the programme. Nevertheless, the committee was surprised that the education committee didn't follow more closely the supervision of research projects. The committee advises to organise the education committee in such a way that it also holds meetings without the programme director, in order to enhance its independence.

Considerations

The committee is positive about the curriculum of this programme. The curriculum is thorough and clearly reflects its research-based profile. The committee appreciates the direct link the students have with the research groups of the institute. Students appreciate the flexibility of the four research specializations. The combined specializations however attract very few students. The committee states that these should be better promoted or integrated with the other specializations in order to attract more students. The committee found no information on the intended learning outcomes of individual courses. The committee advises management to add this information, in order to provide students with a better insight in the link between programme and intended learning outcomes. Notwithstanding these remarks, the committee is confident that the curriculum in general relates adequately to the intended learning outcomes of the programme and the Dublin descriptors, based on the course descriptions and course materials.

After discussions with students and alumni, the committee concludes that the programme informs them correctly about the intensive study programme. The committee encourages management to achieve its own goals for the average duration of study. The committee is impressed by the commitment, expertise and academic qualities of the staff.

There is an open and direct communication between the education committee and the Director of Teaching. The committee concludes that the education committee plays a good and efficient role in the programme. It advises to organize the education committee in such a way that they also meet without the teaching director, in order to enhance its independence.

Conclusion

Master's programme Astronomy: 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 system and the level achieved by the graduates of the master's programme Astronomy of Leiden University. These subjects will be described in sub sections. In order to establish an opinion about these subjects the committee studied the assessment system, the test procedures, test regulations, the test forms used and several tests made by students. The committee also had a meeting and discussion with the Board of Examiners responsible for the master's degree programme.

The committee studied a selection of theses to assess the achieved level of the graduates and had discussions with the students, teachers, and alumni about the qualifications of the graduates and the relation to the requirements of the labour market.

Assessment System
The critical reflection lists the use of a variety of tests: written exams, oral exams, presentations, short essays, the internship report and the master thesis. In order to assure the quality of the assessments, the Board of Examiners (BoE) assigns the examiners for each course. The BoE verifies that each exam is checked on clarity, length, level and coverage of the course material by a second reader. Every lecture series is visited at least once by a member of the board of examiners. They give feedback. The board conducts spot checks on the grading of the theses and the evaluation forms. With regard to the research project, the programme uses evaluation forms which not only list remarks about the grades, but also about student's performance during the research project. This allows the BoE to check consistency of both the student's results and his/her functioning in a research environment. The report or the thesis is judged by two examiners, one of whom acted as supervisor; the other examiner should be member of a different research group. Members of the BoE regularly form part of the committee of three examiners which hold the final exam session.

From an organisation chart provided during the site visit, it became clear that management describes the Board of Examiners as an advisory body. The BoE itself emphasizes it is a controlling body, especially in the light of its legal tasks since 2010. The committee urges the Board to take up some tasks more explicitly at short notice: to control the quality of exams beforehand, to check the model answers and to more structurally scan for plagiarism and fraud. The committee asks the programme management to facilitate the Board for these tasks. It emphasises that the new tasks of the BoE should not be seen as merely a bureaucratic control mechanism, but can be an impulse for the quality of teaching.

During the visit and discussions with both the BoE and the programme management, the committee established that the BoE did not control the quality of the system of tests and assessments within the combined specializations Science Based Business (SBB) and Science Communication & Society (SCS). The programme management explained that the Faculty had plans to introduce of mandated Board of Examiners at Faculty level, since these combined specializations are offered under the auspices of the Faculty of Science. This

mandated Board of Examiners was not effectively installed at the moment of the site visit. The committee concludes that over the past three years, the Board of Examiners has neglected its legal task in controlling the tests and assessments within SBB and SCS. After the site visit, the programme management provided the committee with documentation on the duties and tasks of the mandated Board of Examiners, which was installed on February 3rd, 2014.

The committee concludes that the testing and assessment system within the combined specialisations SBB and SCS is working adequately. The BoEx should, however, have made more efforts in controlling it. The committee is reassured by the quick repairs the Faculty made by installing a mandated Board of Examiners, but urges the programme to pay more attention to the overseeing of testing and assessment quality.

Achieved learning outcomes

Prior to the site visit, the committee members received 15 master theses, written in the academic years 2010-2011, 2011-2012, 2012-2013. The student numbers of the selected theses are provided in Appendix 7. For all theses the committee studied the thesis report and – if available – the evaluation forms.

The committee concludes that the theses reflect scientific research at master level and sound academic work. Overall, the committee was positive about the topics chosen, the research carried out and the quality of the reports. The committee in general agrees with the grades given. The committee noticed that a high percentage of students graduate cum laude. The committee advises management in charge to consider more strict regulations on cum laude. Not all assessment forms were filled in completely; the committee urges management to make sure this is common practice at short term.

Because of its finding that the Board of Examiners did not check on the quality of tests and assessments within the SBB and SCS specializations, the committee decided to assess the quality of three SBB internship reports as well (no students recently applied for the SCS specialization). Two of the three reports selected were written by students whose thesis report had already been studied by the committee. Based on this assessment, the committee concludes that those internship reports show that the SBB-specific intended learning outcomes are indeed acquired at an adequate level by students. That being said, it established that some of the grades given were higher than expected. Also, it was not particularly impressed by the academic ('science based') level of the internship reports. It advises the newly installed mandated Board of Examiners to critically check the academic level and grades of the internship reports.

Notwithstanding the remarks with respect to the SBB and SCS specialisations, the committee concludes that the achieved learning outcomes of the master's programme are satisfactory. The quality of the theses reflect the solid research profile of the programme.

Considerations

The committee concludes that the testing and assessment system is working adequately, but that the Board of Examiners should have made more efforts in overseeing it. It established that the Board did not oversee the quality of tests and assessments within the SBB and SCS specializations. The committee is reassured by the quick repairs the Faculty made by installing a mandated Board of Examiners, but urges the programme to pay more attention to the overseeing of testing and assessment quality.

The committee concludes that the theses it studied reflect scientific research at master level and sound academic work. The committee agrees with the grades given, and urges management to make sure all assessment forms are filled in completely. It also concluded that the internship reports of the SBB specialization show that students obtain the SBB-specific learning outcomes. It is less convinced of the academic level of the internship reports and concludes that some of the grades given were higher than expected.

The committee would like to emphasize that the achieved learning outcomes as reflected by the master theses leave no doubt about the quality of the programme. Although the Board of Examiners did not control the tests and assessments of all specializations within the programme during the site visit, this omission has now been repaired. The extra check it performed on the SBB internship reports has proven for the committee that the SBB-specific learning outcomes are also obtained. Based on those considerations, the committee concludes that the programme meets all requirements for Standard 3.

Conclusion

Master's programme Astronomy: the committee assesses Standard 3 as 'satisfactory'.

General conclusion

In the committee's judgement, the master's degree programme Astronomy at Leiden University fulfils 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 the programme meets the current generic quality standards and shows a satisfactory level across its entire spectrum and consequently can be assessed as 'satisfactory'.

Conclusion

The committee assesses the *master's programme Astronomy* 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 W. (Wim) de Boer from the Karlsruhe Institute of Technology is a leading expert in the fields of particle - and astroparticle physics. His main interest focuses on the search for the elusive dark matter, which makes up more than 80% of the matter in the universe, but its nature is unknown. Prof. De Boer participates in the search for dark matter using the CMS detector at the Large Hadron Collider (LHC) at the European Particle Physics Laboratory CERN in Geneva and the AMS-02 detector on the International Space Station. He also contributed to the phenomenology of Supersymmetry by showing that Supersymmetry can lead to a Grand Unified Theory with a perfect candidate for a dark matter particle.
Prof. De Boer received his PhD at Delft University of Technology in 1974. Since 2009, he is member of the Advisory Committee of the IMAPP institute of the Radboud University, Nijmegen.

Prof. dr. E. (Elias) Brinks earned his doctorate in 1983 at Leiden University with a study of the neutral hydrogen distribution in Messier 31, the Andromeda galaxy. Following a postdoctoral fellowship at the European Southern Observatory (ESO) in Garching and an employment as Senior Research Associate at the former Royal Greenwich Observatory in the UK, he spent nearly six years as Associate Scientist at the National Radio Astronomy Observatory's Very Large Array (NRAO-VLA) in Socorro, New Mexico (USA). He then moved to "Old" Mexico to help set up the Department of Astronomy at the University of Guanajuato and subsequently was appointed as staff scientist at the Instituto Nacional de Astronomía, Óptica y Electrónica (INAOE) in Puebla, where he contributed to efforts to build the Large Millimeter telescope. Since September 2004 he is back in Europe, as Full Professor at the University of Hertfordshire.
Upon retuning to the UK he was elected Secretary of the European Astronomical Society (2006-2012). His research focuses on nearby normal and dwarf galaxies, galaxy interactions, and their formation and evolution.

Prof. dr. M.J. (Martin) Goedhart is trained as a biochemist and, from 1982 to 1992, worked as a teacher in chemistry in vocational education. In 1990, he got his PhD at Utrecht University with a thesis on chemical didactics. Between 1992 and 2004, he was teacher and primary teacher at the University of Amsterdam (UvA), as course didactic of chemistry at the academic teacher training, among other things. Since 2004, he has been a professor of Mathematics and Science Education at University of Groningen. He also acts as programme director for the master's programme Education and Communication in Mathematics and Science. He leads the research group IDO (Institute for Didactics and Development of Education), which researches mathematics and science education in secondary and university education. He is editor and member of the editorial committee of national and international magazines, member of the programme committee DUDOC (programme focussed on PhD research by secondary education teachers in beta subjects), coordinator of the network

chemistry/pharmacy of ICAB (Innovation Centres Academic Beta Education) and chair of the faculty BKO assessment committee. He was a member of the visitation committee of the master's programme Science Education and Communication at the 3TU.

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 quantitative 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).

P.A. (Sander) Breur MSc studied the bachelor's programme Physics and Astronomy at the University of Amsterdam (UvA). After graduating in 2012, he continued his studies with the master's programme Particle and Astroparticle Physics at the UvA/Nikhef. He graduated in 2013. During his studies, Breur was chair of the Dutch Student Union LSVB, board member of the Central Student Council and chair of the Faculty Student Council at the UvA. For three years, he was a member of the Physics Board of Studies. He also taught seminars Calculus and Linear Algebra to first year bachelor students Physics and Astronomy. In 2014 he started his PhD at the Nikhef, University of Amsterdam.

Appendix 2: Domain-specific framework of reference

The domain specific reference frame for the Master degree programmes in Physics, Applied Physics, and Astronomy.

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

All specializations:

- theoretical and/or practical skills in more than one specialist area of astronomy, to such an extent that the graduate can carry out research under global supervision;
- the ability independently analyse astronomical problems, analyse the relevant specialist literature, formulate verifiable hypotheses, design and carry out research to test these hypotheses and critically reflect on these results, as well as those of others;
- the ability to interrelate and integrate various areas of astronomy and areas of physics and astronomy;
- the ability to present clearly, orally as well as in writing, one's own research results, the ability to discuss these results with colleagues and to present these results as a contribution to a conference or as (part of) a scientific publication;
- an understanding of the role of the sciences in society sufficient to be able to reflect upon them and to develop an ethically sound attitude to the practice of science.

Science Based Business specialization:

- knowledge and understanding of science- and research-driven business and introduction into the most relevant business disciplines;
- the ability to make a business plan or a plan for an innovative project in a relevant field;
- experience in performing business activities in an existing company, or directed towards setting up a new company or organization.

Science Communication and Society specialization:

- knowledge and understanding of modern information and communication technology;
- experience in science communication;
- knowledge of ethical, historical and social aspects in the area of the natural sciences.

Science and Education specialization:

- all qualifications necessary for teaching all levels of secondary education and technical and vocational training (for 16-18 year-olds);
- an approach to education/teaching taking into account the relationship between school and society, taking into account the moral values that are accepted in our multiform society.

Appendix 4: Overview of the curriculum

Specialization Research in Astronomy:

Programme (120 EC)
The programme has the following structure:

Year 1	**Level**	**EC**
Minor Astronomy research project	500	24
Astronomy courses	400-500	24
Non-Astronomy courses	400-500	12
Year 2		
Major (master's) Astronomy research project	600	36
Astronomy courses	500	12
Non-Astronomy courses	400-500	12

The Astronomy curriculum must contain the following courses:

- mandatory for all: Stellar structure and evolution (6 EC),
- a minimum of two (2) other Astronomy core courses (12 EC),
- a minimum of one (1) instrument-related Astronomy course (6 EC)
- a choice of Astronomy courses of any type (12 EC)
- both a Minor and a Major Research Project (60 EC).

Astronomy and Instrumentation Stream:
Within the "Research in Astronomy" programme, students may choose to focus on the subject "Astronomy and Instrumentation". This stream is offered in collaboration with the Department of Applied Physics at Delft University of Technology. In addition to the general admission requirements mentioned above, students should have successfully completed the TUD BSc course "Systemen en Signalen" (TN4525), or its equivalent.
The requirements for the two years are as follows:

	Level	**EC**
Mandatory Courses:		
Stellar structure and evolution	500	6
Detection of light	500	6
Choice of:		
core/general/specialist Astronomy courses	400-500	18-12
instrument-related Astronomy courses	400-500	6-12
instrument-related Physics courses	400-500	24
Research projects:		
Minor in General Astronomy	500	24
Major in Instrumental Astronomy (Master's Project)*	600	36

*The major (Master's) research project may involve designing, building or testing of an instrument or instrument system, or any combination of these activities. It may be carried out in any of the Leiden Astronomy or Delft Applied Physics labs, or at external organisations directly involved in astronomical instrumentation.

Cosmology Stream:
Within the "Research in Astronomy" curriculum, students may choose to focus on the subject "Cosmology". This stream is offered in collaboration with the Institute Lorentz for Theoretical Physics in the Department of Physics at Leiden University (LION). Fundamental

elements are theory, data handling, and numerical simulation. In addition to the general admission requirements, students should have successfully completed the BSc course "Physics of elementary particles" (Fysica van elementaire deeltjes), or its equivalent, and should have in-depth knowledge of undergraduate courses with theoretical and mathematical emphasis, such as quantum physics, electrodynamics, statistical physics, and complex analysis. The requirements for the two years are as follows:

	Level	EC
Mandatory Astronomy Courses:		
Stellar structure and evolution	500	6
Origin and evolution of the Universe	500	6
Large-scale structure and galaxy formation	500	6
Choice of:		
core/general/specialist Astronomy courses	400-500	18
Mandatory Physics Courses:		
Particle physics and early Universe	500	6
Theory of general relativity	400	6
Choice of:		
Related Physics courses	400-500	12
Minor in General Astronomy	500	24
Major in Cosmology (Master's Project)	600	36

The two research projects together should cover the three fundamental elements: theory, data handling and simulations.

Specialization Astronomy and Science Based Business:

The Astronomy research component of the Science Based Business (SBB) specialisation consists of:

- a Medium Research Project (30 EC) supervised by a member of the Leiden Observatory scientific staff, as well as courses to be selected in correspondence with the research topic to a minimum of 30 EC and a maximum of 50 EC. These include at least:
- the mandatory course Stellar structure and evolution,
- one other Astronomy core course, and
- 8-14 EC of non-Astronomy courses.

Specialisation Science Based Business: Courses

Foundation:	**Level**	**EC**
SBB Fundamentals	400	15
Research Based Business Opportunities	400	5
Research Based Business Ventures	400	5
Research Based Business Planning	400	5
Advancement:		
RBB New Business Development*	500	3
RBB Technology Transfer*	500	3
SBB Management	500	3
Learning from Silicon Valley: Entrepreneurship and New Business Venturing**	500	5
SBB Essay	500	3-7
SBB Elective	400-600	3-15

Finishing:		
SBB Internship	600	22-35
RBB Assignment	600	22-35

* When these courses are taken together, tot total amount of credits is reduced to 5 EC
** This course is offered in collaboration with Delft University of Technology and Erasmus University Rotterdam, and will only be taught when sufficient participants from all three universities are enrolled.

Specialization Astronomy and Science Communication & Society

The Astronomy research component of the Science Communication & Society (SCS) specialisation consists of:

- a Medium Research Project (30 EC) supervised by a member of the Leiden Observatory scientific staff, as well as courses to be selected in correspondence with the research topic to a minimum of 30 EC and a maximum of 50 EC. These include at least:
- the mandatory course Stellar structure and evolution,
- one other Astronomy core course, and
- 8-14 EC of non-Astronomy courses.

The Communication component consists of the following:

Mandatory:	Level	EC
Fundamentals of Science Communication and Society	400	17
Training period	600	23-34

The training period can be in the field of Journalism, Museology or New Media and includes a written report, and an oral presentation.

Choice of:		
Courses within the research component of the MSc programme		0-20
Courses in Communication	≥400	0-8
Communication Master thesis	500/600	5
Communication research project correlated to the Master thesis	500/600	4

Specialization Astronomy and Education

The specialisation Education (EDU) consists of 60 EC in the MSc Astronomy programme and 60 EC in Education. When the student has passed the minor Education (30 EC) during the BSc programme, the compulsory education component is reduced with 30 EC. The remaining 30 EC can be used for both the education specialisation and the research component of the MSc programme.

The Astronomy research component of the Education (EDU) specialisation consists of:

- a Medium Research Project (30 EC) supervised by a member of the Leiden Observatory scientific staff,

as well as courses to be selected in correspondence with the research topic to a total of 30 EC. These include at least:

- the mandatory course Stellar structure and evolution,
- one other Astronomy core course, and
- 12 EC of non-Astronomy courses.

Education (60 EC)

The Education specialisation is offered as a joint programme of the faculty and the Leiden University Graduate School of Teaching (ICLON) and consists of the following components:

	Level	EC
Educational Theory	300	5
Learning and Instruction 1	400	5
Learning and Instruction 2	400	2
Teaching Methodology 1	500	5
Teaching Methodology 2	500	5
Design Research	600	7
Individual Choice	400	1
Teaching Practice 1		15
Teaching Practice 2		15

Appendix 5: Quantitative data regarding the programme

Data on intake, transfers and graduates

Intake:

Year	total cohort	Male	Female	from abroad	RM	SBB	SCS	EDU
06/07	6	3	3	5	4	2	0	0
07/08	12	9	3	1	11	1	0	0
08/09	11	7	4	5	11	0	0	0
09/10	17	7	10	5	16	1	0	0
10/11	13	7	6	6	9	4	0	0
11/12	11	9	2	3	9	2	0	0
12/13	17	13	4	4	13	4	0	0

Completion rates:

Year	Inflow	% finished after 2 years	% finished after 3 years	% finished after 4 years	% finished after >4 years	Number stopped	Number still in MSc program
06/07	6	100				0	0
07/08	12	42	67	75		3	0
08/09	11	46	100			0	0
09/10	17	35	77	82		1	2
10/11	13	46	54			0	6
11/12	11					1	9
12/13	17					0	17

Teacher-student ratio achieved

Qualifications teaching staff and staff/student ratio:

Category	Number	PhD	BKO	SKO	% time in MSc teaching	Ratio
Permanent Staff	15	15	13	1	15	
Tenure Track	3	3	1	0	15	
Adjunct faculty	2	2	0	0	10	
PhD students	75	0	0	0	10	
Active Students	34					3.3

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

Year	**1**	**2**
Hours	12	13

Appendix 6: Programme of the site visit

<table>
<tr><th>11.00</th><th>12.00</th><th colspan="2">Aankomst commissie en lunch</th></tr>
<tr><td>12.00</td><td>15.00</td><td colspan="2">Voorbereidend overleg van de commissie + inzage documenten</td></tr>
<tr><td>15.00</td><td>16.00</td><td colspan="2">Management
Paul van der Werf, Opleidingsdirecteur Sterrenkunde
Huub Röttgering, Wetenschappelijk directeur Sterrenkunde
Nathalie Strookman, Onderwijscoördinator Sterrenkunde
Jan Aarts, Opleidingsdirecteur Natuurkunde
Eric Eliel, Wetenschappelijk directeur Natuurkunde
Chequita Bhoendie, Onderwijscoördinator Natuurkunde
Han de Winde, Vice Decaan</td></tr>
<tr><td>16.00</td><td>17.00</td><td>Studenten Natuurkunde
Max Snijders (N+Stk)
Yanni Evers
Kevin Widdershoven
David Doelman (N+Stk)
Mila Schipper (N+W)
Kim Vendel
Bartosz Benenowski
Koen de Reus</td><td>Studenten Sterrenkunde
Larissa Wolters (Stk + Ntk)
Guus de Wit (Stk+Wis)
Nikki Zabel
Sebastiaan Haffert
Steven Duivenvoorden
Ritse Heinsbroek</td></tr>
<tr><td>17.00</td><td>17.30</td><td>Alumni Natuurkunde
Steffie Ypma
Tom Viering
Merlijn v. Deen
Robert-Jan Slager
Floris Kalff
Mark Vervest
Inge Leermakers</td><td>Alumni Sterrenkunde
Sierk van Terwisga
Yorick Bonnema
Jens Hoeijmakers
Renske Smit</td></tr>
<tr><td>17.30</td><td>18.00</td><td colspan="2">Intern overleg commissie</td></tr>
<tr><td>19.30</td><td></td><td colspan="2">Diner (alleen commissie)</td></tr>
</table>

Dag 2:			
9.00	09.45	**Docenten Natuurkunde** Jan v. Ruitenbeek Joost Frenken Sense Jan vd Molen John v. Noort Tjerk Oosterkamp Ana Achucarro Vincenzo Vitelli	**Docenten Sterrenkunde** Harold Linnartz Ignas Snellen Bernhard Brandl Michiel Hogerheijde Elena Rossi Simon Portegies Zwart Matt Kenworthy Jarle Brinchmann B. Pila Diez
9.45	10.30	**OLC (studenten en docenten)** Harold Linnartz (SK) Marijke Segers (SK) Marthijn Sunder (SK) Arthur Jakobs (SK) Martin van Exter (NK) Ana Achucarro (NK) Falco de Wit (NK) Jorinde van de Vis (NK)	
10.30	11.15	**Examencommissies en studieadviseurs** Ignas Snellen (SK) Jan Lub (SK) Henk Hoekstra (SK) Joop Schaye SK) Gerard Nienhuis (NK) Peter Denteneer (NK) Reyer Jochemsen (NK) Hara Papathanassiou (NK)	
11.15	11.45	Open spreekuur	
11.45	12.15	Rondleiding	
12.15	12.45	Lunch	
12.45	13.30	Voorbereiden eindgesprek management	
13.30	14.15	**Eindgesprek met management** Paul van der Werf, Opleidingsdirecteur Sterrenkunde Huub Röttgering, Wetenschappelijk directeur Sterrenkunde Nathalie Strookman, Onderwijscoördinator Sterrenkunde Jan Aarts, Opleidingsdirecteur Natuurkunde Eric Eliel, Wetenschappelijk directeur Natuurkunde Chequita Bhoendie, Onderwijscoördinator Natuurkunde Han de Winde, Vice Decaan Geert de Snoo, Decaan	
14.15	16.30	Opstellen bevindingen en voorbereiden mondelinge rapportage	
16.30	17.00	Mondelinge rapportage (openbaar)	

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:

1067184	0934887	0530913
1011677	0327891	0838594
0881686	0843822	0604127
1051970	0838586	0701327
0802980	0854255	0733954

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):

- Standard / basic books
- Tests, assessment criteria, assessment forms and answers
- Minutes of the Board of Examiners 2010-2011, 2011-2012
- Minutes of het Educational committee 2010-2011, 2011-2012, 2012-2013
- Course evaluations

Course dossiers:

Origin & Evolution of the Universe
Detection of Light
Large Scale Structure & Galaxy Formation

Appendix 8: Declarations of independence

Overzicht commissiesamenstelling:

Universiteit Leiden (4)	**Opleiding (CROHO-nummer)**	**Variant**	**Vervaldatum accreditatie**
	B Natuurkunde (50206)	Voltijd, deeltijd	31-12-2014
	B Sterrenkunde (50205)	Voltijd, deeltijd	31-12-2014
	M Physics (60202)	Voltijd	31-12-2014
	M Astronomy (60200)	Voltijd	31-12-2014
Secretaris:	Astrid van Vliet		
Commissieleden	Daan Lenstra, Wim de Boer, Elias Brinks, Jan Hoogenraad, Martin Goedhart, Sander Breur		

nvao
nederlands - vlaamse accreditatieorganisatie

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

nvao
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 oktober 2013

HANDTEKENING:

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Willem de Boer

PRIVÉ ADRES: Dekan-Hofheinz-Str. 26
D-76229 Karlsruhe

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

[redacted]

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: Karlsruhe DATUM: 21.11.2013

HANDTEKENING:

nvao
nederlands - vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: ELIAS BRINKS

PRIVÉ ADRES: CENTRE FOR ~~ASTROPHYSICS~~ RESEARCH
UNIVERSITY OF HERTFORDSHIRE, COLLEGE LANE
HATFIELD AL10 9AB, UNITED KINGDOM

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

nvao
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 OKTOBER 2013

HANDTEKENING:

nvao
nederlands - vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: M.J. Goedhart

PRIVÉ ADRES: Botanicuslaan 55
9751 AB Haren

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

natuurkunde (B+M)
sterrenkunde (B+M)

AANGEVRAAGD DOOR DE INSTELLING:

Universiteit Leiden

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;

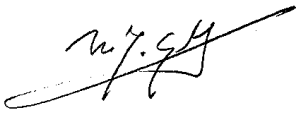
VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

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

PLAATS: Groningen

DATUM: 10 - 12 - 2013

HANDTEKENING:



nvao
nederlands - vlaamse accreditatieorganisatie

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

nvao
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 OKTOBER 2013

HANDTEKENING:

nvao
nederlands-vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: P. A. (SANDER) BREUR

PRIVÉ ADRES: GRUBBENHOEVE 56

1103 GV AMSTERDAM

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

NATUUR- EN STERRENKUNDE (BSC EN MSC)

U. LEIDEN

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

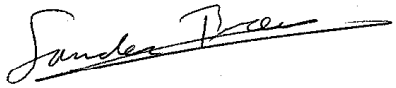
nvao
nederlands-vlaamse accreditatieorganisatie

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: AMSTERDAM DATUM: 25-11-2013

HANDTEKENING: 

nvao
nederlands - vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Astrid van Vliet

PRIVÉ ADRES: QANU
Postbus 8035
3503 RA 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

nvao
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: 1/7/2013

HANDTEKENING: