RESEARCH REVIEW

PHYSICAL AND CHEMICAL SCIENCES

2010-2015

UTRECHT UNIVERSITY

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

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

Project number: 0630

REPORT ON THE RESEARCH REVIEW OF PHYSICAL AND CHEMICAL SCIENCES OF UTRECHT UNIVERSITY

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1. FOREWORD COMMITTEE CHAIR

In accordance with the Standard Evaluation Protocol 2015-2021, the committee has reviewed and assessed Physical and Chemical Sciences at Utrecht University over the period 2010-2015. Physical and Chemical Sciences are part of the Faculty of Science; the research unit constitutes of the complete Physics Department and roughly half of the Department of Chemistry, concerning the research activities of four research institutes within the Faculty of Science: the Debye Institute for Nanomaterial Science (DINS), the Institute for Marine and Atmospheric Research Utrecht (IMAU), the Institute for Theoretical Physics (ITP) and the Institute for Subatomic Physics (SAP).

This report presents the review and assessments by the committee, based on the information provided by the various institutes and Faculty of Science. The committee wishes to express its gratitude for the enthusiastic support, hospitality and efficient cooperation encountered at Utrecht University. It highly appreciated the openness of information provided before the site visit and the frankness expressed in the various discussions with all members of the Faculty during the site visit. The committee hopes that its review and recommendations will assist the Physical and Chemical Sciences unit, the Faculty of Science and Utrecht University in their continuing efforts to foster a culture of international excellence, openness and inclusiveness.

Prof. D. Frenkel
Committee chair

This report was finalized on 31 August 2017

2. THE REVIEW COMMITTEE AND THE PROCEDURES

2.1. Scope of the review

The review committee Physical and Chemical Sciences has been asked to perform a review of research in Physics and Chemistry conducted by Utrecht University. The review includes the following research units:

- Debye Institute for Nanomaterials Science (DINS);
- Institute for Marine and Atmospheric Research Utrecht (IMAU);
- Institute for Theoretical Physics (ITP);
- Institute for Subatomic Physics (SAP).

In accordance with the Standard Evaluation Protocol 2015-2021 (SEP) for research reviews in the Netherlands, the committee was asked to assess the quality, the relevance to society and the viability of the scientific research at the research unit as well as the strategic targets and the extent to which the unit is equipped to achieve these targets. Furthermore, a qualitative review of the PhD training programme, research integrity policy and diversity was part of the committee's assignment.

2.2. Composition of the committee

The composition of the committee was as follows:

- Prof. Daan Frenkel [chair] is Professor of Theoretical Chemistry and Director of Research at the Department of Chemistry at Cambridge University;
- Prof. Anne Davis is Professor of Mathematical Physics at the Department of Applied Mathematics and Theoretical Physics (DAMTP) at Cambridge University;
- Dr Svetlana Mintova is Director of Research at the École Nationale Supérieure des Ingénieurs de Caen (ENSICAEN) and the Université de Caen Normandie;
- Prof. Catherine Rouvas-Nicolis is Professor at the Institut Royal Météorologique de Belgique;
- Prof. Peter Wölfle is Professor at the Institute for Theoretical Condensed Matter Physics at the Karlsruhe Institut für Technologie;
- Prof. William A. Zajk is the I.I. Rabi Professor of Physics at the Department of Physics at Columbia University of New York.

The curricula vitae of the committee members are included in Appendix 2.
The committee was supported by Dr Els Schröder, who acted as secretary on behalf of QANU.

2.3. Independence

All members of the committee signed a statement of independence to guarantee an unbiased and independent assessment of the quality of Physical and Chemical Sciences of Utrecht University. Personal or professional relationships between committee members and the research units under review were reported and discussed at the start of the site visit amongst committee members. The committee concluded that no specific risk in terms of bias or undue influence existed and that all members were sufficiently independent.

2.4. Data provided to the committee

The committee has received the self-evaluation report of the units under review, including all the information required by the SEP.
The committee received the following documents:

- Self-assessment report Physical and Chemical Sciences 2010-2015;
- the SEP 2015-2021;
- lists with an overview of publications;
- information on the PhD programme (including information on the courses Graduate School of Natural Sciences);
- list of committees (at Faculty, department and institute level).

2.5. Procedures followed by the committee

Prior to the first committee meeting, the committee chair allotted the four research institutes to individual panel members. Each research unit had a principal and a second reviewer. During the review process, each committee member focused on his or her allocated research institutes and took the lead during the interviews dedicated to it. All committee members independently formulated a preliminary assessment of the allocated research institutes under review based on the written information that was provided prior to the site visit.

The final review is based on both the documentation provided by the research units and the information gathered during the interviews with management and representatives of the research units during a site visit. The site visit took place on 15-17 February 2017 (see the schedule in Appendix 3) in Utrecht.

Preceding the interviews, the committee was briefed by QANU about research reviews according to SEP. Also, the committee discussed the preliminary assessments and decided upon a number of comments and questions. The committee also agreed upon procedural matters and aspects of the review. After the interviews the committee discussed its findings and comments in order to allow the chair to present the preliminary findings and to provide the secretary with argumentation to draft a first version of the review report.

The draft report by committee and secretary was presented to the research unit concerned for factual corrections and comments. In close consultation with the chair and other committee members, the comments were reviewed to draft the final report. The final report was presented to the Board of the University and to the management of the research unit.

The committee used the criteria and categories of the Standard Evaluation Protocol 2015-2021 (SEP). For more information see Appendix 1.

3. QUANTITATIVE AND QUALITATIVE ASSESSMENT OF PHYSICAL AND CHEMICAL SCIENCES

The assessment of the research unit is highly dependent on the performance of the various research institutes underlying the research unit Physical and Chemical Sciences. In this Chapter, the research unit as a whole will be described and assessed, with some general remarks based on the evidence provided by the research institutes. However, these assessments should not be seen independent of the extended assessments of the four research institutes as presented in Chapter 4 which serve to underpin the committee's conclusions and recommendations, and vice versa.

3.1. Broader Context

Against the background of ongoing research profiling on a national scale, the Faculty of Science was confronted in 2010 with structural cuts, in particular in the funding provided by the Ministry of Education, Culture and Science mainly as the result of national budget cuts. Utrecht University met these challenges by refocusing its research activities and reducing costs. As a result, some research lines at the Faculty of Science were terminated and several research groups were transferred to other universities, faculties or departments. For Physical and Chemical Studies, this meant the loss of certain established institutes and a redefinition of its focus in line with the Sectorplan Physics and Chemistry. The restructured unit received a boost through three NWO Gravitation Grants that involved three out of four research institutes under review, namely ITP, DINS and IMAU. The Department of Chemistry chose to focus on three main themes: colloids, catalysis and structural biology. In the department of Physics, the current focus is on theoretical physics, climate physics, experimental sub-atomic physics, soft matter & biophysics and nanophotonics.

Utrecht University has identified four strategic themes: 'Dynamics of Youth', 'Institutions for Open Societies', 'Life Sciences' and 'Sustainability'. Both IMAU and DINS are of fundamental importance for the research strands defined within the theme of 'Sustainability': IMAU is a key participator in the research strand 'Water, Climate and Ecosystems' and DINS is leading in the research strand 'Future Energy & Resources'. In view of their international standing in the field, both DINS and IMAU should be considered as flagships for the University's 'Sustainability' research theme. In addition to its strategic themes, Utrecht University defined eleven focus areas across its faculties. The two most relevant for this assessment are 'Foundations of Complex Systems' and 'Future Delta's'. Due to its research focus, ITP will have a leading role in the 'Foundations of Complex Systems' focus area. IMAU, in turn, offers plenty of potential to be involved in the university focus area of complexity research next to being closely involved in the 'Future Delta' research.

Several members of the Physical and Chemical Studies' staff, in particular at DINS and ITP, are part of the strategic alliance forged between Utrecht University, the University Medical Center Utrecht and Eindhoven University of Technology, focusing research on sustainable energy, medical imaging and regenerative medicine. All four institutes pursue research that aligns well with one or more of the themes of the Dutch National Research Agenda, in particular in the areas of 'Man, the Environment and the Economy' (DINS, IMAU, ITP) and 'Fundamentals of Existence' (SAP, ITP). They are, as a result, at the heart of the Dutch scientific community.

The four institutes that together form the research unit join forces on a regular basis. The committee established that ITP collaborates on a regular basis with SAP, resulting in experimental particle physics benefiting from high-energy theoretical insights, and vice versa. Between ITP and DINS also exist successful collaborations, in particular on soft and hard condensed matter physics. All four institutes contribute to the Center for Extreme Matter and Emergent Phenomena (EMMEΦ), launched in 2014, thereby contributing to an overarching discussion between researchers of the various research institutes in Physics. DINS has close connections with the

Bijvoet Center, the departments of Biology and Pharmaceutical Sciences, and the Electron Microscopy facility EM Square. Similarly, IMAU has strong links with the Faculty of Geosciences, and the same holds for the interactions between ITP and the Department of Mathematics. All these cross-interactions enhance the synergy within the Faculty of Science and *a fortiori* within the research unit Physical and Chemical Studies, and strengthen the central role of the four institutes. In this context, the committee is enthusiastic about the ongoing and the potential for further expansion of the highly successful collaboration between ITP and DINS and considers the connection between ITP and SAP a clear asset.

Based on the evidence provided, the committee concluded that the institutes at Physical and Chemical Studies are crucial for both implementing and formulating the University's strategy: they are therefore of decisive importance for the University's international research profile. It follows that the research unit deserves full support for its current and emerging research activities. The committee supports the Faculty in its ambitions; in particular with respect to the potential creation of a biophysics research collaboration between DINS, the Bijvoet Institute, the departments of Pharmaceutical Sciences and Biology, the Hubrecht Institute, the Utrecht Medical Center and the Faculty of Veterinary Medicine. Such collaboration should be very viable as it builds on existing strengths and connections: it would create a new and unique research profile for the University and even further raise its research profile.

3.2. Research quality

All four research institutes have their own focus areas of research and as a result, they have different strategies towards meeting their targets. Nevertheless, the committee concluded that the four institutes have a strong synergy and that various intertwining strands of research and research interests result in an internationally excellent profile for Physical and Chemical Studies: it is one of the leading research units worldwide. All four research institutes perform consistently at the highest international level and produce excellent research with high impact on the global academic community and beyond. Prior to the site visit at Utrecht University, the committee read the selected key publication for each of the four institutes. The committee is of the opinion that the publications submitted are of excellent quality, resulting in a major scientific impact by all four of the research unit's institutes on their respective fields and on the combined field of Physical and Chemical Sciences as a whole. The committee is convinced that a number of the groups' key publications have transformed their field of research and are therefore of the highest international quality; their findings are likely to be integrated in textbooks for future generation of scientists.

Over the period under review, DINS researchers reported several important breakthroughs that have a profound impact on the fields of photonics, catalysis, colloid science and self-assembly. The local infrastructure available for researchers at DINS is impressive and well-balanced: it provides a solid base for further scientific research at the highest level. The committee was particularly impressed by the large number of unique instruments that had been developed at the site, mainly in the area of microscopy, which will result in further advances in our scientific knowledge. These instruments are accessible both to 'internal' researchers and to third parties, hence other scientists both in industry and academia will benefit from this unique infrastructure. The very strong international position of DINS is reflected in several marks of recognition, including an exceptional number of personal grants.

Albeit a relatively small research institute within Physical and Chemical Studies, SAP (in collaboration with the Dutch National Institute for Subatomic Physics Nikhef) represents one of the largest groups within the international experimental setup 'A Large Ion Collider Experiment' (ALICE), located at the Large Hadron Collider (LHC) at CERN, the European Organization for Nuclear Research. SAP/Nikhef is in a leadership position of the ALICE upgrade programme and works closely together with the most influential international research groups on experimental heavy-ion physics. The committee considers the strong alliance between SAP and Nikhef of clear added value for the research quality of this institute. It has resulted in outstanding research opportunities for both its staff and its research students, which have translated into paradigm-

shifting results. The international reputation of the SAP's staff is excellent. A clear sign of SAP's international recognition is the fact that both faculty and postdoc researchers are group leaders and sub group leaders within the ALICE experiment. The well-developed research agenda offers good options for further scientific advance in the field.

IMAU has consistently and with remarkable success addressed the difficult task of conducting fundamental as well as applied research in the field of climate physics. Amongst its research advances, IMAU's revolutionary work on oceanic circulation and its multi-decadal variability as well as on the modelling of the development of ice sheets should be listed as pioneering work with scientific impact at world level. The committee appreciates that IMAU is one of the few groups in its field worldwide to keep fundamental research high on its agenda whilst simultaneously consistently producing innovative results. Strengths of IMAU include its use of non-linear dynamics and its large array of methodologies underpinning its valuable and important contributions to the field. IMAU's high standing in the international field has been acknowledged by a large number of personal grants for its staff, textbook citations and notable awards. The international importance of the type of high-quality experimental data and analysis provided by IMAU cannot be overstated.

ITP at Utrecht University is one of the few theory institutes in the world covering an exceptionally broad range of research topics and managing to carry out ground-breaking research in all these fields. This breadth of research is in particular valued by the committee and is widely recognized as proof of excellence amongst peers in the field. It results in an impressive number of personal grants, with synergy between the various areas of research – in particular between the various strands of soft and hard condensed matter theory. In addition, ITP carries out vibrant research on the theory of ultra-cold gases. ITP performs outstanding research in string theory, quantum physics and gravity. Furthermore, ITP is one of the few places in the world with the high-level expertise required to pursue the recent developments in linking AdS-CFT and condensed matter physics.

The scale, diversity, quality and quantity of the work that is produced by the staff of the research unit Physical and Chemical Studies at Utrecht is very impressive in terms of academic impact. Such excellence is only possible because of the exceptional quality of the research staff of the four institutes: not surprisingly, the committee views this human resource as the unit's biggest asset. The committee was therefore pleased to notice that the institutes' management and the Faculty are aware of the need to maintain a solid base to fund and support high-quality staff. It detected a keen awareness of the need to maintain excellence by continued recruitment of top-level staff members and of the need to nurture young in-house talent. These observations naturally also feed into questions of viability, as discussed below.

3.3. Relevance to society

Although the four institutes underlying the research unit address different areas of expertise, all have a clear relevance to society with international impact. All four institutes have a vibrant outreach programme, which is both rich and diverse, to inform societal stakeholders about the aims of their research. They are involved in setting the Dutch National Research Agenda, and on a regular basis they discuss the influence of scientific research on policy with national and international policy makers – both in person and through policy briefs. Patents and applications, for example medical imaging equipment, are part of the research unit's output with a direct use in and impact on society. The research unit as a whole creates an infrastructure in which theory meets industry, for example by enabling meetings between researchers and professionals in the field at which problems of societal impact and a need for theory-based solutions are discussed. The research schools linked to the four research institutes train highly skilled scientists, who are of vital importance for the transfer of technical and scientific knowledge to society.

The committee stresses that societal relevance is both found in experimental and in theoretical research, and in particular in the strong connection between the various research institutes within

this research unit: the connections between SAP and ITP are already strong, ITP and DINS expand their collaboration to include more topics, and the attention paid to 'Sustainability' and 'Complexity' in the University's research agenda should result in interesting new opportunities to connect IMAU to other research groups in the Faculty of Science and beyond.

The committee urges the Faculty to continue upholding the strong fundamental research strands in place. It emphasizes the unique nature of the breadth and width of available knowledge encountered at Utrecht University. This broad scope of research is considered one of the most valuable assets of the research unit for society at large, the more so as it is a pre-requisite to maintain the current wide-ranging interaction with industry. Fundamental research and novel theoretical insights are at the basis of most major technological innovations. The technology that surrounds us today (computers, GPS, flat displays, lasers etc.) are all based on the basic discoveries of past decades. With the increasing power of computing, tools that derive from theoretical statistical physics have become of key relevance for subjects ranging from genomics (and related 'omics') to finance and economics. Excellence in basic physics and chemistry is underpinning the skills and the knowledge that are needed to keep our society viable.

The four institutes underlying the research unit all contribute to the unit's relevance to society. ITP's theoretical research translates into outreach that is of essential importance for society at large, not least by kindling the interest in science of high-school students (and other groups in society). It does so by working together with all relevant stakeholders in society. Its 'Theory at work' meetings are another successful initiative of ITP. Here, representatives of the professional field, industry leaders and many other interested parties meet and discuss problems with societal impact and at which ITP contributes with theoretical yet applicable solutions. Next to their crucial role in training highly-educated scientists who will be of vital importance in designing the analytical tools that will underpin a sustainable economy, ITP also diversifies into research directions with direct technological relevance, for example with their current Blue Energy initiatives.

The committee is similarly supportive of IMAU's strong theoretical research profile. This theoretical research feeds into IMAU's experimental research and its knowledge transfer activities in the context of climate change, one of the most pressing concerns in modern society. The relevance of IMAU's research for society is self-evident: IMAU is one of the world's key players in connecting research to policy makers, and its influence could literally change the world as we know it. The relevance of IMAU's research and data are internationally recognized, as evidenced by the incorporation of their research results in the reports of the Intergovernmental Panel on Climate Change. As a result, IMAU's research has a direct impact on climate change discussions and influences policy makers.

The committee also encountered overwhelming evidence for the relevance to society of both SAP and DINS. SAP's research activities have the high potential of contributing to the development of new medical applications, of which the successful development of medical imaging equipment is one example out of many. DINS benefits from a clear policy that feeds naturally into the strategic research themes of the University; the institute takes centre-stage in the Dutch Gravitation Programmes and proactively sets the scientific research agenda in both the Netherlands and the international field. It is heavily involved in both discussions and research concerning sustainability; the research output of DINS informs and influences national policies, and the institute's relevance to society is as a result palpable. The suggested Faculty strategy to connect its research unit Life Sciences more closely to its research unit Physical and Chemical Sciences, addressing the topic of biophysics, will even further enhance the DINS profile within the scale of its societal relevance. Both SAP and DINS produce highly qualified students, who contribute to the essential technology-transfer to society with theirs skills. In addition, DINS benefits from strong connections with industry and produces many patents.

3.4. Viability

The committee looked at the viability of the research unit Physical and Chemical Sciences from various perspectives, paying attention to both the strategic choices made by the Faculty and University (through the strategic themes) and to the financial underpinning of current groups. The committee noted that the Faculty of Science is fully aware of the problems that may arise in the future regarding the ability to continue attracting adequate levels of funding and of support for theoretical and fundamental research, now that funding tends to focus increasingly on projects aiming at either short-term solutions or reacting to direct societal concerns. It was impressed with the efforts and initiatives both at Faculty and institute level to address and counterbalance potential threats over the review period.

The Faculty has managed in a period when funds within academia were diminishing to sustain a healthy level of funding, due to restructuring and successful external fundraising. It has attracted many substantial grants as a result of the research unit's excellent staff and research output and is, as a result, crucial for the University's reputation and international standing. Together, research institutes and Faculty management, have been able to agree on a research policy and research direction that is upheld by all and that additionally promises new strands of research. These new research initiatives try to combine both the continuous need for and benefits of fundamental and theory-based research that also address society's interests and demands.

The committee congratulates the Faculty on its proactive attitude and daring choices supporting many of its current measures. It stresses that the Faculty's management deserves the full support of the University Board and its leadership for its research policy, and should receive adequate funding to achieve its ambitious aims. In the light of dwindling external funding for theory-based research and long-term projects, the Faculty needs to allocate sufficient financial means by the University, which would allow it to sustain its current research and its resulting world-class reputation. Such support will also result in the necessary innovation and reorientation needed to maintain that standing. Also, the committee considers additional funds necessary for addressing the existing gender imbalance. Without schemes allocating money towards this aim, the committee fears for the Faculty's ability to maintain its reputation as a high-quality and inclusive organisation.

The Faculty should also be congratulated with its well-functioning and highly-valued Grants Office and Finance Department. The committee was pleased to note that there was universal enthusiasm about the quality of the support that junior and senior academics received from the Financial Department and the Grants Office. These units contribute in no small part to the Faculty's current success in attracting external funding. These support units and their important role in attracting funds were repeatedly acknowledged by staff and management – at both Faculty and institute level. Support staff, and sufficient means for maintaining the current high quality and expertise of the Faculty's support staff, is therefore considered by the committee to be as of crucial importance.

The committee was impressed by the quality of leadership encountered, both at Faculty level and in the four institutes of the unit. The leadership combines an open and inclusive consultation culture with an ability to distil actionable decisions on the basis of the information thus gathered. Staff members, both at junior and senior level, commented on their ability to influence strategic choices of their research institutes. The institute directors indicated that they were consulted on a regular basis by the Faculty and University, and felt informed, supported and in control. Physical and Chemical Sciences seem therefore to combine the transparency of a bottom-up organisation with the flexibility of a unit that has a top-down management structure. The current management style creates an open and inclusive atmosphere throughout the ranks, resulting in broad support for the Faculty's leadership and decisions – even when difficult choices regarding funding and reorganization have to be made.

Based on the evidence of high research quality and great social relevance of the unit, the Committee concludes that Physical and Chemical Sciences form a vital unit underpinning the international scientific profile of Utrecht University. The research unit comprises four world-class institutes that drive and uphold Utrecht University's natural sciences profile. In the view of the committee, Utrecht University and the Faculty of Science would be wise to protect and nurture the reputation of its research institutes, which is based on the quality of its transformative research. Such research will lead to new ideas and tools that will place the unit in a stronger position to compete successfully for theme-driven, externally funded projects. Real advances in the application of research are never based on 'business as usual'. It is the combination of basic research with strategic, application-oriented research that underlies breakthroughs with a large societal impact.

The committee notes that the current university financial allocation model is skewed heavily towards teaching. Whilst this seems to make financial sense, it is not the way in which leading institutions maintain their international reputation. Utrecht University in general and the research unit of assessment in particular, can be proud of their international standing in research. To maintain this standing, it is crucial to provide the necessary support to maintain and strengthen those units that belong to the world top in their field of research. It takes many years to build outstanding institutes like DINS, SAP, ITP and IMAU and their level of excellence can only be maintained if the recognition of their importance is translated, wherever possible, into sustained support by the Faculty and the University. Such support is all the more important as research funding has become more theme-based: the number of sources funding for high-risk/high-gain initiatives is very limited and this has a negative effect on the turn-around time between idea and implementation. Building such units is a slow process – but, with increased mobility of (top) researchers, losing them can be fast.

In this context, it is gratifying to see that the DINS management team has been able to join forces with other institutes to strengthen the broader strategic focus on 'Sustainability', which is also one of the University's strategic themes. The committee stresses that, with DINS, Utrecht University has established itself as one of the world-leaders in research on future energy and resources: the UU should try very hard to maintain and strengthen this international position. Sources of funding are increasingly derived from external interests and (often) short-term objectives. Leaving external funders dictate the strategic research agenda could result in research driven by the fashion of the day.

Supporting the entire chain from fundamental discoveries to studying 'real-life' problems will create ample opportunity to build relationships with industry and drive technological developments that could strengthen the Dutch economy. Moreover, it will inform policy makers to deal with challenges facing society in the near future concerning energy, climate change and the implications of an ageing population. The leading role of Utrecht, and in particular of IMAU, in the field of basic and applied climate physics could enable a national policy that integrates insights obtained in theoretical and experimental climate research. The committee appreciates that IMAU has been able to establish strong connections with key research institutes and international organizations in this area, a fact that further strengthens its viability and the prospects of long-term viability.

As long as funding will be secured, the research potential of SAP is enormous as the well-developed research agenda offers good options for further scientific advance in the field. The committee established that the continued link with Nikhef is crucial to this continuing success. Currently, SAP and Nikhef are very well positioned in high-visibility leadership roles at the ALICE experiment at CERN's Large Hadron Collider (LHC). SAP, together with Nikhef, play a critical role in securing the on-going upgrades which feed into ALICE's viability. If the envisaged appointment in dark matter materialises, this will further strengthen the link between SAP and Nikhef and add diversity to the research programme, also feeding into SAP's long-term viability.

The committee is impressed by the fact that the Faculty has been able to rejuvenate, in particular at ITP and DINS. During the assessment period, ITP has been successful in hiring a group of highly promising young faculty in the subfields of string theory, holography and cosmology, as well as in hard condensed matter. The field of soft condensed matter, biophysics, or complexity is receiving attention in the immediate future by a planned new hiring, adding to the already strong soft matter group and strengthening the possibility of strategic, application-oriented theoretical physics research. Due to sensible hiring policies, DINS has developed a unique suite of atomic-resolution (concentrated in the EM squared centre) and optical imaging instruments that other departments and industry can use (if necessary together with technical assistance). A healthy charging system is in place to guarantee that the EM squared equipment can be maintained in optimal condition. The committee was pleased to note that the University has made a major contribution to EM squared.

The new appointments have also fuelled new exciting research directions and have brought new themes to the forefront, in particular the current movement in the direction of biophysics. For this development, close collaboration with top groups in the life-sciences department and the Hubrecht Laboratory will be key. DINS is in a unique position to form such a strategic partnership, which will allow the collaborating groups to develop novel directions in experimental and theoretical biophysics. This theme will further be strengthened by an appointment in the bio/complexity theme at ITP. These developments will allow the University to expand in a new direction that is quite likely to be attractive to future students. Experience in other institutions indicates that biophysics research tends to attract a more gender-balanced mix of students and PhD students than most other areas in the physical sciences. Hence its introduction will likely contribute to a more healthy gender balance. This is also considered of importance for the long term viability of the research unit.

In 2016, the Complexity Laboratory Utrecht (CLUe) was launched to further embed the natural sciences within the research strategy of the University. The study of 'emergent' complex behaviour in systems consisting of many simple components is relevant for a very wide range of topics in the Sciences, Life Sciences and the Humanities. The science of complexity nowadays pervades many scientific fields, from mathematics to sociology and finance. Almost all areas of research within the unit of assessment's study systems are 'complex' in the above sense. It is logical that ITP should play a coordinating role in the CLUe, as many of the tools used in this complexity research are closely related to those used in theoretical (in particular, statistical) physics and numerical simulation. Engagement in the CLUe offers great opportunity for further cooperation within the Faculty itself and between the various research institutes across the Faculties. The committee is enthusiastic about the current initiatives.

These examples illustrate that the Faculty, whilst having been completely restructured and having made painful decisions over the last years regarding the strands of research to retain in Utrecht, has nevertheless been able to take the necessary steps to formulate a vibrant new research policy within the unit. The committee was particularly impressed by the fact that the Faculty has managed to create synergy between the various research groups and to rebuild trust within the research unit. All four research institutes now appear united and broadly supportive of the Faculty management and its overarching research policy. The committee considers the Faculty's ability to rejuvenate a great strength. The committee underlines the fact that a similar active approach is needed for addressing the gender balance as the current imbalance could potentially influence the Faculty's vitality, as discussed below under diversity. Interviews with the Faculty staff have strengthened the committee's belief that the management is aware of the need to address the current imbalance, yet it hopes with its suggestions, below in 3.7, to offer some advice how to organize this practically.

3.5. PhD programmes

The PhD programmes of the four institutes assessed are all covered by the Graduate School of Natural Sciences (GSNS). Each PhD programme is currently directed by the scientific directors of

the fours institutes, which results in a good connection between the institutes and the school. The administrative head is the Vice Dean of Education of the Faculty of Science. Quality assurance of the MSc and PhD programmes are the responsibility of the GSNS Board of Studies. The GSNS organizes training of the academic and generic skills. Further development of scientific skills is organized through the national research schools (Dutch Research School for Theoretical Physics, Dutch Institute for Research on Catalysis, The Buys Ballot Research School Fundamental Processes in the Climate System and the Research School Subatomic Physics) in which the four institutes participate. The committee considers the opportunity to partake in discussion at the national research schools and in international summer schools additional assets of the way in which PhD training is organized in the Netherlands, as it allows PhD candidates to encounter their peers and to explore the wider scientific community.

At the start of every PhD project, a Teaching & Supervision Agreement (TSA) is agreed upon between the PhD supervisor and the PhD candidate. In the TSA, not only the scientific content of the project is described, but also the activities that the PhD candidate will undertake with regards to training, teaching and personal development are defined. Training exists of a minimum of 20 EC credits and it includes further development of scientific skills, academic skills and generic skills including orientation on future careers. The committee considers the supervision and programme plans to be well conceived. PhD candidates are given several opportunities to discuss progress with their supervisors and to communicate their results to wider audiences, including publication in international scientific journals and presentations at international conferences.

Teaching tasks, usually as a teaching assistant in tutorials and practicals, are agreed upon in direct communication with both the PhD supervisor and the Director of Education of the department in question. PhD students can apply for the position of 'super teaching assistant', who are responsible for leading and developing the tutorials of two compulsory 7.5 EC courses. This extra effort is compensated by a three-month extension of their PhD contract, which is appreciated by the committee. As a result, PhD candidates master a broad range of skills helping their career perspectives in academia, but also in the private sector and government organizations.

The committee has been impressed by the quality and enthusiasm of the PhD students interviewed at all four institutes. Extensive discussions with the PhD students revealed that the students felt motivated and well-supported. They were grateful that there was total clarity about their targets and they were full of praise about the way in which PhD supervision was implemented, both by their direct supervisors and by the research schools that provide courses that are of direct relevance to students. Also, flexibility of choice and of interest was fully supported and available for all candidates. In addition, students had access to summer schools for training in their field of research and received funding to attend international conferences to present their results. The committee also established that all international PhD candidates did not encounter any adjustment problems; they felt supported and welcomed in the research community and at the University, were offered practical help regarding visa and housing (from either the research group or department) and were very enthusiastic about the opportunity to follow Dutch language classes.

In terms of the number of PhD students, all four institutes naturally differ: during the period under review DINS hosted 138 PhD students, IMAU 51, ITP 43, and SAP 11. Overall, PhD completion rates were good to very good, although of course differences exist between different institutes. This is at least partly due to statistical fluctuations in the small number of students who did not complete or who completed very late. In view of these small numbers, the committee feels that one should be cautious when comparing the completion rates between the various research institutes. The more so as all four institutes tailor towards different research fields with its own particularities and challenges (e.g. delays in equipment delivery), and additionally the various fields experience differing levels of competition from industry and/or governmental organizations for high-potential candidates before and during the PhD trajectory. The committee

members are also aware that every PhD candidate is different and may have personal reasons for either finishing or not finishing his or her project (in time). When asked in detail, all PhD candidates of all four institutes felt well-supported by their PhD supervisor, daily supervisor, research group, the institute and the Faculty support group. They all indicated that they knew exactly what was expected from them and that they could easily obtain the information to whom to turn to if they experienced any problem during their research time in Utrecht.

Nonetheless, the committee wants to point out two matters of relevance with regards to particular institutes. It wants to congratulate ITP in particular with its completion rates for the period under review: the ITP PhD candidates praised the structured and clear supervision practice and support experienced during their Utrecht years, which also seem to translate in very good completion rates that impressed the committee. Although the committee recognizes the fact that a theory-based project may be easier to plan than a research project based on experiments that potentially may present unforeseen problems, it also seems to the committee that ITP has an exceptionally well-functioning screening and selection procedure on admittance for which the institute may take full credit. The investment of time and interest in potential candidates, combined with extensively interviewing candidates in person or by Skype, seems to truly pay off in the selection of highly dedicated and successful candidates.

Whilst there is no immediate reason for concern, the higher percentage of PhD candidates at IMAU who have discontinued their studies over the period under review requires closer scrutiny. From IMAU management and staff, the committee learned that the relatively high dropout level was mostly due to personal choices of the PhD candidates involved. Nevertheless, the committee wants to point out that continued low completion rates may become a matter of concern in the future. It is essential to secure a healthy flow of master and PhD students in this area of expertise and therefore to maintain a good balance between admission levels and completion rates. In the longer term, a high dropout rate could have an impact on the viability of the institute.

To maintain a good balance between admission levels and completion rates, the committee the committee supports the recent action taken by the IMAU management board for a stricter admission procedure for the screening of potential candidates at IMAU, and to pay special attention to the planning of experiment-based PhD projects that rely on external partners. This includes the action that, for PhD students who will work on such projects, a 'Plan B' will also be formulated during the TSA-procedure. Experimental climate research is more susceptible to externally caused delays than, for instance, theory-based projects. Good planning of this type of projects is therefore of supreme importance; although all the IMAU PhD candidates felt well-supported by their supervisors, some also indicated to find planning a difficult part of their projects and may therefore warrant further attention. Additionally, it would help to secure a larger home grown inflow of PhD candidates.

3.6. Research integrity policy

The committee established that the research integrity policy was clearly formulated: it seems to be ingrained within the institutes in a clear and conscious manner. Both students and staff are aware of the policies in place to secure an environment in which research integrity takes centre stage. From the interviews during the site visit, it was clear that both students and staff were well aware of the importance of research integrity and of the possible issues that could arise. They knew how to contact the relevant staff member dealing with integrity issues, although, apparently, no issues had arisen within the assessment period. In addition, the GSNS is currently in the process of designing a 2 EC course on scientific integrity that will be compulsory for all PhD candidates. The committee considers this a good way to ensure and further encourage the necessary attitude with the Utrecht scientists of tomorrow.

In view of potential controversies that may arise in the future in the especially sensitive field of climate science, the panel stresses that the integrity policies of the Faculty should be visible to the outside world. Of special interest is also the recent planning of a master's course on scientific

integrity addressed to students in climate physics, fully acknowledging the importance and sensitivities around this issue. The committee verified that the sensitivities around climate science research in the period under review have been successfully dealt with in an outstanding manner. Regular presentations of results to wider research groups offer additional checks of quality, originality and integrity. In the committee's view, it is of key importance that research data remain publically accessible in an unfiltered way within the context of international organization and accessible to third parties, just as they currently are. The committee also noticed that the third-party use of produced data is successfully monitored and reviewed. Data storage is very well-organized. The committee is appreciative of all of these initiatives.

3.7. Diversity

The committee approached the topic of diversity mostly from the gender perspective for this review, as addressing the historical gender imbalance is one of the major challenges for this Faculty. Physical and Chemical Sciences in Utrecht are well-aware of the challenges posed by gender diversity to their research field. The management of both departments has implemented policy to address the asymmetric gender balance, based on the goals set in the Sectorplan Physics and Chemistry to promote the flow of women into more senior scientific positions. As a result, female staff members have been added to selection committees and the best female candidate are being kept in the selection procedure till the end. Nonetheless, this has so far only resulted in a 20% female representation for the Sectorplan positions instead of the desired 40% female representation. On a positive note, both the Chemistry and Physics department managed to secure or promote some strong female candidates within their research groups.

In 2013, the Faculty stepped in to further the female representation within the Faculty at large. The goal is to raise the amount of female staff in senior positions from 10% to 20% in 2020. This has resulted in the creation of the three-year tenure track Westerdijk Fellowship, policies to support women picking up their careers after returning from maternity leave, the successful organization of workshops to raise awareness of gender bias among Faculty staff and awareness courses offered to evaluation and advisory committees of professorship positions and the creation of the so-called Gender Diversity Policy project in 2014. In addition, the Faculty is aware of the need to 'court' suitable female candidates. In discussion with the various managements and groups, it turned out that in several cases the Faculty of Science within this research unit has been slightly unlucky: a senior female staff member recently departed and their attempts to hire successful female candidates fell through at the very last stage, even though in all cases good employment packages were offered. Highly qualified female candidates are much sought after.

The committee is positive about the attention paid to gender diversity at Faculty level and the awareness of the fact that unconscious bias may play a role in selection procedures. The committee also recognizes the fact that addressing the gender balance is often met by worries at department and institute level regarding the necessary achievement level of candidates. It therefore praises the projects regarding awareness training and it hopes this will partly address these anxieties and open up the floor for further successful female candidates. Also, the workshops offered by female role models are appreciated as a good way to address gender dynamics. However, sustained action is crucial as gender dynamics has a potential impact on the institutes' long-term viability – not least because funding bodies are increasingly emphasizing the importance of a healthy gender balance. Therefore, the committee has some additional suggestions about ways to strengthen the current initiatives.

Given the limited number of female role models, one way to ensure that PhD students and postdocs are aware of the fact that women can be successful in their field is to make use of seminar series and colloquia. The committee advises all four institutes to make sure that female speakers are actively considered. The increased visibility of high-profile female speaker can encourage female junior researchers to aim high in their (academic) career. The committee also suggests addressing the current gender imbalance among holders of prestigious temporary appointments such as the Kramers Chair in Theoretical Physics.

The committee established that female PhD candidates are aware of how few women there are in their area. It was gratifying to note that these PhD candidates felt welcome and valued in the scientific community at Utrecht and that they looked with confidence towards their own futures. Nevertheless, the committee feels that it may be sensible to take additional steps to nurture and encourage women at an early stage in their careers, to help them develop into being the next generation of postdocs and faculty. The committee therefore urges the various institutes, but also the Faculty and the University, to explore all options to retain promising female staff members at Utrecht University.

One specific recommendation of the committee to the Faculty is to allocate funds to underwrite PhD positions for stellar female undergraduates. There is high in-house female potential, but at present, many promising young female academic staff are in non-tenure track positions. The committee realises that extra initiatives may be needed to address this issue. Sustainable financial support for such initiatives would largely be beyond the current means of the unit of assessment and sufficient funds should therefore be made available to address this particular issue. Other steps are also possible. For instance, some countries operate fellowship schemes, which are only available to those who require flexible working, such as to those with caring responsibilities. A possibility to improve the gender balance would be to consider such a fellowship scheme, which would complement the NWO WISE tenure track. Again, the committee is aware that such an initiative would require serious support from other major players in Dutch academia, but it is worth pursuing.

The panel also wishes to draw attention to returning-carers schemes in other universities, like Cambridge for example. Cambridge has established a modest fund to support those returning from a career break to 'kick start' their research. Although Utrecht University already has measures in place to support young women after their maternity leave, such funds could be used to enable women to attend conferences with a carer to look after the baby, or to hire an assistant to help with the experiment whilst on maternity leave. An additional benefit of such a scheme would be that it could be inclusive: many male staff members nowadays often share in child care responsibilities. Several early career male researchers pointed out that they would also be interested in a good infrastructure allowing for care responsibilities. Additionally, researchers in need of care after an accident or due to disabilities could also potentially benefit from such a scheme.

3.8. Conclusion

From the documentation received, but more specifically from the interviews held during the site visit, the committee encountered an outstanding research unit in Physical and Chemical Sciences at Utrecht University, which deserves the full support of both the Faculty and the University to pursue current research interests and open up new fields. In the eyes of the committee, the research units' scientific output is of the highest international level, which is attested by numerous marks of international recognition and impressive amounts of personal grants, where it should be noted that the committee found evidence for a collegial culture that resulted in applicants for prestigious personal grants being extensively mentored by their colleagues.

The research of the unit has huge potential for societal impact through its many patents, its influence on policy makers and its impact on the Dutch science agenda. Further examples of its relevance to society are: its research into climate change and sustainability, which drives policy and informs innovations. The research unit's output also includes patents and the development of applications and equipment. In addition, it fuels interaction between scientists, professionals in the field, industry and policy makers with encounters organized by research groups and institutes, and through policy briefs. The research schools linked to the research unit train highly skilled scientists who are of vital importance for the transfer of technical and scientific knowledge to society. The combined experimental-theoretical research makes crucial contributions to the

foundations of a sustainable society with a high quality of life. Both research quality and relevance to society, and the close link between both, are rewarded with an assessment of 'excellent'.

The committee praises the Faculty's proactive attitude in times of cuts and the reorganization of sources of funding that are increasingly driven by external priorities that may not always prioritize the most ambitious research. Although the Faculty has been able to maintain healthy funding levels for all four institutes forming this research unit, the committee also identified some risks, mostly associated with external priorities that may impact funding streams. These external factors, if left unchecked, could weaken the ability of the Physical and Chemical Sciences within Utrecht University to have a maximal impact on society. A second (but related) threat is the practical difficulty in reversing the large, historical gender imbalance in a short time.

The committee wishes to commend the Faculty for its efforts over the last years to increase its viability. It is confident that, if all plans could be implemented, the viability of the unit would be excellent. However, the identified 'external' risks, have an impact on the committee's overall assessment. The committee, however, is of the opinion that praise alone is not enough to ensure viability in the long term. Hence, it recommends that the University Board pays close attention to the factors that threaten the viability of the Faculty and the unit of assessment. Recognition of the Faculty's key role in sustaining the University's international reputation should translate into the allocation of adequate financial means to enable the Faculty and the unit to implement their strategy: in this way, the research unit's world-class standing can be maintained. The committee therefore assessed the viability of the research unit as 'very good' and strongly recommends the University to value, nurture and protect these research institutes of excellent international standing.

3.9. Overview of the quantitative assessment of the research unit

Research quality:	excellent (1)
Relevance to society:	excellent (1)
Viability:	very good (2)

4. QUANTITATIVE AND QUALITATIVE ASSESSMENT OF THE SEPARATE RESEARCH INSTITUTES

The research assessment Physical and Chemical Sciences reflect on four separate research institutes: the Debye Institute for Nanomaterial Science (DINS), the Institute for Marine and Atmospheric research Utrecht (IMAU), the Institute for Theoretical Physics (ITP) and the Institute for Sub-Atomic Physics (SAP). These institutes are part of the departments of Physics and Chemistry at the Faculty of Science at Utrecht University. All four institutes will be separately discussed with regards to research quality, relevance to society and viability.

4.1. DEBYE INSTITUTE FOR NANOMATERIALS SCIENCE (DINS)

Overview
DINS is a large institute comprising six substantial research groups: four belonging to Chemistry and two to Physics. Its research aims are to generate new, fundamental knowledge that is crucial for the development of new technologies underpinning a sustainable future. The DINS research focused on the synthesis, physical and chemical characterisation, and modelling of nano-structured materials for conversion, storage, and more efficient use of energy. The research of the different research groups reflects the 'slogan' of DINS "Make, Measure and Model", and covers topics as diverse as the preparation and microscopic characterisation of micro-porous catalysts, the study of self-assembly of tailor-made colloids and the study of novel photonic phenomena.

Research quality
DINS is an excellent research institute of international renown, which is in the eyes of the committee highlighted by the DINS' ability to attract funding, its outstanding academic reputation, its high number of publications in top-ranging international journals, and the embedment of its staff in the international research community as leading members of boards and committees. Other signs of recognition of DINS' staff are editorships, membership of evaluation committees, and visiting professorships. In addition, numerous (international) conferences, workshops and schools were organized by the DINS staff.

In the period 2010-2015, two large research programmes were funded: 1. The Gravitation Programme Multiscale Catalytic Energy Conversion for 'multiple length scale science and engineering for catalysis' (MCEC). It enables collaborations between several groups from Utrecht, Twente and Eindhoven, and 2. The Advanced Research Center Chemical Building Block Consortium (CBBC), in which a substantial number of industries (BASF, AkzoNobel, Shell, etc.) participate. In addition, extensive funding was obtained through successful bids VENI (8), VIDI (4), and VICI (2). In addition, DINS researchers secured a number of very prestigious ERC Starting and Consolidator grants (3) and ERC Advanced grant (4).

Several breakthroughs have attracted 'News and Views' style comments in top journals, and over the period under consideration several principal investigators have been asked to write a review of their field for leading journals. Many of the scientific results were published in highest-level journals. The publications are extremely well received by the scientific community as apparent from the very high numbers of citations. The papers published in high-quality international journals covered chemistry, physics and materials science (in total of 1145 with an average IF of 6). Strikingly, some 30 articles were published in *Science* and *Nature* family journals. The high impact of these papers is reflected in the high number of citations: 19600 citations (17.2 citations per paper); on average 33 citations per paper over the assessment period. An average number of 191 articles per year was produced.

The international academic reputation of DINS is excellent. There is ample evidence that both early-stage and more senior researchers are receiving marks of recognition commensurate with

their career stage. The high quality of research is also visible in the many personal grants awarded to members of the institute. In 2013 for example, a member of the DINS staff was awarded a highly prestigious Spinoza award. The success rate in obtaining highly competitive personal grants is nothing less than astounding.

Most senior staff and even some junior staff are world-leading. Apart from the so-called objective indicators that all show that DINS research is published in the very best journals, several research breakthroughs made during the reporting period are clear game changers. It is gratifying to note that such breakthroughs have been reported in a number of different DINS groups. Hence, quality-wise, DINS is not only very strong, but also balanced. A number of discoveries by the DINS researchers have resolved decade-old problems in their field. Such contributions are likely to end up in textbooks. A more substantial contribution to the body of scientific knowledge is hard to imagine. As documented below, the demonstrable output is excellent.

The great quality of the staff members is also reflected in the fact that three senior staff are members of the Royal Academy of Arts and Sciences, whilst two are members of the Academia Europaea. In addition, an early career staff member is a member of the 'Young Academy' indicating a promising future. Several societal partners provide funding to second staff members to work as part-time researchers at DINS. As a consequence, some 10-15% of Debye's publications include authors with a non-academic affiliation. This reflects on the DINS' research quality and its societal and social relevance. A unique sign of societal recognition is the award of the title Knight in the Order of the Dutch Lion to one of its leading staff members.

Relevance to society
In the medium to long term, there is no doubt that the main contribution of DINS to society is a steady stream is highly-skilled, diverse young scientists who have experience with inter-disciplinary projects. There is substantial evidence supporting the assumption that the DINS graduates are highly employable with about equal numbers of PhDs moving to a positions in industry and government on the one hand and in academia (possibly only temporarily, as postdoc) on the other. Young researchers trained at DINS are easily employed and make an impact in many segments of society. During the assessment period, 129 DINS PhD theses were produced.

DINS played a key role in shaping local and national science policy and setting strategic agendas, as reflected by the Dutch National Research Agenda and the outline of the Topsector Chemistry (NWO and Ministry of Economic Affairs). This emphasizes its relevance to society as a whole. The DINS researchers engage actively with a wide range of potential stakeholders including more than 20 industries, including petro-chemical industries, catalyst manufacturers, chemical industries, steel manufacturers, companies producing coatings and solar cells, and industries in the area of semiconductors and biotech. The pro-active approach of the DINS researchers translates into a substantial number of patents for materials, processes and novel experimental tools. The University usually files the patent applications but the industrial partners have the first option to use the patent. During the assessment period, some 18 patents were issued, and some of them already offered to the industrial partners; 6 processes are under current developments in industry. Some 10,000 users are using DINS software.

Viability
DINS has positioned itself as a leading player in the broad field synthesis, characterisation and applications of nano-structured materials. Over the past few years, DINS has achieved a remarkable integration of their different research lines and this has enabled them to play a leading role in two major Gravitation Programmes, viz. MCEC and CBBC. DINS has recently succeeded in attracting a group of very promising young faculty, which puts it in the position to continue the tradition of excellent research established in the past by the senior staff members. DINS is well prepared to meet the challenges of an ever-changing research landscape for the next few years.

There is much evidence for synergy in the DINS strategy for applying for grants. This policy has contributed to the exceptional number of prestigious personal grants (ERC, VENI, VIDI, VICI) of researchers at all career stages and in all divisions of DINS. Partly, this success is due to internal support mechanisms that ensure that applicants get expert advice on their proposals and, where applicable, training for panel interviews. The DINS strategy to acquire funding and, more generally, to actively create support for their research aims (e.g. sustainability), is very well joined-up. This clear focus, combined with a strong team spirit is an excellent basis for future excellence. The future viability of DINS is strengthened by the fact that DINS will tentatively be 'under one roof' by 2022, thus enhancing the interactions between the different groups and enhancing the opportunities for even more collaborative projects.

Conclusion
Over the period under review, DINS researchers reported several important breakthroughs that have a profound impact on the fields of photonics, catalysis, colloid science and self-assembly. The local infrastructure available is impressive. The committee was particularly impressed by the large number of unique instruments that had been developed at the site, mainly in the area of microscopy, which will result in further advances in our scientific knowledge. The very strong international position of DINS is reflected in several marks of recognition, including an exceptional number of personal grants.

The institute takes centre-stage in the Dutch Gravitation Programmes and proactively sets the scientific research agenda in both the Netherlands and the international field. DINS produces highly qualified students, who contribute to the essential technology-transfer to society with theirs skills. In addition, DINS benefits from strong connections with industry and produces many patents. The research output of DINS informs and influences national policies, and the institute's relevance to society is as a result palpable. Taking all aspects into consideration, the committee considers DINS to be a world-leading research institute, with a high degree of societal relevance as evidenced by its ability to set the research agenda in its field. Hence it assessed both DINS' research quality and relevance to society as 'excellent'.

DINS's viability is closely linked to its success in attracting young scholars, funding and support for its research aims within the Faculty and University. In all of these areas, DINS has performed well in the period under review: it rejuvenated its faculty with a group of very promising young faculty, it successfully acquired substantial external funding as a result of adjustments in research focus and entered into new collaborations with other institutes, testimony to skilful governance and a proactive attitude in times of cuts and the reorganization of sources of funding.

The research interest in the biophysics and complexity theme within Utrecht University should result in further cooperation between research groups within the Faculty and between the various research institutes across the Faculties. DINS holds a strategic position within these collaborations and is therefore of vital importance to further these research initiatives. The committee is enthusiastic about the current initiatives, allowing the University to expand in a new research direction that is quite likely to be attractive to future students and that potentially will attract a more gender-balanced mix of students. This is also considered of importance for the long term viability of the research unit – not least because funding bodies are increasingly emphasizing the importance of a healthy gender balance.

The committee stresses that, with DINS, Utrecht University has established itself as one of the world-leaders in research on future energy and resources: the University should try very hard to maintain and strengthen this international position. Although healthy funding levels have been maintained for DINS, the committee also identified some risks in Chapter 3 above that may impact funding streams in the future. These risks, which hold true for DINS and the other three institutes within the research unit Physics and Chemical Studies alike, could weaken the ability of DINS to have a maximal impact on society. The current gender imbalance, the increased

competition for (top) researchers and a funding model which has become increasingly theme-based may threaten research institutes of excellence, such as DINS. Taking all these observations into consideration, the committee assessed the viability of DINS in this wider context as 'very good' and strongly recommends the University to value, nurture and protect it together with the other three research institutes that formed part of this research review.

Quantitative assessment
Research quality: excellent (1)
Relevance to society: excellent (1)
Viability: very good (2)

4.2. Institute for Marine and Atmospheric Research Utrecht (IMAU)

Overview
IMAU is an interfaculty institute embedded in the Physics department of the Faculty of Science and in the Physical Geography department of the Faculty of Geosciences of Utrecht University. Currently it comprises 5 research groups with a total of 14 staff members, 23 postdocs and 17 PhD candidates. It conducts world-class research in atmospheric, oceanic and cryospheric processes with emphasis on climate change and related issues. IMAU researchers have been at the origin of breakthroughs in connection with the discovery of multiple modes of oceanic circulation and of multiple equilibria in glacier mass balance. During the reporting period models combined with observations were used to address problems of current concern such as glacier surges in a warming climate, and the mechanism underlying the Southern Ocean multi-decadal variability.

Research quality
IMAU successfully manages the difficult task of combining fundamental 'underpinning' research as well as collecting essential experimental data for a large community of stakeholders, with the training of young scientists in the field of climate physics. Its activities span a wide range of subjects in atmospheric, glacier and ocean dynamics and draw on a large array of methodologies (models, data analysis and experiment; analytic nonlinear science-based as well as numerical approaches). In a context where societal concerns on climate change tend to shift funding priorities away from fundamental research, IMAU represents one of the few major teams worldwide to keep fundamental research high on its agenda and to produce ground-breaking results. IMAU is strongly encouraged to maintain its involvement in both the fundamental and the applied aspects of climate science and to promote the synergies and the transfer of knowledge across these two areas of activity.

The quality of the IMAU contributions is widely recognized by the international scientific community. This is witnessed by a total of 496 peer-reviewed publications during the reporting period among which an impressive number of 31 articles published in *Nature*, *PNAS* and other high impact journals; by a total of 92 short and long-term visitors hosted; and by several distinctions (academy memberships, highly cited authors, EGU medals) awarded to staff members and postdocs. In addition, IMAU has managed to attract a relative stable funding level over the assessment period. Significantly, approximately 45% is attracted externally, mainly through prestigious grants from the NWO and EU. In addition, IMAU secured a considerable Gravitation Grant. IMAU's success in obtaining external funding is another indicator of the high level of research.

In the period under consideration, several prestigious personal grants were obtained reflecting the IMAU's excellent staff performance. Three postdoctoral researchers were awarded a VENI grant. International marks of recognition and prizes bestowed upon IMAU researchers during the reporting period included *Excellence in Refereeing* for AGU (2011), a national (2011) and global (2013) Enlighten Your Research award and the 2013 Distinguished Lecturer of the European

Association of Geochemistry. The IMAU staff is also member of prestigious boards and committees. Currently, three out of the IMAU's six full professors are member of the Royal Academy of Arts and Sciences, and two out of six are fellows of the Society for Industrial and Applied Mathematics and the Royal Society of South Africa, respectively.

Societal relevance
The research carried out at IMAU belongs to a field that ranks among the most directly relevant scientific fields of our days. On the one side the atmosphere, the oceans and the climate as a whole are among the most complex systems encountered in nature and, as such, they are parts of fundamental science. But on the other side their societal relevance calls also for concrete, practically-oriented approaches to tackle specific problems of concern for both everyday experience and long-term perspectives. IMAU meets this double challenge in a very successful and effective way. The outstanding quality of its contributions to society stems from its ability to pursue actively concrete goals of societal relevance while drawing at the same time on knowledge acquired through fundamental in-house research.

The IMAU contributions are manifested at different levels: judicious choice of research themes, interest of the results obtained, competitive training of MSc and PhD students and postdocs, conference and school organization, contribution to public awareness through contact with media and popularization, the use of research products for further scientific developments and for decision-making, and strong visibility in international collaborative programmes and scientific advisory boards.

Viability
The prospects for future viability are bright in view of the increasing importance of climate research in the science agenda. Moreover, IMAU has just recruited an earlier career member in the field of large scale ocean circulation. In addition, two tenure track positions will be filled in the next two years. Nine IMAU researchers have been contributing authors in recent reports issued by the IPCC (Intergovernmental Panel on Climate Change), the principal international body coordinating activities in this area. The quality of the staff, of the research environment and of the management, a large network of national and international collaborations, and the diversity of the subjects developed, of the methodologies used and of the sources of funding offer further guarantees of robustness and viability. Additionally, the visibility of climate physics is expected to be enhanced by new national initiatives such as the focus area on Complex Systems and by various EU actions in the context of the H2020 program. However, the committee shares the concern of the IMAU management that, in the absence of a national programme to support climate research, the current national focus on application-driven research may starve basic climate science of funding at a critical moment in time.

The committee supports the ongoing effort to enhance the links between the Atmospheric Dynamics and Coastal and Shelf Sea Dynamics groups, which are currently under-represented, and the teams involved in the three other research themes within the Institute. The suggestion by the IMAU board to use the new tenure track position 'Earth System Modelling' to this end would likely further strengthen IMAU's profile.

Whilst there is no immediate reason for concern, the higher percentage of PhD candidates at IMAU who have discontinued their studies over the period under review, as discussed above in 3.5, requires closer scrutiny. From IMAU management and staff, the committee learned that the relatively high dropout level was mostly due to personal choices of the PhD candidates involved. Nevertheless, the committee wants to point out that continued low completion rates may become a matter of concern in the future. It is essential to secure a healthy flow of master and PhD students in this area of expertise and therefore to maintain a good balance between admission levels and completion rates. In the longer term, a high dropout rate could have an impact on the viability of the institute.

Conclusion

IMAU has consistently and with remarkable success addressed the difficult task of conducting fundamental as well as applied research in the field of climate physics. Amongst its research advances, IMAU's revolutionary work on oceanic circulation and its multi-decadal variability as well as on the modelling of the development of ice sheets should be listed as pioneering work with scientific impact at world level. The committee appreciates that IMAU is one of the few groups in its field worldwide to keep fundamental research high on its agenda whilst simultaneously consistently producing innovative results. Strengths of IMAU include its use of non-linear dynamics and its large array of methodologies underpinning its valuable and important contributions to the field. IMAU's high standing in the international field has been acknowledged by a large number of personal grants for its staff, textbook citations and notable awards. The international importance of the type of high-quality experimental data and analysis provided by IMAU cannot be overstated. IMAU's research quality is therefore assessed by the committee as 'excellent'.

The committee is supportive of IMAU's strong theoretical research profile. This theoretical research feeds into IMAU's experimental research and its knowledge transfer activities in the context of climate change, one of the most pressing concerns in modern society. IMAU is one of the world's key players in connecting research to policy makers, as evidenced by the incorporation of their research results in the reports of the Intergovernmental Panel on Climate Change. As a result, IMAU's research has a direct impact on climate change discussions and influences policy makers. As a world-leading research institute on natural physical phenomena including climate change, the committee considers IMAU of quintessential societal relevance. Hence, the committee assessed IMAU's societal relevance 'excellent'.

IMAU's viability is closely linked to its success in attracting young scholars, funding and support for its research aims within the Faculty and University. IMAU has successfully pertained a healthy level of funding in the period under review due to clever funding bids and it entered into new collaborations with other institutes, testimony to skilful governance and a proactive attitude in times of cuts and the reorganization of sources of funding. The committee appreciates that IMAU has been able to establish strong connections with key research institutes and international organizations in the field of basic and applied climate physics, which could enable a national policy that integrates insights obtained in theoretical and experimental climate research. As a result, the prospects for IAMU's future viability are bright in view of the increasing importance of climate research in the science agenda.

The committee also identified some risks that may impact funding streams in the future, which hold true for IMAU and the other three institutes within the research unit Physics and Chemical Studies alike, as discussed in Chapter 3 above. The current gender imbalance, the increased competition for (top) researchers and a funding model which has become increasingly theme-based may threaten research institutes of excellence, such as IMAU. The committee shares the concern of the IMAU management that, in the absence of a national programme to support climate research, the current national focus on application-driven research may starve basic climate science of funding at a critical moment in time. These external forces may negatively impact IMAU's viability in the long term.

The committee also recommends securing a larger home grown inflow of PhD candidates to positively impact the long term viability of the institute and to continue paying attention to addressing the current gender imbalance within the institute – not least because funding bodies are increasingly emphasizing the importance of a healthy gender balance. Taking these observations into consideration, the committee assessed the viability of IMAU in this wider context as 'very good' and strongly recommends the University to value, nurture and protect it together with the other three research institutes that formed part of this research review.

Quantitative assessment
Research quality: excellent (1)
Relevance to society: excellent (1)
Viability: very good (2)

4.3. INSTITUTE FOR THEORETICAL PHYSICS (ITP)

Overview
ITP is organized in two themes: 1. String Theory, Cosmology and Elementary Particles, and 2. Soft and Hard Condensed-Matter Theory. These research themes cover a plethora of physical phenomena, varying over an enormous range of length scales. In the first research line, research topics include the quantum nature of black holes, string, theory and holography, cosmology and inflation in the early universe, subatomic physics and quantum field theory. In the second research theme focuses on questions about high-temperature superconductivity, strongly correlated systems cold atoms, graphene-like systems, spintronics and applications to memory devices, and the properties of colloids, polymers and electrolytes in relation to physical chemistry and biology.

Research quality
ITP is in the view of the committee one of the premier theoretical physics institutes in the world. It meets the goal formulated in its mission statement 'to be a top research institute covering a broad spectrum of research within an internationally very competitive environment' in impressive ways. The research performed in both thematic groups is of highest quality. In many cases one may foresee a significant impact on the further development of the subfield. Many of the results presented make a lasting contribution to the body of scientific knowledge.

The String Theory, Cosmology and Elementary Particles research group line is world class. The intellectual leadership in string theory is unique, the methodological advances are ground-breaking. The Theory of Soft and Hard Condensed-Matter research line is outstanding, innovative, resourceful, highly productive and internationally highly visible. Research topics cover many of the presently worldwide most intensely studied problems. The breadth of the research themes addressed at ITP is remarkable, reaching from the most fundamental questions of particle physics and cosmology to, e.g., applied physics of sustainable energy production. The international academic reputation of ITP is excellent.

There is synergy between the parts of ITP with interesting collaboration between members in condensed matter physics and string theory leading to new and important results in the field. These research initiatives are strengthened by the strong research connections between ITP and DINS on condensed matter physics. The members benefit from being on the same corridor enabling them to meet and discuss. Research students share offices and discuss amongst themselves. In future, space may be an issue but it is important that they remain in close proximity to enable continuing synergy. There is also interesting collaboration between researchers in ITP and SAP in quark-gluon plasma which has led to new ideas and possibly new experimental results.

The research output in the form of articles, books, (invited) talks, conference organization is excellent, both in quantity, and even more important, in quality. The relevance of the research is best gauged by considering the number of `firsts' reported in the self-assessment report. The key point is that most of these `firsts' were in very active fields of great current interest and may be expected to change the future development of the corresponding field of research. It seems likely that a number of ITP breakthroughs will end up in the next generation of text-books. Most of the results are published in highly rated journals like *Physical Review Letters* and *Journal of High Energy Physics* for example. The citation scores are impressive. Members of the group have published several well-established text books.

As a further sign of the excellent quality of the research at ITP one may note that many members of ITP have received personal grants in the time period under consideration. Some have been honoured with prestigious prizes. ERC personal grants are the best examples of international marks of recognition. But the NWO VENI (3), VIDI (4) and VICI (5) grants, and the comparable Emmy Noether (2) awards, are about equally competitive. It is fair to say that the success of the ITP researchers in these competitions has been outstanding.

Many of the ITP's staff are part of national and international scientific advisory committees, are in editorial boards and part of prestigious international networks an honorary members of various societies and institutes. Both at the Royal Academy of Sciences and the American Physical Society, ITP is represented. Also young members of staff are part of these networks, with recently an appointment at the Young Academy of Europe and the newly founded Utrecht Young Academy.

Relevance to society
There are several ways in which the research at ITP has an impact on 'users' outside theoretical physics. The appeal of the 'Theorie in Praktijk' programme – carried out in the context of the D-ITP Gravitation programme, illustrates the great interest in applying the approach of theoretical physics to a wide variety of problems outside academia. The main impact is, of course, the training of stellar young scientists who move to important positions in academia or industry (or elsewhere in society). During the assessment period, 36 ITP PhD theses were produced.

In addition to its mission to educate young theoretical physicists, ITP has made substantial, highly important contributions to the knowledge base available to society, both in the realm of pure knowledge and of applied physics and chemistry. These advances form the foundation of future technological breakthroughs. An exciting project emerging from ITP is theoretical underpinning of methods to enhance the efficiency of Blue Energy sources – a topic that is of considerable relevance for a river-delta country such as the Netherlands. This research is attracting substantial interest from industrial and societal stakeholders.

Viability
The future prospects of ITP received a huge boost through the funding acquired via the Gravitation Programme Delta Institute for Theoretical Physics (Utrecht-Leiden-Amsterdam). The strategy of ITP is to be active in vibrant areas of research. This is achieved on the one hand through established faculty members initiating new lines of research and, on the other through the recruitment of new faculty members. Some of these recruitments were made possible by funding from the National Sectorplan Physics and Chemistry. During the assessment period, ITP has been successful in hiring a group of highly promising young faculty in the subfields of string theory, holography and cosmology, as well as in hard condensed matter. The field of soft condensed matter, biophysics, or complexity is receiving attention in the immediate future by a planned new hiring, adding to the already strong soft matter group and strengthening the possibility of strategic, application oriented theoretical physics research.

Conclusion
ITP at Utrecht University is one of the few theory institutes in the world covering an exceptionally broad range of research topics and managing to carry out ground-breaking research in all these fields. This breadth of research is in particular valued by the committee and is widely recognized as proof of excellence amongst peers in the field. It results in an impressive number of personal grants, with synergy between the various areas of research – in particular between the various strands of soft and hard condensed matter theory. ITP is one of the few places in the world with the high-level expertise required to pursue the recent developments in linking AdS-CFT and condensed matter physics. In addition, ITP carries out vibrant research on the theory of ultra-cold gases, performs outstanding research in string theory, quantum physics and gravity. ITP's research quality is therefore rewarded with an assessment of 'excellent'.

The committee considers ITP central to Utrecht's research profile as a university of international scientific renown and sees its research strands of great societal importance both in its orientation and in its training of scientists for both academia and industry. ITP underpins future scientific research by its fundamental approach. Its broad range of topics fuel various world-leading research groups, resulting in ground-breaking fundamental discoveries. ITP's theoretical research translates into outreach that is of essential importance for society at large, not least by kindling the interest in science of high-school students (and other groups in society).

Its 'Theory at work' meetings are another successful initiative of ITP, at which representatives of the professional field, of industry and many other interested parties meet and discuss problems with societal impact and at which ITP contributes with theoretical yet applicable solutions. Next to their crucial role in training highly-educated scientists who will be of vital importance in designing the analytical tools that will underpin a sustainable economy, ITP also diversifies into research directions with direct technological relevance, for example with their current Blue Energy initiatives. Hence, the committee assessed ITP's relevance to society as 'excellent'.

ITP's viability is closely linked to its success in attracting young scholars, funding and support for its research aims within the Faculty and University. In all of these areas, ITP has performed well in the period under review: it rejuvenated its faculty with a group of very promising young faculty, it successfully acquired substantial external funding as a result of adjustments in research focus and entered into new collaborations with other institutes, testimony to skilful governance and a proactive attitude in times of cuts and the reorganization of sources of funding.

The research interest in the biophysics and complexity theme within Utrecht University should result in further cooperation between research groups within the Faculty and between the various research institutes across the Faculties. In 2016, the Complexity Laboratory Utrecht (CLUe) was launched to further embed the natural sciences within the research strategy of the University. It is logical that ITP should play a coordinating role in the CLUe, as many of the tools used in complexity research are closely related to those used in theoretical (in particular statistical) physics and numerical simulation. The committee is enthusiastic about the current initiatives, allowing Utrecht University to expand in a new research direction that is quite likely to also attract a more gender-balanced mix of students. This is also considered of importance for the long term viability of the research unit – not least because funding bodies are increasingly emphasizing the importance of a healthy gender balance.

The committee also identified some risks that may impact funding streams in the future, which hold true for ITP and the other three institutes within the research unit Physics and Chemical Studies alike, as discussed in Chapter 3 above. The current gender imbalance, the increased competition for (top) researchers and a funding model which has become increasingly theme-based may threaten research institutes of excellence, such as ITP. The institute's viability is good as long as it keeps on being supported in maintaining its broad research base and as long it is allowed to explore new research directions that are intertwined with and supported by their areas of expertise. Hence, the committee assessed the viability of ITP in this wider context as 'very good' and strongly recommends the University to value, nurture and protect it together with the other three research institutes that formed part of this research review.

Quantitative assessment

Research quality:	excellent (1)
Relevance to society:	excellent (1)
Viability:	very good (2)

4.4. Subatomic Physics Division

Overview
The Subatomic Physics Division (SAP) focuses on the experimental study of relativistic nuclear collisions to investigate new states of nuclear matter at high temperatures and densities. One of the primary motivations for this effort is the creation of quark-gluon plasma (QGP), a state of nuclear matter that pervaded the early universe in the first few microseconds after the big bang. These studies received additional impetus in 2005, when experiments at Brookhaven National Laboratory established that the QGP was a near-perfect fluid with the lowest value of specific viscosity of any thermal fluid. The investigators of SAP played key roles in that discovery, and now lead a major programme in the ALICE experiment at CERN's Large Hadron Collider (LHC). The research programme of SAP focuses on both the hydrodynamic flow of the 'bulk' QGP matter created in high energy nuclear collisions and on 'hard probes' (jets, electromagnetic radiation, heavy quark production) that give insight to the earliest moments of the collision when the QGP is being formed. This broad effort draws on and informs work in quantum chromodynamics (QCD), lattice QCD, relativistic hydrodynamics, strongly correlated systems, and string theory's gauge/gravity duality.

Research Quality
The group's research programme is carried out within the context of the ALICE experiment at the LHC. The ALICE experiment was constructed by (and is operated by) an international collaboration of over 1800 scientists from more than 150 institutes located in 37 countries. The Utrecht group, when combined with the Nikhef staff, is one of the 10 largest groups working in ALICE. All physics results in ALICE are developed in the context of 8 'Physics Working Groups'. Two co-conveners lead each of these groups. Somewhat unusually, two of the Utrecht researchers are working as group co-conveners, which indicates strong leadership within the collaboration. This is a clear indication of international recognition for the level of excellence found at SAP. A SAP postdoc chairs a topical sub-group in one of the Physics Working Groups. The very close coordination of the SAP division with the Nikhef staff is extremely effective in extending the leadership role of the group. A Nikhef staff member holds the prestigious role of ALICE Physics Coordinator, and another is the leader for a major upgrade of the ALICE Inner Tracking System.

Attribution is often difficult in large international collaborations, but it is clear that SAP members played a key role in the analysis of highly-cited major results from ALICE in both the low-momentum flow results and the high-momentum jet suppression data. ALICE publishes approximately two dozen papers per year, with considerable representation from SAP in the oversight and guidance of a significant number of these results. A very significant number of these results are published in the top journals in the field, such as *Physical Review Letters*, *Physics Letters B*, and *European Journal of Physics J*. Another welcome development is the collaboration with members of the Institute for Theoretical Physics in joint supervision of PhD students.

Another important measure of productivity is the development of new detector technologies. A SAP-associated Nikhef staff member is the Project Leader for the Outer Layer of the ALICE Inner Tracking System, a state-of-the-art silicon pixel detector. The group is conducting R&D on an advanced highly-segmented calorimeter with applications ranging from forward physics at the LHC or an Electron-Ion Collider (EIC) to medical imaging.

Relevance to society
The primary driver for the research programme of SAP is to understand the fundamental interactions that govern matter at the highest achievable temperatures and densities. Nonetheless, at least three payoffs with societal benefits can be identified: 1) Potential medical applications (imaging) of advanced silicon pixel detectors 2) The HISPARC program, involving high schools provides distributed detection of cosmic rays, with associated educational and outreach benefits 3) Big data and grid computing, which of course is a distributed effort not

specific to SAP. More broadly, the education of PhD candidates in advanced computational and technical skills provides a societal benefit when these talents are transferred to industry, finance, medicine and beyond.

Viability
The group is currently very well positioned in high-visibility leadership roles in the ALICE experiment at the LHC. ALICE's viability is critically dependent on on-going upgrades, where SAP+Nikhef is playing a critical role. Successful implementation of those upgrades in the upcoming 'Long Shutdown 2' (2019-2020) will enable enhanced ALICE capabilities that will be exploited in data-taking through 2028. A nascent effort to broaden SAP's portfolio is underway, with the appointment of a special professor in astro-particle physics who is working on the XENON dark matter search located in the Gran Sasso Laboratory in Italy. Such diversification will strengthen the master's programme in experimental physics which SAP administers, as well as increase the vital ties to Nikhef. Care should be taken to ensure that this new addition is fully integrated into the scientific life and strategic vision of SAP.

Conclusion
SAP, in collaboration with Nikhef, is in a leadership position of the ALICE upgrade programme and works closely together with the most influential international research groups on experimental heavy-ion physics. The committee considers the strong alliance between SAP and Nikhef of clear added value for the research quality of this institute. It has resulted in outstanding research opportunities for both its staff and its research students, which have translated into paradigm-shifting results. A clear sign of SAP's international recognition is the fact that both faculty and postdoc researchers are group leaders and sub group leaders within the ALICE experiment. Hence, the committee assessed SAP's research quality as 'excellent'.

SAP's role in training young scientists with advanced computational and technical skills feeds into academia, industry and society at large. Its strong (inter)national collaborations put SAP (and Nikhef) at the forefront of these technological advances. It is the synergy between SAP and Nikhef that maximizes their joint relevance for society. The committee was very pleased to notice that, through this route, the SAP team does contribute to the development of new medical imaging equipment, to the HISPARC outreach programme and to developments in big data and grid computing. These combined SAP-Nikhef activities seem excellent. The panel feels that it would be inappropriate to rank SAP's societal relevance in isolation. Only a joint assessment together with Nikhef would be meaningful. In this respect, SAP was different from the other three institutes. Hence, the panel, will not give a specific grade for societal relevance to SAP alone.

As long as funding will be secured, the research potential of SAP is enormous as the well-developed research agenda offers good options for further scientific advance in the field. The committee established that the continued link with Nikhef is fundamental to this continuing success. Currently, SAP and Nikhef are very well positioned in high-visibility leadership roles at the ALICE experiment at CERN's LHC. SAP, together with Nikhef, plays a critical role in securing the on-going upgrades which feed into ALICE's viability. If the envisaged appointment in dark matter arises, this will further strengthen the link between SAP and Nikhef and add diversity to the research programme, while also feeding into SAP's long term viability.

In Chapter 3, the committee identified some risks that may impact funding streams in the future which may threaten all institutes within the research unit Physics and Chemical Studies alike. The current gender imbalance, the increased competition for (top) researchers and a funding model which has become increasingly theme-based may threaten research institutes of excellence, such as SAP. Based on these observations, the committee assessed the viability of SAP in this wider context as 'very good' and strongly recommends the University to value, nurture and protect it together with the other three research institutes that formed part of this research review.

Quantitative assessment

Research quality:	excellent (1)
Viability:	very good (2)

5. RECOMMENDATIONS

General recommendations:

- The current University financial allocation model is skewed heavily towards teaching. Whilst this seems to make financial sense, it is not the way in which internationally leading institutions foster top research and move up the international rankings. For the international reputation of Utrecht University it is crucial to provide the necessary support to maintain and strengthen those units that belong to the world top in their area of research. Building such units is a slow process – in a connected world, losing them can be fast.
- The committee stresses that a sustained and active approach is needed for addressing the gender balance. The current gender imbalance could in the longer term have a negative impact on the Faculty's viability. The committee recommends that Faculty allocates funds to underwrite PhD positions for stellar female undergraduates.
- The committee endorses the ambitions of the Faculty, in particular with respect to the potential creation of a research collaboration in the area of biophysics between DINS, the Bijvoet Institute, the departments of Pharmaceutical Sciences and Biology, the Hubrecht Institute, the Utrecht Medical Center and the Faculty of Veterinary Medicine. It would create an additional unique profile of research and would strongly benefit from the existing connections between the various research groups and departments.

Debye Institute for Nanomaterial Science (DINS):

- The committee endorses the plan to form a strategic partnership with the life-science departments and with the Hubrecht Laboratory to develop novel directions in (experimental) Biophysics. This theme will further be strengthened by an appointment in the bio/complexity theme at the Institute for Theoretical Physics. These developments will allow the University to expand in a new direction that is quite likely to be attractive to future students, irrespective of gender.

Institute for Marine and Atmospheric research (IMAU)

- An effort should be made to enhance the links between the Atmospheric Dynamics and Coastal and Shelf Sea Dynamics groups (currently under-represented) and the teams involved in the three other research themes within the institute.

Institute for Theoretical Physics (ITP)

- The ITP is a jewel among theoretical physics institutes worldwide. The committee encourages further intensifying interdisciplinary collaborations, such as the joint projects in soft condensed matter with experimental groups in DINS already under way. A further target of opportunity is the focus area Foundations of Complex Systems involving collaboration with members of Utrecht University departments as diverse as Mathematics, Biology, Epidemiology, Social Sciences, and more, with the aim of carrying over ITP expertise in modelling complex physical systems into model building for these more general complex systems.

Institute for Sub-Atomic Physics (SAP)

- The continued link with Nikhef is fundamental to the continuing success of the work of SAP in ALICE at CERN. If the envisaged appointment in dark matter arises, this will further strengthen the link with Nikhef and add diversity to the research programme.

APPENDICES

APPENDIX 1: THE SEP CRITERIA AND CATEGORIES

There are three criteria that have to be assessed.

- Research quality:
  - Level of excellence in the international field;
  - Quality and Scientific relevance of research;
  - Contribution to body of scientific knowledge;
  - Academic reputation;
  - Scale of the unit's research results (scientific publications, instruments and infrastructure developed and other contributions).

- Relevance to society:
  - quality, scale and relevance of contributions targeting specific economic, social or cultural target groups;
  - advisory reports for policy;
  - contributions to public debates.

The point is to assess contributions in areas that the research unit has itself designated as target areas.

- Viability:
  - the strategy that the research unit intends to pursue in the years ahead and the extent to which it is capable of meeting its targets in research and society during this period;
  - the governance and leadership skills of the research unit's management.

Category	Meaning	Research quality	Relevance to society	Viability
1	World leading/excellent	The unit has been shown to be one of the most influential research groups in the world in its particular field.	The unit makes an outstanding contribution to society	The unit is excellently equipped for the future
2	Very good	The unit conducts very good, internationally recognised research	The unit makes a very good contribution to society	The unit is very well equipped for the future
3	Good	The unit conducts good research	The unit makes a good contribution to society	The unit makes responsible strategic decisions and is therefore well equipped for the future
4	Unsatisfactory	The unit does not achieve satisfactory results in its field	The unit does not make a satisfactory contribution to society	The unit is not adequately equipped for the future

APPENDIX 2: CURRICULA VITAE COMMITTEE MEMBERS

Prof. Anne Davis is Professor of Mathematical Physics at the Department of Applied Mathematics and Theoretical Physics (DAMTP) at Cambridge University. She was a postdoc at Durham University, Imperial College, CERN and IAS Princeton. Her recent research is in Particle Cosmology. Her current work is on modified gravity theories, such as the chameleon model and related scalar-tensor theories of gravity. She has studied the full cosmological evolution of the chameleon, considered solar system constraints, laboratory constraints and cosmological constraints. She has shown that chameleons could be detected in future Casimir force type experiments. She has also worked on inflation and extra-dimensional theories. In addition to her research, Professor Davis is University Gender Equality Champion for STEMM (Science, Technology, Engineering, Mathematics and Medicine) subjects.

Prof. Daan Frenkel [Chair] received his PhD in experimental Physical Chemistry from the University of Amsterdam. Subsequently, he worked as a postdoctoral research associate in Chemistry at the University of California at Los Angeles. After that, he worked at Shell Research (Amsterdam), the Universities of Utrecht and Amsterdam and the FOM Institute for Atomic and Molecular Physics in Amsterdam. In 2007, he was appointed to the 1968 Chair of Theoretical Chemistry at Cambridge. He was Head of the Cambridge Department of Chemistry from 2011 to 2015. His research focuses on numerical simulations of many-body systems, with a special emphasis on problems relating to ordering and self-assembly.

Dr Svetlana Mintova is Director of Research first class in CNRS, Laboratory of Catalysis and Spectroscopy, University of Caen, France. She did postdoctoral study in Luleå University of Technology, Sweden, and then spent two years as Visiting Scholar in Purdue University, USA. She was appointed as C2 (docent) at the Department of Chemistry, University of Munich (LMU), till 2006 and then moved to CNRS, France. Her scientific interests include preparation of porous materials, nanosized zeolites, films, composites and related applications including catalysis, separation, chemical sensors, semiconducting industry, medicine, and liquid/gas membranes. She is the recipient of the 2016 Donald Breck Award of the International Zeolite Association (IZA), for fundamental studies on zeolite nucleation in organic-free hydrogels that brought the current state of the art to the level of rational design of zeolite crystals and synthesis of high quality nanosized zeolites.

Prof. Catherine Rouvas-Nicolis is Professor emeritus at the Université Libre de Bruxelles and Scientific Consultant at the Institut Royal Météorologique de Belgique where she has been, successively, head of the Dynamical Meteorology and Climatology Unit and acting head of the Research Department. Her research interests are centred on the mathematical modelling and analysis of atmospheric and climatic variability and predictability from the standpoint of nonlinear dynamics, chaos theory and stochastic processes. Specific topics include transitions between states and stochastic resonance, dynamical and statistical properties of forecasting errors, extreme events, atmospheric analogs and recurrence time statistics.

Prof. Peter Wölfle is Professor emeritus at the Institute for Theoretical Condensed Matter Physics at the Karlsruhe Institute of Technology, Germany. Before moving to Karlsruhe he was Professor at the University of Florida, Gainesville, USA (1986-1989) and the Technische Universität München, Germany (1975-1986). His research area is the theoretical physics of condensed matter, in particular quantum matter. He developed and applied quantum transport theory to unconventional superfluids (Helium 3, unconventional superconductors), disordered metals (Anderson localization), and nanostructures in and out of equilibrium (Kondo quantum dots, Luttinger liquid junctions). He contributed to the development of slave particle theories for strongly correlated systems (high-Tc superconductors, heavy fermion metals). More recently, he has developed strong coupling theories of quantum criticality for metallic systems.

Prof. William Zajc is the I.I. Rabi Professor of Physics at Columbia University. He received his PhD in experimental nuclear physics from the University of California-Berkeley. Subsequently he worked as a postdoctoral research associate and assistant professor at the University of Pennsylvania before moving to Columbia University in 1986. He was the Chair of Physics at Columbia from 2009 to 2015. HIs research focuses on the properties of the quark-gluon plasma formed in high energy nuclear collisions. Prof. Zajc was the spokesperson of the PHENIX Experiment at Brookhaven National Laboratory's Relativistic Heavy Ion Collider from 1997 to 2006, and was instrumental in the discovery of the 'perfect liquid' properties of the quark-gluon plasma.

APPENDIX 3: PROGRAMME OF THE SITE VISIT

Programme site-visit Physical and Chemical Sciences and Research School of Theoretical Physics

February 15 - 17, 2017, Faculty of Science, Utrecht University

Tuesday, February 14

18:00 – 19:00 Welcome drinks
Review panel, Gerrit van Meer, Els Schröder (QANU)
Utrecht University Hall, Faculty club, Huiskamer, Achter de Dom 7, 3512 JN Utrecht

19:00 – 21:30 Welcome dinner
Review panel, Els Schröder (QANU)
Utrecht University Hall, Faculty club, Achter de Dom 7, 3512 JN Utrecht

Wednesday, February 15					**Location**
8:30	9:00		Initial committee meeting	Review committee	BBG 747
9:00	9:45		Meeting Faculty management board	Dean, vice-dean, Heads of departments (Physics and Chemistry)	BBG 712
9:45	10:15		Meeting Institute management of all 4 institutes	Directors of DINS, IMAU, ITP, SAP, and research school, WK, RvR	BBG 712
10:15	10:30		Brief evaluation + coffee break	Review committee	BBG 747
10:30	11:30		SAP 25’ discussion by board 25’ discussion by staff 10’ tour	Board and staff	BBG 712
11:30	11:45		Pre-evaluation SAP	Review committee	BBG 747
11:45	12:30		Meeting with early career staff of all 4 institutes	See list	BBG 712
12:30	13:15		Lunch with early career staff of all 4 institutes	See list	BBG 712
13:15	14:45		IMAU 40’ discussion by board 40’ discussion by staff 10’ tour	Board and staff	BBG 712
14:45	15:00		Pre-evaluation IMAU	Review committee	BBG 747
15:00	15:10		Coffee break	Review committee	BBG 747
15:10	16:40		DINS 10’ introduction 40’ discussion by board 40’ discussion by staff	Board and staff	BBG 712
16:40	18:00		Lab tours 5’ walk to Ornstein 35’ lab tour Nanophotonics & STM 15’ walk to DdW 25’ lab tour Catalysis labs	Staff and students	Ornstein/DdW
18:00	18:15		Pre-evaluation DINS		BBG 747
19:00	21:00		Dinner	Review committee	De Artisjok Nieuwegracht 33, 3512 LD Utrecht
Thursday, February 16					**Location**
9:00	9:15		Committee meeting	Review committee	BBG 747

9:15	10:45		ITP 45’ discussion by board 45’ discussion by staff	Board and staff	BBG 712
10:45	11:00		Pre-evaluation ITP	Review committee	BBG 747
11:00	11:30		Committee discussion and coffee break	Review committee	BBG 747
11:30	12:15		Meeting with PhDs of all 4 institutes	See list	BBG 712
12:15	13:00		Buffet lunch with PhDs of all 4 institutes	See list	BBG 712
13:00	14:00		Meeting with postdocs of all 4 institutes	See list	BBG 712
14:00	15:00		First assessment: identifying further questions	Review committee	BBG 747
15:00	16:00		First writing session	Review committee	BBG 747 / 647
16:00	16:30		If necessary: answer session to additional questions / office hour	T.b.a.	BBG 747
16:30	17:00		Poster pitches PhDs / postdocs	See list	BBG 712
17:00	18:00		Poster session with drinks and bites PhDs / postdocs	See list	BBG 712 / pantry
19:00	21:00		Dinner	Review committee	Restaurant BIS Lijnmarkt 26, 3511 KH Utrecht
Friday, February 17					**Location**
9:00	9:30		Committee meeting	Review committee	Kruyt East 1
9:30	10:00		Final interview with management / feedback session	Dean, vice-dean, Heads of departments (Physics and Chemistry)	Kruyt East 1
10:00	12:00		Deliberation, writing and finalizing scores	Review committee	Kruyt East 1
12:00	12:15		Brief oral report	Public Faculty	Kruyt East 1
12:15	13:00		Buffet lunch	Public Faculty	Kiosk Kruyt

Day 1 February 15

Meeting Faculty Management Board

Faculty Management Board Utrecht University / heads of department

- Prof. dr. G.F.B.P. (Gerrit) van Meer, Dean
- Prof. dr. J.C.M. (Sjef) Smeekens, Vice Dean research
- Prof. dr. Ir. H.A. Dijkstra, Head of Department, Physics
- Prof. dr. R.J.M. (Bert) Klein Gebbink, Head of Departement, Chemistry

Institute Management four institutes and Director Graduate School

- Prof. dr. Ir. M. (Marjolein) Dijkstra, Debye Institute (DINS)
- Prof. dr. S. (Stefan) Vandoren, Institute for Theoretical Physics (ITP)
- prof. dr. M.R. (Michiel) van den Broeke, Institute for Marine and Atmospheric Research (IMAU)
- Prof. dr. T. (Thomas) Peitzmann, Institute for Subatomic Physics
- Prof. dr. Willem Kegel (Chem)
- Prof. dr. R. (René) van Roij (Phys)
- Prof. dr. H.E. (Huib) de Swart, Chair Graduate School for Natural Sciences (GSNS)

Institute for Subatomic Physics board (25 min)

- Prof. dr. Thomas Peitzmann, Director
- Prof. dr. Raimond Snellings

Institute for Subatomic Physics staff (25 min)

- Dr. André Mischke
- Dr. Paul Kuijer (Nikhef)
- Dr. Panos Christakoglou (Nikhef)

Meeting: Early career' staff of all 4 institutes

- Dr. Marc-Etienne Moret (DINS)
- Dr. Jovana Zecevic (DINS)
- Dr. Ingmar Swart (DINS)
- Dr. Marijn van Huis (DINS)
- Dr. Lars Fritz (ITP)
- Dr. Anna von der Heydt (IMAU)
- Dr. Carleen Tijm-Reijmer (IMAU)
- Dr. Alessandro Grelli (SAP)

Lunch: Early career' staff of all 4 institutes

- Dr. Rosa Bulo (DINS)
- Dr. Florian Meirer (DINS)
- Dr. Peter Ngene (DINS)
- Dr. Laura Filion (DINS)
- Dr. Sanli Faez (DINS)
- Dr. Dirk Schurich (ITP)
- Dr. Enrico Pajer (ITP)
- Dr. Rupert Holzinger (IMAU)

Institute for Marine and Atmospheric Research board

- Prof. dr. Michiel van den Broeke, Director
- Prof. dr. Huib de Swart
- Prof. dr. Thomas Roeckmann
- Mw. Sandra Tap

Institute for Marine and Atmospheric Research staff

- Dr. Anna Von der Heydt
- Dr. Aarnout van Delden
- Dr. Willem-Jan van de Berg
- Dr. Roderik van de Wal

Debye Institute board

- Prof. dr. Marjolein Dijkstra, Director
- Prof. dr. Ir. Krijn de Jong
- Prof. dr. Peter van der Straten
- Prof. dr. Alfons van Blaaderen
- Prof. dr. Bert Weckhuysen
- Dr. Celso de Mello Donega

Debye Institute staff

- Prof. dr. Petra de Jongh
- Prof. dr. Frank de Groot
- Prof. dr. Leo Jenneskens
- Prof. dr. Andries Meijerink
- Prof. dr. Willem Kegel
- Prof. dr. Allard Mosk
- Prof. dr. Daniel Vanmaekelbergh
- Dr. Laura Filion
- Dr. Dries van Oosten

- Dr. Pieter Bruijnincx
- Dr. Marijn van Huis

Day 2 February 16

Institute for Theoretical Physics board
- Prof. dr. Stefan Vandoren, Director
- Prof. dr. Henk Stoof
- Drs. Joost van Zee

Institute for Theoretical Physics staff
- Prof. dr. René van Roij
- Prof. dr. Eric Leanen
- Prof. dr. Cristiane Morais Smith
- Prof. dr. Henk Stoof
- Prof. dr. Bernard de Wit
- Dr. Dirk Schurich
- Dr. Umut Gürsoy
- Dr. Tomislav Prokopec
- Dr. Lars Fritz
- Dr. Thomas Grimm

Meeting: PhD's of all 4 institutes
- DINS Dide Verhoeven
- DINS Robin Geitenbeek
- DINS Pepijn Moerman
- IMAU Claudia Wieners
- IMAU Tjebbe Hepkema
- ITP Tara Drwenski
- ITP Tycho Sikkenk
- SAP Alberto Caliva

Lunch: PhD's of all 4 institutes
- DINS Nynke Krans
- DINS Emily Monkcom
- DINS Joep Peters
- IMAU Claudia Wieners
- IMAU Tjebbe Hepkema
- ITP Tatjana Puskarov
- ITP Erik van der Wurff
- SAP Jacopo Margutti

Meeting with postdocs of all 4 institutes
- DINS Javier Hernandez Rueda
- DINS Baira Donoeva
- DINS Ivan Rehor
- IMAU Elena Popa
- IMAU Stefan Ligtenberg
- ITP Scott Bender
- ITP Cora Uhleman
- SAP Barbara Trzeciak

Poster pitches PhDs
- DINS Jaco Geuchies

- DINS Marjolein Velthoen
- DINS Wiebke Albrecht
- IMAU Claudia Wieners
- IMAU Tjebbe Hepkema
- ITP Giuseppe Soligno
- ITP Watse Sybesma
- SAP Mike Sas

Postersession PhDs/Postdocs
- DINS Wiebke Albrecht
- DINS Sebastiaan Greveling
- DINS Harini Pattabhiraman
- IMAU Claudia Wieners
- IMAU Tjebbe Hepkema
- ITP Anton Quelle
- ITP Bogumila Swiezewska
- SAP Annelies Veen

Day 3 February 17

Meeting Faculty Management Board

Faculty Management Board Utrecht University / heads of department
- Prof. dr. G.F.B.P. (Gerrit) van Meer, Dean
- Prof. dr. J.C.M. (Sjef) Smeekens, Vice Dean research
- Prof. dr. Ir. H.A. (Henk) Dijkstra, Head of Department, Physics
- Prof. dr. R.J.M. (Bert) Klein Gebbink, Head of Departement, Chemistry

APPENDIX 4: QUANTITATIVE DATA

The quantitative data provided in this appendix is based on the information provided in the self-evaluation report by the research institutes of the research unit Physical and Chemical Sciences of Utrecht University. This data set cannot be compared as such with the quantitative data for other research units Physical and Chemical Sciences as the definition of what entails a research unit varies between universities.

Research staff at the research unit Physical and Chemical Sciences

Faculty	**2010**		**2011**		**2012**		**2013**		**2014**		**2015**	
	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE
Scientific staff	69	25	65	24,1	69	24,8	71	24,9	70	25,9	72	26,3
Postdocs	49	37	80	58,9	75	59,5	56	51,9	74	57,2	78	59,7
PhD candidates	178	155,7	186	164,8	177	156,5	175	158	193	170,6	201	181,3
Employed by UU	*127*	*112,1*	*136*	*119,5*	*122*	*111,1*	*126*	*113,5*	*136*	*122,3*	*144*	*130,3*
Non employed by UU	*51*	*43,6*	*50*	*45,3*	*55*	*45,4*	*49*	*44,5*	*57*	*48,3*	*57*	*51*
Total res. Staff	**296**	**217,7**	**331**	**247,7**	**321**	**240,8**	**302**	**235**	**337**	**253,7**	**351**	**267,3**
Support staff	40	36,4	42	37,7	40	33,2	39	34,7	40	35,4	42	37,6
Total staff	**336**	**254,1**	**373**	**285,4**	**361**	**274**	**341**	**269,7**	**377**	**289**	**393**	**304,7**

#	Total number of staff members
FTE	The research capacity in full time equivalents
Scientific staff	Professor, Assistant Professor and Associate Professor: Research capacity = 40% of the appointments
Postdocs	Research capacity amounts to 90% of the appointments (if not otherwise specified)
PhD candidates	Research capacity amounts to 90% of the appointments (all categories)

Research funding at the research unit Physical and Chemical Sciences

FUNDING							
	2010 kE	**2011** kE	**2012** kE	**2013** kE	**2014** kE	**2015** kE	**2010-2015** kE
Direct funding (1)	10977	11269	10932	11295	12247	13220	11656
University	*10286*	*9798*	*9362*	*9167*	*10156*	*9770*	*9757*
Sectorplan	*0*	*169*	*576*	*999*	*1393*	*1702*	*806*
Top research school/Gravitation	*691*	*1299*	*995*	*1130*	*698*	*1747*	*1094*
Research grants national (2)	9110	8740	8461	8254	9089	9196	8808
Research grants international (3)	1577	1971	2679	2000	2291	4023	2424
Contract research (4)	2772	2308	2495	2760	2388	1738	2385
Other (5)	9	51	90	100	46	220	86
Total funding	**24446**	**24336**	**24658**	**24410**	**26059**	**28398**	**25384**
EXPENDITURE							
	2010	2011	2012	2013	2014	2015	2010-2015
Personnel costs	19063	19663	19106	19011	20771	21719	19889
Other costs	5384	4673	5550	5398	5289	6677	5495
Total expenditure	**24446**	**24336**	**24658**	**24410**	**23059**	**28398**	**25384**

(1) Direct funding by the university ('Eerste geldstroom') including both research and education budgets. Funding through Sectorplan and Top Research Schools/Gravitation (NRSC_C and MCEC are shown separately)
(2) Research grants from NWO and KNAW ('Tweede geldstroom')
(3) Research grants from the European Union (FP6, FP7 and Horizon2020 funding)
(4) Research grants from other funding agencies and private partners (e.g. SmartMix, ministries, companies)
(5) Funds that do not fit into any of the above categories (e.g. consultancies, conferences etc.)

Research staff at Debye Institute for Nanomaterials Science

Faculty	2010		2011		2012		2013		2014		2015	
	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE
Scientific staff	32	12,4	30	11,5	33	12,7	33	12,5	34	13,3	36	14,1
Postdocs	22	19,1	36	30,8	38	30,2	28	24,3	35	27,9	36	28,1
PhD candidates	104	92,7	109	97	104	91	105	93	119	105,6	130	115,2
Employed by UU	*77*	*69,3*	*82*	*73,6*	*75*	*66,2*	*79*	*70,9*	*91*	*81,7*	*103*	*91,7*
Non employed by UU	*27*	*23,4*	*27*	*23,4*	*29*	*24,8*	*26*	*22,1*	*28*	*23,9*	*27*	*23,5*
Total res, Staff	**158**	**124,2**	**175**	**139,3**	**175**	**133,8**	**166**	**129,8**	**188**	**146,8**	**202**	**157,4**
Support staff	25	23,8	26	24,8	22	20,3	23	21,7	24	22,8	27	25,4
Total staff	**183**	**148**	**201**	**164,1**	**197**	**154,1**	**189**	**151,5**	**212**	**169,6**	**229**	**182,8**

#	Total number of staff members
FTE	The research capacity in full time equivalents
Scientific staff	Professor, Assistant Professor and Associate Professor: Research capacity = 40% of the appointments
Postdocs	Research capacity amounts to 90% of the appointments (if not otherwise specified)
PhD candidates	Research capacity amounts to 90% of the appointments (all categories)

Research funding at Debye Institute for Nanomaterials Science

FUNDING							
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2010-2015**
	kE/%	kE/%	kE/%	kE/%	kE/%	kE/%	kE/%
Direct funding (1)	6.408/ 43%	6.913/ *47%*	6.626 44%	6.451 44%	6.506 42%	7.260 42%	6.694 43%
University	*5.717/ 38%*	*5.606/ 38%*	*5.253 34%*	*4.750 33%*	*5.412 35%*	*5.516 32%*	*5.376 35%*
Sectorplan	*0/ 0%*	*7/ 0%*	*379 2%*	*637 4%*	*734 5%*	*960 6%*	*453 3%*
Top research school/Gravitation	*691/ 5%*	*1.299/ 9%*	*1.064 7%*	*1.064 7%*	*360 2%*	*784 4%*	*866 6%*
Research grants national (2)	5.179/ 35%	4.464/ 30%	4.578 30%	4.481 31%	5.409 33%	4.730 27%	4.747 31%
Research grants international (3)	628/ 4%	932/ 6%	1.504 10%	760 5%	1.529 10%	3.577 20%	1.488 10%
Contract research (4)	2.764/ 18%	2.303/ 16%	2.481 16%	2.738 19%	2.356 15%	1.668 10%	2.385 15%
Other (5)	9/ 0%	51/ 0%	90 1%	100 1%	46 0%	220 1%	86 1%
Total funding	**14.989**	**14.663**	**15.280**	**14.530**	**15.485**	**17.455**	**15.400**
EXPENDITURE							
	2010	2011	2012	2013	2014	2015	2017
Personnel costs	11.284/ 75%	11.314/ 77%	11.065 72%	10.889 75%	11.716 76%	12.779 73%	11.508 75%
Other costs	3.706/ 25%	3.349/ 23%	4.215 28%	3641 25%	3.769 24%	4.674 27%	3.892 25%
Total expenditure	**14989**	**14.663**	**15.280**	**14.530**	**15.485**	**17.455**	**15.400**

(1) Direct funding by the university ('Eerste geldstroom') including both research and education budgets. Funding through Sectorplan and Top Research Schools/Gravitation (NRSC_C and MCEC are shown separately)
(2) Research grants from NWO and KNAW ('Tweede geldstroom')
(3) Research grants from the European Union (FP6, FP7 and Horizon2020 funding)
(4) Research grants from other funding agencies and private partners (e.g. SmartMix, ministries, companies)
(5) Funds that do not fit into any of the above categories (e.g. consultancies, conferences etc.)

Research staff at Institute for Marine and Atmospheric Research Utrecht

Faculty	2010		2011		2012		2013		2014		2015	
	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE
Scientific staff	17	5,6	16	5,6	16	5,4	16	5,4	14	5	14	5
Postdocs	10	7	15	10	17	12,2	15	12,7	20	14,6	23	16,5
PhD candidates	33	28,1	35	30	36	31,3	29	30,1	24	21,5	17	19,4
Employed by UU	*27*	*22,5*	*29*	*23,9*	*28*	*26*	*23*	*23,9*	*19*	*16,4*	*13*	*15,6*
Non employed by UU	*6*	*5,6*	*6*	*6,1*	*8*	*5,3*	*6*	*6,2*	*5*	*5,1*	*4*	*3,8*
Total res. Staff	**60**	**40,7**	**66**	**45,5**	**69**	**19**	**60**	**48,4**	**58**	**41,1**	**54**	**40,9**
Support staff	10	8,2	11	8,5	13	8,8	11	8,9	11	8,5	10	8,1
Total staff	**70**	**48,9**	**77**	**54**	**82**	**57,8**	**71**	**57,3**	**69**	**49,5**	**64**	**48,8**

#	Total number of staff members
FTE	The research capacity in full time equivalents
Scientific staff	Professor, Assistant Professor and Associate Professor: Research capacity = 40% of the appointments
Postdocs	Research capacity amounts to 90% of the appointments (if not otherwise specified)
PhD candidates	Research capacity amounts to 90% of the appointments (all categories)

Research funding at Institute for Marine and Atmospheric Research Utrecht

FUNDING							
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2010-2015**
	kE/%	kE/%	kE/%	kE/%	kE/%	kE/%	kE/%
Direct funding (1)	2.663	2.364	2.330	2.557	2.928	2.646	2.581
	56%	53%	49%	50%	62%	59%	55%
University	*2.663*	*2.364*	*2.330*	*2.557*	*2.847*	*2.271*	*2.505*
Sectorplan	-	-	-	-	-	-	*-0*
Top research school/Gravitation	*0*	*0*	*0*	*0*	*81*	*374*	*76*
Research grants national (2)	1.520	1.598	1.734	1.669	1.458	1.610	1.598
	32%	36%	36%	33%	31%	36%	34%
Research grants international (3)	561	462	721	899	361	231	539
	12%	10%	15%	18%	8%	5%	11%
Contract research (4)	-	-	-	-	-	-	-
Other (5)	-	-	-	-	-	-	-
Total funding	**4.743**	**4.423**	**4.785**	**5.125**	**4.747**	**4.487**	**4.718**
EXPENDITURE							
	2010	2011	2012	2013	2014	2015	2017
Personnel costs	3.526	3.713	3.967	4.141	3.976	3.721	3.841
	74%	84%	83%	81%	84%	83%	81%
Other costs	1.217	710	818	984	771	766	878
	26%	16%	17%	19%	16%	17%	19%
Total expenditure	**4.743**	**4.423**	**4.785**	**5.125**	**4.747**	**4.487**	**4.718**

(1) Direct funding by the university ('Eerste geldstroom') including both research and education budgets. Funding through Sectorplan and Top Research Schools/Gravitation (NRSC_C and MCEC are shown separately)
(2) Research grants from NWO and KNAW ('Tweede geldstroom')
(3) Research grants from the European Union (FP6, FP7 and Horizon2020 funding)
(4) Research grants from other funding agencies and private partners (e.g. SmartMix, ministries, companies)
(5) Funds that do not fit into any of the above categories (e.g. consultancies, conferences etc.)

Research staff at Institute for Theoretical Physics

Faculty	2010		2011		2012		2013		2014		2015	
	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE
Scientific staff	14	4,6	13	4,6	14	4,3	16	4,6	16	5,4	17	5,2
Postdocs	16	10	26	15,8	17	14,4	8	10,4	13	9,7	15	11,5
PhD candidates	31	25,9	30	27	24	22,5	26	21,4	31	26,4	36	30,5
Employed by UU	*22*	*19,4*	*23*	*20,2*	*17*	*17,1*	*22*	*16,9*	*24*	*22,4*	*27*	*22,1*
Non employed by UU	*9*	*6,5*	*7*	*6,8*	*7*	*5,4*	*4*	*4,5*	*7*	*4*	*9*	*8,4*
Total res, Staff	**61**	**40,5**	**69**	**47,4**	**55**	**41,2**	**50**	**36,4**	**60**	**41,5**	**68**	**47,2**
Support staff	3	2,4	3	2,4	3	2,1	3	2,1	3	2,1	3	2,1
Total staff	**64**	**42,9**	**72**	**49,8**	**58**	**43,3**	**53**	**38,5**	**63**	**43,6**	**71**	**49,3**

#	Total number of staff members
FTE	The research capacity in full time equivalents
Scientific staff	Professor, Assistant Professor and Associate Professor: Research capacity = 40% of the appointments
Postdocs	Research capacity amounts to 90% of the appointments (if not otherwise specified)
PhD candidates	Research capacity amounts to 90% of the appointments (all categories)

Research funding at Institute for Theoretical Physics

FUNDING							
	2010	2011	2012	2013	2014	2015	2010-2015
	kE/%	kE/%	kE/%	kE/%	kE/%	kE/%	kE/%
Direct funding (1)	1.596	1.555	1.415	1.637	2.122	2.597	1.820
	46%	40%	47%	52%	59%	62%	51%
University	*1.596*	*1.547*	*1.377*	*1.368*	*1.383*	*1.434*	*1.451*
Sectorplan	-	*7*	*38*	*204*	*482*	*574*	*217*
Top research school/Gravitation	-	*0*	*0*	*66*	*257*	*589*	*152*
Research grants national (2)	1.653	1.888	1.309	1.320	1.173	1.342	1.447
	48%	49%	43%	42%	32%	32%	41%
Research grants international (3)	209	392	280	181	300	165	255
	6%	10%	9%	6%	8%	4%	7%
Contract research (4)	8	5	14	211%	31	70	-
	0%	0%	0%		1%	2%	
Other (5)	-	-	-	-	-	-	-
	3.467	**3.839**	**3.018**	**3.160**	**3.625**	**4.174**	**3.547**
EXPENDITURE							
	2010	2011	2012	2013	2014	2015	2017
Personnel costs	3.134	3.450	2.738	2.694	3.242	3.685	3.157
	90%	90%	91%	85%	89%	88%	89%
Other costs	333	389	279	466	383	489	390
	10%	10%	9%	15%	11%	12%	11%
Total expenditure	**3.467**	**3.839**	**3.018**	**3.160**	**3.625**	**4.174**	**3.547**

(1) Direct funding by the university ('Eerste geldstroom') including both research and education budgets. Funding through Sectorplan and Top Research Schools/Gravitation (NRSC_C and MCEC are shown separately)
(2) Research grants from NWO and KNAW ('Tweede geldstroom')
(3) Research grants from the European Union (FP6, FP7 and Horizon2020 funding)
(4) Research grants from other funding agencies and private partners (e.g. SmartMix, ministries, companies)
(5) Funds that do not fit into any of the above categories (e.g. consultancies, conferences etc.)

Research staff at Institute for Subatomic Physics

Faculty	2010		2011		2012		2013		2014		2015	
	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE
Scientific staff	6	2,4	6	2,4	6	2,4	6	2,4	6	2,2	5	2
Postdocs	1	0,9	3	2,3	3	2,7	5	4,5	6	5	4	3,6
PhD candidates	10	9	12	9,8	13	11,7	15	13,5	19	17,1	18	16,2
Employed by UU	*1*	*0,9*	*2*	*1,8*	*2*	*1,8*	*2*	*1,8*	*2*	*1,8*	*1*	*0,9*
Non employed by UU	*9*	*8,1*	*10*	*9*	*11*	*9,9*	*13*	*11,7*	*17*	*15,3*	*17*	*15,3*
Total res, Staff	**17**	**12,3**	**21**	**15,5**	**22**	**16,8**	**26**	**20,4**	**31**	**24,3**	**27**	**21,8**
Support staff	2	2	2	2	2	2	2	2	2	2	2	2
Total staff	**19**	**14,3**	**23**	**17,5**	**24**	**18,8**	**28**	**22,4**	**33**	**26,3**	**29**	**23,8**

#	Total number of staff members
FTE	The research capacity in full time equivalents
Scientific staff	Professor, Assistant Professor and Associate Professor: Research capacity = 40% of the appointments
Postdocs	Research capacity amounts to 90% of the appointments (if not otherwise specified)
PhD candidates	Research capacity amounts to 90% of the appointments (all categories)

Research funding at Institute for Subatomic Physics

FUNDING							
	2010	2011	2012	2013	2014	2015	2010-2015
	kE/%	kE/%	kE/%	kE/%	kE/%	kE/%	kE/%
Direct funding (1)	310	437	561	650	691	717	561
	25%	31%	36%	41%	31%	31%	33%
University	*310*	*281*	*402*	*492*	*514*	*549*	*425*
Sectorplan	-	*155*	*159*	*158*	*177*	*168*	*136*
Top research school/Gravitation	-	-	-	-	-	-	-
Research grants national (2)	758	790	840	784	1.409	1.514	1.016
	61%	56%	53%	49%	64%	66%	59%
Research grants international (3)	179	185	174	160	101	50	142
	14%	13%	11%	10%	5%	2%	8%
Contract research (4)	0	0	0	1	1	0	0
	0%	0%	0%	0%	0%	0%	0%
Other (5)	-	-	-	-	-	-	-
Total funding	**1.247**	**1.411**	**1.575**	**1.595**	**2.202**	**2.282**	**1.719**
EXPENDITURE							
	2010	2011	2012	2013	2014	2015	2017
Personnel costs	1.119	1.186	1.336	1.287	1.837	1.534	1.383
	90%	84%	85%	81%	83%	67%	80%
Other costs	128	225	238	307	366	748	335
	10%	16%	15%	19%	17%	33%	20%
Total expenditure	**1.247**	**1.411**	**1.575**	**1.595**	**2.202**	**2.282**	**1.719**

(1) Direct funding by the university ('Eerste geldstroom') including both research and education budgets. Funding through Sectorplan and Top Research Schools/Gravitation (NRSC_C and MCEC are shown separately)
(2) Research grants from NWO and KNAW ('Tweede geldstroom')
(3) Research grants from the European Union (FP6, FP7 and Horizon2020 funding)
(4) Research grants from other funding agencies and private partners (e.g. SmartMix, ministries, companies)
(5) Funds that do not fit into any of the above categories (e.g. consultancies, conferences etc.)