

REVIEW
DUTCH RESEARCH SCHOOL FOR
THEORETICAL PHYSICS
2010-2016

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REPORT ON THE REVIEW OF THE DUTCH RESEARCH SCHOOL FOR THEORETICAL PHYSICS

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1. FOREWORD COMMITTEE CHAIR

In accordance with the Standard Evaluation Protocol 2015-2021, the committee has reviewed and assessed the Dutch Research School for Theoretical Physics over the period 2010-2016. This report presents the review and assessments by the committee, based on the information in the provided documentation and gathered during the site visit in Utrecht.

The committee wishes to express its gratitude for the enthusiastic support, hospitality and efficient cooperation encountered at the Dutch Research School of Theoretical Physics as hosted by Utrecht University. It highly appreciated the openness of information provided before the site visit and the frankness expressed in the various discussions with staff and students during the site visit. The committee hopes that its review and recommendations will assist the Dutch Research School for Theoretical Physics in their continuing efforts to foster a culture of international excellence, openness and inclusiveness.

Prof. D. Frenkel
Committee chair

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 the Dutch Research School for Theoretical Physics (DRSTP). In accordance with the Terms of Reference of the DRSTP, the committee assessed the DRSTP on the following: (1) the quality of the PhD educational programme of the DRSTP, including community building and general academic skills; (2) the governance and quality control of the DRSTP. The quality of the scientific research conducted within the partner institutions is explicitly not part of this assessment, as this will be covered by the separate research assessments of the various units. The committee has been requested to take into account current international trends and developments in science and society in its analysis.

The committee applied hereto the assessment criteria in the Standard Evaluation Protocol 2015-2021 (SEP) with regards to (research) quality, relevance to society and viability. In addition to a qualitative assessment, the committee assigned a category (1, 2, 3 or 4) to the three criteria in accordance with the SEP guidelines. For a description of the SEP criteria and the guidelines for assignation of a category, see Appendix 1.

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;
- Prof. Peter Wölfle is Professor emeritus at the Institute for Theoretical Condensed Matter Physics at the Karlsruhe Institut für Technologie.

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 the Dutch Research School of Theoretical Physics. 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 there are no specific risk in terms of bias or undue influence existed and all members were sufficiently independent.

2.4. Data provided to the committee

The committee received the following documents for their assessment:

- Self-assessment Dutch Research School for Theoretical Physics 2010-2015;
- Terms of Reference Dutch Research School for Theoretical Physics;
- the SEP 2015-2021;
- An overview of the lectures and seminars offered within the curriculum of the Dutch Research School for Theoretical Physics.

2.5. Procedures followed by the committee

Prior to the first committee meeting, all committee members independently formulated a preliminary assessment of the DRSTP based on the written information provided. During the first meeting, the committee agreed on the use of the SEP assessment criteria and categories. Their interpretation, both of the criteria and categories, will be discussed in the report. The committee discussed the preliminary individual assessments and decided upon a number of

comments and questions. The committee also agreed upon procedural matters and aspects of the review.

The final review is based on both the documentation provided by the DRSTP and the information gathered during the site visit at the DRSTP, hosted by Utrecht University. The site visit took place on 17 February 2017 in Utrecht. For a schedule of this visit, see Appendix 3. 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. After deliberation amongst committee member, the draft report was presented to the DRSTP 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 Scientific Director of the DRSTP, who reports back to the School's Governing Board.

2.6. Use of the Standard Evaluation Protocol (SEP)

The SEP, created by the Association of Universities in the Netherlands (VSNU), the Netherlands Organization for Scientific Research (NWO) and the Royal Netherlands Academy of Arts and Sciences (KNAW) describes the methods used to assess research conducted at Dutch universities and NWO and Academy research institutes. The DRSTP is a collaboration by six Dutch universities and the Nikhef and offers PhD training rather than partaking in research. In this sense, the SEP and its assessment criteria are incompatible with the objectives of the DRSTP. The committee was asked to assess the DRSTP according to the SEP on the criteria of (research) quality, relevance to society and viability. As the DRSTP is not involved in research, the committee had to agree on the way how to assess the SEP criteria. The committee used the following interpretation and operationalization of these three SEP criteria with regards to the DRSTP:

(Research) quality

The committee looked into the *quality of the PhD educational programme in an international context*, comparing the educational programme of the DRSTP with international training programmes for PhD students. The committee looked into several aspects to assess this criteria: it looked into the aims of the DRSTP, the content of the educational programme, at the PhD community and its manner of interaction, at general and academic research skills trained to students, at the research integrity policy of the DRSTP, at the contribution of the DRSTP to the training of general research skills applicable for the field, at the reputation of the DRSTP and at evidence for/against the added value of the multi-site structure of the DRSTP.

Relevance to society

The committee looked into the employability of the DRSTP graduates as proof of the *relevance of the School's educational activities to society*. The committee paid attention to the skill sets obtained by graduates and the way in which these prepared PhD students for a career in either the professional or academic field.

Viability

The committee looked into the viability of the DRSTP, paying attention to the aims and objectives of the programme, its financial support, the governance and leadership and quality assurance mechanisms.

2.7. Use of the SEP scores by the committee

The committee explicitly looked at the way in which the DRSTP contributes to PhD training within the field of theoretical physics in the Netherlands. The SEP scores for very good and excellent explicitly have an international component and therefore ask for an international comparison. Yet international equivalents of a national research school are not common in the field and as a result, the committee would have to compare incomparable institutes and/or schools to the DRSTP. The committee member's own international experience and knowledge of

PhD training programmes should therefore be considered as the international component in the use of the scores of very good and excellent.

3. REVIEW OF THE DUTCH RESEARCH SCHOOL FOR THEORETICAL PHYSICS

3.1. The Dutch Research School for Theoretical Physics

The DRSTP was established in 1993 by the executive boards of the University of Amsterdam, the VU University of Amsterdam, the University of Groningen, Leiden University, Radboud University and Utrecht University. This agreement has been renewed in 1999 and 2004. As of January 2009, the National Institute for Subatomic Physics (Nikhef) joined the research school as seventh partner institution. In 2010 and 2016, the agreement between these seven partners has been renewed. The current Common Agreement is for a period of six years.

The DRSTP is coordinated by Utrecht University and organized as stipulated in the Common Agreement, which has been signed by all executive boards of the partner institutions. Each of the participating partners appoints a representative in the Governing Board of the School, which is responsible for the mission and overall policy of the DRSTP. The commissioner (Utrecht University) has appointed a Scientific Director, who is responsible for implementing the decisions of the Governing Board of the DRSTP, for the day-to-day management and for coordinating DRSTP activities. The Scientific Director has an advisory role in the Governing Board. An International Scientific Advisory Committee, Educational Board and PhD Student Council also advise the Governing Board regarding the School's curriculum and activities.

All PhD students in theoretical physics, enrolled at one of the universities that take part in the collaboration, follow parts of their training through the DRSTP. Eindhoven University of Technology, Delft University of Technology and the University of Twente are associate member of the DRSTP, which means that they can enrol PhD students for parts of the programme offered by the DRSTP. The local graduate schools oversee the full training programme taken by each student. The DRSTP needs to comply with the partner universities' rules and procedures, in particular regarding quality assurance of the programme and student matters.

3.2. Quality of the PhD educational programme

The DRSTP is a collaboration between the theoretical physics groups of six Dutch universities and the Nikhef. This collaboration results in a highly diverse research field being translated into an equally diverse training programme. The DRSTP aims to establish cross-talking between the many research fields and methods employed in theoretical physics. The research areas covered by the DRSTP can be grouped into two overlapping, broad themes: (1) Particle physics, cosmology, quantum gravity and string theory, and (2) quantum matter, quantum information, soft condensed matter biophysics. The DRSTP addresses important cross-links between these themes and pays attention to change within the fields, depending on scientific developments.

The DRSTP compulsory programme consists of:

1. A choice between the PhD School for Theoretical High Energy Physics (THEP) or PhD School for Statistical Physics and Theory of Condensed Matter (SPTCM). All PhD Student attend one of these schools at least twice during their appointment during the so-called 'block weeks' and give a presentation of their work each time;
2. PhD Day – an annual event organized by members of the PhD Student Council specifically aimed at PhD students of the DRSTP;
3. 'Trends in Theory' Symposium – organized every other year; a poster presentation is obligatory for all PhD Students.

In its compulsory programme, the DRSTP focuses on theory; it offers a concise programme of two weeks of block courses, in which the above themes are addressed. Students ideally follow

the two block weeks in the first two years of their PhD. The DRSTP organizes its block courses at a conference centre and provides full board to the attending students. In this way, attendance is controlled and students are truly taken 'out' of their own research environment. The PhD Student Council is closely consulted and actively engaged in choosing the programme. After every block, the week is evaluated by students and staff alike. During the block weeks, students spent at least ten hours in lectures. Additional training sessions on methods, discussion time and exchange of ideas fill the rest of the week. Students also train during these weeks their general academic skills. They present posters on their research and practice in giving peer-to-peer feedback, while also paying attention to research integrity. Next to theoretical training, the block weeks allow for community building between students and students and staff, and in doing so they create awareness of trends within and an overview of the field.

In addition to the block weeks, local universities offer additional courses open to all members of the DRSTP. These are shared within the DRSTP community by a weekly newsletter. Events open to DRSTP members are communicated, such as the Lorenz Lecture (at Leiden University) or Kramers Lecture (at Utrecht University), yet also information on relevant courses at international universities and on summer schools is provided. The PhD students interviewed during the site visit mentioned that they truly value the weekly communications by the DRSTP and the committee sees it as evidence of the commitment of the DRSTP to the creation of a true national network and community of theoretical physicists. These non-compulsory courses at the local institutions are sometimes even aligned with the DRSTP programme, even beyond the consortium of six partner institutions. For example, the Delta Institute for Theoretical Physics (DITP) offers state-of-the-art courses that run for an entire year. DRSTP and DITP are linked and discuss the choice of topics within both educational programmes. Both staff members and students value this connection tremendously. The committee wants to commend both the DRSTP and the DITP for the established collaboration, which is also in its eyes of high added value.

Next to the block weeks and the local courses open to DRSTP members, two mandatory events are part of the DRSTP curriculum: the annual student day and every other year, the 'Trends in Theory' symposium. At both events, the students closely interact with the professional field. The mandatory annual student day is organized by the PhD students. During this day, focus is on career advice. Two speakers focus on career aspects, one from the academic and one from the professional aspect. In the past, speakers have been invited reflecting upon careers in consultancy or in fibre security for example. Representatives of the professional field are invited to attend and informally discuss with students. Students were very positive about the event, which also seems in the committee's eyes of great value for students as part of their PhD training. At the 'Trends in Theory' symposium, both academic and professional specialists attend and discuss trends within the field – contextualized in its historical setting yet with a clear eye for the future. In this way, 'state of the art' research meets those working with it. In the committee's eyes, this symposium is an excellent way to build again further research networks.

Staff members involved in teaching in the local courses at partner institutions indicated that attendance levels in general were rather good, although students from institutions further afield (Nijmegen, Groningen) naturally were in attendance less due to travel and time constraints. Utrecht has a slight overrepresentation, in particular regarding the second theme of quantum matter, quantum information, soft condensed matter biophysics. This is a matter of expertise, but is also partly due to its centrality in the country and to the local Utrecht practice of listing all PhD training as part of the contract between supervisor and PhD student. This is not considered a problem by either the DRSTP or the committee, but may create a slight imbalance in the representation of this large group in the various representation bodies, as mentioned by the interviewed PhD students.

PhD students reported back that they value the broad scope of the training programme, that they felt encouraged and challenged to move beyond their field. They considered the DRSTP's profile closely defined and clearly different from training provided at, for instance, specialized

summer schools on their own research topics. The broadness and diversity of the programme is considered a strong feat, yet also results in some complaints from individual students. As the courses are tailored towards the complete PhD research community, some advanced students feel unproductive from time to time as they tend to search for specialization rather than broadening within their own particular field. String theorists, for example, are not interested in an introduction to soft matter theory. Students felt free to offer suggestions for change through either the PhD Student Council or on an informal basis. They indicated that these suggestions were always actively pursued and that implementations were communicated adequately.

The committee discussed the students' objections with the staff and Governing Board of the DRSTP. Both recognized these complaints and already suggested changes to the programme in consultation with the various advisory boards. The committee agrees with the Governing Board that these suggestions will always be inherent to the objectives of the school, and is satisfied with the way how the Governing Board and staff try to meet these objections. The committee, however, wants to remind the DRSTP to keep in mind that not all students are fully committed to the DRSTP's programme and therefore, continuous effort is needed to communicate the School's objectives and goals to students – by clearly pointing out the benefits of a diverse knowledge base also for specialized research.

The committee was highly impressed by the quality of the offered educational programme. It studied the offered courses and lectures of the block weeks as programmed over the last four years. The scope and diversity of the courses offered during the block weeks is extremely wide-ranging, yet also qualitatively strong. Domain specific knowledge is rendered crucial for outstanding research, as is a broader knowledge of the field of theoretical physics. The committee is therefore fully supportive of the DRSTP's objectives and aims and considers the block weeks an excellent way to achieve these aims. The local courses offer specialization and the annual student day is a good way to create interaction between the academic and professional field in the eyes of the committee members. By combining the expertise of all seven institutes, PhD students are offered courses by experts on the various topics of research. It truly allows students to interact with experts and creates a broad domain specific knowledge base.

Additionally, the committee found plenty of evidence regarding the international standing of the DRSTP within the international community. In an appendix to the self-assessment report, it read a report by the Scientific Advisory Council, existing of many prominent international specialists in the field of theoretical physics, reflecting upon the outstanding quality of the DRSTP's programme. The committee independently established to be in full agreement with this assessment. Staff involved in the DRSTP belong to research groups within institutions of excellent international repute and they are involved in highly esteemed international collaborations, publishing in the foremost international journals and obtaining prestigious grants. The DRSTP itself is also involved in international collaboration: it organized block courses in cooperation with the Jorge André Swieca/IFT Summer School in both Brazil and PhD students from outside the Netherlands regularly follow courses at the DRSTP

In the committee's view, the DRSTP creates conformity within the PhD programmes in theoretical physics in the Netherlands and also allow students to look beyond their own area of expertise. It therefore has a different objective from specialized summer schools and is, for its breadth in learning, considered an excellent addition to the available courses on offer for PhD students. The broad, general set up of the DRSTP themes brings students into contact with adjacent fields, deliberately moving them out of their comfort zone. This objective in particular is valued by the committee, who fully agrees with the underlying academic principle. In its eyes, the diversity and variety of the programme offers students a chance to stay open-minded throughout their PhD.

The committee was very impressed with the amount of dedication to communication and community building created through the established institutional links. The DRSTP brings together both PhD students and research staff of the seven institutions, allowing the exchange

of research and ideas. It could therefore, in the eyes of the committee, be seen as an important mechanism to ensure further research and innovation. It also forms a true national platform and creates a network that both stands for broadness of learning and for quality, due to the assurance mechanisms of seven different partner institutions to uphold and guarantee the quality of the educational programme.

Conclusion

The curriculum of the DRSTP is, in the eyes of the committee members, of excellent quality with a balanced approach, addressing relevant themes, good structure of courses, and interactive set up. The committee learnt that general 'soft' academic skills are trained at the local graduate schools. Also integrity courses are delivered at the local institutions. To the committee, this division of training seems sound and an excellent way to organize PhD training of the highest quality. The DRSTP offers a platform at which both professional and academic skills are tested through presentations and poster sessions, offering students a safe environment to practice and hone their skills. Also, the attention paid to connections of the professional field are highly valued by the committee; the DRSTP caters in this way for the creation of a truly scientific community, in which both the academic and professional field partake and in which PhD students automatically are welcomed. The DRSTP has an excellent international reputation amongst its international peers and a clear profile that differs from specialized summer schools. The committee considers the multi-site structure of the DRSTP a true asset: it combines the expertise of faculty in the member universities, offering students access to skills and expertise they would not have otherwise. The committee also noted that the DITP input is considered by both staff and students as of enormous added value, and warmly supports collaborations as such.

Quantitative assessment

The SEP criteria of research quality was interpreted by the committee as the quality of the PhD educational programme in an international context, comparing the educational programme of the DRSTP with international training programmes for PhD students. The committee looked into several aspects to assess this criteria: it looked into the aims and objectives of the programme, the content of the educational programme, at the PhD community and its manner of interaction, at general research skills trained to students, at the research integrity policy of the DRSTP, at the contribution of the DRSTP to the training of general research skills applicable for the field, at the reputation of the DRSTP and at evidence for/against the added value of the multi-site structure of the DRSTP. It considers the quality of the PhD educational programme in an international context as of the highest international standing and therefore assesses this criteria as excellent (1).

3.3. Relevance of the DRSTP's educational activities to society

The school aims to contribute to society by means of offering a concise and balanced training programme for all PhD students in theoretical physics. As a result, the DRSTP is neither involved in setting a research agenda, nor in formulating a concise outreach programme related to independent research. This does not mean, however, that staff and students of the DRSTP are not involved in both; their contributions need to be, however, assessed at the partner institutions of the DRSTP. The committee found the DRSTP aware of this fact and also of the potential threat created by this set up on the School's assessment in terms of social relevance – and therefore of their viability, as discussed below under 3.4. In the eyes of the committee, the DRSTP's relevance to society can therefore only be truly assessed in conjugation with the impact of all partners institutions on society according to the SEP criteria. As this is far and beyond the scope of this review, the committee decided to look into the employability of the DRSTP graduates as proof of the *relevance of the School's educational activities to society* for this assessment.

In the self-assessment report, the DRSTP listed both the number of graduates of the school for the last ten years and the employment of PhD students following the PhD. The committee was highly impressed by both numbers, although both are naturally influenced by factors outside of

the DRSTP's control, e.g. the supervision and contacts with the professional and academic field at the home institutions, which are, again, independently assessed from the research school at the various partner institutions. The committee also paid attention to the skill sets obtained by graduates and the way in which these prepared PhD students for a career in either the professional or academic field. As general academic skills are trained at the home institutions, the committee looked into the way in which the DRSTP allowed students to practice these skills. As discussed above under 3.2, The DRSTP offers a platform at which these skills are tested through presentations and poster sessions, offering students a safe environment to practice and hone their skills.

Based on the information in the self-assessment report and the interviews during the site visit, the committee noted that the DRSTP delivers highly skilled young scientist who find easily employment inside and out of academia. It considered the number of graduates recruited by consultancy firms and ICT companies striking, as it indicates the value placed on the skills of students in theoretical physics by the professional field. In discussion with the committee, students indicated to consider the variety of the DRSTP's programme of value for their further career, in particular in relation to their employability in the professional field, where broad general knowledge of many different topics, theories and research skills is often considered a true asset over or next to specialized knowledge of a particular topic.

PhD Students were also appreciative about the ways in which the DRSTP created a platform of interaction between the academic and professional field: they listed the annual student day, the 'Trends in Society' symposium and also the collaborative nature of the consortium and the availability of information. The DRSTP truly creates the networks and contacts necessary for reaching out and beyond the home university. The committee also wants to underline that this overarching outreach potential of the DRSTP is enormous, being the only national organization within the field of theoretical physics. The national network created by and through the DRSTP, which is further guaranteed by the quality assurance mechanisms of all participating institutions, is of enormous added value and potential to the field and hence, to society.

Conclusion

The committee has concluded that the DRSTP is an atypical unit to assess using the SEP criteria. The committee does not include outreach activities as part of their interpretation of this particular criteria, as all seven partner institutes involved have vibrant and very successful outreach programmes. If the DRSTP were to start their own independent outreach programme to increase its profile, that might create tension in a very harmonious collaboration. The committee is of the view that the DRSTP should play an enabling and supporting role, but should not develop its own parallel activities.

The DRSTP is unique in that it includes the expertise in theoretical physics available at seven prominent universities and research institutions in a common PhD training program. This is a very unusual construction worldwide and is only possible in a compact country where the spatial distances between the institutions are small, enabling students to travel easily to sites offering training courses. The extra gain in quality and breadth of PhD training achieved in this way is very noticeable. The committee concluded that the employability of graduates of the DRSTP is very good, both inside and out of academia. The DRSTP's mission to offer a broad education is recognized as of value by both students and staff, in particular in relation to graduates' employability beyond the academic field. The high levels of graduates entering positions in consultancy and ICT also reflects the relevance placed upon theoretical physicists by the job market.

The committee acknowledges that the partner institutions are of clear importance, yet also wants to underline the important role of the DRSTP in the PhD students' training: the DRSTP offers a platform at which the professional and academic field engage with one and another and at which students exchange ideas and practice their skills. As a result, the DRSTP has a

'benchmarking' function, at it is at the moment the only organization representing theoretic physics at a national level, both for students amongst themselves but also in relation to the job market in its totality. The committee recommends that the DRSTP strengthens its support for the many outreach activities of the participating partner institutes, in particular in helping them achieve national rather regional impact.

Quantitative assessment

The committee looked into the employability of the DRSTP graduates as proof of the *relevance of the School's educational activities to society*. The committee paid attention to the skill sets obtained by graduates and the way in which these prepared PhD students for a career in either the professional or academic field. It considers the relevance of the school's educational activities to society in an international context as of the highest international standing and therefore assesses this criteria as excellent (1).

3.4. Viability of the DRSTP

The day-to-day management of the DRSTP is in the hands of a Scientific Director, who is responsible for implementing the decisions of the Governing Board of the DRSTP. An international Scientific Advisory Committee, Educational Board and PhD Student Council advise the Governing Board concerning its planned activities and scheduled courses. Students, staff and members of the Governing Board praised the running of the School in interviews with the committee: they all feel heard and represented and indicated to have plenty of opportunities to offer feedback and advice to the Scientific Director and/or Governing Board. This system is, in the eyes of the committee, functioning well. Students reported on their active involvement in the organization of DRSTP events and activities.

The committee evidenced the way in which advice of the Scientific Advisory Committee was followed up and reported back on. In this way, the Scientific Advisory Committee also acts as an additional, effective and independent quality assurance mechanism, next to the established quality assurance mechanisms put in place by the various partner institutions – often organized through the local graduate school and/or PhD student supervisor at his/her local institution.

Since the 2010 re-accreditation report of the KNAW ECOS committee, many measures of improvement regarding the management structure were implemented. Staff at the DSTRP now apply to become involved in the educational programme of the DRSTP and are assessed for their suitability and their willingness to contribute and engage with the School and its intentions, including the promise to enrol their new PhD students. As a result, the DRSTP now works with a dedicated, engaged and involved staff that is willingly contributing its time and expertise to the educational programme and also shares its support for the DRSTP's mission with their students.

Membership management of the DRSTP has also been strengthened: students fill out registration forms, describing their research projects and signed by the appropriate bodies and persons to confirm and support his/her enrolment. Students therefore are formally committed to following the mandatory parts of the DRSTP's curriculum. In addition, the PhD council has taken on a more active role in approaching, informing and assisting new and aspiring DRSTP student members with regards to the DRSTP and its activities, which is appreciated by both the students and the members of the current review committee. Nonetheless, the committee wants to remind the DRSTP of its own purpose: the purpose of the DRTSP is to offer students an excellent, broad, theory-based educational programme. This means that neither diversification nor growth of the student body for its own sake are necessarily part of the DTRSP's mission.

The main aim of the DRSTP is to establish cross-talking between the many research fields and methods employed in theoretical physics. The DRSTP formulated hereto three objectives:

- to implement a joint program of graduate education in theoretical physics that draws upon a dynamic research environment;

- to maintain and strengthen research in theoretical physics from a broad unifying perspective that exploits the interrelationships between different fields of theory;
- to strength, both in research and graduate education, connections with experimental physics and other disciplines such as mathematics, computer science, astronomy, earth science, physical chemistry and the life sciences.

The DRSTP is a long-established institution within the Dutch academic landscape and benefits from a long-standing experience in collaboration. The programme of the school has been judged as of the highest value, quality and relevance and is, as such, recognized by international peers. The committee considers the DRSTP's objectives sound and highly relevant to the field and for a national research school in theoretical physics.

In addition to their educational objectives, the DRSTP aims to create a community of theoretical physicists within the Netherlands. The DRSTP offers a platform for PhD students to meet their peers at other institutions and with members of both academia and industry. The committee has established that no other organization represents theoretical physics at the moment at national level. The committee ascertained that the DRSTP is considered vital for the community building within the field, which is also broadly attested to by staff of the DRSTP, its students and by Scientific Advisory Board. This aim in particular seems to be closely related to the DRSTP's viability in the long run, as it underpins the very existence of the collaboration between the various partner institutions.

The committee did not encounter any threats to the existing collaboration. In the self-assessment report, the DRSTP indicated that specialized summer schools sometimes appealed more to students and that local graduate schools in the partner organizations of the DRSTP are more and more beginning to assert themselves as the responsible unit for the education of their PhD students. This seems a logical result of the current attention for the quality of the graduate schools and PhD training at local institutions, an outcome of an heightened interest in the quality assurance of PhD training in the Netherlands. In the committee's view, this heightened interest and assertion does not necessarily lead to competition between the local and national educational programme, and neither do international summer schools automatically pose a threat to the DRSTP. This holds true as long as the partner institutions recognize the added value of the DRSTP's addition to PhD training and as long as the various schools complement each other rather than compete with each other.

In this context, the committee also discussed the matter of potential PhD positions funded by the DRSTP with the School's management. The School's management indicated to consider applying for research grants, for example through one of the EU schemes. The committee recognizes that DRSTP research positions would raise the School's potential relevance to society: it would create ownership over certain research strands and its potential societal output. Yet PhD positions may also result in tensions between the various partner institutions within the current consortium. Potentially, partner institutions would end up competing with each other within the DRSTP for these positions and graduate schools at the local (host) institutions and the DRSTP would have to agree on the final responsibility over the students winning a DRSTP PhD position. This could result in a lot of additional work for the DRSTP. In the committee's view, these potential strains may also potentially harm the DRSTP's chances to actually successfully win research grants in the first place and hence, the application procedure may turn out to be demanding yet not rewarding.

The committee recommends exploring the options for potential PhD funding, but strongly advises to do so only in close collaboration with all partner institutions to avoid any damage to the current collaboration and to consider the costs involved in bidding in grant competitions. The DRSTP could play a coordinating role in applications for EU (ETN) funding. Additionally, the committee advises the DRSTP to concentrate on their current strengths in the first place. The DRSTP strong feat is to provide an excellent educational programme for theoretical physicists in

the Netherlands. This should be allowed to be considered vital for their relevance to society in itself, perhaps strengthened by efforts to further initiate debate between members of the School and policy makers and members of industry.

In the eyes of the committee, theoretical physics in the Netherlands as a field should consider itself fortunate with the current state of affairs: the DRSTP, with its strong history of success and established collaboration, offers an excellent educational programme focussing on broad overview and theory and a platform to practice general academic skills – as taught by graduate schools at local institutions and, if considered necessary, added upon by specialized summer schools. The committee was therefore pleased to find an atmosphere of full engagement to the School by both Governing Board and Scientific Advisory Board. The full commitment to the DRSTP is also reflected in the recently renewed Common Agreement for the period 2016–2022, which all partner institutions signed. Also, the financial situation of the DRSTP is guaranteed for this period: as Commissioner, Utrecht University provides an adequate annual budget to pay for the management and secretariat costs.

Conclusion

The committee concluded that the future for the DRSTP looks bright. The School is served by a fully committed management and staff, supported by adequate funding and broadly recognized by both the partner institutions and the international field for its excellent educational programme and important function in community building within the Netherlands. The quality of the educational programmes is assured both by the partner institutions and by the independent Scientific Advisory Board, which operates freely without interference from either the DRSTP or the partner institutions. The added value of a national network guaranteed by the quality assurance of all participating parties gives a quality mark that cannot be surpassed. The committee advises to tread very carefully in bidding for research grants to establish DRSTP-funded research positions and to do so only in close collaboration with the partner institutions. It also recommends to explore options outside of the EU schemes as, to its opinion, the DRSTP may not be considered a suitable candidate for EU money. The committee recommends the DRSTP to never lose sight of its current strengths: an excellent educational programme and its vital role as a national platform within the community of theoretical physics.

Quantitative assessment

The committee looked into the viability of the DRSTP, paying attention to the aims and objectives of the programme, its financial support, the governance and leadership, and quality assurance. It considers the viability of the DRSTP fully secure and excellently equipped for the future. Hence, the committee assesses this criteria as excellent (1).

3.5. General conclusion and quantitative assessment

In the eyes of the committee, theoretical physics in the Netherlands is fortunate to benefit from the broad PhD training provided at the DRSTP. The DRSTP, with its strong history of success and established collaboration, offers an excellent educational programme focussing on broad overview and theory and a platform to practice general academic skills. Also, the attention paid to connections with the professional field are well established and highly valued: the DRSTP caters in this way for the creation of a truly scientific community, encompassing both the academic and professional field. The committee considers the multi-site structure of the DRSTP a true asset: it combines the expertise of faculty in the member universities, offering students access to skills and expertise they would not have otherwise. The DRSTP has an excellent international reputation and benefits from strong links with both national and international partners.

The committee concluded that the employability of graduates of the DRSTP is excellent, both inside and out of academia. The high levels of graduates entering positions in consultancy and ICT reflects the relevance placed upon theoretical physicists by the job market. The DRSTP offers a platform at which the professional and academic field engage with one and another and

at which students exchange ideas and practice their skills. As a result, the DRSTP has a 'benchmarking' function, at it is at the moment the only organization representing theoretical physics at a national level. The committee wants to underline that the overarching outreach potential of the DRSTP is enormous as it is the only national organization within the field. The national network created by and through the DRSTP, which is further guaranteed by the quality assurance mechanisms of all participating institutions, is of enormous added value and potential to society.

The committee concluded that the viability and prospects of the DRSTP are excellent. The School is served by a fully committed management and staff, supported by adequate funding and broadly recognized by both the partner institutions and the international field for its excellent educational programme and important function in community building within the Netherlands. The quality of the educational programmes is assured both by the partner institutions and by the independent Scientific Advisory Board, which operates freely without interference from either the DRSTP or the partner institutions.

Quality of the PhD educational programme: 1 (excellent)

Relevance of the DRSTP's educational activities to society: 1 (excellent)

Viability of the DRSTP: 1 (excellent)

4. RECOMMENDATIONS

- Explore the options to offer PhD positions to students only in close collaboration with the partner institutions. The DRSTP could play a coordinating role in applications for EU (ETN) funding.
- Never lose sight of the DTRSTP's current strengths: it offers an excellent educational programme and has a vital role within the community of theoretical physics as the only national platform in the field. The purpose of the DTRSTP is neither to diversify for its own sake nor necessarily to attract more students: the purpose of the DTRSP is to offer students an excellent, broad, theory-based educational programme.
- Value and recognize the national network created by and through the DRSTP, which is further guaranteed by the quality assurance mechanisms of all participating institutions. This added value should be considered as another example of societal outreach, which overarches the complete field.
- The DITP input is considered by both staff and students as of enormous added value. Strengthen and nurture connections like these between the DRSTP and other institutions and/or schools of international renown.

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.

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-T_c superconductors, heavy fermion metals). More recently, he has developed strong coupling theories of quantum criticality for metallic systems.

APPENDIX 3: PROGRAMME OF THE SITE VISIT

DRSTP Assessment meeting Schedule

February 17, 2017

Session I:

Meeting with Research School Management

13:30-14:15 in BBG 7.12

Prof.dr. Erik Verlinde (Chair of the Governing Board, University of Amsterdam)

Prof.dr.ir. Henk Stoof (Scientific Director, Utrecht University)

Prof.dr. Bernard Nienhuis (Chair of the Educational Board, University of Amsterdam)

Session II:

Meeting with staff Research School

14:30-15:15 in BBG 7.12

Prof.dr. Wim Beenakker (Radboud University Nijmegen)

Prof.dr. Jean-Sébastien Caux (University of Amsterdam)

Prof.dr. Cristiane de Morais Smith (Utrecht University)

Prof.dr. Eric Laenen (Nikhef, University of Amsterdam, Utrecht University)

Session III

Committee meeting with PhDs/student council

15:15-16:00 in BBG 7.12

Francesca Ferrari MSc (PhD student council, University of Amsterdam)

Mathijs Janssen MSc (Utrecht University)

Benedikt Schönauer MSc (Utrecht University)

Jorinde van de Vis MSc (PhD student council chair, Nikhef)