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<i>Uw brief van</i>		<i>Doorkiesnr.</i>	
<i>Onderwerp</i>	Aanbiedingsbrief Evaluatie LION	<i>Contactpersoon</i>	bestuur@science.leidenuniv.nl

Geacht College,

Het Leids Instituut voor Onderzoek in de Natuurkunde (LION) is onlangs gevisiteerd in het kader van hun onderzoeksevaluatie over de periode 2015-2021. Met genoegen bieden wij u bij deze het rapport van die evaluatie aan, en de reactie van het instituut daarop.

Het Faculteitsbestuur (FB) sluit zich aan bij de positieve woorden van de evaluatiecommissie, in het bijzonder over het toonaangevende onderzoek en de voortdurende verjonging van het instituut. Het feit dat het toonaangevende onderzoek toch vooral gestoeld is op individuele excellentie, heeft bij LION niet geleid tot singulariteit en isolatie van onderzoekers en onderwerpen. Vooral de jongere onderzoekers zoeken zelf proactief naar interactie binnen en tussen secties en instituten, wat door LION als positief wordt ervaren en, mede aangemoedigd door de onderzoeksevaluatie, gestimuleerd blijft worden. Het FB verwelkomt deze ontwikkeling, die goed past in haar ambities op het terrein van onderzoek voor de komende periode.

LION heeft de ambitie uitgesproken om voor Smart, Living & Active Matter (SLAM) aansluiting binnen de faculteit en met het Leiden Bio Science Park (LBSP) te verkennen. Het FB ziet ook mogelijkheden voor synergie tussen het onderzoek bij LION en bestaande expertise binnen andere instituten en is daarom verheugd met dit voornemen.

Eén van de aandachtspunten die het FB in haar aanbiedingsbrief aan het College van Bestuur bij het zelfevaluatierapport van LION had vermeld, betrof maatschappelijke relevantie. Hoewel het onderzoek zeer fundamenteel en veelal nieuwsgierigheids-gedreven van aard is, ziet het FB graag dat LION de maatschappelijke impact van haar onderzoek breder verkent. Voorbeelden zijn het laten aansluiten van fundamenteel op toegepast onderzoek en het aandacht geven aan maatschappelijke toepassingen in het onderwijs, waar LION al veelbelovende activiteiten in ontplooid. Het FB is daarom verheugd over de constatering van de evaluatiecommissie dat fondsenwerving bij LION via industriële partners is toegenomen, dat LION diverse onderzoeksgebieden heeft die kansen bieden voor maatschappelijke impact en dat LION heeft geïnvesteerd in een business generator en in wetenschapscommunicatie. Het FB moedigt LION aan op haar basis van excellent



Blad 2/2

fundamenteel onderzoek, de diverse mogelijkheden voor het vergroten van haar maatschappelijke impact te blijven verkennen.

Een ander aandachtspunt dat het FB in de bovengenoemde aanbiedingsbrief aan het College van Bestuur had vermeld, betrof de gender balans in het instituut. De evaluatiecommissie uitte waardering voor de inspanningen van het instituut en de vruchten die die inspanningen al hebben afgeworpen, maar benadrukt ook dat gender balans een blijvend aandachtspunt is. Het FB onderschrijft de aanbeveling aan het LION om voor de komende periode concrete doelen en tijdlijnen te formuleren om de genderbalans te (blijven) verbeteren en denkt daarbij graag mee.

De gezamenlijke reactie en deze aanbiedingsbrief geven wat mij betreft goede handvatten voor een afrondend gesprek over de evaluatie. Wij verzoeken u om het initiatief te nemen voor het afrondend bestuurlijk overleg.

Met vriendelijke groet,
namens het faculteitsbestuur,

Prof. dr. J. Knoester
Decaan

Response by the Faculty of Science and the Leiden Institute of Physics (LION) to the Research Evaluation report LION 2015-2021
26 June 2023

The Leiden Institute of Physics (LION) and the Faculty of Science (hereafter: Faculty) are grateful to the evaluation committee for their insightful assessment of the research at LION. In this response, we would like to address a number of points the committee raised, offer some thoughts on how we will seek to further improve the institute in the coming evaluation period and highlight a number of particularly relevant recommendations.

Echoing the sentiment of the preface, written by the committee chair, LION was pleased with, and grateful for, the open discussions during the site visit. The committee was very well prepared, and the discussions implicitly made clear that such a visit is a crucial part of the evaluation process, that allows putting the right perspective on local habits and boundary conditions. As a result, we can largely understand and embrace the remarks, conclusions and recommendations presented in the evaluation report.

With respect to the conclusions and recommendations, LION and the Faculty would jointly like to note the following.

- The committee recommended that both the institute and faculty continue to nurture a research culture without barriers for interaction, based on a strong individual freedom and excellence, yet encourages the faculty to formulate a joint ambition and plan to accommodate even stronger connections between groups, sections and institutes in order to stimulate inter- and multidisciplinary collaboration.

This recommendation fits within the intended Strategy Plan of the Faculty for the period 2023-2028. It will contain six scientific themes that shape the Faculty's profile to the outside world, within which collaboration is stimulated. LION and the Faculty's other institutes are encouraged to consider engaging with scientific expertise available throughout the Faculty in the themes. LION is well positioned to contribute to the (preliminary) 'Quantum and Space' theme, in which we aim to connect LION's fundamental quantum research to space applications, as well as the one on Complex Networks. In addition, the 'Quantum Leiden' research hub, founded in the context of our participation in the Quantum Delta NL research program, aims to improve collaboration among the different aspects of quantum research internally, and with external partners. LION expects advantages for the researchers themselves because of the improved connectivity.

- The committee has observed excellent research in LION, and recognizes that this (partly) stems from a strategy focusing on individual excellence. Without abandoning the principle of striving for excellence, they recommend that the institute encourages and steers towards more interactions within the (three) sections.

LION promotes individual excellence, a downside of which can be singularity and isolation. Present research and funding opportunities require pooling resources, both intellectually and financially. Having more interactions allows younger researchers to more quickly carve their own niche, while for (PhD) students, more interactions in a section allows them to obtain a broader view on the field they are studying or working in. Recent initiatives by LION's researchers in this are promising and will continue to be encouraged by the institute and taken into account when new hires are going to be contemplated.

- The committee commented positively on the network formed by the Dutch physics community and the participation of LION researchers in NWO advisory committees, but finds the current absence of representation in the NWO Physics Roundtable a deficit.

LION has tried to secure participation in the Round Table for several years, but does not have the tools to enforce this. The diverse representation that NWO and the Round Table strive for makes them oblivious to the needs of individual institutes - even though almost all physics institutes in the Netherlands are somehow represented.

- The committee commented positively on the work-life balance the institute is able to provide for its staff members and proposes that we communicate this more formally, to make everyone aware of the possibilities.

LION will discuss ways to put 'more formal communication' into practice, such as including it in onboarding and as a standardized topic in the P&D interviews. A 'LION practices handbook', intranet-based, is also an option.

- There are both positive comments and recommendations with respect to scientific integrity, open science practices, staff mentoring, and support of postdocs.

LION recognizes the points being made, in particular when it comes to postdoc support. We will address this in consultation with the Faculty, as there may be a desired distribution of activities between the Faculty and the institute. Similarly, LION would like to be part of efforts to anchor (best) practices in Open Science and scientific integrity at the level of the Faculty, in order to avoid duplication. LION already makes use of the services of data stewards available at the Faculty. For scientific integrity, a training module for all scientific staff (not only PhD students) is desired by LION.

- The report makes a number of detailed observations about research quality, societal relevance, and viability. On the whole, we experienced the tone as very positive, and supportive of the choices that the institute makes in these areas.

As to *research quality*, we noticed that the committee is quite positive about the governance structure and the strategic choices. The Lorentz Institute is mentioned as a worldwide recognized excellence center in theoretical physics, but also for its bridging function between and across fields. The experimental sections, Quantum Matter and Optics (QMO) and Biological and Soft matter (BSM) are productive and demonstrate a high level of research. Both sections can still benefit from more connections between groups. On the QMO side, the committee believes that Quantum Metrology can be further developed; on the BSM side, the section suffers from labs being in different buildings, which makes forging more connections also more difficult. The committee sees further opportunities if 'active matter' can take advantage of the life science expertise in the Faculty. LION will explore opportunities for collaborations for Smart, Living & Active Matter (SLAM) between institutes as well as with the Leiden Bio Science Park. Finally, LION will look out for opportunities for collaboration between institutes when new NWA-calls are published. The institute will take these remarks to heart.

When it comes to *societal relevance*, the committee sees the steady amount of funding through industrial partners, and notes that biophysics, optics, and instrumentation have potential for societal impact. They are pleased with the choice to also invest in research into the (societal) impact of science

and science communication, embodied by an assistant professor (0.5 fte), and an endowed professor in physics communication (0.2 fte). The institute considers this an encouragement to continue along these lines as a matter of policy. The recent appointment of a business developer in the institute also fits with these developments.

The committee considers the *viability* of the institute to be very good, both with regard to funding as to succession planning. With respect to *HRM*, they remark that there could be more clarity and transparency when it comes to promotion to full professor. The committee would also like to see a more structurally supportive framework for postdocs, which we have already reacted to above. The committee also remarks that, although PhD students are well taken care of, for a significant subset, the time-to-thesis is too long (30% not finished after 6 years). They appreciate that some measures (installing a PhD platform, for instance) already have been taken to address such issues. LION will investigate causes and formulate appropriate further measures, in consultation with the faculty.

LION will draft a plan of approach in which the remarks in this letter will be addressed in more detail. This letter serves as a starting point for that. The institute aims to deal with these topics appropriately in the coming evaluation period.

Kind regards,

A handwritten signature in blue ink, appearing to be 'JA', written in a cursive style.

Jan Aarts (Scientific Director, LION)

A handwritten signature in blue ink, appearing to be 'JK', written in a cursive style with a long horizontal stroke extending to the right.

Jasper Knoester (Dean, Faculty of Science)

Leiden University
Prof.dr. Annetje Ottow, President of the Board
Rapenburg 70
2311 EZ Leiden
The Netherlands

Enschede, 6 March 2023

Dear Prof. dr. Ottow,

Please find enclosed, on behalf of the assessment committee, the report of the Research Evaluation Assessment 2015-2021 of the Leiden Institute of Physics of the Faculty of Science of Leiden University.

Yours sincerely,

A handwritten signature in blue ink that reads "T Palstra". The signature is written in a cursive style with a large initial "T".

Prof. dr. Thom Palstra
Chair

Research Evaluation
Leiden Institute of Physics
Faculty of Science
Leiden University
2015-2021

March 2023

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Preface

Dear Reader,

The assessment committee is pleased to present its Research Evaluation report of the Leiden Institute of Physics, LION, of the Faculty of Science over the period 2015-2021, as requested by the Executive Board of Leiden University.

The committee has worked according to the SEP protocol 2021-27, and the Terms of Reference that were provided to us. Our goal is thus to maintain and improve the quality and societal relevance of research and to facilitate continuous dialogue about research quality, societal relevance and viability. The assessment is based on the self-evaluation report and on discussions with various researchers and support staff during the site visit in December 2022. The site visit was very important to further clarify the strategy of the institute and its three sections after reading the self-evaluation report. The discussions with the institute and faculty board were very open, allowing for frank discussions. The committee has sent its preliminary report to LION for a check on factual errors. The institute's response has been incorporated into the final version.

The report details our findings on LION and its three sections, along which the institute is organized. The institute showed many examples of world-leading research. In recent years the staff has rejuvenated considerably, and this process will continue. We think that our report provides input for the continuous dialogue within the institute and with the Faculty Board and/ or the Executive Board.

We thank the institute members and faculty for their hospitality and open discussions. The well-prepared site-visit is much appreciated, certainly after the extended Covid period. We hope that the evaluation report assists in further improving the research quality and reputation of the institute.

A handwritten signature in blue ink that reads "T Palstra". The signature is written in a cursive style with a large, stylized 'T'.

Prof. Dr. Thom Palstra (chair)

Main Conclusions and Recommendations

Research Quality

- The committee recommends that both the institute and faculty continue to nurture a research culture without barriers for interaction, based on a strong individual freedom and excellence, yet encourages the faculty to formulate a joint ambition and plan to accommodate even stronger connections between groups, sections and institutes in order to stimulate inter- and multidisciplinary collaboration.
- The Institute Lorentz shows an excellent choice of topics and there are ample bridges to other fields. The committee recommends that its distinct identity is maintained such that it can act as bridge and foster collaborations across fields. The committee welcomes the efforts to establish a programme in Quantum Information. Considering the strong world-wide competition in this field, we recommend establishing a unique research profile, in conjunction with the Quantum Algorithm expertise in the faculty.
- The Quantum Matter and Optics group shows excellent research with many interactions locally, nationally and internationally. The committee recommends encouraging to invest in synergies between the groups. Also, the committee thinks that Quantum Metrology can be further developed, certainly considering the national context.
- For Soft Matter and Biophysics, the focus on ‘active matter’ is a good and timely strategic choice with ample potential. While there is good expertise, the committee recommends developing the strategic goals and vision to become better recognized in this very active field and to take advantage of the expertise in Leiden University surrounding life sciences.
- The committee was very pleased to learn how the Institute ensures a good work-life balance for its staff members, which is already addressed during hiring interviews. Working hours are flexible, and the institute is very attentive to the needs of its staff. To ensure that everyone is aware of the possibilities and feels free to make requests, the committee proposes that LION communicates its approach more formally to its employees.
- The committee encourages continued attention to the awareness of scientific integrity and independence, among all staff members, including PhD candidates.

Societal relevance

- The committee is pleased to see that the institute is actively investing in the standardization and a solid infrastructure for Open Science and data management practices. It recommends that the institute develop a protocol not only for sharing data, but also for code and software.

Viability

- The strategy of LION is driven by a focus on individual excellence. This can be an excellent strategy and has worked very well. With a new generation of staff picking up the baton, and certainly after the Covid period, we think it is essential that staff members interact in a more structural manner within the sections. We have seen evidence of excellent collaborations, but to have a leading role, the committee recommends that junior researchers interact more to define their uniqueness and carve out their own niche in their specific field of expertise.
- The committee is very positive about the mentor-system set up for tenure track staff members, who receive guidance from more senior and experienced researchers. It is highly appreciated among tenure track staff, and the committee recommends to also put such a structure into place for new hires that enter at associate professor level.

- The committee recommends that postdocs are offered a more structurally supportive framework in which they can develop their talents, share experiences, and prepare for future steps in their careers.
- Regarding the anticipated move to the new building, the committee would like to emphasize the importance of a joint location for all sections. If sections want to interact on a world-class level and enable synergy, this requires a shared location to encourage collaborations and knowledge exchange.

1. The review committee and the procedures

1.1. Scope of the review

The review committee was asked to perform a research evaluation of the Leiden Institute of Physics (LION) of the Faculty of Science of Leiden University, covering the period from 2015 up to 2021. The review committee consisted of seven members. The review committee was requested to assess the quality of research conducted by LION as well as to offer recommendations in order to improve the quality of research and the strategy, and to answer an additional question posed by the institute.

The committee was requested to carry out the evaluation according to the guidelines specified in the *Strategy Evaluation Protocol 2021-2027* (SEP). The evaluation includes a backward-looking and a forward-looking component. Specifically, the committee was asked to judge the performance of the unit on the main evaluation criteria and offer its written conclusions as well as recommendations based on considerations and arguments. The main evaluation criteria are:

1. Research Quality
2. Societal Relevance
3. Viability

During the evaluation of these criteria, the committee was asked to incorporate four specific aspects. These aspects are as follows:

1. Open Science: availability of research output, reuse of data, involvement of societal stakeholders;
2. PhD Policy and Training: supervision and instruction of PhD candidates;
3. Academic Culture: openness, (social) safety and inclusivity, and research integrity;
4. Human Resources Policy: diversity and talent management.

The Executive Board provided the review committee with Terms of Reference concerning the evaluation. In this document, the Board asked the committee to pay special attention to the following question:

With our focus on curiosity-driven research in Quantum Physics, in Biological, Soft and Complex systems, and in Cosmology, plus our emphasis on Science Communication, we believe we are viable. Does the committee see a direction or opportunity we are not sufficiently exploring?

1.2. Composition of the committee

The composition of the committee evaluating the Institute was as follows:

Ms. Femke Bangma, MA, University of Nijmegen
Prof. Dr. Lesley F Cohen, Imperial College London
Prof. Dr. Laura Covi, University of Göttingen
Dr. Laura Filion, Utrecht University
Prof. Dr. Thom Palstra (chair), University of Twente
Prof. Dr. Jan Vermant, ETH Zürich.
Prof. Dr. Peter Zoller, University of Innsbruck

The review committee was supported by dr. Jesseka Batteau, secretary to the committee.

1.3. Independence

All members of the review committee signed a statement of independence to ensure that they would assess the research quality of the LION Institute in an unbiased and independent way. Any existing personal or professional relationships between committee members and the research unit(s) under review were reported and discussed in the first committee meeting. The committee concluded that there were no unacceptable relations or dependencies and that there was no specific risk in terms of bias or undue influence.

1.4. Information provided to the committee

The committee received the self-evaluation report from the LION Institute, including all information required by the SEP. Before the site visit, additional information was provided at the request of the committee. This consisted of the PowerPoint slides of the groups presenting during the site visit, as well as information on Open Access publishing, teaching efforts and student numbers, the number of PhD's, the PhD-platform and career perspectives of MSc and PhD students of LION. The Committee also received the Terms of Reference for the evaluation.

1.5. Procedures followed by the committee

In preparation for the site visit, the committee convened twice, on 14 September 2022 and 16 November 2022. During these meetings the committee was informed of the procedures and criteria of the Strategic Evaluation Protocol, and discussed its preliminary findings based on the Self Evaluation Report and supporting documents provided by LION. Committee members identified themes and questions that would serve as starting points for the discussions with the institute during the site visit. The committee also agreed upon procedural matters and aspects of the review. After the interviews the committee discussed its findings and comments, allowing the chair to present the preliminary findings to the Institute. Each committee members provided written input for the evaluation report.

A draft evaluation report was presented to LION for factual corrections and comments. In close consultation with the chair and other committee members, the comments were reviewed by the secretary and incorporated in the final report. The final report was presented on 6 March 2023 to the Executive Board of Leiden University.

2. Evaluation of Leiden Institute of Physics (LION)

2.1 Introduction to LION

The Leiden Institute of Physics (LION) is the physics research institute of Leiden University, and is part of the Faculty of Science. The mission of LION is to perform foundational and curiosity driven research in the domains of experimental and theoretical physics, and to provide physics education, at the highest international standard. Research and education go hand in hand at all levels.

The Institute is divided into three sections:

- **Theoretical Physics** is housed at the Institute Lorentz (IL). Theoretical physics covers quantum physics (condensed matter at nanoscales, low temperatures) and quantum information (quantum algorithms); physics of cosmology and elementary particles (large scales, high energies, gravity and quantum); and statistical and phenomenological physics (soft condensed matter and biological matter, at room temperature).
- **Quantum Matter and Optics (QMO)** (experimental physics) is part of the Huygens – Kamerlingh Onnes Laboratory. The section explores quantum matter and quantum optics/information. The ‘Quantum and Society’ group is also part of QMO.
- **Biological and Soft Matter (BSM)** (experimental physics) is part of the Huygens – Kamerlingh Onnes Laboratory. The focus is on soft, active and biological matter, and on mechanical metamaterials.

Each section consists of roughly ten Principal Investigators (PI’s), who lead their own group. On average, LION has a research and teaching staff of about 30 FTE. At the time of the site visit the institute had 16 full professors, 11 associate professors and 6 assistant professors. On average, LION employs around 30 postdocs and 70 PhD students, about 40 technicians (research-connected, plus fine mechanical and electronic departments), and 13 administrative support staff. The total number of employees is about 170-180 FTE.

The Scientific Director, Prof. dr. Jan Aarts, has integral responsibility for the workings of the institute. He chairs the Management Team (MT) that is responsible for the governance and budget, as regard to research and for teaching. The MT consists of the Scientific Director, the adjunct Scientific Director, the Teaching Director(s) (TD) and the Institute Manager (IM), who is responsible for the budgetary and operational side of the Institute. Since the beginning of 2021, there are two Teaching Directors, one for the BSc programme and one for the MSc programme Physics.

For discussions on strategy, and staff appointments, additional and more varied insights are needed, which are provided by the Coordination Team (CT). It consists of the MT members, but with the TD-MSc instead of the TD-BSc, and additionally the three section leaders mentioned above. Formally, the CT gives advice to the MT and the Scientific Director. Discussions in the CT will be relayed by the section leaders to the different sections in lunch or other meetings, which is one of the channels to exchange information between staff and management.

At LION, all academic staff, both in research and teaching, are part of the Scientific Council. It meets six times per year, chaired by the SD. For wider employee participation there is the Institute Council, where academic staff, support staff, and PhD students are all represented. The Institute Council meets four times per year. Finally, LION has an external advisory board (‘Raad van Advies’), which has been revived in 2021, and which is asked advice when needed.

2.2 Aims and strategy

During the evaluation period, LION's mission has been to:

- perform high-level foundational and curiosity driven research in the domains of experimental and theoretical physics;
- provide physics education at the highest international standard, fostered by its research efforts;
- interact with society through the products of the research, through the young professionals it trains, as well as through active science communication.

The overall mission was supported by concrete strategic aims, which were also based on the recommendations made by the previous evaluation committee in 2015. In the audit period, LION has:

- Capitalized on its newly developed research areas in Quantum Matter and Quantum Information, in Biological, Soft and Complex Matter, and in Cosmology;
- invested in and maintained relevant networks and fruitful collaborations with adjacent disciplines;
- fostered a stimulating research atmosphere for researchers to excel in;
- invested in connecting research with and impacting society at large;
- continued to strengthen gender balance, diversity and inclusion within the institute.

Research in the review period was supported by earlier acquired funding of two large Dutch Science Foundation (NWO) 'Gravitation' programmes, running in the period 2012 – 2023. Important developments were the participation in a new Gravitation Programme, the Quantum Software Consortium (2017), (permanent) funding received in the 'Sectorplan Bèta en Techniek' to strengthen research (2019), and the advent of the Quantum Growth fund (2019).

2.3 Qualitative Evaluation

The information provided by the institute in its Self-Evaluation Report and additional documents, as well as the open nature of the interviews, allowed the committee to gain good insight into the quality of research, the societal impact, and viability of LION. The committee was very satisfied with the constructive and frank discussions it had with all the representatives of the institute, allowing it to get an in-depth view into the institute. In its evaluation of LION, the committee encountered a vibrant physics institute, with high-quality research and motivated staff and students, and outstanding instrumentation.

2.3.1 Research Quality

Mission, strategy and governance

According to the committee, the institute's mission is highly relevant and distinctive. Its strategy is driven by an emphasis on individual scientific excellence and curiosity-driven science, with a lot of freedom for individual PI's to set out their own research lines. In LION, individual PI's manage their own research effort, connected to colleagues within the same thematic area through common interests. The LION strategy is to invigorate the Institute regularly through the hiring of young, talented, ambitious researchers, who start in a Tenure Track position. From the start, researchers are encouraged to build their own research group. This leads to a flat and non-hierarchical organization, which allows for open discussions and mentoring of younger staff.

The committee observes that LION was able to make excellent progress in the areas identified within

its strategic programme in the period under review. Important developments, also prompted by recommendations offered by the previous evaluation committee, include the newly developed research cores in Quantum Matter and Quantum Information, in Biological Soft and Complex Matter, and in Cosmology enabled the hiring of ten new staff members, funded through the Sectorplan Bèta and Techniek (with funding starting in 2019) and Quantum Growth fund (also starting 2019). The institute made conscious strategic choices to strengthen particular scientific areas, such as research on Applied Quantum Algorithms for Quantum Computers, Active Matter in the area of Biological and Soft Matter, Particle Cosmology and Numerical Cosmology, and Condensed Matter Research. The Quantum Growth fund also enabled the institute to start a research group on Quantum and Society in 2019.

The committee is positive about the governance structure and strategic choices of the institute, which shows itself to be open-minded, supportive as well as flexible. In its conversations with the various representatives of LION the committee could establish that all participants subscribe to the strategy and ambitions of the institute and are appreciative of the way the institute is managed and the freedom they have to develop their research lines. Also, the research community of LION is actively involved and consulted when it comes to strategic choices and positioning, both formally and informally.

Clearly, the current Institute Director is valued highly and the whole institute is grateful that the new Dean brings stability to the Faculty. The new Faculty-level strategy is currently under development and will be available in April 2023. It is likely that LION's research directions will contribute strongly to this future strategy. According to the committee, the Institute is in a very good position in this regard and is well supported.

Research directions

When considering the LION institute as a whole, the committee observes that the three research sections – Theoretical Physics, Quantum Matter and Optics (QMO) and Biological and Soft Matter (BSM) – offer a very well-chosen focus on research in which the Institute has shown excellent results and retains a very high potential. The documents and conversations with representatives of the institute testify to robust research lines and productive connections and collaborations within the ecosystems of the institute, the Faculty, Leiden University as well as with external scientific partners and stakeholders, both nationally and internationally.

The committee appreciates the level of freedom that all researchers have (starting with the post-doc level) to explore and develop their own research lines and the support they receive from the institute to enable this. Staff the committee spoke to emphasize that they value the support in grant applications, possibilities to ask for help, and the mentoring programme for tenure-track researchers.

Theoretical Physics

The committee observes that the Lorentz Institute has a long history and tradition as a world-wide recognized excellence center in theoretical physics. The institute represents an effort on a broad range with focus on fundamental science, including cosmology and astrophysics, soft and biological matter, and low temperature mesoscopic and condensed matter physics of strongly correlated systems. The committee is pleased with the strong international Theoretical Physics groups, with very established and successful senior PIs and new promising young talents, as reflected by the very strong publication record and student output. The committee values the ambitious long-term vision of the Theoretical Physics groups as well as the wide range of shorter-time-scale projects exploiting the LION environment, the connection to the experimental group/astronomy and opportunities for possible funding. Research groups within the Theoretical physics section show a very healthy interaction and collaboration in topics like quantum information, bio-matter and quantum optics. Networking within

the Netherlands is very strong allowing to collect expertise also beyond the local group (Cosmo network/QDeltaNL, Bio/SM activity for NL community).

The committee welcomes the effort in the Lorentz Institute during the last years to establish a research programme in quantum information. Enabled and motivated by the Quantum Growth Fund, a research group of promising young talents with a focus on applied quantum algorithms (aQa) has been established as an interdisciplinary research effort beyond Leiden physics *per se* including computer science and other Dutch centers. Leiden's identification of applied quantum algorithms and quantum software with a focus on quantum chemistry, high energy physics and quantum many-body physics, and emphasis on artificial intelligence, is seen by the committee as a promising and well-balanced strategic choice.

While Leiden has potential to establish itself as a visible player in quantum information/applied quantum algorithm research, the challenge in the coming years will be to establish a strong and unique research profile, considering the strong competition from national and world-wide academic institutions and industry pursuing similar goals. Such a unique profile could build on, and benefit from the broad spectrum of quantum expertise and theory research topics in the Lorentz Institute, and should be complementary, but coherently connected to the quantum algorithm effort in the faculty in computer science. It would be beneficial to develop quantum software in close connection with developing quantum hardware.

The committee also recommends that the distinct identity of the theory group be maintained so that it can function as a bridge between the other two fields, and foster collaborations across fields. Support for these interdisciplinary activities from LION would be useful.

Quantum Matter and Optics, experimental

The committee is also positive about the research conducted within the Quantum Physics groups (QMO): quantum fundamental (gravity and ultrasensitivity), quantum matter (STM), quantum light (single photon, quantum dot and cavities) and quantum society. The merger between quantum optics and condensed matter was successful, a process that has led to many shared PhD students and several new Tenure Track hires. It observes that the research quality is excellent in the different groups. It sees high level results on single photon sources, but also expects the development of entangled photon sources & applications in the future. There are clearly valuable connections between the groups and the committee encourages the QMO section to tap into the added value of each group, strengthening these connections and investing in the creation of synergy between the groups. The committee also recommends that the researchers of this young group receive the support and guidance they need as they develop their scientific identity, vision and direction, in relation to and connection with other fields.

The groups in this section maintain productive collaborations with relevant research institutes and centers, within the faculty, university as well as nationally. There are strong collaborations with the TU Delft, via the Quantum Delta NL, participation in the Nanofront research programme. Furthermore, LION became a partner in the Gravitation programme 'Quantum Software Consortium' (allocation M€ 19; until 2027). The University of Amsterdam was the main applicant, other partners are Delft University and in Leiden the mathematical and computer science institutes (MI and LIACS). The LION activity here is mainly experimental, within the Quantum Optics group. The committee appreciates the productive collaboration with the Mathematics institute. The groups in this section give evidence of excellent connections with industry on instrumentation and grant income is strong, and notes that investing in spin offs is something that can be further developed in the future. Quantum metrology is an important area that the committee thinks can be further developed, given the interest also within the national context.

The committee appreciates very much the hire of a permanent researcher per 2021 within QMO who focuses on the impact of quantum science and technology in society. It is a combined position with the research group Science, Communication & Society. The group currently consists of a postdoc and two PhD students. This position is an example of the laudable efforts made by the Institute to contribute to society by actively investing in science communication for different target groups. (See also Societal Relevance 2.3.2)

Biological and Soft Matter, experimental

According to the committee, the section Biological and Soft Matter (BSM) has a prominent position in the Dutch research landscape. This field in the Netherlands has a longstanding and strong international reputation. Important to this is a strong national network. Members of LION have been instrumental in ensuring the success of this field on a national level with multiple members of the staff having taken leading roles in developing and continuing this network. As example the committee notes the introduction of the Dutch Soft Matter Days, first introduced by van Hecke (LION) and Schall (Amsterdam), and later by Kraft (LION) and others.

The committee judges the research in the BSM section to be of excellent quality, focused on topics that are at the forefront of the field – from tissue research on cancer metastasis to soft matter robotics. While the BSM group is one of LIONs experimental groups, it has strong connections to theory: the research also strongly aligns with specific theory group members. One of the challenges, however, of working in a research field that is nationally strong is defining a clear local character. To this end, LION has strategically identified the overlapping interest in out-of-equilibrium soft matter and biological processes. To build on this collective strength, the BSM group is currently in the process of building a center for Soft Living and Active Matter (SLAM) in Leiden. The committee thinks that the focus on active matter is strategically very sound and can put them in strong position in the field.

The committee thinks that this center can indeed ensure the visibility of LION's soft matter and biophysics section on the national and international level and considers it to be an excellent platform to encourage collaborations both within LION and towards the outside. SLAM has significant potential to facilitate a vibrant and enriching research environment that all members of the group will benefit from. SLAM already has planned a research day for January 2023, and the committee recommends that similar collaboration events should become a standard practice in the future. This is perhaps even more important as different parts of the BSM group find their labs in different buildings. Therefore, the committee encourages the staff to find avenues for the PhDs and post docs to be aware of what other groups in the BSM group are working on.

The committee applauds the achievements of BSM and encourages the section to continue on the chosen direction. At the same time the committee urges the groups, some of which are still quite young and new, in BSM to invest in identifying common vision, goals and ambitions, and to think about how they can be stronger as a team.

LION's networks and collaborations

When considering the Institute as whole, the committee observes that it is well-embedded in local, national and international networks – from joint positions with other departments and other universities, to roles in many of the NWO (physics) advisory committees, and various European programmes. The institute has made great use of its participation in three Gravitation programmes – a large number given the size of the institute. As several of the current Gravitation programmes are in their last stages, the institute has concrete plans for new Gravitation programmes, which will likely play a key role in the further development of the institute.

During the period under review, LION has invested in continued engagement with interdisciplinary collaborations, both within and outside Leiden University. LION is participant in two NWO-gravitation

programmes in which various different research institutes participate. During the period under review, the institute became a partner of the 'Quantum Software Consortium', in collaboration with various institutes (also from Mathematics and Computer Science) in Leiden, Amsterdam, and Delft. Furthermore, LION also became a member of the consortium 'Quantum Delta NL' that received considerable funding (M€ 615 in total) from the Quantum Growth Fund, itself funded by the Ministry of Economic Affairs. In that framework, Leiden and Delft have also started to prepare a joint Master programme 'Quantum Information, Science & Technology' (QIST). This also led to collaboration with LIACS, leading to the aQa group mentioned above. Within the Science Faculty, collaboration with the Leiden Institute of Chemistry intensified in the area of electrochemistry and electrically recognizing single molecules.

At the national level, a network is formed by the Dutch physics community, where contacts are made and maintained (for instance at the yearly Physics@Veldhoven meeting). This often leads to collaborations in research programmes funded by NWO which typically last four to five years. LION researchers are part of the NWO advisory committees for Particle and Astroparticle Physics, Physics of Fluids and Soft matter, Physics of Life, and Physics of Instrumentation, but absent in the one for Nano, Quantum and Materials Physics. One important network the institute is currently not represented in is the NWO Physics Roundtable. The institute considers this a deficit, and the committee strongly supports its efforts to be represented on this platform in the future.

At the international level, LION researchers partake in various European programmes. The FET-open (future and emerging technologies) projects 'Qluster' (on many-photon quantum entanglement) and ONEM (on developing Optical Near-field Electron Microscopy) should be mentioned as well as the COST (Cooperation in Science and Technology) action 'Nanoscale Coherent Hybrid Devices for Superconducting Quantum Technologies).

LION also engages in important collaborations within the Science Faculty of Leiden University, such as with Astronomy (the 'Leiden Observatory'), with Chemistry, and to some extent with Mathematics (in the Leiden Complex Networks Network LCN2) and the Life Science cluster formed by the Institutes for Chemistry, Drugs research, and Biology.

When it comes to inter- and multidisciplinary collaboration within the institute, as well as between institutes within the Faculty, the committee encourages both institute and Faculty to find ways to remove possible barriers for interaction, and urges the Faculty to formulate a joint ambition and vision to accommodate more connections between groups, sections and institutes. One example, offered by the researchers the committee spoke to, has to do with genome research: all researchers working in this field are at the periphery of their institutes. This makes it hard to create an infrastructure for exchange and collaboration with peers, but also with external stakeholders (funding agencies, companies and spin outs, for instance). The committee is pleased to hear that the forthcoming strategic plan of the Faculty pays attention to the balance between individual research and collaborative activities, and aims to remedy the somewhat siloed nature of the institute, that reaches down through all career levels as well as PhD student culture.

Academic Culture and Scientific Integrity

The committee applauds the manner in which LION stimulates and fosters a research atmosphere in which researchers can excel. The organizational structure and governance style contribute to an open, supportive and flexible working environment. It observes that the excellent research of the different groups at LION is the starting point for an ideal environment where researchers from all levels are able to excel and have potential for growth.

The environment at LION is characterized by a highly flat research landscape where all staff members are treated on essentially the same footing. Each staff member – from tenure tracker to full professor – is in charge of their own research group, with the expectation that everyone acts as an independent principal investigator. The work environment described by all staff is highly collegial, with a management that is highly supportive and flexible. Management was considered to be highly supportive of different home situations, willing to adapt teaching schedules to e.g. child-care needs when possible. Overall, the work environment for staff was presented as quite excellent. As the institute is currently in the process of finding a new director, it is hoped that the flexibility and encouraging atmosphere of the current management and director can be maintained.

The policies and scientific practice within LION comply with the Netherlands Code of Conduct for research integrity. The University has established an Academic Integrity Committee that investigates complaints about academic integrity. If it is unclear whether a complaint should be submitted, or if (other) concerns need to be discussed in confidence, there are confidential counsellors available. One of the staff members at LION is such a counselor. Furthermore, a LION staff member is part of the ethics review committee of the Faculty of Science (established in 2020). For PhD students, there is a compulsory course on Scientific Conduct, offered by the Science faculty. Research integrity is also an integral part of the performance evaluation interview for all staff members, as well as an important topic in the training courses for Master students and PhD candidates. The committee was happy with the formal policies and encourages the institute to ensure that scientific integrity is frequently discussed within different settings and all levels of the organization.

Based on its interviews with researchers in different stages of their careers the committee could establish that the management endeavors to support the (research) staff at LION in such a way that they find time and energy for all the facets of their work (see also Human Resource section for more on talent policy and diversity). Research staff can further develop different skills (for teaching as well as research) through courses and training. Other forms of support consist of technical and administrative support for all research staff, PhD students, and postdocs. Furthermore, LION offers 1.5 FTE ‘pre-’ and ‘post’-award project management, in order to assist researchers in taking care of the many details around grant applications, budgets, and spending rules. Professional support is offered for writing large personal grants, and for practicing interviews with panels from grant agencies.

The committee was very pleased to hear how the Institute ensures a good work-life balance for its staff members, which is already addressed during hiring interviews. Working hours are flexible, and the institute is very attentive to the needs of its staff. To ensure that everyone is aware of the possibilities and feels free to make requests, the committee suggests for LION to communicate its approach more formally to its employees.

Output quality

Objective evidence for the quality of research at LION is the increase in output of publications and papers, the number of impactful peer-reviewed publications, the number of research products resulting from interdisciplinary collaborations, the acquisition of grants, and honorable memberships and distinctions for its staff members.

On average, LION produces about 150 peer-reviewed publications and 20 theses per year. The output was lower in 2021 and 2022, due to the restrictions of COVID-19. LION’s publications and citations were analyzed by The Center for Science and Technology Studies in Leiden (CWTS), which were presented in a separate report to the committee. The results show that the “mean normalize citation score” (MNCS) over the period 2016-2021 is 1.20 (1.36 measured over the period 2018-2020), which implies that LION publications are cited 20% more often than world-average. The CWTS assigns the quality label ‘high’ to such scores. The PpT10 (publications that belong to the top 10% of their field)

value is 14%, which also represents high impact. LION also publishes in a journal package that is well cited, as measured by a 'mean normalized journal score' (MNJS), which is 1.2 over the full period.

The committee recognizes that, although numbers and citations may give an approximate indication of research quality, they do not give insight into the content of the publications and why these are thought to be of importance by LION. For the committee it was important to gain insight into what publications the Institute itself thinks of as of high quality and impactful, and why these publications are a good reflection of what the institute's ambitions. To this end the committee paid careful attention to the case studies presented in the Self Evaluation Report and also queried management and research on what their unique angle and ambitions are. Based on the documentation and discussions with representatives of the institute, the committee concludes that LION has performed excellently during the period under review, with highly relevant publications that reflect the focal points of LION and align with its goals and ambitions.

The number of prizes and significant memberships of prestigious committees, and high-profile conference contributions are also indicators of research quality and academic reputation. Researchers from LION are recognized by peers through various prestigious academic positions and activities, such as the Edison Volta Prize of EPS 2016; the Physica Prize of the Royal Netherlands Physical Society (NNV) in 2016 and 2020; the Spinoza Premie NWO 2017; the Dutch Athena Award for outstanding female researchers in 2019, an APS outstanding referee award in 2018; the Bryan Coles prize for early career experimentalists 2017, an Honorary doctorate at the Bogolyubov Institute of the National Academy of Sciences of Ukraine in 2018, and the Young Scientist Prize of the Atomic, Molecular, and Optical Physics Division (AMOPD) of EPS (given every 3 years) in 2022. Three researchers became fellow of the APS and eight PI's were invited to give key-note lectures at high-profile conferences in the period under review.

According to the committee, this overview shows that LION researchers are highly respected by their peers and that the sections and groups have a substantial representation in each of these venues. LION shows itself to be a strong research institute, internationally recognized, and working at the frontiers of science.

Funding and grants

The number of grants acquired also shows to what extent the research quality of the institute is recognized nationally and internationally. LION is funded through three major funding streams. The first stream (GS1), is direct funding through the university. The second funding stream (GS2) comes from Dutch research grants 'acquired in competition', the third stream (GS3) concerns European funding, contract research plus a non-structural component such as funding from Gravitation programmes, called GS3+. The total is more or less constant at M€ 17. Half of that amount comes from the university funding (GS1), half comes from the other sources. Of the total, 75% is personnel costs, and 25% materials costs. In the Leiden system, the institute does not pay for amenities such as floor space or electricity.

LION aims to achieve a balanced mix of individual and collaborative research projects on national and European level. In the period under review, research was supported by significant funding from two large Gravitation programmes, both of which will end in 2023. LION is now part of a third Gravitation programme 'Quantum Software Consortium', in collaboration with various institutes (also from Mathematics and Computer Science) in Leiden, Amsterdam, and Delft. LION also has several connections (in the form of joint appointments) with the National Institute for Subatomic Physics Nikhef, linking LION to the (astro)-particle community.

In Talent programmes (VIDI's; ERC Starting/Consolidator/Advanced), 11 LION researchers received a total of 14 grants, including the Spinoza prize for one professor. In individual NWO grants, in larger (NWO) programmes, and in EU programmes (Horizon 2020), 19 researchers received funding at the level of one or more PhD positions and/or materials budget. One researcher received the 'NWO-Groot' grant of about M€ 2.5 for building a Multimodal UHV scanning probe microscope at ultra-low temperatures. The grant is equipment-only, and aligns with LION's tradition of instrumentation building.

The committee is positive about the funding and grants acquired by LION, which are very prestigious and ensure continuity in funding for highly relevant research. Also, the individual grants procured by the researchers testify to their scientific reputation and the quality of their research. Furthermore, the committee is pleased to hear that LION self-funds a small number of PhD students, on the basis of grant applications that received good reports but were not (yet) funded.

Leiden University is contemplating a shift of financial means away from research-intensive (STEM) programmes by changing the allocation parameters. As these plans are not clear yet, the committee cannot make any detailed recommendations. The committee thinks LION should discuss such development in depth with the dean and carefully consider how to mitigate adverse effects and maintain the balance between research, teaching, and (research) support.

2.3.2 Societal relevance

The committee is very positive about the way LION achieves societal impact. Given its underlying focus on fundamental and curiosity-driven research, its contributions to society are inherently (for the most part) long-term, via the well-established process of fundamental research acting as the foundation of more applied studies in the future. As such, LION's main contribution to society is the training of highly skilled young scientists whose expertise is of fundamental importance to: a) the high-tech industry in the Netherlands, b) the quest for solutions to many of societies largest challenges (e.g. climate change, clean water, pollution), and c) Dutch and international academia.

LION has made a number of strategic decisions that ensure that it has an impact on society. Of special note in the direction of community engagement is the hiring of a new Communications Specialist who helps facilitate good communication with the community at large as well as the engagement of two high school teachers who work part-time at LION. They act as a bridge between the department and high schools and help coordinate meetings between staff at LION and physics teachers from across the country.

The committee is impressed by LION's long-standing engagements with local high schools, particularly with schools generally not well connected to university education. For years, LION has, together with the student organization RINO, organized trips to high schools where students show physics demos. Strategically, LION is not only focused on VWO education with these trips, but wishes to engage pupils from all levels of high school. Through these activities, LION is able to interact with students whose interactions and awareness of universities is otherwise limited.

LION has invested in research into the societal impact of science and science communication. In 2019, LION hired a postdoctoral researcher, together with the research group Science, Communication & Society. Her research focuses on the impact of quantum science and technology on society. Her position became permanent, at the Assistant Professor level, in 2021. Currently, she has started a research group with a postdoc and two PhD students. Additionally, from January 2022, LION appointed an extraordinary professor in physics communication, for 0.2 FTE. The committee considers these appointments to be excellent and unique examples of how a science institute can organize science communication.

During the period under review, LION has received a steady amount of funding through industrial partners, with a revenue of M€ 0,5 a year. In the period under review (2016-2021), 13 invention disclosures were submitted internally, some of which jointly with other organizations. Those led to 6 patent applications within this review period, most in the area of instrumentation development. The committee thinks that the research areas of biophysics and optics, and also instrumentation, have great potential for societal impact. The committee also appreciates the interactions with spinoffs and companies related to metrology and quantum materials. The committee supports the institute in its intention to appoint a business development manager to streamline the contacts with industry and other stakeholders.

Open Science

The committee compliments the institute for the steps it has taken with regard to open-access publishing. LION complies with the policies of Leiden University and the Leiden Science Faculty when it comes to implementing Open Science principles and Research Data Management Regulations. The institute is well on its way to having its entire publication record publicly accessible. Less than 2% of the articles since 2019 have been published closed, with the majority appearing as green open access. In terms of open data, LION is expected to follow the policies at the Science Faculty and Leiden University, and many staff are already using established data repositories. Facilities to store research data long-term in Leiden University are currently being developed. Additionally, the institute has been given funding to hire a Data Steward (0.5FTE) whose job is to support data management tasks within the institute and to help the institute to determine what data storage means for them.

The institute is in the process of standardizing its data management policies. At present, most grant proposals require a Data Management Plan (DMP), but the requirements have seen an evolution in the last few years. As a result, researchers are at different levels with respect to FAIR principles. The committee is pleased to see that the institute is actively investing in the standardization of data management practices. The committee recommends that these should not only pertain to data, but also include code and software.

2.3.3 Viability

The committee considers the viability of the institute to be very good, both with regard to funding as to succession planning. Its strategy for the future and appointments of new staff are solid guaranties for its viability. The research programmes are very well established and are expected to continue to bring important new results in the future, extending the range of topics due to the new hires. While LION has shown excellent results, after a large rejuvenation of the staff, the institute may experience a delay in being successful for the most competitive grants. The committee recommends that for such a transition period, the institute maintains good interactions with faculty to ensure continuity of policy, as well as support for interdisciplinary research and the strengthening of collaborations within the institute.

Human Resource Policy

LION demonstrates a vigorous effort to identify, attract and develop, and retain scientific personnel on all career stages, from PhD to postdoc, and tenure-track to tenured faculty, while maintaining a strong educational programme. This is guided by the principle to foster and stimulate scientific quality, plurality and collaboration, while establishing diversity, inclusion and gender balance.

Talent selection and development

For LION, research quality is achieved by appointing and retaining excellent researchers, and by offering its staff members good support structures for grant application and career development. Talent selection at the institute is very competitive and offers generous start-up packages for those

that are hired, which are key to enabling their success. The committee explored how LION recruits young talent and manages career tracks of its early career and senior researchers.

New researchers at LION are mostly recruited as junior researchers and start in a tenure track assistant professor position. According to the policy of the Science Faculty, this generally means a six-year appointment, with a tenure decision to be made after five years. When it comes to talent development, LION works according to the policy formulated by the joint Dutch Physics Institutes. Junior researchers are monitored and receive feedback each year, and receive mentoring from the senior staff. The tenure decision is the prerogative of the dean of the Science Faculty, based on the recommendation of the Scientific Director, who is advised about this step by the CT. In applying performance indicators, LION is increasingly aware of the Recognition and Reward discussion and handles the indicators more qualitatively than quantitatively. Excellence in teaching and teaching development, special skills in guiding BSc and MSc students, or contributions to society are also valued. However, excellence in research is still a cornerstone for LION.

Over the last six years, LION has seen the promotion of 7 staff members from assistant professor (UD) to associate professor (UHD). Talent management continues after tenure. Since 2018, associate professors can obtain the *ius promovendi* when they have supervised at least three PhD candidates to a successful PhD defence, which is usually soon after the promotion. The position of associate professor is not a final position. In accordance with the policy of the Science Faculty progress to full professor, assuming continued growth and independence, may be expected after five years. Three promotions to full professor have occurred in the report period.

The committee recommends that the institute considers allowing for more clarity and transparency when it comes to advancement to full professorship. This way, the associate professors are aware of the steps in the advancement process and what the criteria are for this decision. Associate professors meet once a year with the scientific director to discuss their progress. In contrast to tenure trackers, their progress is less strongly monitored, and the progression to full professor seems somewhat less clear.

The committee appreciates LION's focus on talent, and the guidance and support that it offers to both its senior and early-career professors. The Institute is clearly committed to giving all its researchers the support, mentoring, and funding they need to take the necessary and important steps in their careers. The committee was very positive about the mentor-system set up for tenure track staff members, who receive guidance from more senior and experienced researchers. It is highly appreciated among tenure track staff, and the committee recommends to also put such a structure into place for new hires that enter at associate professor level.

Overall, with a new generation of staff picking up the baton, and certainly after the COVID-19 pandemic the committee thinks that it is essential that the junior staff members at the same career level interact in a more structural manner within the sections. The committee has seen evidence of excellent collaborations within the institute, but to have a leading role, the committee recommends that junior researchers interact to define their uniqueness and carve out their own niche in their specific field of expertise. The committee is happy to note that initiatives have indeed been taken to strengthen synergy across sections and groups, such as a staff retreat in the beginning of September aimed at strengthening the cohesion of LION's research community.

Support for postdocs

PIs from all sections of LION are able to attract high quality postdoctoral researchers. Postdocs are hired by individual research groups and identify themselves as members of these groups with excellent working conditions, group identity, and diverse scientific environment. Postdocs, in particular theory postdocs, enjoy complete freedom in choice of their scientific research topics and collaborations. The

committee was pleased to hear that most postdocs feel quite at home at LION; several postdocs the committee spoke to, described a highly independent situation, where they are encouraged to be the last (lead) author on publications, to start-up new collaborations (even without their PI), and to co-supervise PhD students. Given the fact that most postdocs work quite independently under supervision of their PI, the committee thinks that they could benefit from more interaction with peers and support from more senior researchers. The committee recommends that postdocs are offered a more structurally supportive framework in which they can develop their talents, share experiences and prepare for future steps in their careers.

Diversity

The committee appreciates the progress the institute has made during the period under review to improve diversity and inclusion within its staff composition. The committee observes that LION shows awareness of the need for more diversity and gender equality and that it takes active measures for a more inclusive HRM policy. As a result, the staff makeup of the institute is now much more balanced. On the other hand, gender diversity appears less of a priority when looking at the gender balance of invited speakers. The committee recommends that the institute expand on its strategic aim for diversity (for example, by considering more aspects than gender when hiring) and to formulate concrete milestones and timelines to achieve its ambitions in this area.

Facilities

The committee enjoyed visiting the new building where LION will be housed, as well as the labs and technical facilities, which it considered to be very impressive. The fact that the BSM groups will be located with other disciplines from Chemistry/Life Sciences is a great advantage. The massive infrastructure investment in building specifications for ultra-stable vibration isolated cryogenic scanning imaging instruments is to be highly commended. The benefits of the micro-mechanical and electronics workshops provide a level of integration across the experimental groups. Regarding the anticipated move to the new building, the committee would like to emphasize the importance of a joint location for all sections. If sections want to interact on a world-class level and enable synergy, this requires a shared location.

PhD Policy and training

Per year, LION enrolls around 15 to 20 PhD students. PhD candidates at LION partake in the Graduate School of Science of the Faculty of Science of Leiden University. Within the School, they develop academic and transferable skills. In addition, LION is a member of two Research Schools: the Casimir Research School, jointly with the Applied Physics Department at the TU Delft; and the national research school for theoretical physics LOTN. Within these Research Schools, PhD candidates can follow advanced courses focused on their specialization, join events and seminars, and meet fellow PhD candidates from other Dutch universities within their field. The Casimir School also offers a platform for PhD students, which allows students to share their experiences, find common denominators, and facilitates a dialogue with supervisors and institutes management.

Leiden University has general guidelines and procedures for all PhD trajectories. At the start, the PhD student and the supervisor draw up an Education and Supervision Plan. This includes research and education targets, supervision and training. Each PhD student should at least spend 140 hours on academic activities (specialized courses, workshops, conferences) and 140 hours of transferable skills. One of those courses is compulsory, namely Scientific Conduct. A set of courses is offered by the HRM Department of Leiden University, and PhD students can also follow courses elsewhere. Each PhD student has regular supervision meetings with her or his supervisor(s) to discuss research, training and progress. Each year the supervisor officially evaluates the PhD student in a Result and Development assessment. The Scientific Director sees assessments, and the progress of PhD students is also part of the Performance and Development interview between the PhD supervisors and the Scientific Director.

In addition to the specifications of the Graduate School, LION has created its own PhD system which includes i) a committee (platform) consisting of 3 LION staff and 3 PhD students who meet several times per year to discuss any issues that play a role in the situation of the PhD students, and ii) a mentoring system whereby each new PhD is assigned a senior PhD who helps them get to know the institute and can help them get a feeling for what is expected both on the side of the student and supervisor.

The committee observes that PhDs are well taken care of in LION. PhD candidates that the committee spoke to, are aware of where they can go for support and questions, and they feel heard by their supervisors and mentors. PhD candidates receive good support from their supervisors and promoters. PhD students are satisfied with the work-life balance and feel well-prepared for their future careers, whether this be in or outside academia. The committee is very pleased with the establishment of the mentoring system and the PhD platform, which will help to strengthen the cohesion among PhD, especially after the negative impact of COVID-19 on their interactions. The committee encourages the institute to continue its efforts to ensure that PhDs are not too isolated and have opportunities for exchange and collaborations with other PhDs.

The committee noted that in the years from 2014 and onwards, on the order of 30% of students had not finished their PhD after 6 years of work. This is a relatively high drop-out rate. Though partly due to the lock down periods (when labs were shut down) during the COVID-19 pandemic, these delays also predate the pandemic period. The committee appreciates the proactive response of by LION to address this issue and is confident that the various measures implemented (mentoring, PhD-platform, cohort intake meetings) will help the staff at LION identify causes for delays and reduce the fraction of students not submitting their PhD Thesis.

Appendices

2. Programme Site Visit of LION

Tuesday 29 November				
1	16.30 – 17.30	Welcome	Dean, Management Team and Coordination Team	Faculty Club Leiden
2	18.00 – 21.00	Dinner (Committee only)		Restaurant de Klok - Leiden

Wednesday 30 November				
3	09.00 – 09.30	Presentation by Scientific Director LION	Dean, Management Team and Coordination Team	Casimir room Oort 276
4	09.30 – 10.20	Interview with Management Team, Coordination Team	Dean, Management Team and Coordination Team	Casimir room Oort 276
5	10.20 – 10.40	Break		Casimir room Oort 276
6	10.40 – 11.30	Interview with representation from Biological Soft Matter	Martin van Hecke, Martina Huber, Daniela Kraft, Alexandre Morin, John van Noort and Thomas Schmidt	Casimir room Oort 276
7	11.30 – 12.20	Interview with representation from Quantum Matter and Optics	Milan Allan, Julia Cramer, Martin van Exter, Wolfgang Löffler, Sense Jan van der Molen, Tjerk Oosterkamp and Jan van Ruitenbeek	Casimir room Oort 276
8	12.30 – 13.30	Lunch (Committee only)		Gorter room Oort 173
9	13.30 – 14.20	Interview with representation from Theoretical Physics	Ana Achúcarro, Carlo Beenakker, Alexey Boiarskyi, Luca Giomi, Silke Henkes, Koenraad Schalm, Alessandra Silvestri and Jordi Tura Brugués	Casimir room Oort 276
10	14.20 – 15.10	Discussion Diversity and Inclusion	Jan Aarts, Ana Achúcarro, Sense Jan van der Molen, Subodh Patil, Monique de Ridder, Thomas Schmidt and Alessandra Silvestri	Casimir room Oort 276
11	15.10 – 15.30	Break		Casimir room Oort 276
12	15.30 – 17.00	Tour facilities	Alexandre Morin (coord)	
13	17.45 – 21.00	Dinner	Committee, MT & CT	Restaurant Allemansgeest - Voorschoten

Thursday 1 December				
14	09.00 – 09.45	Discussion PD representatives	Marine Le Blay, Jacky Ge Kevin Grosvenor, Stefan Plugge and Amin Moradi	Casimir room Oort 276
15	09.45 – 10.30	Interview with Tenure Track hires	Semonti Bhattacharyya, Jordi Tura Brugués, Julia Cramer, Alexandre Morin Subodh Patil, Kaveh Lahabi, Matthieu Schaller	Casimir room Oort 276
16	10.30 – 10.45	Break		Casimir room Oort 276
17	10.45 – 11.30	Interview with PhD representatives	Zhenia Cheipesh, Jeremy Ernst, Kirsten Kannevorf, Anna Negro, Solenn Riedel, and Willem Tromp	Casimir room Oort 276
18	11.30 – 12.15	Discussion Medior Staff	Milan Allan, Vadim Cheianov, Luca Giomi, Daniela Kraft, Dorothea Samtleben, and Alessandra Silvestri	Casimir room Oort 276
19	12.15 – 13.45	Lunch and discussion	Committee, Management Team	Gorter room Oort 173
20	13.45 – 15.30	Work on preliminary report		Casimir room Oort 276
21	15.30 – 15.45	Presentation preliminary findings	Committee, Dean, Management Team, Coordination Team, Scientific Council, Institute Council, all that have been involved (PhD's & Postdocs)	Casimir room Oort 276
22	15.45 – 17.00	Informal drinks	LION staff	Gorter room Oort 173

1. Quantitative Data

Table 1 Research Staff

Table 1: LION-at-a-glance (this is mandatory Table E2)

LION	2016		2017		2018		2019		2020		2021	
	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE
Full professor	16	15	18	16	19	17	18	17	19	16	18	14
Associate (UHD)	9	8	9	8	9	7	11	9	12	10	11	10
Assistant (UD) - TT	6	5	4	4	4	4	4	3	6	2	6	6
Assistant (UD)	3	3	3	3	3	3	2	2	1	1	2	1
Total research staff	34	31	34	31	35	31	35	31	38	29	37	31
Postdocs	49	30	46	31	38	27	46	30	35	25	44	23
PhD LION	102	88	96	72	89	67	90	66	88	69	97	79
PhD Ext.	11	9	18	13	16	15	13	12	10	9	6	4
Total Research	196	158	194	147	178	141	184	139	171	132	184	137
Technicians	45	39	47	39	46	37	38	34	41	34	40	32
Support staff	21	13	20	13	19	13	17	12	18	13	18	12
Total Support staff	66	52	67	52	65	50	55	46	59	47	58	44
Total Staff	262	210	261	199	243	191	239	185	230	179	242	181

Note: all numbers rounded to integers. The category PhD Ext. concerns students with personal external funding such as from the China Scholarship Council.

Table 2 PhD success rates LION

Enrollment				Success rates											
Starting year	Enrollment			Graduated ≤ year 4		Graduated ≤ year 5		Graduated ≤ year 6		Graduated > year 6		Not yet finished		Discontinued	
	M	F	Total	#	%	#	%	#	%	#	%	#	%	#	%
2013	33	2	35	5	14%	28	80%	34	97%	34	97%	1	3%	0	0%
2014	16	4	20	3	15%	14	70%	14	70%	17	85%	2	10%	1	5%
2015	15	7	22	5	23%	14	64%	17	77%	19	86%	2	9%	1	5%
2016	13	2	15	3	20%	6	40%	11	73%	11	73%	2	13%	2	13%
2017	14	7	21	2	10%	10	48%	13	62%			5	24%	3	14%
Total	91	22	113												

* For 2017, the entry Graduation ≤ year 6 contains 3 theses defended up to September 2022.

Table 3 Funding

Table E3: Funding

LION	2016	2017	2018	2019	2020	2021
<i>Funding</i>	<i>FTE / %</i>	<i>FTE / %</i>	<i>FTE / %</i>	<i>FTE / %</i>	<i>FTE / %</i>	<i>FTE / %</i>
Direct Funding Scient. Staff	37 (18%)	34 (18%)	30 (17%)	34 (19%)	36 (21%)	41 (23%)
Direct Funding Support Staff	43 (21%)	47 (25%)	48 (27%)	43 (25%)	41 (24%)	37 (21%)
Research Grants (national)	67 (33%)	60 (32%)	52 (29%)	52 (30%)	53 (31%)	55 (31%)
Research Grants (European)	7 (3%)	7 (4%)	11 (6%)	14 (8%)	13 (8%)	20 (11%)
Contract research	7 (3%)	4 (2%)	4 (2%)	2 (1%)	3 (2%)	4 (2%)
Other	40 (20%)	35 (19%)	32 (18%)	30 (17%)	26 (15%)	23 (13%)
Total Funding	201	187	177	175	172	180

Categories

Direct Funding Scientific Staff:	GS1, Sectorplans, Research Focus Areas (Leiden University)
Direct Funding Support Staff:	GS1, Sectorplans, Research Focus Areas (Leiden University)
Research Grants National:	NWO (Dutch Research Foundation), STW (Dutch Foundation for Technical Sciences)
Research Grants European:	ERC grants, FET Open grants, Marie Curie grants
Contract Research:	Foundation 'Econophysics', Fraunhofer Institute Würzburg, SHELL, Quantum Growth Fund, Templeton Foundation, Nanonext Consortium, Nimic, Axa, FNSF Sinergia, TU Dresden, Surfsara, Intel, Toyota
Other:	Gravitation Programs (Nanofront; Matter at all Scales, Quantum Software Consortium)

In particular the Research Grants EU shows an increasing trend.