Evaluation 2011-2016

SRON

Netherlands Institute for Space Research

Utrecht, 13 October 2017

NWO Netherlands Organisation for Scientific Research
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Content

1 Introduction

1.1 Scope and context of this review

This evaluation concerns the activities carried out at the Netherlands Institute for Space Research (SRON) since 2011. The evaluation was commissioned and organised by the Netherlands Organisation for Scientific Research (NWO) and supported by Dialogic Innovation & Interaction and Birch Consultants. The external evaluation follows the Standard Evaluation Protocol 2015-2021 (SEP, amended version September 2016). It is the protocol for research assessment in the Netherlands as agreed upon by NWO, the Royal Netherlands Academy of Arts and Sciences (KNAW) and the Association of Universities in the Netherlands (VSNU). The primary aim of the assessment procedure is to reveal and confirm the research quality, relevance to society and viability and to provide recommendations to improve these aspects. In addition, the procedure includes considerations with regard to PhD programmes, the research integrity, and the diversity of the (scientific) staff.

An international Evaluation Committee was established to evaluate the institute and its research programmes, in accordance with the SEP. Prior to the external evaluation, SRON submitted a self-assessment document covering the period 2011-2016 and a strategy document for the period 2017-2023. These documents were approved by the NWO Executive Board on 5 July 2017. The self-assessment report and addendum included a SWOT analysis and a full set of statistics at institute and programme level concerning input (finances, funding and staff) and output (such as refereed articles, books, PhD theses, conference papers, publications aimed at the general public) for the six years prior to the evaluation. A number of tables were included about research staff, main categories of research output, funding, and PhD candidates (see SEP appendix D, D3). The self-assessment report, therefore, offered a concise picture of the institute and research groups' work, ambitions, output and resources in accordance with the guidelines provided by the SEP. A site visit formed an important part of the evaluation and included interviews with the management of the institute, the programme coordinators, other levels of staff, and a tour of the laboratories and facilities.

1.2 The Evaluation Committee

The Evaluation Committee was installed on 10 October 2017 by Prof. dr. C.C.A.M. Gielen, president of the Executive Board of NWO. Its members were:

- Prof. dr. Chryssa Kouveliotou (chair), Professor of Astrophysics, Director, Astronomy, Physics and Statistics Institute of Sciences (APSIS), Physics Department, George Washington University;
- Prof. dr. Matt Griffin, Head of the School of Physics and Astronomy, Cardiff University;
- Dr. John Worden, manager of the Earth science section at Nasa's Jet Propulsion Laboratory;
- Prof. dr. Gillian Wright, Director UK Astronomy Technology Centre, Royal Observatory, Edinburgh.

A short curriculum vitae of each of the members is included in Annex 1. The Committee was supported by NWO (Drs. Helga Varwijk) and Dialogic Innovation & Interaction (Dr. Pim den Hertog).

Before the site visit all members of the Committee signed the NWO Code of Conduct, by means of which they declared that their assessment would be free of bias and without regard to personal interest, and that they had no personal, professional or managerial involvement with the institute or its research programmes. It was concluded that the Committee had no conflicts of interest.

The Evaluation Committee is indebted to the SRON Director and Personnel for their welcoming, open and constructive interactions and dialogue, both during their formal presentations and in smaller groups. We would not have been able to obtain such an extensive overview and insight of SRON without the quality of the provided information prior to and during the review. The Committee, and the Chair in particular, are grateful to Drs. Helga Varwijk and Dr. Pim den Hertog for their unwavering and excellent support during the site visit and for this report.

1.3 Data supplied to the Committee

Four weeks prior to the site visit the Evaluation Committee received the self-assessment report of SRON together with the site visit programme and an accompanying letter. The documentation supplied to the Committee included all the information required by the SEP as well as by the additional questions raised by NWO.

Prior to the site visit the Committee was informed about the Dutch science policy and the organisation of scientific research in the Netherlands, about (the transition of) NWO and the governance structure of the NWO research institutes.

1.4 Procedures followed by the Committee

The Committee proceeded in accordance with the Standard Evaluation Protocol 2015-2021. The assessment was based on the SRON self-assessment report and the other documentation provided by NWO, the institute, and the interviews.

The interviews took place during the site visit on 10 - 13 October 2017. The programme of the visit is included in Annex 2.

The Committee met in the afternoon and evening preceding the site visit to discuss and plan the interviews with the directorate, board representatives and staff.

The Committee agreed on procedural matters and aspects of the assessment as described in the following paragraphs.

At a formal meeting in Utrecht, the Committee met with the president of the Executive Board of NWO, Prof. dr. C.C.A.M. Gielen who also formally installed the Committee.

The interviews with the SRON directorate and management, board representatives, senior research staff, PhD students, postdocs, SRON's stakeholders and Scientific Advisory Committee took place during the site visit on 10 - 13 October 2017. All interviews were conducted by the entire Committee.

After completing the interviews, the Committee discussed the comments on the institute and its research programmes and determined the final assessment.

At the end of the site visit, a meeting was held with the SRON director, a representative of the Executive Board of NWO, a representative of the board of SRON and the Evaluation Committee to report on the Committee's main findings.

On 8 December 2017, a draft version of this report was sent to the SRON director for factual correction and comments. The report was subsequently submitted on 22 December 2017 to the Executive Board of NWO.

1.5 Aspects and assessment scale

The Standard Evaluation Protocol 2015-2021 required the Evaluation Committee to assess three main aspects of the institute and its research. These are (as described in the SEP):

1. *Research quality.* The Committee assesses the quality of the institute's research and the contribution that research makes to the body of scientific knowledge. The Committee also assesses the scale of the institute's research results (scientific publications, instruments and infrastructure developed by the institute, and other contributions to science).
2. *Relevance to society.* The Committee assesses the quality, scale and relevance of contributions targeting specific economic, social or cultural target groups, of advisory reports for policy, of contributions to public debates, and so on. The point is to assess contributions in areas that the institute has itself designated as target areas.
3. *Viability.* The Committee assesses the strategy that the institute 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. It also considers the governance and leadership skills of the institute's management.

These three main evaluation criteria were rated according to a four-category scale, as specified in the SEP. The verdict was given in qualitative form, though a quantitative figure must be added. The scale is as follows: 1. World leading/excellent; 2. Very good; 3. Good; 4. Unsatisfactory (see Annex 4).

The Evaluation Committee considered three additional topics. These were:

1. *PhD programmes.* The Evaluation Committee considered the supervision and instruction of PhD candidates.
2. *Research integrity.* The Evaluation Committee considered the institute's policy on research integrity and the way in which violations of such integrity are prevented.
3. *Diversity*. The Evaluation Committee considered the diversity of the institute. It is precisely the presence of mutual differences that can act as a powerful incentive for creativity and talent development in a diverse institute.

These topics were considered in qualitative terms (instead of using the four-category scale).

In addition to the topics above NWO formulated three questions for all NWO institutes and three specific questions for SRON:

1. What is the institute's added value in the national context and its international position?
2. How does the institute stimulate and facilitate knowledge utilization and open access?
3. How does the institute's structure, size and financial policy contribute to its mission?

For SRON:

1. The financial conditions; has SRON set adequate priorities to pursue its tasks and responsibilities as “home-base-institute” for The Netherlands participation in the scientific programme of ESA?
2. What is the Committee's opinion concerning the positioning of SRON within the domain of earth observation (i.e., our part in the data-chain)?
3. What is the Committee's opinion concerning the activities regarding knowledge utilization in general and in particular within the “Deal van het Noorden”, i.e. the collaboration between the University of Groningen, SRON, and local companies, supported by the Province of Groningen?

2 Institutional framework of SRON

SRON, an institute of NWO, is the national expertise institute for scientific space research and home base for the Netherlands' membership of the science programme of the European Space Agency (ESA). The institute develops pioneering technology and advanced space instruments, and uses them to pursue fundamental astrophysical research, Earth science and exoplanetary research.

2.1 Mission

The mission of SRON is to bring about breakthroughs in international space research. Therefore the institute develops pioneering technology and advanced space instruments, and uses them to pursue fundamental astrophysical research, Earth science and exoplanetary research. As national expertise institute SRON gives counsel to the Dutch government and coordinates - from a science standpoint - national contributions to international space missions. SRON stimulates the implementation of space science in our society.

SRON defines its core values as pioneering, quality driven, world-leading and relevant to society.

The institute wants to continue to belong to the international forefront in search for answers to fundamental (space) questions. SRON is the main institute for Dutch contributions to the scientific payload of missions in the mandatory ESA Science Programme, and to ESA's Earth Observation Programme.

2.2 Research

The scientific focus of SRON has two main components: (1) origin of the Universe and origin of stars, planets, and life; and (2) the Earth's atmosphere, focussing on understanding climate and air quality. These topics require access to space platforms. In order to reach its scientific goals, SRON develops science cases, key enabling technologies, space qualified instrumentation, and data-analysis tools by bringing together scientists, instrument scientists, and engineers.

In 2014 SRON restructured its organisation and decision-making processes in order to be better equipped to maintain its ambitious programme (see Figure 1). The institute recalibrated SRON's scientific focus, building on its track record (astrophysics and Earth atmosphere research), in close alignment with Dutch science priorities. This resulted in the formation of four programme lines with science groups attached:

- ***Astrophysics*** – dedicated to unravelling the history of the universe, from the first stars and black holes to large-scale structure.
- ***Exoplanets*** – dedicated to the study of atmospheres of planets beyond our solar system.
- ***Earth*** – aimed at the climate and air quality of planet Earth through measurements of the carbon trace gases and aerosols.
- ***Technology*** – the backbone for the development of enabling technology.

SRON has also established two expertise groups, both of which provide resources for all SRON instrument projects:

- ***Instrument science*** – covers SRON's skills and know-how with regard to instrument physics, system engineering and project management.
- ***Engineering*** – covers SRON's skills and know-how with regard to product and quality assurance, configuration control, design engineering and parts procurement.

2.3 Organisational structure

Space research laboratories were founded at several locations in the Netherlands in the early sixties of the last century. SRON was founded in 1983 as "Stichting RuimteOnderzoek Nederland" (Space Research Organisation Netherlands). Its name changed in 2005 to SRON Netherlands Institute for Space Research. It has been assigned the status of Public Benefit Organisation (in Dutch: ANBI).

The institute has two locations, in Utrecht and Groningen. About three quarters of the employees are located in Utrecht.

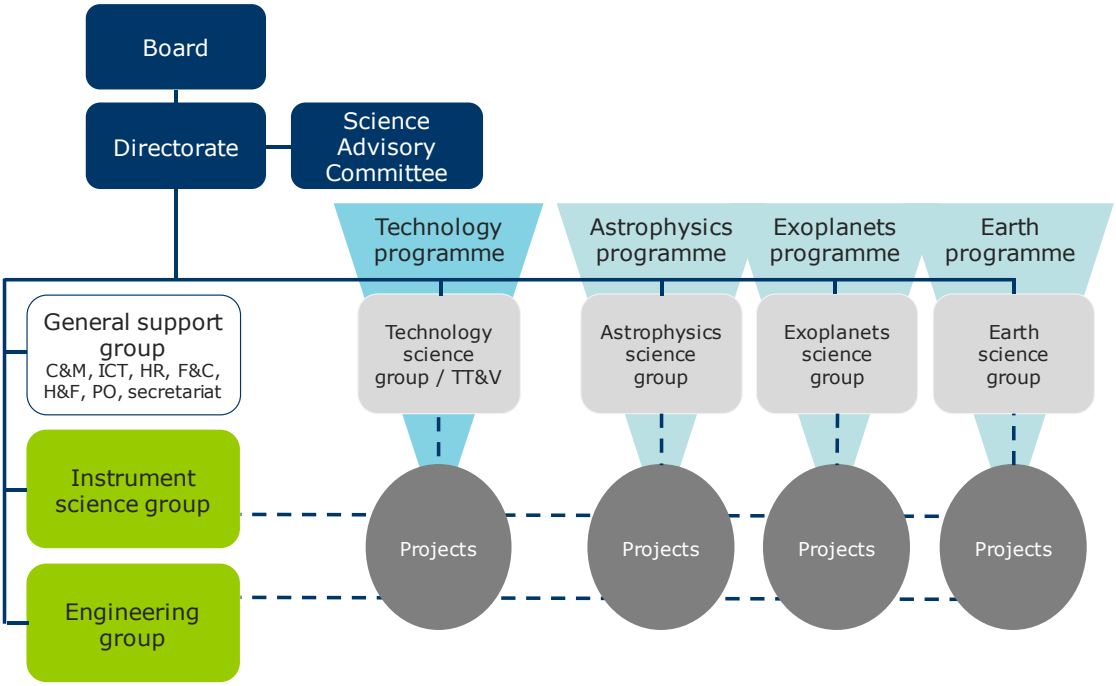

Figure 1. Organogram

2.4 Financial matters

On average, SRON receives about ~M€20 funding per year. About three quarters of that is primary funding (about 98% of which is from NWO). The other ~M€5 is secondary funding (mainly project funding from competitive calls). In 2016, for example, SRON received M€15.0 primary funding, mainly from NWO, and M€5.1 secondary funding, mainly project funding from competitive calls. Personnel costs have been quite stable over the review period and amounted to M€13.8 in 2016 (i.e., 72% of primary and secondary funding). In the same year expenditures not directly related to a programme line (i.e., expenditures on central support, infrastructure and other costs) amounted to M€5.4. Annex 3 provides more details on funding and expenditure at institutional and programme level for the period 2011-2016.

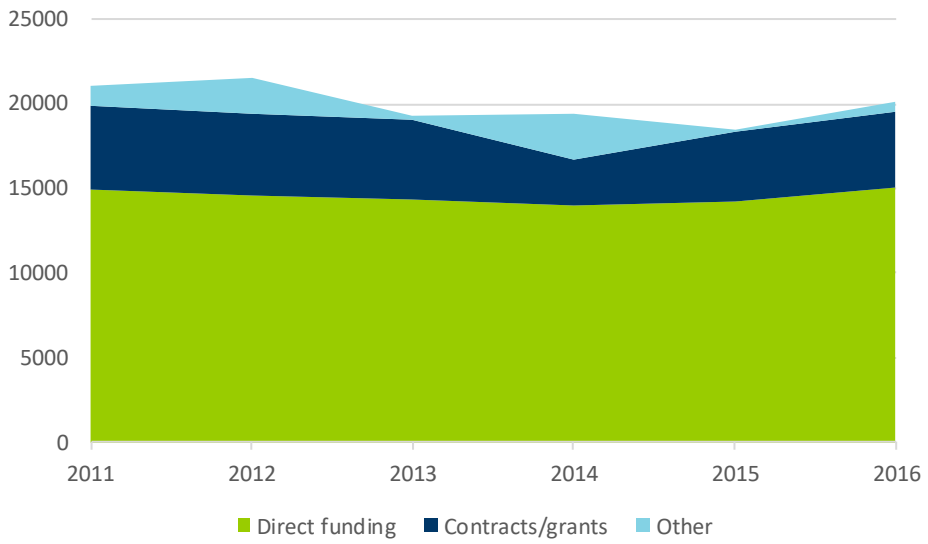

Figure 2. Funding of the running budget (k€)

About 60% of the total budget of SRON (direct funding plus external funding) goes to the astrophysics programme. The Earth observation programme and technology programme receive on average 30% and 10% respectively. Since 2015, about 2% of the budget has been allocated to the exoplanets programme.

2.5 Staff

The number of staff slightly diminished over the review period, from 193.6 FTE in 2011 to 179 FTE by the end of 2016 (204 persons in total).[1] About 58% constitutes research personnel (see Figure 3). In 2016 about 130 FTE out of the 179 were financed through primary funding (i.e., 73%). SRON welcomes about 60 guests (e.g., visiting fellows, interns, and former SRON scientists who continue to be active in the institute) every year for periods ranging from several weeks to years. Including 37 guests, in 2016, by the end of the year, a total of 241 persons worked at SRON. As to the staff[2] diversity, SRON houses 24 nationalities and 16% of its personnel are female. In addition, SRON indicated to the Evaluation Committee during the site-visit that it has a fairly flat age-distribution between 23-65. On average the age of the employees is 41.5 years.

[1] In addition to Figure 3 below more detailed information is included in table 8 in the self-evaluation 2011-2016 by SRON. Some extra detail was provided during the site visit at the request of the Evaluation Committee. In October 2017, the number of persons working at SRON (including guests) amounted to 244 spread as follows over the various groups: astrophysics science group (43); exoplanets science group (1); earth science group (21); technology science group (9); instrument science group (56); engineering group (64); general support group (41); directorate (2) and other (7).

[2] See section 3.8 of the self-evaluation as well.

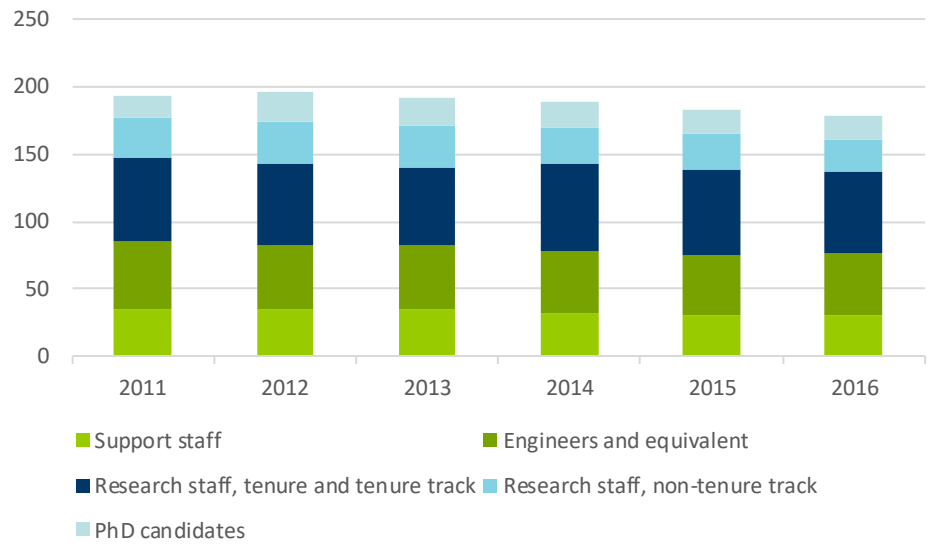

Figure 3. Personnel composition (FTE)

3 Assessment of the institute SRON

3.1 Strategy and targets SRON

SRON combines scientific research, technology, and instrumentation development to operate successfully in a worldwide setting. This expertise triangle is rare for European space institutes and is the key ingredient for SRON's success. It provides in-house capability to determine and pursue fundamental areas of space research with frontier key technologies in space-qualified instruments. Moreover, as the Dutch national space expertise institute, SRON is embedded in space research priority-setting processes in the national, European, and global arenas. Its authority is widely recognized in networks operating at the top level and with international agencies, such as ESA, NASA, and JAXA.

The Evaluation Committee finds that SRON's outstanding combination of science with technology is recognised worldwide and secures a forefront position for the Netherlands beyond that which is typical for space science in a country of that size. The Evaluation Committee also finds that SRON continues to make good strategic decisions for long-term investments in performance-critical technologies to secure leadership/prominent roles in mission implementation and in science exploitation for both themselves and the Dutch community. The missions that they engage in are all well matched to the scientific priorities of the broader Dutch community. Their technology development for MKIDS, TES, and immersed gratings, ranks among the best in the world and is essential to the science that has been, and will be, delivered by missions in which SRON participates.

Overall, the Evaluation Committee ranks SRON as World leading/excellent. In more detail, the Committee considered the major landmarks achieved and whether and how the 2010 report recommendations were addressed during the last five years, and the impact of these actions on research quality, relevance to society, and viability.

With respect to funding, cuts were implemented in recent years in SRON's base funding leading to reduction in staffing levels, contrary to the 2010 Evaluation Committee suggestions to sustain and increase the budget. This new financial environment motivated the Director to reorganise SRON, adapting the institute's management structure to focus on its strengths. The current groups are Astrophysics, Earth Sciences, Exoplanets, Technology science, Instrument science, and Engineering. Further, there are plans for involvement in ESA's future Gravitational Wave mission, LISA. *The EC finds that the reorganisation is a very significant improvement and addresses important emerging scientific areas.*

The Committee expresses some concerns, particularly relating to the critical mass and sustainability of the new Exoplanets group, the ability of the Astrophysics group to deliver both on Athena and SPICA, unless these are conveniently staggered in the next 5-10 years, and the uncertainty of how and when SRON may engage in LISA.

The Committee considered the SRON personnel development programmes, including those for postdocs and PhD students, as well as the institute's overall diversity in multiple directions. Personnel are evaluated regularly and postdocs and students are given ample opportunities for development, including travel to meetings, workshops, and overall exposure to the scientific community. Regarding staff diversity, the Committee notes that there is a substantial international environment in SRON. Regarding gender diversity, postdocs and students have a ~30% female participation, but in the higher ranks the levels of female representation are very low, and this needs to be addressed.

The long-term viability of SRON is strongly dependent on its ability to complement its base NWO funding, bringing in roughly 25% of the total budget via external grants for technology development and for participation in ESA missions preferably at PI or Co-PI level. These extra income resources are aligned with the scientific goals of the institute, currently set by the Director and the Board. However, from January 2018, SRON will no longer be an independent entity, as it will become part of the NWO institute structure. *It is important that SRON management be able to continue to set their own policy and scientific directions within this new structure.*

To allow for more opportunities in developing technology, SRON engages effectively in the relatively new "Topsectoren" policy initiated by the Dutch Ministry of Economic Affairs and partly executed by NWO, which has provided additional funding to develop R&D projects with industry and SMEs. SRON works with several stakeholders developing forefront technology with great valorisation potential. The development of these technologies places SRON in a favourable position among European and even worldwide laboratories. Further, this technology expertise is strongly supported within SRON, ensuring a continuation in a coherent and balanced program between scientific goals and instrument development.

An important factor in SRON's success and its ability to flourish in the future is the embedding of the institute within a very fertile and creative academic environment, especially in Groningen. The planned move of the Utrecht part of SRON (after the unfortunate dissolution of the Utrecht University Astronomy group) to a new location offers the prospect of improving the current situation. It is, therefore, imperative that the selection of the new partners and the move itself take place in the most expeditious, well-planned, and carefully executed manner, to allow the SRON science, technology development, and instrumentation programmes to remain unperturbed and competitive.

3.2 Research quality

SRON delivers world-class research through its staff scientists, and even more so through the science enabled by the instruments and software developed in-house. Its research quality reputation attracts an excellent international staff, with scientists and engineers working at the forefront of their fields. Recognition of the scientific standing of SRON staff can also be seen in the number of international/Space Agency advisory boards with senior SRON staff as members. Bibliometric study of publications by SRON staff, including benchmarking with nine space research institutes/groups (performed by the Centre for the Science and Technology Studies) confirms that their quality (e.g., fraction of papers in the top 10% worldwide ranking) compares well with institutes in other countries with a similar emphasis on technology and science. The individual merit of SRON staff and the scientific research environment at SRON are also reflected in their success with highly competitive ERC research grants totalling €7.9M in the last five years. SRON has several researchers holding one starter grant, two consolidator grants and one prestigious advanced grant, a number that is comparable to a top university with a similar number of research scientists.

As befits a national centre for the space sciences, SRON covers a broad scientific base and is a focal point providing the infrastructure for top quality research and training for astrophysics and Earth sciences in Dutch universities. The instruments developed by SRON – operational in the 2011-16 period – are used worldwide resulting so far in more than 1200 papers in refereed journals (more than 500 in the 2011-16 period) with > 35,000 citations.[3] We particularly call out as a significant value-added contribution to research quality the in-house developed scientific software and modelling, which were also made available for

[3] Detailed info can be found in Table 3 of the self-evaluation report.

general use with user support (e.g., codes for radiative transfer, analysis and interpretation of high-resolution X-ray spectra, atmospheric chemistry and transport, among others). This software supported the scientific community in producing similar numbers of papers as the instrumentation, with some 20,000 citations. This demonstrates that instruments and software developed at SRON clearly enable a forefront international scientific standing for Dutch research.

The SRON scientific programme is divided into three themes: astrophysics from stars to large-scale structure, the earth's atmosphere, and exoplanets. The Herschel HiFi instrument, led by SRON, was a stunning scientific success, resulting in a very large number of high profile papers, including in Science and Nature, press releases about discoveries, and many student theses. It opened a new era in far-infrared high-resolution spectroscopy for the worldwide astronomy community. Without cutting edge SRON developed technologies in the HiFi instrument, together with its leadership of the international instrument consortium, none of this internationally renowned research would have been possible.

SRON now has a large and leading role in the ESA Athena mission – an X-ray observatory to study the hot and energetic universe – building the X-IFU instrument. The SRON leadership is both scientific and technical in this mission and it perfectly illustrates the importance of SRON research to international space science. Their cryogenic sensors are a key technology that enabled the selection by ESA of this mission. SRON also leads a very large international consortium proposing the SPICA mission to JAXA/ESA and, if it is selected for flight, SRON will be the PI for the SAFARI instrument. To have two such high profile PI roles in an institute the size of SRON will bring challenges, while amply demonstrating the excellence of SRON scientists and the engineering/technology base.

In Earth Sciences, the Committee was happy to see during its visit the live launch broadcast of the ESA Tropomi mission, in which SRON is playing a major role. SRON has developed the immersed grating and read-out electronics for the SWIR module (with expert contributions to its calibration) and a state-of-the art methane and carbon monoxide trace gas retrieval algorithm, with the accuracy needed to meet the Tropomi project goals. The SPEX instrument is an important technology demonstrator for future space missions, as well as scientifically important as an airborne instrument. SRON research in aerosols addresses key uncertainties in climate studies and has leading international impact.

Exoplanets, is a relatively new and small scientific research area for SRON and the Committee expressed concerns about the viability and long term scientific competitiveness of such a small effort in this rapidly expanding area of science. However, the general strategy to develop this programme in very close interaction with larger more established Dutch university research groups is a good one and the focus on retrieval algorithms capitalises on SRON's expertise in Earth Sciences. Moreover, SRON technology has led to collaborative/subsystem roles in the PLATO and ARIEL exoplanet missions. It is clear that for the foreseeable future this exciting new area will be important for many new missions and so SRON developing strong collaborative endeavours is a good long-term strategy. Nonetheless, the Committee finds that, given that there is only one staff member in this area, particular care will need to be taken to ensure this area is grown and sustained with university support.

In summary, the Evaluation Committee finds that the SRON performs top quality scientific research and technology development in Astrophysics and Earth sciences across Dutch universities and institutes and indeed globally.

Overall score research quality	**1**

3.3 Relevance to society

SRON is engaged in a number of activities that support Dutch industry, education and society. They serve as a focal point for high quality Astrophysics and Earth Sciences research as-well-as training for Dutch universities by teaching courses and hiring student interns. SRON performs world-class research, a fruitful training ground for graduate students and postdoctoral scholars. Utilizing the relatively new "Topsectoren" policy, SRON has developed technologies with external industries and SME's that have yielded high returns for the Netherlands. Their scientific directions with respect to climate and air-quality are important activities that will help evaluate the role of climate variability and human activities on human and ecosystem health. The level of activity related to the "relevance to society" criteria is impressive for an institution of SRON's size. These activities have led to the strong endorsement from all of the external stakeholders interviewed by the Committee and, moreover, underscore the value of the organisation in the eyes of the wider community and of its partners and collaborators. The Committee considered the following activities in detail.

Interactions with stakeholders and external industries: The activity related to knowledge utilisation via technology transfer and "co-working" with industry is impressive. SRON managers pro-actively seek such opportunities, networking with industry and stimulating discussion within the institute to explore options. There is a dedicated industry liaison officer helping to identify collaborative opportunities and early stage technologies with potential for co-development. More than 20 (public-private) contracts with external partners (plus several patents) existed in the last year alone. Examples of these activities include: 1) THz imaging for non-destructive examination of composites and for seed inspections; 2) SRON helps Dutch companies to win ESA contracts, enhancing the value to the Netherlands of the European Space Research and Technology Centre (ESTEC) being based in Noordwijk; 3) SRON shares their understanding of the space and advanced instrumentation fields with companies through the maintenance of long-term technology development plans in their areas of expertise; 4) SRON collaborates with Airbus for commercial air quality measurements, especially with development and testing of its SPEX aerosol sensor.

Training of PhD and MSc students and postdoctoral scholars: SRON has an active scientific staff with many sharing duties with Dutch universities. These activities have led to several opportunities to support the educational development of masters and doctoral students (there are on average 19-20 PhD students supervised per year by SRON staff over the last several years). SRON's state-of-the-art science activities provide for excellent opportunities for students and postdocs and their scientific development, leading to well qualified graduating scientists from the SRON graduate and postdoctoral programmes. Training of students and postdocs is critical towards advancing the science and technology needs of not only the Netherlands but of science and technology as a global endeavour; it is also enabling collaborations with external agencies (e.g. NASA, JAXA, and ESA) and universities as graduating students and postdocs typically work with these institutions after their work with SRON is finished.

Science and its importance to society: Scientific research does not just advance technological capabilities but is important for finding our place in the universe, how the universe and life have evolved, and what the future holds for our species and our planet. SRON scientific activities span these basic questions. For example, SRON's astrophysics activities look at the history of the universe, from the first stars to its large-scale structure, to the characteristics of black holes and how they affect galaxy development. SRON is involved in a number of astrophysics missions intended to explain these phenomena such as Herschel Far-Infrared astronomy mission, the HITOMI and Athena X-ray astronomy missions, and the proposed SPICA mission. Within the Earth sciences, SRON's involvement with the SCIAMACHY, GOSAT,

and the recently launched Tropomi satellites have led to ground-breaking research in understanding the processes and sources controlling the distribution of atmospheric methane, an extremely strong greenhouse gas that will affect the future state of the Earth system unless we can devise strategies to mitigate emissions of this gas. SRON's development of state-of-the-art aerosol measurements is now being jointly tested with NASA and could provide key insights into how aerosols affect cloud formation and light scattering, both of which are important for understanding future global temperatures and precipitation. Finally, SRON's nascent exoplanet programme could help determine if life is capable of forming in other stellar systems, something of enormous cultural importance.

Outreach activities: SRON participates in a number of outreach activities including 1) joint exhibitions with ESA and NASA; 2) open days with the public where visitors can learn about the latest developments in the Earth and Astrophysics sciences as well as children lectures and a "fun lab"; 3) a citizen science activity in which the public uses their mobile phones to measure the level of aerosols in the atmosphere.

The Evaluation Committee finds that there are no obvious recommendations that can substantively improve over their current efforts without detracting from SRON's core mission.

Overall score relevance to society	**1**

3.4 Viability

SRON has a high reputation for successful contributions to space projects and is recognised nationally and internationally as the Dutch centre of expertise for space science. The institute is known for its competence and reliability as a partner, for its strong scientific expertise, for its excellent staff, and for its impressive record in technology development. Although, like other European space institutes, it is facing significant funding and programmatic challenges, these factors provide SRON with a strong foundation for continuing viability.

SRON's international repute, and the strong endorsement of all of the external stakeholders interviewed by the Committee, underscore the value of the organisation in the eyes of the wider community and of its partners and collaborators. There is every reason to expect that it will continue to secure and play significant and influential roles in major space missions, to exploit them scientifically in-house, and to facilitate their scientific productivity by enabling science to be done by the Dutch and worldwide communities.

The organisational changes implemented in 2014 have resulted in a more modern and effective management structure, well-optimised and flexible for the efficient use of staff and resources, albeit with scope for better utilisation of the knowledge and wisdom of the senior staff in well-informed and timely decision-making, and for improved communication to all staff.

SRON's technical expertise and capability, and its beneficial links with in-house scientists, are what makes it truly unique. While future funding constraints and major project responsibilities may limit the ability to recruit on the scientific side, developing further its scientific relationships with Dutch universities offers an approach to maintaining and strengthening this scientific and technical synergy, and will be particularly important in building strength in the areas of Gravitational Waves and exoplanet science. One possibility, which the Committee agrees could be beneficial, is to create joint appointments with universities. The most important potential benefit of the planned move of the Utrecht division is the prospect of further strengthening academic links.

The Utrecht move will constitute a major endeavour for SRON in the coming years, and it presents opportunities and risks, which will need careful and thorough assessment in the evaluation process. The Committee identifies two major risks in particular. Firstly, loss of key personnel could affect current projects and future capabilities, and disrupt support activities if significant numbers of administrative and support staff do not move. Secondly, delays could occur to time-critical activities due to movement of laboratories and, especially, clean rooms, and the need to re-establish facilities and processes; at least six month loss has been mentioned in connection with re-establishing cleanroom operation, and the impact on the Athena X-IFU project is a particular concern. The Committee recommends that a comprehensive and detailed risk assessment and risk mitigation plan be drawn up and maintained at all stages, from assessment to implementation. Schedules are difficult to rely on, both for space projects and for new building moves, so there will be a need to be flexible and adaptable; a phased approach to the move could mitigate some risks.

SRON is well-supported by a high level (approximately 75%) of core funding, constituting a very substantial and stable financial foundation, which is conducive to retaining its complement of expert staff in the face of fluctuations and programmatic uncertainties in the ESA space programme. However, the core budget has been declining in real terms in recent years, presenting some problems in sustaining capability and securing leadership roles in projects. Difficult decisions are inevitable when funding is constrained, and the Committee notes that SRON could have achieved a higher level of involvement in Athena X-IFU had more funding been available. The organisation will need to compensate for the static or declining core budget by securing additional external funding.

Supplementary national funding, especially for participation in major projects such as Athena X-IFU and SPICA-SAFARI, is available via competitive application to NWO. However, there is a disconnect between the schedules for ESA mission selection and the NWO competitive funding cycle, namely the lack of phasing between the ESA announcements of opportunity for missions addressing specific research areas and the inclusion of those areas in the Dutch National Roadmap for Large Research Infrastructure (DNRLRI), so that successful SRON proposals can be funded in a timely manner. This results in a hysteresis in available funding, which presents serious challenges. The solution to this problem would have to be reached through negotiations between the SRON Director and DNRLRI and/or NWO on new measures with respect to new initiatives submitted to the DNRLRI, such as requests for expedited decisions or even efforts to phase the two agencies. If this issue is not addressed, it will introduce complications and difficulties, and this could be damaging to SRON's ability to secure leading mission roles in the future, since clear financial commitments by member states are required by ESA at mission selection. It could even become a factor in whether missions reliant on SRON participation are selected by ESA, and this could damage the reputation of the Netherlands as a reliable partner in space science. The Committee recommends that NWO investigate methods of dealing with this issue, allowing SRON to engage in the national competitive funding process in a framework better aligned to ESA schedules.

As rightly noted in its self-evaluation report, SRON's staff constitute its most valuable asset. So, it will be important for SRON to nurture and develop its staff and to ensure continuing staff satisfaction and loyalty. The Committee recommends that close attention be paid to the results of the recent staff survey, and an action plan developed to address some areas in which significant staff concerns have been identified. In particular, the Committee notes that there is a potential negative impact, both to the staff development and to the institute goal fulfilment, arising from the term limit of temporary employment contracts. This is most profound in the R&D area, where a temporary instrument scientist or engineer is (by law) let go after two or three years, or else hired as permanent staff, assuming there are open positions. If the former, there is a risk that expertise matured in the course of these years will be lost

and the team would have to train from scratch the replacement, investing additional time and energy. In R&D development, it usually takes much more than two years to reach the building stage of a mature instrument. Although a clear solution is not obvious, the Committee would like to point out the risks of losing trained personnel as well as the frustration this creates on both sides. In addition, to foster the retention of expert staff and skills, SRON could consider offering permanent contracts to some fixed-term staff if appropriate, even though they may need to be funded on external grants or contracts (this is a common practice in other institutes and universities, and one which can be of low risk bearing in mind reasonable expectations of future externally-funded work).

In the area of Astrophysics, following from the success of Herschel-HIFI, SRON has now secured a major (Co-PI) role in Athena X-IFU. In addition, it leads the international SPICA-SAFARI team. Should SPICA be selected for study by ESA (with a decision expected in early 2018), and subsequently for flight (decision expected in 2021), this will cement SRON's continuing worldwide leadership in far-infrared astronomy. Significant additional funding will be required from NWO to allow SRON to fulfil the PI role for SAFARI. Coping with the demands of both SPICA and Athena simultaneously will present challenges to SRON, which it is ready for and capable of meeting, although it will require very careful planning, continually responsive management by the senior team, and possibly tough decisions concerning participation in other projects. In the longer term, involvement in LISA, ESA's third large mission, is an ambition for SRON. Further definition of SRON's potential role in coordination with the European LISA team will be needed to achieve this; and with no in-house scientific expertise in this area, close collaboration with the relevant Dutch university groups will be essential (ideas for collaborations to enhance SRON's role in Gravitational Wave astrophysics include collaboration with the LISA Consortium and Nikhef in the Einstein Telescope, and developing a small project with Nikhef on the LISA phase meters). While Athena and LISA may be regarded as certainties, ESA has yet to make firm decisions on other astrophysics missions, so that SRON must remain flexible and keep options open.

The recently-established SRON exoplanets programme is small, without critical mass, and working in a highly competitive area. Re-evaluation will be needed as soon as the final ESA's decision on ARIEL is known. ARIEL was recommended by the ESA Evaluation Committees for selection as M4. However, at the Science Programme Committee (SPC) meeting in November it was decided to postpone the decision until the next meeting in February 2018. In any event, the exoplanets programme will need close coupling to university academics to have sufficient strength. The field of exoplanet research is certain to feature strongly in future space science, and it presents great opportunities to SRON; but a clear strategy based on the institute's strengths will need to be maintained.

The Earth Observation programme is significant and substantial, with a viable strategy for the future, and SRON has much to contribute to the field, especially with development of new ways to quantify greenhouse gases such as, methane and carbon dioxide, as well as aerosols, that allow for attribution of the processes controlling these quantities and how they affect the global radiation budget. With smaller and more frequent mission opportunities envisaged, it also presents a more reliable and flexible future programme than ESA's astrophysics programme, which has fewer and more expensive missions. For example, SRON should consider emphasising development of instruments that fit within a constellation. These constellation-based missions, which are being considered for the next generation of ESA and NASA missions, use a collection of low-cost small satellites to increase sampling or accuracy of required geophysical parameters or measure multiple tracers to evaluate unresolved processes and interactions within and between components of the Earth System. For example, use of the SPEX aerosol instrument will likely result in greatly improved accuracy of the CO2 total column measurements, needed to advance the current state of carbon cycle

science, because aerosols are one of the primary confounding factors. Co-measurement of SPEX aerosols with CO2 and surface composition measurements would support attribution of the aerosols to specific sources such as fires or desert sand. The SRON Earth observation programme should also emphasise development of observationally constrained models (with the Copernicus programme, with national and international universities and institutions, and through internal funding) to enable the scientific use of SRON developed data and to identify new observables needed to characterise the state and evolution of the Earth System.

The Instrument Science, Engineering, and Technology groups provide a high level of expertise and effective management, supporting and enabling SRON's current activities and laying the foundation for future projects with world-class project support and technology development, especially in superconducting detector technology. There is an effective approach to valorisation and engagement with industry, which is becoming increasingly important and may need to be further developed in the future.

In summary, SRON is a well-run organisation with continuing high relevance and importance to contemporary and future space science. It has many strengths and a well-thought-out strategy for the future. Bearing in mind some of the challenges noted above, in particular the Utrecht move and the difficulties in matching its funding cycle to major commitments, we assign a score of 2 to viability, which reflects the care and attention that will need to be given by SRON and NWO to addressing such issues.

Overall score viability	**2**

3.5 Considerations regarding organisation, management policies and staffing

3.5.1 PhD programmes

During the review period 26 SRON PhD students graduated. 17 of these were in the area of astrophysics, with Herschel-HIFI science featuring prominently, six were in the area of Earth observation, and three were based on technology development.

The Committee was informed that the number of internally funded PhD places has been cut from 7 to 2 in recent years, as a cost-saving measure. More importantly, this change is on a structural basis, namely the two students will have to finish before new ones can be hired. While the reasons for this are well understood in the context of tough decisions being necessary to cope with financial constraints, the loss of PhD places at SRON is something that will have a negative effect if it persists. If it remains impossible for SRON to support enough studentships directly, we recommend that efforts be made to get more students via collaborations with universities, and maybe even in association with industrial partnerships. With the successful launch of Tropomi, there is new scope for PhD students to be involved in in-house Earth observation science.

The Committee notes that in addition to the graduating students listed in the report, the Utrecht KID detector development group also very fruitfully supported a number of university-based PhDs during the review period. Given the strength in technology development at SRON, with only three SRON PhD students graduating in that area in the review period, the Committee sees this as a missed opportunity, and encourages SRON to develop more possibilities to obtain and train additional PhD students working on its technical programmes.

In a private interview session with the PhD students, the Committee was very impressed by the quality, the maturity, and the enthusiasm of the students, and with their very positive accounts of the academic and practical support they were getting in their research from their supervisors and from SRON in general. It was clear that they see SRON as a great place to do a PhD and are appreciative of the environment in which they are working. The formal evaluation processes that SRON and the partner universities operate appear to be well-thought out and conscientiously followed on both sides, and students experience a healthy pressure, accompanied by good support, to complete their PhD in a timely way.

SRON's PhD programme constitutes a valuable contribution to society via the training of young people, and makes an important contribution to the vibrant and dynamic research environment in a way that benefits the institution overall. The Committee hopes that the current numbers can be sustained or enhanced in the coming years.

3.5.2 Research integrity policy

Thus far there seem to have been no credible issues with integrity in the SRON scientific research and technology development areas. During our discussions and interviews, it appeared that such issues had been identified in the Netherlands, albeit specifically in the areas of medicine and psychology. The response of the Director to a question on how would such issues be controlled or addressed by SRON was that he has on multiple occasions discussed the institute's integrity policy with the staff, and he will continue to do so. Another safeguard is the fact that the publication system is self-correcting, with the referees' reports and the automated plagiarism searches by the publishers. In addition, the SRON community actively participates in meetings and conferences reporting their results to the broader audience, thereby subjecting themselves to their scrutiny. The Director was, therefore, confident that there were no valid fraudulent reports or plagiarism cases thus far within the SRON community.

3.5.3 Diversity

Gender and racial diversity has improved at SRON in the last five years, possibly as a result of hiring practices. Most improvements are in the temporary staff, PhD students and post-docs, and interns, where female participation is ~30%. However, there are only a handful of women in the scientific and technical groups and the diversity in the SRON workforce (especially women) needs to greatly increase before SRON is likely to be viewed as an institution that welcomes a diverse workforce. We also recognise that limited hiring of core staff due to tightly constrained finances makes for a challenging environment to improve diversity within SRON.

A more proactive approach is needed to improve diversity in SRON, given the cultural environment they operate within. Increased gender diversity needs to be given a higher priority. While we recognize that management is working hard at the recruitment level, this needs to be supported by broader organisational training and other measures that are typical of other institutions of SRON's size, such as annual training in ethics, harassment, and implicit/explicit bias. Staff should be knowledgeable of the NWO policy and representatives, and an independent point of contact should be clearly identified in SRON for harassment reports.

3.6 Supplementary questions by the NWO Executive Board

3.6.1 Generic questions

1. What is the institute's added value in the national context and its international position?

SRON's sterling reputation has enabled partnering with international space agencies (e.g., NASA, JAXA, China, as well as European national agencies) to conceptualise and implement new astrophysics and Earth science missions, which are critical towards advancing these scientific fields. In the national context, SRON serves as a focal point for high quality astrophysics and Earth sciences research and training for Dutch universities. A great place for a PhD, SRON provides an excellent educational and training environment for young researchers. In addition, the institute's proactive approach to valorisation and engagement with industry and SMEs has yielded high returns for the country.

2. How does the institute stimulate and facilitate knowledge utilization and open access?

SRON builds instrumentation for astrophysics and Earth sciences which produce data of value to scientists world-wide and to the general public. These data are made openly available to all via existing mechanisms in the relevant scientific domains. For example, all data from ESA missions are made public, after a short commissioning period, via the relevant ESA archives. SRON is a main processing centre for SWIR data from atmospheric Earth observation missions, where the data are made open via the ESA/Copernicus portal – for example, for the recently launched Sentinel-5P mission with the Tropomi instrument, the data are made open after 6 months via the ESA Sentinel-5P scheme/portal. For collaborations such as balloon-borne FIR experiments, the Infrared Processing and Analysis Centre (IPAC) makes raw and processed data available. The Committee did not find any areas of concern with regard to open access to data taken by instrumentation developed by SRON. It is a clearly recognised requirement within the institute and effective use is made of appropriate international centres to achieve this.

As in all scientific institutes, SRON scientists and engineers publish their work in peer-reviewed journals and through magazine articles, press releases, web pages etc. These scientific publications are made open access either through the use of open access journals, or (more often) on arXiv (astro-ph and physics). If the final proof copy of paper is posted to arXiv, then this meets the minimum EU requirements for open access publishing without cost to the institute. Staff from postdocs through to managers recognise the need for and value of open access to scientific results in this way. SRON also encourages its engineering staff to publish their work, and has an exemplary process whereby scientists in the instrument science group have helped engineers with the rigour of peer-reviewed publication. Some engineering journals, and "trade magazines" are not open access and yet are the appropriate publications for SRON work to reach and be recognised by others in the field. Some concerns were identified around the potential cost implications of using "gold standard" (paid for) open access to engineering publications. More systematic use of arXiv to openly share engineering publications should be considered, given that there are now subcategories for papers in instrumentation and detectors available there. Nonetheless a clearly allocated budget line for open access publishing will help the organisation to embed this with engineering and scientific staff alike.

The activity related to knowledge utilisation via technology transfer and "co-working" with industry is impressive. SRON managers are pro-actively seeking such opportunities, networking with industry and stimulating discussion within the institute to explore options. There is a dedicated industry liaison officer helping to identify collaborative opportunities and early stage technologies with potential for co-development. We saw some good examples in the laboratory, such as using SRON's expertise and technologies for THz imaging for non-destructive examination of composites and for seed inspections, and there are several other important examples of joint working with companies to maximise the use of the technical knowledge of SRON staff. SRON also plays an active role, through the industrial liaison officer, in helping Dutch companies to win ESA contracts, and this enhances the value to the

Netherlands of ESTEC being based in Noordwijk. SRON shares its understanding of the space and advanced instrumentation fields with companies through the maintenance of long term technology development plans in their areas of expertise.

We did not find any areas for improvement here with SRON following best practices already and an exemplary level of success.

3. How do the institute's structure, size and financial policy contribute to its mission?

We find that SRON's size, structure, and financial approach are well matched to its mission and allow the flexibility to provide the strength and depth of technical and managerial expertise needed to lead major space projects in astrophysics, alongside the technology development and studies for future missions. The balance between scientific staff, instrument scientists, engineers and managers is particularly effective and a key factor in their excellent reputation for delivery of state of the art instrumentation. Implementing both astrophysics and Earth science missions in the same institute, with the engineering and management skills shared between these two scientific areas, ensures cross disciplinary exchange to the benefit of both. We have commented in more detail on the organisational structure in sections 3.1 and 3.4 and note that the financial policies are a good response to the available resources in section 3.4.

3.6.2 Institute specific questions

1. The financial conditions; has SRON set adequate priorities to pursue its tasks and responsibilities as "homebase-institute" for The Netherlands participation in the scientific programme of ESA?

Yes. SRON is looked to by the Dutch and the international scientific communities, and by ESA and other space agencies, to represent and implement Dutch involvement in space science and in particular the ESA programme. Its strategy and planning are explicitly and very closely coupled to ESA's planning and potential future missions. As noted above, uncertainties as to which missions will be selected, and the increasing cost and decreasing frequency of astrophysics missions, both pose major programmatic challenges to SRON and similar institutes. The Committee concurs with SRON's careful approach of keeping options open with respect to potential missions that are in line with its scientific strategy. Although this can be a difficult juggling act and involves some stretching of resources, it is overall a wise approach under the circumstances.

2. What is the Committee's opinion concerning the positioning of SRON within the domain of Earth observation (i.e. our part in the data-chain)?

SRON scientists and engineers operate at all levels of Earth sciences instrument development and implementation, composition retrievals and validation while supporting data processing and storage.

Instrument development includes the immersed grating and polarimeter (using spectral modulation) both of which advance Earth sciences by enabling small-sat constellations to perform multi-tracer observations of the Earth system. For example, the immersed grating is a critical piece of the (now successfully launched) Tropomi, a satellite instrument that will greatly advance our ability to characterise carbon and air quality interactions and corresponding emissions or fluxes. SRON instrument and science capabilities will allow them to participate in what is believed to be the next implementation of Earth science missions that are focused on multi-tracer measurements for evaluating processes controlling the Earth System.

SRON scientists are also leaders in the field in advancing composition retrieval algorithms needed to relate the observed radiances to geophysical parameters with the accuracy and precision required to advance the science. Finally, SRON scientists are engaged with the international Earth science community to use these data to advance our understanding of the Earth system.

Many of the SRON Earth sciences staff are funded through competitively selected grants. As a result of this funding profile and Dutch law, most of the staff are temporary or can only work as long as a project is funded; consequently, many staff are concerned about future funding levels, likely encouraging applications to other institutions and thus depleting SRON intellectual capability.

3. What is the Committee's opinion concerning the activities regarding knowledge utilization in general and in particular within the "Deal van het Noorden", i.e. the collaboration between the University of Groningen, SRON, and local companies, supported by the Province of Groningen?

SRON in Groningen is strongly and successfully embedded in the university environment. The Kapteyn institute at the University of Groningen includes a mix of university and SRON employees strategically interspersed in all floors. Such an arrangement has been proven successful in fostering collaborations, open discussions, and research and technology ideas. At the same time, SRON supports joint positions of its personnel with the university.

The local industry collaborations aim to balance the national aspect with all departments. However, a slight concern was voiced to the Committee that the line of communication between SRON and the local SMEs may need some improvement, to increase the opportunities for SMEs to take advantage and participate in space work with SRON. Engineering degree MSc students need to participate more into regional development and perhaps more PR is needed to the outside world from SRON.

From the industry side, Airbus is interested in collaborating with SRON on commercial air quality measurements (SPEX development) as well as in obtaining PhD and MSc student training for their employees. Already valorisation of SRON technology was improved on the combined SRON-Airbus SPEX development. The Airbus representative suggested that SRON needs to enhance its level of activity with industry to cover potential future strategic area gaps, since there are currently a lot of missions to complete. In particular, he was interested in how industry and SRON could best collaborate, with companies offering their industrial capabilities and SRON focusing on key technological capabilities.

All external stakeholders consulted by the Committee (NASA/GSFC, JAXA, CNRS, NOVA, Technical University of Delft, University of Groningen, TNO, Airbus Defence & Space NL, and VU Free University Amsterdam) were very pleased with the results of the collaboration with SRON.

4 Conclusions and recommendations

4.1 Conclusions

SRON has a sterling reputation worldwide for its competence and reliability as a partner, for its strong scientific expertise, for its excellent staff, and for its impressive record in technology development. The institute is renowned for delivering state-of–the-art quality products in a timely manner to a variety of national and international stakeholders – space agencies, industry, and universities. SRON's outstanding performance in combining science with engineering and technology development to advance space research has earned its strong international recognition as the Dutch centre of expertise, and a reputation for excellence in space science above and beyond what is expected from a country of this size.

SRON's exceptional technology development (e.g., TES, MKIDS, immersed gratings) ranks among the best in the world. The development of these technologies places SRON in a unique position among European and even worldwide laboratories. Further, this technology expertise is securely preserved within SRON, ensuring a continuation in a coherent and balanced program between scientific goals and instrument development.

SRON maintains excellent personnel quality – scientists and engineers at the forefront of science and technology. It is regarded as a great place to work with international culture, broad scientific spectrum, and instrument development facilities.

Research quality

SRON serves as a focal point for high quality astrophysics and Earth sciences research and training for Dutch universities and indeed globally; it delivers world-class research through its own scientists, and even more so through the science enabled by the instruments developed in-house.

In Earth sciences, SRON's in-house capabilities (instrument development and implementation, composition retrievals and validation, and data processing and storage) place its scientists very well to participate in the next implementation of Earth science missions, focused on multi-tracer measurements for evaluating processes controlling the Earth System.

One of SRON's major advantages in staying on top of its game is the current embedding of the institute within a very fertile and creative academic environment, especially in Groningen. The Committee expresses concern about the current uncertainties and risks related to the Utrecht group move and their negative effect on the staff morale, as well as potential disruption or interruption of the Institute operations.

Societal relevance

SRON's very effective proactive approach to valorisation and engagement with industry and SMEs (e.g. Deal van het Noorden) has yielded high returns and is becoming increasingly important for the country.

SRON is engaged in an impressive number of activities that support Dutch industry and education, such as knowledge utilization via technology transfer and "co-working" with industry, in addition to publications in peer-reviewed journals, magazine articles, press releases, web pages etc.

Viability

Although operating in a context of unpredictable mission opportunities and in a difficult funding environment, SRON's international reputation and expertise ensures that it will continue to be invited to participate in front rank space missions and that it will be able to contribute to, strongly influence, and exploit those missions scientifically, both nationally and internationally, ensuring long term viability. Moreover, the strong endorsement of all of the external stakeholders interviewed by the Committee underscores the value of the organisation in the eyes of the wider community and of its partners and collaborators.

SRON is well-supported by a high level (~75%) of core funding, constituting a very substantial and stable financial foundation, which is conducive to retaining its complement of expert staff in the face of fluctuations and programmatic uncertainties in the ESA space programme. However, the core budget has been declining in real terms in recent years, presenting problems in sustaining capability and securing leadership roles in projects.

The lack of phasing between ESA announcements of opportunity for missions addressing specific research areas and the inclusion of those areas in the Dutch National Roadmap for Large Research Infrastructure (DNRLRI), prevents successful SRON proposals from being funded in a timely manner and, unless it is addressed, will pose serious challenges to SRON's ability to secure leadership roles in future missions.

The Committee expresses concerns about some issues: the viability of the new exoplanets group, which with only one staff member is obviously lacking critical mass, which is likely to be hard to achieve in the near future; the uncertainty of how and when SRON would engage in Gravitational Wave research; the ability of the astrophysics programme to deliver on both Athena and SPICA, unless these are conveniently staggered in the course of the next 5-10 years.

The Utrecht move presents great opportunities but also some viability risks, such as potential loss of key personnel and delays to time-critical activities, which will need careful and thorough assessment and attention in the selection and implementation process.

Management

The 2014 management restructuring is a very significant improvement and has already proven to be very successful. The recently introduced informal brainstorming sessions with the science and engineering leaders are a positive step in the strategic planning. However, the Committee finds that although gender diversity reached ~30% among the PhD students and postdoctoral fellows, it is alarmingly low in the higher ranks and needs to be improved.

SRON's size, structure, and financial approach are well matched to its mission and allow the flexibility to provide the strength and depth of technical and managerial expertise needed to lead major space projects, alongside the technology development and studies for future missions.

In summary, SRON is a well-run organisation with continuing high relevance and importance to contemporary and future space science. It has many strengths and a well-thought-out strategy for the future.

4.2 Recommendations

Specific recommendations for the near future, bearing in mind the governance and leadership skills of the research unit.

Research quality

- It would be beneficial to some SRON personnel to create joint appointments with universities, as part of their embedding into the academic environment in Groningen and after the upcoming move of the Utrecht group. The most important potential benefit is the prospect of further strengthening and maintaining academic links. Although this applies in all research areas, the Committee finds that the exoplanet area would benefit in particular if care were taken to ensure their growth with university support.

- With respect to the Earth sciences data chain, SRON should: (i) maintain focus on the instrumentation, retrieval algorithms and validation with continued support of data delivery and storage as these are more software oriented tasks; (ii) expand its scientific infrastructure that allows it to relate their retrieved data to flux or state and then to processes – these capabilities are critical towards identifying the next generation of observables needed to advance the field; (iii) continue developing and submitting proposals for external grants that build on SRON expertise, with a view towards expanding core strategic capabilities, especially in characterizing carbon, aerosol, and climate feedbacks and corresponding fluxes.

Relevance to society

- SRON should strive to increase their already strong engagement with industry and SMEs, as well as their proactive approach towards valorisation, as long as these activities do not affect their core science and technology mission.

Viability

- The Exoplanets programme will need close coupling to university academics to have sufficient strength. The field of exoplanet research is certain to feature strongly in future space science, and it presents good opportunities for SRON. However, the initial strategy of one staff member and technical roles based on the institute's strengths will need to evolve and requires monitoring to ensure viability in the long term.

- NWO needs to investigate methods of allowing SRON to engage in the national competitive funding process in a framework better aligned to ESA schedules.

- Close attention needs to be paid to the results of the recent staff survey, and an action plan developed to address areas in which significant staff concerns have been identified. In addition, to foster the retention of expert staff and skills, SRON could consider offering permanent contracts to some fixed-term staff if appropriate, even though they may need to be funded on external grants or contracts.

PhD programmes

- SRON is a great place for a PhD, offering an excellent educational and training environment for young researchers. However, it is imperative that their current numbers be sustained or enhanced in the coming years. Further, SRON needs to develop more possibilities to obtain and train more PhD students working on its technical programmes. If it remains impossible for SRON to support enough studentships directly, we recommend that efforts be made to get more students via collaborations with universities, and maybe even in association with industrial partnerships.

- There is a potential negative impact, both to staff development and to the institute goal fulfilment, affected by the 2-year term limit of temporary employment contracts, which is most damaging in the R&D area. SRON needs to mitigate the risk that expertise which has been built up in the course of these years will be lost and the team would have to train from scratch the replacement, investing additional time and energy. Although a clear solution is not obvious, the Committee would like to point out the risks and disadvantages of losing trained personnel as well as the frustration this creates on both sides.

Research integrity

- There are no issues at SRON in this area, however, it is advisable that management continue to pro-actively bring it under the attention of SRON's employees.

Diversity

- A more proactive approach is needed to improve diversity in SRON, given the cultural environment they operate within. Increased gender diversity, particularly at the higher SRON ranks, needs to be given a higher priority. While we recognise that management is working hard at the recruitment level, this needs to be supported by broader organisational training, such as ethics and harassment and implicit/explicit bias. An independent point of contact needs to be clearly identified in SRON for harassment reports. Staff should be knowledgeable of the NWO policy and representatives.

Other issues

- The Committee did not find any areas of concern with regard to open access to data taken by instrumentation developed by SRON.

- More systematic use of arXiv to openly share engineering publications should be considered, given that there are now subcategories for papers in instrumentation and detectors available there. Nonetheless, a clearly allocated budget line for open access publishing will help the organisation to embed this with engineering and scientific staff alike.

Management

- The effectiveness in strategy formulation and planning should be enhanced by better utilising the inputs, collective wisdom, and corporate knowledge of the senior management team in arriving at strategic decisions. In general, the management needs to ensure that any important decisions affecting the SRON strategic direction or SRON staff are clearly and timely communicated to the relevant staff.

- Starting January 2018, SRON will no longer be an independent entity, as it will become part of the NWO institute structure. It is important that SRON management continue to be able to set their own policy and scientific directions within this new structure.

- The Committee urges the Director to consider appointing a Deputy Director to allow for more efficient workload distribution, other general management issues, as well as to better identify and evaluate SRON strategic goals and internal activities.

- The rationale for the choice of the new SRON location needs to be well articulated within the organisation and an up-to-date risk analysis and mitigation plan is needed to assess selection and implementation needs. A quick and clean decision is planned

with regard to the move of the Utrecht group; it is, however, imperative that the selection and the move take place in an expeditious, well-planned, and well-executed manner, to allow the SRON science, technology development, and instrumentation programmes to remain competitive.

Annex 1. Curricula Vitae of Evaluation Committee Members

Prof. dr. Chryssa Kouveliotou (Chair)

Chryssa Kouveliotou is Professor of Astrophysics and Director, Astronomy, Physics and Statistics Institute of Sciences (APSIS) at the Physics Department, George Washington University, Washington. Previously, she was a senior technologist in high-energy astrophysics at NASA's Marshall Space Flight Center in Huntsville, Ala; she retired in 2014. A long time leading researcher in multiple NASA space science missions, Kouveliotou conducted forefront research on a host of transient astrophysical phenomena including, Gamma Ray Bursts (GRBs), Magnetars (which she discovered in 1998), GRB associated Supernovae, X-ray Binaries, and recently Kilonovae. She has been the principal investigator on numerous research projects in the United States and Europe. Kouveliotou has published over 450 papers in refereed journals and has been among the top 10 most-cited space science researchers in published journals worldwide. She has received numerous awards for her work, including the Descartes Prize, the Rossi and Heineman Prizes, and she has been decorated by the Greek Government as a Commander of the Order of the Honor for excellence in science. She is a member of the US National Academy and of the Academy of Arts and Sciences and a corresponding member of the Dutch Royal Academy and the Greek National Academy, and a Fellow of the American Physical Society (APS) and of the American Association for the Advancement of Science (AAAS). She holds two Honorary Degrees from the University of Sussex and the University of Amsterdam. She has been a Councillor and a Vice President of the American Astronomical Society (AAS) and a Chair of the High Energy Astrophysics Division of AAS and the Division of Astrophysics of APS; she is currently the President of Division D of the IAU and a member of the Executive Councils of the NAS/Space Studies Board and of AAAS. Kouveliotou hails from Athens, Greece. She received her Bachelor's degree in physics from the National University of Athens, Greece, in 1975, and earned her Master's degree in Astronomy from the University of Sussex, England, in 1977. She received her doctorate in Astrophysics in 1981 from the Technical University of Munich, Germany.

Prof. dr. Matt Griffin

Matt Griffin is Head of the Cardiff University School of Physics and Astronomy. Having graduated and worked originally as an electronic engineer, he studied for a PhD in astrophysics at Queen Mary, University of London, graduating in 1985. He is a member of the Cardiff Astronomy Instrumentation Group, with many years' experience in Far Infrared and submillimetre astronomy and instrumentation, both ground-based and space-borne. He was a Co-Investigator for the ISO Long-Wavelength Spectrometer instrument and Principal Investigator for Herschel-SPIRE. He has served on numerous national and international Committees including the UK Science and Technology Facilities Council Science Board and the ESA Science Programme Committee.

Dr. John Worden

John Worden is the manager of the Earth science section at NASA's Jet Propulsion Laboratory. His background is on the remote sensing of tropospheric composition (Ozone, HDO/H2O, CH4, CO2, CO, PAN, OCS) and the use of these data for investigating linkages between the carbon and water cycles and atmospheric chemistry. Worden is a member of the Aura TES Science Team (TES Principal Investigator Emeritus), the OCO-2 Validation

Team, the GEOCAPE Working Group and TEMPO Mission Standing Review Board Science Lead.

Prof. dr. Gillian Wright

Gillian Wright is director of the UK-ATC. She is also the European PI for the James Webb Space Telescope Mid-IR Instrument, and a visiting professor of the Institute for Astronomy, University of Edinburgh. She obtained her Ph.D. in physics from Imperial College in 1986 and was appointed to an ROE Fellowship. She was a staff scientist at UKIRT and then Head of Instrumentation from 1995 until 1997, when she returned to the UK to join the newly formed UK-ATC. She has 30 years' experience of ground- and space-based instrumentation for astronomy having provided scientific, technical and management leadership for projects ranging from observatory management software, through critical mechanism sub-systems, to entire instruments. Gillian was awarded an MBE for Services to Science in 2006, and is a member of a number of National and International Advisory Panels for astronomy and astronomical instrumentation.

Annex 2. Programme of the Site Visit 10 – 13 October 2017

Programme site visit SRON October 10-13, 2017

Tuesday October 10

Committee arrives in the Netherlands, transport to hotel Mitland in Utrecht

16.00 – 17.00 Committee meeting, starting with installation by a member of the Board of NWO
17.00 – 18.00 Closed session Committee

18.00 Dinner, closed session Committee

Wednesday October 11 (Utrecht)

08.00 – 08.30 Transport from the hotel to SRON Utrecht

08.30 – 08.45 Welcome at the institute
08.45 – 10.00 Interview with directorate and representatives of the board of SRON
- Prof. Rens Waters (general/scientific director)
- Dr. Remco den Besten (managing director)
- Dr. John Marks (chairman of the board)
- Prof. Han Dolman

10.00 – 11.30 Presentations[4] of the programmes Astrophysics, Exoplanets, and Earth (each individually, by the three programme heads, including [first] questions and discussion)

Astrophysics
- Dr. Frank Helmich (head of the programme), accompanied by dr. Jan-Willem den Herder
- Dr. Peter Roelfsema

Exoplanets
- Dr. Frank Helmich (representing dr. Michiel Min, head of the programme)

Earth
- Dr. Avri Selig (head of the programme), accompanied by
- Prof. Ilse Aben
- Dr. Otto Hasekamp

11.30 – 12.30 Tour of the premises

12.30 – 13.30 Lunch with directorate

13.30 – 14.30 Presentations[5] of the Technology programme, the Instrument Science group, and the Engineering group (each individually, by the programme head and the two group managers, including [first] questions and discussion)

Technology

[4] Also Prof. Rens Waters present

[5] Also Prof. Rens Waters present

- Dr. Henk Hoevers (head of the programme), accompanied by
- Dr. Jochem Baselmans
- Dr. Roland den Hartog

Instrument Science group

- Dr. Pieter Dieleman (manager of the group), accompanied by
- Paul Hieltjes, MSc (manager of the Engineering group)

Engineering

- Paul Hieltjes, MSc (manager of the group), accompanied by
- Dr. Pieter Dieleman (manager of the Instrument science group)

14.30 – 15.15 Interview following the six presentations of the programmes/groups (the four programme heads and the two expertise-group managers are present)

- Dr. Frank Helmich (also representing Michiel Min)
- Dr. Avri Selig
- Dr. Henk Hoevers
- Dr. Pieter Dieleman
- Paul Hieltjes, MSc

15.15 – 15.45 Break

15.45 – 16.30 Interview with staff of the four programmatic science groups

- Dr. Elisa Costantini (Astrophysics)
- Dr. Peter Jonker (Astrophysics)
- Prof. Floris van der Tak (Astrophysics)
- Dr. Lingyu Wang (Astrophysics)
- Prof. Ilse Aben (Earth)
- Prof. Sander Houweling (Earth)
- Dr. Jochen Landgraf (Earth)
- Dr. Jochem Baselmans (Technology)
- Dr. Jian-Rong Gao (Technology/Instrument science)

16.30 – 17.15 Interview with staff of the Instrument science group and Engineering group

- Dr. Aaldert van Amerongen (Instrument science)
- Dr. Jian-Rong Gao (Instrument science)
- Dr. Brian Jackson (Instrument science)
- Dr. Ruud Hoogeveen (Instrument science)
- Dr. Gert de Lange (Instrument science)
- Herman Jacobs (Engineering)
- Peter Paul Kooijman, MSc (Engineering)
- Martin Grim, MSc (Engineering)
- Frans Zwart (Engineering)

17.15 – 17.45 Transport from institute to hotel/restaurant

19.00 Dinner, closed session Committee, followed by transport to hotel Mitland

Thursday October 12 (Groningen)

08.30 – 11.15 Transport from the hotel near Utrecht to SRON Groningen

11.15 – 11.30 Welcome at the institute
11.30 – 12.30 Tour of the premises
12.30 – 14.00 Lunch with poster session
- Separate programme

14.00 – 14.30 Interview session with PhD students
- Junjie Mao, MSc (Astrophysics)
- Daniele Rogantini, MSc (Astrophysics)
- Kristhell Lopez, MSc (Astrophysics)
- Katya Frantseva, MSc (Astrophysics)
- Giacomo Cannizarro, MSc (Astrophysics)
- Patrick Rauer, MSc (Astrophysics)
- William Pearson, MSc (Astrophysics)
- Iris Dekker, MSc (Earth)
- Sudhanshu Pandey, MSc (Earth) – completed PhD thesis in 2017
- Sebastian Haenle, MSc (Technology)
- Alejandro Laguna, MSc (Technology)
- Chris de Jonge, MSc (Technology)

14.30 – 15.00 Interview session with postdocs
- Dr. Francesca Onori (Astrophysics)
- Dr. Davide Lena (Astrophysics)
- Dr. Margherita Giustini (Astrophysics)
- Dr. Zuzanna Kostrzewa-Rutkowska (Astrophysics)
- Dr. Haili Hu (Earth)
- Dr. Lianghai Wu (Earth)
- Dr. Antonio di Noia (Earth)
- Dr. Ralf Kohlhaas (Instrument science/ Earth Earth)
- Dr. Juan Bueno (Technology)
- Dr. Pieter de Visser (Technology)

15.00 – 15.15 Break

15.15 – 16.15 Interview with a selection of SRON's stakeholders
- Dr. Didier Barret* (PI X-IFU, Director of Research at CNRS/IRAP, France)
- Prof. Ewine van Dishoeck* (Scientific director NOVA, University of Leiden)
- Dr. Bas Henzing* (TNO, Climate, Air & Sustainability)
- Prof. Bayu Jayawardhana (Engineering and Technology institute Groningen, ENTEG)
- Arnaud de Jong* (CEO Airbus Defence & Space Netherlands)
- Prof. Kazuhisa Mitsuda* (Research Director ISAS/JAXA, Project Sci. Hitomi, Japan)
- Prof. Andrea Neto (Head THz Sensing Group, Delft University of Technology)
- Dr. Rob Petre* (Chief X-ray Astrophysics Laboratory, GSFC/NASA, USA)
- Prof. Scott Trager (Director Kapteyn Institute, University of Groningen)
- Prof. Guido van der Werf (Earth and Climate, VU Free University Amsterdam)

*) via videoconference

16.15 – 17.15 Interview with a delegation of the SRON Scientific Advisory Committee
- Prof. Xander Tielens* (SAC chairman)

• Prof. Christoffel Waelkens
*) via videoconference

17.15 – 17.45 Transport from the institute to restaurant

17.45 – 20.00 Dinner, closed session Committee

20.00 – 22.30 Transport from SRON Groningen to hotel Mitland

Friday October 13 (Utrecht)

08.30 – 09.00 Transport from the hotel to SRON Utrecht

09.00 – 10.00 Interview session General support staff (includes diversity and integrity)
• Sandra van Gessel (HR)
• Annemieke Oehlen (Finance & Control, Project office)
• Frank van Rijn, MSc (Housing & Facilities)
• Frans Stravers (Communications & Media relations)
• Dr. Hans Bloemen (ICT, internal projects for directorate)
• Gerard Cornet, MSc (policy support, coord. network industrial liaison officers NWO)
• Bert Warmelink, MSc (process management general support, temporary support HR)

09.45 – 10.15 Interview with group of female researchers (change to original programme at the request of Evaluation Committee)

10.15 – 12.30 Interview with individual members management team (change of original programme at the request of Evaluation Committee)
• Dr. Frank Helmich
• Dr. Michiel Min
• Dr. Avri Selig (absent because of TROPOMI launch)
• Dr. Henk Hoevers
• Dr. Pieter Dieleman
• Paul Hieltjes, MSc

12.00 – 13.00 Lunch and interview Prof. Rens Waters

13.00 – 16.00 Closed session Committee (work on report)

16.00 – 16.45 Closure with directors, representative of the board of SRON and NWO Board (preliminary conclusions)
• Prof. Rens Waters
• Dr. Remco den Besten
• Prof. Han Dolman (representative of the board of SRON)
• Dr. ir. Christa Hooijer (representative of NWO board)

16:45 – 17:15 Transport from institute to Hotel

Annex 3. Quantitative data composition and financing

Funding

in k€	2011	2012	2013	2014	2015	2016
Funding:						
Direct funding 1)	14.901	14.527	14.335	13.978	14.195	15.036
Contracts/grants 2)	4.932	4.915	4.763	2.736	4.147	4.519
Other 3)	1.275	2.121	240	2.748	110	545
Total funding	**21.108**	**21.563**	**19.338**	**19.462**	**18.452**	**20.100**
Expenditure:						
Personnel costs	14.113	14.677	13.645	13.351	13.699	13.814
Other costs	6.944	5.601	6.656	5.785	6.081	5.429
Total expenditure	**21.057**	**20.278**	**20.301**	**19.136**	**19.780**	**19.243**
Technology programme	1.437	1.243	1.909	1.698	1.789	1.847
Astrophysics programme	9.045	8.933	9.560	8.489	7.297	7.803
Earth programme	4.643	4.264	3.445	3.730	4.571	3.902
Exoplanets programme	-	-	-	-	321	333
Not assigned to a programme 4)	5.932	5.824	5.387	5.219	5.802	5.358
Total expenditure	**21.057**	**20.278**	**20.301**	**19.136**	**19.780**	**19.243**

1) NWO (98%) and the universities of Utrecht (until 2015) and Groningen

2) Funding acquired in competition (22% on average)

3) Not obtained in competition (e.g. project-support work ordered by industry)

4) Costs of central support staff, infrastructure, and other costs not related to a particular programme. The personnel costs of the Engineering group and the Instrument science group are assigned to the programme lines depending on their actual involvement in each line.

Staff

fte	2011	2012	2013	2014	2015	2016
Research staff, tenure and tenure track	63.3	60.3	58.5	65.1	64.3	60.4
Research staff, non-tenure track	29.5	32.1	31.3	27.0	26.5	23.5
PhD candidates	15	21	20	20	18	19
Total research staff 1)	**107.8**	**113.4**	**109.8**	**112.1**	**108.7**	**102.9**
Engineers and equivalent 2)	49.7	46.6	47.2	44.8	44.5	45.8
Support staff 3)	35.1	35.6	34.4	32.5	30.3	30.3
Total personnel 4)	**193.6**	**187.6**	**184.4**	**189.4**	**183.5**	**179.0**
Guests 5)	47	52	45	55	78	68

1) On average the research staff consists of about 55% scientists (including PhD candidates), 30% instrument scientists, and 15% other personnel. With regard to 'other personnel', we follow here the International Standard Classification of Occupations by including senior personnel that 'conducts research, advises on, designs, and directs construction' as research staff (i.e. manager and section heads of the Engineering group, senior design engineers, system engineers, and the managing director).

2) Largely the Engineering group and in addition the research assistants in the Instrument science group.

3) HR, ICT, Finance & Control, Project office, Communication & Media relations, Housing & Facilities, and Secretariat.

4) On average about 70% permanent/tenure track and 30% temporary.

5) Mainly visiting fellows, students, interns, and ex-SRON scientists. The total number of guests during the year is shown.

Research output

	2011	2012	2013	2014	2015	2016	avg
Scientific publications							
In refereed journals 1) 2)	107	155	140	147	133	155	140
- of which SRON 1st author 3)	32	54	35	55	32	44	42
- Technology programme	16	22	22	26	16	10	19
- Astrophysics programme	65	111	86	93	94	113	93
- Earth programme	27	31	39	27	28	23	29
- Exoplanets programme	-	-	-	6	6	11	8
In proceedings	39	60	36	73	28	49	47
PhD Theses	2	2	6	5	4	5	4
Other scientific publications	33	17	42	18	31	33	29
Scientific presentations							
Oral presentations 4)	116	173	132	127	121	134	134
Poster presentations	47	30	57	26	43	22	38
Aimed at general public							
Publications (articles, press releases, news items) 5)	34	29	29	29	35	42	33
Presentations (lectures for a broad audience)	68	49	47	44	48	49	51
Media appearances/quotations	34	50	22	36	24	37	34

1) This is the number of publications by SRON in refereed journals. A publication can result from more than one programmatic line, so the sum of the number of publications per programme is larger.

2) On average, each scientist (including PhD students) publishes 2.3 papers per year in a refereed journal.

3) For papers in refereed journals, SRON is first author of 51% of the papers from Technology, 23% for Astrophysics, 37% for Earth, and 6% for Exoplanets in the period 2011-2016.

4) Up to 15% of the scientific oral presentations concerns invited talks, depending on seniority.

5) SRON also shares its news via the social media (Twitter, Facebook, and LinkedIn), which is not included in these numbers. We give high priority to sharing knowledge with a wider public.

Research facilities

Facility	Description
Instruments/data (including calibrations, analysis software)	
XMM-Newton/RGS (ESA)	Reflection Grating Spectrometer (RGS), SRON PI Data: www.cosmos.esa.int/web/xmm-newton
Chandra/LETGS (NASA)	Low Energy Transmission Grating Spectrometer (LETGS), SRON PI Data: cxc.harvard.edu/cda/
Herschel/HIFI (ESA)	Heterodyne Instrument for the Far Infrared (HIFI), SRON PI Data: archives.esac.esa.int/hsa/whsa/
Hitomi/SXS (JAXA)	Soft X-ray Spectrometer (SXS), SRON part of instrument team
ENVISAT/SCIAMACHY (ESA)	SCanning Imaging Absorption SpectroMeter for Atmospheric CHartographY, SRON co-PI Data: earth.esa.int/instruments/sciamachy
Data for European Commission	Data for Copernicus Atmospheric Monitoring service (CAMS) & Copernicus Climate Change Service (C3S) https://atmosphere.copernicus.eu https://climate.copernicus.eu
Data for ESA Global Monitoring of Essential Climate Variables/Climate Change Initiative (CCI) programme	Data sets of Essential Climate variables (CO2, CH4) to which ESA has committed Data: cci.esa.int/data
Scientific software/modelling (for general use, with user support)	
SPEX	Code for the analysis and interpretation of high-resolution X-ray spectra in astrophysics www.sron.nl/spex
RADEX and RATRAN	Codes for radiative transfer and excitation of molecular lines in astrophysics www.sron.nl/radex and www.sron.nl/ratran
MCMax and MCMax3D	Codes for simulating radiative transfer in dusty media of massive circumstellar disks in astrophysics sites.google.com/site/mancualmcmax/project-definition
TM5	Code for atmospheric chemistry and transport tm5.sourceforge.net
LINTRAN	Code for vector radiative transfer and retrieval of several Earth
RemoTec and Sicor	Codes for retrieval of carbon cycle data products
Laboratory facilities (also available for partners or commercial orders	
Clean rooms	ISO 5 for sensor development and optical assembly, alignment and testing ISO 6-7 for integration, mechanical assembly and testing
Specialised laboratory facilities	Low temperature vacuum environment, 0.05 K up to room temperature, and X-ray, visible, UV, infrared and far-infrared sources and detector test facilities Thin layer deposition, patterning and characterisation facilities: sputtering, evaporation, deep UV lithographic patterning, wet, chemical and dry etching, Marangoni cleaning
Materials characterisation facilities	Electron microscopy (SEM): surface roughness, spectral reflection/transmission
Space qualification facilities	Climate chambers, deep cryogenic cycling, mechanical fatigue tests
3D measuring machines	Optical interferometry, mechanical coordinates measurement machine (CMM)
SMD assembly	Surface-mount technology

PhD candidates

Enrolment			Success rates			Total		
Starting year	Enrol-ment (male/ female)	Total (male+ female)	Gradu-ated after (≤) 4 years	Gradu-ated after (≤) 5 years	Gradu-ated after (≤) 6 years	Total gradu-ated	Not yet finished	Discon-tinued
2007	4/0	4	2	2		4		
2008	7/1	8		4	3	7		1
2009	2/3	5	2	3		5		
2010	1/1	2	1	1		2		
2011	3/4	7	2	3		5	1	1
2012	1/0	1		1		1		
Total	**18/9**	**27**	**7 (26%)**	**14 (52%)**	**3 (11%)**	**24***	**1 (4%)**	**2 (7%)**
2013	2/3	5					5	
2014	1/3	4					4	
2015	3/1	4					4	
2016	4/1	5					5	

*) Two instrument scientists of SRON also obtained their PhD degree in the period 2011-2016, so the total number of PhD theses in this period is 26 (shown in Appendix III).

Public-private partnerships

Funding source 1)	**2012**	**2013**	**2014**	**2015**	**2016**
ESA programme		3	3	3	
H2020 programme	5	5	5	2	
NWO	5	3	1		
NSO 2)	10	10			
Industry and Top Sectors 3)	6	3	4	16	22
Regional/co-development 4)				2	1
Total	**26**	**24**	**13**	**23**	**23**

1) The contracts started in the year indicated.

2) The PEP programme of the Netherlands Space Office (NSO) (Pre-qualification of ESA Programmes) was stopped in 2014.

3) The Top Sectors funding scheme exists since 2014.

4) Co-development via 'Deal of the North' and 'Space Cluster East' exists since 2015.

Patents

Description	Filed by
Method and system for inspection of composite assembliesusing terahertz radiation (EP283562)	SRON
Method and apparatus for estimating a seed germination ability (EP3030070)	SRON with Wageningen University
Method and apparatus for classifying a seed as inbred or hybrid (WO2016114649)	SRON with customer
Method for producing an immersed diffraction grating (EP 2718752)	TNO with SRON

Annex 4. Explanation of the categories

Table 1. Meaning of categories in SEP 2015-2021

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

Annex 5. Terms of Reference

The board of The Netherlands Organisation for Scientific Research (NWO) hereby issues the following Terms of Reference to the assessment committee of SRON, chaired by Prof. dr. Chryssa Kouveliotou.

Topic	Description
Title	External evaluation of SRON of the period 2011 – 2016
Why	NWO organizes periodic evaluations of each research institute within the organisation every six years. This is part of the standing agreement with the Ministry of Education, Culture and Science. Together with Royal Netherlands Academy of Arts and Sciences (KNAW) and the Association of Universities in the Netherlands (VSNU), NWO has stated to conduct these evaluations according to the Standard Evaluation Protocol (SEP). The goal of the periodic assessments is primarily to identify the quality of the research and the societal relevance and secondly to - partly on the basis of the assessment results - determine the mission and the basic funding for the next six years (2018-2023).
What	The assessment committee evaluates the quality and the relevance to society of the research conducted by the institute, as well as its strategic targets and the extent to which it is equipped to achieve them. The committee does this by judging the institute's performance on the three SEP assessment criteria, taking into account current international trends and developments in science and society in the analysis. Each criterion should receive a ranking in one of the four categories in accordance with the SEP guidelines. The committee also ensures that the qualitative assessment (text) and the quantitative assessment correspond. Furthermore, the committee should give recommendations for improvement. **The three SEP assessment criteria are**: - **Research quality** - **Relevance to society** - **Viability.** The assessment committee also gives a qualitative evaluation on three **additional aspects**: - **PhD programmes** - **Research Integrity** - **Diversity** Further information about the criteria and additional aspects can be found in chapter 2 of the Standard Evaluation Protocol (SEP). **In addition to the topics above NWO has formulated three questions**: 4. What is the institute's added value in the national context and its international position?Anne 5. How does the institute stimulate and facilitate knowledge utilization and open access? 6. How does the institute's structure, size and financial policy contribute to its mission? **For this particular institute NWO has also formulated the following specific topic**:

	- The financial conditions; has SRON set adequate priorities to pursue its tasks and responsibilities as "homebase-institute" for The Netherlands participation in the scientific programme of ESA? - What is the committee's opinion concerning the positioning of SRON within the domain of earth observation (i.e. our part in the data-chain)? - What is the committee's opinion concerning the activities regarding knowledge utilization in general and in particular within the "Deal van het Noorden", i.e. the collaboration between the University of Groningen, SRON, and local companies, supported by the Province of Groningen?
For whom	- The researchers themselves in order to establish where they stand, how they can improve and what the research should aim for. - The management of the institute who wishes to track the impact of their policy. - The board of NWO who decides on the accountability of the institute and the support for the institute. - Other stakeholders from, for example, the society and private sector. - The Ministry of Education, Culture and Science has requested a portfolio analysis of all the research institutes of NWO and the Royal Netherlands Academy of Arts and Sciences in 2018. The results of the SEP-evaluations will act as input for this portfolio analysis.
Who	The independent assessment committee consists of 4-7 renowned international experts within the realm of the institute. Each committee member signs a statement of impartiality and confidentiality.
How	The assessment committee will be supported by a liaison officer from NWO and an independent secretary. The necessary documentation to conduct the assessment will be made available to the committee one or two months before the site visit. This documentation includes at least a self-evaluation by the institute, a strategy document of the institute and the conclusions and recommendations from the previous assessment. If feasible the institute may provide a bibliometric analysis or a different study of its own choice to support the self-evaluation. The assessment committee will be invited to the institute for a site visit of two days during which the institute will present itself in short lectures and interviews by the committee. The assessment committee will deliver a draft evaluation report to the NWO board no later than eight weeks after the site visit and a final version no later than 12 weeks after the site visit. Finally, the NWO board will publish the assessment report on the website accompanied by a public statement.
When	The site visit will take place in September or October 2017. NWO distributes the necessary information and documents to the committee 1 or 2 months in advance of the site visit. For further information on the general time schedule please refer to the attached Standard Evaluation Protocol.
Contact	Dr. Pim den Hertog (Dialogic) and Drs. Helga Varwijk (NWO)

Necessary documents that will be made available to the assessment committee:

- Self-evaluation 2011-2016
- Strategy document
- Further description of what the committee needs to know about the scope/context, assessment questions, method, time schedule, final report
- Programme of the site visit
- Standard Evaluation Protocol (SEP)
- Conclusions and recommendations from previous evaluation
- Response NWO to the previous evaluation report

- <optional> Bibliometric analysis