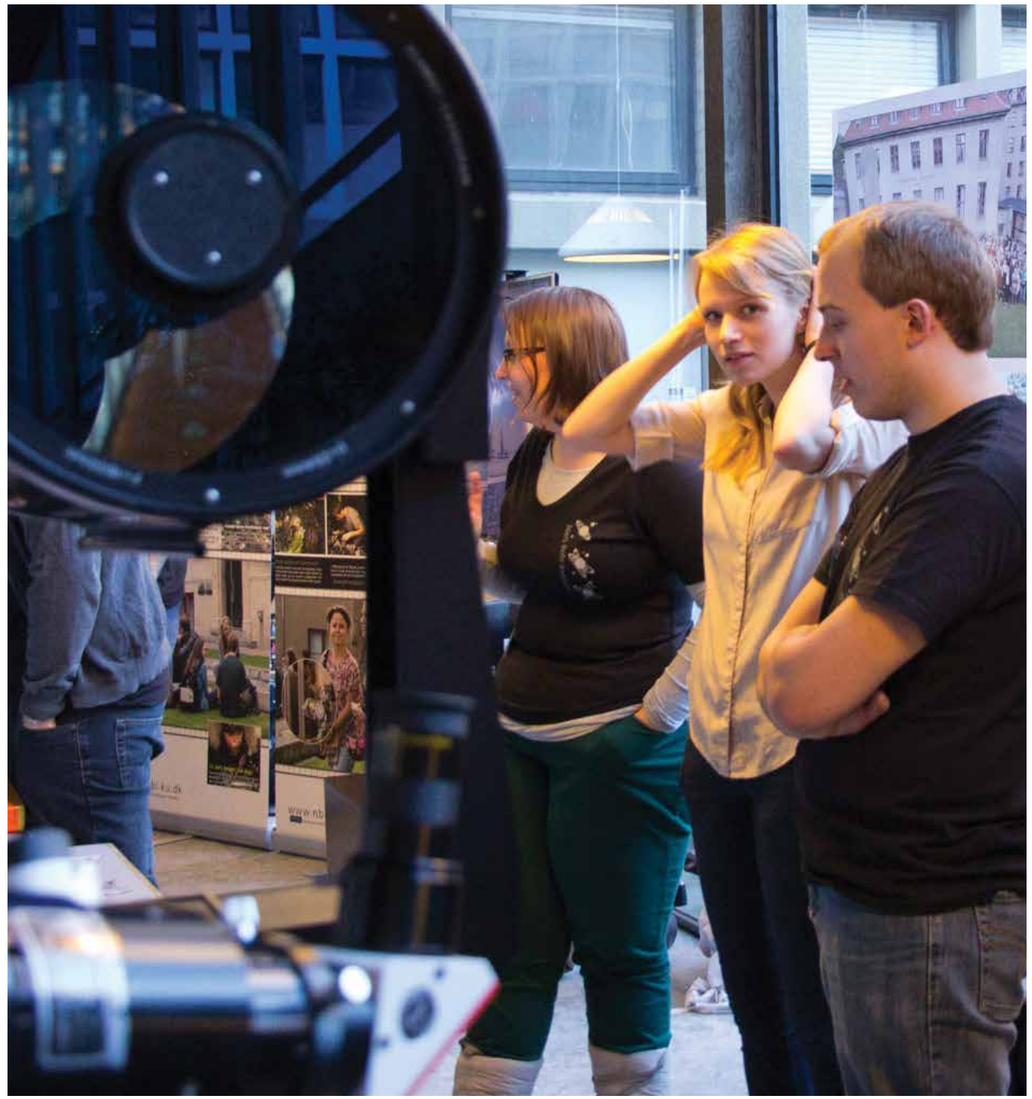
NIELS BOHR INSTITUTE
UNIVERSITY OF COPENHAGEN

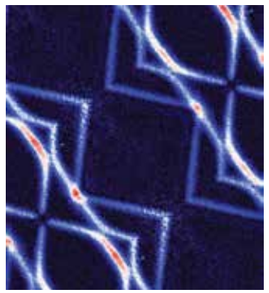
# NIELS BOHR INSTITUTE TOWARDS 2017

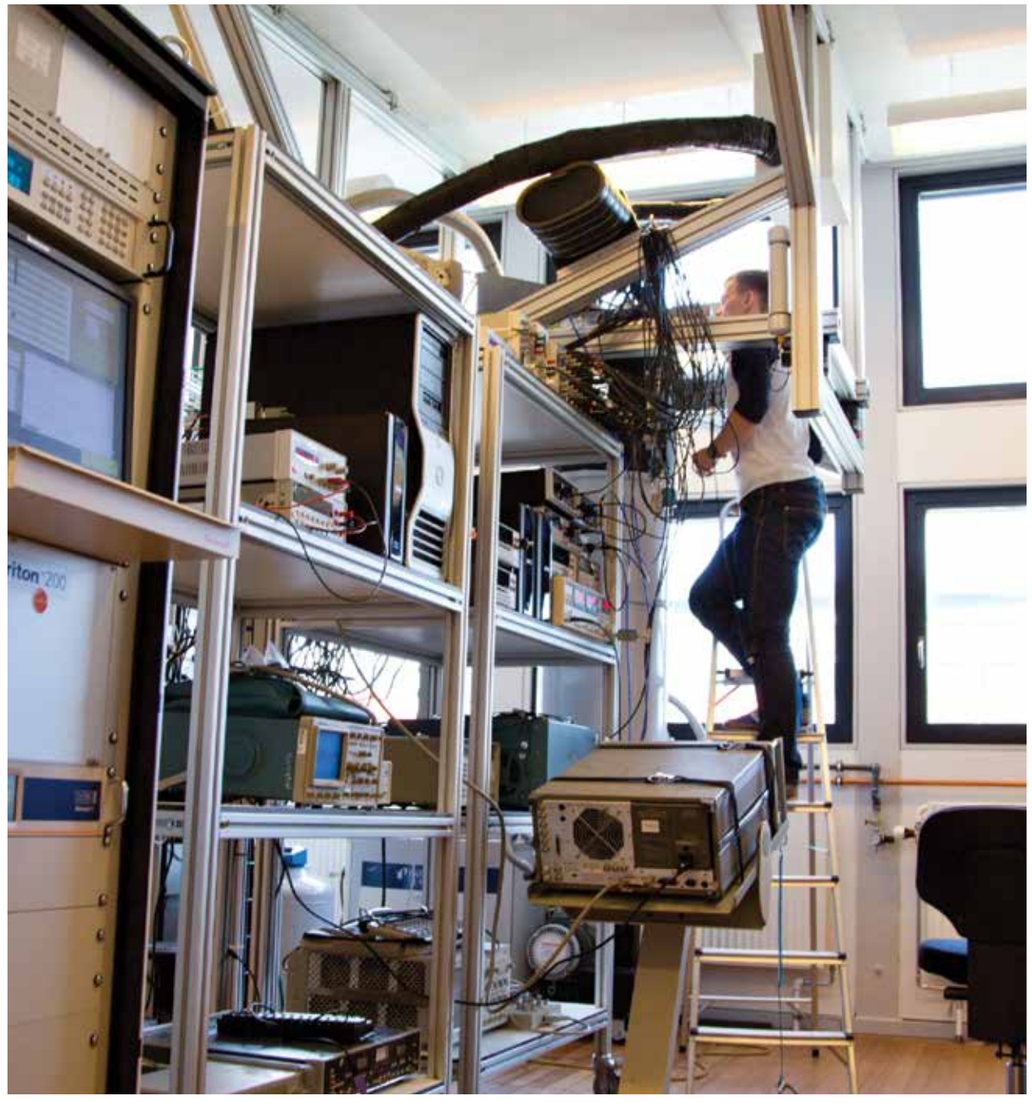
**STRATEGY 2013**



## CONTENTS







## INTRODUCTION

The Niels Bohr Institute has a long-standing tradition of excellence in research and education in all fields of physics. In the past 20 years, the Institute has seen a number of mergers and experienced tremendous development. In 1993, the then four institutes for physical sciences of the UCPH were merged into one, and due to a merger at the faculty-level, the Institute recently welcomed new colleagues formerly located at the Faculty of Life Sciences. Throughout the years, a common identity with generous space for the research groups' individual development and targets has been the goal of the Institute. Today, the Institute comprises 11 research sections and the Niels Bohr International Academy.

Since the turn of the millennium, strategic plans have formed the common framework and set the general direction of the Institute's rapid development. The first of NBI's strategic plans were unveiled in 2002.
This strategic plan was prepared by the Vision, Strategy, and Structure Reflection Group. The group comprises, in addition to the Institute management, representatives of staff groups, students, and upper secondary schools.

**The vision of the Niels Bohr Institute is**

- to perform groundbreaking basic science on the world stage
- to recruit world-class researchers and students
- to deliver top-notch research-based educational programs
- to provide an attractive work and study environment with a high degree of freedom for staff and students
- that all staff and students feel ownership of the work and strive to achieve the best results
- to encourage an open dialogue among all staff and students
- that very early in their academic career, our students become part of the Institute's research environment
- that the Institute will play an active role in society by educating future physicists, carrying out groundbreaking basic research, disseminating research results, and actively take part in their application

## CHALLENGES

As an efficient organization, the Niels Bohr Institute has a solid base upon which we can meet challenges emerging in the coming years. It is imperative that we are well prepared and that the facts we base our decisions and plans on are accurate.

**The challenges to be tackled during the coming years include:**

- to keep attracting research staff at the highest international level, including young talents at PhD and post doc levels, and provide opportunities for them also when their current funding runs out
- to maintain or even increase the external funding base to ensure possibilities for future development
- to maintain our bachelor student enrolment, and increase the intake of master's students, even if the coming years will see a decline in the number of students graduating from the upper secondary schools
- to attract an even larger fraction of the very best students from the upper secondary schools
- to enroll more international students at the master's level
- to relocate the Institute to the Niels Bohr Building and develop research activities for the Blegdamsvej buildings as an essential part of the Institute.

**Recruitment of Students**

As one of its core activities, the Institute offers educational programmes in physics at the highest academic level with the option to specialize in several sub-fields. Our goal is to increase the number of students graduating with a degree in physics to meet the need for physicists in research, business, and secondary school teaching.

**Research Development**

Development of the research environment and results at the Institute will attract highly qualified and dedicated academic staff. We will offer an attractive work place, not least so that young and talented researchers with high potential will seek positions at the Institute in competition with the best departments in the world. This goes for both national and international candidates. The Institute will clarify career paths leading to permanent positions and possibilities for longer-term external funding. While the Institute's focus is on fundamental research, we will follow up on secondary results with potential for industrial applications. In general, the Institute will develop further collaboration with industry.

**Funding Academic Excellence**

In recent years, the Institute's staff have been successful in attracting external research funding. At present, the Institute hosts six Danish National Research Foundation Centres of Excellence, three Danish Council for Independent Research - Natural Sciences centres, and a number of other grants of considerable size, particularly EU grants. As these larger grants expire, these centres will need to secure new funding in order to support their high level of research activity. A sound embedment of the expiring centres in the Institute is vital for both the researchers concerned and the Institute, and we will ensure that research hubs developed and nurtured by the centres continue.
External funding will continue to play a significant and vital part in the Institute's financial portfolio; we intend to prioritize more preparation time and competent administrative assistance for the researchers' preparation of high-quality research funds applications.

**The Physical Environment**

The Niels Bohr Building will be completed during the year 2017, when the Niels Bohr Institute, Department of Chemistry, Department of Computer Sciences, Department of Mathematical Sciences and Department of Science Education will move into the new premises together. The Institute will play an active role in the process to ensure that the new surroundings provide the optimal support for research and "Institute life". Furthermore, the relocation will be prepared in detail to avoid unnecessary hassle to staff and students during the transition, with particular attention paid to laboratories.

Niels Bohr applied for the Institute's establishment, and the first building was inaugurated in 1921. The buildings at 15-17 Blegdamsvej hold essential parts of the Institute's history, and they are inseparably attached to its identity. Maintaining the buildings as a part of the Institute will require significant fund-raising that will enable us to maintain an active research environment in the historical buildings with the Bohr Office and Auditorium A.

The Institute currently hosts 6 Centres of Excellence funded by the Danish National Research Foundation. Each contributes significantly to the NBI's fundamental research:

**Dark Cosmology Centre**
- Center Director Jens Hjorth
The Dark Cosmology Centre studies the cosmological aspects of the very distant, very young Universe, combining theoretical investigations and observations of cosmic lighthouses.

**Center for Quantum Devices**
- Center Director Charles Marcus
The Center for Quantum Devices studies how to create, control, measure, and protect quantum coherence and entanglement in solid-state electronic devices.

**Discovery Center for Particle Physics**
- Center Director Peter Hansen
The Discovery Center conducts experimental and theoretical studies of elementary particle physics at the smallest of length scales and of astro-particle physics and cosmology at length scales comparable with that of the Universe.

**Centre for Ice and Climate**
- Center Director Dorthe Dahl-Jensen
The Centre for Ice and Climate's main activities are drilling of ice cores through the Greenland ice sheet and analysis of ice cores with the objective of understanding the governing processes of past and future climate.

**Center for Models of Life**
- Center Director Kim Sneppen
Center for Models of Life uses methods from physics to develop quantitative understanding of decision making, communication and evolution in biological systems. The center develops models that can reproduce the dynamics found in living model systems.

**QUANTOP Center for Quantum Optics**
- Center Director Eugene Polzik
The center concentrates on quantum state engineering for light, atoms and ions, including entangled, squeezed and other interesting states. Quantum information processing is one of the major directions of the research.



## DEVELOPMENT OF THE INSTITUTE AS AN ORGANISATION

The Institute is a place that inspires creativity and innovative thinking at all levels. Staff and students are proud of belonging to the Niels Bohr Institute. We need room to meet and further develop our common identity with physics as the central part, both within the groups and in general. The Institute is renowned for its international milieu, where visiting researchers, together with the Institute's physicists, develop new methods and theories. It is a key priority to develop and expand these activities.

The Niels Bohr Institute is an organisation in constant development. Its academic environment is built up around 11 research groups, each with their section leader, who, together with the management, form the Institute's Management Team. The support functions comprise, in addition to administration, IT, buildings operations, public outreach, library, and technical support. In recent years, the Institute has grown, thus emphasizing the need for staff, students and visitors to find ways to share a common, research and social


The researchers at the Niels Bohr Institute have a large network and collaborate with research colleagues all over the world. The Institute hosts around 25 longterm guests each year and several hundreds visitors for shorter periods of time.

environment in and outside working hours. The fact that the Institute is located at three different addresses further intensifies the wish to gather common events.

Cooperation between the research administrative and technical staff groups, will be encouraged in the coming years. A closer cooperation will result in a higher degree of knowledge sharing and efficiency, and will contribute to fruitful inspiration from other research groups. We will support a more organic and cooperative culture in order to promote healthy interdisciplinary curiosity.

The Institute encourages an open and confident dialogue between management and staff. Together they should perform the day-to-day tasks, and at the same time prepare the Institute for future. We have a visible management continuously involved in decision-making through dialogue with staff and students. The Institute continues to challenge the possible and will be willing to take risks in order to make the best of opportunities turning up.

**The Institute and the UCPH**
As for the best and most efficient execution of the various work tasks, we will develop the collaboration ground between the Faculty and the Institute; we must carefully consider where the tasks are best placed. We believe in proximity, where the tasks we solve with competence remain within the Institute.

This is in particular true for tasks with special requirements for the solutions, as well as tasks requiring close cooperation between the parties.

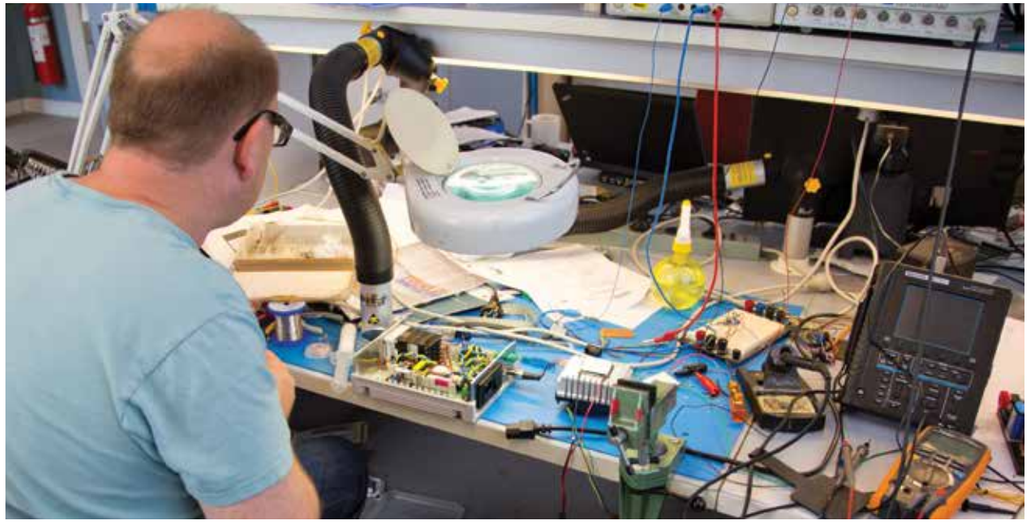
## EDUCATING TO CREATE VALUE

Today, the educational programmes in physics at the Niels Bohr Institute are comprehensive, research-intensive and linked with the Institute's engagement in national and international activities. Physics is the shared foundation among our students. The Institute keenly encourages and supports activities that contribute to a strong study environment and an active social and academic network.

The physics education at the Niels Bohr Institute presents itself as an attractive education at an international level, with an appealing study environment where students are an integrated part of the Institute in close dialogue with research staff.

**Recruitment**
We want to attract the best students from every high school in Denmark, as we see talent as a prerequisite for studying physics. We want the students we enroll to be well prepared for and proud of taking a physics education at the Niels Bohr Institution.

The teaching combines traditional lectures with lab exercises, projects, math classes, study trips and the like. During the first three years, the students learn both in depth and breadth the fundamental disciplines and achieve their own identities as physicists.



Student activities include induction weeks, the Physics Revue, and the yearly gala performance.

We will promote ourselves to attract the talented students whose first priority is an education in natural science and provide them with the opportunity to become scientist already from the bachelor level.

The present size of student intake for the undergraduate programmes matches well the Institute's infrastructure and size of its academic staff. We must focus on maintain the intake of bachelor's students at the current level, even though the number of students graduating from secondary school will decline in the coming years. This means that we must seize a larger percentage of the students graduating from secondary school than we have achieved so far, while maintaining and increasing the quality of the student population.

An active outreach effort, directed at science students in upper secondary schools, will enhance their awareness of the physics educations at the Institute and the exciting career opportunities and full employment for highly qualified students.

An increase in the student intake for the Master's programmes is essential. We will ensure that our bachelor's students feel prepared and encouraged to continue as Master's students at completion of their study programme. Furthermore, we will actively seek to recruit students from other universities in Denmark and abroad. Structurally and academically our Master's programmes should work well with undergraduate programmes elsewhere, and our programmes will reflect the Institute's stimulating, international academic environment.

The Institute's students are an integral part of an exciting international research environment. Teaching at the Institute includes theory, experiments, project- and field-work. All students develop a thorough insight into physics and can also specialise in a sub-field, such as studying the Universe through astronomy, living organisms' physics through biophysics, planet physics through geophysics, atmospheric physics in meteorology and the smallest particles through nanophysics. Students can also study classical physics with topics such as particle or quantum physics. In the course of their education our students are invited to join one of the research groups and will write his or her thesis within the group's research field.



**High-Quality Teaching**
Lecturers of the Niels Bohr Institute are highly qualified and motivated. The programmes and teaching adapt to the changing skills of the incoming students and the needs of society. Didactics will be an integrated part of the teaching, as to maintain the high quality.

We will clearly spell out that all career paths are equally recognized by the Institute: research, teaching, business and industry. Our teaching provides all our students with a broad and solid knowledge of physics, which will launch some of them into an international research career. We secure the breath of the programmes by offering our students coursework in all basic subjects of physics, also in subjects outside the research groups' areas of specialisation.

As early as possible in their study programme, students are invited to join one of the Institute's research groups, and thus become active members of the Institute's research environment. The students will play an increasingly active part in the Institute's ongoing research projects, and collaboration with business and industry should be considered and initiated whenever relevant.

Physics teachers for upper secondary schools are in strong demand. We will support the education of future physics teachers by offering a specialisation in this field, and by supporting students who have chosen a career as physics teacher.

To enhance international mobility, the Institute facilitates study abroad for our students. Spending time at a foreign university attending courses and collecting material for their theses provide our students with new insights and networks. We also want to attract more foreign students, both exchange students and students who are working toward a full Master's degree at the Institute.

**On Time Study Completion**
Students completing their studies within the prescribed period is a priority, and we see it as a joint responsibility among staff and students. We believe that students will have the best career opportunities if they can show future employers that they can complete an

ambitious program without delay. The Institute supports the students so they can finish in time and ensures that the study programmes allow this. Hence, the Institute will work to remove structural barriers that may cause delays.

The education in Nanoscience was established in 2002 as a cooperation between the Niels Bohr Institute and the Department of Chemistry. 50 students are enrolled per year, and they receive their education at the H.C. Ørsted Institute. The students studying Nanoscience learn to comprehend the nanoscale world in the borderland between physics, chemistry and biology and to control the smallest parts of our world – atoms.



## EXCELLENT RESEARCH

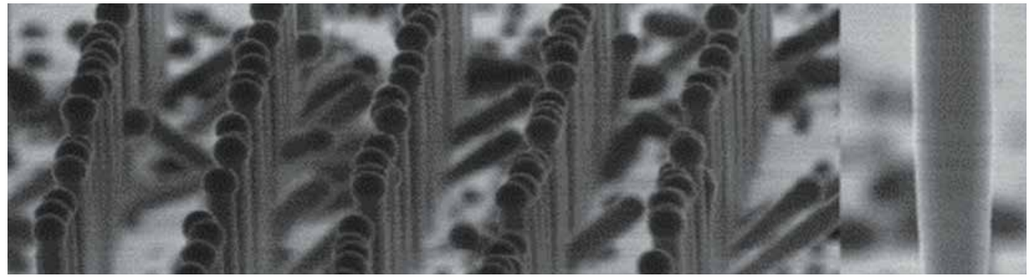
**The Institute's Research Profile**
The Niels Bohr Institute builds upon its position as one of the world's leading physics institutes to be among the top choices for excellent students and research staff. A unique research environment, internationally renowned researches, and outstanding technical and administrative support are vital factors ensuring both the present health of the NBI and the promising future necessary to attract the best talent available.

Transparency and potentially reform in the academic position structure will encourage talented researchers to take positions at the NBI. Our PhD students and post doctoral researchers play important roles in research as well as teaching, and should feel encouraged to take an active part in the academic and social life at the Institute.

The success of the NBI is built on a foundation of academic freedom and conditions favourable for excellent research; these must be maintained. Through dialogue academic staff will shape the research profile of the Institute in the years to come. The factors to consider include the integration of new talent attracted and activities started by the major research centres, commitments to educational programs and teaching, as well as our responsibilities to society, including business and industry. We will continue to make the most of our participation in major international research collaborations such as CERN, ESO, ESS, and XFEL. The role of eScience at the Institute is key and will further be developed, offering expert knowledge and support needed in many areas of physics, for example on large scale computation, modelling and handling of large quantities of data.

We will remain internationally competitive by conducting excellent research in diverse areas of physics. Cooperation and collaboration is becoming increasingly important in solving complex problems and broad research questions, and the NBI should encourage and facilitate cooperation among the Institute's research groups and, of course, internationally with other institutes and organizations. The Institute offers possibilities in many different fields and we will strive for a research-oriented culture rather than one solely focussed on short-term projects. Continuous development and openness towards new opportunities are of great importance to the Institute. In order to facilitate this, we must make an environment conducive to the sharing of thoughts and ideas and interaction among staff, students and international guests, through continued activity at The Niels Bohr International Academy and within the research sections.

The Niels Bohr International Academy was developed in light of the traditions of internationalism, interdisciplinarity and excellence in physics which have characterized the Niels Bohr Institute since its founding. The Academy serves as a research centre for theoretical and mathematical physics and other disciplines with seven permanent researchers. The Academy also hosts guest professors and organises many international workshops, seminars and colloquia.



**The PhD Programme at the Niels Bohr Institute**
The PhD programme is of great importance to the Niels Bohr Institute, since the PhD students perform a significant research of the Institute's research and teaching. They are the future of physics. The Niels Bohr Institute will continue to strengthen its position in the growing international competition for the most talented PhD students, for example by offering highly competitive and attractive programmes.

The institute has 11 research sections that cover a large range of sub-areas within physics:

Dark Cosmology Centre
Astro Physics and Planetary Science
Ice and Climate
Climate and Geophysics
Xray and Neutron Science
Condensed Matter Physics
eScience
Theoretical Particle Physics and Cosmology
Experimental Particle Physics
Bio Complexity
Ultracold Atoms and Quantum Optics

Today, the most talented students from the Master's programme are a central source of incoming PhD students, though international recruitment is also strong. In order to continue to attract the best international candidates, procedures for enrolling and employing foreign students as PhD students at the Niels Bohr Institute will be simplified. Together with our international collaborators, we will develop double and joint degrees both to strengthen our programmes and to promote international mobility.

While the Institute has a long-standing tradition of offering high-quality international PhD courses, there is room for development. In the years to come, we will develop more courses which are attractive both to our own students as well as to PhD students from other universities.

An International Workplace

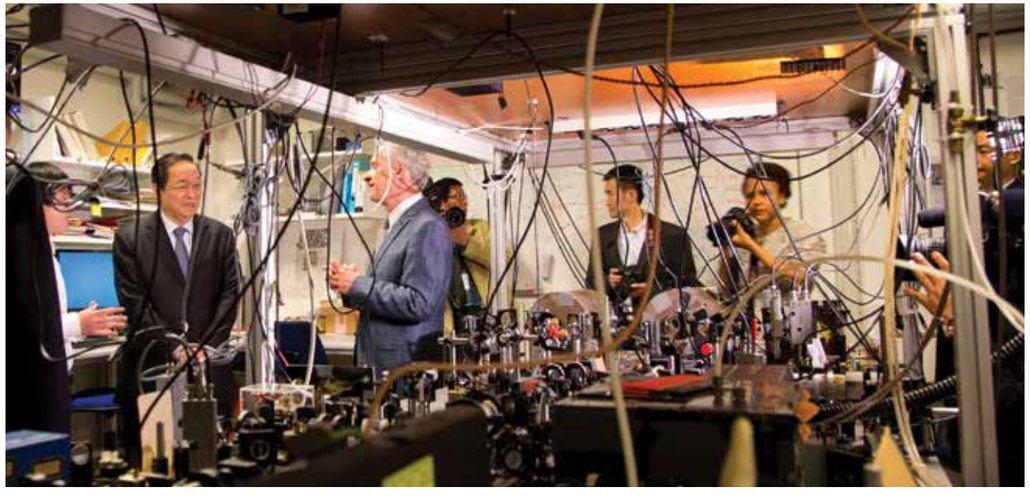
Of the 155 PhD students enrolled at the Institute, 88 have an international background. Among the research staff 52 out of 147 come from abroad.



## STRENGTHENING INTERACTION WITH OUTSIDE WORLD

The Niels Bohr Institute actively promotes interest in physics throughout society. We will strengthen our activities directed toward the general public with a particular eye toward awakening an interest in science, and particular in physics, in children and young people. By offering activities away from the Institute we will ensure that we reach children and youth who would not have visited our events on their own accord. This will be done in close collaboration with primary and secondary schools, and teacher training colleges as well as with other educational and research institutions.

**Cooperation with Business and Industry**
Through close dialogue with business and industry we will ensure that our graduates are always attractive in the job market and are known to possess a useful and high-quality education. Prior to their specializations within the various subfields of physics they have all achieved a substantial knowledge of basic sciences. Our students should be aware of their qualifications and it should be clear to them where they can apply for jobs. An increased amount of collaborative projects with business and industry will lead to a higher number of students carrying out study-related projects in private companies; thus the students will become familiar with their opportunities in the corporative job market, including the industrial PhD programme, early in their academic career. The Niels Bohr Institute is industry-friendly; throughout the years we have been housing small companies that have come into existence as a result of the research carried out at the Institute.



It is important that the benefits of our basic research, including the technical training of our students, reach society. When opportunities and interest arise, the Institute will establish contact with businesses that will develop applications of our scientific knowledge. Our ambition is to promote passion-driven collaboration on topics of common interest between our researchers and industry.

**Public Outreach**
The Niels Bohr Institute's researchers appear frequently in the media, and our Public Outreach Section is doing extremely well helping researchers communicate their findings to a broad audience. The Niels Bohr Institute is a well renowned institution with a proud tradition in research and a strong brand. We will also focus on promoting the NBI in new ways to effectively reach various audiences. We will communicate professionally with the Institute's various stakeholders, including the political world. On a broader scale, we strive to increase awareness among the public of the value of physics research for the development of knowledge and technology. We will safeguard our historical values while using them efficiently in our fundraising and recruitment activities, nationally as well as internationally.



## INFRASTRUCTURE

To provide our staff and students the best possible working conditions, a flexible, well-run infrastructure that effectively supports the Institute's functions is essential. Flexibility and adaptability are critical to the development of administrative and technical support and must be enhanced while maintaining close cooperation with the research groups.

**The Physical Framework – the Buildings of the Niels Bohr Institute**
The Institute is challenged in terms of space, as we have seen a large increase in staff but not in square metres. To provide the students with an attractive study environment, lecture rooms and laboratories must be kept up-to-date. The Institute should be a pleasant place to work and study for us all: staff, students, and visitors. Availability of meeting rooms and public space is a prerequisite to develop a common identity and encourage the development of new scientific ideas.

There are already comprehensive and fruitful collaborations among several of the institutes that are to move into the Niels Bohr Building, both in research and education, for example via the Nano-Science Center. The Niels Bohr Building is an opportunity to strengthen and develop these ties. Furthermore, we will facilitate continuous collaboration between staff at the different addresses of NBI, including the electronic and mechanic workshops.


The library is not only an academic gathering point, it also offers study rooms for our students

**Technical Infrastructure**
The mechanic and electronic workshops play a vital role at the Niels Bohr Institute, since much of the equipment used in the research projects is custom made. Technicians also assist with teaching, especially in experimental classes that involve the use of technical equipment. Experience shows that productive collaboration between researchers and technicians works best in physically close settings, so it is vital that the Technical Workshops are located as close as possible to researchers. To best use our technicians' skills, knowledge and creativity, standard equipment and services should be bought externally.

It is important that the size and skills of the technical staff group is adequate to adapt to the changing demands of the Institute. Technical support will be upgraded to achieve an acceptable, stable level. The Technical Workshop strives to be internationally competitive, enabling it to successfully bid for large international projects, such as instrumentation development for ESA, ESS, CERN, and MAX IV.

**IT Infrastructure**
Today, a well performing IT infrastructure with facilities and software programmes in demand is crucial if the employees should be able to solve their tasks within research as well as education. This includes, among other things, good network facilities with sufficient capacity to cover all employees and students, a well performing email programme, backup and sufficient power for calculations necessary for minor as well as medium-sized projects, and a suitable range of software programmes. As far as the Institute does not deliver this service, we must make sure that ScienceIT and KoncernIT do.

Finally, there is a need for a software workshop comparable to the mechanic and electronic workshops, where the researchers can get assistance with the construction of necessary programmes in relation to their projects. Regarding support, the optimal solution is that the users only have to address a single point of entry. Generally, IT support should be close to the users and adaptable to their needs.

**Administrative Infrastructure**
Competent and service-minded administrative staff members ensure that staff and students get the assistance they need, and that the Institute presents itself as a professional and well-run organisation. The administrative staff feel ownership of their tasks and the results they achieve, while developing their skills and knowledge to meet the evolving needs of the Institute. Our administration will remain flexible and solution oriented.

Administrative resources will be distributed in the most logical way to support research. Flexibility is key word both regarding administrative units and time; the best solution at one time may not be the best at another. Joint responsibility and even better interaction and cooperation in the administrative teams should lead to a dynamic administration able to react swiftly and effectively to the researchers' varying needs. Regarding research funding, we will have a professional and proactive culture, where researchers are well advised on the many funding possibilities and assisted by competent administrative staff members. The Institute has an extensive and active programme for visiting researchers, which we will continue handling and supporting at the Institute level. Other examples of areas where local support is needed are communication and administration regarding teaching.
The Niels Bohr Institute will continue to challenge the boundaries and look for novel solutions when it comes to administrative challenges. We want to become a role model for other institutes and faculties at the University and to play an active role in the development of the entire University.



Today, the Institute is located at three different addresses. Particle Physics, Quantum Optics, Biophysics, the Academy and the administration are placed at the old institute at Blegdamsvej, while Condensed Matter Physics and Xray and Neutron Science are at HCØ. Geophysics, Astronomy and the Dark Cosmology Centre are housed in the Rockefeller Complex.

Places and events that bring people together are of direct scientific value. An essential part of the internal communication occurs at an informal social level, such as receptions and common events. All staff should feel welcome to and support the traditional yearly events: Kick-off, Summer Party, Christmas Lunch, and the like.



## DIALOGUE AND COMMUNICATION

**Internal communication**
Open dialogue among all staff categories, including the leadership, is essential for the development of the Institute. On-going projects, roles and special achievements are visible in order to enable our staff to better understand each other's work areas. Efficient and effective internal communication promotes a positive work climate and helps establish and maintain good work relations.

Meetings, where the Management Team visits the research groups, are valuable opportunities for a direct dialogue between staff and leaders. Regular meetings internal to the research sections are also of great importance, as they encourage dialogue and flow of information from and to the Management Team. Online information, newsletters, email and face-to-face are all important means of communication, and we will give more attention to using the right media for communicating effectively in various situations.

**Language Policy and Internationalisation**
The Niels Bohr Institute is an international institution, and many nationalities are present among our staff, students and guests. Our communication must be efficient and clear and should accommodate non-Danish speakers.

**From Strategy to Action**
An action plan group has been appointed to analyze the final strategy and move ahead on creating an action plan based on the main themes of the strategy.
The action plan group will coordinate the process and ensure momentum in relation to the various themes and their eventual action items. A wide variety of Institute staff will be consulted in the development of the action plan, which will eventually be presented, discussed and evaluated by the Institute Council.

The strategy is based on input from the Institute's Vision, Strategy, and Structure Reflection Group (VSSRG):

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