

Evaluation of NORDITA's activities, organisational structure and cooperation

Report of the Evaluation Committee

The Evaluation Committee was composed of the four following members:

Prof. Curtis Callan (Princeton University, USA)
Prof. Susan Coppersmith (University of Wisconsin, USA)
Prof. Peter Fulde (Max-Planck Gesellschaft, Germany)
Prof. Edward van den Heuvel (University of Amsterdam, the Netherlands)

Prof. Risto Nieminen (Helsinki University of Technology, Finland) acted as the secretary of the Committee.

The Committee has received written background material from NORDITA, including their latest annual reports, outline of present activities, and future vision. The Committee has also received the Letters of Intent from Copenhagen University and the consortium of Stockholm University and the Royal Institute of Technology in Sweden. The Committee has visited NORDITA during November 22-23, 2004. During the site visit the Committee has interviewed the NORDITA faculty and director, heard the presentations of the two prospective host organisations, and met with representatives of the NORDITA Board.

The terms of reference and the schedule for the Copenhagen visit are appended to this report.

The Committee's conclusions and recommendations are based on the information available at the time of its meeting. The Committee is unanimous in its findings and recommendations.

1. Executive summary

The Committee fully endorses the vision of future NORDITA as an active hub and catalyst for research in the broad area of theoretical physics and with a very beneficial influence in other scientific disciplines and application areas for advanced methodologies. We feel very strongly that such measures be taken that best secure the scientific and financial independence for NORDITA. Despite its small size, NORDITA has demonstrated in the past its ability to move quickly into new and emerging areas of science. It has also had a very important role as a training ground and intellectual home for the Nordic theoretical physics community. In our opinion, it should continue to have this special role also in the future, where we see great opportunities for NORDITA both in research and in researcher training. It is crucial to maintain a strong independent role for NORDITA to preserve its Nordic character and support and to maximize its attractiveness for world-class research leaders.

The Committee is impressed by the scientific achievements and the track record of NORDITA. It has identified several areas where NORDITA has a strong international impact. NORDITA is a small but agile organisation capable of making initiatives and launching high-risk projects in new areas of theoretical physics. The Committee is convinced that such an organisation is a major asset to the Nordic countries. A

strong research environment at NORDITA supports and complements the theoretical physics activities at Nordic university campuses. The Nordic Fellowship program continues to have a very positive influence in the career development of young physicists, and the visitor programs attract a large number of scientists and increase the international impact and visibility of Nordic theoretical physics. The Committee also commends the activities NORDITA in post-graduate and undergraduate education.

Of the two suggested future hosting organisations, *the Committee unhesitatingly prefers the proposal by Stockholm University and the Royal Institute of Technology*. Not only does this proposal provide a much stronger independence and Nordic role for NORDITA, but it also provides a bridging solution in terms of host funding to overcome the loss of NMR funding in the near future. This will enable the NORDITA faculty and fellows to build new initiatives for external funding, both from within the Nordic countries and from Europe.

In our opinion, NORDITA is a unique scientific infrastructure and should be supported as such. Combined with the foreseen changes in the senior faculty due to retirements, the move to the greater Stockholm area would provide a major opportunity for NORDITA for renewal and continued success in basic research.

2. The relevance and degree of success of NORDITA's past and present activities

NORDITA views itself as an institution that promotes frontier research in theoretical physics in the Nordic countries first, by carrying out such research at a high international standard and, no less important, by serving as an easily accessible source of inspiration and training for young Nordic scientists. The Evaluation Committee believes that this is an extremely important mission and that NORDITA has been, and continues to be, a remarkably successful vehicle for its accomplishment.

In our brief meeting, we did not have the time to perform an in-depth evaluation of the quality of NORDITA's various activities: what follows is our best attempt at a collective judgement on the basis of previous knowledge and information gathered at the meeting.

1. Research

Research at NORDITA covers a remarkably wide range, considering that there are only six senior faculty (beside the director). The major fields are astrophysics, many-body physics, biological/statistical physics and particle theory. In each area there are one or more faculty who do world-class research on specific topics and who also organize schools and training programs on broader topics within their area. Our comments on the specific areas are as follows:

a) Biological/Statistical Physics: Hertz is a pioneer in the theory of neural networks and the author of one of the defining textbooks in the field. Sneppen is known for important work on self-organized criticality and other problems in nonlinear dynamics. Over the past several years he has focused on biological networks and his work in this field (some together with Minnhagen) is world-class. It is distinguished by close interaction between theory and experiments on specific biological systems, most notably on bacteriophages (viruses infecting bacteria).

b) Astrophysics: NORDITA has been instrumental in building the field of astrophysics and cosmology in the Nordic countries, through its programs, workshops and summer schools and also through the training of young researchers. Many of the prominent astrophysicists at Nordic universities had postdoctoral appointments at NORDITA and, in fact, some twenty current astrophysics permanent staff members at Nordic universities are NORDITA alumni.

Astrophysical research at NORDITA itself is outstanding in its areas of specialization: the study of compact objects and high-density matter (neutron stars, black holes), led by Pethick, astrophysical magneto-hydrodynamics and plasma astrophysics, led by Brandenburg, and the important emerging field of particle astrophysics and cosmology, led by Mazumdar.

c) Many-body Physics: Pethick has a long history of imaginative applications of many-body theory to novel physical systems, starting with helium liquids, continuing with neutron star dynamics and supernova collapse, and culminating recently in analyses of the rich physics of ultracold atomic condensates. He and his colleagues constitute one of the most important theory groups in this "hot" area and are engaged in a continuing dialogue with the relevant experimentalists. He has written the definitive textbook in this new field and has organized numerous schools and workshops. Luther has made seminal contributions in the area of low-dimensional systems, in particular the bosonization of fermionic degrees of freedom. Together with Emery from Brookhaven National Laboratory, he has received the prestigious Oliver Buckley Prize of the American Physical Society.

d) Particle Theory: Di Vecchia is an excellent string theorist who has participated actively in many of the recent developments in this fast-moving field. He is a tireless expositor and summer school organizer and was instrumental in winning an EU Marie Curie Training Grant to bring PhD students from all over Europe to NORDITA for advanced graduate training in string theory. Diakonov is an expert in applying perturbative QCD to high-energy processes and most recently launched a worldwide storm of experimental and theoretical activity with his prediction, on the basis of non-perturbative QCD, of the existence (and precise mass) of a remarkable pentaquark baryon.

It is notable that this research activity, and the personnel involved, has steadily evolved over time, in keeping with the vision that NORDITA should be a focus for the importation of new developments in theoretical physics into the Nordic physics environment. This intellectual nimbleness is the outcome of the consistent implementation over many years of the NORDITA policy of international recruiting on the basis of the highest intellectual standards and giving the faculty so recruited the resources to follow their research program wherever it leads. We note that NORDITA has, as a result, consistently put itself well ahead of most of its competitors in investing in important emerging fields. In particular, NORDITA staked out a position in the modern, more thoroughly biological approach to biophysics well before the current surge in popularity of this field. This attitude, if maintained and nurtured, will guarantee NORDITA's success in the future.

II. Training and Nordic impact

These two aspects are so closely intertwined as to be nearly inseparable and we will discuss them together.

A training activity that is most closely intertwined with research at NORDITA is the Nordic Fellows program. At any given time, NORDITA hosts about fifteen postdoctoral fellows from the Nordic countries on a two-year contract. These fellowships are a structural element of the NORDITA program, paid out of the NORDITA base funding and not tied to a specific research project or faculty sponsor. For this reason, the fellows have the freedom to move into new areas as their own curiosity, or new developments in science, dictate. This program has been the vehicle for generations of fellows to make the transition from research neophyte to the status of mature, independent scientist. The statistics are impressive: over the years, more than 300 fellows have passed through the program and more than 50% of these have made their way into faculty positions (or equivalent) in Nordic universities! This one NORDITA program has benefitted virtually all Nordic universities in a major way, and at remarkably low cost. Similarly, Nordic lecturers and assistant professors (both fixed-time appointments) have had a very visible role in shaping the activities at Nordic universities.

A second activity of note is the training of graduate students from Nordic universities. In the first instance,

NORDITA faculty directly supervise the thesis research of graduate students from various Nordic universities. At the moment, there are about ten such students in residence who will eventually receive a Ph.D. from their home university. These students derive a double benefit: they are able to work in a wider variety of areas in theoretical physics than might have been accessible at their home university and they are exposed at an early stage to the intellectual standards of physics at the international level.

In the second instance, NORDITA faculty run summer schools and workshops on a wide variety of topics of current interest, acting as lecturers themselves and recruiting top people from outside to lecture as well. Although NORDITA pioneered in this mode of graduate student instruction, such workshops are now much more widely available in Europe. The NORDITA difference (beyond the tradition of high quality and impact) is that Nordic graduate students can attend these activities "as of right" and easily obtain travel support directly from NORDITA for such participation. More than one person we interviewed contrasted this with the effort and advance planning needed to obtain the funds to send a student to a typical non-NORDITA training activity.

Both of the above activities have a clearly discernible impact on Nordic graduate training in theoretical physics, most importantly in emerging areas where large centers of excellence have yet to nucleate at other Nordic universities. It should be noted that to have this kind of Nordic impact, it is important that funding for student and lecturer support be part of the NORDITA infrastructure budget: the model of requesting separate topical support from funding agencies for individual workshops would soon bureaucratize the process and remove the flexibility that has made this program such a historical success.

Finally, we would like to note with approval a relatively recent outreach activity known as the NORDITA Master Class. This is typically a one-week meeting at which undergraduate students in physics from the Nordic region attend a series of lectures by four or five international experts on a broad range of frontier topics in physics and engage in informal interactions with this faculty. The intent is to give talented undergraduates a more concrete idea of the excitement and ferment of modern theoretical physics in the hope of inspiring them to continue on to graduate study in this area. These are new activities and it is hard to say what their long-term impact will be, but it is likely to be very positive. This is a very promising initiative and one which should be included in the base of activities of the new NORDITA.

In closing, the Committee would like to note that it was struck by the consistency of the attention given by all the NORDITA personnel, from the director to the fellows, to the question of "Nordic impact" of their activities and their institution. We were also struck by the consistency of the reports from outsiders in the Nordic theoretical physics community that this impact had been very strong and very valuable over a long period of time. The concrete evidence of this impact that we were able to gather was fully consistent with these opinions. It is quite clear to us that any diminution of the activity of NORDITA would create a real hole in Nordic scientific life, and one that would be very hard to fill in some other way. Considering the modest cost of NORDITA, to force such a diminution of activity for budgetary reasons would, in our considered opinion, be a false economy.

3. NORDITA's vision for the future

With the rapid development of theoretical physics taking place worldwide it becomes increasingly difficult for small or even medium size and large universities to bring new trends and progress at an early enough stage to the attention of students. Therefore it is highly desirable to have an institution where advanced students and post-doctoral fellows of the Nordic states can learn about them and contribute to the development of emerging fields. NORDITA is ideally suited to serve this purpose. A prerequisite is a complete independence in choosing its directions in research and to be able to hire absolutely top people. Visibility of emerging fields can be accomplished by organizing workshops and symposia to which young

scientists from the Nordic countries are invited together with leading experts working at the cutting edge of those fields. It is important that young researchers can see the level which must be reached in order to be able to contribute to a field. The organization of workshops and seminars should therefore play an even larger role in the future than it has in the past. The Evaluation Committee feels also that the Master Classes which have been established some years ago should be continued in the future. They serve the purpose of educating selected students on a somewhat lower level, *i.e.*, at an earlier stage of their education.

We consider it also important that junior staff members of the universities of the Nordic countries have the opportunity to spend a limited time at NORDITA in order to get started in new research areas. A successful start into a new field can be done only in an environment where enough partners for discussions are available and in an atmosphere of high intellectual level. Again, NORDITA can provide such an environment, provided that it stays completely independent, in particular with respect to its hiring policy. For an institute which aims at remaining of the same quality as the very best in the world this is an absolute "*conditio sine qua non*".

Doing research at the forefront in theoretical physics and transferring that knowledge to young researchers can be done only when an Institute is open also to visitors of other parts of the world. The guest program should therefore be kept by all means and even expanded if possible. One cannot work successfully by being screened or isolated.

We also recommend that Nordita establishes ties to other European institutions which have similar aims such as the Institute for Theoretical Physics in Trieste, the Isaac Newton Institute in Cambridge, the Institute Henry Poincare in Paris and the Max Planck Institute for the Physics of Complex Systems in Dresden. This will ensure that the young academic staff in theoretical physics of the Nordic countries is well embedded in the larger European community.

4. Future organizational structure and cooperation

In the terms of reference, a number of questions were posed to the committee:

A. Is the organizational structure, including the local infrastructure and the cooperation optimal for future activities?

To answer this question, the committee decided first to make a list of what NORDITA needs to be effective. There are several conditions which are crucial for NORDITA to succeed in promoting theoretical physics in the Nordic countries in the future. These conditions follow because (1) NORDITA must be directly relevant to all the Nordic countries, (2) NORDITA must be organized so that it has the flexibility to keep evolving at the forefront of theoretical physics over the long term, and (3) it must remain a place where young people from Nordic countries as well as seasoned researchers from Nordic universities can be exposed to the latest developments in emerging fields.

Crucial needs for an effective NORDITA

- NORDITA must have autonomy in hiring decisions, both of permanent faculty and of shorter term employees,
- The positions at NORDITA must be as attractive as possible, so that NORDITA is able to recruit permanent faculty of the highest caliber,
- NORDITA must have the ability to continue pan-Nordic activities such as Nordic fellows, workshops, and summer schools,

- NORDITA must have funding that enables it to enter into new fields in a flexible manner. The committee feels that the organization cannot function effectively on a budget of less than 20 million kroner/year.

B. How should the cooperation and sharing of responsibilities between NORDITA and other national institutes for research and researcher training be organised?

NORDITA provides a unique means for students and young researchers to learn about cutting-edge developments in theoretical physics, and to provide a fruitful research environment in emerging fields. It complements the university system in each of the Nordic countries by enhancing communication and bringing together communities of geographically separated researchers. The need for this type of institute is recognized internationally by the presence of theoretical physics institutes in Santa Barbara, Trento, Trieste, and Cambridge. The Nordic focus of NORDITA is important to providing opportunities on an appropriate scale.

C. How should the cooperation with the future host institution be organized?

Concerning the future organisational structure, including optimal local infrastructure and local embedding: The 50 per cent reduction of the NORDITA budget supplied by the NMR and the fact that NMR's contributions are guaranteed for periods of no longer than five years forces a serious rethinking of the organisation and location of the institute in order to adapt optimally to this new situation. The Committee feels that a solution of these issues is to be preferred which compromises *the least* the crucial needs listed above.

Offers from Copenhagen and from Stockholm

Two letters of intent have been received from institutions who are offering to host NORDITA in the future, one from University of Copenhagen, Denmark, and the other from University of Stockholm and the Royal Institute of Technology (KTH) in Sweden. The committee also heard oral presentations from representatives of each of these groups on 22 November, 2004, where some additional details were fleshed out. We now present our understanding of the offers of these two parties.

I. The Copenhagen alternative

In the offer from *University of Copenhagen (KU)*, NORDITA would continue to be housed in its present location. NORDITA would become an independent Institute located at the Faculty of Science at KU, on equal footing with its Niels Bohr Institute. The Institute would be governed by a Nordic Board consisting of two representatives from each of the five Nordic countries. The members would be formally appointed by the Rector of the KU upon suggestions from the Joint Committee of the Nordic Natural Science Research Councils. In addition, one Board member from KU would be appointed by the KU Rector. The Director, who is appointed by the Rector upon the recommendation of the NORDITA Board for a term of five years, is responsible for NORDITA's scientific and budgetary decisions.

According to the organizational structure presented by KU representatives, NORDITA will – in this model – be part of the Faculty of Science of KU, which will provide the present building as well as library and network facilities, etc. The new situation, as part of the Faculty of Science, is particularly relevant with regard to the future of the tenured staff of NORDITA. This staff presently consists of the six NORDITA professors, one of whom will be leaving in March 2005. Since in the new situation NORDITA can no longer offer tenure, KU proposes the following model to achieve a new situation in which there is a tenured “core-staff” in NORDITA. In the future there will be five tenured “Distinguished NORDITA-NBI Professors,” who have permanent appointments at KU, their salaries being paid by KU. The proposal

regarding the appointments of the Distinguished NORDITA-NBI Professors is that the NORDITA Board identifies thematic research programs, which will run for up to five years, and will be led by a distinguished NORDITA-NBI Professor. To this end, KU will internationally advertise a professor position in this field and, in collaboration with the NORDITA Board, select the candidate, which will be appointed by KU and will be “on leave” from KU at NORDITA for a five-year period, possibly extendible to ten years or more. After the term at NORDITA, the professor will move to the NBI. A candidate’s appointment needs approval both from the NORDITA Board and from KU.

Because of the budgetary situation at KU, there will be a three-year transition period before the appointment of these new professors can be started. For this transition period 2006-2008, KU proposes that, temporarily, present NBI professors can be appointed as “Distinguished NORDITA-NBI Professors” to lead new programs at NORDITA. After this, starting in 2008, the five new “Distinguished NORDITA-NBI Professors” will be appointed, presumably one per year. In the meantime, the remaining five present NORDITA professors will be paid from the 10 million Danish kroner base budget provided by the NMR.

Regarding financing for appointments temporary staff, workshops and the visitor program (roughly 50 per cent of the present budget), the KU proposal suggests that funds should be obtained from external sources (private foundations, Nordic Research Councils, and EU).

Most of the permanent faculty presently at NORDITA will be retiring over the next 5-8 years, and during this period their salaries would be paid from NMR funds.

II. The Stockholm alternative

The second offer considered by the committee is from Stockholm. In this NORDITA would become an independent Institute under the auspices of *Stockholm University (SU)* and the *Royal Institute of Technology (KTH)*. It was stated at the oral presentation that *University of Uppsala (UU)* also would be joining this consortium. In this offer, NORDITA would be located in a newly renovated building with about 1500 square meters of usable floor space at the AlbaNova University Center, which is in the immediate neighborhood of SU’s and KTH’s departments of physics, astronomy and biotechnology as well as near the Karolinska Institut. The running costs and overheads of the physical infrastructure would be covered by the host universities. In the Stockholm offer, NORDITA would be independent but affiliated with SU, KTH, and UU, falling administratively directly under the Rectors of the universities. NORDITA would have autonomy in hiring, and each permanent faculty member would be guaranteed a tenured position at the one of the three universities of his or her choice. The Board would be appointed by the Nordic Research Councils through NOS-N and be composed of delegates from the Nordic countries.

The committee’s impression is that the expectation is that the permanent faculty would mostly remain at NORDITA, and that the tenured positions at the local university are employment guarantees, and do not represent an expectation that the NORDITA faculty would be routinely obligated to rotate through the local departments. The Stockholm consortium also offered 10 million Swedish kroner for five years (three in the written confirmation) to serve as bridge funding, while new sources to replace the reductions in the NMR funding are identified and developed. The Rectors at SU and KTH suggested infrastructure funds from the Swedish Research Council as a possible future funding source, especially after the termination of the bridge funding.

We now discuss the committee’s view of how the different offers address NORDITA’s crucial needs.

Autonomy: As stated above, the Committee feels that autonomy in hiring decisions is crucial. In the Stockholm offer NORDITA would have autonomy in hiring decisions, while in the KU offer all hiring decisions for permanent faculty would be made jointly with the Niels Bohr Institute. Moreover, all the hiring decisions at KU would be subject to KU regulations, which would preclude the entire NORDITA Board from considering the job applications. We thus expect that NORDITA would eventually lose its

special identity and become an institute of KU. Therefore, the Swedish offer is much more attractive in this regard.

Attractiveness of permanent faculty positions: The Committee feels that the faculty positions in the KU proposal are less attractive than in the Stockholm proposal, because in the Copenhagen scheme the expectation is that after five years the NORDITA person would join KU as a regular faculty member, with the attendant teaching and administrative duties, whereas in the Stockholm scheme the expectation is that an active and successful NORDITA faculty member could remain at NORDITA for a longer term.

Maintenance of pan-Nordic activities: In the KU proposal, in the near term most of the NMR contribution to the budget would be used to pay the present permanent faculty, administrative and running costs, so that the temporary positions, summer schools, and visitors program would not be possible until alternative funding sources are developed. The Committee feels that this hiatus in activities is a severe disadvantage that is not present in the Stockholm proposal, where bridge funds can be used to support these important programs for the next several years.

Funding: The Committee is confident that in the long run the high quality of the researchers and programs at NORDITA will enable it to attract enough outside funding for the organization to be viable in the long run. However, the committee feels that the effectiveness of the organization will be significantly enhanced if the funds are not earmarked to specific projects but rather are flexible enough so that new research directions can be explored. The Committee also feels that the infrastructure funding of the Swedish Research Council suggested by the Rectors would allow for sufficient flexibility and hence be an extremely attractive funding source for NORDITA in the future.

5. Conclusions

The Evaluation Committee recommends that *negotiations be undertaken with the consortium of universities in the greater Stockholm area to host NORDITA in the future.* In our opinion, the Letter of Intent from the Stockholm area university consortium, complemented by the hearing on November 22, provides a good platform for a scientifically strong, independent NORDITA, which can continue to play an important role in the Nordic community of theoretical physics. When properly implemented, the new organisation will enable NORDITA to flourish scientifically, with new types of local interactions and renewed impact in the larger Nordic context. The new hosting organisation will also be more natural for a basic-research institute such as NORDITA, compared to the present hosting through NMR. As a specific activity in the new organisational framework, the Committee strongly recommends that scientific evaluations become a regular instrument in the future NORDITA.

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