

# NOT Beyond 2009: Towards the Common Northern Observatory

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## Executive Summary

The rapid development and increasing integration of European astronomy requires a redefinition of the future role of the Nordic Optical Telescope (NOT) within this context. A merger of the major night-time telescopes on La Palma, called the Common Northern Observatory (CNO), has been identified as the most scientifically powerful and cost-effective model for the future. Based on the conclusions of wide community consultations (see Annexes), this report summarises the priorities and strategy for NOT in the period of transition. The recommendations include strong specialisation on a few fields in which Nordic astronomy can be particularly competitive with NOT; focus on a single set of permanently mounted instruments; increased flexibility in operations; and a series of proactive initiatives to realise the benefits of the CNO as early as possible.

## Background

The Nordic Optical Telescope (NOT) was founded as a general-purpose Nordic observing facility in 1984. Since then, the scientific profile of Nordic astronomy and the competition from powerful international facilities have changed dramatically. The role of NOT must be redefined accordingly: A sharper scientific profile within the context of European astronomy is needed, focused on innovative science where world-class impact can be made. The ambition level must be higher, new frontiers must be opened, the instrumentation be renovated, and operations made more efficient.

## Vision and Strategy for the Future

For compelling scientific and operational reasons, the most powerful and cost-effective future for NOT is an integrated partnership with the British 4.2m William Herschel Telescope (WHT) and 2.5m Isaac Newton Telescope (INT), the Italian 3.5m Telescopio Nazionale Galileo (TNG), and eventually also with the Spanish 11m Gran Telescopio Canarias (GTC), all located on La Palma. This new European facility, known provisionally as the *Common Northern Observatory* (CNO), will be equipped with a coordinated suite of instruments, be operated as a single, efficient unit, and be open to new partners as appropriate in each case. It will also play a key role in the training of the next generation of young European astronomers.

The fully-fledged CNO is our vision for the long-term future of NOT. It was strongly endorsed by the international evaluation of NOT in 2006. To make it a reality, a number of scientific, technical, administrative, financial, and psychological barriers must be overcome, and it will take time and effort to reap all the benefits. Our strategy is to define a competitive role for NOT in cutting-edge Nordic astronomy that will last well into the CNO era and, building on this lead, work proactively towards the realization of the full CNO as our strategic objective.

## Recommendations

The scientific success of NOT in recent years is based on *(i)* access to the northern hemisphere and its unique datasets, such as the Sloan Survey and VLA radio maps; *(ii)* good image quality; *(iii)* instruments tailored to the scientific needs of the community, and *(iv)* flexible operations enabling science-driven scheduling for projects of high scientific merit. In parallel, NOT has become a very successful tool in training young Nordic researchers, a need filled by neither ESO nor ESA. These strengths must be preserved and further developed on the way into the CNO era.

## What Must Improve

In the future, NOT must focus more sharply on the highest-impact Nordic science and not attempt to satisfy all needs. An integrated view of its operation must be taken, from the way observing time is distributed and observations scheduled to the suite of instruments and pipeline data processing tools offered. A new approach to instrumentation must be taken: Instrument projects must be based on a strong science case and end-to-end design, be backed by adequate financial, technical, and human resources, and be completed on schedule and budget or face cancellation. The *ad hoc* use of NOT in training courses must be replaced by a systematic, coordinated, and cost-effective approach, and NOT Research Students should receive more effective scientific support. Each of these is discussed in the following.

### Time allocation

The allocation of observing time at NOT is based strictly on peer review, as reflected in the large fluctuations in national time shares from semester to semester. If ranked above the cutoff grade, projects are assigned the time requested unless it was calculated wrongly. Yet, typical observing runs remain short, 3-5 nights. While never formally imposed, this 'glass ceiling' may discourage very ambitious proposals and impede the completion of large projects on a competitive schedule.

Future *Calls for Proposals* should explicitly invite both large, medium-size, and small proposals. Pooling of related and synergistic projects by consortia should be encouraged. For proposals by senior researchers, the peer review should emphasise their track record (publications, citations), but for young researchers, innovation should be given high priority if the project is feasible.

### Scheduling

The fraction of service observing time should be increased to optimise success on transient and other variable sources and to improve scientific efficiency, especially in the winter season. For the service mode to become fully effective, the instrumentation should be trimmed to a competitive subset that can be mounted permanently (see below). The rapid response to transient events should be further improved and perhaps automated. A considerable initial development effort is required.

Costed options for the gradual introduction of this new style of operations are being prepared, and first steps towards its implementation should be taken as soon as possible.

### Instrumentation

Certain improvements of the instrumentation should be made with immediate effect: The obsolete CCD in StanCam should be replaced by a modern device with larger field, higher UV sensitivity, and low fringing in the red. MOSCA can then be decommissioned. A similar CCD is needed for ALFOOSC to alleviate the fringing problems in the red. Modern, fast controllers should be installed everywhere, and the choice must be made before the end of 2007.

The use of NOTCam is now impeded by a lack of pipeline reduction software. Such software and associated calibration routines should be implemented for all active instruments as soon as possible, drawing on the experience and active involvement of experts in the user community.

Wide-field telescopes with large CCD arrays have become operational in the 15 years since the focal reducer FRED was conceived, and the community reports indicate that there is now little interest in the type of imaging that FRED can offer. Mounting FRED at the main focus would also counteract the primary strategy of achieving maximum flexibility of response in the future. Accordingly, but regrettably, the FRED project should now be abandoned.

Polarimetric imaging and spectroscopy are gaining increasing importance. A Wedged Double Wollaston device in ALFOSC would provide this in a convenient manner, and a new calcite plate in FAPOL would increase efficiency. A tradeoff study between these options should be commissioned from the interested community, and action taken accordingly.

There is a demonstrated, continuing need for a stable high-resolution optical spectrograph that can be deployed in a flexible manner regardless of what instrument is mounted at the main focus. This need is filled by FIES, perhaps with another CCD to minimise fringing in the red. A polarimetric option for magnetic field measurements with FIES is desirable and should be investigated; SOFIN can be decommissioned when FIES can take over.

Many projects in cosmology or extragalactic science require simultaneous imaging and polarimetry with good image quality in a moderate field over the wavelength range 300 nm - 2 microns, as well as high-efficiency low-resolution spectroscopy. Desirable options include optical imaging with the highest possible spatial resolution, high time resolution, and high-quality polarimetric capabilities. An efficient standby successor to ALFOSC could fill these needs and should be studied further.

### **Management of Instrument Projects**

Projects for new instrumentation should be preceded by a Call for Proposals. The proposing teams must present a compelling science case, backed by a proven track record, and demonstrate the efficiency and feasibility of the chosen technical approach as well as a commitment to provide the necessary scientific and technical skills, manpower, and funding to complete the project in a timely manner. Calibration devices, calibration plans, and pipeline reduction software should be included, so the resulting data will enter seamlessly into future Virtual Observatory. An appropriate amount of guaranteed observing time should be awarded in return for these contributions; failure to meet agreed targets should result in loss of that reward and/or cancellation of the project.

### **Education**

Since 2003, an annual undergraduate course in observational astrophysics at Stockholm University includes an observing period at NOT. Courses at the PhD level were conducted at NOT in 2003 and 2006 and in remote mode from Molėtai Observatory, Lithuania, in 2002 and 2005, all with NorFA support. Following the success of these initiatives, similar Danish courses at both undergraduate and PhD levels will start from 2007, and plans are under way also in Norway.

This level of activity requires a more systematic approach. Training must be formally defined as part of NOT's activities and an appropriate amount of observing time reserved for it. Competitive proposals to use this resource in a cost-effective Nordic university-level training programme should be invited and the best be implemented for a fixed period, followed by an evaluation of the results. The cost-effectiveness of on-site vs. remote use of the telescope should be evaluated under realistic conditions at an early stage, and a plan for making NOT an effective tool for Nordic MSc projects should be included as well.

The success of the NOT Research Student programme merits an increase in the number of students. This expansion must be balanced with the need to ensure adequate supervision and telescope access for each student. Scientific supervision could be improved by visiting postdocs, and cooperation with the supervisor at the home institute should be strengthened and made more systematic.

Two trial visits (½-1 night) by high school classes studying astronomy have been very successful. Such visits are potentially valuable in recruiting new students to the sciences, but should not detract significantly from the primary mission of NOT to serve professional astronomy.

Finally, all educational activities at NOT should be coordinated by the STC. Education should be a permanent agenda item at all its meetings.

## Pushing Towards the CNO

Rationalising its instrumentation and operation as described above will give NOT a strong role in the period leading into the future CNO. It will offer a unique combination of flexibility and power in scientific fields that have high priority in the Nordic countries as well as worldwide. It will thus provide a capability that will be in demand for the foreseeable future and unlikely to be duplicated by other CNO telescopes. It will also establish NOT as a model of rationalisation and coordination in the OPTICON access programme under FP7, and in the CNO.

However, the full scientific and economic benefits of the CNO will only be realised if operations are fully integrated. Therefore, NOT should continue to push aggressively towards the full CNO. For this to happen, the partners should form a committee to draft mechanisms for sharing observing time, staff, and other resources in a cost-effective manner. Although strongly recommended in the evaluations of both the ING and NOT, no real progress on this front has yet been made.

Nevertheless, progress can be made without waiting for clarification of all legal and administrative issues. As a concrete and immediate initiative, NOT should offer to open a substantial fraction of the Nordic observing time (perhaps 1/3) to the other partners in return for corresponding access to their telescopes. At the same time, NOT should make clear which of the other facilities have highest priority for the Nordic community (e.g. integral field spectroscopy with adaptive optics or HARPS II at the WHT, near-IR high-resolution spectroscopy at the TNG, ULTRACAM at the INT, and access to the GTC). This will also make clear what facilities are *not* of interest for the future.

## Epilogue

The NOT user community is to be commended for reaching such a large degree of consensus on the scientific priorities and specific proactive initiatives to be taken as we proceed towards establishing the CNO, yet without watering down the recommendations with bland compromises. This places NOT in an excellent negotiating position, both as regards the CNO and when the OPTICON access programme is redefined in the contract proposal for FP7.

Along the way, the role of NOT will change from that of a single, small telescope by the standards of today into a focus for fruitful Nordic cooperation within the integrated European astronomy of tomorrow. Hopefully, the result will be not only an increased number of high-impact publications, but also a new generation of Nordic astronomers with a hands-on experience that is increasingly difficult to obtain elsewhere, and whose friendships with other Nordic astronomers will lead to the formation of strong scientific and/or technical teams across the Nordic borders. On this background, it deserves reflection whether the role of NOTSA itself should be revised to promote such broader Nordic collaboration rather than remain limited to the operation of NOT itself.

December 4, 2006

Johannes Andersen  
Director, NOTSA

## Annex I.

### Background and preparation of this report

The international evaluation of NOT commissioned by NOS-N in 2005-6 recommended the Common Northern Observatory (CNO) as the (only) optimum and realistic framework for NOT in the long-term future. It also recommended that negotiations to define the scientific, technical, and organisational requirements for the CNO be initiated in the immediate future.

At its 49th meeting, the NOT Council endorsed the recommendations of the evaluation panel. However, before an effective Nordic negotiating position can be defined, the needs and priorities of the community for the services of the CNO must be clarified. Accordingly, the Council requested that the NOT Director initiate a consultation with “a focused set of representatives from each country, to discuss major projects for the Nordic use of the CNO as well as of the present NOT in the interim, and to set up a coherent priority list for the next 5-10 years. The future of the student programme should be discussed at the same time.” This process has now been completed.

As a preparatory step, the NOT STC and OPC members contacted representatives of all significant research groups in each country, asking them to reflect on their future use of the CNO and NOT. Each research group then submitted a short report in a roughly uniform format, outlining its plans and priorities. In parallel, the NOT Instrument User Groups (IUGs) reviewed current and planned instruments at NOT and the other prospective CNO telescopes, focusing on competitiveness, overlaps, and redundancies as well as on desirable future developments, and considering also the facilities available through ESO and ESA. These reports are available, together with the report of the international evaluation panel, at <http://www.not.iac.es/news/reports>

Subsequently, the long-term role of NOT within the context of contemporary European astronomy was debated at a meeting in Copenhagen on November 8-10, 2006. About 25 astronomers took part, representing interested research groups from all five countries and including all members of the STC (see list of participants in Annex II). Most relevant fields of astronomy were covered, from cosmology to small Solar System bodies, and the use of NOT in training the next generation of researchers was discussed in depth.

~10 days before the meeting, the research group and IUG reports were provided to the participants, who were also familiar with the earlier report of the international evaluation panel. STC members filled in any gaps from groups that were interested, but had been too busy to submit a report. The role of the ongoing EU-sponsored initiatives to strengthen cooperation and integration in European astronomy, notably OPTICON, RadioNet, and ASTRONET, was considered as appropriate,

A wide-ranging, constructive, and exhaustive discussion took place; many valuable suggestions were made; and a broad consensus was achieved on several key issues, as summarised in this report. A draft of this document was circulated to all participants for comment, but the present final version is the sole responsibility of the undersigned.

J. Andersen

## Appendix 2.

### List of Participants at the meeting November 8-10, 2006:

Andersen, Johannes	NOTSA
Andersen, Michael I.	Astrophysikalisches Institut, Potsdam, Germany
Augusteijn, Thomas	NOTSA
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