

Durham University ELECTRA-NAOMI Agreement.

wht-naomi-65

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1. Introduction.

Durham University Department of Physics is collaborating with ROE and RGO in the production of an Adaptive Optics system, NAOMI, for the WHT. Part of the collaboration is for Durham to supply hardware and software components bought and/or developed from rolling grant funds for the ELECTRA project. From the NAOMI project's viewpoint, the route to production of NAOMI is via an intermediate stage of the ELECTRA project termed E1. Durham also have a rolling grant goal for an even earlier stage, termed E0. An Agreement between the NAOMI Project and Durham University for delivery and use of various components of the NAOMI Project and its intermediate stages is therefore required to enable both projects to be managed so that they can achieve their goals with the best mutual benefit.

This note describes the mutual gains and potential disadvantages NAOMI and ELECTRA will receive from the collaboration and suggests terms of agreement for the development and use of shared components. These will form the basis of a Memorandum of Understanding between the ING and Durham University Physics Department.

2. Advantages and Disadvantages.

2.1 Advantages for NAOMI

- (a) Durham characterize a DM at an early stage their own expense.
- (b) The ELECTRA DM is potentially better than a continuous facesheet DM in fitting error (i.e. performance) and in not requiring an active (closed loop) figure sensor.
- (c) Durham develop at no cost to NAOMI a RTCS (Real Time Control System) and mirror control during their EO and E1 stages of their total adaptive optics work.
- (d) NAOMI gets an early test of the DM and drivers in the environment in which it will eventually work.
- (e) Many (> 50%) of visualisation tools will be already written for EO and E1 and will be testable at a much earlier stage than otherwise.
- (f) NAOMI sees an early test of a WFS with detector identical or similar to final NAOMI detector.
- (g) Early ELECTRA tests will allow better and more informed decisions to be taken about NAOMI priorities.

2.2 Advantages for Durham and ELECTRA

- (a) Durham get telescope commissioning time for E0 and E1 as part of the development and commissioning of a facility instrument.
- (b) There is a potential broader funding base for DM development, which may allow acceleration of development timescales or final enhanced performance.
- (c) Staged development of DM co-phasing using strain gauges (original plan was tip-tilt mode only for the segments then a development to optical-quality co-phasing via partial co-phasing without a completely co-phased IR stage).
- (d) Closer involvement with the facility programme offers potential greater involvement with facility laser development, in which Durham are interested.

2.3 Risks and expenses for NAOMI

- (a) DM failure: strain gauge testing was brought forward as a first check of potential - the ELECTRA mirror system past the test*.
- (b) In case of total DM failure, it is likely that a different type of mirror (continuous facesheet) will need to be purchased and characterized as a replacement.
- (c) The NAOMI project will need to supply Durham with a DM suitable for continuing research and development of AO and particularly instrument interfaces.
- (d) Durham will characterize this second deformable mirror so that it can be used at short notice with the NAOMI system if required. The cost of the characterization will be met by NAOMI, recognising that the ELECTRA DM is being fully characterized for E0 and E1 at no charge to NAOMI.
- (e) Durham would still require access to the ELECTRA DM on some basis to continue rolling grant programme. This should have full interoperability with the NAOMI DM.
- (f) The NAOMI project will not have total control over the early phase of development.

[*system will also be designed to fit with a commercial DM.]

2.4 Risk/loss for Durham

- (a) The ELECTRA DM will not be available as a continuing development and research tool either for laboratory or telescope work, except by special agreement.

(b) There may be an adverse effect on rolling grant goals as a result of (much) more limited access to the DM.

(c) If the ELECTRA DM fails in its capacity of being used with NAOMI, Durham staff will immediately supply the second DM to the ING and install or assist in installing it into NAOMI. At the discretion of the ING, the ELECTRA mirror will either be repaired at the ING's expense and re-installed at the ING or will be returned as is to Durham.

3. Project Responsibilities and Funding

3.1 Development of EO

Durham : (i) provision of all components, RTCS and visualisation S/W and hardware, packaging, transport and commissioning costs.

(ii) EO will be developed into E1. Durham should undertake to make every reasonable effort to ensure efficient technology transfer from EO to E1 and NAOMI. This would largely be by following NAOMI software and hardware standards and by bearing in mind NAOMI software/hardware architecture requirements. However, it must be recognised that at this stage such co-operation must be in the spirit of collaboration and is not enforceable by the NAOMI project.

NAOMI : At a minimum NAOMI has no responsibility for E0 but there are some areas which it may help E0, described in (i) to (iii) below.

(i) Provide funds to bring forward any development stages which could provide early information which would prove useful to later project stages, if this can be done without significantly delaying EO timescale or diverting goals.

(ii) Provide some resources for improving an E0 or E1 telescope interface, to aid observing efficiency, if appropriate.

(iii) Supply a broader expertise base to call upon in case of problems (e.g. the NAOMI systems engineer, who is very experienced in operating AO systems).

3.2 Development of E1

(i) Infrared co-phasing strain-gauge development cost will be funded by Durham. However if a decision is made by the NAOMI project to develop digital control for the strain gauges the incremental cost will be funded by the NAOMI project.

(ii) RTCS hardware above that required for EO will be funded jointly by Durham and NAOMI on an 'as needs' basis (i.e. components purchased after EO should be identified as being required by and belonging to NAOMI or ELECTRA and separately accounted for under the appropriate budget headings). It is recognised that the final ELECTRA goal of optical co-phasing would require extra hardware over that for E0 and also that NAOMI will eventually need a full set of hardware independently capable of running the RTCS to NAOMI specification.

(iii) RTCS software for the E1 stage will be funded and provided by Durham, including source code and libraries. It will be subject to NAOMI project software standards.

(iv) Visualization and GUI development (latter will be kept to low level as part of overall project plan) for E1 will be funded by and be the responsibility of the Durham but will be subject to NAOMI project software standards.

(v) Opto-mechanical hardware enhancements (IR science arm, WFS ADC if adopted), all E1 commissioning costs and some of the management costs (up to 1 day per week) of work specific to E1 will be funded by the NAOMI project. The NAOMI project will not pay for any ELECTRA components already required to implement E0 or the optical wavelength correction concept of ELECTRA.

(vi) Once the E0 stage commissioning run is completed, the availability of the DM, drivers, E1 enhancements, become subject to the access agreement.

(vii) Once the E0 stage commissioning run is completed, the availability of the E0 opto-mechanical hardware, visualisation hardware (plus software) become subject to access agreement (1).

(viii) Durham shall undertake to develop E1 RTCS software, whether by commercial purchase or their own efforts and whether by modification and development of E0 software or by new software, according to NAOMI specification and software standards and shall be subject to NAOMI project control for this work (the access agreement does recognise the Royal Society conditions on the WFS Hardware). There is an intention for Durham to undertake any further development of the RTCS software which is required, for example as necessary for a system upgrade.

3.3 Development of NAOMI

(i) Durham undertake to provide the NAOMI RTCS and Visualisation system, whether by commercial purchase or their own efforts and whether by modification and development of E0 software or by new software, according to specifications given by the NAOMI project and under NAOMI project control (i.e. subject to project reporting conditions, and according to project standards).

(ii) On completion of E1 commissioning, E1 becomes subject to the access agreement.

4. Access Agreements

4.1 Agreement Concerning E0 components and development to E1

Prior to the E0 commissioning run or until 1/1/97, whichever comes first, all ELECTRA hardware and software are made available to the NAOMI project only with the agreement of the Durham group. The rest of section 4.1 describes the availability of erstwhile E0 components after the E0 commissioning run.

(i) DM. The DM must be available for E1 development and NAOMI development. Proposed location and access at this stage are:-

Location: Durham

Access: NAOMI project management determines availability for all uses including those other than meeting direct goals of the NAOMI project. However the NAOMI project recognises that with the DM located in Durham the Durham group may need to carry out additional tests and development of the DM using effort not funded by the project but stipulates that these must not entail any additional level of risk to the mirror over that it undergoes during E1/NAOMI development. In the event of conflict, E1/NAOMI development work takes priority over other uses.

(ii) Wavefront sensor (WFS). The ELECTRA WFS is largely funded by a Paul fund grant and the funded items cannot be made a long-term part of any facility instrument. Access to the WFS shall be provided by Durham to the NAOMI project for E1 laboratory tests and commissioning. Further access to the WFS is subject to agreement by the Durham group.

(iii) Other E0 opto-mechanical components. These remain the property of Durham. The NAOMI project shall have unlimited access to these in Durham, until 30 June 1998 or the NAOMI chassis has successfully completed its laboratory testing, whichever date comes first.

(iv) RTCS Hardware. The basic E0 RTCS hardware belongs to Durham, but may be supplemented by the NAOMI project as part of compatibility and development tests. Such additional components will be clearly identified before purchase. The NAOMI project has top priority on the availability and use of the Durham RTCS hardware until 30 June 1998 or NAOMI's own full set of RTCS hardware has successfully completed its laboratory testing (whichever comes first) , but recognises that some development of ELECTRA goals may require use of the system by Durham. The expectation is that the hardware will remain in Durham except for during commissioning run(s).

(v) Visualisation and GUI hardware. This was also purchased using Paul Fund money. It will be required for development of E1 and NAOMI operational tools. .Access to the hardware shall be provided by Durham to the NAOMI project for E1 laboratory tests and commissioning. Further access to the visualisation hardware is subject to agreement by the Durham group.

(vi) RTCS, Visualisation and GUI software. Up to the commissioning of E0, Durham undertake to bear in mind the NAOMI software standards and make reasonable efforts to conform to them in writing E0 software. After E0 commissioning, Durham undertake to follow NAOMI project software standards in producing E1 and NAOMI RTCS and Visualisation software. Deviations from this standard shall only be by agreement with the Project Manager. Durham retain intellectual property rights on the software but will make all source code and libraries available to the project, for E0, E1 and NAOMI stages.

4.2 Agreement Concerning development from E1 to NAOMI A(2)

This section describes the availability of E1 components after E1 commissioning is completed until NAOMI has been commissioned on the telescope or until 31 March 1999, whichever occurs sooner. E1 will be an AO system whose prime function is to test key ELECTRA elements proposed for use with the NAOMI system, in the environment in which they will operate with NAOMI. Important but

secondary goals are to demonstrate a working AO system with near-IR capability and to confirm that system modelling predicts system performance satisfactorily.

The requirement for availability of most E1 components will therefore depend on whether additional use at the telescope is needed after the first commissioning run. Current expectation is for only one E1 run. Therefore the availability of the E1 components not directly funded by the programme follows the same agreement as the E0 components.

4.3 Agreement for use of ELECTRA components after NAOMI Commissioning.

This is the agreement which describes the use and availability of ELECTRA components after NAOMI has been commissioned on the WHT or after 31 March 1999, whichever occurs sooner.

NAOMI is the baseline AO facility system for the WHT. As such its operation and availability will generally be the responsibility of the ING, as will routine maintenance and trouble shooting. However it will have key components which were originally produced under the auspices of the Durham rolling grant and Durham will need some access to them to enable the group to carry its future R & D programme. Availability of these components therefore needs to be the subject of a tighter agreement than the essentially collaborative nature concerning E0 and E1 components.

4.3.1 Components other than the DM, RTCS and Visualisation software.

On completion of the commissioning of NAOMI or after 31 March 1999, whichever occurs sooner, all ELECTRA components not specifically supplied by the NAOMI project except those listed in the above heading shall be available only at the discretion of the Durham group. E1 components supplied by NAOMI shall be available only at the discretion of the NAOMI project. However the intention for these latter components is that they should be available for indefinite use by Durham.

4.3.2 DM and drivers.

- (i) Availability and use of the DM and its drivers shall be determined by an access priority list, with continued but limited availability to Durham to pursue its R & D programme.
- (ii) The priority on use is as follows, in descending order:
 - ?? ING
 - ?? Durham for on-telescope experiments
 - ?? Durham for laboratory experiments
- (iii) It is envisaged that requirement to meet PATT allocations will be the main driver for use of the DM and drivers. At other times, on request from Durham but at the discretion of the ING, the DM and drivers shall be made available to Durham for R & D work. The frequency of this access is expected to be about twice a year.
- (iv) After each occasion on which Durham have used the mirror for their own research purposes, they shall re-install, align and test the DM in the NAOMI system (either at GHRIL or on its test platform, whichever is required by ING), re-instating it to the working order it had before Durham's use of the mirror. This shall be completed at least one week prior to its scheduled use by PATT observers.
- (iv) Durham shall not carry out any experiments with the DM which entail higher risk than it would encounter in normal use at the telescope.

4.3.3 RTCS and Visualisation Software.

All source code and libraries developed by Durham for the RTCS under the E0, E1 and NAOMI projects shall be made permanently available to the NAOMI project. All intellectual property rights remain with Durham.