GEMINI PROJECT

# NEWSLETTER

Number 1 March 1992

This is the first newsletter from the Gemini Project. Gemini news will no longer be included in the NOAO Newsletter, and this change is being made to underscore the fact that the Project is entirely independent of NOAO. In order to expedite the start-up phase, the Gemini Project has initially operated under the same cooperative agreement between NSF and AURA that covers NOAO. That condition is expected to change in the near future so the funding and accounting for the Project and NOAO are completely separate. Because of the business the project does with its partners outside the US, both receiving funds from them and spending money in the partner countries, the rules the Project operates under will be somewhat different from those that govern NOAO, but will conform to AURA policy.

**L.K. Randall**

## Gemini Working Groups

Working groups are being established for the different areas of the project to provide additional sources of expertise and to ensure that the scientific requirements of the project are being met. The Building and Enclosure Working Group met in December to discuss how to meet the imaging requirements in terms of the thermal control and airflow issues for the enclosure. Meetings are planned in March for the Optics Working Group and the Telescope Working Group. The Controls Working Group plans to meet in April. The Instrument Working Group will be formed next; most of the activity to date has concerned instrument planning, as described separately in this newsletter. There is also a plan to establish a Working Group for Adaptive Optics.

The membership of the working groups will change as the project work evolves. The first phase of their work will last about six months. The current membership of the groups that have been formed is listed below.

**Patrick Osmer**

| | | |
|---|---|---|
| Building/ Enclosure | D. DeYoung, Chair (NOAO) | R. Racine (Montreal) |
| | B. Edwards (RAL) | J. Sovka (CFHT) |
| | M. Johns (WIYN) | C. Woods (Oxford) |
| | M. Merrill (NOAO) | N. Woolf (Arizona) |
| Optics | G. Walker, Temporary Chair (UBC) | P. Osmer (Gemini) |
| | M. Fletcher (DAO) | D. Schroeder (Beloit) |
| | F. Gillett (NOAO) | A. Vaughan (JPL) |
| | P. Hickson (UBC) | R. Willstrop (Cambridge) |
| | C. Humphries (ROE) | |

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## The United Kingdom Project Team

There is a small UK project team, based in the Astrophysics Group in Oxford, consisting of Roger Davies, the UK Project Scientist, and Justin Greenhalgh who acts as the UK technical manager. They plan and co-ordinate all the UK Gemini activity and act as the interface between the Tucson project team and the UK community. Recent activities sponsored by the team include studies of the instrument complement for the Gemini telescopes, a discussion of the software environment, and an investigation of the effects of print-through on the image quality specification for structured mirrors. An evaluation of inductive tape encoders on the William Herschel Telescope is underway. A series of technical reports has been produced by the UK group, a list is given on pages 11-12, and copies may be obtained by writing to Justin Greenhalgh at the address below.

A SERC UK Gemini Scientific Advisory Committee has recently been formed, chaired by Professor Richard Ellis of Durham University. The membership of the UK SAC is listed on pg. 4. This group provides a broader scientific interface to the UK community and advises the UK members of the Gemini Science Committee (Roger Davies and Richard Ellis) on UK priorities. It has met twice and focused on the requirements for instrumentation and on the need for optimum performance from the ultra-violet to infrared wavelengths. The SAC is discussing the merits of alternating the coating on the primary (between silver and aluminium), how often this should be done and whether it should be done on both telescopes or on Mauna Kea only. They discussed the gains in the infrared offered by a silver primary, and the science programmes that will benefit from those gains as well as the scientific programmes that may be lost in the ultra-violet. The group thought that the potential gains in the infrared arising from a silver coated primary were worth pursuing via a switched coating on one or both telescopes. They were keen to see a clear demonstration of the gain and were concerned about the durability of silver coatings. Several members commented that the cost of implementing the versatile coating scheme should not impact significantly on other areas, for example the instrumentation budget. The group felt that the UV to IR optimization policy was important to define soon since it affected not only the telescope design and instrumentation priorities, but the communities' perception of the GEMINI goals.

There will be a presentation on the Gemini Project at the National Astronomy Meeting in Durham, 7-10 April, when there will be an opportunity for wider UK input to the project.

The address for the UK Project Team is: Department of Physics
Astrophysics Group
Keble Road
Oxford, OX1 3RH
Phone: 44-865-273-296
Fax: 44-865-273-418

**Roger Davies**

# Gemini Project Organization

As you can see in this newsletter, there are seven engineering groups as well as the Project Manager's office. Each of those groups has a manager that is technically very competent in the activities covered by the group he manages. Five of the groups are part of the line organization (Building/Enclosure, Telescope Mounting, Optics, Controls, and Instruments). Two groups, Administration and Systems Engineering, are in support roles. One reason this needs to be clear is that if someone reading this wants a specific contact in the project, coming through the Project Manager's office only adds a middle man. If, however, you don't know who to contact by all means call the Project Manager's office. The telephone number is (602) 323-4105, the E-mail is Internet: lrandall@noao.edu and the Fax is (602) 322-8590.

We are now fully staffed in the Managers' positions and have staffed or have recruitment notices out for the technical positions for the line groups. The Administrative and the Systems Engineering groups are still defining staff needed, writing job descriptions and recruiting. The current staff of the Project is as follows:

Project Manager
Larry Randall

Administration Group
Jack Morton, Manager
Ken Krohn, Contracts Administrator
Janet Grace, Administrative Assistant
Patricia Baker, Secretary
Jean Pelz, Secretary

Controls Group
Richard McGonegal, Manager

Instrumentation Group
David Robertson, Manager
Stephen Pompea, Instrument Scientist
Susan Wieland, Instrument Systems Engineer
David Montgomery, Engineering Supervisor

Optics Group
Larry Stepp, Manager
Eugene Huang, Lead Opto-Structural Engineer
Myung Cho, Opto-Structural Engineer
Ron Price, Lead Opto-Mechanical Engineer
Eric Hansen, Opto-Mechanical Engineer
John Roberts, Opto-Mechanical Engineer

Interim Project Scientist
Patrick Osmer

Building/Enclosure Group
Henry M. Blair, Manager
Evelyn Billberg, Construction Coordinator
Ruth Kneale, Technical Liaison
Robert Ford, Mechanical Systems Engineer
Steven Hardash, Enclosure Design Engineer
Jim Shelton, Engineering Aide
Naomi Libby, Administrative Assistant

Telescope Mounting Group
Keith Raybould, Manager
Paul Gillett, Senior Engineer
Peter Hatton, Senior Engineer
Michael Sheehan, Senior Engineer
Mark Warner, Mechanical Engineer
Gordon Pentland, Mechanical Engineer

Systems Engineering
Earl Pearson, Chief Systems Engineer
Frank Bull, Project Computer Coordinator

**Larry Randall**

## Canadian Update

Capital funds for Canada's 15% share will come from the National Research Council, the Natural Sciences and Engineering Research Council, and Westar (a consortium of Canadian Universities). A management plan is being drawn up both to administer these funds and to organize a Canadian Project Office at the DAO in Victoria. The latter will act as an interface to the Tucson Office for both engineering and science in Canada. Dr. Tim Davidge has just been taken on as a full-time astronomer, and we plan to hire a Project Manager and a small number of engineers during the summer. I shall continue at UBC as Canadian Project Scientist.

The Science Steering Committee will meet on 7 and 8 February at DAO. The members are: Gordon Walker (chair), David Crampton (DAO), Eduardo Hardy (Laval), Simon Lilly (Toronto), Tony Moffat (Montreal), Don Morton (HIA NRC), Chris Pritchet (Victoria), Derrick Salmon (CFHT), and Doug Welch (McMaster). A major preoccupation will be instrumentation priorities. Rene Racine (Montreal) is the other Canadian member on the international scientific advisory committee.

**Gordon Walker**

## Gemini Working Groups

(continued from page 1)

| | | |
|---|---|---|
| Software/ Controls | R. Murowinski, Chair (DAO) | S. Heathcote (CTIO) |
| | J. Allington-Smith (Durham) | J. Kerr (CFHT) |
| | T. Boroson (KPNO) | S. Unger (RGO) |
| | C. Christian (Berkeley) | P. Wallace (RAL) |
| | S. Grandi (NOAO) | R. Wolff (NOAO) |
| Telescope | F. Gillett, Chair (KPNO) | R. Laing (RGO) |
| | D. Crampton (DAO) | D. Pettie (ROE) |
| | W. Grundmann (DAO) | C. Pilachowski (KPNO) |
| | R. Joyce (KPNO) | S. Shectman (Carnegie) |

### The United Kingdom Gemini Scientific Advisory Committee Membership Listing

Richard Ellis, Chair (Durham)
Roger Davies (Oxford, UKPS)

Andrew Cameron (Sussex)
Mike Edmunds (Cardiff)
Jim Hough (Hatfield, Ground Based Programme Committee)
John Major (Durham)
Keith Mason (Mullard Space Science Lab)
John Peacock (Royal Obs Edinburgh)
Max Pettini (Royal Greenwich Obs)
Ian Robson (Preston)
Pat Roche (Oxford)

# Gemini Group Updates

## ADMINISTRATIVE GROUP

The Gemini Administrative management Group is currently establishing its own set of contracting procedures based on the Federal Acquisition Regulations (FARs) and AURA's contract with the NSF. These contracting procedures should be ready by the end of the second week in February. These procedures will be presented to the Gemini Board for review and to AURA and the NSF for approval.

The Gemini Group now has a new Contracts Administrator on board to assist the Administrative Manager in the preparation of contracts of the Gemini program. Mr. Kenneth Krohn, the Contracts Administrator, has considerable experience in this area, and although he will not be acting as legal counsel for the project, he is a member of the Arizona Bar. Mr. Krohn came from the Evergreen Corporation where he was the Corporate Contracts Administrator. He is now writing Gemini contracts and contracting procedures to be used for letting contracts on the Gemini Program. Mr. Krohn recently attended a two-day seminar on the Canadian Free Trade Agreement (CFTA). This knowledge will assist the project in resolving problems concerning the CFTA should the need arise.

In January, Jack Morton and Ken Krohn attended the Building Enclosure Group design team meeting in Hilo, Hawaii where they met and talked with contractors who will be involved in the conceptual design of the enclosure for the Gemini 8m Telescope to be built on Mauna Kea. While there, they visited the CFHT Observatory, the Joint Astronomy Centre, and the Keck Observatory. Conversations were held with managers of those organizations, and lessons learned from the experience of those organizations were passed on to Project Gemini.

**Jack Morton**

## GEMINI E-MAIL

The normal convention for e-mail addresses in Gemini uses the person's first initial and last name and the NOAO Internet address, noao.edu, ie, lrandall@noao.edu.

For those of you who have trouble reaching personnel at the Gemini Project, we have set up a generic e-mail account. If you are having trouble of any kind, send mail to gemini@noao.edu .

For those wishing to exchange documentation with the Gemini Project, the word processor in use is Ami Pro for Windows release 2.0. Ami Pro files can be sent via e-mail using the ccmail macro.

If you have any questions concerning e-mail, computers or software, please call Frank Bull at 602-325-9208 or via e-mail (bull@noao.edu).

**Frank Bull**

## OPTICS GROUP

The Optics Group is responsible for the design, fabrication, assembly and installation of the telescope optics. These include the primary mirror, (three) secondary mirrors, tertiary mirror, and f/6 wide field and narrow field correctors with atmospheric dispersion compensators (ADCs). In addition, Optics Group personnel provide technical support to other groups in the project.

### Staffing

All of the engineers in the Optics Group are now in place. The group consists of an engineering manager plus five other engineers, each of whom has a good knowledge of optics and extensive experience working with optical systems. However, since most of the design challenges facing the group are opto-mechanical in nature, the engineers in the group have degrees in Engineering Mechanics, Physics, Mechanical Engineering, and Aerospace Engineering. Two additional technical experts have been retained as consultants: Dr. Ann Dinger of Sterling Software is performing stray light and emissivity analyses, and Charles Harmer of NOAO is doing the optical design of the f/6 correctors and ADCs. During the design phase of the project, one to two design draftsmen will be required at various times; they will probably be brought in either as temporary employees or on a contract basis.

### Activity this quarter

Much of the quarter has been spent working on the solicitation for the primary mirror blanks. Thanks to J. Morton and K. Krohn of the Administrative Group, the solicitation procedures are becoming much better defined. L. Stepp and R. Price prepared specifications and configuration drawings for the three types of mirror blanks being considered and made plant visits to the three proposed vendors: Corning, Schott and Steward Observatory Mirror Lab. E. Huang and M. Cho have been doing finite-element studies to define the technical issues involved in mirror support and thermal control. A study was commissioned from Royal Observatory, Edinburgh, to define image effects caused by print-through on a structured primary mirror; they delivered an excellent report to the project in December. It will be published by the Gemini Project as a technical report.

### Other technical activities

R. Price prepared layouts of each of the telescope optical configurations, showing preliminary baffle designs for each configuration. R. Price and E. Huang have been developing a preliminary error budget. They have also been conducting a literature search on the subject of mirror supports. M. Cho has written special programs to translate data between different finite-element programs and optical analysis programs. L. Stepp has continued coordination with the NOAO 3.5-meter Mirror Project and presented an SPIE paper on NOAO large optics testing procedures in October.

In addition, there have been numerous administrative activities. Organization plans, schedules and budgets have been prepared. Learning new software and debugging the computer systems has taken more time than expected. Quite a bit of effort was spent on recruiting. Meetings have been held with other project groups, with representatives from other telescope projects, and with potential vendors.

**Larry Stepp**

# CONTROLS GROUP

**What is the Computer/Controls/Software Group ?**

Before answering this question, perhaps we could agree to call this the Controls Group. Not only is the above too long but the acronym generated, CCS, has many prior uses. The Gemini Project Controls Group are the people charged with the responsibility for the design, contracting, integration, acceptance testing, and delivery of all software, computer, and control systems that will be delivered to the Gemini Operations Staff as part of the project. These systems span (at least) the range from telescope control, active mirror, acquisition and guiding units, through instruments to data reduction. As such the Controls Group must maintain interfaces with virtually all of the other Gemini Groups. This represents a unique challenge which we are now working on.

We should also mention what the Controls Group is **not**. The Controls Group has no responsibility for the software and computer systems used by the Gemini Project in their day-to-day work. The philosophy here is that all these systems are essentially office equipment which, with the rest on the Gemini office, are not part of the delivered product. The Gemini Project is fortunate to have a very capable Systems Manager who manages this area.

**Who are the Controls Group ?**

Although referring to myself currently as a group could be considered immodest, the intention is to hire an additional three engineers to help manage this part of the project. The division of labor required and the exact flavors of engineers is still being worked on but should be along the lines of:

* Servo Systems Engineer - responsible for all project servo systems
* Software Systems Engineer - responsible for software, integration, and standards
* Instrument Control Systems Engineer - responsible for instruments and telescope peripherals

**Current Work**

The current task is to detail the science and performance requirements in order to produce a conceptual design for the systems needed. As part of this a number of design studies will be commissioned. We intend to draw on the best resources that can be provided by the partner countries as part of these efforts. Guiding these tasks is a Working Group set up to provide both direction and advice. The intent here is to have community input to make sure that the Controls Group is working on the correct tasks. It will be the Controls Group's responsibility to make sure that these tasks are discharged correctly.

**Richard McGonegal**

# Gemini Group Updates

## BUILDING ENCLOSURE GROUP

The Group held a design team meeting in Hilo, Hawaii in January. The primary goals for the meeting were to establish criteria, methodology, and schedules for the Mauna Kea soils testing program this year. Due to the integrated nature of the task, appropriate staff from the Telescope Group also attended the meeting. The Group took advantage of the situation to allow Island-based engineering contractors and Group staff to meet and develop contracts for future technology transfer. A contract has been awarded to Townscape, Inc. of Honolulu to aid Gemini in preparation of the document submittals to the Institute for Astronomy (IFA) to facilitate the permit application which will allow us to proceed on Mauna Kea. We expect to provide our first draft application to the University of Hawaii, Institute for Astronomy in late March, 1992. A preliminary Design Review of the Hale Pohaku Construction Camp facility addition is scheduled for March 2 and 3 in Tucson. IFA is the reviewing agency.

Evelyn Billberg, Group Construction Coordinator, has moved to Hawaii. She will represent the Group and the Project in matters of administration and permit applications. In addition, she will be the interface for documentation and information interchange between the Project and Island contractors. Her office is located in the Joint Astronomy Centre facility at the UofH campus in Hilo.

Design phase staffing is complete for the BEG. Philosophically, we decided to keep the direct-hire staff to a minimum. The Group mission involves so many disciplines, frequently for very short durations, that recruiting would be nearly impossible. In addition, it would be difficult to maintain good morale and staff interest for very short lived appointments. The result of this reasoning is that the vast majority of our design and drafting hours will be contract engineering.

**Henry M. Blair**

## TELESCOPE GROUP

The Group has optimized the design of the telescope top-end structure to minimize the top-end mass. We are currently developing FEA models to enable prediction of the telescope performance under wind loading and chopping secondary excitation.

To allow the top-ends to be optimized for specific applications, there will be two top-ends, an f/6 and an f/16. The f/16 top-end will have interchangeable IR and optical secondary modules. To ensure repeatable replacement of the top-ends on the telescope, mechanisms have been designed for accurately locating and for safely locking the top-ends to the telescope structure. Designs have been developed for the telescope center section, upper trusses, mechanisms for the tensioning of the top-end ring vanes, for handling the telescope optical baffles during the daytime, and for deploying the tertiary mirror during the night.

The telescope mount design has been designed and optimized based on two concentric azimuth tracks. The performance of mat and drilled pier designs for the telescope piers have also been evaluated with FEA.

A development program has been started with three other telescope groups (WIYN, MMT, and Magellan) to test the design of friction driven encoder mounts. The test rig design concept is complete and detailed drawings are being made.

Inductoyn tape encoders are being fitted to the W.H.T. 4.2-m telescope for evaluation and comparison with conventional encoding systems. On-telescope testing will start in April this year. This work is being undertaken by the Royal Greenwich Observatory.

RFPs have been sent out and proposals received for the development of protected silver coatings.

**Keith Raybould**

## Optimization for the Infrared

The draft Gemini Science Requirements Document calls for very high performance at infrared wavelengths. Critical factors include achievement of better than 0.1 arcsec image quality at 2.2 microns with the use of active optics and wavefront-tilt correction and a telescope emissivity goal of 2%. In order to meet these requirements and provide the wide field f/6 capability, the Gemini telescope design team is pursuing a telescope concept that incorporates interchangeable top-end rings: one for the f/16 IR and f/16 Optical UV secondaries and one for the f/6 Wide-field optical secondary. One concept for the IR/opt top-end ring has a minimum resonant frequency of 10 Hz and a mass of approximately 2 tons.

The Gemini Project team has also initiated several efforts specifically in support of fulfilling the infrared requirements, and this article gives a status report on these activities. The work includes an engineering analysis of the IR secondary mirror; providing capability for calculation of the emissivity and scattering properties of the IR configuration; initiation of studies of mirror coatings and cleaning systems; and measurements of IR sky noise and its spatial correlation.

### IR Secondary Mirror Design

The conceptual IR configuration has a f/16 final focal ratio, delivered by an articulated secondary mirror which is capable of two-axis square wave chopping with a focal plane amplitude of 15 arcsec image motion at 10Hz with 80% duty cycle and 30 arcsec of image motion at 5 Hz with 80% duty cycle. The secondary must also be capable of two axis tilting for image motion compensation of amplitude 2 arcsec at a bandwidth of 10 Hz, 1 arcsec at 40 Hz, and 0.2 arcsec at 100 Hz. Structural analyses by Earl Pearson, now Gemini Systems/Chief Engineer, have shown that a 1.04m diameter, f/16 Silicon Carbide mirror, weighing only 50 kgm, can be simply supported at three points and meet the above imaging and articulation requirements with substantial margin. While much work remains to be done, this result is very encouraging.

### Emissivity calculations

The Gemini team has contracted with Ann Dinger of Sterling Software to use the APART software program to calculate the expected IR emissivity of the IR configuration. This program accounts for diffraction and particulate scattering as well as the detailed properties and geometry of surfaces, and will be used in the optimization of the IR configuration design. First results are expected in early February. Measurements of the IR emissivity of sample mirror coatings and the contributions of different components of the KPNO 1.3-m telescope to its emissivity are also underway at NOAO.

### Mirror coatings and cleaning

As reported in the previous newsletter, the cost of developing a single primary mirror coating that simultaneously has high reflectance below 3500 A and very low IR emissivity is prohibitively high. Therefore, Gemini is pursuing a capability that would allow the use of either aluminum (for good reflectivity below 3500 A) or protected silver coatings (highest reflectivity longward of 3500 A and lowest IR emissivity) for the primary mirror, according to the scientific needs. The telescope group is also studying different methods for preventing contamination of the mirror surfaces. One promising approach under consideration is

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frequent cleaning of the mirror surfaces with a UV laser. Laboratory tests have shown it to be effective in removing both particles and molecular deposits on mirror surfaces.

**Sky Noise Measurements**

The articulation requirements for the IR secondary are driven by the need for "chopping" to suppress the spatial and temporal variations of sky noise, particularly around 10μm. Measurements are being undertaken with the UKIRT and IRTF telescopes on Mauna Kea, with particular emphasis on the extent to which the use of 2-d imaging IR arrays can suppress excess sky noise and thus potentially relax the "chopping' requirements. Both bolometer and photoconductor detector arrays will be utilized in this long term study and the cooperation and support of the instrument teams involved and the UKIRT and IRTF managements is greatly appreciated.

**Fred Gillett**
**Patrick Osmer**

## INSTRUMENT PLANNING

The next step in the development of the science requirements for Gemini is the review, selection, and prioritization of the instruments. Instrumentation has been an integral part of the project from the beginning, both because the instruments are fundamental to doing science with the telescopes and because instruments influence the telescope design and vice versa. All three national proposals discussed instrumentation in detail, and those efforts are a natural starting point for Gemini.

The national science committees are now working to develop their recommendations for instrumentation, both optical and infrared and for the two telescopes. Then the international Gemini Science Committee will meet in the U.K. March 13-14 to integrate the national recommendations and prepare a plan for the Gemini project. At the same time, the Instrumentation Group is developing the proposed procurement procedure for the instruments so that it can get underway once the science committee has completed its work.

Three stages of instrumentation are identifiable at this time: 1) Instruments needed for testing and commissioning of the telescopes; 2) Instruments needed at first light for the initial science programs; and 3) Instruments to be brought on line subsequently for science programs. The plan is to develop priorities for instruments along these lines, also taking into account the possibly distinct needs of the northern and southern telescopes.

While the details of the instrument procurement process are not available at this time, the science communities should be aware that the intent is to announce opportunities to construct Gemini instruments with sufficient advance notice to permit interested groups to form and begin their planning activities.

**Patrick Osmer**

# UKLT Technical Reports

As of January, 1992

**Reports Released So Far**

*Copies of those marked with an asterisk are no longer available*

* UKLT1. Interim Report on UKLT Top-end and Enclosure Design. Harris, Hastings, Montgomery and Pettie. 3 October 1989. ROE.

* UKLT2. Sputtering Front Surface Aluminium Mirrors. Loughborough Consultants Limited. June 89.

* UKLT3. UKLT- Enclosure and Site Works, Estimate of Costs. R Tolcher. 16 November 89. CWU.

* UKLT4. Thermal Performance of an 8m Meniscus Mirror in a Carousel Enclosure. K Raybould. September 1989. Oxford Project Team.

* UKLT5. Mirror Support System. S.M. Atkinson, D.J. Harman, B. Mack, C.G. Marirradriga. RGO/IAC.

* UKLT6. Mechanical Structure and Hydrostatic Bearings. D.J. Harman, B. Mack. RGO.

* UKLT7. Drives and Servo Control System. S.M. Atkinson, G. Coll, D.J. Harman, B. Mack. RGO/IAC.

* UKLT8. High Resolution Imaging Techniques. Major and Hanif. Durham and Cambridge.

* UKLT9. UKLT Primary Mirror Handling Arrangements. F Row. 20 September 89. RAL.

* UKLT10. Finite Element Analysis of the UKLT Structure. K. Raybould. Oxford Project Team. April 90.

* UKLT11. Friction Drive Systems for the UKLT. R.J.S. Greenhalgh. June 90. RAL.

* UKLT12. Design of an Open Truss Mounting for the United Kingdom 8m Optical Infrared Telescope Part 1. K. Raybould (Oxford Project Team), K. Yeo (RAL), P. Hatton (RAL), R. Hopes (RAL). 6 November 1990.

* UKLT13. Optical Design and Imaging Performance of the UK Large Telescope Part 1. E. Atad, J.W. Harris, C.M. Humphries. September 1990. ROE.

UKLT14. Operational Versatility Considerations for the United Kingdom 8m Optical/Infrared Telescope. K. Raybould (Oxford Project Team) K. Yeo (RAL). 14 December 1990.

UKLT15. Design of Friction Drive System for the UKLT. Cranfield Precision Engineering.

UKLT16. Primary Mirror Support Analysis. D. Harman, B. Mack. RGO. March 1991.

UKLT17. Primary Mirror Active Supports Test Facility. S. Atkinson, D. Harman, B. Mack (RGO). G. Coll, J. Herreros, C.G. Marirrodriga (IAC). March 1991.

UKLT18. Design of an Open Truss Mounting for the United Kingdom 8m Optical Infrared Telescope Part 2. K Raybould (Oxford Project Team), D. Apsey (RAL), K. Yeo (RAL), P. Hatton (RAL), R. Hopcs (RAL). April 91.
UKLT 19. Control System Study for the UKLT. N Cunliffe, D. Sole (RAL). June 91.
UKLT 20. The Initial Instrument Complement for the Gemini Telescopes. UK Large Telescope Working Group. July 91.

**Reports in Preparation**

Findings of the UK working group into Scientific requirements for the computing infrastructure of Gemini.
Report on fitting and use of Inductosyn tape encoder on WHT, La Palma. (RGO)
Primary Mirror testing using a lateral shearing interferometer. C. Humphries *et al* (ROE)

**R.J.S Greenhalgh**

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8-Meter
Telescopes