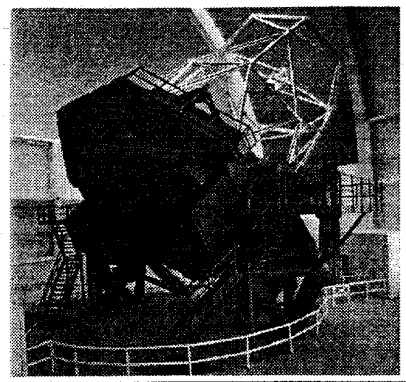
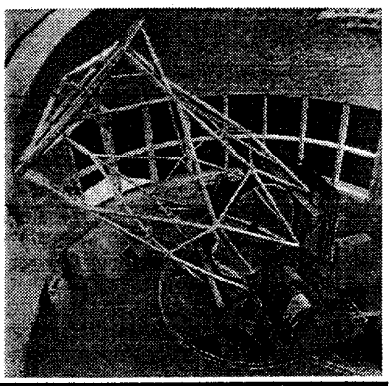


GEMINI 8-M TELESCOPES PROJECT

NEWSLETTER



December 1995 Number 11

Gemini Accepts First 8-M Blank from Corning, Inc.

On 6 November, at 11:59 EST, as the gantry lift gently settled the 25-ton meniscus blank onto the support pads of its shipping container, Corning formally delivered the first Gemini 8-m primary mirror blank. REOSC immediately took delivery of the blank and began the preparation for its shipment to France for polishing. Over the next few days, a restraining hub was installed in the central hole of the blank to secure it, and instrumentation was installed into the container so that REOSC, and their insurance company, can monitor the state of this precious cargo as it becomes the first 8-m blank to cross an ocean.

The 8-m diameter, 200mm thick blank of Ultra Low Expansion (ULE)™ glass, which has had the central hole generated and been ground to within 0.2mm of its final shape, was completed one month ahead of schedule. Corning, in addition, has met all the design requirements for this blank with a substantial margin. The size and number of inclusions are well below allowable limits, and the coefficient of thermal expansion of the entire blank was far smaller than anticipated -- the 8-m diameter will change in diameter by less than 4 microns as it is moved from the warm polishing shop in France to the near zero temperatures of Mauna Kea. The Corning 8-Meter Team has to be congratulated for a professional job well done. Almost immediately, once their furnace turntable had been cleared, the Corning team started the preparations for fusing the second Gemini blank scheduled for February next year.

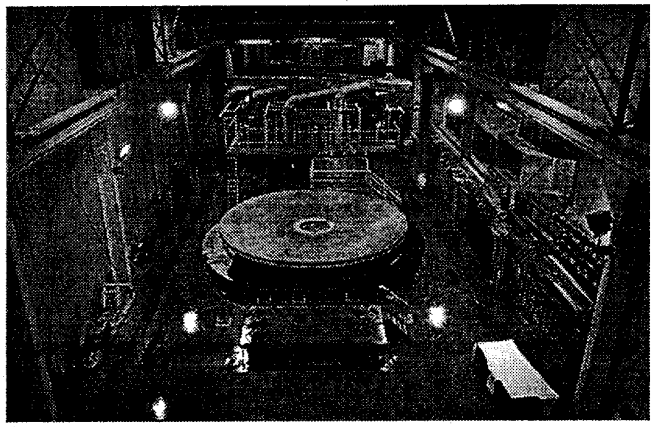


Figure 1. The first mirror blank at Corning, New York.

This has been an exciting culmination of a year of reassessment for the Gemini Project.

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The Gemini Project in 1995

In January we undertook a major review of the project schedule. This was precipitated by a number of factors: an early winter on Mauna Kea that delayed the start of the road relocation work; continued lengthy negotiations with potential telescope contractors; exceptionally high bids for the Mauna Kea construction work that required a descoping of the Mauna Kea support facility and a complete restructuring of the Mauna Kea construction contracts. This reassessment led, with Board approval, to a delay of the Mauna Kea first light date by five months from July to December 1998.

Secondly, throughout 1995 there has been a series of discussions within the Operations Science Working Group, the National Science Advisory Committees, Gemini Science Committee, and the Gemini Project Team on the possibilities of finding new ways to operate the Gemini Telescopes. The scientific driver for these discussions is to make more optimum use of the superb condition sites like Mauna Kea and Cerro Pachon offer. A key event in these discussions was the organization of a workshop in Hilo, Hawaii, to explore "New Observing Modes for the Next Century", which was sponsored jointly by the Joint Astronomy Center, ESO, the US Gemini Project Office and by the International Gemini Project. All of the major observatories were represented at the workshop. The result of all this activity has been a substantial revision of the Gemini Operations Plan.

Finally, as first light for the Mauna Kea Telescope is only a little over three years away, the Systems Engineering and Science Groups have been taking a first look at how to transition Gemini from a construction project to an operational observatory. The challenge we face during this transition is to ensure we meet our first light dates of 1998 and 2000 for the Mauna Kea and Cerro Pachon Telescopes, while ensuring that both telescopes are ready to hand over to the operations staff in 2000 and 2001, respectively. The result has been the development of a very detailed Integration, Test, and Commissioning Plan for the Gemini Telescopes. This plan starts in 1997 and tracks all of our activities. It defines the roles of individuals already on the construction project, identifies all of the key interfaces in the

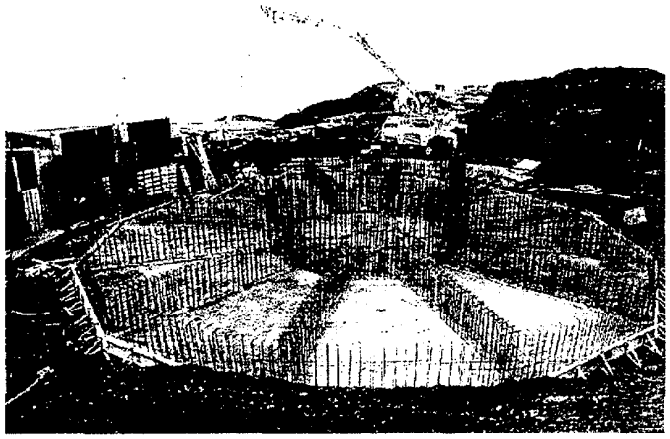

Figure 2. The concrete pad being poured on Mauna Kea.

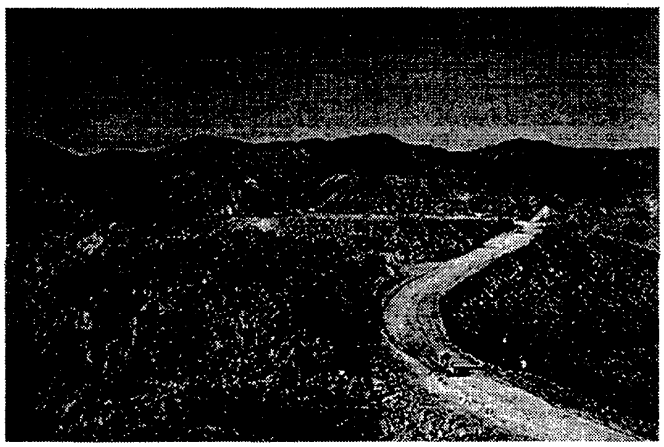

Figure 3. The Cerro Pachon site, leveled for construction.

Figure 4. The enclosure ring base at Coast Steel, Canada.

Gemini Project (making sure everything fits together), considers the logistics of bringing together all our subcontracts and workpackage components and teams, as well as defining key tasks for the early operations staff. Both the Operations Plan and the Integration, Test, and Commissioning Plan have been extensively discussed by the Gemini Science Committee and the Gemini Board at the November meeting.

Underlying these broader issues has been a solid foundation of progress within the construction phase of the Gemini Project. A significant milestone was passed with the acceptance of the first Gemini blank at Corning in early November. Substantial progress has been made on Mauna Kea with the site construction (see the movie on our Web page) and we are expecting completion of the foundations five months ahead of our schedule set in early 1995. This will allow an early start on erection of the base steel and enclosure. Excavation work on Cerro Pachon has been completed and work on the foundations and steel erection commenced in late October. Coast Steel in Vancouver has begun the test erection of the first Gemini enclosure. The first controls work package was delivered to the project, on budget and on schedule. The Critical Design Review for the primary mirror assembly was successfully completed and we have just had a successful review of the Lockheed tip/tilt and chopping mechanism for the secondary mirror. Lockheed have developed a system which exceeds our requirements and meets many of our goals, while only dissipating 30-40 watts.

What of next year? At the start of the year REOSC will begin the finishing of the first Gemini primary mirror and Corning will fuse and slump the second primary mirror blank by the end of 1996. Also, 1996 will mark the beginning of the enclosure erection on Mauna Kea, and the completion of the support facility and enclosure base on Cerro Pachon. The first elements of the Telescope Control System will be brought together in a simulator in Tucson. With the appointment of a new Project Scientist, the science team will start the development of a detailed science operations plan and work with the Controls Group on the "observers interface" of the Observatory Control System. It will also be a busy time for the science team in the instrument area as the majority of the science instruments will reach PDR during 1996.

With the anticipated start of operations funding in 1997, the detailed logistical and personnel planning for the integration, test, and commissioning phases as well as for the administrative staff of the Gemini Observatory must also start next year.

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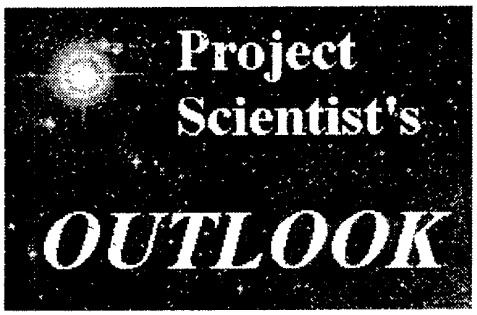
The Gemini Science Operations Plan



The Gemini Operations Science Working Group was established to develop a plan by which the Gemini Telescopes could be operated to meet their science requirements. The outcome of many discussions on all aspects of this charge is the Gemini Science Operations Plan, a document which describes the steps and responsibilities from proposal preparation to distribution of data. The following is a brief overview of this plan. Many refinements and additions to this plan are expected as we approach the operations phase.

Gemini will not be a stand-alone observatory; it will continue to depend heavily on the national offices and national observatories in the operations phase just as it does in the construction phase. These national Gemini offices (NGOs) will be responsible for interacting with their communities before and after a Gemini observing run, and will provide assistance with proposal preparation. Proposals will be submitted to the NGOs, who will be responsible for organizing and

coordinating their national Time Allocation Committee (TAC).

Proposals will be solicited twice a year by each NGO from its own user community. NGOs will supply assistance to the communities in preparing proposals, using information about the capabilities of the Gemini facilities distributed by the International Gemini Office (IGO). After proposals are submitted, NGOs will be responsible for a top-level confirmation of their technical feasibility. The proposals first go to a national TAC, which forms a ranked list of approved programs and submits it to the IGO. An international TAC (ITAC), consisting of representatives from the national TACs and IGO staff, reviews a merged schedule and merged queue, and addresses conflicts. Following the ITAC meeting, PIs of approved proposals are asked to submit observing plans that describe their observations in sufficient detail to ensure that all necessary information is available to execute the program.

Gemini will schedule about 50% of the telescope time in queue mode in order to allow the matching of program requirements to conditions in a flexible manner.

For the queue to run efficiently, three types of tasks must be accomplished. First, Gemini contact scientists will work with each proposer to ensure that all information required to execute the program and to decide if conditions are suitable is available at the observatory. This person is a local representative of the program. Second, a queue scheduler puts the big picture together, based on the programs near the top of the queue, the current telescope configuration, and a prediction of the conditions for the upcoming night. This big picture takes the form of a small number of one-night queues, each one tailored to a particular set of conditions. Third, the observer carries out the programs and makes real-time decisions about which observations to execute.

After the observations are made in queue mode, the data are run through a reduction pipeline process for quality assessment. In the case of ambiguity about the suitability of the data for the science proposed, the data is forwarded to the proposer for review. At the completion of the program, the pipeline-reduced data, the raw science observations, and the appropriate calibration observations are distributed to the proposer. All observations are written into the archive, which serves both as a backup and record of the data taken with the Gemini telescopes, and as a database for future scientific studies.

Along with the conventional approach to applying for time outlined above, the Gemini Operations Science Working Group suggests that a "quick response queue" be established as a parallel mechanism to get small amounts of telescope time. This alternate route would address the criticism that queue-scheduling does not allow the successful proposer to spend a small fraction of the allocated time performing follow-up or exploratory observations. Proposals for small amounts (e.g., three hours or less) of telescope time could be submitted to the NGOs at any time, and after review and ranking by the appropriate national TAC, would be forwarded to the IGO for inclusion in the queue. The intent is to use only a small fraction of each country's time in this fashion.

There are clearly a great many issues yet to be resolved in defining the detailed mechanisms of Gemini operations. The description above represents only a outline of the process. Comments and suggestions are encouraged.

Many thanks to the Gemini Operations Science Working Group, whose members are:

- Todd Boroson (USGPO, chair)
- Fred Chaffee (MMTO)
- Tim Davidge (DAO)
- John Davies (UKIRT)
- Mike Edmunds (U. Wales)
- Bruce Gillespie (APO)
- Rick McGonegal (IGPO)
- Bob McLaren (U. Hawaii)
- Phil Puxley (ROE)
- Doug Simons (IGPO)

- Malcolm Smith (CTIO)
- Steve Strom (U. Massachusetts)

-Fred Gillett
Gemini Project Scientist
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-Todd Boroson
Chair, Operations Science Working Group
usgp@noao.edu

For current information, up-to-date pictures, and announcements of upcoming events, be sure to visit Gemini's home page on the World Wide Web!

http://www.gemini.edu/

More information can be found on Page 16.

AURA News

Welcome New Members! We are pleased to announce that the University of Minnesota and the University of North Carolina - Chapel Hill have joined AURA as its newest members. Bruce Carney from Chapel Hill and Len Kuhi from Minnesota have joined our Board. We cordially welcome Bruce and Len. Len had served on the Board previously, from 1978 to 1989, when he was at the University of California -- we are glad to have him back! Bruce has worked closely with us in several capacities. We are glad to see him in his new role.

-- Goetz Oertel

Key AURA Committees. Annual elections at the AURA Board meetings change the membership of key committees of the Board. For your information, following are the members of the Executive Committee and the AURA Oversight Committee for Gemini (AOC-G), as a result of this year's elections.

-Diana Whitman

Executive Committee:
Bruce Margon, Chair - *University of Washington*
Richard Zdanis, Vice Chair - *Case Western Reserve University*
Donald Baldwin - *University of Washington*
Jay Frogel - *The Ohio State University*
John Huchra - *Harvard/Smithsonian Center for Astrophysics*
Morton Lowengrub - *Indiana University*
Richard Margison - *University of Illinois*
Goetz Oertel - *AURA*
Vera Rubin - *Carnegie Institution of Washington*
Lee Anne Willson - *Iowa State University*

AURA Oversight Committee (AOC-G):
John Casani, Chair - *Jet Propulsion Laboratory*
Jay Frogel, Vice Chair - *Ohio State University*
Timothy Heckman - *Johns Hopkins University*
Simon Lilly - *University of Toronto*
Peter Napier - *National Radio Astronomy Observatories*
Goetz Oertel - *AURA*
Michal Simon - *State University of New York at Stony Brook*
Domenick Tenerelli - *Lockheed Corporation*

GEMINI GROUP UPDATES

SYSTEMS ENGINEERING

Recently, the two major system engineering activities have been integration and test planning and continued work on interface control documents. A brief description of where we are is given along with the status of a few other points of interest, such as recent updates to Gemini's World Wide Web (WWW) site.

System Integration and Test Planning. The last article gave an overview of the process we are following for integration and test planning along with a status update. Since then, we have completed the overall Mauna Kea and Cerro Pachon integration and test schedules, tied all of the individual group schedules into this and estimated the resources required for the integration, test, and commissioning effort. An overview of the flow chart is shown in Figure 5.

The integration, testing, and commissioning plan forms the basis of the requested operations manpower ramp-up. This process began with the systematic identification of subsystems and interfaces, followed by planning how all of these subsystems and parts would come together. Each engineering group and the project science staff was involved with systems engineering in developing this plan and determining the required resources. Though not discussed here, input from all areas in determining other costs such as test equipment was received. How to transition smoothly to the final operations staff was considered and is an integral part of the plan, as was identifying key personnel from the current project and work packages to help ensure a smooth integration process. Using many of the eventual operations staff (some of the same key people) to help integrate, test, and commission the telescopes and instruments will result in a highly qualified operations team to operate the Gemini Telescopes.

The next step in this area is to concentrate on organizing, outlining, and beginning on the detailed

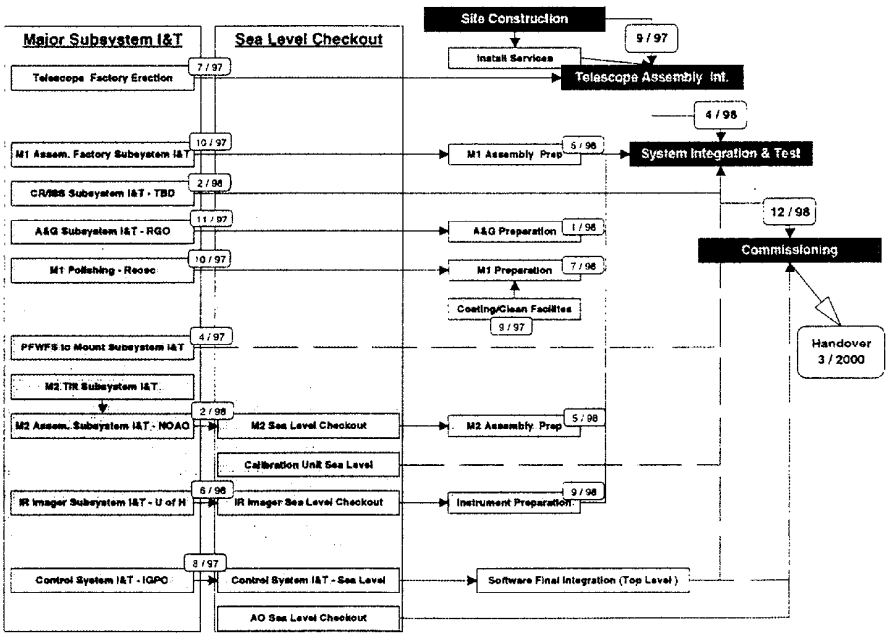

Figure 5. Gemini 8-meter Telescopes Integration and Test Plans - 8/95

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I&T plans for each major step outlined in this overall plan. This will be a major systems engineering activity through '96 and '97.

Interface Control. In the last article, the new interface control organization was described. Since then, many people have been involved with "filling" in the system with the various ICD's identified. It has been the number one priority for all systems group employees. Some areas such as the telescope structure have essentially all of their identified interfaces formally documented and agreed to. (37 ICD's in the telescope structure case!)

Several other key areas of interfaces are now in the process of being formally documented. These include the enclosure, the support building, the M1 assembly, and the Cassegrain area. John Horne has taken on all electronic/cabling and services ICD's and has made significant progress in this important but sometimes forgotten area. Ruth, with the help of Dan Eklund and Andrew Flach, has improved upon the ICD database to ease the effort in tracking the more than 300 interfaces we need to document.

Other activities. Ruth Kneale is continually updating our WWW page with new information. It has substantially expanded over the course of the last year (see the article on the page 16 for more information about Gemini's exciting new Web page developments!). Many new photographs are now available showing the state of various Gemini construction and fabrication activities such as the enclosure and the primary mirror.

The latest area is from a new video camera, installed on the CFHT enclosure, with a view of our construction site. Digital pictures are taken every 15 minutes (during daylight!) and automatically loaded to Gemini's Web site. Frank Bull has also produced a MPEG movie file, showing a "movie" of our construction with the "2:30pm" picture from each day for the last two months. This is accessed from the "daily construction photos" on the Gemini Page (URL on back page). A recent Mauna Kea construction picture from the video camera is shown in Figure 6.

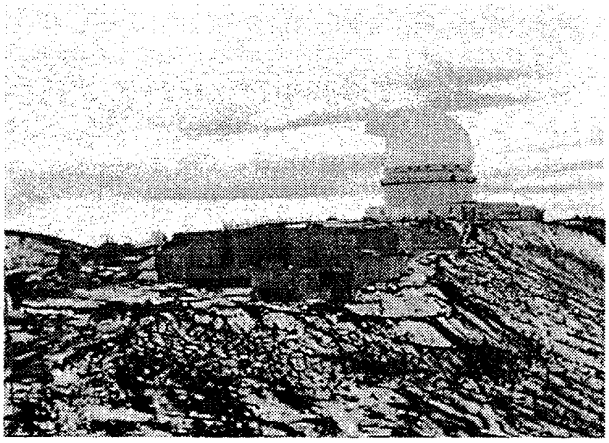

Figure 6. Gemini's Mauna Kea construction site, as seen from the new WWW camera on 11/3/95.

System Review #3. We are currently in the process of planning and scheduling our next system review (#3). It is expected to be in February or early March. Highlights of the review are expected to be I&T planning status and various software system demonstrations that the Controls Group has been working on.

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TELESCOPE & ENCLOSURE

Telescope Structure. Mark Warner, the Gemini on-site representative in France, together with Mike Sheehan and Gordon Pentland in Tucson, have been working with the telescope contractor, G.I.E. Telas, on the telescope fabrication drawings. A contractors meeting was held 31 July- 4 Aug, after which Gemini

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granted approval to TELAS to order materials for the fabrication of the telescopes. Fabrication of the Mauna Kea telescope structure will start in January 1996 and will be completed by the end of 1996.

The telescope hydrostatic bearing request for proposals was released and proposals received on 11 August. AURA has started contract negotiations with a contractor. Gordon Pentland has been working with M3 Engineering on the design of the Primary Mirror Cell Cart that will used during recoating of the primary mirror. The design is now complete and we will soon be bidding the fabrication.

Enclosure. Significant progress on the design and fabrication of the enclosures has been achieved. Mike Sheehan, the enclosure engineer, has been working closely with Coast Steel Fabricators (CSF). CSF have submitted 68% of the enclosure fabrication submittals to Gemini for approval. They have fabricated 33% of both the Mauna Kea and Cerro Pachon enclosures, including fabrication of the ring beams, arch girders, bogies, shell ribs, inner and outer skirts, tie beams and ventilation gate rings and columns.

Preassembly of the first enclosure has started. Currently the Mauna Kea ring beam has been fully assembled on CSF premises (shown in Figure 7).

Figure 7. The enclosure ring beam.

CSF have placed a subcontract with Shaflik for the design and fabrication of the enclosure control system. A kick off meeting was held on May 25 and a 65% design review was held on October 18.

Mauna Kea Site. Steve Hardash has been working with many contractors in Hawaii this year and significant progress has been made with the Mauna Kea site work.

Relocation of the access road to CFHT was completed in April 1995. This allowed Keahou Kona Resort Company (KKRC) to demolish the 24-inch telescope that resided on the Gemini site. Following this, KKRC started the relocation of the utilities (power and communication) that crossed the Gemini site. HELCO and HawTel were responsible for pulling the new power cables and communication lines, respectively, through the new utility conduits and service was switched over by 11 August.

San Juan Construction was scheduled to start the foundation work on 1 August 1995 and to be finished by 1 May 1996. Due to San Juans' experience in the winter of 94/95 on the road construction, they decided to start the construction early, mobilizing at the end of May 1995, with the aim of completing the construction before December 1995. As of 20 October they have completed 85% of the construction and are on schedule to complete the work before the end of 1995. The pouring of the concrete for the Mauna Kea pier mat foundation that occurred on 23 August this year is shown in Figure 8.

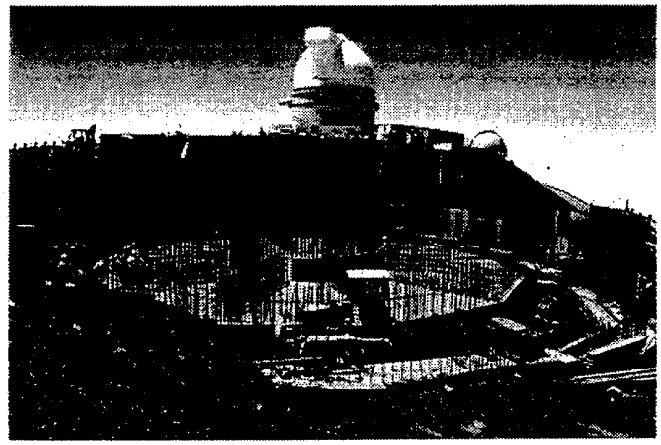

Figure 8. Concrete pouring on Mauna Kea.

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M3 Engineering completed the Mauna Kea steel construction documents for the new facility in February 1995. This work has been awarded to CSF, the contractor responsible for constructing the enclosures. This has allowed the Project to maintain an aggressive construction schedule on Mauna Kea. CSF have completed many of the fabrication submittals, and fabrication of the steel work for the enclosure base has started.

M3 Engineering completed the Mauna Kea support facility and enclosure base design, and an IFB for the construction was released on 8 August 1995. Bids were received on 6 November.

Cerro Pachon Site. Paul Gillett has been managing many aspects of the site construction in Chile, including the excavation of the enclosure, telescope pier and support facility, relocation of a water tank, road construction, and completion of the 20-unit dormitory. In addition, he prepared the documents for bidding the foundation, telescope pier, and steel work.

In a manner similar to the preparation of the Mauna Kea design documents, M3 Engineering prepared three sets of documents for Cerro Pachon. IFBs for the foundation and telescope pier and for the site steel work were released in February 1995. Work to be performed on the site (foundation work and steel erection) was bid in Chile only, but the steel fabrication was bid in all three of the Gemini South American partners. A contract has now been signed with ConPax, a Chilean contractor, for the foundation, telescope pier and steel work. They started work on the site on 23 October. The site is shown in Figure 9. Take a good look, it will not stay like this for long!

Coating Plant, In-Situ Cleaning, Protected Silver Coatings. The procurement of the coating plant is being divided into three main contracts: (a) the coating vessel; (b) the pumping system; and (c) the sputtering head, mirror support, and rotation system. Items (a) and (b) will be released for international bid. Royal Greenwich Observatory (RGO) will perform the detailed design of item (c) and then procure the elements of the system, and perform the assembly and testing of the completed system. RGO released the bid package for the coating vessel on 8 September. Bids are due back by 1 December.

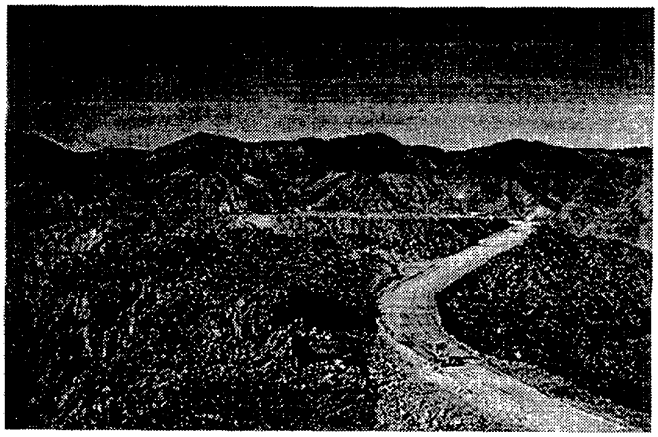

Figure 9. Construction on Cerro Pachon.

The work under contract to Optical Data Associates (ODA) to develop a protected silver coating for the primary mirror has been completed. Two coatings were investigated. The first was a silicon-nitride-protected silver coating developed by AIRCO under subcontract to ODA. The second was a hafnia-protected silver coating developed by Deposition Sciences Incorporated, again under subcontract to ODA. The coatings were optimized to meet the Gemini Science Requirements and the results indicated that the protective layer contributed as little as 0.1% emissivity. Both coating so far have been deposited with emissivities approaching 0.9%. The coatings were characterized and tested for adhesion, abrasion, and durability. The coating removal procedures were verified to ensure the substrate was not damaged during the coating removal process.

STI Optronics are undertaking tests to investigate the performance of excimer lasers for cleaning the

GEMINI GROUP UPDATES

protected silver coatings developed by ODA's subcontractors.

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OPTICS

Primary mirrors. On 17 October, a ceremony was held at the Canton, New York plant of Corning, Inc. to mark completion of the first 8.1-meter diameter primary mirror blank for the Gemini Telescopes. We were gratified at the interest shown by the many key people from Corning and the Gemini Project who attended. Corning staff gave tours of their large mirror fabrication area, with displays set up to illustrate the fabrication steps involved, but the mirror blank itself was the center of attention (see Figure 10). It is not only one of the largest pieces of glass ever created, it is of truly excellent quality -- meeting all of its specifications for material properties, dimensional accuracy, and freedom from bubbles and inclusions by a considerable margin. Several speakers congratulated the Corning workers and managers who were responsible for producing this remarkable piece of glass.

Figure 10. The first Gemini blank at Corning, with attendees of the ceremony.

The REOSC-designed shipping container arrived at the Corning plant during the first week of November. The blank was lifted from the furnace turntable (see Figure 11), carefully placed into the container, and will be transported by truck to the port of Ogdensburg, about 30 kilometers to the north. There, it will be loaded onto a ship for the trip to France in late November.

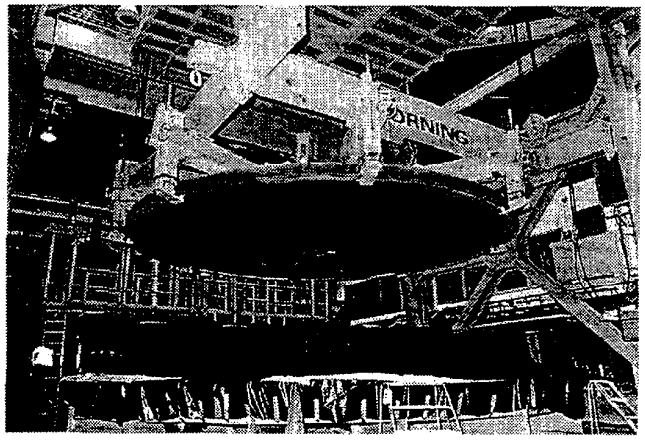

Figure 11. The Gemini blank being loaded into the transportation container.

Corning has already produced all the glass for the second mirror. As in the first blank, the glass for the second blank meets all specifications by a considerable margin. All the boules of glass have been generated flat, fused into two-boule stacks, and machined into hexagonal segments. The second mirror blank will be fused into a monolith once the first blank is removed from the large turntable.

M1 Cell Assembly. The Critical Design Review for the M1 (Primary Mirror) cell assembly was held in September. We are currently well along in the selection process for fabricators for the cell structure and the radiation plate system. Staff at the Royal Greenwich Observatory are preparing to issue orders

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for fabrication of the components of the mirror support system.

We are still in the process of developing the primary mirror surface heating system. A third generation prototype system using a 95-cm diameter mirror is nearing completion.

M1 Lifting Fixture. The detailed design of the lifting fixture has been completed by the Optomechanical Engineering Group at the Optical Sciences Center of the University of Arizona, under subcontract to Gemini.

M2 Assembly. The M2 (secondary mirror) assembly successfully passed its Preliminary Design Review in October. This assembly is divided into several subsystems. The M2 Tilt System is being designed by the Dynamics & Control Lab of the Palo Alto Research Labs of the Lockheed-Martin Corporation. The project staff in Tucson is designing the positioning system and deployable baffle. The Secondary Control System is being developed by staff from the Royal Observatory Edinburgh. The contract award for fabrication of the silicon carbide secondary mirrors has been delayed pending completion of negotiations with potential vendors.

Baffle design. A detailed stray light analysis of the telescope has been performed by Breault Research Organization. This analysis included the optical elements, primary and secondary baffles, the enclosure dome, telescope structure, and Cassegrain instrumentation area. The results of the analysis show the stray light performance of the telescopes will be satisfactory.

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CONTROLS & INSTRUMENTATION

Staffing Changes within the Controls Group. Peregrine McGehee, our local EPICS guru and all round real time expert, has left the project for a position with CFHT in Hawaii. We wish Peregrine and his family all the best with his new job.

Bret Goodrich, from the GONG project in Tucson, has joined the project as of 1 November, 1995. Bret has a solid VxWorks background and is familiar with the challenges of remote observing and robust programming practices.

Progress on Software and Controls. The Controls Group had a visible presence at the recent ADASS '95 conference in Tucson. There were papers and posters presented on the following topics from the extended Gemini community:

- Steven Beard, *The Gemini Core Instrument Control System*
- Mike Burns, *The Gemini Interlock System - an EPICS Application*
- Severin Gaudet, *The Gemini Data Handling System*
- Kim Gillies, *The Design of the Gemini Observatory Control System*
- Chris Mayer, *The Gemini Telescope Control System*
- Rick McGonegal, *Gemini's Development Methodology*
- Shane Walker, *A Demonstration of the Gemini Observing Tool*

In addition Gemini sponsored a Birds of a Feather meeting where Bob Dalesio presented an overview of EPICS and we discussed people's experiences with EPICS - all of which were positive. As well, Gemini was invited to present several papers at the recent ICALEPCS conference in Chicago where Steve

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Wampler presented two papers (co-authored with Rick McGonegal). The first paper, *The Gemini Control System*, presented an overview of the Gemini control system with an emphasis on how the design has been driven by the requirements, both for system performance and system development. The second paper, *Managing an Internationally Distributed Software Project*, focused on the practical issues and solutions that have arisen during the management of the Gemini control system development.

Since the last newsletter, the Controls Group has sponsored two more *Principal Systems* meetings to bring the major system developers together to discuss problems and arrive at solutions. This has proven to be a very effective way to help ease the difficulties inherent in a distributed development environment. The September meeting was held at the Royal Observatory Edinburgh in conjunction with reviews of the Observatory Control System and the Telescope Control System. In October, a meeting was held during the ADASS conference.

The *Observatory Control System* team passed PDR in September and is now attacking the design and implementation of the *Interactive Observing Infrastructure (IOI)*, the first of several development tracks. The IOI track provides much of the fundamental support needed for the OCS and is the foundation of all subsequent work.

The *Data Handling System* team has been following the progress made by the other principal systems while staffing up to start meeting the challenges of their system. The other principal systems have put a lot of effort into defining the interfaces to and functionality of the Data Handling System as they reach a better understanding of the services that this system must provide.

The *Telescope Control System* group met its SDR milestone by delivering all documentation for the TCS System Design Review to the project office this July. In addition to the requirements specification and documentation plan, initial copies of the interface control documents for the OCS to TCS interface and each of the eight TCS subsystems were provided. These interface documents will be refined continuously up to CDR when they will go under change control. Also delivered with the SDR documents were updated papers describing the telescope pointing flow as well as new documents describing how guiding and the control of M2 could be integrated into the main pointing flow.

The SDR itself was held at the ROE in September and was passed successfully. At this meeting a demonstration was given of a prototype TCS which incorporated all the main pointing flows running under EPICS in a VxWorks crate. The prototype incorporated simulations of the mount and cassegrain rotator so that the telescope could be slewed, tracked and offset in a realistic manner. As well as demonstrating how a full and rigorous pointing flow could be linked into an EPICS database, the prototype provided a first demonstration of how the CAD/CAR records could be used both to control the TCS from a higher level system and also how they could be used between the TCS and its subsystems. Work on the TCS is now directed towards Preliminary Design Review, which is scheduled for mid-January 1996.

The *Core Instrument Control System* passed its PDR on 26 October 1995. The first prototype is expected to be delivered in January 1996. An alpha release designed specifically for the A&G will be made in May 1996. This system will be generalized into a beta release in August 1996, and final delivery is expected in January 1997.

The *Communications* system will provide the infrastructure needed at the telescope sites and the connectivity required between the summit and the base facilities in order to support remote use of the telescopes. The project has started discussions of this package with our Chilean partners and look forward to

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continuing to define Chile's involvement in the new year.

The *Mount Control System* team at RGO now consists of John Wilkes (servos/control), Chris Carter (Electronics) and Andy Foster (Software). The preliminary design of the hardware is now complete. The Mount Control System Design Description, which describes the hardware, is ready for review. A number of investigations have been conducted concerning timing and communication between EPICS and hardware. The Software Design Description is about 50% complete and should be ready in time for the actual Preliminary Design Review, which is due to occur in December.

The *Interlock System* has been taken over by our servo engineer, Mike Burns. Toward this end, Mike has taken an Allen Bradley training course in programming the Programmable Logic Controllers which will be used in the telescope. He has also been working on the list of action items which must be resolved prior to our PDR in January, 1996.

The *Telescope Encoders* are vital to meeting the tracking requirements of the telescope and present a unique challenge both in terms of the diameter which will be encoded (9 meters) and the resolution required (5 milliarcseconds). The project has completed the trade studies needed to make a choice and will be announcing this choice in the near future.

The *Hydrostatic Bearings* will be controlled by an Allen Bradley system similar to that used for the plant room and control of the enclosure. Once the bearing supplier is chosen, we expect to go through a definition phase of the functionality required. At this point we will develop a schedule to meet the first milestone - which could be as soon as the testing of the altitude axis of the telescope in the factory.

The *M1 Control System* is now preparing for its Preliminary Design Review which will be held at the RGO in December. This review will concentrate on the architectural design of the software and on ensuring that external interfaces to the control system are correctly defined.

As mentioned in the last newsletter we have decided on a distributed approach to I/O, using CANbus to communicate between the VME based controller and remote I/O nodes. A joint development between Gemini and the UKIRT mirror support upgrade project has produced a CANbus software driver for EPICS. This allows EPICS records to interface to the CANbus. It is now being used successfully on UKIRT.

We have selected the Siemens C167 micro-controller as the CPU for the node control units. This is a low cost 16-bit device which includes an integrated CANbus interface. The increased power of this device over an 8-bit solution should not only make software development easier, but also allows us to control the proportional pneumatic valves of the support system digitally. This makes it possible to dispense with much more costly analog electronics in the control units. The design for the control boards has been completed and an order has been placed for construction of prototypes.

The *Secondary Control System* has passed its System Design Review and is now progressing towards its PDR to be held in the next few months. The M2 control team attended the recent design review of the M2 assembly in Tucson and went to Palo Alto to meet with their counterparts on the Lockheed team. We now have a well defined interface between the work being done on the various parts of the M2 assembly and can proceed relatively independently.

The *Enclosure Control System* team recently met in Vancouver to go over the functionality and interfaces to the system being provided by Coast Steel. We now have this defined and will be proceeding towards a Preliminary Design Review in February 1996. Our goal is to have a prototype of the system ready to test with the Coast control system and hardware in mid 1996.

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Infrared Instruments. Work on the *Near Infrared Imager* over the past months has concentrated on reaching a Phase II agreement with the University of Hawaii, Institute for Astronomy, as well as continuing with the work needed to carry the instrument through to Preliminary Design Review by mid-96. We have decided to change the on-instrument wave front sensor location so that it mounts internal to the vacuum jacket, on the cold structure. This change is due to concerns about reaching the needed level of mechanical coupling between the science focal plane and wavefront sensor if the latter is bolted on to the outside of the vacuum jacket, as originally planned.

We are currently working on finalizing the agreement for the *Near Infrared Spectrograph,* which will be built by NOAO. One of the near-term design options under consideration includes embedding a tip/tilt/focus wavefront sensor (like the near-infrared imager) without impacting the scientific performance of the instrument. If possible, we will try to preserve a cross-dispersion design option while permitting on or off-axis guiding. The next milestone is the Conceptual Design Review in the first quarter of 1996.

The *Near Infrared Arrays* that Gemini has selected as best meeting its scientific requirements are the ALADDIN arrays from Santa Barbara Research Corporation. Discussions are underway with NOAO to handle a foundry run of these devices for Gemini. This foundry run may start as soon as Q1 '96 with delivery of engineering devices in Q1 '97 and science arrays in Q2 '97.

The *Mid Infrared Imager* will be obtained via a competitive procurement held by the US Gemini Project Office. The current plan is to circulate an Announcement of Opportunity in December of this year and to select two different groups to produce conceptual design studies by Q4 '96. This would be followed by a second competitive procurement, open to all US institutions, for the final design and fabrication - leading to delivery of an instrument to Gemini in mid-2000. This imager will consist of the imager camera, controller, and array with design emphasis on high throughput and diffraction-limited optical performance. As part of this program, Gemini has arranged with NOAO to test and characterize mid-IR arrays from SBRC. Anyone interested in participating in the competition should contact the US Gemini Project Office at (520) 318-8175 or send email to kwood@noao.edu.

Optical Instruments. The *Gemini Multiple Object Spectrograph* completed its Conceptual Design Review in June '95 and is now going through a detailed costing exercise. Two of the largest unknowns currently are the true cost of the optics and the machines needed to produce the masks - both of which are challenged by the large field of view and the demanding image quality requirements. The next milestone for this program is the Preliminary Design Review in Q1 '96.

The *High Resolution Optical Spectrograph* has started its Conceptual Design Phase with a workshop held at University College London this November. This instrument will have to meet a number of design challenges to provide the scientific performance desired in a Cassegrain-mounted configuration. The next milestone for this project is its Conceptual Design Review.

The *CCD Controllers* required by Gemini have to meet demanding requirements in terms of readout speeds and noise and are key to the success of both GMOS and HROS. Gemini is currently investigating the possibility of adopting a single CCD controller which could handle both the Science CCDs as well as the Wavefront Sensor CCDs.

The *CCD Arrays* required by Gemini for GMOS and HROS are state of the art. We are currently monitoring the off-the-shelf devices available from various vendors, as well as the status of other groups who are participating in foundry runs. Gemini intends

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to make a decision by the end of 1995 and to start procurement of the 6+ devices required early in the new year.

Facility Instrumentation. The UK is preparing to issue an RFP for the major opto-mechanical subassembly of the *Acquisition & Guidance Unit*. We have decided to separate out the wavefront sensing and calibration aspects of the requirements (discussed below). The next milestone in this program is the issuing of the RFP in Q1 '96.

The *Gemini Adaptive Optics System* team is currently working hard on developing a system that will meet the scientific performance requirements within budget. A recent workshop was held in Tucson on the feasibility of upgrading the system currently proposed. The meeting confirmed that a low power laser could be added to improve the sky coverage. The next milestone is the Preliminary Design Review in mid-96.

A new separate *Wavefront Sensor* package has been created. We believe that, by concentrating the wave front sensing, array detectors, and signal processing in a single work package we can achieve significant cost savings, while meeting all of our design requirements. This work package will provide the High Resolution Wavefront Sensors, the Peripheral Wavefront Sensors, and the On-Instrument Wavefront Sensors. We expect to have a Preliminary Design Review of this program in Q1 or Q2 of '96.

We are currently investigating *Infrared On-Instrument Wavefront Sensors*. The project has been working to identify a solution to the problem of supporting wavefront sensing in dark clouds, where optical sensors have a significant problem finding adequate numbers of guide stars. Studies of near-infrared guide star availability and the expected performance level of current near-infrared arrays when operated in a fast readout mode indicate we can achieve the necessary level of correction over the entire sky (including dark clouds) with a non-thermal near-infrared array patrolling a ~3 arcmin field of view. The Project is now investigating technical trades associated with implementing near-infrared wavefront sensors in the near-infrared imager and spectrograph. We will reach a conclusion on the details of this new WFS soon in order to avoid impacting the design schedules of the Near-IR imager and spectrograph.

The *Cassegrain Cluster* recently held a successful Critical Design Review of the rotator, cable wrap, and instrument support structure subsystems. We are currently working towards issuing RFPs for these subsystems in Q1 '96. Once these subsystems are out for bid, we will continue with the remaining subsystems - instrument services and cooling/thermal conditioning.

The *Calibration Unit* will provide calibration for all instruments - both in terms of flat fielding and wavelength calibration. Designs completed to date at ROE indicate the most difficult science requirement is the need to maintain illumination uniformity across GMOS's full field of view to <1%. A combination of sky flats and long-term stability in the calibration unit is expected to handle this key performance area. We expect to review the requirements of this program in the next few months - after which the preliminary design process will start.

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THE GEMINI 8-METER TELESCOPES PROJECT is an international partnership managed by the Association of Universities for Research in Astronomy under a cooperative agreement with the National Science Foundation.

Gemini on the World Wide Web

As you may know, Gemini has had a presence on the World Wide Web since April of 1994, at *http://www.gemini.edu/*. Many changes have been made since the last newsletter, and the site is undergoing a total upgrade that will be complete before the end of the year.

One of the new additions to Gemini's Web site is the Documentation section. Now, you can peruse a list of available Gemini documents, and download PostScript versions of some of them. (We are continuing to obtain electronic copies; if it's not available for download on the site, mail me and request them.) This section is accessible directly from Gemini's main page.

The most exciting recent addition is the Daily Construction Page, showing up-to-the-minute pictures of the Mauna Kea construction site. This section is accessible directly from the main page, and also through the Photo Gallery section. The Photo Gallery section also has current pictures of the primary mirror, the enclosure construction, and Cerro Pachon construction.

-Ruth Kneale
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The following technical documents have been published by the Gemini Project since the last edition of the Gemini Newsletter (June 1995). Copies of these and other publications are available on request by contacting the Gemini Project Documentation Coordinator at the project address, or by e-mailing *rkneale@gemini.edu*. Specific report numbers are listed in parentheses.

- Fast Tip/Tilt Loop Latency Document, R. McGonegal, June 1995. (ICD-G0012)
- Observatory Control System Design Review Document, McGonegal, June 1995. (REV-C-G0043)
- Standard Controller Acceptance Testing System Design Review Documets, McGonegal, June 1995. (REV-C-G0044)
- GMOS Critical Design Review (2 vols), June 1995. (REV-I-G0045)
- Primary Mirror Cell Cart Design Requirements Specification, Raybould, June 1995. (SPE-TE-G0055)
- The Use of the Hipparcos Catalog as Gemini's Pointing Basis, Simons, July 1995. (TN-PS-G0029)
- Longitudinally Averaged R-Band Field Star Counts Across the Entire Sky, Simons, July 1995. (TN-PS-G0030)
- Stray Light Analysis of the Gemini Telescope, Breault Research, August 1995 (CON-BRO-G0040)
- A&G Phase 2 Interim Review Material, Craig, August 1995. (REV-I-G0048)
- M1 Assembly CDR Material (2 vols), Stepp, August 1995. (REV-O-G0049)
- Report of the Preliminary Design Review Committee for the ARCON CCD Controller, Simons, August 1995. (REV-I-G0050)
- ARCON Technical Description, Heathcote et al, August 1995. (RPT-I-G0060)
- M2 Positioning System Design Requirements Document, Roberts, August 1995. (SPE-O-G0057)
- M2 Deployable Baffle Design Requirements Document, Roberts, August 1995. (SPE-O-G0058)
- A&G/AOSWG Background Materials, Simons, August 1995. (SWG-I-G0026)
- Minutes of the Gemini A&G/AO SWG Meeting, Simons, August 1995. (SWG-I-G0028)
- Near-IR Wavefront Sensing, Gillett, August 1995. (TN-PS-G0031)
- Remote Sensing of Atmospheric Emissivity over Mauna Kea Using Satellite Imagery, Simons, September 1995. (TN-PS-G0032)
- IR Imager SWG, Gillett, September 1995. (SWG-I-G0027)
- Cassegrain Area CDR Documentation, Wieland, October 1995. (REV-I-G0051)
- f/16 Secondary Assembly PDR (3 volumes), Roberts, October 1995. (REV-O-G0052)
- Availability of Infrared Guide Stars in Dark Clouds, Simons, October 1995. (TN-PS-G0033)