Report to the Gemini Director on the 20th meeting of the Gemini Science Committee, held in La Serena, Chile on 13-14 October 2003

GSC members in attendance were: Taft Armandroff (US), Tim Bedding (AU), Bob Blum (US), Guillermo Bosch (AR), Malcolm Bremer (UK), Bruce Carney (US), Warrick Couch (AU, Chair), Marcos Diaz (BR), Karl Glazebrook (US), Ken Hinkle (US), Isobel Hook (UK), Harvey Richer (CA), Ray Sharples (UK), Luc Simard (CA), and Charles Woodward (US). Luis Campusano (CH) joined the meeting by phone for the final executive session.

Gemini Observatory staff in attendance were: Jean-Rene Roy (Associate Director, Gemini North), Phil Puxley (Associate Director, Gemini South), Doug Simons (Associate Director, Instrumentation), and Peter Gray (Head of Engineering). Matt Mountain (Director) participated in most of the meeting by video-link from Hilo.

The following 'observers' were present for all but the executive sessions: Bob Abraham (CA), Dennis Crabtree (CA), Jeff Down (PPARC, UK), Magnus Paterson (UK), and Chris Tinney (AU). Rosie Wyse (US) also joined the meeting for the "Aspen" sessions by video-link.

The GSC appreciated the comprehensive and accurate note-taking of Marcel Bergmann.

Votes of thanks: The meeting commenced with members expressing their deep appreciation of the leadership and energy that Bob Joseph had contributed to the GSC in chairing it over the last two years. This was also Harvey Richer's and Ray Sharples' last meeting, and the GSC thanked them for their hard work and the invaluable contributions they had made while being members.

1. Aspen and the 2nd Generation Instrument Program

The main task facing the GSC at this meeting was to review the outcomes of the Aspen process, specifically the scientific visions that had emerged and the corresponding set of new instrument capabilities that were required to achieve these visions. The GSC's considerations were based on careful evaluation of the two documents: "Scientific Horizons at the Gemini Observatory: Exploring a Universe of Matter, Energy, and Life" and "Managing Gemini Observatory's Future Instrumentation Program". Further elaboration of the contents of these documents was provided at the meeting through presentations given by the four Aspen Group Chairs (Abraham, Blum [in place of Michael Meyer], Tinney & Wyse) and by Doug Simons.

The GSC congratulates Doug Simons and the Aspen Group Chairs on the outstanding job they have done in producing the above two major Aspen documents on such a short time-

scale and with such high quality. It was also extremely appreciative of the valuable input and the contributions they provided at the meeting.

1.1 The process and its outcomes

The GSC was in unanimous agreement that the Aspen process had been highly successful in identifying the future scientific visions of the Gemini community, in a comprehensive and all-encompassing way. It clearly had been effective in involving the whole community, both geographically and scientifically. Of key importance was starting the process at the 'grass roots', with the pre-Aspen workshops and meetings held within the partner countries and which were generally structured along the same science themes as the Aspen meeting. This allowed clear scientific directions to be developed within each partner country, which were subsequently fed into the Aspen meeting through the partner representatives within each of the science theme groups. Despite the diversity of science cases and instrument requirements that were presented in each group, it is apparent that all groups were readily able to converge on what its top 3-4 big science questions were, and therefore identify, unequivocally, a set of required instrument capabilities.

1.2 The Aspen documents

The GSC endorsed the way the Aspen outcomes had been distilled and structured into two documents, one dealing with the science and the observations required to do the science, and the other dealing with the associated instrumentation and the related procurement, costing, technical and operational issues. This approach provided the appropriate clear division between the science case material that would be required to sell the Aspen outcomes to the funding agencies, and the programmatic details associated with the desired new instrumentation.

While some editing work remains to be done on the "Scientific Horizons at the Gemini Observatory" document, the GSC was nonetheless very impressed with its overall structure and presentation. In particular, it very much liked the way the scientific aspirations to come from Aspen had been packaged up into a series of 'Big Questions' that were linked and unified under the overarching theme of "The Universe of Matter, the Universe of Energy, and the Universe of Life". The presentation of these, not just in words but also pictorially, as being like the intricately linked pieces of a giant jig-saw puzzle, was thought to be extremely effective. It felt that it is well on the way to being a document that will excite and hence sell the Aspen outcomes to the funding agencies.

At a more detailed level, the GSC identified a number of specific areas where the document required further work:

- A better balance between the Matter, Energy and Life sections in terms of their length and the level at which they are pitched.
- Homogenization of the writing style across the entire document.
- More emphasis on the expansion of parameter space that will be gained from any given instrument.

- Further elaboration of the uniqueness of capabilities that the Gemini telescopes will be acquiring from the Aspen instrumentation program.
- The science/instrument visions need to be placed in the context of other facilities, and the synergies they will have with the next generation of telescopes (ELTs, JWST, ALMA etc). Competition between telescopes and duplication of capabilities will be an important consideration of the funding agencies.

1.3 Recommendations

The GSC came to a clear scientific consensus on what it saw as being the highest priority options to come from Aspen; its recommendations are as follows:

- The GSC recommends the following as being the core set of capabilities that are the minimum to fulfill the scientific visions to come from Aspen:

Minimum core package *(in no priority order)*		
Instrument	**Science enabled**	**Comments**
• Extreme AO	• Direct detection of gas-giant planets • Protoplanetary disks	Potential for extremely high-impact science.
• Hi-Res NIR Spec (with MCAO-fed MOS)	• Doppler detection of earth-mass planets • Star formation vs age, abundance, environment • Nature of circumstellar environments • Physical state/composition of ISM • Black Hole–SF connection in Milky Way	Unique facility with wide applications.
• Wide Field Fiber-Fed Optical MOS	• Dark energy • Dark matter on galactic scales • Galaxy genesis	Unique facility with wide applications.

It sees this package setting Gemini on an exciting scientific mission whereby it will be able to answer the key 'big questions' identified across the three "Universe of Matter", "Universe of Energy", and "Universe of Life" areas. Furthermore, it builds on Gemini's strengths and excellence in the areas of high resolution AO imaging and near-infrared astronomy, and it will also give it a unique capability that no other telescope in its class will be able to match viz.,4000-5000 multiplex optical MOS over a ~1.5 deg field of view.

- The GSC also identified the following instrument options that had sufficiently high potential to warrant further investigation:

Other opportunities		
Instrument	**Science enabled**	**Comments**
• GLAO System	• First light objects in the universe • Dark matter on galactic studies • Proper motion studies across the Local Group	The potential for this system to offer high spatial resolution over a wide field down to 0.6μm was seen as a very powerful capability, particularly in the post-HST era.
• Tunable Filter with GSAOI	• First light objects in the universe	This might provide a low-cost, rapid route to 'First Light' studies; a comparative study between it and GLAO required.
• IFU Optical Spec	• Formation of Hubble sequence • Stellar population studies beyond the Local Group	Addresses important Aspen science cases and provides a unique capability.
• HiRes MIR Spec	• Star formation & ISM studies	Bringing the TEXES instrument to Gemini should be explored as a means of providing this high-priority capability identified at Aspen and further exploiting Gemini's low-emissivity advantage in SF & ISM studies.

1.3.1 Recommended feasibility studies

In making the above recommendations, the GSC was well aware that there were a number of issues relating to science trade-offs, technical feasibility, impact on the telescopes and their operations, and costing, that remained unanswered and required thorough investigation. It therefore recommends that the Gemini Observatory move quickly to commission full feasibility studies for the following instruments:

- Wide-field Fiber-Fed Optical MOS
- GLAO System
- TEXES (in providing HiRes MIR spectroscopic capability).

Included in these studies should be a comprehensive assessment of: (a)the impact these new instruments will have on other instrumentation and its scheduling, and (b)the division between 'large campaign' and normal 'PI' science that they will enable.

With regards to (b), the GSC recognized that a number of the Aspen science missions (e.g., Dark Energy, Galaxy Genesis) required large amounts of telescope time to achieve their goals. It seems likely that large teams that span the partnership and bring special expertise will be required for these 'large campaign' projects. In fact, the deep and broad scientific talent that is encompassed by the Gemini partnership is an important resource and enabler for such high-impact science projects. No formal mechanism currently exists to bring such teams together and fund them. The GSC recommends that the NGOs and Gemini initiate a discussion within the partner communities about how such projects would best be executed. It may be possible to include 'PI' science alongside these major proposed programs.

The GSC also recommends that a comparative study be conducted to assess whether the use of a tunable filter with GSAOI provides a viable, low-cost alternative to the GLAO System for conducting 'first light' studies with Gemini.

1.3.2 Instruments not supported

The GSC was of the view that three of the new instrument capabilities identified at Aspen did not merit support; these and the reasons for this are as follows:

- **HiRes Optical Spectrometer** – this capability is already available on other 8m class telescopes.
- **Wide-Field Optical MOS in f/6 configuration** – provided less expensively by the Wide-Field Fiber-Fed Optical MOS.
- **AO-fed NIR Spectrometer –** the concept proposed was considered to be overly specialized.

2. Priorities for commissioning of instruments and their modes

The GSC first reviewed the status of Michelle, bHROS, and Hokupa'a-85, since there were recent important developments with these instruments that impacted on their availability and hence the priority they should be given for commissioning.

2.1 Michelle

The GSC welcomed the news of Michelle's permanent return to Gemini in May 2004, and sees this as a major hurdle that has been overcome in ensuring it becomes a reliable and fully commissioned instrument which is continually available to the Gemini community. The GSC encourages the Observatory to make every effort to make it available to the Gemini community in 2004B, so that it can be used for SIRTF follow-up.

2.2 Hokupa'a-85

The GSC was informed that there had been recent major progress on this instrument, with the two new deformable mirrors – which were on the critical path – now being available and ready for wiring. Commissioning of Hok-85 could start as soon as Q1, 2004 (2 week period) on Gemini North, using the NOAO NIR camera Abu. It would then be available for use on Gemini South during the 2004B and 2005A semesters, assuming NICI remains on schedule and is used as a replacement for Hok-85. The ability of Hok-85 to provide Gemini with a faint guide star AO capability and hence provide valuable scientific opportunities for its community, as well as the importance of this instrument as a prototype for NICI, were also acknowledged.

After careful consideration of this information as well as the imminent pressures on commissioning time coming from new and existing facility instruments, the GSC recommends that Hok-85 be commissioned, subject to the following provisos:

- It must not replace a facility instrument,
- It must be commissioned on Gemini South during UH's guaranteed time,
- It is available to the community by 2004B.

The priority given to its commissioning relative to other facility instruments (and their modes) is given below.

2.3 bHROS

A decision on whether this instrument should be commissioned cannot be made until its measured throughput is known. At the time of the GSC meeting, one attempt had been made to make this measurement, and this yielded a value of <1%. It was suspected that this low value was due to the misalignment of the telescope beam into the fiber entrance lenses. An attempt to rectify this problem and make a second throughput measurement was scheduled on the two nights after the meeting. The GSC decided it would wait until it heard the outcome of this second attempt before making a recommendation on whether

to: (i)commission bHROS, and (ii)carry out the proposed CCD upgrade, involving replacement of the existing 2-CCD package with a 4-CCD package using the CCDs that are being replaced in GMOS-S. However, it determined that the throughput[1] would have to be at least 10%, if it was to consider proceeding with (i) and (ii).

2.4 Final commissioning priorities

Having considered the above developments and been presented with the 'strawman' lists of commissioning priorities for each of the two Gemini telescope assembled by the Gemini Observatory staff, the GSC reached a clear consensus on what it considered the commissioning priorities should be over the next 12 months (when it will review these again at its next meeting). These are listed in the table below, where we have grouped instrument/modes into three priority bands, with Band 1 being the highest, Band 2 the next highest and so forth.

Commissioning Priorities		
Priority band (high to low)	**Gemini North**	**Gemini South**
1.	Michelle spectroscopy ALTAIR + NIRI spectroscopy GMOS – new CCDs ALTAIR + LGS	GNIRS – key modes GMOS – new CCDs GMOS – IFU GMOS – OIWFS-elec-offsets
2.	GPOL + NIRI polarimetry Michelle polarimetry Michelle echelle spectroscopy	GNIRS – R=18k mode [1] Hokupa'a-85 GNIRS – IFU(3-5μm) [2] GMOS – n/slit – red *bHROS* [3]
3.	ALTAIR + GMOS spectroscopy GMOS – non-sidereal mode	GPOL + GNIRS GMOS – n/slit – blue + ADC *bHROS with Iodine cell* [3]

Notes:

- [1] & [2] – indicates that the R=18k mode of GNIRS has a higher commissioning priority than its IFU(3-5μm) mode.
- [3] – these commissioning priorities for bHROS are subject to its measured throughput meeting the GSC's requirement (>10%); see above.
- NICI – the GSC remains enthusiastic about the scientific opportunities provided by NICI, but feels it is premature to give it a commissioning priority.

[1] Includes: sky + telescope + fiber system + slicer + spectrograph + detector

3. The Gemini AO Program

The GSC appreciated the reports they received from Francois Rigaut and Mike Sheehan on the status of ALTAIR and the MCAO program, respectively, and were encouraged by the good progress with both, in particular seeing some of the first images to be taken with ALTAIR (+NIRI) which looked very promising. The GSC supports the Observatory's proposal to address the anisoplanatism issue with ALTAIR, since achieving close to diffraction-limited performance over a bigger field with this instrument would be extremely valuable. Rigaut also answered questions in relation to GLAO (which had arisen in the GSC's Aspen discussions), for which it was also very grateful.

3.1 AO Working Group

Although the GSC did not have a lot of time to devote to AO issues, it was clear that a number of quite important ones – of a strategic, scientific, technical and managerial nature – will continue to arise as the AO program (in particular MCAO) progresses. Moreover, many of the technical issues are quite complex (taking GLAO as an example), requiring expert advice. This reemphasized the need for the GSC to have an active Adaptive Optics Working Group (AO-WG) which could look at the full range of issues in more detail and advise it accordingly.

The GSC and the Observatory will work together to reconstitute the AO-WG as a matter of urgency, and suggests the following people as being excellent possibilities for chairing this working group and/or being recruited as new members: Richard Myers (UK), Ben Oppenheimer (US), Paul Schechter (US). Given that the Gemini Observatory is entering a critical period in the development of its LGS and MCAO programs, it would seem prudent that this working group meet on a regular basis (no less than once per year) in order to keep pace with these developments.

4. Gemini Science Meeting

The GSC enthusiastically endorsed the Board's recommendation that a scientific meeting of users of the Gemini Observatory be held in 2004. In addition to fostering scientific collaboration amongst the partnership, it was seen as an excellent opportunity to showcase the science done with Gemini so far, and in doing so highlight its key/unique capabilities. The GSC also recommends that a 'users' meeting, of a half to one day duration, be held in conjunction with the 'science' meeting. This should focus on the use of the Gemini Telescopes with presentations on such things as the Observing Tool, queue management, instrument developments, and data reduction software.

The GSC had the following suggestions to make with regard to the organizational details of the science meeting:

Venue and date – Harvey Richer's invitation to host the meeting in Vancouver should be accepted; the meeting should be held sometime within the May 6-18 period (to minimize clashes with academic teaching).

Format – A three-day meeting, comprising a mixture of invited and contributed talks, as well as a poster session. Of order 10-12 invited speakers would seem appropriate, with major Gemini users, instrument scientists, and coordinators of large Gemini programs being targeted. The meeting would also be a timely opportunity for Doug Simons to provide the community for an update on the Aspen process. Need to be proactive in encouraging users with completed programs to attend and give talks. See no need to restrict the number of attendees.

SOC – This include the following GSC/NGO members/representatives: Armandroff, Bedding, Bremmer, Côté, Glazebrook (all of whom are willing to serve); suggests either Kátia Cunha or Beatriz Barbuy (Brazil) also be approached.

LOC – Richer, Crabtree, and Armandroff are willing to take care of local arrangements, and enlist Stéphanie Côté to assist them.

Proceedings – Recommends there be no formal published proceedings; rather all contributions are made immediately available on a (Gemini) website in a standard (eg. pdf) format.

Special funding – Endorses Roy's proposal that special funding be made available to support attendance of postdocs and students (particularly those who have used Gemini).

5. Scientific productivity and impact of the Gemini telescopes

The GSC noted the two reports "Recent Science Highlights From the Gemini Observatory" (by Roy, Puxley, & Mountain) that were presented to the Board at its May and November meetings, and were pleased to see the continued stream of new science results, particularly those from some quite large multi-partner programs (eg., the Gemini Deep Deep Survey).

The Director informed the GSC that the AOC-G was of the view that while exciting science was now emerging from Gemini, it was yet to make/have the scientific impact/profile that other 8m-class telescopes enjoyed. As a consequence, they had a major concern that Gemini would have difficulty exciting the Agencies into funding its Aspen aspirations. Advice was therefore sought from the GSC as to how Gemini could be more pro-active in raising its scientific profile.

The GSC was well aware of the unfavorable perception of Gemini which underlies the AOC-G's concern. However, past experiences with other new telescope facilities had shown time and again that they require a 'lead-time' of several years to reach full scientific productivity and make a major impact. With the fraction of science time on the

Gemini telescopes now exceeding 70%, and major programs now coming to fruition, the GSC felt that Gemini was now 'on the cusp' of producing significant scientific returns. Hence it saw no need for drastic measures to be taken. In particular, it was not enthusiastic about Director's Discretionary (DD) and Science Verification (SV) time being used more liberally to address the problem, believing that in the long term, the integrity of the TAC system has proven its worth. Rather it felt that efforts would be better directed at addressing two major impediments to Gemini achieving the maximum and timely scientific return from the usage of its telescopes:

- Queue programs not being fully completed,
- Observers having considerable trouble reducing Gemini data.

The GSC felt strongly that if significant improvements could be made in these two areas, the flow of science from the telescopes would rise markedly, with a commensurate heightening of its profile.

To this end, the GSC has already endorsed the SRB1 rollover proposal, which will come into force in 2004 and should make a big impact on ensuring the highest ranked programs are completed.

As recommended elsewhere (§6), the GSC cannot stress enough the importance of making stable, user-friendly, and robust pipeline reduction software available to the Gemini user community, and is fully supportive of the Gemini Observatory being given and allocating additional resources to do this.

The GSC is also well aware that generating media coverage of the scientific discoveries made on Gemini is also a very important part of raising its scientific profile. A clear message received from the NGO representatives on the GSC was that every effort was being made to do this within the partner countries. Nonetheless, it was recognized that this effort must be maintained, if not enhanced, with the NGOs and the Gemini Observatory Public Outreach Office needing to be proactive in monitoring Gemini programs and seeking out news-worthy stories from their PIs.

6. Software issues

6.1 High Level Software (HLSW)

The GSC was pleased to learn that the basic components (and many advanced capabilities) of the HLSW system are now in place. It was also pleased to receive confirmation that the recommendation from its last meeting that further instrument commissioning only proceeds once the HLWS for that instrument is in place, is being adhered to.

6.2 Gemini IRAF project

Roy reported that this project – a two year effort – was progressing well. This will produce a 'base set' of ~15 Gemini IRAF routines. The GSC very much endorses this project and recognizes the importance of it succeeding. The backward compatibility problem raised by the GSC at its last meeting is now reported to be solved.

6.3 Data reduction pipelines

The Director requested comment from the GSC on a proposal for Gemini to move from the provision of "quick look" data reduction tools to "fully processed" data pipelines. This would represent a significant change in Gemini's scope in this context, requiring significant additional resources (5-10 extra FTEs across the two sites). Hence the importance of data pipelines needs to be carefully assessed, and it is in this regard that GSC input would be valuable.

As recorded in the previous section (§5), the GSC has already identified the difficulty experienced with Gemini data reduction as being one of two major 'bottle-necks' to generating scientific results from Gemini observations. Therefore it strongly endorses this proposal to provide data pipeline reduction software, but urges that attention be paid to the following points:

- It is essential that the pipeline systems are stable, user-friendly, and robust, irrespective of the operating system under which they are run.
- It is important that the 'quick look' capability be retained, since it is vital to the Observatory in carrying out its quality assessment of data.
- The Observatory should avoid committing itself to producing pipeline reduction software for all observing modes. Rather it should concentrate on the popular observing modes and provide pipelines that produce science-grade processed data sets for those.
- The timely release of quality assessed data remains paramount in ensuring the best interests of the Gemini community's science are served.

7. Operational Issues

7.1 Operational efficiency and settling time

The GSC applauded the current campaign to improve the operational efficiency of the telescopes through reducing the observing overheads, particularly those associated with chopping and nodding that have a big impact on NIR and MIR observations. The GSC asks that a report on the outcomes of this campaign be presented at its next meeting.

7.2 Image quality assessment

The GSC noted that an external review of the image quality (IQ) at the Gemini telescopes had recently been held and that it had identified the following important requirements:

- External seeing monitors and accurate logging of IQ and aO parameters.
- Routine monitoring and logging of the IQ performance from science images.
- Develop standardized, well-understood aO procedures for telescope operators.
- Implement thermal-wind control systems.

The GSC was pleased to hear that a seeing monitor will soon be installed at CP; on the other hand it was concerned that there has been little progress at MK in this regard.

7.3 Engineering support at the telescopes

The GSC noted with some concern the possible lack of adequate engineering support personnel being available at the telescopes over weekends. As telescope and telescope system downtime adversely affects scientific productivity, we urge the Observatory to closely monitor the impact of this staffing model. The GSC would appreciate a report on this at its next meeting.

7.4 Review of 50:50 queue/classical model (as per Board resolution 2003.A.7)

The Board asked the GSC to review the current Observatory model of queue and classical observing fractions being 50%:50%, and assess whether such a split is appropriate for addressing the science objectives of the communities.

The GSC felt that the best (and really only) indicator in this context was the present demand for queue and classical time coming through the proposal/TAC process, where currently the split between the two is not preset. However, this needs to be treated with caution, given that the Observatory is far from a 'steady state' in terms of the instruments (and modes) that are available, the fraction of telescope time made available for science observations, and the very few semesters in which classical time has been offered. Moreover, applying for classical time is not really an option for observers in the smaller partner countries because of the 3-night minimum length for classical runs. Bearing this in mind, the GSC's views can best be summarized as follows:

- Current evidence would suggest that in the major partner communities, the demand for queue/classical time is roughly 75%/25%.
- The GSC saw no problem with this imbalance between queue and classical time, and felt that the science objectives of the communities are best met, at the moment at least, by letting the queue:classical fractions 'float'.
- However, it would not want to see classical observing disappear altogether. Indeed, it made a strong statement to this effect at its last meeting, emphasizing the importance of classical observing in the training of young astronomers in the

art of observational astronomy, and the value it brings to the Observatory through having astronomers visit and interact with its staff.

- Accordingly, the GSC is supportive of initiatives to facilitate classical observing, such as NGOs packaging programs into classical ‘mini queue’ runs, and consideration of ways in which the 3-night minimum requirement might be relaxed.

8. Gemini Science Archive

The GSC noted that the OpsWG had received a detailed update on the GSA program and were happy to accept their advice that it was progressing well, and applauds the imminent release of the prototype GSA to the Gemini community.

9. Next meeting: date and venue

Being sympathetic to the large number of meetings the Gemini Observatory management are required to attend and the very heavy load that places on them in preparing documents and presentations, the GSC agreed to the proposal that in future its meetings overlap with and be held in the same place as those of the AOC-G. Hence the GSC Chair would, in consultation with Gemini management, need to consult with his AOC-G counterpart before a date and venue for the next meeting could be set.