Gemini User's Committee 2019 Report

The User's Committee for Gemini (UCG) met at the Gemini Observatory Northern Operations Center in Hilo, Hawaii on July 31 and August 1, 2019.

The UCG members present included: Karen Meech (University of Hawaii, chair), Matthew Bayliss (MIT Kavli Institute for Astrophysics and Space Research and the University of Cincinnati), Mark Brodwin (University of Missouri), Scott Chapman (Dalhousie University), Thiago S. Gonçalves (Observatório do Valongo UFRJ), J.J. Kavelaars (National Research Council of Canada), Maria Celeste Parisi (Observatorio Astronómico de Córdoba), Vinicius Placco (University of Notre Dame), Thomas Puzia (Pontificia Universidad Católica de Chile), Jonelle Walsh (Texas A&M University), and Letizia Stanghellini (ex-officio, US NGO).

Also present: Jennifer Lotz (Director), Andy Adamson (Associate Director Hawai'i Site), Joanna Thomas-Osip (Head of Science User Support), John Blakeslee (Chief Scientist), René Rutten (Associate Director Gemini South operations), Fredrik Rantakyro (GPI Scientist Gemini South), Ruben Diaz (Instrumentation Program Scientist Gemini South), Atsuko Nitta (Gemini North Head of Science Operations), Jerry Brower (ITS Gemini North), Bryan Miller (Astronomer Gemini South), Operations Working Group (on day 2) including Edgardo Costa (Chile NGO, Eder Martioli and Alberto Ardila (Brazil NGO), Gabriel Ferrero (Argentina NGO), Stephanie Coté (Canada NGO), Jacqueline Keane (UH NGO), Soung-Chul Yang (Korea NGO), André-Nicolas Chené (Science User Support Astronomer Gemini North), Sandy Leggett (Astronomer Gemini North), Andy Stephens (Scientist Gemini North).

The UCG members would like to thank the Gemini staff, in particular, Terry Lee and Bobbi Kikuchi for all their work in flawlessly setting up the logistics for the meeting.

In each section of the report we summarize any recommended actions, and then all of these are accumulated in a prioritized list at the end of the report.

Response to Last Year's Report

The 2018 UCG report had a ranked list of high priority action items that affected the ability to collect, reduce and analyze high-quality science data. Additionally, the UCG recommended several smaller action items. The UCG thanks Gemini for addressing many of these issues. There are a few items that remain as high priority issues, however, as discussed below. For future responses, the UCG would like a brief summary from Gemini when issues are not able to be addressed. We would also request that our highest priority action items get addressed first whenever possible.

High priority items:

1 - Data Reduction pipelines - *Finish the development of the data reduction pipelines for science quality calibrated data (flat fielding for imaging and spectra, and wavelength calibration for spectra). This has been requested as urgent for several years.*

The soon-to-be-released DRAGONS software is the data reduction package for all the Gemini imagers and spectrometers. The new packages are a very good step forward. Having an easy-to-use data reduction software that is modular and flexible so that users can handle program-specific situations will help to improve the science impact of the observatory.

The UCG believes the tutorials are a great first step for users to get acquainted with the reduction process, including the use of the DRAGONS pipeline. Nevertheless, we believe that in order to provide the best possible science product, the user needs control over the parameters, in which case a comprehensive manual with detailed explanations of the optional inputs is of fundamental importance.

Recommended Actions

- Starting with the simpler data reduction cases and building up in complexity is a good path forward, but the UCG would like to see a sustained effort in the future for different instruments and observation modes (e.g., MOS). This should be a top priority in order to attract a larger user community to the observatory.
- The UCG encourages the data reduction team to provide documentation that confirms that these new packages provide properly calibrated datasets that reproduce previously accepted data analysis outputs (e.g. verify that the ZeroPoint derived from DRAGONS analysis match IRAF reduced versions and whether the NIRI stacks are as deep as previously produced stacks).

2 - Flat field Calibration - *Assess the strategy for getting fewer (than the standard 25 flats) per filter per twilight to ensure observers have near-simultaneous calibrations at the same lunar phase and assess if red band twilight flats in the evening and blue in the morning is a good strategy to accomplish this.*

One of the key issues in the 2018 report concerned the poor quality of the GMOS flattening, and the likelihood that this was caused by the fact that the calibrations are often not done close in time to the observations. Gemini responded that the major issue was due to the impact of air bubbles in the optical system. While this may be the main reason, the issue of the flat calibrations being taken far in time from the data has **not** been demonstrated to be of little impact.

The UCG provides clarification of the statement on photometric standard calibration from the 2018 report, as follows. Generally, fields are better calibrated using internally calibrated stars. To turn those filter calibrated fluxes to a standard calibration requires knowledge of the transform from the used filter system to the standard system. This requires engineering effort to ensure that color corrections for the filters are well enough known that transformations at the 1% level can be achieved.

***Recommended Actions**:*

- Assess whether or not taking flat fields far in time from the science observations is an issue now that the air bubbles in the optical system at GMOS south has been repaired, and for GMOS north after the summer shutdown repairs.
- Provide guidance to GMOS users (for the past ~2 years) which flat fields (i.e. specific files) will best reduce their data.
- Assess the strategy for getting more frequent flat fields in each filter to ensure observers have near-simultaneous calibrations at the same lunar phase. Assess whether taking fewer than the standard 25 flats per filter per twilight will be a more efficient way to accomplish this.
- Assess a strategy for periodically obtaining the color corrections from the Gemini filters to the large survey filter systems (e.g. SDSS, Pan-STARRS, DeCALS).

3 - Characterize and solve the problem of GMOS-S detector stripes

The UCG thanks Gemini for addressing the GMOS-S detector issue.

4 - Repair the F2 OIWFS sensor

The UCG thanks Gemini for overseeing the repair of FLAMINGOS-2 OIWFS, and looks forward to hearing about long-term options for this issue since it has again broken and will be repaired in the summer 2019 shutdown.

5 - Timing issues - *Document the timing keywords in the GMOS header and ensure that the exposure start time is accurate immediately to 1 sec, longer-term to the millisecond.*

The UCG was very pleased with the detailed investigation of the timing issues and commends the Gemini staff for the planned short term fixes which include better documentation of the timestamps used in the headers and which keywords are most closely coupled to the time that photons arrive at the detector. We encourage that the “mid-term” goals of updating the fits headers with the missing keywords (DUT1, average shutter speed opening) should be done as soon as is reasonably feasible.

Recommended Actions:

- Provide an estimate of the total time stamp error for the telescope+instrument+shutter system (i.e. provide the best estimate for the time stamp dispersion so that users who have precise timing requirements have an idea of the start time error associated with the UTSTART timestamp). Observations of GPS satellites with high-precision orbits could be used as clocks to help determine this dispersion directly, such observations would provide the necessary shutter timing calibration. The state of the art for timing precision for decades has been absolute timing accuracy better than 0.1 second. However, in the era of Gaia, high-precision solar system astrometry requires absolute timing accuracy at the millisecond level.

- In the long-term achieving knowledge of the shutter open time to the millisecond level is very important for all projects relying on accurate astrometry for moving objects, in particular fast moving NEOs.

6,7 - IR Spectral Calibration - *Quantify what is needed for telluric IR standards, and Explore the use of atmospheric absorption modeling software for calibration*

One general concern that has been raised by some in the community is that some PIs have been disinclined to propose for Gemini time following past negative experiences, specifically including experiences with the Gemini calibration structure and a perceived lack of flexibility of Phase II design. However, the observatory has clearly communicated to the UCG that policy is to allow for PI customization of program plans and calibration strategies so long as the telescope/instrument are not endangered. We recommend that this information be explicitly stated on Gemini webpages, ideally in several places, such as the "Queue Mode Observations" page under "Proposal Routes and Observing Modes". It would also be prudent to modify the language on pages such as the "NIR Baseline Calibrations" page (here for example: https://www.gemini.edu/sciops/instruments/nearir-resources/baseline-calibrations) that explicitly state that the baseline calibrations are taken according to a set plan "to ensure long term utility of the data", which contradicts the idea that program PIs have the final say on how their observations and calibrations are organized. The core idea here is that the specific needs of a program PI should supersede any potential concerns over long term utility of observations in a database if this affects the ability of the PI to do the science they have proposed.

The UCG is pleased with the work that Gemini has done to assess if spectroscopic archival data may be calibrated without obtaining telluric standards before and after the observations. Work on one GNIRS high-resolution data set showed that an atmospheric modeling code does a reasonable job at the 10% level. Since this is a single example, the UCG agrees with the calibration strategies report that significant testing would be needed before taking on the risk of forgoing observations of telluric stars. During the UCG meeting, the case of IRTF using satellite data to enable removal of telluric absorption was noted and suggested as an avenue that Gemini should investigate.

Lower Priority / Small Action Items (in Priority order)

1,2 - Fix the archive bugs *(1) preventing search on comet names, and (2) preventing selection of file ranges* - **Not addressed**.

UCG is happy to note that a new hire who will work on archive issues has nearly been secured. The UCG looks forward to the hoped-for archive enhancements.

3 - Provide estimates of likely completion rate for conditions, RA requested with the time allocation award letters. – *improves community satisfaction with the observatory* - **Done**

4 - Move the GRACES ITC software to a free platform (with the help of users in Argentina)

The UCG noted there is no mention of this request. The requested action should be addressed, even when the answer is that no effort was committed to the request.

5 - Hide the "Night Basecal Time" from the PIs in the Phase I - *annoying, but not urgent* - **Done**

6 - Set up a data staging area for ingestion of LLP data products – *will help LLP programs implement observatory request faster*

See item (4) above. The new hire will be dealing with this.

7 - Monitor trends in program length (*if the observatory feels there is an issue that needs to be addressed; it was not clear to the UCG that this is an issue*)

There was no mention of the problem occurred during the SciOps/NGO meeting.

8 - Clarify wording in ToO policy *to specify what is meant by "same instrument configuration", and determination of "first trigger" of observation.* **Done**

9 - For instruments that are not fully functional, ensure that they are advertised as "shared risk" in the call for proposals **- will do this in future calls.**

Recommended Actions

- Fix the archive bugs (1) preventing search on comet names, and (2) preventing selection of file ranges
- Update Gemini webpages to clearly and accurately communicate that program PIs have final say over observation and calibration strategies in their programs

Gemini Card Game

The Gemini staff introduced and demonstrated an instructive and fun way to learn about the queue scheduling. This represents a significant investment in time and is a great promotional tool. Gemini should explore ways to leverage this for outreach, including distribution at conferences and events. For example, perhaps this can be more widely distributed in a digital format (for example, some UCG members would have benefitted from bigger cards and/or larger text to make it easier for players with "older vision" to enjoy).

NCOA Update

Gemini is requesting feedback on what the user community needs in terms of user support resources in the NCOA era. The UCG feels strongly that the main issue is to have science-quality, calibrated data delivered quickly to the community and that this should not just support time-domain astronomy. Below are the issues raised by the UCG, however, the committee felt it would also be important to get input from the general user community on what their priorities are for

additional user support. The UCG feels that this can be accomplished via a poll of the community. The UCG has prepared a draft poll of around 60+ questions and will be happy to collaborate with Gemini to generate additional questions, and to help with the data analysis and interpretation. The results of such a poll could be used to seed or frame an open discussion forum at the 2020 Gemini Science Meeting. This would be an excellent investment of resources that will allow attendees of the 2020 science meeting to directly contribute to an open discussion of what the community would like to see prioritized in the NCOA era.

Recommended User Support Resources (Examples)

- Gemini should develop the quick-look program ASAP but then continue with the same pace and allocated personnel FTE to extend this to the full science-ready archive reduction product. This transition is crucial as the UCG unanimously believes that an official science pipeline is the most important product of the observatory to enable science. This is not a one-time reduction; as issues are resolved the pipeline is re-run for the entire archive to ensure that the archive data has the best calibration. This is currently done at other major observatories.
- In addition to the automated pipeline data reduction support, there is a community need for data reduction manuals. The details have been addressed in previous sections, but the UCG requests that this remains a priority under NCOA management.
- Having more ways for Gemini users to access telescope resources to allow for experimentation with different observing modes.
- Better documentation on non-standard observations, including what has been tried and worked or did not work.
- To be able to access the data archives for all of the NCOA facilities with a single interface. This initiative would facilitate scientific analysis.
- Ingestion of higher-level data products such as those that LSST will provide.
- The Canadian Astronomy Data Center (CADC) has developed a tool to search for images where specific moving objects may be found, called the Solar System Object Image Search (SSOIS; http://www.cadc-ccda.hia-iha.nrc-cnrc.gc.ca/en/ssois/). After submission of a moving object name SSOIS generates an ephemeris and returns a list of images that have that object's position in their field of view. At present, because there is no standardized data exchange format, the tool does not directly return the images. Gemini should collaborate with the CADC to implement the capabilities of this moving object image identification and access tool for all of the Gemini archive data. At a later stage, this could be extended to NCOA archival resources.
- Migrating the NOAO datalab (http://datalab.noao.edu/) tools to the larger NCOA environment (including Gemini data) would benefit the community. Datalab connects users to products (e.g. catalogs) and provides basic tools for analysis of those catalogs.

The UCG is also concerned about the continued existence of the US NGO as an entity focused on Gemini support. In the discussion of the NCOA era, it was not made clear that the US NGO will continue in its current role. The US NGO provides extremely important support to the entire Gemini community and these activities need to continue to be supported. As the largest Gemini

partner, the US-NGO provides critically needed capacity to the NGO effort and this capacity needs to be maintained. The activity of the National Gemini Office (NGO) staff in the NCOA era should continue to have the science productivity of Gemini as their primary focus. Specifically, the NGOs fulfill their mission through active support of the complete science process, from proposal preparation (Phase 1) to proposal evaluation (TAC support), to preparing observations (Phase 2) and acting as a point of contact between the observatory and the scientist during the data acquisition phase. Because the NGO staff are present during this complete process, they can be fully aware of the goals and pressures of the various active science programs, as well as the science priorities of their national communities. This all-encompassing role of ensuring that the facility delivers on its science mission is a critical activity and must continue to be supported during the NCOA area.

Finally, the UCG would like to ensure that non-time-domain use of the observatory is also supported and has growth opportunities. There is a perception, correct or not, that in the NCOA era the prioritization of time-domain astronomy (TDA) will lead to degraded service to the larger static-universe community, in terms of instrument upgrades, pipelines, manuals, etc. One suggestion is to pursue initiatives that make an effort to engage broader swaths of the observing community, and that encourage new/novel/experimental uses of the observatory. The Instrument Upgrade and Fast Turnaround programs are great (and successful!) examples of these kinds of initiatives, and the UCG recommends that the observatory support new programs such as a special call for engineering time to test out obvious combinations (e.g., GEMS+GMOS; GEMS+F2). This program could include funding for outside observers to travel to the telescope, which would provide an avenue for enthusiastic members of the observing community to contribute effort toward providing new proven observing modes.

Quick-look Products Questions

Gemini requested that the UCG provide a list of the products we want to have for the ToO triggers to tell the PI if this is an object that needs further observation. This will allow the observatory to know where they should spend their effort. We imagine that the Quick-look data products will result from an automated (i.e., no direct human input) pipeline run on the data in real-time. There is strong synergy here between providing quick-look products and developing data reduction pipelines. To first order, the ideal quick-look product would be the result of pushing data through existing pipelines with a default parameter setup.

We separate the quick-look recommendations into two cases: imaging and spectroscopy, and suggest quick-look products motivated by the measurements that we anticipate will need to be made from the quick-look products.

<u>Imaging quick-look products desired</u>

Quick-look analysis of imaging data should allow the PIs to quickly perform measurements on the data including source fluxes (magnitudes), the shape, FWHM and extent of sources, and the astrometric positions of sources. The quick-look products that need to be delivered to the PI in

order to facilitate these measurements are listed in priority order below. These should include an estimate of the precision achieved.

1. Flattened, fringe-corrected, and flux-calibrated images of sufficient accuracy (5%) to determine useful colors when multiple filters were observed.
2. A basic spatial World Coordinate System in the image header of sufficient accuracy (0.1") to allow localizing moving objects.
3. An estimate of the FWHM of the point spread function.
4. Stacks of multiple images of sources (including sources that move at non-sidereal rates), to enable detection of faint objects or placing meaningful limits on non-detections.

Spectroscopy quick-look products

The primary purpose of quick-look spectroscopic products should be to classify the target objects, but it is unrealistic to expect a quick-look pipeline to reliably (~100% of the time) make it all the way to accurately classifying the targeted object. Rather, it should be the responsibility of the PI/observing team to produce the final object classification, as well as any "high level" measurements from the resulting spectra (e.g., redshifts, line widths, equivalent widths, etc.). With this in mind, for (longslit) spectroscopy we summarize the natural quick-look products (in priority order) that should be provided in an automated/push-button way as follows:

1. Wavelength calibrated (i.e., spectral WCS with the wavelength centroid of each pixel), sky-subtracted (trivial given the wavelength solution) 2D images of each spectroscopic science frame.
2. The quick-look pipeline could (or should) then attempt to generate an automated, forced 1D extraction of the object of interest or the pipeline's best guess at what the object of interest is. The area of the automated extraction trace should be indicated in the 2D spectroscopic science frame.
3. There should be no expectation that an automated pipeline can always produce an optimal (or even usable) extraction, but when successful, this step would enable the fastest possible classification of the source.

How quickly should the quick-look processing be done?

A quick-look processing system that relies on running an automated (no human intervention) pipeline on data should be performed as soon as the observations are completed (i.e., shutter closed) and made available for download by PIs to be analyzed and used to promptly plan additional observations. The products should be available for download by PIs as near simultaneously as possible, as is done at the VLT, in order to be able to use these results not only the following night but also for follow-up observations in different time zones.

Workshop at the 2020 Gemini Science Meeting in Korea

Gemini informed the UCG that the Science Meeting will take place in Korea next year. The UCG was encouraged to propose possible topics for discussion, similar to the "Under the Hood" Workshop and "Speed collaboration" events that were organized at the Gemini science meeting in San Francisco in 2018. The UCG and Gemini should commit to making our communities aware of the opportunity, inquiring whether they have any ideas for such events. We ask that Gemini helps by making an announcement of the Meeting dates and venue, requesting suggestions from the community at large via the users poll.

As discussed in the “NCOA Update” section above, the UCG would like to see a town hall or discussion forum event in which the impact of the upcoming NCOA changes are explained and discussed with attendees. This transparency will help dispel community concerns and misconceptions about the changes in the NCOA era and help guide future discussions regarding user requests and priorities in the upcoming years. Specific community concerns include, but are not limited to 1) the reallocation of observatory resources to disproportionately support time-domain subfields in astronomy, for instance at the expense of developing software and instrument capabilities primarily suited to users in other fields (‘TDA over prioritization without representation’), 2) the potential loss of specialized NGO support (discussed above), 3) lack of a clear idea of the impact that TDA programs will have on the effective observation completion of the allocated non-TDA programs, 4) potential loss of the innovation by cutting or diverging future funding resources for the successful Gemini instrumentation upgrade program that generates unique observing capabilities on 8m-class telescopes.

Comments on OpsWG Reports

The UCG requests that the materials presented by the OpsWG in the joint session be made available days in advance to the UCG. It would be additionally valuable to require that everyone read the materials in advance so that the face-to-face meeting could be used for discussion. It was difficult to synthesize all of the completion numbers, proposals pressure, etc. in order to identify issues for discussion in real-time.

For example, the committee noted that many of the partners were not fully utilizing their FT program access. Is this because the programs aren’t well advertised or because there is a perception of review biases, or because of the requirement that the proposer has to participate in the review?

- The UCG suggests that the NGOs explore ways of determining why FT is not being used by some of the partners as it is a valuable resource for those who do use this mode.
- The UCG will also explore this issue in the users poll.

Observatory Control Software (OCS) Upgrades and Features

Gemini presented a report of the current software activities, and the UCG provides the following comments:

- The committee acknowledges that the software upgrades will provide a seamless transition between phase I and phase II, including the capability of calculating exposure times based on S/N requirements from the ITCs.
- For cases when GN and GS observations are included in the same program: how will Gemini combine programs and make them work in case the observing bands are not the same on each telescope? A flag (similar to the "Acceptable for Band 3" option in the current PIT) could be added specifying if the program accepts different bands for each telescope.
- Automatic time-domain scheduling will be very beneficial for solar system objects.
- Having all the tools together in a friendlier web interface will be greatly appreciated.

Gemini requested input on several software issues from the UCG and the responses are included below:

- Requirement of Active CoI Confirmation - It is important that CoIs are fully aware they are on proposals and agree to the project. However, in the real world proposals are often written close to the deadline and it may not be possible to get approval from all CoIs by the time of submission. We do not want long-time collaborations penalized because of this. The UCG recommends that an automated email is sent to the CoIs that gives them the option to opt-out.
- Automatic CoI editing privileges - The UCG agrees that the PI should have the authority to authorize which CoI has edit privileges; CoIs are only automatically given read authority.
- PIT collection of information about previous allocations - The UCG commends Gemini for implementing this system as it will be enormously beneficial both to Gemini, the review process and for the community. It sounds like this will be automated and no extra work for the community.
- Gemini System Scheduling - The UCG feels that this is not necessary to notify teams when observations are put in the nightly schedule. There is no specific benefit and there will be a lot of overhead.

Prioritized Summary of the Recommended Actions (All)

1. Data Pipelines:
    a. Starting with the simpler data reduction cases and building up in complexity is a good path forward, but the UCG would like to see a sustained effort in the future for different instruments and observation modes (e.g. MOS). This should be a top priority in order to attract a larger user community to the observatory and has been an ongoing issue for nearly two decades now.
    b. The UCG encourages the data reduction team to provide documentation that confirms that these new packages provide properly calibrated datasets that reproduce previously accepted data analysis outputs (e.g. verify that the ZeroPoint derived from DRAGONS analysis match IRAF reduced versions and whether the NIRI stacks are as deep as previously produced stacks).

c. This is evidently in tandem with current work towards the production of quick-look products. In summary, we believe these need to be reliable products that will allow the PIs to determine immediate results from the observations, and make follow-up decisions within the timeframe of an hour or less.
d. In addition to the tutorials, we strongly encourage the observatory to dedicate resources to creating clear, comprehensive data reduction manuals, that will allow a wide range of observers to produce the desired scientific data products.

2. Flatfielding and Calibration:
    a. We recommend that Gemini should assess whether or not taking flats far from the time of corresponding science observations affects the quality of the flat fielding is an issue now that GMOS south has been repaired, and for GMOS north after the summer shutdown repairs.
    b. We recommend that Gemini provide guidance to GMOS-N users (for the past ~2 years) which flat fields (i.e. specific files) will best reduce their data.
    c. Assess the strategy for getting more frequent flat fields in each filter to ensure observers have near-simultaneous calibrations at the same lunar phase.
    d. Assess whether taking fewer than the standard 25 flats per filter per twilight will be more a more efficient way to accomplish this.
    e. Assess a strategy for obtaining the color corrections from the Gemini filters to the large survey filter systems.

3. Timing issues:
    a. Ensure that correct explanation for all timing keywords is in the header, including identifying the keyword that best denotes the observation start time.
    b. The UCG requests that Gemini provide an estimate of the total time stamp error for the telescope+instrument+shutter system, i.e. provide a "best estimate" for the time stamp dispersion so that users who have precise timing requirements have an idea of the start time error associated with the UTSTART timestamp.
    c. Add the DUT1 timing keyword to the header.
    d. In the long-term achieving knowledge of the shutter open time to the millisecond level is very important for all projects relying on accurate astrometry for moving objects, in particular fast-moving NEOs.

4. Ensure that non-Time-Domain use of the observatory is also visibly supported and has growth opportunities: There is perception, correct or not, that in the NCOA era the prioritization of time-domain astronomy will lead to degraded service to the larger static-sky community, in terms of instrument upgrades, pipelines, cookbooks, etc,

5. Collaborate on NCOA Resources Poll and Community Forum at 2020 Science Meeting: In order to involve as much of the community as possible in a discussion of what resources should be prioritized in the NCOA era, the UCG proposed to work with Gemini Observatory to request community input via a users poll to feed and frame a forum-like discussion (which UCG members would help to moderate) at the 2020 Gemini Science Meeting.

6. Fix the archive bugs: (1) preventing search on comet names, and (2) preventing selection of file ranges.

7. Update Webpage: Where calibration strategies are discussed the Gemini Observatory webpage - such as the “Queue Mode Observations” page under “Proposal Routes and Observing Modes” and the “NIR Baseline Calibrations” (these are example pages, not an exhaustive list) -- it should be updated to explicitly communicate that Gemini Observatory policy is to allow for PI customization of Phase II program plans and calibration strategies so long as the telescope/instrument are not endangered.

8. Special calls for engineering time: one perceived disadvantage of observing with Gemini is the rigidity regarding instrument use. We suggest that Gemini issues special calls for engineering time that might encourage creative use of the available instrumentation, including currently unsupported modes and possible combinations of existing facilities (e.g. GEMS+GMOS, GEMS+F2), as well as develop better documentation on such non-standard observations, including what has been tried and worked or did not work.

9. Requested NCOA User Support Resources
    a. Enable access to the data archives for all of the NCOA facilities with a single interface.
    b. Ingestion of higher-level data products into the archive (such as those that LSST will provide).
    c. Collaborate with the Canadian Astronomy Data Center (CADC) to implement the Solar System Object Image Search tool for Gemini to search for images where specific moving objects may be found.
    d. Migrate the NOAO datalab (http://datalab.noao.edu/) tools to the larger NCOA environment would benefit the community. Datalab connects users to products (e.g. catalogs) and provides basic tools for analysis of those catalogs.