The Queued Service Observation (QSO) Project: Guidelines for the Time Allocation Committees

QSO-005/Version 3.2/04-15-02/REVISED
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1. Background

This document presents guidelines for the Telescope Allocation Committees (TAC) in their evaluation of the proposals submitted for the queued service observations (QSO) mode with CFH12K. Starting at the semester 2001A, a large fraction of the CFH12K observations were executed in a queue mode. At the time of writing, we have now operated CFH12K in a QSO mode for about 130 nights. From this experience and queue experiments undertaken at other facilities, it is clear that specific tasks must be assigned to the TAC in their evaluation of the proposals for the QSO mode to work properly.

This is an updated version of a document distributed to the TAC last year for the evaluation of the 2001A/2001B/2002A proposals. Please DISCARD the old documentation since the text presented here contains new, and slightly different, information for the evaluation of the CFH12K proposals for 2002B. These changes follow our experience acquired during the first three QSO semesters. In particular, this version contains some comments on the importance of “shapshot” programs.

2. Queued Service Observations: Basic Execution Requirements

The goal of the QSO mode is to gain in observing efficiency, quality (and quantity) of the science data, and value of the calibrations. The advantages of the QSO mode have been previously extensively documented:

- Queued observations allow an optimum match of the program requirements to the current atmospheric conditions. The most impressive gains are expected for programs requiring excellent (often-exceptional) conditions.

- The QSO mode allows the execution of a larger fraction of approved programs (i.e. no “backup” programs).

- Queued observations optimize the distribution of programs according to predictable conditions (e.g. dark vs. gray time).
• Programs with non-standard requirements (e.g. target-of-opportunity, monitoring, observations for only a fraction of a night) can be more easily integrated within the QSO scheme.

So far, these goals have been achieved by the QSO Project by defining a set of rules and using software tools assisting in the selection and execution of the queued programs submitted for CFH12K (see document QSO-011). However, following the results of previous queue experiments, and our own experience during the semesters 2001A/2001B/2002A, it is clear that the efficiency of the QSO mode depends strongly on how the queue is filled. It is important that programs requiring a wide range of conditions are available in the queue database. For instance, it is particularly critical to not exclusively approve programs requesting dark time since it then becomes extremely hard to fully execute these programs in the queue within the realistic amount of dark time available. Programs requesting diverse image quality are also fundamental for the queue as well as programs that can tolerate non-photometric conditions.

This is the key point for the TAC: By considering realistic conditions (i.e. number of photometric nights, seeing statistics, dark time), the proposals accepted should not only include programs requiring the best conditions but also others with less severe constraints. As a reference, the following table displays some statistics on weather conditions on Mauna Kea (observations done with FOCAM between 1993 and 1995). A more recent analysis using data collected with the CFH12K camera during the semester reveals a similar distribution in the image quality. However, the number of photometric nights on Mauna Kea seems to be lower than these statistics. Also, the time completely lost to bad weather has been higher than 20% during the last 4 months and the median IQ has been higher by at least 0.2”; if this tendency will continue remains to be seen….

<table>
<thead>
<tr>
<th>Image Quality (IQ) in R band</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>IQ ≤ 0.55”</td>
<td>5%</td>
</tr>
<tr>
<td>0.55” &lt; IQ ≤ 0.65”</td>
<td>25%</td>
</tr>
<tr>
<td>0.65” &lt; IQ ≤ 0.80”</td>
<td>30%</td>
</tr>
<tr>
<td>0.80” &lt; IQ ≤ 1.0”</td>
<td>25%</td>
</tr>
<tr>
<td>1.0” &lt; IQ ≤ 1.2”</td>
<td>15%</td>
</tr>
<tr>
<td>IQ &gt; 1.2”</td>
<td>5%</td>
</tr>
</tbody>
</table>

Usable Nights           ~ 80%
Lost to weather           ~ 20%
Usable Photometric Nights           ~ 55%

2.1 Evaluation at a Glance

The selection of programs to be executed is performed by the queue coordinator using the scheduling software and reviewed by the observers during an observing night. This task is based on the program specifications (see document QSO-008), the actual sky conditions, position of targets, status of the programs, and the science and technical evaluation from the TAC.

During the evaluation process, the TAC will provide the following information (see section 5):

1. An evaluation of the sky conditions requested for each program (i.e. image quality and sky background)
2. A qualitative grade for each proposal (i.e. “must do”, “priority”, “best effort”, “snapshot”)
3. A quantitative ranking for proposals within each grade (1/7, 2/7,…)
4. The maximum total integration time (I-time, in hours) allocated for each program.
3. Types of QSO Programs

The QSO programs can be divided into three distinct types. These types must be specified by the investigators during the Phase I submission with Poopsy.

1 – Regular Programs: These programs consist of typical observations, on fixed or moving targets (i.e. Solar System objects). Monitoring and/or time constraints on these targets might be requested. These programs can be executed under diverse sky conditions, from excellent to mediocre. The total number of hours requested must be of **at least 5 hours** (SAC recommendation); several programs shorter than that have been submitted and accepted in the past so this limit is at the discretion of the TAC. Please, also note that **programs on moving targets have still not been implemented in the NOP system**. Most of the implementation on the QSO side is done but there are still some issues to be solved with other components: testing is planned during bright time in 2002B. For any concerns about these programs, you can always contact me.

2 – Target-Of-Opportunity (TOO): For these programs, the targets are not known before the beginning of the semester and might be only defined on a short notice during a QSO run. These programs can be divided into two specific types: 1) **The anticipated TOO**, that is, a **program reviewed by TAC** and with a certain amount of allocated I-time to observe targets not specifically defined at the time of the evaluation (e.g. gamma ray burst); 2) **Unanticipated TOO**, that is, a program not previously known to the QSO Team and not evaluated by TAC to observe a “transient” phenomenon (e.g. a supernova).

In the first case, the QSO Team expects to receive a TAC evaluation similar to the regular programs. The difference is that it becomes the responsibility of the PI to inform the QSO Team that an observation block has been prepared on a TOO through the Phase 2 tool and it is now ready to be inserted in the queue. For 2001A, such a program was allowed time and the system in place worked really well; after submission of the appropriate observation blocks to observe a GRB, excellent observations (I think!) were gathered during the following night. The second TOO case is significantly different. The proposal submission is first done through the QSO channel, via a Web form (available). The CFHT Director, as detailed in the CFHT Policy, does the evaluation of the proposal and also determines the priority of the project, after reviewing the status of the queue with the QSO Team. If the time is approved, the observations are prepared by the QSO Team using the Phase 2 tool and included in the queue database. No TOO programs have been requested (so far) for 2001B/2002A.

3 – Snapshots: Following the last SAC meeting and subsequent discussions, the **meaning of a “snapshot” program has now been considerably changed in 2002A**. A “snapshot” program consists of short blocks of observations (BVRI filters are preferable) that are to be executed **only** in bad conditions, in case no programs with higher priority can be executed in these conditions. The time spent on these programs is **NOT** charged to the Agencies and the proprietary period is reduced to three months, following the end of the semester.

During the current semester 2002A, the weather has been quite mediocre so the snapshots programs have been frequently executed when the seeing was >1.2”. We want to emphasis to the TACs that these programs are **VERY** important in case of bad seeing or poor weather conditions (but still useful for science). We strongly encourage TAC to approve snapshot programs, if requested, especially since the Agencies scheduled time is not “penalized”.

Time-constrained Programs. During the last three semesters, we have acquired some experience of dealing with programs with time constraints. Most of these programs consist in observations having to be done during a short time period, usually about 3 nights. These observations have usually to be repeated at other periods. The QSO mode is well-adapted to this kind of constraints and we have been able to generally execute the observations in a timely manner, except for one program in 2001A that was almost completely wiped-out to bad weather. It is, however, important for TAC to consider the following points in their evaluation of these time-constrained programs:
• The time-constrained programs have a strong impact on scheduling the other, more regular programs. For instance, the second epoch observations for these programs is generally the crucial one; it is clear that priority must be given to these programs at the right period. However, this is not as simple as it looks because if some fraction of the time is lost to weather during that period, the impact will mostly automatically be absorbed by the regular programs. In other words, in the presence of time constrained programs, the weather will play a larger factor in the completion level of highly ranked program than it would in normal circumstances.

• In some cases, time-constrained programs can be more risky in term of telescope time. Observations taken during a first epoch could become useless if the succeeding epochs are wiped out by weather.

• It should be noted that the overall execution priority of execution of the programs, for which TAC grading and ranking plays a major role, cannot be maintained with time-constrained programs. Catching up the observations on the second epoch, for instance, strongly diminishes the importance of the grading/ranking system.

Following the above remarks, the most important issue is probably the following: Even if the QSO mode is successful at handling this kind of programs, the number of time-constrained programs to be executed in a QSO mode during a semester should remain small. In fact, I would suggest the following: 1) Not more than three QSO programs should have time-constraints during the entire semester; 2) Probably not more than 20-30% of the total integration time for a given agency should be time-constrained programs; 3) Unless these programs do not have a high science merit (grade A or top-third of B grade), they should not be approved for QSO observations (i.e. a lower-ranked B program or a C program with time constraints do not make any sense).

4. Agency Time Accounting

The different agencies at CFHT have guaranteed access to the telescope time. With the arrival of the queue mode, the specific fraction of time for a given agency (C,F,H) is given by $F_{\text{agency}} = \left[ C_{\text{agency}} + Q_{\text{agency}} \right] / T$, where C is the classical time, Q is the queue time, and T is the total telescope time available. The introduction of the queue mode changes the way we can now schedule the telescope time. For instance, one agency can get more classical time while another can get more queue time, with their total respective share being respected. As in the past, the TAC should evaluate the total time of the combined classical and QSO proposals in regard with the total time allocated for their respective agency. However, the final combination $C + Q$ for the different agencies and overfilling of the queue will be achieved by the Senior Resident Astronomer from the pool of approved classical and queue programs.

At the start of the semester, the total I-time allocated in the queue mode ($\Sigma (I\text{-time})_Q$) will be calculated from the QSO database. The fractions with respect to this total will be calculated for all the agencies (i.e. allocated fraction from one agency: $q_{\text{agency}} = \Sigma (I\text{-time})_{\text{agency}} / \Sigma (I\text{-time})_Q$). These are the fractions that QSO will try to reach during a semester. With the right balance achieved during the scheduling process, this QSO strategy will ensure a fair distribution of the executed time between the different agencies.

During 2001A, the final fraction of the Agencies was within about 2% of their requested values, i.e. about 5 hours of integration time. The semester 2001B was a bit more difficult because the last run was almost completely wiped out by bad weather. For 2002A, we are aiming again at balancing the Agencies time at a 2% level.

5. CFH12K: Proposal Evaluation

The evaluation process of the CFH12K queue proposals differs slightly from that of the other CFHT proposals. We recommend the following approach:

5.1 General Evaluation
The TAC should consider the CFH12K QSO proposals as proposals for any of the other instruments. TAC will first rank the QSO proposals among the pool of all the submitted proposals for 2002B (classical and queue) and determine the cut-off (as usually done). For instance, the TAC should review the science merit and the technical justification for the QSO proposals within the context of not only the amount of time and the sky brightness required but also relative to the image quality indicated. The TAC should also review the justification of not applying for the QSO mode for CFH12K proposals requesting the classical mode. If a proposal appears better suited for the QSO mode, it should then be considered as a QSO proposal (the technical review of these proposals conducted by the CFHT astronomers might be very helpful here). It is important that the CFH12K QSO proposals found below the cut-off are ranked too (see below) since some of these proposals might be used to overfill the queue and keep the balance for the different agencies during the scheduling of the telescope time.

5.2 Conditions Requested:

As a second step, as with the normal proposals, if time is allocated, the TAC might recommend that a queue program should be done under other conditions than the ones specified during the Phase 1. For instance, TAC should indicate if a QSO proposal should be done in dark or bright time; this will be helpful during the telescope scheduling process. As stated above, the QSO mode will only work as intended if the proposals in the queue cover the full range of observing conditions. The approved proposals should not exclusively request the best seeing or sky conditions. Proposals with less severe constraints must also be included. We are expecting a correlation between the science merit (grading; see below) and the image quality requested.

5.3 Integration Time Evaluation

The time allocated to a specific program is the integration time (I-time). Whether the I-time requested during Phase 1 should include or not the photometric calibrations depends somewhat of the proposal:

1) No programs under any circumstances are allowed to request "detrend" calibrations (i.e. bias, barks, flatfields, fringing frames) during Phase 1 or Phase 2. These calibrations are exclusively handled by the QSO and Elixir Teams.

2) The readout time of the CCD mosaic (60 seconds) MUST be included in the calculation of the I-time. Telescope slewing and guide star acquisition should not be taken into account.

3) If the program includes the CFH12K broad-band filters B, V, R, I and Z', the photometric calibrations (i.e. standard stars) will be automatically done during the QSO runs. These calibrations should not be included with the I-time requested.

4) If the program includes any CFH12K broad band-pass filters and the investigators request to obtain their own photometric calibrations, this time must be added to the I-time during the Phase 1. However, TAC will evaluate this request and approve or disapprove the I-time calculated. If approved, the integration time will be automatically charged to the program for this kind of observations during the Phase 2.

5) If the program includes the Ha, HaOFF, CN, and TiO filters, the photometric calibrations will NOT be done automatically by the QSO Team. The time required for those should be included in the I-time.

For each QSO proposal, TAC should give the approved I-time in hours (not nights!). Fractional nights are acceptable (smallest unit is 0.1 night). The approved I-time is automatically entered in the queue database and is used during the Phase 2 proposal submission by the investigators to define their observations. During the execution of the queue, the allocated I-time is used as the reference to evaluate the fraction of the program that has been completed.

Our experience acquired during the semesters 2001A/2001B/2002A shows an important, if obvious, fact: The probability for lower
ranked programs to get observations done depends strongly on the total I-time allocated for the higher ranked programs. In short, TAC should be well aware that approving long programs in the “must-do” grade (see below) means that several shorter programs, especially those with good ranking in the next grade and competing within the same range of sky conditions, might never get observations. This is not a new problem for the queue model. Other experiments have also showed that it is probably better to allow less telescope time for certain highly ranked programs in order to improve the chance of performing observations for other (well-ranked) programs.

Our experience also has shown that not charging for the overheads (except for the readout time) is fair for most programs. However, in the previous two semesters, some programs with very short exposure times (~60 sec) on numerous targets have been approved. There is nothing technically wrong with these programs (even of the readout overheads are already of the order of 50%) but the TAC should be aware that the additional overheads (mostly slewing, dome rotation, guide star acquisition and numerous filter changes) for such programs are not negligible, even if we try our best to minimize the number of long slew.

One final point: In the last semesters, it has happened frequently that all the integration time requested by the investigators during the Phase 1 was allocated for the Phase 2. There is nothing wrong with that but since most of the time requested in classical mode is reduced, I find it strange that this procedure does not take place often for QSO programs. Again, it is important to remain realistic, especially for lower ranked B programs: the probability of a long (30 hours) low ranked B program to be finished at a high completion level is not very high…. Completeness of programs remain a high priority for the QSO Team but we cannot achieve the impossible!

5.4 Qualitative Ranking (Grade)

As further step in the TAC evaluation, all the CFH12K QSO proposals above and below the cut-off should be divided into these grades:

**Grade A.** This is the “must-do” programs. These programs always have the highest priority in the queue list and will be executed unless the conditions are not adequate or have deteriorated. These programs will have the highest absolute quantitative ranking. About 20% of the total integration time approved for all the QSO programs of a given agency should be in this class. The QSO mode aims to have a level of completion of 100% for these programs.

**Grade B.** This is the “priority” list and constitutes the bulk of the queue database. About 40% of the total integration time approved for all the QSO programs of a given agency should be in this class. We aim to have a level of completion between 50% and 100% for these programs.

**Grade C.** This is the “best effort” list of programs. These programs deserve some observing time but, in general, are unlikely to be executed during the best observing conditions. About 40% of the total integration time approved for all the QSO programs of a given agency should be in this class. A fraction of these programs might be fully performed but most likely, some programs will be completed at the 50% level. During 2001B/2002A, these programs have been very important for overfilling the queue and were often done during non-photometric (i.e. thin – thick cirrus) conditions.

**Grade S (Snapshots).** As discussed above, these programs can cover the worse observing conditions. We recommend that basically all the snapshot programs requested during the Phase I should be allowed in the queue after, of course, that their science merit and technical justification are reviewed by TAC. No ranking is necessary but I-time must be given. As mentioned previously, these programs must have realistic requests on image quality, sky background, integration time and cloud coverage.

5.5 Quantitative Ranking

Another element in the selection process of executable programs by the QSO Team is the TAC ranking. The grade and rank within the grade will determine which program is chosen among an ensemble of programs requiring the same conditions.
As a final step, **TAC should quantitatively rank all the approve Grade A, B and C proposals**, relative to the total number of proposal within a grade. For example, if 9 projects are in grade B and 7 are in grade C, all the B projects are classified 1/9, 2/9, etc, while C projects are classified 1/7, 2/7, etc. Following this evaluation, the CFHT QSO Team will include this quantitative ranking in the queue database. For **snapshot programs, no ranking is necessary**. Since the TAC normally provides the ranking of all the proposals, it should be fairly easy to achieve ranking of the QSO proposals alone. Again, it is important that QSO proposals below the cut-off are given a grade and a rank.

### 5.6 QSO Time

As a reference, we will use the following numbers for scheduling the telescope time and the overfilling of the queue database. Following our experience with CFH12K since its commissioning and the previous QSO semesters, we are expecting a total observing efficiency (i.e. open shutter) of about 85% with CFH12K queued programs for the first semester of QSO mode (higher values should be reached for the subsequent semesters). The remaining time will be mostly spent on the field acquisition and the calibration plan. We can calculate the number of nights that should be allocated for all the queued programs according to this efficiency and the statistics on weather conditions for Mauna Kea (e.g. Table 1). An observing night on Mauna Kea is about 9.5 hours long. If the weather is 100% favorable, roughly 100 hours of total I-time requires about 13.2 nights. However, in reality, about 20% of this time is lost due to weather so **100 hours of total I-time will require 15.5 nights for reaching close to a level of 100% completion for all the queue programs, including the calibration plan.** Our experience during the previous semesters has showed that these numbers are correct, except for certain programs requesting a lot of slewing or specific pointing requirements.

### 6. Other Issues

#### 6.1 Classical Mode

Some specific programs (e.g. Hippo polarimetry) are not suitable for the QSO mode. If the investigators think that their program should not be executed in a QSO mode, they should have justified their request in their proposals. The **TAC should evaluate this justification**. If it appears that the observations should be carried out in a classical mode (visiting astronomers at the telescope), TAC should give CFHT some indication on the sky brightness (dark time, gray, bright) under which these programs should be performed. We will build our schedule to accommodate these requirements and the selected dates will be fixed (that is, no switch allowed with queue nights). The other queued programs will be executed around these dates. We recommend, however, that TAC tries to minimize the number of nights allowed in a classical mode, if possible. Only exceptional circumstances or programs that cannot be executed in a QSO scheme for 2002B can justify the classical mode.

Also, we strongly discourage the sharing of nights between the classical and QSO mode. The transition period and complication on the filter selection result in an reduced efficiency of the telescope observing time.

### 7. Summary

The CFH12K QSO mode requests more effort for the TAC members in their evaluation of the Phase I proposals. The main differences are found in the evaluation of the conditions requested, grading and ranking procedure, and the calculation of the I-time for each individual program. Following our experience in 2001A/2001B/2002A, we recommend that the TAC follows the approach described here. In particular, the total telescope time allocated for the A programs and the availability of bright/grey programs in the queue are seen as very important parameters on which the TAC should remain vigilant. It should simplify the scheduling process and the operation of the queue mode. For more information, please contact me or Christian Veillet.