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**A - Introduction**

**1) The QSO Project**

The main concept behind the queue observation scheme is to perform programs only during sky conditions required to meet their science goals, as defined by the investigators. This can be achieved if the programs are all grouped together in a database and are selected appropriately according to a set of constraints, rules and sky conditions. Each night, several queues composed of different programs are prepared to cover diverse sky conditions and constraints. Observations are then carried out by a well trained, local team of observers in a service mode.

During 1999, CFHT started a project to implement the necessary software and to review all the issues for achieving a queue/service observing mode with its CFH12K mosaic camera. This Queued Service Observations (QSO) Project has been developed in parallel to other projects necessary for the data acquisition (NEO), processing and analysis (Elixir), and archiving and distribution (DADS). The software tools required for proposal submission, selection of programs, database management, and execution of the observations have all been developed within the QSO Project. Most of these software components are for internal use only except for two obvious exceptions: Poopsy, the proposal submission tool developed and maintained at CADC, and PH2, a Web based tool implemented and maintained by CFHT for the second tier of proposal submission (see below).

Since January 2001, queue observations have been performed with the CFH12K camera for about 220 nights. By reaching good statistics on completeness, image quality...
requirements, Agency time balancing, and by meeting time constraints requirements for several programs, the QSO mode has been quite successful. All of the observations with Megaprim are also being conducted in the QSO mode. The actual tutorial describes a version of PH2 developed specifically for observations with Megaprim. Following the evaluation of the different Time Allocation Committees (TAC), the successful proposals have received a certain amount of telescope time, a grade and a rank, and are now ready to prepare detailed observations, the Phase 2 submission period.

2) The Phase 2 Proposal Submission

The Phase 2 submission for proposals accepted for the semester 2008B extends over a period of several weeks. The two important dates to remember are given in the table below:

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 2 Starts for Semester 2008B</td>
<td>June 20, 2008 14:00 (HST) (24:00 UTC)</td>
</tr>
<tr>
<td>End of Phase 2 for Semester 2008B</td>
<td>July 24, 2008 14:00 (HST) (24:00 UTC)</td>
</tr>
</tbody>
</table>

Please take these points into consideration:

- **It is very important that the Phase 2 deadline is respected.** Diverse issues must be examined by the QSO Team prior to the semester regarding the information provided by the investigators during the Phase 2 (e.g. target positions, guide star availability, time constraints). Observations will start shortly after the Phase 2 deadline.

- **Even if PH2 is straightforward, preparation of QSO observations can be time-consuming.** This is VERY IMPORTANT: *We strongly recommend that you prepare your observations during the Phase 2 well ahead of the deadline.* Unfortunately, our experience shows that 75% of most of the investigators wait until the last three days to prepare their phase 2. Preparing your observations well in advance of the deadline will allow you (and us) to make sure that mistakes have been avoided. Also, if a problem occurs, the QSO team will have enough time to react and find a solution. Thanks for your cooperation...

- **PH2 is available from the CFHT HQ Web site ([http://qso.cfht.hawaii.edu:2001/Instruments/Queue/PH2/](http://qso.cfht.hawaii.edu:2001/Instruments/Queue/PH2/)).** A backup site, located at the summit, is also available: ([http://qso2.cfht.hawaii.edu:2001/Instruments/Queue/PH2/](http://qso2.cfht.hawaii.edu:2001/Instruments/Queue/PH2/)). The CDS site has now been retired. However, to ensure data integrity, **only one session with the same user ID is allowed at the same time.**

3) Document Outline

This document presents the complete information for the second submission Phase of the QSO proposals accepted for MegaPrime. A general description of the Phase 2 tool is first presented in the section B. It includes a broad overview and, maybe more important, a description of the "strategy" behind the tool itself: the creation of the "observation blocks", subsequently leading to the "observation groups", the entity scheduled at the telescope. A brief discussion on the calibrations is also provided. The tool is simple enough that this overview might be sufficient for users accessing PH2 for the first time. Quick help files are also available from the "Help" button in PH2. Users already familiar with PH2 might want to consult the section entitled "PH2: Recent changes" to learn about the most recent modifications done to PH2. A much more detailed tutorial is presented in Section C. For a complete description of the Phase 2 tool and other issues related to the Phase 2 submission, please refer to this section. Finally, the last two sections include some discussions already presented in the tutorial for the Phase 1 submission but still very relevant to the preparation of the observations during the Phase 2.

If you require more information about the Phase 2 submission, contact the QSO Team.

**B - Overview of the Phase 2 Tool (PH2)**

1) PH2: Purpose

The Web based Phase 2 tool (PH2) has been developed for one main purpose: **Allowing the investigators of accepted QSO proposals to prepare a full description of their observations and to store this information in a database, accessible to the CFHT QSO Team.** Observations to be carried out are extracted from this database during the QSO observing nights. **PH2 represents then the key element in the QSO mode scheme.** This is where the investigators tell the observers what observations should be done, and how (and sometime when) they should be done.

PH2 is flexible enough to accommodate many kinds of queue programs (but not all of them...) while remaining relatively simple to use. It is also constantly a work in progress. We hope to introduce more options in the future versions to add more versatility. And, of course, suggestions are always welcome!

2) Some PH2 Notes

Some important characteristics of the actual version of PH2 for the general user are:

- **PH2 is compatible with Netscape, Internet Explorer, and Firefox browsers.** We highly recommend the Firefox browsers. Due to the recent prolific development of browsers on several platforms, we cannot support all of them. Browsers on Unix, Linux and Windows platforms are usually the most reliable for working with PH2. PH2 now works also with the Safari version 3 browsers.

- **Except for one optional tool, PH2 does not include any Java code.** It is entirely developed around JavaScript and the ColdFusion language. There are some differences in the way the PH2 code is handled between the different browsers but all functionality should be preserved.

- **For all of the accepted QSO proposals, the most relevant information entered in Poopsy during the Phase 1 is transferred to the PH2 database and is available for the user.** So, if you have entered your targets in Poopsy, you won't have to do it again in PH2. The possibility to upload a specifically formatted ASCII file instead of typing everything by hand for the targets is also provided in PH2.

- **VERY IMPORTANT:** **There is a time-out of 2 hour for inactivity periods** (that is, between "save" activations) recorded on the server. A window reminds the user of this minutes before the expiration of the session. This is to ensure that in case of a problem (e.g. local crash), you can always come back later and log in again with your user ID. So, **save your work frequently!** If you cannot access PH2 due to this but immediately must do so, send us an email and we will correct the situation.

- **Of course, during the Phase 2 period allocated by CFHT, you can access PH2 at all time and as many times as you want. All your work is saved in the database so you do not have to finish everything at once.** Also, **there is no "submit" button:** when you're satisfied with the preparation of your observations (for instance, what you see in your program summary), that's all there is to it!
The actual version of PH2 does allow the observations of moving targets (e.g. Solar System objects) by entering targets ephemeris. However, "non-sidereal guiding" is not possible at the moment. Programs with moving targets can be complex so do not hesitate to contact us during the preparation of your observations.

There is the possibility to define "user dithering patterns" in PH2. However, this practice is not recommended because it can result in severe difficulties during the data reduction. Only use the nonstandard dithering patterns when necessary, or if you are already very familiar with data analysis of MegaPrime observations.

Due to some difficulties in tracking the sizing activity applied to a browser window from PH2, we recommend that you size PH2 to the maximum allowed by your screen at the beginning of the session (before logging in) and keep it that way. All the necessary scroll bars have been implemented for navigating within the browser frames.

3) The PH2 Interface

The typical schematic presentation of the PH2 interface is shown below:

![QSO Phase 2 Tool](QSO_Phase_2_Tool.png)

**HINT:** You can change the size of all the frames inside PH2 by dragging their side with the mouse.

- **Navigation Menu:** The left frame is a navigation menu, presented with buttons of the names of the different sections of PH2. The button corresponding to the current form goes from blue to white.

- **Top Frame:** When present, it displays diverse passive information (e.g. list of target names). For two sections of PH2, however, the user must select diverse entries from several lists in order to create the observation blocks or groups (see below).

- **Middle Frame:** This frame presents the different tables for the targets, instrument configurations, etc. The maximum number of rows displayed at once is 5 (restrictions due to the speed of JavaScript) but buttons allow to navigate through different pages inside this frame. At the bottom of each table, a series of buttons allow the manipulation of the data entry in the table. The purpose of each button can be seen if the mouse is placed directly on it. The main function of some of the most important buttons is illustrated in the table below.

- **Bottom Frame:** This frame includes the buttons for saving the data to the database and a help button. The purpose of each button can be seen if the mouse is placed directly on it. The main function all the buttons is illustrated in the detailed tutorial.

4) The Concept of Observation Blocks

The entire architecture of PH2 and its database is based on the concept of "Observation Block" (OB). As illustrated below, an OB is formed of one (and only one) target, one (or many) instrumental configurations, and one (and only one) constraint.

![Observation Block](Observation_Block.png)

The idea behind PH2 consists in several tables where the user can define these targets, instrumental configurations and constraints. Each row of these tables receives an unique label so each target, configuration or constraint is an "individual" entity. In other words, for example, one instrumental configuration defined only once might be subsequently used numerous times for observing different targets during the creation of the OBs.

**Important:** Since it is easier to schedule short observations at the telescope in a QSO mode, there is a limit of 2 hours (7200 seconds) for the total integration time of one
individual observation block. PH2 will remind you if this time is exceeded...

The following four steps lead to the creation of these observation blocks:

i) Targets: When this section is selected, a table with several entry fields is presented (see below). The user can then define all the targets in the program by adding the appropriate rows to the table. Pointing coordinates can be entered in the table or grabbed from the Aladin tool. When the "Save" or "Proceed" buttons are pressed, this information is automatically saved in the database.

ii) Instrument Configurations: A table is presented for this section and the user can define all the instrument configurations (e.g. filter, dithering pattern, exposure time) planned to be used for observing the targets of the program (see below). Remember: The same configuration may be used for different targets over and over again so you might have to define it just once!

iii) Constraints: Finally, the last ingredient required for the creation of an OB is the constraint. These requirements for the observation (e.g. image quality, sky background) can be entered in a table similar to the one below. Again, one constraint may be used several times for different observations.

iv) Observation Blocks: Here you are! It is now time to associate all the above individual "entities" to create the observation blocks. This is very easy to do. You must first select one (or several) targets in your list (mouse click), then create a list of instrumental configuration(s) by selecting one or several of them (can be ordered with the arrows in the list), and finally, select one constraint. By clicking on the "Create OB" button, you add automatically one (or several) row(s) to the table of Observation Blocks. The creation of the OBs can be done very quickly if many targets used the same configurations and constraints because these remain selected after creating an OB. Very Important: The number of configurations that can be linked within an OB is unlimited; however, due to the large overhead in changing a filter in MegaPrime, we recommend avoiding too many filter changes within an OB. You are almost done.....
5) The Observation Groups

In principle, all the information entered in the tables above and used for the OBs would be enough for the operation of the QSO mode. However, to add more flexibility to PH2, we have introduced the concept of "Observation Groups" (OG). The OG will be the unit actually scheduled at the telescope and executed by the QSO Team. So, it is necessary to fill the observation group form! The interface to prepare the groups is illustrated below. Three different types of groups are available, as illustrated below:

- **Single OB (1OB):** In this case, a group is only constituted of one single OB. If this is what is needed, all the groups can be created from all the OBs defined earlier by clicking on the "Quick Create OG" button. This is the recommended approach for the QSO mode.

- **Sequence (SOB):** It is possible to create sequence of OBs, that is, to link different OBs that should be executed successively, under the same constraint. Contrary to the individual OBs, a sequence can include different targets. However, since this procedure can introduce additional overheads in telescope slewing time, so we do not recommend sequences unless necessary for the program. The limit of 2 hours of total integration time remains also valid for a SOB.

- **Monitoring (MOB):** If an OB must be observed several times at a regular period, a monitoring observation group including this OB can be defined. There is a window on the right (not showed) that allows the user to define the period (P), the number of iterations (N) and the minimum number of iterations acceptable. Note that it is not possible to define monitoring OGs which are sequences of OBs.
I-Time Accounting. An important aspect of the Observation Groups form is the accounting of the integration time (I-Time). This calculation is presented in the third frame and is automatically updated when an OG is created. The total readout time for the OBs, and the total I-time for the monitoring OG (N(iter) x I-Time (OB)) are automatically taken into account. If the "I-time left" becomes negative, a warning is displayed and the OG(s) created cannot be saved in the database.

The preparation of your observations is now completed! There are other options available for the observation groups (e.g. time constraints, relational execution link); information can be found in the detailed section below. A summary of the information saved into the QS O database is also available and can be sent by e-mail to the user. There is also a sophisticated HelpDesk available for e-mail exchanges between the QSO team and the investigators, if needed.

6) A Word on the Calibrations

One of the main advantages of the queue mode is the possibility to share calibrations between programs. More so, since the queue runs are spread over about 10-20 consecutive nights, the quality of the calibrations can also be greatly improved compared to the ones obtained during a short run in a classical mode. To achieve this, a calibration plan has to be defined and carried out regularly by the service observers. This plan includes the necessary "detrend" frames for removal of the instrument signatures (bias, darks, flat-fields, fringing) and the astronomical calibrations (standard stars, astrometric fields).

For the current semester, you can consider the following situations:

1- No programs under any circumstances are allowed to request "detrend" calibrations during Phase 1 or Phase 2. These calibrations are exclusively handled by the QSO and Elixir Teams. It is, in fact, not possible to define detrend calibrations through PH2 for the general users...

2- If your program includes the standard MegaPrime filter set, u*g'r'i'z', the astronomical calibrations will be automatically done during the QSO runs and distributed to you. You do not have to include these calibrations during the Phase 2, that is, the integration time allocated should not be used for these calibrations. The accuracy of the photometry through the Elixir calibration plan for MegaPrime should reach a level of 2% or better (see point 4 if this is not enough for your program).

3- If your program includes the CFH12K narrow-band filters (Ha, HaOFF, CN, and TiO filters), the astronomical calibrations will not be done automatically by the QSO Team. You must include these specific calibrations during the Phase 2. Photometric calibration for these filters consist generally in observing a spectrophotometric standard star across the mosaic. To simplify, the entire mosaic will be relatively calibrated by the Elixir team so we rather recommend that you observe a spectrophotometric star on only two of the MegaPrime chips. The predefined offsets included in PH2 (below) allow you to define these positions very rapidly. The frequency of these observations depends, of course, of the relative photometry accuracy aimed for in your program. For this kind of procedure, we recommend to link the photometric observations with the science observations using the "sequence of OBs" (SOB) option.

4- If your program includes any MegaPrime filters with a broad bandpass and that you prefer to obtain your own astronomical calibrations, these calibrations can be added as normal observation groups during the Phase 2. Of course, the integration time will be automatically charged to the program for this kind of observations.

7) PH2: MegaCam and Recent Changes

The most important changes to PH2 are:

- There is now a new question related to the image quality limit in the program constraints section. Additional explanation are also included on the validation process and how the upper limit of the IQ range specified is used to judge the quality of the data.

C - PH2: A detailed Tutorial

1) Accessing PH2

Accessing PH2 is limited to users having received confirmation of telescope time in the QSO mode with MegaPrime for a given semester. Before accessing PH2 through an User ID/Password system, some characteristics of PH2 should be known:

- PH2 can be accessed either from the CFHT HQ Web server or the summit server (backup). The database is replicated at both sites.
- To preserve data integrity, only one user with the same UserID is allowed at the same time. This is valid for both PH2 sites, since the verification is done through the
PH2 is compatible with Netscape, Internet Explorer, and Firefox browsers. We highly recommend the Firefox browsers. At the moment, PH2 does not work with Safari browsers. Depending on the speed of your connection, it can take up to 30 seconds to upload a page in PH2. If you are filling up a long list of entries in a table, save your work regularly!

**IMPORTANT:** There is a time-out of 2 hour for inactivity periods recorded on the server. A window reminds the user of this 2 minutes before the expiration of the session. This is to ensure that in case of a problem (e.g. local crash), you can always come back later and log in again with your user ID. Beware: No "save" is performed if you session has automatically timed out. Save your work regularly!

Of course, during the Phase 2 period allocated by CFHT, you can access PH2 at all time and as many times as you want. All your work can be saved in the database so you do not have to finish everything at once... Also, there is no "submit" button: when you're satisfied with the preparation of your observations (as seen in your program summary), that's all there is to it!

Due to some difficulties in tracking the sizing activity applied to a browser window from PH2 (upon resize, the modifications to the current form might be lost), we recommend that you size PH2 to the maximum allowed by your screen at the beginning of the session (before logging in) and keep it that way. All the necessary scroll bars have been implemented for navigating within the browser frames.

Access to PH2 is done through this small window:

- **User ID:** The User ID is the same one that was used for Poopsy during the Phase 1, or was provided to you by e-mail by the QSO Team. If you used PH2 before, it's the same User ID as before. If you do not remember it, please contact the QSO Team (not CADC!).
- **Password:** The Password is the same one that was used for Poopsy during the Phase 1, or was provided to you by e-mail by the QSO Team. If you used PH2 before, it's the same password as before. If you do not remember it, please contact the QSO Team (not CADC!).

### 2) Navigating within PH2

The left frame of PH2 is the Navigation Menu. The user can easily go from one page to the other by just clicking on the appropriate button. The button corresponding to the form currently opened becomes white with blue fonts.

**HINT:** It is highly recommended to navigate through PH2 with the menu buttons instead of the normal browser buttons. Activity in the different forms is monitored so using the PH2 buttons ensure that all the data are saved before moving to another section of the tool.

The navigation buttons and their corresponding pages are described below.

<table>
<thead>
<tr>
<th>Button</th>
<th>Corresponding Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Login</strong></td>
<td>First page of PH2 (Login). UserID and Password required.</td>
</tr>
<tr>
<td><strong>Prg Selection</strong></td>
<td>Program Selection Page, for multiple programs under the same User ID</td>
</tr>
<tr>
<td><strong>Prg Details</strong></td>
<td>Page describing the QSO program, the investigators (PI) and the TAC evaluation.</td>
</tr>
<tr>
<td><strong>Prg Constraints</strong></td>
<td>General Constraints and Information for the program. Depending on the answers, some options will be made available in the subsequent pages. Includes also a complete section for the distribution of the data.</td>
</tr>
<tr>
<td><strong>Fixed Targets</strong></td>
<td>Page containing the table used to define all of the targets used in the creation of the observation blocks</td>
</tr>
<tr>
<td><strong>Ephemeris</strong></td>
<td>Page containing the table used to define all of the targets for which coordinates are changing with time (ephemeris). Only accessible if requested in Program Constraints page</td>
</tr>
<tr>
<td><strong>User DPs</strong></td>
<td>Page used to define user dithering patterns. Not mandatory and only accessible from the navigation menu</td>
</tr>
<tr>
<td><strong>Instr Configs</strong></td>
<td>Page containing the table used to define all of the instrument configuration (e.g. filters, exposure time, dithering pattern) used in the creation of the observation blocks</td>
</tr>
<tr>
<td><strong>Constraints</strong></td>
<td>Page containing the table used to define all of the sky constraints entering in the creation of the observation blocks.</td>
</tr>
<tr>
<td><strong>Obs Blocks</strong></td>
<td>Page allowing the creation of the observation blocks from the lists of targets, instrumental configurations and constraints defined in the previous pages.</td>
</tr>
<tr>
<td><strong>Obs Groups</strong></td>
<td>Page allowing the creation of the observation groups (e.g. sequences) from a list of observation blocks. The I-time used for the program is also calculated and compared to the time allocated by TAC. Time constraints and REEL can be accessed here, if requested.</td>
</tr>
</tbody>
</table>
3) Program Selection

This page allows the selection of your program for your session:

![Program Selection Page](image)

This page can be opened at all times; it is possible to work on several programs at the same time without having to log out from PH2. The programs are first sorted out according to the semester (pull-down menu) and then are identified by the runID, instrument, and title. **Be careful: always make sure that you are editing the right program!**

For your convenience, the runID is shown on all the PH2 forms. **Note:** Following recommendations by the Time Allocation Committee, it is possible that a program was split into different programs with some specific I-time and grade/rank. If it's the case, the program with the higher ranking will keep the same runID as assigned during Poopsy Phase 1 but the other programs will be assigned a different runID by the QSO Team.

**HINT:** It is necessary to first select a program and click on the "Proceed" button before being able to navigate through the other pages of PH2.

<table>
<thead>
<tr>
<th>Button</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Help Button" /></td>
<td>Open the help files to the current page.</td>
</tr>
<tr>
<td><img src="image" alt="Proceed Button" /></td>
<td>Save the content of the current page in the QSO database and open the next form.</td>
</tr>
</tbody>
</table>

4) Program Details

This page presents information regarding the program, the investigators, and the TAC evaluation:
• **Program Title:** This is the program title as entered with Poopsy during the Phase 1 proposal submission period (or through the TOO form). This field cannot be edited. The program title is available to the QSO Team at all time during the observations.

• **Program Abstract:** This is the abstract of the program, as entered during the Phase 1 proposal submission period (or through the TOO form). This field cannot be edited. The program abstract is available to the QSO Team at all time during the observations.

• **Investigators:**
  - **PI:** Name of the Principal Investigator for this program. It cannot be changed.
  - **Institute:** Current working institution of the PI. It must be up-to-date.
  - **Phone:** The current phone number of the PI. It must be up-to-date and include the area code.
  - **Fax:** The current Fax number of the PI. It must be up-to-date and include the area code.
  - **E-mail:** The current e-mail address of the PI. It must be up-to-date and accurate. This is the main contact resource used by the QSO Team for communication with the PI!

• **Program Information:**
  - **RunID:** Identification number for your QSO program. This number is assigned during the Phase 1 submission process and is attached to all of the QSO programs. It is important to remember your runID to communicate with the QSO Team (see HelpDesk) and also to monitor the progress made on your program using the night reports. The first three digits indicate the semester, the letter indicates the Agency and the last two digits is the number assigned by Poopsy or the QSO Team.
  - **Agency:** Agency for which this telescope time has been assigned, as specified during the Phase 1. The values are CNRS (F), NRC (C), UH (UH), KAO (K), NTU (T), LEGACY (L), CFHT (D-time).
  - **Program Type:** The type of the program, as requested in Phase 1 or as assigned by the TAC. Three types are possible: Regular, Target-of-Opportunity (TOO), and Snapshots. The specific definitions of these programs is given in the Phase 1 tutorial.
  - **TAC Grade:** Grade assigned to your proposal by the Time Allocation Committee (TAC) for your Agency. Four grades are possible: "A: must do"; "B: prioritized"; "C: best effort"; "S: snapshot". The corresponding priorities of these program grades are highest, good, medium and lowest, respectively. Grades C and S are considered for "overfilling" the queues (that is, these programs would not have received any time in a classical mode). See Phase 1 submission tutorial for more information.
  - **TAC Rank:** Rank of your proposal within your program grade, assigned by the TAC. See Phase 1 submission tutorial for more information.
  - **I-time:** The total integration time allocated for your QSO program by the TAC. This time is automatically calculated during the preparation of your observation groups and cannot be exceeded. The readout time of the MegaPrime mosaic (40 sec) is calculated automatically for each individual exposures within an observation block.

<table>
<thead>
<tr>
<th>Button</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Help]</td>
<td>Open the quick help files to the current page.</td>
</tr>
<tr>
<td>![Cancel]</td>
<td>Cancel all the modifications done to the current page and reload data stored in the database.</td>
</tr>
<tr>
<td>![Save]</td>
<td>Save all the modifications done to the current page in the database and reload current page.</td>
</tr>
<tr>
<td>![Proceed]</td>
<td>Save the content of the current page in the QSO database and open the next form.</td>
</tr>
</tbody>
</table>

5) **Program Constraints**

This page requests some important information regarding your QSO program. Depending of some of the answers you provide here, options will become available in the subsequent pages of PH2. This page is divided into several sections:
• **IQ Limit:** The image quality (IQ) constraint is one of the important parameters for QSO. In the constraints form later on, you will be asked to define a range (in r band) of IQ for your observations. During the validation process, the QSO Team uses the upper limit defined by this range to judge if the images meet the requirements or not. A margin of about 15% higher than this upper limit is still considered acceptable for allocating a "grade 1" for the quality of the data. Example 1: A range of 0.55-0.65" in r band is selected; images in r band with IQ = 0.72" will be considered as valid. Example 2: A range of 0.65 - 0.80" is specified in r band, but the u filter is used instead (which has usually an offset of about +0.2" with respect to r band). So, images with IQ = 0.8 x (0.8 x 0.15) + 0.2 = 1.1" will be acceptable. If this is not acceptable, the user should specify this here and describe in the comments box what the upper limit for the observations should be.

• **Monitoring:** If your program requires several executions of the same observation spread over a specific period, monitoring is required and you should indicate so here. Monitoring is defined as executing an observation for a certain number of iterations, Niter, within a specific period, P. A date for the first observation can be specified but is not obligatory. These parameters can be entered in the observation groups form. Repeating an observation block for a certain number of times but without a specific period is not considered monitoring. At present, it is not possible to have monitoring for sequences of observation blocks (SOB), only individual blocks.

• **Time Constraints:** It might happen that some of your observations will have to be performed within certain dates. If this is the case, you can indicate so here. The options will then be available in the OG form. Note that time constraints are the most demanding constraints on a queue system. Use only if science depends on it!

• **REEL:** This option in PH2 allows the user to create specific links between observation groups. In short, we can resume the REEL concept as: "if OGx is observed and validated, then observe OGy within a certain opportunity window". The REEL are a powerful way to prepare specific sequence of observations, if science requires to do so. REEL must be used only if necessary, not for instance in the context "the object should be observed with this filter because it was observed with this other filter first".

• **Moving Targets:** If your targets (or some of them) have changing coordinates with time (e.g. comet), you can define their ephemeris in a special table located further in PH2. To access it, you must indicate so here.

• **CCD Failure:** MegaCam has 40 detectors (36 available) and the possibility that one of them fails during an observing run and cannot be fixed until the camera is removed from the telescope is not negligible. In such a case, it would be very useful for the QSO Team to know what option would be preferable for your program without compromising the science. The figure below illustrates the location of the 14 "central" CCDs (within the black frame) versus the "peripheral" CCDs.

![Schematic position of the CCDs within MegaCam](http://www.cfht.hawaii.edu/Instruments/Queue/ph2_tutorial_v2.html)
Program Comments: It is important that the investigators transmit any comments that they judge useful for the QSO Team in their endeavor to carry out the observing program. This space is reserved for general comments on the program. These comments will be available at all time during the preparation of the queues and while performing the observations. If you have any special constraints, requirements, etc., they can be included here.

**HINT:** Do not be shy in this section! Examples of valuable comments include: "Observations to be done in photometric conditions only"; "Thin cirrus acceptable"; "Dark time requested but 20% Moon at more than 45 degrees is acceptable"; "Observe high priority groups first", etc. **The more we know, the better!**

Data Distribution: CFHT is now offering only one options for the data distribution: network distribution. Your processed data will be placed in a special FTP site at CFHT for downloading over the network.

Several options are possible for indicating the moment you would like to receive your data. Four options are available here:

1. **Quick Access:** For certain programs, it is important to evaluate the data soon after being gathered at the telescope. However, if you ABSOLUTELY need access to the data during the QSO run, indicate so. We cannot promise that the observations will be immediately available due to the large volume of data produced by MegaPrime. However, we will try our best. Please note that this will be achieved ONLY for programs requesting a quick access to the data and for which this procedure is entirely JUSTIFIED. Please indicate also if raw data are acceptable.

2. **After Each QSO Run:** If your program is long and that you prefer to receive data regularly through the semester, you can choose to receive the data after each QSO run. Due to the data volume produced with MegaPrime, this will be done on a best effort only by the QSO/Elixir/DADS Teams. Please justify this request also in the entry field. The QSO Team will also review this request and decide if it makes sense or not to prepare the network files after the run (for instance, in the case where only a few files were acquired). You can expect a delay of 7-10 days before we start the distribution after a run; this delay is necessary for Elixir to produce the best calibration data possible.

3. **100% Completion:** If you would like to receive your data only when your program is completed, indicate so. If your program does not reach a completion level of 100% at any time during the semester, you will only receive the data at the end of the semester, unless the QSO Team judges that no additional observations will be performed for the rest of the semester due to other constraints (i.e. target distribution on the sky).

4. **End of semester:** If this option is selected, all data accumulated during the semester for your program will only be sent all together after the end of the semester. This is the default option.
### Data Distribution Recipient

Only one copy of the data will be distributed (DLT or Network). By default, the PI will receive the tape or will be contacted for the network distribution, unless an "alternate" person is selected. In that case, you must fill the delivery address and email of this person in the entry fields below. Please verify that the address is complete and accurate. For the CFHTLS, the alternate contact, CADC, must be specified.

6) Fixed Targets

This page represents the first step toward the creation of the observation blocks. This is where the user defines all the targets of the program and their precise pointing coordinates. The main section of this page is composed of a table and a few buttons for the manipulation of the entry fields:

#### HINT:

The maximum number of rows displayed at once is five. The "Next Page", "Previous Page" buttons can be used to navigate between the different pages. The blue hyperlinks FT# represent the first row of each individual pages and can also be used for moving quickly from a page to another.

- **Top Row:**
  - **RunID:** Identification of the program you are currently working on.
  - **Table Status:** List of the current rows and the total number of configurations already defined in the current table.
  - **Instrument:** Link to the MegaCam Web page.

- **Table (1):**
  - **Label:** The label identifies a row in the table. The fixed targets are simply identified as FT#. The label is automatically updated if the rows are changed.
  - **Name:** The name of the target, as given by the user. A mnemonic name (e.g. Virgo Field1) will make the subsequent steps easier. The name must be shorter than 20 characters.

#### A word on Target Coordinates

Coordinates for the targets can be entered from different ways in PH2. However, at the telescope, **pointing coordinates**, that is the combination of the target coordinates and the pointing offsets will be used. Basically, **Pointing Coordinates = Target Coordinates + Pointing Offsets**. So, placing the object on the right location on the CCD mosaic can be done from two ways: By using the real coordinates of the target and set up the pointing offsets to the appropriate values or, by modifying the target coordinates, so that they become the pointing coordinates, and set the pointing offsets to zero. Both ways can be easily achieved in PH2, as described below.

- **Table (2):**
  - **Aladin:** Aladin is an efficient software to display sky images. It has been developed by CDS and can be very useful for different tasks in PH2. However, it is optional: pointing coordinates can be entered directly in the target table with the combination of target coordinates and pointing offsets. First, if you know the real astronomical name of your target, Aladin can find the coordinates for you. Just enter the name (e.g. NGC 4258) and click one of the "Aladin" buttons (Note: To search by name, the coordinates entry fields have to be empty). The CDS database will be contacted and a window showing an area surrounding the pointing location will be displayed.
coordinates will be displayed. If you know already the coordinates of your target and want to verify the positioning or transform the target coordinates into pointing coordinates, you can enter the coordinates and click again on one of the Aladin buttons.

What are the "LR" and "HR" buttons? These buttons allow you to display your field with two different spatial resolutions: 1) The "Low Resolution" offers a field of view of 1.5 x 1.5 degrees (1 pixel = 6.8") and 2) The "High Resolution" option displays an 15 x 15 arcmin image of the field (1 pixel = 1.7"). This HR image can be used for accurate positioning. However, due to the display limitations and the astrometry of the plates, the pointing accuracy of Aladin will never be better than 3-4". ATTENTION: Aladin works only with coordinates for J2000.0. The coordinates sent back are automatically in J2000.0. Important: Please also note that the slight rotation of the superimposed MegaPrime grid does not mean that we can rotate the mosaic! It is fixed at a given position at prime focus. The rotation in Aladin is just for respecting the orientation of the sky image. For instance, for the low resolution field surrounding M33 in the Aladin window will look like that:

Basically, an image of the target is displayed, stars in the fields are identified from the GSC with red circles, and a grid showing the MegaPrime mosaic (including the gaps) is superimposed (see below for correct identification and orientation of the CCDs). The blue circle has a diameter of 1 degree. The coordinates indicated at the top left refer to the position of the center of the mosaic, indicated by the red cross, at the top corner of the chip22. By clicking and holding the left button of the mouse, the mosaic can be moved across the field to position exactly the object where it should be. To be very precise, the zooming option can be used. When the object is correctly positioned, the pointing coordinates (that is, the center of the mosaic showed as the red cross) can be transferred to PH2 by simply clicking on the "Grab" button in the PH2 table, before closing the Aladin window. The coordinates will be included in the table and the pointing offsets set to zero; the target coordinates have now been transformed into pointing coordinates. That's it!

NOTE: The CFH12K filters offered for MegaCam provide a field of view of about 42'x28', much smaller than the normal MegaCam configuration. Essentially, CCDs 10 - 16 and 19 - 25 are useful with CFH12K filters (see section 9). The mosaic in Aladin does not take into account the restricted field of view with these filters.

As shown in Aladin, the MegaCam mosaic has three different series of gaps between the detectors:

- **Vertical gaps**: The vertical gaps between each CCD is about 14 arcseconds. A dithering pattern with several exposures separated by offsets ~20" will get rid of these gaps (see instrument configurations).
- **Horizontal gap**: The horizontal gap between both rows of detector in the middle of the mosaic is about 12 arcseconds. A dithering pattern with several exposures separated by offsets ~20" will get rid of these gaps (see instrument configurations).
- **Connector gap**: The top and bottom rows of detectors are separated from the detectors in the middle of the mosaic by an important gap of about 85 arcseconds. This gap can be covered with dithering patterns using large offsets (see instrument configurations). However, this introduces complexity in the guide star selection process so these patterns should be used only if necessary.

During commissioning, it was found that the effects of bright stars on the mosaic were much negligible compared to CFH12K. No "rays" or bad blooming effects were seen. However, very bright stars will saturate the chips so if it is an issue, you can use the GSC stars displayed in Aladin (magnitude is given by clicking on the red circles) and the moving grid to carefully define the target pointing.

- **Table (3):**
  - **Coordinates**: Coordinates of the targets can be entered manually through these entry fields, or with Aladin. The "check" and "save" options always verify that no typos resulting in illegal coordinates values (e.g. RA=26h) have been entered. No values lower than -60 degrees in DEC are allowed.
The Epoch of the coordinates of the target. It can be fractional (e.g. 2001.3). All epochs between 1900.0 and 2050.0 are allowed.

Pointing Offsets: Offsets applied from the target coordinates. The seven positions are predefined offsets, illustrated below. These offsets are useful if you want to put the target at a specific location on the six central CCDs of the mosaic. By selecting the "New" button, you can edit the offset fields and define new positions.

When the page is saved, these offsets are referred under the name $U_{nnn}$ (U for "user") and this option becomes available for all the targets in the table. After the save, it is not possible to redefine the values for a given customized offset. Just create a new one... When the target coordinates are rather entered with Aladin, the pointing offsets are set to zero.

Another option offered here is the "random" pointing offsets. For instance, if your program includes monitoring on a specific target and you do not want to repeat the dithering pattern on the same location on the mosaic over and over again, you can select this feature. Each time the observations are put in the queue, the pointing coordinates will be automatically changed. Three options are available depending on the amplitude of the randomized offsets required. "RANDS" (random small) will change the coordinates within a disk of a diameter of 4", "RANDM" (random medium) within a disk of 30", and "RANDL" (random large) within a disk of 1".

Schematics showing the positions of the 7 predefined offsets in PH2 for MegaCam. Position 1 is the default pointing. By selecting these pointing offsets, the target will be positioned on a specific location on the mosaic, as shown here by the green numbers.

Select: Row selection for manipulation of the table with the "Duplicate", "Delete", etc. buttons.

Downloading/Uploading Target Files. At the bottom of the page, an option is available to download/upload a PH2 target list:

Astrores: Astrores is a special XML format that is becoming standard in astronomy for this kind of application.

The "Download" option allows you to transform a list of target in the table of PH2 into an Astrores formatted file. For instance, if you have already a list of targets in a program that you would like to transfer to another program with a different runID, you can first go to the program with the target list, download it to an file on your local machine, edit it if necessary, and upload it in the appropriate program with the "upload" button. You can use also this button to create a template for further use: for instance, first enter a target, click "download", and you'll see the correct format for the Astrores template.

the following is a template of the Astrores file that you can copy to your local machine to use the download/upload features:

```xml
<?xml version = "1.0"?>
<!DOCTYPE ASTRO SYSTEM "http://vizier.u-strasbg.fr/xml/astrores.dtd">
<ASTRO ID="v0.8" xmlns:ASTRO="http://vizier.u-strasbg.fr/doc/astrores.htm">
  <TABLE ID="Table">
    <NAME>Fixed Targets</NAME>
    <TITLE>Fixed Targets for CFHT QSO</TITLE>
    <!-- Definition of each field -->
    <FIELD name="NAME" datatype="A" width="20">Name of target</FIELD>
    <FIELD name="RA" datatype="A" width="11" unit="h" format="Hr:Mm:Ss">Right ascension of target</FIELD>
    <FIELD name="DEC" datatype="A" width="11" unit="deg" format="Dd:Mm:Ss">Declination of target</FIELD>
  </TABLE>
</ASTRO>
```
To upload a file, you can first save the example on your local machine by clicking on the "Astrores" button. All you have to do is to copy this template to your local machine within your favorite editor and then edit the ASCII table with your targets (do not change the XML code!). It is essential that you keep the appropriate format. Use the vertical lines as references for the number of spaces allowed. Most editors will keep this format automatically so it should not be a problem.

**Important Note:** Versions 6 and 7 of Netscape have an unfortunate bug affecting the translation of the XML template downloaded and ruins the format of the file. There is a workaround: 1 - After opening the Astrores template, go to "view page source" in the top menu. This will shows the HTML code. 2 - With the mouse, copy all the code between the 'XMP and /XMP lines and paste to an editor. 3 - Edit the two occurrences of lowercase "table" appearing in the code to uppercase "TABLE", and save. The file is now ready to be edited and is uploadable. You can upload the file to PH2 by giving the right path and by clicking on the "Upload" button. We strongly encourage you to verify carefully your target list after that!

<table>
<thead>
<tr>
<th>Button</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Add" /></td>
<td>Add N rows to the table.</td>
</tr>
<tr>
<td><img src="image" alt="Duplicate" /></td>
<td>Duplicate the selected rows N times.</td>
</tr>
<tr>
<td><img src="image" alt="Select All" /></td>
<td>Select all the rows in the table. Clicking again on it deselect all the rows.</td>
</tr>
<tr>
<td><img src="image" alt="Delete" /></td>
<td>Delete the selected rows. A confirmation window is displayed.</td>
</tr>
<tr>
<td><img src="image" alt="Check" /></td>
<td>Check the entries for errors. The errors found are displayed in a separate window and are indicated by a red frame in the table. An automatic check is done also when the form is saved or when the &quot;proceed&quot; button is activated.</td>
</tr>
<tr>
<td><img src="image" alt="Next Page" /></td>
<td>Display the next rows of the table.</td>
</tr>
<tr>
<td><img src="image" alt="Previous Page" /></td>
<td>Display the previous rows of the table.</td>
</tr>
<tr>
<td><img src="image" alt="Cancel" /></td>
<td>Cancel all the modifications done to the current page and reload data stored in the database.</td>
</tr>
<tr>
<td><img src="image" alt="Save" /></td>
<td>Save all the modifications done to the current page in the database and reload current page. <strong>Regular saving of the current form is recommended!</strong></td>
</tr>
<tr>
<td><img src="image" alt="Proceed" /></td>
<td>Save the content of the current page in the QSO database and open the next form.</td>
</tr>
</tbody>
</table>

### 7) Ephemeris

This form allows the user to define targets for which coordinates might rapidly change with time. The form is only accessible if requested in the Program Constraints section. We hope to add even more options in the future for moving targets. Before explaining how to use the form, here are two **important caveats**: 1 - For the moment, no extrapolation of any sort is conducted on the ephemeris entered; that is, coordinates used during the observations will be the ones matching the closest ephemeris entered for that date and time. 2 - Differential tracking (e.g. rates) is NOT possible right now; telescope tracking will be sidereal, with or without guiding (as can be indicated later in the OB form).

The general idea behind the ephemeris form is very simple: define a series of coordinates for a specific time for a given target. The top of the form, illustrated below, allows the user to first give a name to a target:

![Ephemeris Form](image)

For instance, in the pull-down menu on the left, you can select "New". In the central window, you can then give a name to your target. "Pointing" refer to options for pointing offsets explained in the above "fixed targets" section. When you click on "Update", the table in the middle frame window is then created and your target receives a label "ET#" (for "ephemeris target").
The table below shows the entry fields for the ephemeris of the target specified:

<table>
<thead>
<tr>
<th>EPH#</th>
<th>UTC Date</th>
<th>RA (J2000.0)</th>
<th>DEC (J2000.0)</th>
<th>Select</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>Jul 01</td>
<td>2004</td>
<td>04</td>
<td>00</td>
</tr>
<tr>
<td>E2</td>
<td>Jul 02</td>
<td>2004</td>
<td>04</td>
<td>00</td>
</tr>
<tr>
<td>E3</td>
<td>Jul 03</td>
<td>2004</td>
<td>04</td>
<td>00</td>
</tr>
</tbody>
</table>

Each row in the table is an ephemeris labeled "E#" and includes the UTC Date (beginning of a night in Hawaii is ~ 05:00:00 UT) and the coordinates of the target for this date (in J2000.0). As many ephemeris as wanted can be entered for a target and as many targets as wanted can be entered for a program. After defining all of the ephemeris for the target, we recommend that you save it immediately before starting defining the ephemeris for the next target (if needed). When saved, the ET will appeared in the list of targets used for defining the observation blocks (below).

Since entering a large number of ephemeris can be cumbersome the Astrores format template can be used at the bottom of the page to upload ephemeris for a given target (that is, one upload per target is necessary). To do so, apply first the procedure described above (create a new target name and click on update), since the name of the target cannot be defined from the Astrores template. Below there is a Astrores template (XML) that can copied on your local machine and then used to upload ephemeris to the table in the middle frame. (You can also create your own template on your local machine by first defining a target and click on "download"). However, see important note in the fixed target section if you are using Netscape 6 and 7). It is important that the format is respected. You can then prepare the ephemeris for the target as seen in the lower part of the template and save the template under a specific name. When saved on your local machine, you can then upload it by specifying the path. Check that everything is fine and then save the ephemeris table for that target. Repeat if necessary!

```xml
<?xml version = "1.0"?>
<!DOCTYPE ASTRO SYSTEM "http://vizier.u-strasbg.fr/xml/astrores.dtd">
<ASTRO ID="v0.8" xmlns:ASTRO="http://vizier.u-strasbg.fr/doc/astrores.htx">
  <TABLE ID="Table">
    <NAME>Ephemeris</NAME>
    <title>Ephemeris for CFHT QSO</title>
    <!-- Definition of each field -->
    <FIELD name="DATE_UTC"  datatype="A" width="19" format="YYYY-MM-DD hh:mm:ss">
      <DESCRIPTION>UTC Date</DESCRIPTION>
    </FIELD>
    <FIELD name="RA_J2000"  datatype="A" width="11" unit="h" format="RAh:RAm:RAs">
      <DESCRIPTION>Right ascension of target</DESCRIPTION>
    </FIELD>
    <FIELD name="DEC_J2000" datatype="A" width="11" unit="deg" format="DEd:DEm:DES">
      <DESCRIPTION>Declination of target</DESCRIPTION>
    </FIELD>
    <!-- Data table -->
    <DATA><CSV headlines="4" colsep="|">
      <![][CDATA[
        DATE_UTC | RA          | DEC          |
        YYYY-MM-DD hh:mm:ss | hh:mm:ss    |
        2003-06-04 06:30:00 | 09:34:00.00 |
        2003-06-05 06:30:00 | 09:35:15.00 |
      ]]>]]></CSV></DATA>
  </TABLE>
</ASTRO>
```

8) User Dithering Patterns

This form allows the user to define his/her own dithering patterns. It is NOT a mandatory form and is only accessible from the navigation menu (i.e. "Proceed" from the "Fixed Targets" form will go to the "Instrument Configurations" form, not this one. Defining his own dithering patterns can be useful for some programs. Our experience, however, shows that data reduction can become much more difficult or can even be severely compromised with nonstandard patterns. Use only this form if only necessary for your program and if you have previous, extensive experience with data reduction of wide-field camera observations. For any doubt, do not hesitate to contact the QSO/Elixir Teams.

The idea behind this form is simple: the user can define a list of absolute offsets and saved this list as a dithering pattern under a customized name. This name can then be found under the pull-down menu for the available dithering patterns in the next PH2 form ("Instrument Configurations").

The top frame allows the user to visualize the offsets of a dithering pattern, create a new pattern, or delete a user pattern.
• **Left Window**
  - **Name**: Pull-down menu with the name of the existing dithering patterns, including the predefined "standard" patterns (see next form). The selection automatically displays the offsets in the table in the middle frame.
  - **Description**: Short description of the pattern

• **Middle Window**
  - **Name/Description**: Name and description of the dithering pattern to be defined by the user. Clicking on "Create" opens the table in the middle frame.

• **Left Window**
  - **Delete DP**: Delete the current dithering pattern displayed in the table. A confirmation window will appear.

The middle frame displays the table used to define the dithering pattern:

```
<table>
<thead>
<tr>
<th>Label</th>
<th>RA Offset</th>
<th>DEC Offset</th>
<th>Select</th>
</tr>
</thead>
<tbody>
<tr>
<td>O1</td>
<td>+10</td>
<td>+40</td>
<td></td>
</tr>
<tr>
<td>O2</td>
<td>+00</td>
<td>+00</td>
<td></td>
</tr>
<tr>
<td>O3</td>
<td>+10</td>
<td>+10</td>
<td></td>
</tr>
<tr>
<td>O4</td>
<td>-50</td>
<td>-10</td>
<td></td>
</tr>
</tbody>
</table>
```

*Table:
  - **Label**: The label identifies a row in the table which corresponds to an **ABSOLUTE** offset.
  - **Offsets**: Values of the RA/DEC offsets for each pointing within the dithering pattern. These offsets are **ABSOLUTE**, that is, **DEFINED WITH RESPECT TO THE POSITION (0,0), NOT THE PREVIOUS POSITION**. Positive offsets correspond to East and North. In the example above, the dithering pattern "UDP3", has four pointings: a reference (O1) corresponding to the pointing coordinates of the target since offsets are at 00:00; and three additional pointings: offsets of 5" West and 10" North with respect to the position O1, offsets of 10" East and 5" North with respect to the position O1, and offsets of 15" West and 10" South from position O1.

9) Instrument Configurations

This is the second mandatory step in the creation of the observing blocks. This page allows the user to define all the instrumental configurations necessary for the program. The same configuration can be used several times with different targets. The main section of the page is a table with different options under pull-down menus or editable entry fields.

But, first the top frame can be used to help in the preparation of these configurations by offering the following elements:

• **List of Targets**: This little window displays the name of the targets defined in the previous form. It is just available as a mnemonic resource so that the user does not have to navigate back and forth between page to look at the list of targets. Nothing to click on, it's just a scrolling display!
**Predefined Dithering Patterns:** This window presents some of the different dithering patterns ("DP") offered in one of the pull-down menus in the configuration table. The "single" pattern represents the option for one exposure. The blue circle represents the radius of the pattern and the red dots show the relative positions of the individual exposures within the pattern. Two parameters describe the geometry of the other patterns: the number of exposures (indicated by the digits following the "DP"), and the scale factor within which the offsets are applied. The patterns have been designed so that the coordinates of the objects will never be the same twice during the sequence. Experience has showed that at least a minimum of 4 exposures is necessary to get rid of the gaps between the CCDs. More information on the different options for the dithering patterns is found below.

**Exposure Time Calculator:** There is an exposure time calculator available for MegaCam. The Digital Imaging Exposure Time (DIET) interface is automatically open when this link is activated. We strongly recommend that you use the calculator during the preparation of your observations. By doing so, you will be able to specify the right parameters for your observations (exposure time, seeing, sky brightness) in order to achieve your science goals.

The middle frame of the configuration page consists in a table and buttons to manipulate the entry fields:

- **Top Row:**
  - **RunID**: Identification of the program you are currently working on.
  - **Table Status**: List of the current rows and the total number of configurations already defined in the current table.
  - **Instrument**: Link to the MegaPrime Web page.

- **Table:**
  - **Label**: The label identifies a row in the table. The instrument configurations are simply identified as I#. The label is automatically updated if the rows are changed.
  - **Name**: The name of the instrument configuration, as given by the user. A mnemonic name (e.g. Filter r, short) will make the subsequent steps easier. The name must be shorter than 20 characters.
  - **Filter**: The list of filters currently available for MegaPrime. The current options are: u, g, r, i, z, CN, TiO, Ha, HaOFF. Information on the standard filters can be found on the MegaPrime Web page. The last five filters on that list are CFH12K filters, which can be used with MegaPrime, but resulting of course, in a smaller field of view (42' x 28', see figure below). Note that no photometric calibrations will be included in our calibration plan for these "non-standard" filters and must be included in your program, if you require photometry.

- **Binning**: Only 1x1 is available at the moment.
- **Pattern**: 1) Name of the dithering pattern. Single means one exposure. DP# means "small dither pattern" and LDP# means "large dithering pattern" (see below for the difference between those patterns). The number after "DP" corresponds to the number of exposures taken. 2) Scale for the dithering pattern. Multiple exposures with no dithering are possible by selecting the appropriate pattern and requesting a scale of 0. These values are possible: N/A, 0, 1 and 1.5. Default is 1; value of 1.5 is not available for LDPs.. The N/A is only judged valid for the single exposure.

It is important to know that the MegaCam mosaic has three different series of gaps between the detectors:

- **Vertical gaps**: The vertical gaps between each CCD is about 14 arcseconds. A dithering pattern with several exposures separated by offsets ~15° will get rid of these...
gaps.

- **Horizontal gap:** The horizontal gap between both rows of detector in the middle of the mosaic is about 11 arcseconds. A dithering pattern with several exposures separated by offsets ~10" will get rid of these gaps.

- **Connector gap:** The top and bottom rows of detectors are separated from the detectors in the middle of the mosaic by an important gap of about 85 arcseconds. This gap can be covered with dithering patterns using large offsets of about 2'. However, this introduces complexity in the guide star selection process so these patterns should be used only if necessary.

Dithering patterns offered for MegaPrime at this time are detailed in the following tables. The "DP" patterns can be used with two scale factor. Scale 1 covers the bad pixels but none of the mosaic gaps. Scale 1.5 will cover the vertical and horizontal gaps (but not the connector gap). The large dithering pattern (LDP) is special: some offsets are large (2') and the general geometry is elliptical. **IMPORTANT:** As the field distortion is not negligible, big dithering patterns like the LDP will not allow a simple shift and add, especially on the edge of the field. The tables below give all the offsets defining the dithering patterns.

### Table: Dithering Patterns

**DP2**

<table>
<thead>
<tr>
<th>Position</th>
<th>Scale Factor 1</th>
<th>Scale Factor 1.5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RA Offset (')</td>
<td>Dec Offset (')</td>
</tr>
<tr>
<td>1</td>
<td>00 00</td>
<td>00 00</td>
</tr>
<tr>
<td>2</td>
<td>00 15</td>
<td>01 15</td>
</tr>
</tbody>
</table>

**DP3**

<table>
<thead>
<tr>
<th>Position</th>
<th>Scale Factor 1</th>
<th>Scale Factor 1.5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RA Offset (')</td>
<td>Dec Offset (')</td>
</tr>
<tr>
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<td>Select All</td>
<td>Select all the rows in the table. Clicking again on it deselect all the rows.</td>
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<tr>
<td>Check</td>
<td>Check the entries for errors. The errors found are displayed in a separate window and are indicated by a red frame in the table. An automatic check is done also when the form is saved or when the &quot;proceed&quot; button is activated.</td>
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<td>Cancel all the modifications done to the current page and reload data stored in the database.</td>
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<td>Proceed</td>
<td>Save the content of the current page in the QSO database and open the next form.</td>
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</table>

### 10) Constraints

This page presents the table designed for defining the sky constraints under which the observations should be undertaken. The top frame displays information about the targets and instrument configurations defined previously:

- **List of Targets**: This little window displays the name of the targets defined in the Fixed Targets form. It is just available as a mnemonic resource so that the user does not have to navigate back and forth between pages to look at the list of target. Nothing to click on, it's just a scrolling display!

- **List of Instrument Configurations**: This window displays the names of the instrument configurations and some of their content defined in the previous form. It is just available as a mnemonic resource so that the user does not have to navigate back and forth between pages to look at the list of configurations. Nothing to click on, it's just a scrolling display!

- **Exposure Time Calculator**: There is an exposure time calculator available for MegaCam. The Digital Imaging Exposure Time (DIET) interface is automatically open when this link is activated. We strongly recommend that you use the calculator during the preparation of your observations. By doing so, you will be able to specify the right parameters for your observations (exposure time, seeing, sky brightness) in order to achieve your science goals.

The middle frame presents the table for the constraints:

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</tbody>
</table>
From these tables, a few facts can be stated:

- The FWHM is basically constant between the r, i, and z bands filters but increases by about 0.1-0.2" for each filter "step" bluer than the r band. You must consider these differences in the calculations of your exposure times with DIET.

- Variations of the seeing are fast. This again argues for short observation blocks or groups. These quick variations might introduce images in a sequence for which the image quality is outside the IQ band specified. If the difference is about 15%, these images will be considered valid. However, if the IQ variation is too important, these images might be taken again.

- The probability that your program is executed depends strongly on the image quality required. Be realistic! In particular, for Programs with the C grade, it would be
much preferable not to specify an IQ better than 0.8".
- It is important that you request a realistic IQ also when your targets do not reach a low airmass. For instance, asking for 0.6" when the airmass is never smaller than 1.5 is not very likely to happen....
- By definition, snapshots programs MUST request IQ > 1.2".

A word on the Sky Brightness. At present, only three general qualitative sky brightness can be indicated. During the observations, the sky background will be constantly measured by Elixir and converted to these qualitative values. In gray time (i.e. Moon Illumination 0-50%), and bright time (i.e. Moon Illumination > 50%), the QSO Team will always try to observe at at least -5 degrees away from the Moon. However, it might not always be possible to do that due to scheduling constraints. We strongly suggest to include some comments in the "Program Constraints" page on this issue, for instance, if you think that we could get a bit more Moon without compromising the quality of science of your project.

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11) Observation Blocks

This is it! This page allows the user to link all the previously defined entities within observation blocks (OB). The main page is divided into two main frames:

- **Top Frame:**
  - **Target Selection:** The first element to enter in the creation of the OB is one target. This window lists all the targets previously defined. To select one, simply click on it with the mouse. The selection is then enlighten by a darker background. It is also possible to select several targets in the list by holding the "control" button. An OB will be created for each target selected when the "Create OB" button is pressed. The selection remains visible after the creation of the OB with the "Create OB" button.
  - **Configuration List:** The second element to enter in the creation of the OB is the configuration list. An OB can have one or several configurations. To achieve that, you must create a list with first selecting the configurations and second, by adding them to the list on the right. You can change the order of the configurations with the up and down arrows. The configurations will be executed in the order given in this list.

- **Bottom Frame:**
  - **RUNID:** 03AE99 PL Pierre Martin
  - **Rows OB1 to OB3 of 3 Observation Blocks**

**HINT:** The number of rows displayed at once is only a few. The "Next Page", "Previous Page" buttons can be used to navigate between the different pages. The blue links OB# represent the first row of each individual pages and can also be used for moving quickly from a page to another.

- **Top Frame:**
  - **Target Selection:** The first element to enter in the creation of the OB is one target. This window lists all the targets previously defined. To select one, simply click on it with the mouse. The selection is then enlighten by a darker background. It is also possible to select several targets in the list by holding the "control" button. An OB will be created for each target selected when the "Create OB" button is pressed. The selection remains visible after the creation of the OB with the "Create OB" button.
  - **Configuration List:** The second element to enter in the creation of the OB is the configuration list. An OB can have one or several configurations. To achieve that, you must create a list with first selecting the configurations and second, by adding them to the list on the right. You can change the order of the configurations with the up and down arrows. The configurations will be executed in the order given in this list. **Very Important:** The number of configurations that can be linked within an OB is unlimited; however, changing a filter in MegaPrime is a lengthy process (150 seconds). At this moment, we do not charge these overheads but to
avoid unnecessary overheads, it is highly preferable to avoid too many filter changes within the same observation block. For example, if you need short ugriz exposures on one target, it is much preferable to split these exposures into different observation blocks.

- **Constraint Selection**: The final entity to create an OB is the constraint. As with the target, the selection is done with the mouse and remains enlighten after the creation of the OB.

**Middle Frame**:
- **Label**: The label identifies a row in the table. The observation blocks are simply identified as OB#. The label is automatically updated if the rows are changed. By clicking on the label in the table, the selections are displayed again in the windows of the top frame.
- **Target**: Target label used for this observation block.
- **Configurations**: List of configurations used for this observation block. Individual configurations are separated by the "+" sign and the order of execution goes from left to right.
- **Constraint**: Constraint label used for this observation block.
- **OB I-Time**: Total integration time (I-time) requested for the execution of this observation block. The calculation is done as follows: I-Time(OB) = N(exposures) x [ Exp.Time/Exposure + Readout/Exposure], where readout/exposure = 40 seconds. Since it is much easier to schedule short observation blocks, the total I-time for one OB cannot exceed 2 hours.
- **Tracking**: Two options are offered here: 1) Sidereal, guiding. This is the typical exposure and the default selection. 2) Sidereal, non-guiding. In case of short exposures (e.g. < 10 seconds), it is entirely preferable to select this option because finding a guide star is time consuming and that the image quality is not degraded for images with very short exposure times.
- **Type**: Type of observation. Only "object" is available.
- **Photometry**: Does this OB require a photometric calibration? For ugriz filters, each OB requesting photometry will be calibrated automatically by CFHT. For all the other filters (e.g. Halpha), if the photometric flag is enabled, it only means that you have included the necessary photometric calibrations in your PH2 program. Since most of the programs require photometry, the flag is enabled by default. However, if your OB does not require photometric calibrations, please verify that the flag is not selected.
- **Comment**: You can enter a comment for each individual OB. These comments are visible at all time during the observations. The comment associated to the OB is included in the FITS headers of the images (keyword:CMMTOBS).
- **Select**: Row selection for manipulation of the table with the "Delete" button.

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<td>Create an Observation Block, after selecting one target, one or several instrument configurations, and one constraint.</td>
</tr>
<tr>
<td><img src="modify" alt="Modify OB(s)" /></td>
<td>Modify an observation block. After selecting one or several OBs in the table (&quot;select&quot; column in the table), the OBs will be modified according to the parameters defined by the top lists after clicking this button. Thus, it is possible to change the content of an OB without having to delete it and create it again. <strong>Important</strong>: You must make sure that the total I-time allocated for your program has not been exceeded after modifying the OG.</td>
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</tr>
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12) Observation Groups

This page presents the last step in the preparation of your observations: the creation of the observation groups (OG). The OGs will be the entities scheduled at the telescope so this step is necessary, even if you have previously defined all the observation blocks. The OG page is presented below.
Three types of Observing Groups (OG) are possible: 1) **1OB (Single OB)** means that the observation blocks previously prepared are transformed into individual OGs. If all the OBs should be transformed into OG, this can be done automatically by selecting the "Quick Create OGs" button; it is the recommended approach for the QSO mode. 2) **Monitoring OG (MOB)** means that one specific OB will be observed a certain number of times within a given period. The selection of the OB is done through the list on the right and the OG monitoring parameters are entered in the window on the right. 3) **OBs can be linked together to form a sequence (SOB)**. The list of OBs to link can be done with the entry field on the right. Beware: only OBs requesting the same constraint can be linked together. We also want to discourage the use of SOBs as much as possible: shorter 1OB OGs are easier to schedule and execute! Very Important: The number of blocks that can be linked within an OG is unlimited; however, changing a filter in MegaPrime is a lengthy process (150 seconds). At this moment, we do not charge these overheads but to avoid unnecessary overheads, it is highly preferable to avoid too many filter changes within the same observation group. For example, if you need a sequence of short ugri exposures on one target, it is much preferable to split these exposures into different observation groups.

**OB List:** Except when one desires to transform all the OBs into OGs with the "Quick Create OGs" button, the creation of an OG of any type requires a list of OBs. This can be done using this window. The order of the OB within the list can be altered with the arrows. When clicking on an OB from the list, the window on the right displays a summary of its content. There is a new feature in PH2: it is now possible to do multiple selection of the OB in the left window before clicking on the "add" button. This can diminish greatly the number of clicks necessary to create a sequence of OBs for instance. If multiple OBs are found in the list (on the right) and the "single OB" option was selected, one OG per OB in the list will be created if you click on "Create OG(s)" in the table. If "monitoring OG" is selected and multiple OB are in the list, each OG created will have the same monitoring parameters.

**Observation Groups Options:** See Below

- **Label:** The label identifies a row in the table. The observation groups are simply identified as OG#. The label is automatically updated if the rows are changed.
- **Type:** Identifies the type of groups: 1OB (single OB); MOB (monitoring OB); SOB (sequence of OBs).
- **OB:** Identifies the observation block(s) used to create this specific observation group. Clicking on an OB from this entry field display again the content of the block in the top frame.
- **Group I-time:** Total integration time in seconds for this Observation Group. If monitoring, I-time (OG) = N(iterations) x I-time (OB). The total I-time includes all the readout time for each individual exposures.
- **Priority:** Priority (high, medium, low) of this observation group for your program. This will be used by the QSO Team during the selection process leading to the execution of the observations for your program. Selecting "lowest" does not mean that this OG will never be done; we aim for the completion of programs. It is only a way to ensure that if the completion level of your program is not 100%, that at least the most important targets have been observed.
- **Comment:** Any comments you might think would be useful for the QSO Team.
- **Select:** Row selection for manipulation of the table with the "Delete" buttons.

**Third Frame:**

- **I-Time Allocated:** Integration time allocated by the Time Allocation Committee for your program. This time cannot be exceeded!
- **I-Time Calculated:** Total integration time requested for all the observing groups defined in this page. It automatically includes the readout time for the CCD for all of the individual exposure in the OG and an overhead of 2 minutes for each accurate pointing required, if necessary. The I-time is automatically calculated after the creation of an OG.
- **I-Time Left:** I-time calculated - (I-time calculated); it cannot be negative. If I-time left < 0, a warning window is displayed. The new OG is included in the table but cannot be saved. You must modify the OG table in order to get I-Time equal or larger than zero. If you click on "cancel" instead, the new OG is removed from the table.

**Observation Groups Options:**

There are three important options available for the Observation Groups, useful to precise specific observations. These options are first presented in the "Program Constraints" section and appear only in the OG form if requested.
**Monitoring Parameters:** Parameters for the monitoring OGs. This window appears only if you have indicated that your program requires monitoring. You can enter a period in hours, days or weeks. To enter the parameters, first select the unit and then fill in its value. The number of iterations corresponds to the numbers of times that this OG should be done at the interval of the period. The minimum number of iterations corresponds to the acceptable minimum number of observations to reach the science goals. We will reach for the total number of iterations but only OGs that have met the minimum number of iterations will be considered valid.

**Relational Execution Link (REEL):** For certain programs, it is important that the observations take place within a specific sequence of events. For instance, if OG1 is done and validated, only then OG2 should be done within a certain timescale. It is possible to manage this kind of sequence at a higher level on a small scale (that is, during the preparation of the queues) but on a larger scale, it is much more preferable to have these options "hard coded" in the database. To cover such possibilities, we have developed the concept of the REEL, basically, it is possible to create a causal link between observation groups. This can be done in the last window on the right, if you have selected the REEL option in the "Program Constraints" section. Essentially, a REEL means this: "After the validation of the reference OG, the linked OG should be done within a certain delay." You can then link several OGs, if needed. For instance, OG3 to OG2 to OG1, etc. The links created appear in the OG table. An example of a REEL sequence is showed below.

**IMPORTANT:** The REEL option should be used ONLY when appropriate. If the observations cannot be done within the window defined by the (delay +/- delay) (due to bad weather or technical problems), the completion of the chain will not be done. Also, the logic involved in defining the REELs in PH2 is complicated. It is preferable to define first all the OGs, save them, and then create the links. This can be done using the "modif OGs" button: after defining all the OGs, you can create the REEL link by selecting the OG from its label, entering the REEL parameters, click in the "select" box on the row, click on the "modif OGs" button and save. Deleting OGs which have REELs will not be permitted.

**Time Constraints:** For certain programs, some observations must be done during a specific time range. These entry fields, available in the OG table, allow the user to define such a constraint by specifying a period for which the observations should be undertaken. These fields are optional and will appear only if required in the "Program Constraints" page. It must also be understood that these constraints are very severe: if for a reason or another (e.g. bad weather or conditions not meeting the sky constraints) the observations cannot be done during the period required, these observations will not be tempted again and will be taken out of the queue. Time constraints are not compatible with REELs, for example if an OG is to be done after another one is validated, that OG cannot have time constraints as well.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><img src="create_og.png" alt="Create OG" /></td>
<td>Create one observation group (it can be of types 1OB, MOR, or SOB).</td>
</tr>
<tr>
<td><img src="quick_create_ogs.png" alt="Quick Create OGs" /></td>
<td>Transform all the observation blocks defined in the previous form into observation groups. The recommended approach!</td>
</tr>
<tr>
<td><img src="modif_og.png" alt="Modif OG(s)" /></td>
<td>Modifying an existing observation group. After selecting one or several OGs in the table (&quot;select&quot; column), the OGs will be modified according to the parameters redefined by the top lists after clicking the &quot;modif OGs&quot; button. So, it is now possible to change an OG without having to delete it first from the table! Important: You must make sure that the total I-time allocated for your program has not been...</td>
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exceeded after modifying the OGI(s).

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</table>

13) Summary

This page opens a complete summary of what is currently the Phase 2 status of the program. As showed below, the summary can be sent by e-mail to several destinations as a HTML attachment (to be compatible with people not using a browser for their mail system), by clicking on the "Send this page to" button. The summary can also be printed using the "Print" button of the browser used for PH2.

14) HelpDesk

The HelpDesk offers a powerful communication system between the PH2 users and the QSO Team. It is directly interfaced with the QSO database so it stores all the messages exchanged between the different parties regarding PH2, and more generally, the QSO program. The main interface is simple to use and offers numerous options:

- **Forums:** The left frame presents the users with a series of forums. Two are accessible for all the users of PH2: PH2 Support and QSO Support. All messages written in these forums can be seen by all the PH2 users, after moderation by the QSO Team. There is also a private forum, identified by your runID. Only you and the QSO Team can access the messages posted in this forum.

- **Threads:** These represent the different subjects discussed under the forums. If you want to start a new thread, you can click on the "New Thread" button. The right window will then request that you enter the appropriate forum. A mail editor will then be opened and the thread name will be the subject of your mail. This is the best way to communicate with the QSO Team. To send an e-mail in a thread already existing, just click on it. All the messages contained in thread will be opened in the right window. You can then add your message to this thread by clicking on the "Post new message in the thread" button.

- **Options:** You can search for a specific word through the threads by clicking on the "Search" button at the top. Attachments are possible by clicking on the "Advanced" button in the mail editor.

**HINT:** We strongly suggest that you keep the summary (printed or electronic) of the final version of the program submitted during the Phase 2. It will be useful to you for monitoring the progress of your program with the night reports and for any necessary communication between you and the QSO Team regarding the observations.
15) Logout

To exit PH2, you must confirm it by clicking on the "Logout" button in the window below. If you do not want to do so, select another page with the navigation buttons on the left frame.

![Logout Button](http://www.cfht.hawaii.edu/Instruments/Queue/ph2_tutorial_v2.html)

<table>
<thead>
<tr>
<th>Button</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logout</td>
<td>Log out PH2 and open the first page of PH2.</td>
</tr>
</tbody>
</table>

4 - A Few QSO Rules

Maybe the most difficult task facing the queue observing model is found in the selection process leading to the execution of a science program. This selection can be based on simple criteria (e.g. mounted filters) but it becomes immensely complicated when other parameters like actual sky conditions, completeness level, science merit, monitoring constraints, filters availability, or targets visibility are taken into account.

The process, resulting in the choice of a specific program to be undertaken for the queue observations with CFH12K, will be done in three steps:

1- Selection: This is the first selection of the viable observations stored in the database according to instrumental constraints, sky constraints, actual sky conditions, completeness level, and the position of the targets.

2- Ordering: This second step creates a prioritized list of observations to be sequentially executed regarding their TAC grade, rank, target positions, and user's priorities.

3- Human filtering: The final step consists in the possibility for the QSO observer to modify the queue list according to special constraints like the focus sequences, calibration plan, etc.

Without going into too many details, each of these steps include an algorithm based on a set of selecting rules. The rules given here are not presented in any order of priority. Among them:

- As much as possible, images should not be obtained in worse IQ (or sky brightness) conditions than required. The IQ (sky brightness) measured should not exceed the upper limit of the IQ band required my more than 10-20%.
- Images can be obtained in conditions better than required, if no other observations actually requesting these conditions are available.
- For very bad IQ periods (>1.2"), the snapshot programs requesting bad conditions should be executed, unless other possibilities exist among the regular programs.
- The priority of the programs started is automatically increased compared to programs not started.
- Unless an upper limit is specified during the Phase 2, observations will be tentatively done with airmass smaller than 1.5.
- During ordering, the priority goes from grade A to B to C, followed by the snapshots. Inside these grades, priority is given according to the TAC rank.
- As much as possible, the observer will execute the observations belonging to a given program according to the priority index given by the investigators.
- A QSO run should never be completed without getting all the necessary calibrations for all the programs fully or partially executed during the run.
- All fields requesting photometry should be calibrated with short exposures during photometric periods.
- No programs will be recycled for completion during the next semester.
- When started, a monitoring program receives a higher priority so that the observations to be repeated can be carried out within the specified timeframe period.
- The QSO Team will always try to obtain the required number of observations for a given monitoring program. In case of other constraints, the minimum number of observations scheduled during Phase 2 is the minimum acceptable.
- For target-of-opportunity programs submitted during the semester, these programs will be subject to the same selection process and prioritization based on a grade and a rank as the regular programs.

5 - Other Issues

1) Night reports

After each observing night, a report detailing what observations were performed will be available on the CFHT Web site. These reports include the observations blocks executed and the sky conditions at the time of the observations. This does not mean that your data will be immediately available (see below). The goal of these reports is to inform the community of the progress of the queue and, in particular, the current status of your program.

2) Data Evaluation

As part of the data quality control assessment, all data taken will be automatically processed and calibrated by the Elixir Team. Data evaluation will be done in two steps: during the observation by the Service Observer ("on-line" evaluation) and, during and after the data processing. This last step is very involving and represents one of the reasons why data cannot be distributed immediately. If the observations are judged satisfactory, the queue database is then updated by the Queue coordinator.

3) Data Distribution

Data distribution will be handled by the DAD Team. Our goal is to be able to distribute the data to the PI of each project (or another member if specified during the Phase 2) and the relevant calibrations according to the data distribution preference specified in PH2. Due to the heavy workload during a run, it will not be possible to send the data to the investigators. However, for certain types of programs (e.g. TOO) where looking at the data as soon as possible is important, this will be possible under the supervision of the Queue coordinator.

4) The QSO Team

The QSO Team is formed of Pierre Martin (QSO Project Scientist/Manager), Tom Vermeulen (System Programmer), Billy Mahoney (Database Specialist), Todd Burdullis (Senior Service Observer), and Mary Beth Laychak, Adam Draginda, Rachael Zelman, and Peter Forshay (Service Observers). During a QSO run, supervision is ensured by
the QSO Coordinator (one of the CFHT Resident Astronomers) who, among other things, is responsible for managing the queue database and maintaining the contact with the investigators, if necessary. Observations will be conducted by the Service Observers and with a strong involvement by the Observing Assistants. Software support will also be provided during the observing nights. For TOO programs and decisions related to the viability of some programs, the CFHT Executive Director acts as the final authority.