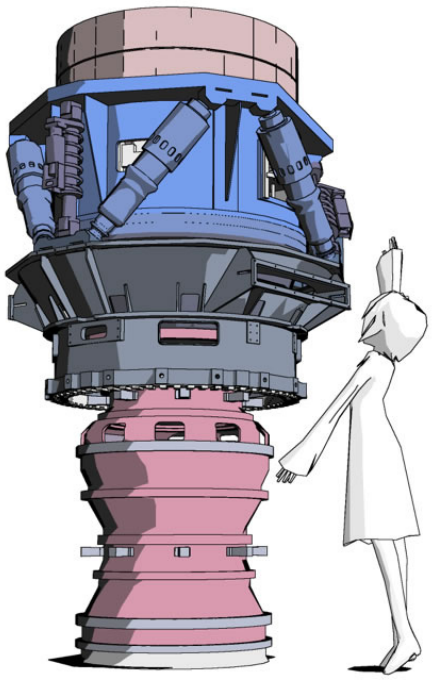
Subaru Telescope

Hyper Suprime-Cam (HSC) queue mode

Program PI Document

Ver. 6.2.0



National Astronomical Observatory of Japan

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Contents

Preface

The purpose of this document is to describe the queue mode (QM) operations of the Hyper Suprime-Cam (HSC) from the user's perspective. Its intention is to present the queue mode itself, help the PI to prepare the proposal and observations, explain how the observations are carried out, as well as how to access the data and other important information.

Important: *In this version the document is intended to work for the QM operation in semester S18B only. The HSC QM observations will not be done in a shared-risk mode any more, but minor details of procedures and policies may be changed. In the future this document will be updated accordingly.*

Some details that need to be specified or confirmed are written in blue. They will be given once they are established, so updates to this document will be done in the future.

KH, MO

General contact for QM proposal PIs and users (questions, comments, suggestions):

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The HSC Queue Working Group:

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Chapter 1

General information

1.1 The Hyper Suprime-Cam

The Hyper Suprime-Cam (HSC) is a gigantic mosaic CCD camera, that is installed at the prime focus of the Subaru Telescope. The HSC uses 104 main science CCDs, which cover 1.5 deg FoV in diameter, with a pixel scale of 0.17", as well as 4 CCDs for auto guider, and 8 CCDs for auto focus. Information about the instrument can be found at:

https://www.naoj.org/Observing/Instruments/HSC/index.html

We recommend to read them first. For each observing run a set of filters is defined, and observations are performed in these filters only. Due to the construction of the instrument, changing filters during the night is time-consuming and is not done frequently.

Questions regarding the HSC should be directed to Dr. Satoshi Miyazaki (satoshi [at] naoj.org) and/or Dr. Fumiaki Nakata (nakata [at] naoj.org).

1.2 The HSC pipeline

There is a dedicated reduction pipeline for the HSC data prepared. For download, installation and usage instructions go to:

https://hsc.mtk.nao.ac.jp/pipedoc_e/index.html.

Please note, that it is possible to use the pipeline on one of the machine environments available. For details, see:

https://hsc.mtk.nao.ac.jp/pipedoc_e/e_env/index.html.

1.3 What is queue mode?

Queue mode (QM) is a type of telescope operation, where the observations are carried out by the telescope and instrument operators, without a direct involvement of investigators (PI or Co-I). Targets are selected from a number of approved programs, on the basis of various criteria, such as: the rank of

the program, the priority of the target, observing conditions (seeing, sky transparency, humidity, moon phase and distance), air mass, telescope slewing time, current telescope configuration, etc. The main differences from the classical mode are that the PI and Co-Is are not present during the observations (at the summit, nor remotely), and objects from various programs can be selected for a given night. Observations for a given program can be done any time during the whole run allocated for the QM. Higher priority is given to higher-ranked programs, and the observations are carried out in conditions that are expected and required by the PIs. The observing procedure is standardized, which ensures uniformity of all the data. Appropriate selection of objects allows to increase the effective time spent on target, thanks to reduced telescope slewing time and possibility of choosing programs that do not require certain strict criteria (for example, allow for worse seeing or sky transparency). The amount of data and scientific outcome of QM observations is thus typically higher than of the classical mode.

The difference between Subaru's Service Program observations, available for some of the instruments[1], but not for HSC, is that the service programs have fixed allocation of typically 0.5n, so their execution is dependent on many factors (like weather). Approved QM programs are executed during few runs, lasting in total at least several nights, thus there is more flexibility in observations and the probability of having the best-ranked proposals completed is much higher.

Queue operations are divided into several parts:

- Phase 1 preparation: proposal submission (incl. target selection, telescope configuration, constraints setting, etc.).
- Phase 2 preparation: observing blocks submission (detailed description of the observations).
- Observations (execution of the observing blocks) and quality assessment (check if the data meet the proposal criteria).
- Data delivery (incl. raw science data, calibrations, logs).

This document describes these steps in more details. In case of unanswered questions regarding the HSC queue mode please contact `queue [at] naoj.org`, or go to:

https://www.naoj.org/Observing/queue/.

1.4 Current stage and progress

Semester S18A&B represent the start of Stage III HSC QM operation (see below), which is no longer performed in a shared-risk mode. The time dedicated for QM is significantly increased, possibly to 80% of the total HSC time, but still depends on the number of accepted queue programs and available resources. From S18A, HSC QM is offered to intensive programs as well as normal programs Bad weather filler programs are allowed for open use. Some observations can be carried out during the dead time (so-called *sukima*) of the classical mode, and during the first and last nights of a Strategic Program run. Strategic programs as well as University of Hawaii and Gemini Telescope time-exchange partner proposals can be executed as HSC QM observations.

[1] https://www.naoj.org/Observing/Proposals/Submit/service.html

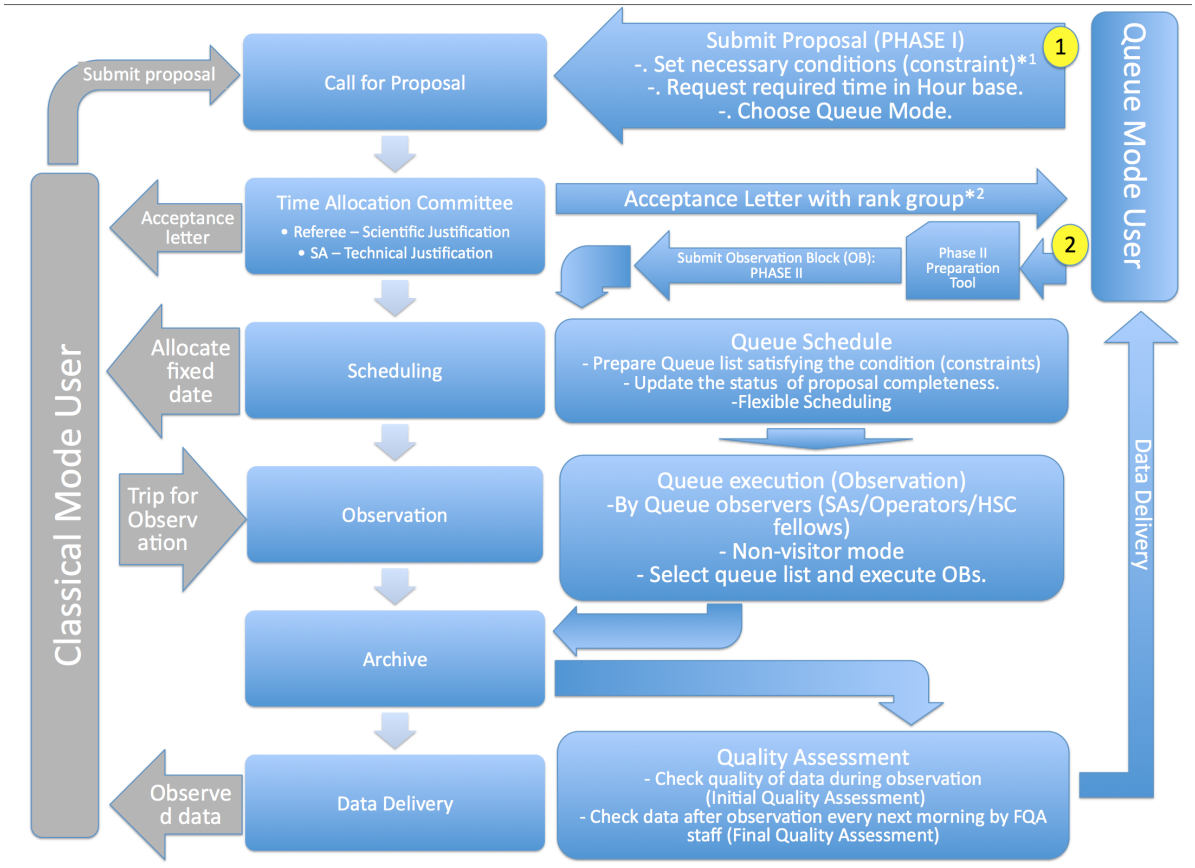

Figure 1.1: The flow of queue and classical modes from CfP to Data Delivery. The queue mode is right side blue diagrams and the classical mode is the left gray flow diagrams. Yellow circles mark Phase 1 and Phase 2.

Since S18A it is possible to propose programs that are time critical. The PI should provide sufficient information about when the observations supposed to be done, i.e. define certain time windows, already in the Phase 1. Please note, however, that the exact allocation of queue nights is not defined until Phase 2. To increase the possibility of execution of the program, the PI should specify the time windows as relaxed as possible. We'd like to remind that, usually, each HSC observing run lasts for ten days or longer during the dark and gray nights.

So-called *cadence* programs (observations taken regularly every certain amount of time) are allowed in a restrictive sense starting from S18B, in the form of shared-risk mode monitoring proposals. Details are provided in Section 2.1.2.

1.5 Acronyms and terminology

AL – acceptance letter
BBF – broad band filter
CfP – call for proposals
Constraints – observing constraints, limitations on seeing, sky transparency, moon phase, moon distance, air mass
GRADE – Priority level of the HSC queue mode proposal
Filler – type of programs intended for bad weather conditions
FC – finding chart
FQA – final quality assessment
HSC – Hyper Suprime-Cam
IQA – initial quality assessment
NBF – narrow band filter
OB – observing block
Partner – University of Hawaii, Gemini Observatory or Keck Observatory
Phase 1 – period of proposal preparation and submission
Phase 2 – period of OB preparation and submission
PI – Principal Investigator, a person responsible for proposal and OB preparation and submission
QM – queue mode
QO – queue observer, a Subaru Telescope staff member who operates the telescope or instrument at QM night
QWG – queue mode working group
Run – period of time when HSC is attached to the telescope
SA – support astronomer, a person who is supporting HSC operations
SNR – S/N ratio, signal-to-noise ratio
SOD – Science Operation Division
SSP – Subaru Strategic Program
Sukima – "dead time", classical night time without any observable targets
TAC – time allocation committee
TO – telescope operator

Chapter 2

Proposals (Phase 1)

HSC queue mode proposals are submitted as Subaru Open Use programs, and all the basic policies of the Open Use apply to QM. For more information, see:

https://naoj.org/Observing/Proposals/Submit/policy.html

Since semester S16B, a separate template is provided for the QM programs. The difference is that in QM the time is allocated in units of hours, where 7.0 hours = 1.0 night, or 1 h = 0.14 n. PIs should first choose between classical and queue (recommended since S17A) modes, and in QM calculate the number of required hours (on-source). The approximate dates of HSC runs, including the QM, will be given together with the call for proposals (CfP). University of Hawaii and Gemini Telescope partners can apply through time exchange for QM observations in S18A&B. Time-critical programs are acceptable, and cadence observations are allowed in the form of monitoring proposals (see Section 2.1.2. Some additional limitations apply in S18A&B (see CfP for the detail).

2.1 Proposal preparation

2.1.1 Categories

If the user decides to apply for time in the queue mode, the proposal may be of one of the following categories:

Normal program Proposal with total requested time of less than 35 hours, but with no lower limit of requested time. Same deadline as for Normal Open Use proposals.

Intensive program Available since S17B. Proposal which satisfied either or both of the following two conditions: (i) one requesting $35 \leq t_{\rm exp}/{\rm h} \leq 140$; (ii) one requesting observing time over up to 6 consecutive semesters and on-source time of ≤ 280 hours in total. In either case, the maximum on-source time per semester is 140 hours. Same deadline as for Normal Open Use proposals.

Filler program Proposals which request equal to or less than 35 hours per proposal, and are *specifically intended for observations during bad weather*, i.e. seeing $> 1.2''$ or transparency < 0.5 (see Section 2.1.4). Once the on-source exposure time of completed OBs of a filler program reaches

4 hours, the priority of the program will be lowered compare to other filler programs which have not yet reached 4 hour completion. PIs can submit filler programs which have the similar scientific objectives as the Normal/Intensive programs by them. Educational and public outreach programs are also welcomed as Filler programs. The same deadline as for Service Open Use proposals, which is typically 1 month after the Normal program.

2.1.2 Monitoring proposals

Starting from S18B, Subaru Telescope offers monitoring proposals, which are executed in shared-risk mode. A monitoring proposal is defined as a proposal whose scientific goal requires more than one observing blocks in the time domain. Monitoring proposals can be submitted as either Normal or intensive programs. The following requirements and remarks apply:

Requirements. Monitoring programs for the HSC queue mode must satisfy the following conditions:

1. PI contacts HSC queue working group (QWG; queue@naoj.org) to confirm the technical feasibility before the proposal submission.
2. Time windows for all observing sequences are defined in observing blocks (OBs) at Phase 2.
3. The duration of each time window is sufficiently large.
4. None of the observing sequences occupies a significant fraction of a night.
5. Observing constraints such as seeing and transparency are not too strict.
6. Only broad-band filters are used.
7. PI has a tolerance for missing data in cadence due to various reasons such as bad weather, telescope/instrument trouble, filter availability, and other highly ranked proposals at the same time).
8. All observing blocks have to be independent, i.e., order of execution of OBs cannot be specified.

Remarks:

1. Requirements 3, 4, 5, and 7 are subjective, as the program feasibility depends significantly on the nature of the requested monitoring plan. PIs should contact QWG for details.
2. We will not change filter only to execute the monitoring OBs. We will execute OBs of monitoring proposals when seeing, transparency, and filter meet the request.
3. As a general rule, execution of HSC queue-mode programs is based on the TAC score and observing constraints. Therefore, if there are proposals with higher TAC scores than a monitoring program, we may choose to execute former ones rather than the monitoring OBs.
4. If a monitoring proposal is accepted as Grade B, there is likely to be many missing data. Note that the completion rate of Grade B programs is on average about 50%. Even Grade A programs can miss some data due to the factors described above.

5. Quality assessment will be carried out for each OB, not for the entire time series.
6. OBs of accepted monitoring programs can be executed during classical SSP nights as well as queue nights.
7. More general cadence observations for which the time windows are determined once the first OB is executed cannot be accepted.

2.1.3 Additional targets

Important policy of the HSC operation, including the queue mode, is the "no additional targets" rule, which means that all the possible targets must be defined in the Phase 1 stage, and (with exception of very special cases) no new targets will be allowed to include in the program during the OB preparation stage and observations.

Some science programs may benefit from proposing more targets than may be possible to observe in the requested time, and defining the final sample after the acceptance and time allocation. During Phase 2 it is also possible to submit list of targets, which total on-source time exceeds the allocation. Targets within one program can also be prioritized.

Some other restrictions apply to the selection of targets for HSC QM. See the "Clearly Prohibited Cases" in:

https://naoj.org/Observing/Proposals/Visit/policy.html.

2.1.4 Observing Constraints

During the night, selection of targets to be observed depends on current conditions, especially seeing, sky transparency, sky brightness (Moon phase) and distance to the Moon. Night observing schedules will be adjusted accordingly, if weather changes. For each individual target they are set in the Phase 2, but the strictest ones must be well defined already in the Proposal.

In their proposals, the PIs should explicitly give the following information:

Seeing the maximum value of seeing, at which observation may be performed, in arcsec.

Air mass the maximum air mass/zenithal distance (or minimum elevation) at which a target may be observed. The recommended value, set by default, is $\sec z = 2$ (30° over the horizon), but PIs may request a lower limit, between 20°–30° ($\sec z \simeq 2$–3). Note, however, that the Atmospheric Dispersion Corrector will not work properly at $\sec z > 2$. Note also that constraining airmass <2 in the proposal is not allowed.

Sky transparency the sky clearness and magnitude drop due to clouds, defined as a number between 0 (totally cloudy) and 1 (clear).

Moon phase/sky brightness : the acceptable brightness of the sky, coming from the illumination and elevation of the Moon – "dark", "gray" or "dark+gray". "Dark" is always 0–3 days from the new moon. Between 4–11 days, "gray" time is defined when the Moon is over the horizon. HSC runs are not allocated during bright time.

Moon distance the minimum separation from the Moon, at which the target can be observed, in degrees. Only distances larger than 30 deg are allowed (to avoid significant contamination with stray light). For "dark" time, 30 deg is set by default, and cannot be changed by the PI. For "gray" time, it is the PI who sets the constraint.

Time constraints window of time when the PI wants the observations to be performed. There are no particular limits for its length, and multiple windows are allowed. It is allowed to put several targets per window, or define several windows for one object. Note that the chance for the OBs to be observed becomes higher by specifying the time windows as relaxed as possible.

Note, that if a highly-ranked proposal is intended for restrictive conditions (for example seeing $< 0.6''$) that are not currently met ($\sim 0.8''$), this proposal will not be executed at such moment, and a lower-ranked one that allows for given conditions ($< 1''$) will be chosen. Relaxing the constraints increases the probability of having observations done. Defining different constraints for different targets is allowed.

In order to help to choose the optimum observing constraints for your project, that will increase the probability of execution and still allow for the science you intend to make, please familiarize yourself with the Statistical Information for Observing Condition Constraints in:

http://www.naoj.org/Observing/queue/phase1/.

Since the semester S17A, time-critical observations may be proposed. If the PI requires the targets to be observed in a specific time, please provide sufficient information, such as: date(s), time, and duration of the time windows. Use the Box 13 of the Application Form, or add comments in the target list (see Sec. 2.2). Note that the chance for the OBs to be executed may increase by specifying the time windows as relaxed as possible. If during the proposed time window the environmental conditions (seeing, transparency, etc.) are not met, the observations will not be carried out.

2.1.5 Filters

The filter exchanger unit of the HSC can hold up to 6 filters in one observing run. Their list for given semester and given run, including QM runs, is published together with the CfP. See the following links for the availability and characteristics of HSC filters:

http://www.naoj.org/Observing/Instruments/HSC/index.html
http://www.naoj.org/Observing/Instruments/HSC/sensitivity.html.

QM proposals requesting filters which are not scheduled for the given semester will be rejected. Please note that the *r* and *i*-band filters have been replaced with new ones – *r2* and *i2*. Please use only the new names in the proposal. The specifications of the old filters are still given, for comparison. They will still be stored, but will not be available any more, unless for special cases. Such cases should be properly justified. Please contact Dr. Fumiyaki Nakata (`nakata [at] naoj.org`) before submitting a proposal with old *r* and *i* filters.

Overall, there are 5 broad band filters (BBF) and a number of narrow band filters (NBF). Note, however, that NBFs are user filters, and to use them in your program you must first get the approval. For this reason the usage of NBFs is a subject to slightly different policies, regarding calibrations or carry-over, for example (see further Sections).

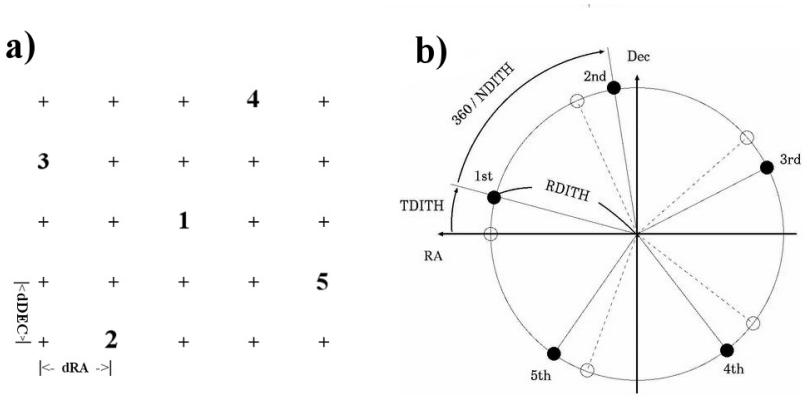

Figure 2.1: HSC dithering patterns. **a)**: the pre-defined 5-point pattern; **b)**: example of a circular pattern for $N = 5$ (TDITH=θ, RDITH=r_D, NDITH=N).

Note also that to change the filter during the night, the telescope has to be pointed to the zenith and the dome closed. The whole filter changing procedure takes approximately 0.5 h, and in general we try to minimize the number of such operations. If your program requires observations of the same field in several filters, very likely they will not be done the same night.

Starting from S19B, a proposal using narrow-band filters with their central wavelength shorter than 400 nm should only be submitted to classical mode, and will not be accepted in queue mode. Currently, this only applies to filter NB387.

2.1.6 Dithering

The chips of the HSC are separated by small gaps (up to 53 arcsec) and some parts have defects[1], so to avoid having a target in such gap or bad chip, and ensure complete coverage of the whole field of view, a dithering is used. Dithering procedures for HSC are similar to the ones available for Suprime-Cam[2]. In particular, there is a pre-defined 5-point dither pattern, a customized N-position circular pattern, and no-dither option is allowed as well. The pre-defined 5-point and 5-position circular patterns are recommended. Only one single exposure is taken on one position, which means that the recommended patterns will result in 5 exposures for a given field.

In the pre-defined 5-point dither, user defines the steps *dRA* and *dDEC*, in arcsec, and the telescope points according to the scheme in Figure 2.1a. In the circular case, user defines the radius r_D in arcsec, initial angle θ in degrees, and number of steps N (5 recommended). Consecutive exposures are taken at positions that lay on a common circle of radius r_D, every $360^\circ/N$ from each other, as in Figure 2.1b. Note, that this is not done by rotation of the instrument, but by moving the telescope; the position angle of the instrument remains constant. The suggested values are $120''$ for *dRA*, *dDEC*, and r_D; and 15° and 10° for θ in the case of $N \neq 5$ and $N = 5$, respectively.

If one sequence, either pre-defined 5-point or any circular, takes a lot of time, it may be split in

[1] http://www.naoj.org/Observing/Instruments/HSC/CCDPosition_20150804.png
[2] http://www.naoj.org/staff/nakata/suprime/observing/opedir/ope.html#sec3_5

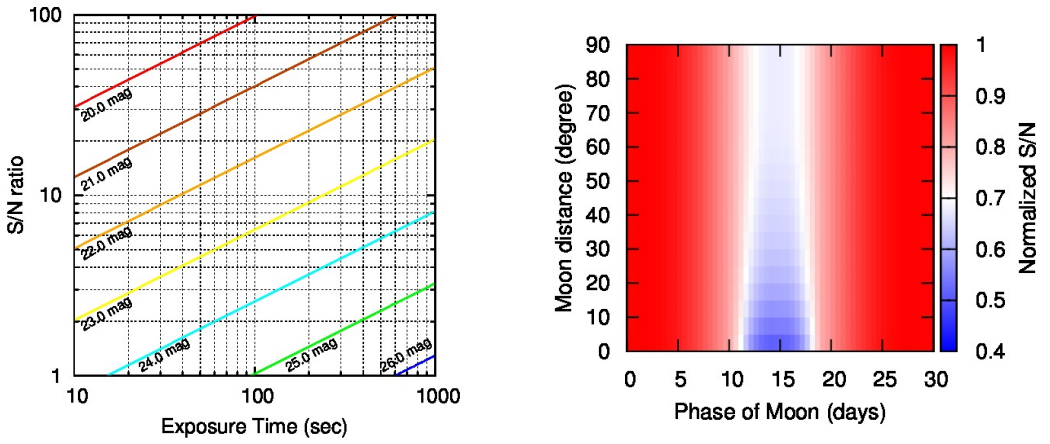

Figure 2.2: **Left:** *SNR* vs. exposure time and target AB magnitude for the HSC-z filter; **right:** *SNR* variations due to the phase and distance to the Moon.

two or more, using the parameters *SKIP* and *STOP*. For example, *STOP* = 3 means that the telescope will observe only in the first three positions, *SKIP* = 3 means that the telescope will start from the 4-th position, skipping the first three. *SKIP* = 1 and *STOP* = 2 will make the telescope move only to the second position. *STOP* must *always* be larger than *SKIP*.

Without dithering, it may be necessary to introduce an offset to the target position, in order to avoid placing it in a gap between the CCDs.

2.1.7 ETC and overheads

In the Phase 1 the total requested time given in the proposal does not need to include overheads, *only the on-target exposure time*. No overheads (detectors readout, slewing time, calibrations, etc.) will be charged, as they are taken into account in the reduced number of hours per night (7 instead of 10, as in the classical mode). It is thus crucial for QM observations to properly estimate the required on-source exposure time.

There is an exposure time calculator (ETC) dedicated for the HSC, that is suggested for the QM proposers:

https://hscq.naoj.hawaii.edu/cgi-bin/HSC_ETC/hsc_etc.cgi.

It is a python-based script that is called through a simple cgi web interface. It assumes that the total noise comes from: photon noise, sky brightness level (as a function of Moon phase and distance), and detector properties such as dark current and read-out noise. It also calculates the sky level, on the basis of Moon phase, Moon distance, and the selected filter. If it exceeds the maximum given sky level (in ADU), it suggests splitting the exposure into several frames.

First in "Brightness" choose the appropriate filter and magnitude (in the AB system) of the source. In case of extended sources, use surface brightness in arcsec^2. Then select between point and extended

source. In the first case, put the desired value of seeing (in arcsec), in the latter give the solid angle (size, in arcsec^2). Now, define the observing conditions, namely the Transparency (0–1), Moon (days to/from the new Moon, and Moon distance), and (for point sources) the diameter of the aperture that will be used for photometry. Finally, set the maximum sky brightness level (counts, in ADU) to be used to determine the number of frames.

To calculate the exposure time required to reach a certain *SNR* please give the desired S/N ratio and click "Calculate exposure time". The number of frames (a bit below) is ignored in this option. As the "Results", the ETC will give the total exposure time, limiting magnitude, saturation magnitude (assuming significant non-linearity at 45000 ADU), and the suggested number of frames. If it's more than 1, the exposure time, limiting magnitude and *SNR* per frame are also given. The output also contains the sky level (in ADU/frame). At the end the total time necessary to execute the observations (with overheads) is also given.

To calculate the *SNR* expected after a certain exposure time, please specify the time in seconds. Choose if it's the total time, or per frame, and in the latter case, set the number of frames. After clicking "Calculate S/N ratio" the procedure will give the *SNR* reached after the total exposure time ("Exp Time"×number of frames, if such option chosen), as well as in each frame. Total and per frame limiting magnitudes, as well as the saturation magnitude and sky level in ADU are given. If the number of frames is specified, and the sky level exceeds the maximum value given earlier, we suggest to shorten the "Exp Time" and increase the number of frames. If "in total" option is chosen, the ETC splits the observation into multiple frames automatically. As previously, the total time necessary to execute the observations (with overheads) is also given at the end.

Currently, the ETC does not include dithering patterns. Set the number of frames accordingly to your desired dither. To simulate several exposures per dither position (coadds), multiply the number of frames accordingly. For example: set 5 frames if you use the pre-defined 5-point dither, but if the resulting sky level is higher than the maximum sky count given, set frames to 10, 15, 20, etc.

In the future, a stand-alone python code will be available for an off-line use.

2.1.8 Calibrations

QM users will not be charged time (i.e. do not have to include it in Phase 1 or 2) for standard calibrations, which are:

Bias 10 frames per each run.

Dark frame 5 frames of 300 sec per run.

Dome flat for each run, dome flats for all 5 or 6 filters will be taken, but only one per night.

Standard stars every night at least 3-4 exposures of SDSS fields, 30 sec each. Additionally, a 30-sec exposure every time when proposal ID, filter or target is changed. For narrow-band observations, spectrophotometric standard stars will be observed just before and after science observations and shared by multiple programs. While PIs will not be charged the default standard star frames, those who want to obtain a specific object as a standard star can set a custom calibration by their own charge.

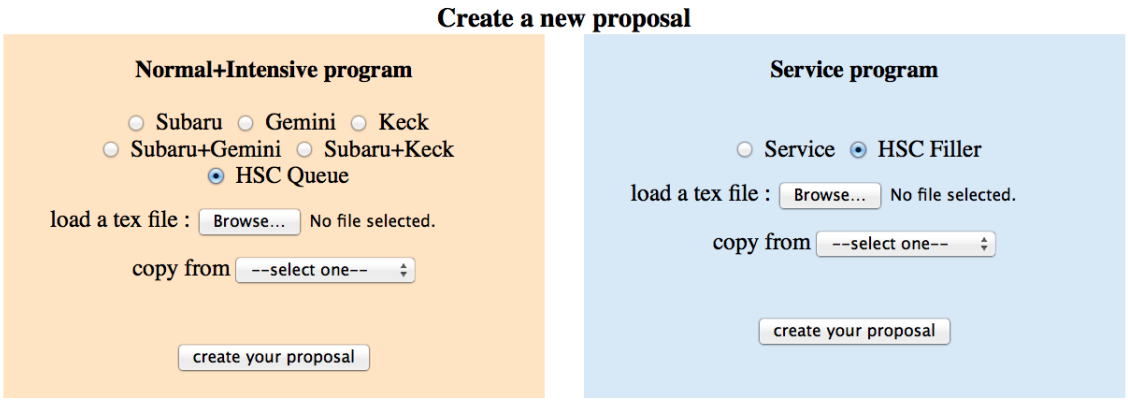

Figure 2.3: ProMS menu since S17A. *Left*: The "Normal+Intensive program" part, from which the normal HSC QM proposal can be selected. *Right*: The "Service program" part with the HSC Filler option.

Important: it is the PI's responsibility to assign a proper SDSS field to each science field (see Sect. 3.2). In general the standard stars field should be the closest SDSS field to the target. If the target itself is in the SDSS area, its field may be used as the calibrator as well. The SDSS imaging coverage can be found for example here:

https://www.naoj.org/Observing/queue/img/SDSSimaging_footprint.png,
https://www.naoj.org/Observing/queue/img/SDSSmap_lb_DR8.png.

We do not recommend to pick up calibrators in the narrow "stripes" of the survey.

Customized standard star calibrations (not an SDSS field, different exposure time, etc.) are allowed, but are treated as additional observations. They should be included in the proposal, separate OBs should be prepared, and time will be charged in the same way as if it is a science target.

The above calibration procedure is not guaranteed for NBFs. Please contact SOD or QWG.

2.2 Queue proposal template and submission via ProMS

Submission of Subaru proposals is done on-line through the ProMS 2.0 system:

https://proms.naoj.hawaii.edu/proms2/login.php.

It is a web form that has an embedded template, which is used to create a final pdf document that is sent to the TAC and referees. From this page one can also obtain current semester templates, which can be used to prepare proposals off-line. After login to the ProMS system, one can choose to create a new proposal from scratch, or load a tex file. One can log in using either the STARS or ProMS ID/password.

Normal

A separate tex template for Normal Queue Mode will be available. Inside the ProMS system, the normal QM proposals can be selected from the field "Normal+Intensive program" (Fig. 2.3). The

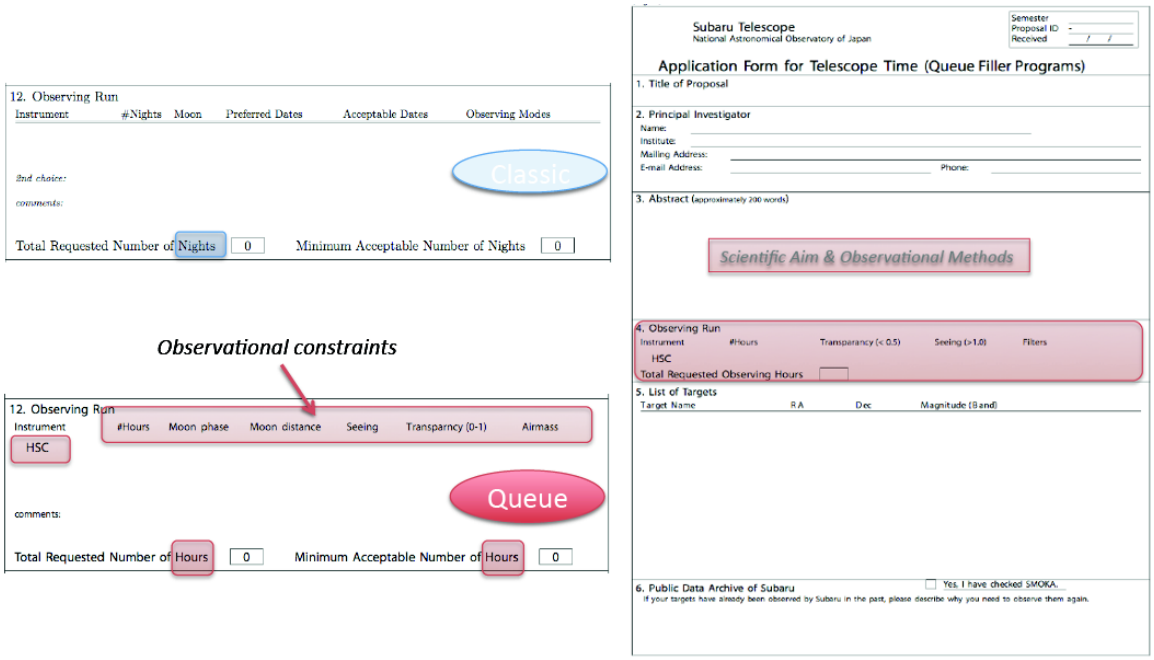

Figure 2.4: Proposal templates for HSC QM since S17A. *Left*: Different box 12 in Normal Queue template (bottom) with respect to the Classical (top). *Right*: QM Filler template, with major differences marked.

major difference with respect to the classical mode is the box 12. "Observing Run" (Fig. 2.4, left). Here the PI should give the number of hours (not nights) and specify the observing constraints (Sect. 2.1.4). The instrument is fixed to "HSC" and no 2nd choice can be given. The total and minimum requested time is also given in hours, not nights. There's no need to have a backup program or giving scheduling requirements other than those necessary to define time constraints.

If time-critical observations are requested, please put "Time critical" in Comments in Box 12, and provide sufficient information on the time constraint (i.e., acceptable time windows) in Box 13 of the Application Form. If different constraints apply to different targets/fields, please define the constraints in the list of targets, by adding comments in the "Magnitude" field. Multiple time windows are allowable. The time constraints of the windows should be clearly described, preferably in UT time. The time windows are limited by the number of queue nights in the semester.

Other fields and boxes should be filled as for a classical mode program, see:

`https://www.naoj.org/Observing/Proposals/Submit/howto.html`.

Intensive

The same applies for Intensive proposals as Normal programs, but the PI needs to uncomment `\intensive` in the box 7 of the application form.

Filler

A separate LaTeX template for Filler Queue Mode will be available. Inside the ProMS system, the filler QM proposals can be selected from the field "Service program" (Fig. 2.3). The template itself is however quite different (Fig. 2.4, right), and no scientific justification is required for HSC QM fillers. Boxes 1 (Title), 2 (Investigators), 5 (Targets) and 6 (Archive) are the same as for other kinds of applications. The Abstract in box 3 should briefly describe the scientific aim and methods. In the box 4 "Observing Run" select "HSC' as the instrument, specify the number of requested hours (≤ 4), set the transparency, seeing, and filters. Time-critical programs may be acceptable as Fillers, but the chance of OB execution might be little unless the PI sets time constraints very relaxed. Since ProMS cannot accept the proposals with the identical title, the PIs submitting filler proposals which have the similar scientific objectives to their Normal or Intensive proposals have to use a different title.

2.3 Evaluation and ranking

2.3.1 Time allocation committee (TAC)

HSC QM proposals will be reviewed by external referees, who will evaluate their scientific content, and by Subaru support astronomers (SAs), who will check the technical feasibility. The time allocation committee (TAC) will then select and rank the proposals based mainly on the referee score[3]. Filler proposals will not be sent to referees, and only the TAC will review them and decide about their acceptance.

2.3.2 GRADE

Basing on the scientific evaluation, the TAC will assign a GRADE to each of the submitted proposals.

GRADE A will be given to QM proposals from the top 5-10% of all accepted HSC proposals (queue+classical). The observatory will put the highest effort to complete these programs. If not completed, they will be carried-over to the next semester (see Sect. 4.5).

GRADE B will be given to the rest of accepted HSC QM proposals.

GRADE C will be given to the non-accepted proposals, which, however, will get the permission from the TAC to be observed. In this way the TAC will ensure that there are more programs than necessary to fill the time reserved for QM, which gives more flexibility and backup options during observations. GRADE C observations will be performed in good or reasonable weather, when there are no A or B targets.

GRADE F will be given to the Filler proposals, i.e. those intended for bad weather (low transparency < 0.5 and/or seeing >1.2"). Filler programs might also be executed during classical nights, if the current classical program has no adequate backup.

When the constraints of a GRADE A, B, or C proposal are found to be too severe, they become a subject of "relaxation", in order to increase the probability of their execution. This may be requested by the TAC, or SAs during Phase 2, or even during the observing run (see Sect. 3.3).

[3]See also point 4 in https://www.naoj.org/Observing/Proposals/Submit/policy.html.

2.3.3 Acceptance letters (AL)

After the proposal evaluation, each PI will receive an acceptance letter (AL), not later than two weeks after the TAC meeting. The AL will include such information as: acceptance judgment, referee score, GRADE, and comments from referees and SAs. For GRADE B and C proposals, in the AL the TAC may also ask to relax the observing constraints. Moreover, the ALs will include the request for preparation of OBs (Phase 2; see next chapter), together with all necessary deadlines and web addresses, as well as the values of the total allocated time and observing constraints (used for OB validity check, see next Chapter).

Grade C program PIs will be asked whether they still wish to participate in the queue programs, given the fact that the completion rate of Grade C programs is very low, typically less than 10%. For GRADE F, the TAC will notify whether the program was allowed for observations or not. Once the OBs for Grade C and F are submitted (Phase 2), there will be no further iteration process involving the PI, although the QWG may make minor changes.

Note that the proposal GRADE may later be published, however the referee score and all comments will only be known to the PI.

Chapter 3

Observing blocks (Phase 2)

3.1 What are OBs?

Observing blocks (OBs) are the smallest units (quanta) of observations in the queue mode. They describe a single observation, defining the observed object or field, exposure time, dithering pattern (if applicable), and telescope and instrument configuration (filter, position angle, etc.). They also define the constraints, which are used for scheduling the observations – if the current conditions do not meet the criteria given in an OB, such an OB is not executed. There are no limits of the number of OBs for a proposal.

Overheads are automatically included in an OB, but are not charged to the PI. One OB should not exceed 100 minutes (6000 sec) of on-source time. In case of Subaru observations one queue OB is translated into one command that is sent to the telescope control system. There is no lower limit for OB total time, and we strongly encourage to make them short, in order to minimize the probability of interrupting one by an emergency situation (sudden weather breakdown, telescope malfunction, etc.). If such situation occurs, the affected OB or exposures will be repeated. However, the general policy is to finish an OB once it has been started.

Remember that due to the specific filter changing procedure, exposures in two filters should be defined as two separate OBs. Two consecutive observations of different exposure times are also not allowed as one OB.

3.2 Phase 2 spreadsheet

Until semester S18A the OBs needed to be prepared using a Microsoft Excel[1] .xls/.xlsx spreadsheet, and a basic knowledge of this program was required. Starting from semester S18B, the OBs should be prepared using a Google spreadsheet[2]. The structure of the Google spreadsheet follows that of the previous Microsoft Excel spreadsheet. An example and an empty template can be found in the QM website:

Example Google spreadsheet

[1] https://products.office.com/en-us/excel
[2] https://docs.google.com/spreadsheets

targets

	A	B	C	D	E	F	G
1	Code	Target Name	RA	DEC	Equinox	Comment	
2	default					Don't remove	
3	ngc4993	NGC4993	13:09:47.7	-23:23:02	J2000	Science target	
4	hr4963	HR4963	13:09:56.96	-05:32:20.5	J2000	Standard star field for ngc4993	
5	ngc4993_sdss	SDSS_CALIB	13:09:47.7	00:00:00	J2000	Standard star field (SDSS) for ngc4993	
6							
7							

envcfg

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Code	Seeing	Airmass	Moon	Moon Sep	Transparency	Lower Time Limit	Upper Time Limit	Comment	Seeing Check	Phase 1 Seeing Constraint	Phase 1 Transparency constraint	
2	dark+gray_s1.0_t0.7	1	2	dark+gray	30	0.7				Seeing okay	0.7	0.9	
3	gray_s1_am2.5_trans0.5	1	2	gray	30	0.5	2017-08-02T20:00:00	2018-02-01T10:00:00	Timezone is UTC				
4	test_env	0.8	2	dark	30	0.8	2017-12-01T20:00:00-10	2017-12-05T05:00:00-10	Timezone is HST				
5													
6										Transparency Check			
7										Transparency okay			
8													
9													

inscfg

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	Code	Instrument	Mode	Filter	PA	Exp Time	Num Exp	Dither	Guiding	Offset RA	Offset DEC	Dith1	Dith2	Skip	Stop	On-src Time	Total Time	Comment	
2	default														0	0	0	Don't remove	
3	r2_300x5	HSC	imaging	r2	0	300	5	5	N	0	0	120	120	0	5	1500	7475		
4	nb656_900x5	HSC	imaging	NB656	0	900	5	5	Y	0	0	120	120	0	5	4500	4700		
5	nb656_900x6	HSC	imaging	NB656	0	30	1	1	N	0	0	0	0	0	1	30	70		
6															0	0	0		
7															0	0	0		

telcfg

	A	B	C	D	E
1	Code	Foci	Dome	Comment	
2	p_opt2	P-OPT2	Open		
3	p_closed	P-OPT2	Closed		
4					
5					

proposal

	A	B	C	D	E	F
1	Prop ID	Ph1 Seeing	Ph1 Transparency	Ph1 Moon	Allocated Time	
2	S18A-QN999	0.7	0.9	dark+gray	10500	
3						
4						

ob

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Code	tgtcfg	calib_tgtcfg	inscfg	calib_inscfg	telcfg	envcfg	On-src Time	Total Time	Priority	Comment		
2	ngc4995_r2_default	ngc4993	default	r2_300x5	default	p_opt2	dark+gray_s1.0_t0.7	1500	7475	1	default calibration	Total On-src Time	
3	ngc4995_nb656	ngc4993	hr4963	nb656_900x5	nb656_30x1	p_opt2	dark+gray_s1.0_t0.7	4500	4700	1	custom calibration	10500	
4	ngc4995_r2_sdss	ngc4993	ngc4993_sdss	r2_300x5	default	p_opt2	dark+gray_s1.0_t0.7	1500	7475	1	custom calibration		
5	ngc4995_r2_nocalib	ngc4993		r2_300x5		p_opt2	dark+gray_s1.0_t0.7	1500	7475	1	blank calib_* columns : no calibration		
6	# You can insert lines below							#N/A	#N/A			Total Allocated Time	
7	hr4963	hr4963	hr4963	r2_300x5	default	p_opt2	dark+gray_s1.0_t0.7	1500	7475	2		10500	
8								#N/A	#N/A				
9								#N/A	#N/A				
10								#N/A	#N/A				
11								#N/A	#N/A				
12								#N/A	#N/A			On-src Time Check	
13								#N/A	#N/A			total on-src time ok	
14								#N/A	#N/A				
15								#N/A	#N/A				
16								#N/A	#N/A				
17								#N/A	#N/A				
18								#N/A	#N/A				

Figure 3.1: Example of a spreadsheet used to create a set of queue OBs. Sample content of each of the tabs is presented. Blue columns are for time calculations and tables with green fields are for the on-the-fly validity check. Note two configurations that compose one long dither pattern in inscfg (rows 6 and 7), and the OBs that use them (in ob, rows 9 and 10 for example). Also, note that you can insert new lines to the ob tab (after row 6).

Template Google spreadsheet

A Google spreadsheet template specified for a given proposal, containing the proposal ID and information from the Phase 1, will be sent to each PI no later than 2 days after the AL. This template can be edited in a web browser. Observers who have restricted access to Google may contact us and request a Microsoft Excel spreadsheet which can be read and edited in Apache OpenOffice[3], LibreOffice[4] or similar programs, but should be saved in the .xlsx or .xls format.

The spreadsheet consists of six tabs: targets, envcfg, inscfg, telcfg, ob, and proposal, that include, respectively: definitions of targets, observing constraints, instrument and telescope configuration, the OB itself, and the constrains given during the Phase 1. Please do not change the names of tabs and columns. Comments and additional calculations can be done aside (out of the named columns). Do not put additional columns or lines, except for lines in the ob tab.

The targets tab

The first tab defines the targets to be observed. Only the targets from the proposal are allowed, except for special cases of targets approved by the SOD (Sect. 3.3). In the first column – Code – place an identifier that will later serve as a reference to this particular target. In the targets tab as well as the subsequent tabs, only alphanumeric characters [0-9a-zA-Z] and the underscore symbol "_" and period symbol "." are allowed in the Code field. This applies for all Code fields. For checking and validation purposes, QWG will fill the Target Name and the RA, DEC fields with the target names and coordinates, which will be write-protected, based on the information in the proposal. If there is need to shift the pointing centers, one needs to define these as new targets below the pre-filled lines. In this case, place a new object in the Code and Target Name fields, and new pointing center coordinates in the RA, DEC fields. Use the hh:mm:ss.ss and (−)dd:mm:ss.ss format, respectively, but be advised that Google spreadsheets do not accept strings starting with the hyphen character "-". Precede such strings (e.g., negative declination) with a single hyphen (" ' "). The entries in Target Name, here and in subsequent tabs, may contain blank spaces (e.g. "My first target"). The Target Name will be the name saved later in the OBJECT keyword of the FITS file header. Set the Equinox in the next column.

If observations of one or more custom standard star fields are desired, define them as a new targets (new lines), and specify them in the calib_target fields in the ob tab. The custom standard star fields can be SDSS fields, in case the science target is outside of the SDSS coverage; 30 second exposures of SDSS fields are taken as part of the normal calibration set, and the field will be used for photometric calibration, IQA and environmental (observing) constraints check. In addition, custom fields outside SDSS can be specified; this is frequently the case for narrow-band observations. Note that starting from S18B, the observatory will observe spectrophotometric standard stars in narrow-band filters, which will not be charged to the PIs. However, if the PI wishes to obtain a specific calibration target, this can be specified as described above, but the time will be charged to the PI.

The envcfg tab

The second tab defines the restrictions that will be used to decide if the OB can be executed at current observing conditions. Refer to the Sect. 2.1.4 for their explanation.

[3] https://openoffice.apache.org/
[4] https://www.libreoffice.org/

The cells regarding the seeing and transparency can be edited, but only to relax the values approved in Phase 1. The Phase 1 values will be sent in the AL, and are also given in proposal tab. Those cells cannot be edited.

The column Code is an identifier which can later be used to refer to a particular set of conditions. Next, set the maximum allowed Seeing (in arcsec) and Airmass (2–3, default=2). Define the sky brightness in Moon, use dark/gray/dark+gray (HSC runs are not allocated during bright time). Then, give the minimum allowed separation from the Moon (Moon Sep, in degrees, 30 for "dark" and not smaller than 30 for "gray" or "dark+gray"), and the sky transparency (Transparency, from 0="cloudy", to 1="completely clear"). If any of the values in Seeing or Transparency will be more strict than the Phase 1 criteria, an error message will appear.

Our recommended values are one of 1.0, 1.2, 1.5, 2.0, and 100 (i.e., no constraint) for Seeing. We also recommend the following seeing values for each GRADE: equal to or larger than 1.0 for GRADE A; equal to or larger than 1.2 for GRADE B; and equal to or larger than 1.5 for GRADE C. However, we do not force PIs to follow the recommendation, although following them would help make night scheduling easier and increase the chance of OB execution.

PIs of the Filler proposals must use values equal to or larger than 1.2 in Seeing and/or equal to or lower than 0.5 in Transparency. The recommended values are 2.0 and 0.3 for Seeing and Transparency, respectively.

There are two optional columns, Lower Time Limit and Upper Time Limit to define the lower and upper time limits of a time window in the case of the time critical program. The PI can leave these blank if there is no time constraint other than the standard visibility defined by the coordinates. The format follows the standard ISO 8601 regulation, e.g., `YYYY-MM-DDThh:mm:ss`. The default timezone is UTC. For example, the following forms can be permissible: `YYYY-MM-DDTHH:MM:SS`, `YYYY-MM-DDTHH:MM`, `YYYY-MM-DD HH:MM:SS`, and `YYYY-MM-DD HH:MM`. Different timezones can be specified by providing an offset from UTC, e.g., `YYYY-MM-DD HH:MM-10` for Hawaii–Aleutian Time Zone (HAST).

Place any additional comments in the last column (Comment). More than just one set of constraints can be defined, but none of them can be more restrictive (lower seeing, better transparency, etc.) than the ones in the proposal.

The inscfg tab

This tab defines the instrumental parameters used during an observation, such as filter, exposure time, or dithering pattern. The Code column defines an identifier which can later be used to refer to a particular set of parameters. Instrument and Mode should be kept at "HSC" and "imaging", respectively. Set the Filter, choosing from g/r2/i2/z/Y, or by putting the name of an NBF manually. Please use only the new names of filters (i.e., *r2* and *i2* instead of *r* and *i*, respectively). PA is the position angle of the instrument[5]. Exp Time is the exposure time for one frame, without overheads. Starting from S19B, the number of allowed short exposures is limited, so that no more than 5 exposures of 60 sec or less are allowed within a single OB. This limit does not apply to longer exposures.

The dithering (Sect. 2.1.6) is defined by Num Exp, Dither, Dith1, Dith2, Skip and Stop. Please remember that there may only be one exposure on a single dither position. To set the 5-point pattern, put Num Exp=5, Dither=5, and desired values (in arcsec) of the steps dRA and $dDEC$ in the Dith1 and Dith2 columns, respectively. To set the circular pattern, put Dither=N, and the desired number of steps

[5]See https://www.naoj.org/Observing/Instruments/HSC/CCDPosition_20150804.png.

in Num Exp. We recommend to keep this number around 5. Put the radius of the circle in arcsec as the Dith1, and initial angle θ in degrees as the Dith2. If you prefer not to use dithering, put Dither=1. In such case the Num Exp column will define how many exposures will be done without moving the telescope (default is 1).

If you decide you need more than 5 points in your dither sequence, you can set higher Num Exp for the circular dither. However, we suggest to keep the total OB time relatively short, and it can't be longer than 100 min (6000 sec) of on-source time. You may choose to split the configuration in two, doing some positions within the first one, and the rest within the other. For this, set Skip and Stop appropriately (Sect. 2.1.6). Remember that Stop may not be smaller than or equal to Skip. These configurations should have different Code identifiers, but the same number of Num Exp, which is the total desired number of positions in your sequence, as well as the same values for all other dithering and instrumental parameters. If you prepare a single setting, do not change Stop – by default it should be equal to Num Exp.

Based on the dithering settings and Exp Time, for each configuration the spreadsheet will calculate the on-source (without overheads) and total time (with overheads), and automatically put it in the On-src Time and Total Time columns, respectively. Please do not edit these columns. For scheduling purposes, in Phase 2 the readout overheads need to be included in the OBs. However, they will not be charged to the PI, and need not to be added to the Phase 1 proposal.

Set Guiding=Y to turn on the guiding, and N to turn it off. If you wish to use an offset from the original position (for example to avoid having the target in a gap between CCDs), set it in Offset RA and Offset DEC columns, in units of arcsec.

The telcfg tab

This tab defines two configurations, where the dome is open (Code = "p_opt2") or closed ("p_closed"). You don't need to change anything in this tab.

The ob tab

This tab defines the complete OB, by gathering all the information defined in previous tabs. *One line is one OB.* Only in this tab the PIs may introduce new lines (but not columns) for comments. If you wish to put a text in such line, please do it in column A and start with a hash #.

Code is the name of the OB. It will be used by the scheduler and telescope control system, so it should be defined as uniquely as possible. Use the drop-down menus to fill the next 6 columns. Choose the codes of the targets, instrument, telescope ("p_opt2" only) and environmental configurations defined in previous tabs. The same target can be observed in various configurations, and a separate line (=OB) is required for each combination. The columns calib_tgtcfg and calib_inscfg have been added to the spreadsheet since S18A. These refer to the standard star fields. "Default" calib_tgtcfg means that the standard star field is at the same coordinate as the main target, which is the case if the main target is located inside the SDSS coverage. In case no calibration is required, leave the field blank, otherwise select from the drop-down menu the desired calibration field code. The same conventions hold for the calib_inscfg column. In case of "default", the same configuration as that of the main target is used and a 30s exposure will be taken. In case of narrow-band observations, setting calib_tgtcfg and calib_inscfg as "default" means a spectrophotometric standard star provided by the observatory as described above.

If you decide to split your dithering into two configurations, make sure you prepare separate OBs for each of them. The On-src Time and Total Time (in seconds) are automatically calculated for the chosen inscfg. Please do not edit these columns. For scheduling purposes, in Phase 2 the readout overheads need to be included in the OBs. However, they will not be charged to the PI, and need not to be added to the Phase 1 proposal.

Finally, prioritize your OBs, by giving them appropriate numbers in the column Priority. The lower the number (the lowest is 1), the more important the OB is, and will most likely be executed earlier. Several or even all OBs may have the same Priority. Prioritizing may be useful in case of programs where more targets were defined in Phase 1 than are expected to be observed.

The table on the right summarizes the total on-source time that has been programmed (sum over all values of the On-src Time column), and compares it with the total time allocated by the TAC (automatically loaded from the proposal tab). If the programmed time exceeds the allocated time, a warning message is shown in the red field to the right, but such a situation is allowed. Please, do not edit these fields.

The proposal tab

The last tab in the spreadsheet shows the ID of the program, the amount of allocated time, and the strictest observational constraints, as defined in the Phase 1 proposal. While different values can be used for these constraints in the envcfg tab, the new values cannot be chosen to be stricter than the values defined here. This tab is filled by an SA before sending to the PI, so please do not edit anything in it.

3.2.1 Finding charts

There is no dedicated tool for finding charts (FC) preparation at the moment when this document written. Nevertheless, during the Phase 2, the PIs are responsible for providing correct target coordinates in the OBs. In order to check the coordinates of the fields, and if the targets do not fall in the gaps between the chips nor into a failed CCD channel, there are a couple of choices available:

First option is to use the Ginga fits viewer[6], with the additional HSCPlanner plugin:

https://hscq.naoj.hawaii.edu/HSCPlanner/.

The plugin helps to visualize a field with a dither on the HSC CCD plane (Fig. 3.2). The detailed instruction of installation and use, including a tutorial video, are available under the link above.

One can also use an Aladin FoV file:

https://www.naoj.org/Observing/queue/img/Subaru_HSC_FoV.xml,

and plot it over a sky image from a selected image server (Fig. 3.3). Detailed instructions can be found here:

https://www.naoj.org/Observing/queue/misc/hsc_field_check_aladin/.

[6] http://ejeschke.github.io/ginga/

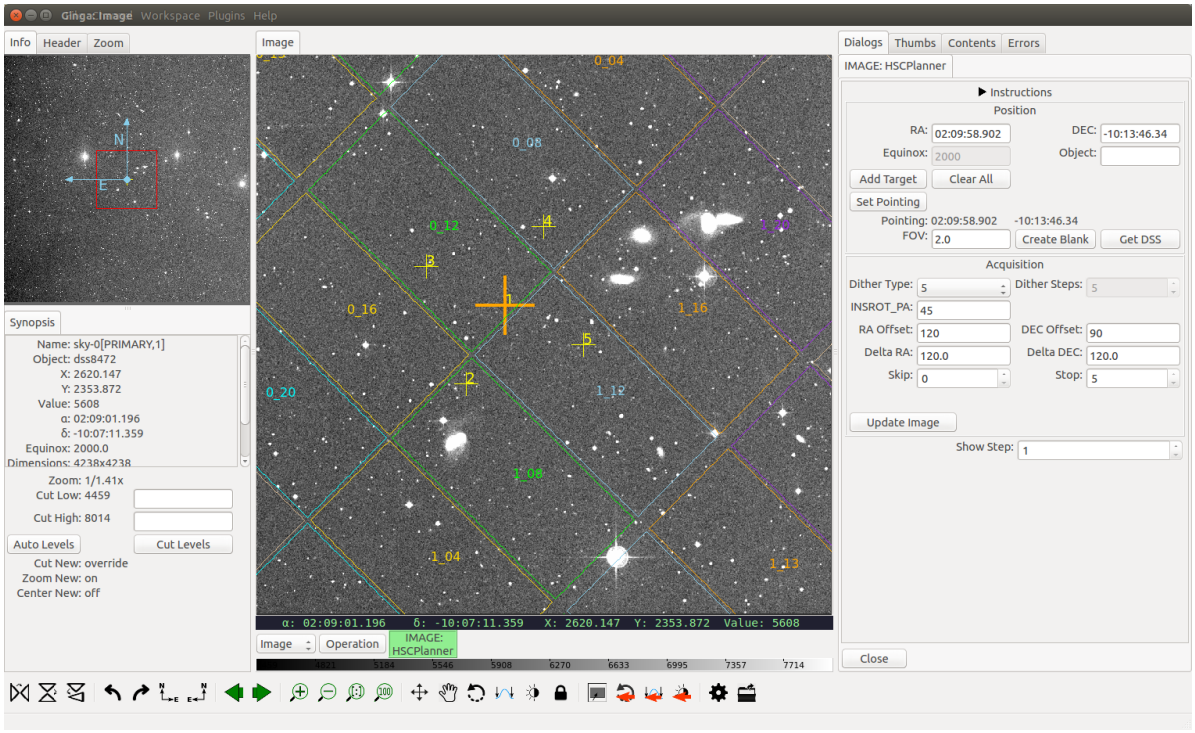

Figure 3.2: Example of a Ginga window with HSCPlanner plugin. Different CCDs are plotted over the (zoomed) sky image as rectangles of different colors. The 5-point dither and field rotation are used.

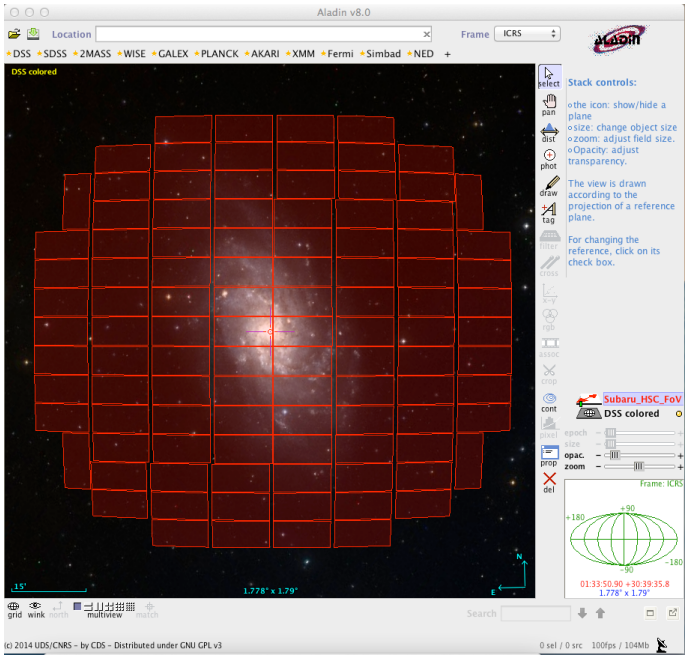

Figure 3.3: Example of an Aladin window with the footprint of the HSC CCDs loaded (red fields) and plotted over the sky image.

3.2.2 OBs check and submission

The exact deadline for OB submission (end of Phase 2) is announced at each CfP individually, but it normally is around mid-December for semesters A and mid-June for semesters B. OB submission is done through the following website:

https://hscq.naoj.hawaii.edu/cgi-bin/qcheck/qcheck.cgi.

This tool should first be used to check if an OB is correct and ready to be submitted (despite some validity test solutions already implemented in the spreadsheets). The PI of the program is responsible for the validity and correctness of the OBs.

To use the check tool, input your spreadsheet name at the top, and click "Check". The system will then list all the errors and warnings found, for example:

https://www.naoj.org/Observing/queue/ph2-check-warning-explained.pdf.

An OB can not be submitted if errors are shown. Warnings do not prevent from OB submission, but the PI should make sure the information in the spreadsheet are correct.

Apart from using this tool, please make sure that the codes within each tab are unique, especially those in the first column of the ob tab. Check, if there are no targets that were not listed in the proposal, and that the observing constraints are less or equally strict as the one from the proposal. Also make sure that no OB exceeds 100 min of on-source time, however it is allowed to prepare OBs that use more total time than allocated by the TAC. This is to allow for some flexibility and backup options during the observations. Note however, that the time spent on the program will not be longer than allocated,

and some OBs will not be executed. For Intensive Program, the PI can submit OBs planned for the following semesters, which can be executed when there is a chance of the early execution.

To use the submission tool, please log in using your STARS username and password (ProMS ID will not work in this case). If this is your first Subaru proposal, the STARS account will be set up, and information will be sent in a separate email. In case of doubts or questions, please contact `queue [at] naoj.org`.

If the login is correct, a "STARS Login succeeded" information will appear. One session lasts for 3 hours, and there is no need to log in again during that time. Input your spreadsheet's name in the box at the top and click "Submit'. After submission, each spreadsheet will be double-checked for errors and consistency with the proposal, i.e. if they do not exceed the allocated time, if the constraints are the same, etc. If inconsistencies are found, the PI will be asked to correct the OBs.

It is possible to list all the spreadsheets and OBs that have already been submitted. For this, put the ID of your proposal in the "Proposal ID" field, and click "List files".

We encourage the PIs to submit their observations as early as possible. This will give the observatory more time for consistency check, introducing necessary corrections, scheduling simulations, and will allow for possible earlier execution (see Sect. 4.2). We will not accept Phase 2 submission after the deadline without an agreement between PI and QWG. If you are willing to proceed to Phase, but will not be able to submit the Phase 2 sheet by the deadline, please contact the queue working group.

Since S19A, we will not carry out a detailed review of Phase 2 and iteration with PI for Grade C and F programs, i.e., we will accept the submitted version of Phase 2 as it is. When we find any obvious points to be corrected, we may modify the Phase 2 without any notifications.

3.3 Changes in OBs

The PIs should be careful when preparing the OBs, as the possibilities of introducing any changes after the submission are limited. Until Phase 2 is finished, PIs can consult with SAs or SOD to change exposure times, or the observing constraints to less strict ones. The SAs and SOD may also contact the PI during Phase 2 and ask to relax the constraints.

Except for constraints relaxation, major changes are not possible once the Phase 2 is finished and OBs are sent to the scheduler. However, during observation the SAs may adjust some parameters (like exposure time) to respond to the variable conditions, but the total time granted to a given program will remain unchanged. To relax the constraints after Phase 2 (in order to increase the probability of execution), the PI should contact the SOD first. If permission is granted, the PI should re-submit those OBs that were not executed yet.

Other changes are basically not allowed, except for special cases. If user wants to change an original target, it should be discussed with the SOD first. It may be allowed if the science goal is unchanged, there is no conflict with other programs[7], and there is a good reason. Changing filters should also be discussed with SOD first.

[7]See also "Clearly Prohibited Case" in https://www.naoj.org/Observing/Proposals/Visit/policy.html.

Chapter 4

Observations

4.1 Scheduling

Before each night, a queue schedule will be made. OBs will be selected basing on the visibility of targets, currently installed filter, time constrains, and priority of programs (based on their GRADE) and particular OBS of the same program (prioritized by the user). In principle, a GRADE A target will be observed if possible. Before starting an OB, current weather conditions will be checked, and the nights schedule can be instantly updated if they suddenly change. The scheduler will also take into account the position of targets on the sky, in order to minimize the telescope slewing time. The number of filter changes during the night will be minimized. Starting from S19B, in case of proposals using both broad-band and narrow-band filters, once it becomes impossible to execute a narrow-band OB due to filter scheduling, the priority of the corresponding broad-band OBs will be lowered.

The schedule for the incoming night will also depend on the FQA of the previous night's data, and will be adjusted on the basis of completeness of programs (especially GRADE A). If a program's completeness is very low, the SAs or SOD may contact the PI and ask to relax the constraints.

4.2 Early execution

The OBs that will be delivered and accepted before the new semester starts, will have a chance to be executed in the semester that comes to an end. If, for example, users send their OBs early December before semester A, their execution will be possible for over a month. For the early execution, all GRADE ABC programs will be assigned GRADE C temporarily. The original GRADE will be restored once the new semester begins.

4.3 Sukima (dead time)

The "dead time", or *sukima*, is a time during classical mode observations when no target is available (due to weather, visibility, etc.). For HSC classical observations, queue programs may be executed in such cases, and will be given higher priority than classical backup targets. All GRADEs (ABC) are accepted for sukima, and the OBs will be prioritized in the same way as for night assigned to the QM.

4.4 SSP time

Part of the HSC time is dedicated to Subaru Strategic Programs (SSP). New SSPs have not been accepted for the queue mode until S18A, but the first and last nights of SSP time (usually gray) is open for QM observations, with the same scheduling and priority rules. Moreover, some observations for already approved SSPs are currently done during queue nights, and this will continue in S18A&B.

4.5 Carry over

4.5.1 Normal Program

GRADE A programs that use BBF and were not completed during a given semester, will be carried over to the next two semester (keeping three semesters in total). There is no guarantee, that OBs using NBFs will get the chance to be completed later. It may happen only if in the future semester the same narrow band filter is installed. Note that programs for which $\geq 90\%$ of total time has been executed and approved (see next Section), will normally be considered as completed, and may not be carried over. If the missing data are crucial for the program completion, the PI should contact the SOD to discuss and justify the possible carry over. Programs assigned other GRADEs are not subject to the carry-over policy.

4.5.2 Intensive Program

In each semester, we will execute OBs of intensive programs up to allocated hours for the semester. After the end of all allocated semesters, hours not executed will be carried over up to two following semesters. This carry over policy applies only for GRADE A intensive programs. During the carry-over semesters, the priority of carried-over GRADE A intensive programs may be re-assigned following the TAC decision after reviewing newer GRADE A programs, while the rank will be kept higher than any other GRADE B programs. The amount of carried-over hours will be decided by the TAC, and may have an upper limit depending on the available open-use nights. Carry over policy for the filters in Intensive Program is the same as that for Normal Program.

4.6 Quality assessment

The quality assessment is performed in two stages. The initial quality assessment (IQA) is done by a QA just after the observation. It includes a quick check of the currently taken data for seeing, sky transparency, detector noise, etc. The QA will then judge if current conditions are acceptable for the next scheduled OB. If not, the night schedule will be updated instantly. Note, that the transparency will be measured directly only on the SDSS fields. Execution of an OB is determined based on its latest available measurement.

The next day after observations, a final quality assessment (FQA) will take place. SAs will double-check the quality of the data, taking into account more factors, and compare with the PIs requests. Each program will have one SA delegated to deal the FQA. Comments will be assigned, and later delivered to the PI (together with other products). When an OB will pass the FQA, it will be considered completed. Otherwise, it will be repeated. Schedule for the next night will be updated accordingly.

Note, that weather may change during observations, so at each stage a tolerance of $0.1''$ for seeing and 20% for transparency will be applied. For example, if the PI asks for seeing $< 0.8''$ and transparency >0.9, OBs executed under the conditions of seeing $\leq 0.9'$ and transparency ≥ 0.72 will be considered as completed. To minimize the probability of having the last exposure of an OB taken in significantly worse conditions than the first one, we encourage the PIs to use dithering sequences with small number of positions (recommended:$\sim$ 5). As a general policy, even if only one of the exposures does not pass the FQA, such an OB will be considered as not completed, and scheduled for re-execution. However, when a significant fraction of exposures in an OB are taken under the requested conditions (including the tolerance factors above), QWG may evaluate the OB as completed.

Chapter 5

Data delivery and feedback

5.1 Delivery package

In order to download her/his data, the PI will receive an email containing instructions on how to download the data. Its form is similar to the next-day delivery used for other Subaru observations, i.e. three forms of obtaining the data will be listed:

- A python-based script for automatic download of the data package from MASTARS or STARS.
- An anonymous login and password for download from Hilo/Mitaka archives, sent using a One-TimeSecret.
- A personal STARS login and password, with a list of URLs to choose from.

Instructions of using all the options will also be included.

The notification email will be sent to the PI after each observing run. Note that, on the contrary to the classical mode, some calibration frames (like flat fields), may not be taken the same night as the scientific observation, so there is no next-day delivery for the QM.

The notification email will also summarize the progress of the observation to date, i.e. which OBs have been executed and which are still waiting, or need to be repeated (identified by the Code given in the ob tab of the spreadsheet – Sect. 3.2). For the executed OBs, comments from the FQA for each OB and frame will be available. Finally, the notification email will indicate the weather logs and reports, in order to inform the PIs of the environmental conditions during the observations.

Because OBs of the same program might be executed over several nights (or even carried over to the next semester), the PIs should expect to get several such emails. Notification will be sent and data will be delivered also for OBs that were executed, but did not pass FQA and that are to be repeated. At the end of the semester the PI will also receive a final email summarizing the whole program, and notifying whether any blocks have been carried over to subsequent semesters.

Important: If the PI should find any issue with the delivered data, please contact us (`queue [at] naoj.org`) regarding it. A decision to re-execute OBs with problematic data may be made in the case that the issues turned out to be due to our fault or they are critical to accomplish the science goals of the program. In a disputed case the final decision will be made by the director of Subaru Telescope. Note

that a swift inquiry after the data delivery would be desirable to increase the chance of re-execution, since it must be in the same semester with the targets being visible.

5.2 Archiving at SMOKA

The HSC QM data are a subject of the same archiving policy as any other Subaru data. In principle, scientific data taken with the Subaru telescope are archived with 18 months proprietary period. After that time they become publicly available at the Subaru Mitaka Okayama Kiso Archive (SMOKA) system:

http://smoka.nao.ac.jp/.

Extension of the proprietary period may be granted in special cases to HSC queue programs that were highly ranked (GRADE A) and were carried over to the next semester or two. In such case, a corresponding request has to be submitted with a detailed justification.

5.3 Feedback to the observatory

In order to ensure better, more efficient operations in the future, and satisfaction of the QM proposers, we ask for your feedback at any moment. We encourage to stay in touch and ask any questions, especially during the Phase 2 and observing runs. All the inquiries should be directed to:

queue [at] naoj.org.

Figure 5.1: Future astronomers already know the queue mode.

Appendix A

Change record

- 6.1.0 – November ’18: Version 6.1.0 for S19A Phase 2 [CER]
  – added S. Okamoto as a member of the queue working group.
  – added an description about pre-filled target list in Phase 2 sheets.
  – added allowed character set for Code columns in Phase 2 sheets.
  – added descriptions on the new Phase 2 policy for Grade C and F programs.
- 6.0.0 – August ’18: Version 6.0.0 for S19A
  – added more description on monitoring proposals. [MO]
- 5.3.0 – June ’18: Version 5.3.0 for S18B
  – added transition from Excel spreadsheets to Google spreadsheets for Phase 2. [CER]
- 5.2.0 – February ’18: Version 5.2.0 for S18B
  – added description of monitoring proposals. [CER]
- 5.1.0 – November ’17: Version 5.1.0 for S18A Phase 2
  – Add H. Suh and C. E. Rusu as members of the queue working group. [MO]
  – Remove M. Imanishi, K. Hełminiak, and S. Yeh from the queue working group. [MO]
- 5.0.0 – July ’17: Version 5.0.0 for S18A CfP.
  – Add T. Terai as a queue working group member. [MO]
- 4.1.0 – May ’17: Version 4.1.0 for Phase 2 of S17B.
- 4.0.1 – February ’17: Version 4.0.1 minor modification during Phase 1 of S17B.
  – Clarify the statement about Sukima time observation. [MO]
- 4.0.0 – February ’17: Version 4.0.0 prepared for the S17B CfP.
  – Newly added: Intensive program. [MO]
  – Updates: Filler programs for educational and public outreach purposes. [MO]

- 3.0.1 – August ’16: Version 3.0.1 prepared for the S17A CfP.

  – Newly added: MO to the QWG members, HSC pipeline, time-critical observations and constraints, checker warning explanation

  – Updates: future implementation plan, some links, data delivery policies, filter names [KH]

- 2.1.0 – March ’16: modifications of 2.0.1

  – Updates: data delivery scheme, Moon distance constraints, exposures in dithering.

  – Removed: obsolete links, minor inconsistencies. [KH]

- 2.0.1 – February ’16: Version 2.0.1 prepared for the S16B CfP. [KH]

- 1.2.1 – November ’15: corrected version for Phase 2

  – Updates: “OB check” and “OB submission” merged into one sub-section, data delivery procedure and policies.

  – Newly added: FoV check with Ginga [KH]

- 1.2.0 – October ’15: initial version for Phase 2

  – Updates: Phase 2 spreadsheet, file checker, Phase 2 related policies [KH]

- 1.1.1 – August ’15: Modifications of 1.1.0.

  – Updated: finding charts preparation with Aladin, www links, OB subission.

  – Other changes: hyperlinks, modifiifications for latex2html, Change Record format. [KH]

- 1.1.0 – August ’15: Version 1.1.0 prepared for the S16A CfP.

  – Newly added: note on targets, dedicated ETC (with figures), notes on SDSS fields, finding charts, checking the OBs.

  – Updated: dark/gray definition, proposal submision and template, OB change policy, carry-over policy, data delivery.

  – Removed: photometric transparency definition, table with observing conditions. [KH]

- 1.0.0 – June ’15: First version prepared for the QM workshop in Mitaka [KH]