Policy for Target of Opportunity Observations

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1. Introduction

SOAR's "agility" makes it a very attractive platform for Target of Opportunity (ToO) programs, especially those that require that observations of an event begin very soon after discovery. If, in practice, SOAR can realize its full potential to switch programs within less than 15 minutes of notification, then it be a forefront facility for pursuing this kind of science.

The policy described below was first devised over a decade ago, and has evolved in response to scientific demands for prompt follow-up of astronomical events. As the field continues to change, the SOAR policy is expected to change as well.

The top-level requirements are that the policy must:

- Be flexible enough to maximize SOAR's potential to carry out ToO science while protecting the interests of regularly scheduled observers. It must also strictly limit the impact on the operating staff and budget.
- Respect the exclusive right of each partner to control how its share of telescope time is employed and ensure each has free access to a fair share of ToO time.
- Allow the duly approved ToO programs of one partner to interrupt the scheduled observers of any of the others, not just its own. Limiting interrupts to a single partner's time-share would unacceptably reduce the probability of being able to pursue intrinsically rare events, especially for the smaller partners.
- There should be a category of protected programs which should not be interrupted.
- Streamline the authorization process required to activate an interrupt by a duly approved ToO Program in the absence of a protected status for a scheduled program. Activation of ToO programs should be enabled by the telescope operator following his/her verification of the validity and status of the ToO program. This presupposes that all necessary higher-level authorization will have been obtained during the process by which the ToO program is approved.

2. Time Available for ToO Observations and Number of Interruptions

2.1. The maximum duration of an interrupt shall be 2.5h (as defined fully in 7.2 this time includes various overheads). It is anticipated that the partner TACs will set a duration for the interrupts allocated to each of their ToO programs according to scientific need, which may be less than, but cannot exceed this amount.

2.2. In the event of bad weather or technical problems, up to 2.5h may be used to try to execute the observation, even if the TAC has allocated a lesser amount of time.

2.3. An actual interrupt may exceed the time allocation set by the partner TAC or the 2.5h window only with the express agreement of the scheduled observer.

2.4. The total number of executed ToO interrupts in any semester shall not exceed twelve (12). If all these interrupts have the maximum duration established in 2.1, then the total time allocated to ToO observations would be 30 hrs or about 1.8% of the time available for observing. Partners may authorize any number of interrupts.
2.5. Interrupts are executed on a "first-come, first-served" basis, up to the cap, with the exception than any authorized program may follow up a single event with up to two (2) interrupts on consecutive nights, if it has had not another interrupt during the semester.
2.6. Individual partners may authorize additional interrupts if these are restricted to their own observing time only.
2.7. Scheduled observers may agree to contribute some of their observing time to a ToO program. (Normally, this would be as part of a scientific collaboration.) In this case the time used is not counted against the quota of interrupts, and no compensation time is provided. *Such agreements or collaborations require the consent of both parties.*
2.8. There may be at most one ToO interrupt on any given night (or half night when the night is split between distinct programs) whether from the same or different ToO programs. The first activation request received is the one executed.
2.9. The SOAR director may, in cases of exceptional scientific merit, allow for additional interrupts. Such waivers are subject to review by the Board.

3. Eligibility

To be eligible for ToO time a program must meet criteria designed to limit the use of this scarce and expensive resource to those programs that genuinely need it. These should include:

- The targets, or phenomena to be observed must be sufficiently rare, and so short lived that they cannot possibly be studied in any other way using conventionally scheduled time.
- ToO time should not be used for any non-time-critical follow-up or supporting observations
- Each partner may impose additional criteria that must be met by their own users in order to optimize or limit the use of ToO time.

4. "Protected" Time

4.1. The decision regarding which programs, or parts of programs, should be granted Protected Status rests with each partner's TAC. However, historically "protected" nights have met the criteria suggested in 4.3.
4.2. The total amount of time which a partner can protect in any semester shall not exceed 20% of their time share.
4.3. It is recommended that Protected Status should only be granted under exceptional circumstances based on a strong scientific justification. Examples might be time-critical observations of extremely rare, but predictable phenomena (hence not ToO's), or programs that form part of a coordinated campaign requiring simultaneous observations with multiple telescopes and satellites. Inconvenience to the observer, or the risk that an extensive sequence of observations would be lost, if interrupted part way through, are not grounds for protection; such issues are dealt with through the high premium included in the Payback of ToO time. In general, if the observation or similar observations could be repeated within the following two semesters, it would not qualify.

4.4. Protected Status should only apply to those portions of time allocated to a program that actually require it (e.g. only the duration of an occultation)

4.5. The SOAR director may grant protected status to scheduled engineering time when the activities to be performed are of a critical nature (e.g. solve problems which impact safety or severely impair performance) or where a delay in completion, once started, would have a severe impact on the next scheduled observer. Such status shall not be granted to routine activities that could be postponed to some future date without significant impact on performance.

4.6. If a ToO for an approved program occurs during protected time, the PI of the ToO program may contact the scheduled observer to see if protected status could be waived. However, *agreement to do so is at the sole discretion of the scheduled observer*.

5. Duplicate Proposals

In the event that two or more partners propose ToO programs to investigate the same or overlapping sets of targets, the SOAR Director will work with the partners (and through them the investigators involved) to arrive at a mutually acceptable resolution. As a first step, an attempt will be made to forge a genuine collaboration between the groups. If this is not possible, then the director will seek a compromise which optimizes the science outcome for all the parties involved, while respecting the rights of each partner to fair access to ToO opportunities. Two potential options are:

- Providing data from the event to all programs; this presumes that the programs want similar data.
- The Director will allocate the opportunities according to a rotating priority list. This mechanism will also be used where different ToO programs happen to require the same observing time.

6. Activation

6.1. Only the PI of the ToO program, or Co-Is explicitly designated in advance, may request the activation of an interrupt. The system will include adequate safeguards to verify the identity and credentials of the requesting individual.

6.2. The authority to act on an activation request lies with the Telescope Operator without the need for further consultation. The activation procedure will include (semi-automatic) checks that the ToO program is within its time allocation, and that any other restrictions on its activation are met, and also a crosscheck on the Protected Status of the program being interrupted.

6.3. We distinguish two modes of activation:

- "Instant Activation" in which an interrupt starts immediately, preempting the telescope and instrument(s) irrespective of whether the scheduled observer has an exposure under way or not.
- "Delayed Activation" in which advance notice is given requesting that an interrupt start at a specified time during the night.

The mode of activation must be specified and justified in the ToO proposal, and only the specified mode may be employed. A series of observations could be proposed as an instant activation interrupt followed by delayed activations on subsequent nights.

6.4. Requests for “Instant Activation” may be received at any time. Requests for “Delayed Activation” must be received by no later than 16:00 Chilean time on the day on which the observations are to be executed. Requests can be submitted earlier; this is highly recommended if modifications to an instrument configuration are desired. *Configuration changes must be requested before 14:00 Chilean time.* Such requests will only be honored if there is no conflict with the scheduled observer’s needs.

6.5. A delayed activation request can be withdrawn without penalty if the withdrawal occurs before 16:00 Chilean time.

7. Observing

ToO programs may be carried out

- As remote observations executed by the PI or Co-Is of the ToO proposal. This is the preferred mode. *Note* – SOAR can facilitate training in the use of the instrument, if needed, with adequate notice.
- ToO observers may, if they wish, enlist the help of the scheduled observer, in carrying out their observations. However, the scheduled observer is entirely free to refuse, and the successful execution of the program must not depend on such help. *This is distinct from established NOAO policy that requires the scheduled observer to carry out the ToO observations.* The scheduled observer may not be using the instrument required for the ToO, and indeed may have no experience with the ToO program’s requested instrument. The scheduled observer is, however, encouraged to work together with the ToO team and on-site staff to maximize the effectiveness and efficiency of the interrupt. *Assistance with the observation is not the same as scientific collaboration* (described in 2.7 above); the scheduled observer may do one, or the other, or both. See also section 10.

8. Time Keeping and Payback Time

8.1. The time used during a ToO interrupt is counted from the moment that the scheduled observers deviate from their observing program to begin the ToO observations to the time at which they resume their own program (defined as the start time of first program exposure following the interrupt). It thus includes any time required to re-configure the telescope and instrument(s) prior to the start of the ToO observation, the time to restore the scheduled observer’s configuration at the end, and the time to slew to, and acquire, the scheduled observer’s next target, as well as any time lost due to weather or other causes after the nominal start of the interrupt (see 2.2).

8.2. Time required for any additional on-sky calibrations (standard stars, twilight flats) obtained, with the agreement of the scheduled observer, outside of the ToO interrupt itself will also be added to the time used.

8.3. The time owed by the partner sponsoring the ToO program to the partner of the scheduled observer will be calculated as:

$$T = K * t + C \qquad (1)$$

Where, t is the time actually used by the interrupt, including weather or other delays, as defined in 8.1 and 8.2, and K and C are constants. Current values are:

K = 2.0

C = 1.5 hours for "Instant Activation"

C = 1.0 hours for "Delayed Activation"

8.4. In the event that a night is split, and an interrupt declared in the first half extends into the second, the fixed portion (C) of the payback is paid entirely to the owner of the first half night. The proportional term is applied to the time actually lost by each partner.

8.5. No charge is incurred for ToO interrupts activated during engineering time unless as a result of the interruption to the engineering activities the telescope cannot be restored to full operation before the next scheduled observer is due to start. In this exceptional case the charge levied will be based on whichever is the smaller of the actual delay suffered by the subsequent observer and the time used by the ToO interrupt. The payback time will be calculated using equation (1) and the constants appropriate to activation in advance. This payback will be credited to the partner sponsoring the next scheduled observer.

8.6. In all cases the payback time is credited to the partner sponsoring the scheduled observer, not the observer him/herself. Whether any attempt is made to compensate the affected program, the policies that govern this, and the means by which it is achieved is the responsibility of the individual partners.

8.7. The SOAR Director may, with the approval of the Board, schedule a small number of compensation nights to be used to compensate individual observers. Such compensation will be in accordance with formula (1). Compensation time may be lost to bad weather or other circumstances; in these case there is no additional compensation. In any case, availability of compensation time for individual observers *is not guaranteed.*

8.8. For accounting purposes time on SOAR is categorized as bright, grey, dark, and very dark according to lunar phase and whether the moon is above the horizon. Payment will be made in time of the same "quality" as that consumed by the ToO interrupt.

8.9. Payback for interrupted time shall follow the algorithm established above, unless the interrupted and interrupting partners agree to alternative terms. This may include providing compensation time directly to affected observers from the interrupting partner's time share.

9. Available Instrumentation.

At present, all facility instruments other than SAM are available for ToO programs. SAM is not available because of the need to obtain clearance for use of the laser.

Instruments still being commissioned or with other restrictions on their use are not considered facility instruments and are not available for ToO programs.

10. Acknowledgements and Authorship

It is expected that any papers based on ToO observations will include a simple acknowledgement of the scheduled observers whose program was interrupted. In the event that the scheduled observers or observatory staff help execute the observations or make some other material contribution, then co-authorship may be appropriate, however, this is purely a matter between the investigators involved and is not required by SOAR.