

Policy For Target Of Opportunity Observations

Top Level Recommendations

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 could become a forefront facility for pursuing this kind of science.

The specific example program put forward by UNC for rapid follow-up of GRBs offers exciting science, and is also very timely, given the imminent launch of the SWIFT satellite which is expected to discover large numbers of candidates and will provide target positions with arc second precision.

The SAC therefore strongly recommends that SOAR establish a ToO policy that permits the partners to exploit this important capability. At top level such a 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 – a strictly limited resource, akin to dark time or top-quartile seeing.
- 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.

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Detailed Policy Issues

The SAC recognizes that a ToO program of the kind we recommend poses a number of very difficult scientific and “political” issues that must be addressed in the policy. This is especially true for a consortium owned, classically scheduled telescope such as SOAR.

The SAC has consulted ToO policy documents from several other observatories, however, none cover the full range of issues we face: those from “national” observatories (e.g. NOAO, ESO, NOT) need not discuss “pay-back” since all time has a single owner, and is allocated by a single integrated TAC. Likewise, Gemini sidesteps many of these issues through queue scheduling. ARC and WIYN have no consortium wide policy (ToO activity at WIYN is currently restricted to NOAO time and governed by the NOAO policy). Magellan comes closest to the SOAR case, but their current policy restricts ToO observations to a single, very simple, instrument and requires that interrupts are activated by no later than 16:00 in the afternoon. Thus just as SOAR pushes back the frontier of what is technically possible, it also requires us to enter previously unexplored territory as regards to policy.

Bellow we discuss, and make recommendations regarding the most important policy issues. These recommendations are to the extent possible “science-based”, however, we found it impossible to completely avoid the political dimension. This is very much a work in progress. We have not yet completed our deliberations in some areas, and have yet to discuss others. Hence, the outline bellow should be considered a “snap shot” intended to indicate the direction of our thinking on these detailed issues, as background for board discussion of the broader principles stated above.

1. Revision of Policy

The ToO policy adopted should be regarded as provisional and subject to review by the SAC and Board towards the end of the first year of regular observing (e.g. at the October 2005 board meeting) and every 12 months thereafter.

However, planning of both observatory operations, and ToO science programs will be simpler if the policy is broadly speaking stable in the longer term.

During the first three (3) years of operation of the ToO program, no **major** changes are foreseen to be made.

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. An actual interrupt may exceed the time allocation set by the partner TAC *only* with the express agreement of the scheduled observer.

- 2.3. The total number of ToO interrupts in any semester shall not exceed eighteen (18).

If all these interrupts have the maximum duration established in 2.1 then the total time allocated to ToO observations would be 45hrs or about 2.7% of the time available for observing.

- 2.4. This total number of interrupts shall be divided between the SOAR partners, and Chile, in proportion to their overall timeshare as established by the SOAR agreement (Brazil 30.8%; NOAO 30.0%; UNC 16.7%; MSU 12.5%, Chile 10.0%)
- 2.5. It is, however, recognized that in any given semester some partners may require less than their share of ToO interrupts, others more. Consequently the partners are allowed and encouraged, but in no way obliged, to trade “ToO rights” so as to fully utilize SOAR’s ToO capability, subject to the cap set on the total number of interrupts in 2.3
- 2.6. 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.

3. Eligibility

- 3.1. To be eligible for ToO time a program must meet specific, and quite restrictive scientific and technical 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
 - The technical demands of the program must be consistent with the current status of the telescope and instrument(s). This will be especially true during the late commissioning and early operational phases. It is worse than pointless to attempt programs requiring “immediate activation” until it has been clearly demonstrated (e.g. through day time dress rehearsals) that the time required to switch to the ToO program and back again is small enough to meet the science requirements.

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 partners TAC
- 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 suggested 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.
- 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 schedule observer.

5. Duplicate Proposals

- 5.1. 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. In arriving at this solution the director may seek (independent) scientific and technical advice. In the event of deadlock the Director will refer the matter to the SOAR board.

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

- 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.

7. Observing

- 7.1. 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.
 - ?? As service observations executed by the Telescope Operator. However, these people, although very experienced, are not professional astronomers so such programs must be relatively simple, capable of being “scripted” in advance, and must not require decisions to be made based on detailed knowledge and understanding of the scientific program. In addition this mode may be limited to a restricted sub-set of the available instruments (e.g. imagers). Remote “eaves dropping” by members of the ToO team may mitigate these restrictions to some extent. In general, it is expected that this mode will only be used if remote observing is impossible because the ToO observers do not have access to the necessary equipment or bandwidth.
- 7.2. 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. Experience shows that some observers are only too happy to help; others regard this as adding insult to injury.

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.

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 observers next target.
- 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:

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

Where, t is the time actually used by the interrupt as defined in 8.1 and 8.2, and K and C are constants. The SAC recommends the following initial values for these constants (subject to review and modification based on actual experience as described in 1)

$$\begin{aligned} K &= 2.0 \\ C &= 1.5 \text{ hours for "Instant Activation"} \\ C &= 1.0 \text{ hours for "Delayed Activation"} \end{aligned}$$

- 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 effected program, the policies that govern this, and the means by which it is achieved is the responsibility of the individual partners. For reference, the currently established NOAO policy does not automatically compensate the effected observers, but does allow them to request DD time, the allocation of which is considered on a case-by-case basis. It is understood that Brazil will follow a similar procedure, while UNC and MSU intend to establish a compensation mechanism.

- 8.7. 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.
- 8.8. Payback for interrupted time shall follow the algorithm established above, unless the interrupted and interrupting partners agree to alternative terms.

9. Available Instrumentation.

- 9.1 At the outset of the ToO program, the available instruments will be the SOAR Optical Imager, and OSIRIS. As other instruments such as the Goodman Spectrograph are commissioned, their suitability for use in ToO mode will be evaluated by the SOAR Director, based on the operational cost and complexity of supporting their use in this way. This evaluation will be communicated to the SAC and Board and will serve as the basis for a decision on whether the instrument should be available for ToO, and in what observational modes. The list of instruments to be offered in the ToO mode will in any case be subject to review and revision during the annual review of the program to be carried out by the SAC.

10 Acknowledgements & Authorship

10.1 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.