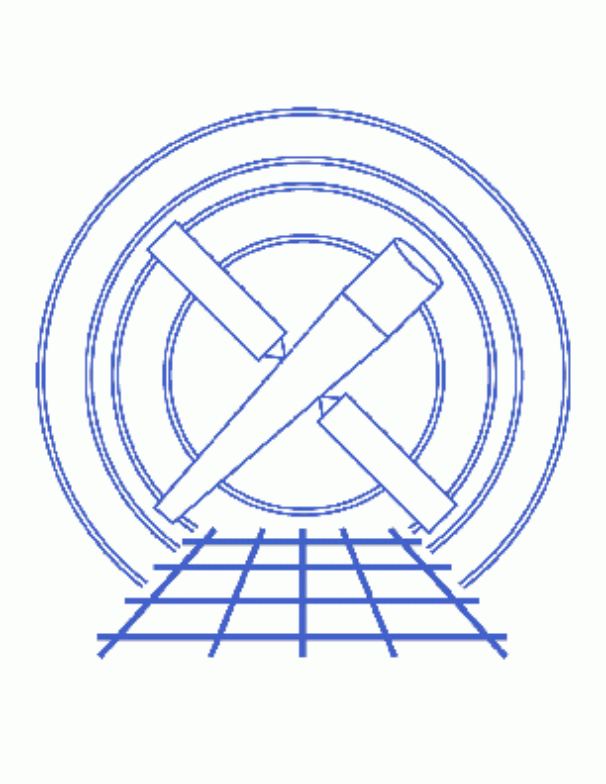
How to Classify Constrained Observations



Proposal Threads for Cycle 11

Table of Contents

How to Classify Constrained Observations

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Classifying and Counting Constrained Observations

Note: the number of constrained observations can now be estimated using the "Constraints/Slewtax" button in RPS.

An observation is time constrained if there are any user-imposed limits on when it can be scheduled. Constrained observations are discussed in more detail in the FAQ for Constrained and Coordinated Proposals thread. Too many constrained observations impact Chandra's observing efficiency, and therefore must be limited. Prior to Cycle 9, the number of constrained observations was limited to about 15% of the total, without any regard for whether a constraint was difficult or easy to meet. Starting in Cycle 9, constrained observations will be classified as "Easy", "Average" or "Difficult". Final constraint difficulty classifications will be determined by the CXC after the proposal deadline, taking into account all declared constraints, including those that must be specified in the remarks. The classifications are provided to the Chandra peer review, at which a maximum quota for the number of observations of each classification is enforced There are quotas for each category. The intent is to limit the most restrictive/difficult observations, while allowing more "easy" constraints to be approved.

Starting in cycle 11, the number and classification of constraints can be calculated using the "Constraints/Slewtax" tool, accessible by button from the top of the RPS form. Note that additional constraints specified in the Remarks section cannot be evaluated by this tool, so any classifications should be taken as estimates. The calculator will also assess the additional slew time required for each pointing, which contributes to the total time for the proposal.

Details of the grading scheme are given in the Call for Proposals. In particular, Table 5.1 lists the "grading parameter" for all allowed constraints. These are:

- **Window** - the length of the time window in days
- **Phase** - the period in days
- **Uninterrupt** - the length of the exposure in ks
- **Observations coordinated with another observatory** - the length of the window (in days) within which both observatories must observe the source
- **Roll Angle** The nominal roll angle of Chandra changes with time. The grading parameter is the length of the time window (in days) for which the roll constraint is satisfied.
- **Monitor** - dimensionless parameter depending on the exposure time, spacing and tolerance of the monitor series.
- **Group** - dimensionless parameter depending on the time interval for the group and total number of observations.

In this thread, we apply the classification scheme outlined in the Call for Proposals to approved Cycle 8 proposals to determine the number/type of constrained observations for each program. Proposers are advised to

have Table 5.1 to hand when reading through these examples!

Example 1. PHASE and UNINTERRUPT

This example is taken from proposal 08400908, **Measuring the Distance and Dust Distribution to Cen X-3 with X-Ray Halo Variability**

The science goal of this proposal is to provide information on interstellar grain properties along the line of sight to Cen X-3. The program consists of a single observation starting 5 ks before eclipse egress and ending 35 ks after eclipse egress. This observation has two constraints: it is phase constrained and it must not be interrupted. We must evaluate both constraints separately. The final classification will be that of the most difficult constraint.

How hard is the Phase Constraint?

According to Table 5.1 in the Call for Proposals, a phase constrained observation of a source whose period is less than 20 days falls in the "easy" category. The period of Cen X-3 is 2.087065 days, and hence the phase constraint is "easy".

How hard is the Uninterrupt Constraint?

The total length of the observation is 40ks, which puts it in the "Average" category for uninterrupt observations.

Final Classification

The resulting classification for this observation is **Average**. i.e. it counts as ONE Average observation against the cycle quota.

Example 2. MONITOR

This example involves observations of a source that is slowly fading. The first observation is 10ks, the second 50ks 1-2 months after the first, and the final observation is 100ks 3-6 months after the second observation.

RPS parameters for the monitor

Required RPS parameters for a monitor observation are exposure time and minimum and maximum time intervals. The monitor table should be as follows:

Monitor	Exposure Time	Minimum Time Interval (days)	Maximum Time Interval (days)
1	10		
2	50	30	60
3	100	90	180

Evaluate the Constraint

The formula to calculate the constraint classification is given in Table 5.1 in the Call for Proposals.

- Identify max(T), the largest exposure time of any observation. In this case it is 100ks, or 1.15 days.
- For each exposure, Imin and Imax are the minimum and maximum intervals (e.g. for the 3rd observation Imin=90 and Imax=180 days).
- Identify min(Imax). This is the smallest Imax value for all observations. In this case it is 60 days, corresponding to the interval between the first and second observations.

Compute the fractional tolerance for the interval with smallest Imax

$$fractol = \frac{Imax-Imin}{Imax+Imin} = \frac{60-30}{30+60} = 0.333$$

Finally, compute the monitor parameter:

$$min(Imax) \times \frac{fractol}{max(T)} = \frac{60 \times 0.333}{1.15} = 17.3$$

The monitor parameter is 17.3, so that each of the three observations falls in the **Easy** category. This program would count as THREE **Easy** observations against the Cycle 11 quota.

Example 3. WINDOW

This example taken proposal 08100480, **X-Ray Observations of Jupiter in Support of the New Horizons Flyby**

The goal of this proposal is to obtain X-ray observations of Jupiter during the New Horizons Flyby. There are three components to this investigation: a time-variability study during approach, a multi-spectral morphology study near closest approach and a magnetotail dynamics study as NH heads to Pluto. Each of these components requires two 18ks (5 hour) observations (a total of 6x18 ks). The time windows for these observations are:

Observation	Start	Stop	Window Duration
1	Feb 24 2007 9:30PM	Feb 25 2007 2:30AM	5 hours
2	Mar 3 2007 5:00AM	Mar 3 2007 1:00PM	8 hours
3	Mar 7 2007 5:30AM	Mar 9 2007 2:30AM	45 hours
4	Mar 7 2007 5:30AM	Mar 9 2007 2:30AM	45 hours
5	Feb 8 2007 8:30AM	Feb 11 2007 1:00AM	64.5 hours
6	Feb 8 2007 8:30AM	Feb 11 2007 1:00AM	64.5 hours

Each of these 6 observations must be done in a time window which is less than 3 days. This program would count as 6 **Difficult** observations against the Cycle 11quota.

Example 4. ROLL, UNINTERRUPT and PHASE

This example is taken from proposal 08400850, **A Chandra HETGS Study of LMC X-4 : Binary Disk and Wind Properties and Studies of Grain Distribution at Small Angles**

The goal of this proposal is to obtain a high resolution spectrum of LMC X-4 to study the disk, wind and ISM of this source. It is multiply constrained. There is a roll constraint to minimize flux contamination from LMC X-1, a phase constraint to ensure the source is in a medium to high flux state and an uninterrupt constraint.

The Roll Constraint

The roll constraint is for angles 0-40 degrees or 90-180 degrees. The nominal roll angle of Chandra changes with time. Therefore a roll constraint translates to a window constraint, and the ease with which the observation can be scheduled is dependent on the length of the corresponding time windows.

The time windows can be calculated using the PRoVis tool. Enter the coordinates of LMC X-1 (RA=05:32:49.80, Dec=-66:22:13.80) in the box labeled "Target Coordinates" and hit the "Generate Plot" button. The resulting page is an interactive plot of roll, pitch and visibility values as a function of time. This plot can be used to determine when the roll constraint is satisfied during the nominal Cycle 11 boundaries (Jan 1 2010 to Dec 31 2010.) Inspection of the plot reveals that the roll constraints are satisfied as follows:

- Roll angles 0-40 between 2010/11/06 -- 2010/12/14
- Roll angles 90-180 between 2010/06/14 -- 2010/09/16

The duration of the corresponding windows are 39 and 95 days, for a total availability of 134 days. The roll constraint is classified as **Easy**. Please note that the pitch angle of this source is always "bad" and hence the maximum exposure time is limited. This is discussed further below, in the section on the "uninterupt" constraint.

The Phase Constraint

The period of the super-orbital phase of LMC X-1 is 30 days. The phase constraint is therefore **Average**

The Uninterrupt Constraint

The total exposure time is 150ks. The maximum exposure time depends on the pitch angle of a source (see the Proposers Guide for more details). For most locations in the sky, this will be at most 80ks. Therefore it will be necessary to split this observation into (at least) 2 segments of approximately 80ks. This counts as 2 **Difficult** uninterrupt constraints.

Please note that the pitch angle of LMC X-1 is such that it will definitely be necessary to split the exposures into even smaller chunks. Inspection of the PRoVis plot for this source shows that the pitch angle is always in the restricted ephin range. The MaxExpo web page shows that for pitch angles in the range 87-92 degrees the maximum exposure will be 20-30ks. For the purposes of counting constrained observations at the peer review, we do not explicitly take pitch into account and so the final count is 2 **Difficult** constraints.

Final Count

The final category is that of the most restrictive (difficult) constraint. This observation counts as 2 **Difficult** constraints.

Example 5. TOO, MONITOR, COORDINATED

This example is taken proposal from 08501014, **Tiny Hiccups To Titanic Explosions: Tackling Transients in Anomalous X-ray Pulsars**

This is a series of observations to study the spectral and timing properties of an Anomalous X-ray Pulsar following a transient event (e.g. an outburst or flare). It consists of 4 observations: a fast Target of Opportunity Observation (TOO) followed by 3 observations spaced by 1-3 days. Ideally, these observations would be simultaneous with RXTE.

The TOO Observation

The first observation (the TOO trigger) occurs within 4 days of the PI notifying the CXC that an event has occurred. This observation does **not** count as a constrained observation. Instead, it counts against the quota of Very Fast TOOs.

The TOO Follow-ups

The three TOO follow-ups are part of a monitor series and count against the quota of constrained observations. Details of how to evaluate a monitor constraint are given in the MONITOR example above. The RPS TOO table is as follows:

Followup	Exposure Time	Minimum Time Interval (days)	Maximum Time Interval (days)	Target Number
Initial	20			
1	20	1	3	
2	20	1	3	
3	20	1	3	

The formula to calculate the constraint classification is given in Table 5.1 in the Call for Proposals. For the three followups:

- Identify max(T), the maxiumum exposure time. In this case the exposures are of equal duration (20ks=0.23 days)
- For each exposure, Imin and Imax are the minimum and maximum intervals. In this case, Imin=1 and Imax=3 for all followups.
- Identify min(Imax). This is the smallest Imax (maximum interval) value for all observations. In this case it is 3 days.

Compute the fractional tolerance for the interval with smallest Imax

$$fractol = \frac{Imax - Imin}{Imax + Imin} = \frac{3-1}{3+1} = 0.5$$

Finally, compute the monitor parameter:

$$min(Imax) \times \frac{fractol}{max(T)} = \frac{3 \times 0.5}{0.23} = 6.52$$

The monitor parameter is 6.52, so that each of the three observations falls in the **Easy** category.

Coordination with RXTE

All of the observations should be simultaneous (exact overlap if possible) with RXTE. Thus the coordination window is less than 3 days. This requirement falls in the **Difficult** category.

Final Count

This program consists of ONE Very Fast TOO and 3 **Difficult** constrained observations.

History

15 Feb 2006	Initial Version
10 Jan 2007	Cycle 10
10 Jan 2009	Cycle 11

URL: http://cxc.harvard.edu/pog/threads/constrained_count/ Last modified: 10 January 2009