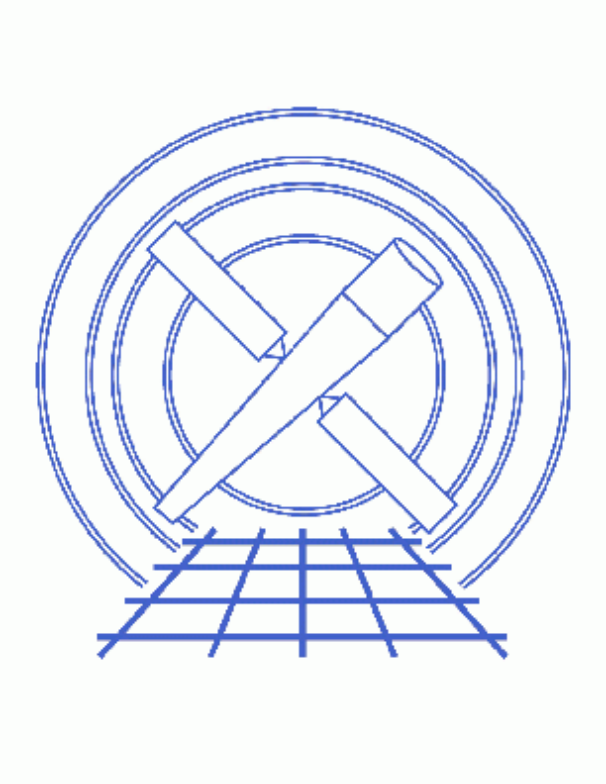
Grids (rasters)−− RPS, Constraints and Scheduling



POG Threads

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Grids (rasters)−− RPS, Constraints and Scheduling

Proposal Threads for

Thread Overview

This thread will describe an observation which requires several adjacent ACIS pointings (i.e. a raster or a grid). It is based on the Cycle 5 SWIRE Survey (Proposal 05900547). The survey consists of nine 70 ks pointings in a 3x3 grid covering 0.6 square degrees in the vicinity of the Lockman Hole. The four ACIS−I chips are used. The layout of the fields is shown schematically in this figure  .

Prior to Cycle 9, it was necessary to enter the target coordinates of all 9 pointings into the RPS form as separate pointings. It is now possible to specify a grid with 4 parameters as described below. In this thread, we show how to specify a grid in RPS. The roll angles of observations in a grid will not necessarily "line up". We show how to constrain the observations if your science were to require that there are no gaps in the survey.

RPS Grid Parameters

As stated in the introduction, prior to Cycle 9 it was necessary to enter each survey position as a separate target. This could be quite time consuming for surveys with a large number of pointings. It is now possible to specify a grid in one of two ways:

- Enter each position as a separate target. This is the "old" way and works well for a small number of pointings.
- Use the new grid parameters. These are:
  - ♦ Coordinates of survey center
  - ♦ Number of pointings
  - ♦ Distance from the survey center to the farthest grid pointing
  - ♦ Total exposure time (sum of all pointings)

Use of the term "grid" is slightly misleading in that the survey region can be irregular; it does not need to be a rectangle.
For the SWIRE survey we use the following RPS inputs:

- Target Coordinates: RA=10:46:00.00, Dec=+59:01:00.00
- Set the flag "Is this observation (part of) a grid?" to Yes
- Number of Grid Pointings=9
- Total Observing Time 630 ks
- Distance from center to farthest grid pointing=0.59 degrees.
  Here we take the farthest point to be the diagonal from the survey center to the aimpoint of any "corner" grid pointing.

Staff from the CXC Director's Office will contact PIs of successful grid proposals after the peer review. PIs must supply a list of target positions at this time.

Slew Tax for Grids

A "slew tax" of 1.5 ks is routinely added to each observation approved at the Chandra peer review. The slew tax is reduced for programs consisting of several closely spaced observations ***if the length of the individual exposure times is less than 15ks***. For longer exposures the slew tax formula reduces to the default 1.5ks per pointing. The slew tax for this survey is therefore ***9x1.5=13.5ks***.

Details of how to calculate slew tax for exposures shorter than 15ks is given in the Call for Proposals and the Slew Tax Worksheet.

Constraints and Scheduling

The observations in a grid are NOT automatically constrained. In practical terms, this means that that they may scheduled at any time during the cycle. Since the nominal roll of Chandra changes with time, the roll angle of each observation may be different. THE ROLL ANGLES WILL NOT LINE UP, as illustrated in this figure. This will most often lead to gaps in the sky coverage.

Please note that it is often most efficient to place several pointings from a survey contiguously in the observing schedule (this minimizes slew time). The number of such pointings that can be accommodated before slewing to a different location on the sky is dependent on the pitch angle of the survey observations. The most likely outcome for a survey with many short pointings is for a group of them to be scheduled together, followed by a second group at a later date, followed by another group until the observations are complete. Observations within a group will have essentially the same roll, but different groups will have different rolls (illustrated here)

If it is essential to have uniform coverage, the proposer must restrict the roll angles of the observations. This can be done is two ways:

- Impose a roll constraints (with associated tolerances) if the roll angle of the survey must be fixed.
- A group constraint should be used if the absolute value of the roll is not important, but the pointings should "line up". A group constraint forces all the observations to be done within a certain time interval, but does not specify the exact window (e.g. all done within 30 consecutive days, but the 30 day period can start at any time during the cycle).

Determine Roll Tolerance

It is important not to have gaps in the coverage of the SWIRE survey. The absolute value of the roll is not important. The maximum acceptable change in roll between two adjacent pointings is illustrated in the following figures.

- Two adjacent fields at zero roll angle. Note the overlap between the two chips
- Two adjacent fields where the second field is rotated: this is NOT acceptable because there is a gap.

- Two adjacent fields with maximum roll difference  . Further rotation will create a gap. This geometry is correct if the overlap between two adjacent chips is small compared to the width of the chips (in this case the overlap is 1 arcmin and the ACIS−I chips are 16 arcmin on a side).

The maximum roll (theta) is calculated from:

cos(45 − theta) = 8/10.6
45 − theta = 41
theta = 4 degrees

Evaluate Group Constraint

The roll angle may change by a maximum of +/−4 degrees between the first and last pointing. The corresponding time interval can be estimated using the web version of the ObsVis tool. Enter the coordinates of the SWIRE field center (RA=10:46:00.00, Dec=+59:01:00.00) in the box labeled "Target Coordinates" and hit the "View Data" button. The resulting page is an ascii list of roll and pitch values as a function of time. It is possible to get this information graphically by hitting the "view Data" button. The first column column gives the MJD, the second column the nominal roll. Inspection of this file, and the plot, shows that a reasonable estimate for the rate of change of roll with time is 5 degrees per week. Therefore, +/−4 degrees tolerance translates to +/− one week, or a group interval of 14 days. The RPS group parameters are set as follows:

- Set Group Observation Flag to Y
- Enter "Group Identification" as SWIRE (can be any string to identify targets)
- Time Interval for Group=14 days

Number and Type of Constrained Observations

Starting in Cycle 9, constrained observations will be classified as "Easy", "Average" or "Difficult" (see the Call for Proposals and Constrained Observations Worksheet). The dimensionless grading parameter for a group constraint is as follows:

$$\frac{\text{Time Interval for the Group}}{\text{Total Duration of Observations in the Group}}$$

The time interval for the group is 14 days. The total duration of the observations is 70x9=630 ks or 7.3 days. The grading parameter is 1.92. According to Table 5.1 of the Call for Proposals, this counts as 9 ***Difficult*** observations. Please note that if the exposure time for each observation was 15 ks or less, the number of time constrained observations would be charged at a reduced rate, as described in the Slew Tax Worksheet.

Summary

Using the SWIRE survey as as example, this thread shows how to plan a grid observation i.e. several adjacent or close pointings. Prior to Cycle 9, it was necessary to enter each pointing into the RPS form as a separate target. It is now possible to specify a survey with 4 parameters −− total exposure time (sum of all pointings), coordinates of

survey center, number of pointings, and distance of the furthest pointing from the survey center. For the purposes of filling in RPS forms, a "grid" can be an irregular region!

The observations in a grid will not necessarily "line up". This is because the nominal roll angle of Chandra changes with time. Observations done at different times will have different roll angles. If your science demands that the observations "line up", it is necessary to impose a roll or group constraint.. A roll or group constraint will limit the time when the observations can be carried out. For the SWIRE survey we calculate the maximum acceptable roll angle change, and use ObsVis to evaluate the corresponding group constraint. Finally, we use the grading scheme in the Call for Proposals to determine that the SWIRE survey counts as 9 ***difficult*** observations.

RPS Forms

SWIRE RPS FORM

History

10 Feb 2007	Initial Version

URL: http://cxc.harvard.edu/pog/threads/grids/ Last modified: 10 February 2007

Image 1: Schematic: SWIRE fields of view

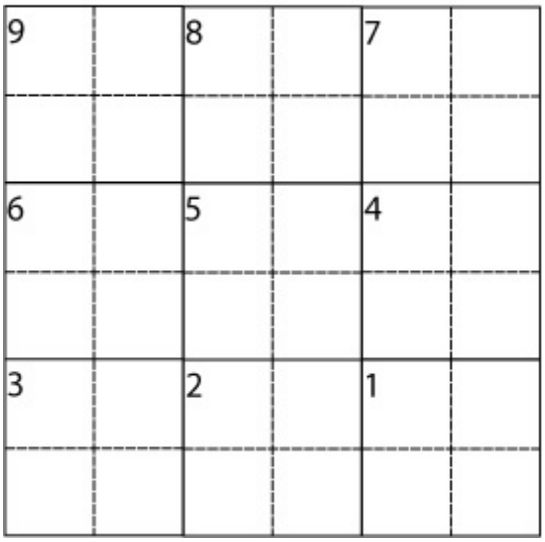


Image 2: Schematic: possible SWIRE pointings with no roll constraint.

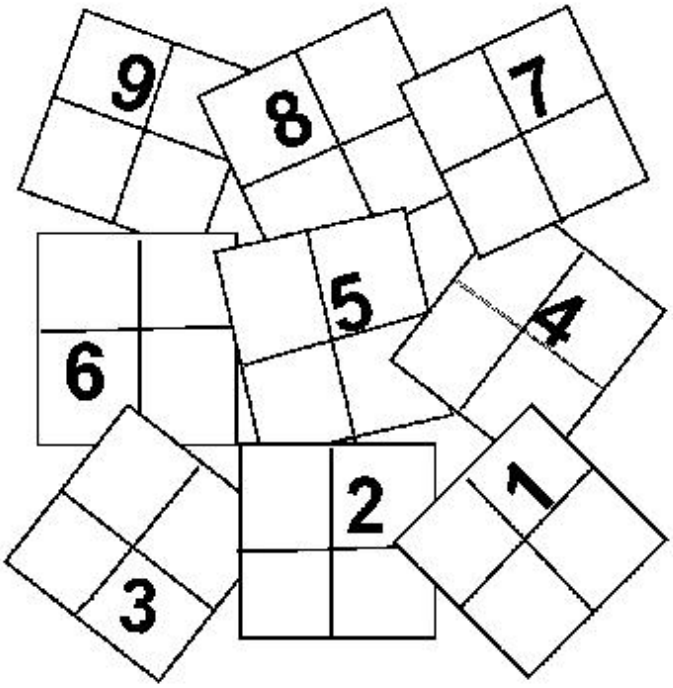


 Image 2: Schematic: possible SWIRE pointings with no roll constraint.

Image 3: Schematic illustrating probable outcome of no roll constraint on a survey with many pointing.

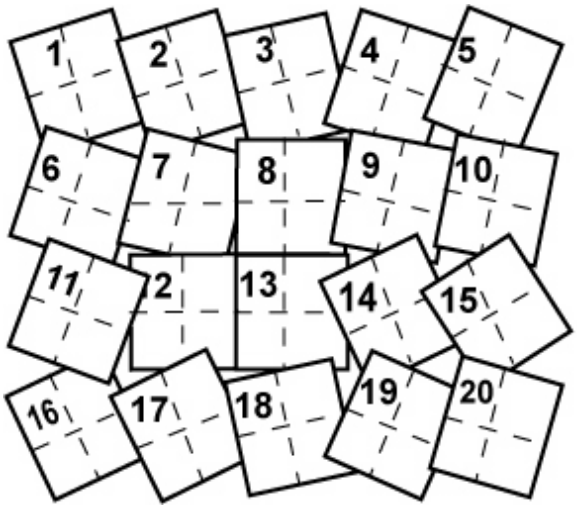


Image 4: Two adjacent pointings at zero roll. Note the overlap between chips.

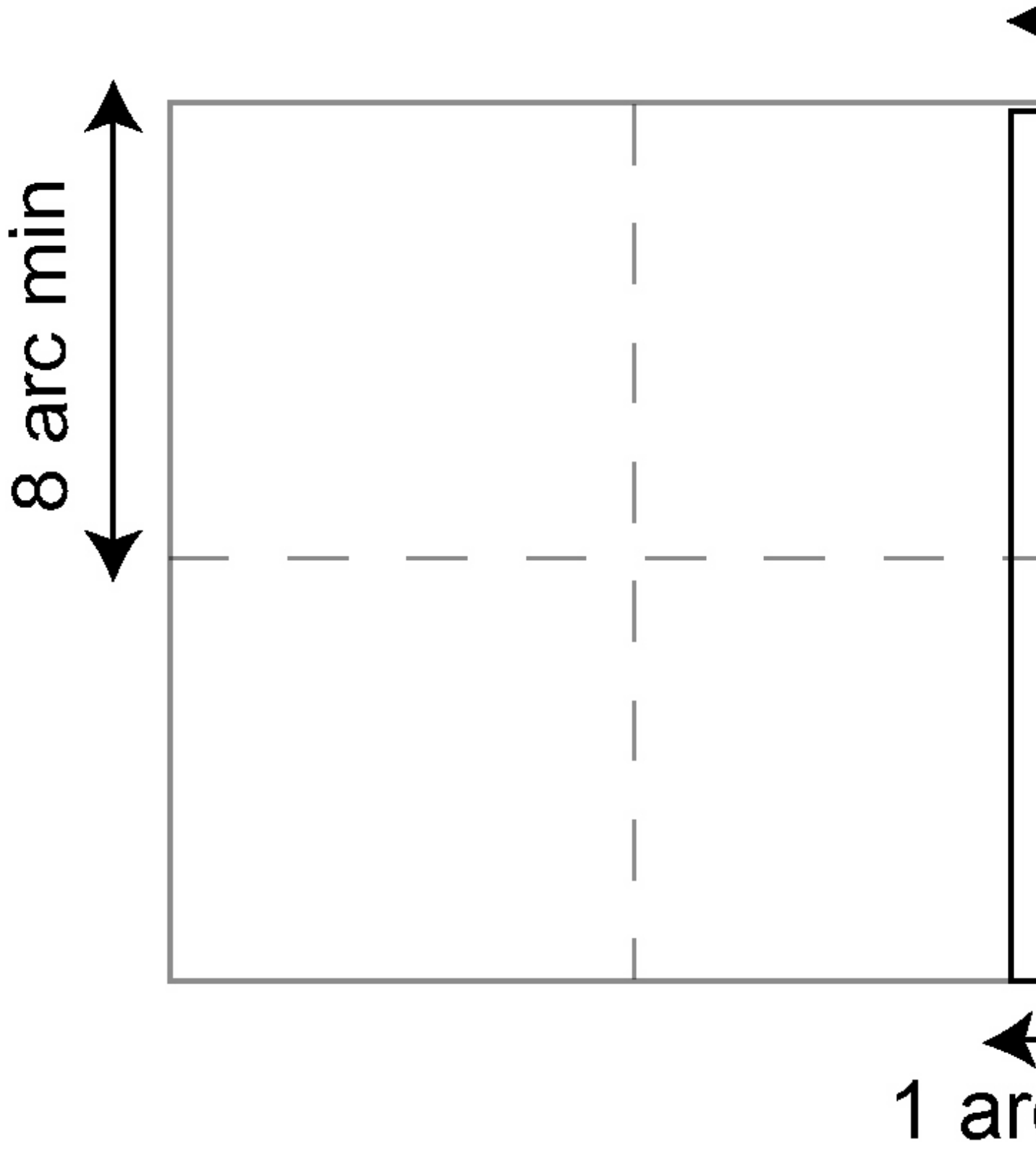
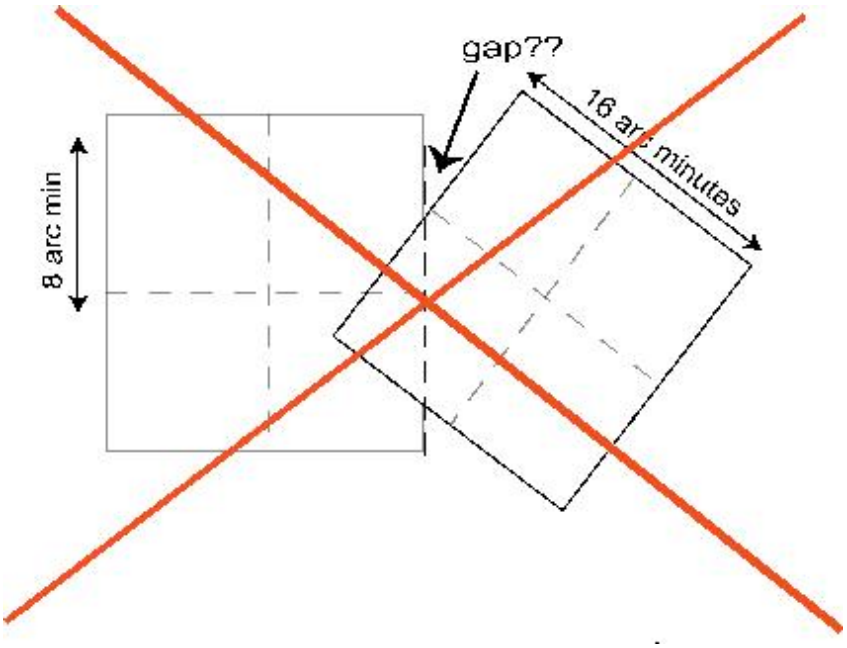


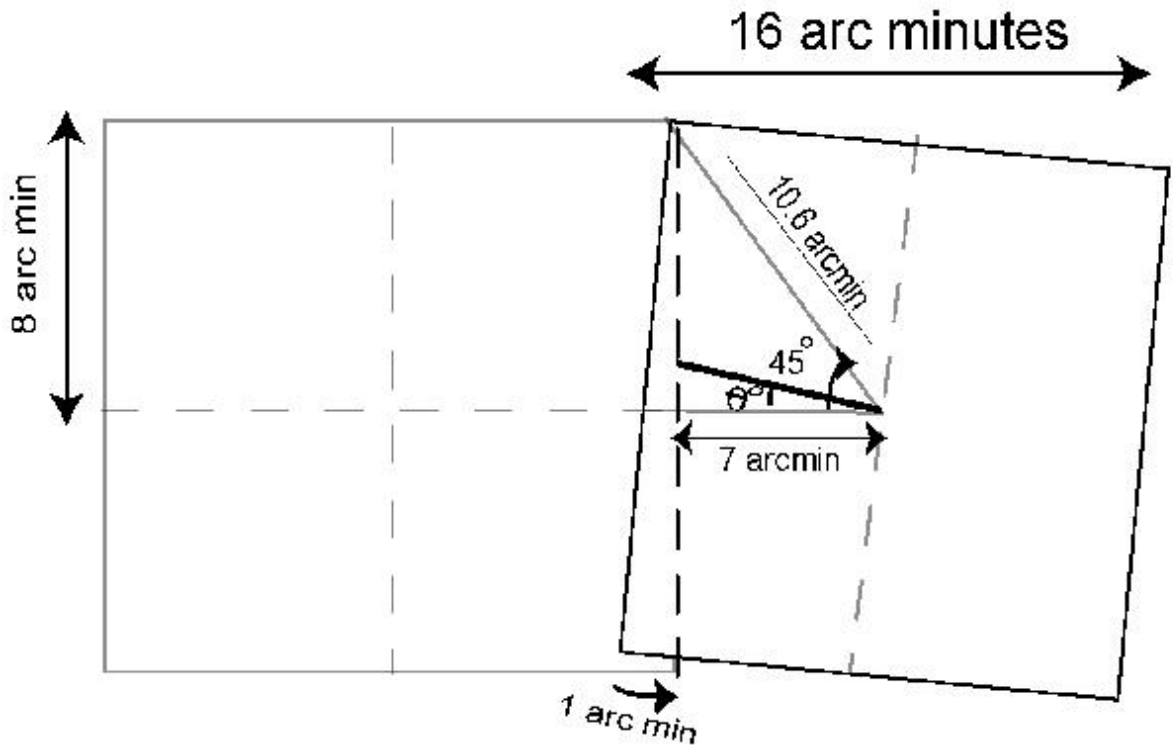
Image 4: Two adjacent pointings at zero roll. Note the overlap between chips.

Image 5: Two adjacent pointings. The roll of the second pointing is such that a gap has been introduced. This is unacceptable.



adjacent pointings. The roll of the second pointing is such that a gap has been introduced. This is unacceptable.

Image 6: Maximum allowed roll change.



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