The ABC of XTE

Screening

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Introduction

Screening means getting rid of invalid or unwanted data - data taken, for example, when the target was at the edge of the field of view. In practice, screening entails applying various criteria to create good time intervals (GTI) which include only the good data. These GTI are then implemented when light curves and spectra are extracted.

This chapter describes the various screening criteria and how to create GTI. The basic scheme is that the screening criteria are constructed from quantities contained in the filter file which is used as input by the GTI-generating ftool **maketime**. As an intermediate step, we recommend plotting selected columns in the filter file (with the ftool **fplot**) before running maketime.

Screening Criteria

Listed below are the quantities in the filter file which are important in screening data. This list is based on experience as the mission has progressed, and may continue to grow as the mission continues to mature.

Please note that the full list of filter file columns can be displayed by running the ftool **flcol** on a filter file.

Current List of Screening Criteria and Corresponding Columns in the Filter File

1. **OFFSET(pointing position):** This column gives the difference between the source position and the pointing of the satellite. When you plot this column, you will usually see the effects of

HEXTE's rocking motion; this should be on the order of 10^-3 degrees and is negligible. Sometimes, however, the on-source data file will contain short stretches of slew data at the beginning or end of an observation. These should be filtered out using the criterion "OFFSET < 0.02".

2. **ELV (elevation angle):** This column contains the instantaneous angle, in degrees, between the Earth's limb and the target subtended by the spacecraft. It is determined from orbit and attitude information.

   As the Earth's atmosphere absorbs X-rays, preferentially at low energies, the shape of the source spectrum is distorted when the elevation angle is low. We recommend restricting the elevation to be greater than 10 degrees for spectral studies. A lower limit can be used for timing studies.

   Plotting the elevation angle will not only show its range, but also whether the target is occulted by the Earth (when the elevation angle is less than zero).

3. **PCUn_ON and NUM_PCU_ON:** The instantaneous voltage, in volts, across the three PCA layers in PCU0 is contained in the `hvXE_PCUo` column. When the PCA is collecting scientific data, the voltage is high and steady (with very small fluctuations). When the PCA is not collecting scientific data, e.g. when it passes through the South Atlantic Anomaly, the voltage is reduced. PCU0_ON is a boolean calculated to be 1 only when the PCU is completely turned on. You can plot all of the PCUn_ON columns to see which detectors are on one at what times; usually, they all go off and on together as they go in and out of SAA. The column NUM_PCU_ON, as it sounds, is the sum of these columns; ideally, it goes from 0 to 5 in a simple step. Sometimes, however, PCU's 3 and 4 will be turned off indepenedently, so these columns should be checked. Data where different numbers of PCU are on must be analyzed separately, so the PCUn_ON or NUM_PCU_ON column can be used as a selection criterion.

4. **TIME_SINCE_SAA:** This column gives a parameterization of coordinates relative to the SAA which represents the time since the peak of the last SAA passage. It is parameterized so that is jumps to negative values before SAA, and has a value of 99.99999 for orbits in which there is no SAA passage. When TIME_SINCE_SAA is between zero and 30 minutes, the background will increase dramatically, resulting in a lowering of the signal to noise. For faint sources, you may wish to discard such data.

5. **ELECTRONn:** The PCA is subject to contamination from electrons trapped in the earth's magnetosphere or from solar flare activity. Such electrons, measured by the coincidence of events between the PCU propane layer and either of the two anodes in the first layer, increase the background at low energies. These values are usually identical across all the PCUs. For faint sources, we recommend screening for values of ELECTRON0 < 0.1.

Plotting the Filter File

Like most FITS files, filter files can be plotted using the ftool **fplot**. The program prompts the user for the column containing the x-axis and then for the columns to be used on the y-axes. It calls the same

PGPLOT subroutines as Xspec and Xronos.

For example, here's the screen dialogue that corresponds to plotting elevation angle (`ELV`), pointing direction (`POINT_RA`, `POINT_DEC`) and PCA high voltage (`hvXE_PCU0`) against time (`Time`) from the filter file FP_3c8fbb1-3c930a9.xfl:

```
rufus [46] [day] filter: fplot FP_3c8fbb1-3c930a9.xfl offset=yes
Name of X Axis Parameter[error][Time] Time
Name of Y Axis Parameter[error] up to 8 allowed[ELV] ELV OFFSET PCU0_ON PCU3_0N PCU4
Lists of rows[-]
Device: /XWindow, /XTerm, /TK, /PS, etc[/te] /xw
```

Please note that fplot can plot at most 10,000 points per graph. If your filter file contains more points, then a series of plots will be displayed. Note too that filter files span entire ObsIds which do not, however, necessarily contain a continuous train of scientific data: the PCA, for example, could be turned off (check, e.g the value of NUM_PCU_ON). The "offset=yes" option produces a plot in which the time axis starts at 0, and the start time of the file is printed at the top of the plot.

Creating GTI

In the RXTE context, the term good time interval (GTI) applies to sets of start and stop times that exist either in the `GTI` extension of data files or in specially created FITS files. The former is described in the Data Files chapter. Here, we'll learn how to make the latter.

In general, GTI files are created with the ftool **maketime** which applies Boolean and/or arithmetic selection criteria to the columns in the filter file and outputs a file containing the time ranges satisfying the criteria. In particular:

- Maketime is a general utility: any file containing a time and other columns can be used to generate GTI, even a light curve. Note, however, that maketime operates on two broad classes of file: "expanded" (one quantity per named column, like RXTE filter files) and "compact" (several quantities per column, like ASCA Housekeeping files).
- Selection criteria may be entered either in Fortran style (e.g. `ELV.GT.10`) or in C style (`ELV>10`). For a full list of permissible expressions, please type **fhelp maketime**.
- The times in the GTI file are in the same units as in the input file. In the case of RXTE filter files, these are SCCS (spacecraft clock seconds), the same as in the data files.

Here's an example of using maketime on a filter file. We'll create the GTI file **basic.gti** from the filter file **FP_3c7a9f5-3c855c1.xfl** containing the times when the elevation angle was bigger than 10 degrees, when the OFFSET was less that 0.02 to cut out a slew at the beginning, and when three PCU's were on (the other two being off for the entire observation):

```
olegacy [84] [day] ~: maketime
Name of FITS file and [ext#][] FP_3c7a9f5-3c855c1.xfl
Name of output FITS file[] basic.gti
Selection Expression[] elv.gt.10.and.offset.lt.0.02.and.num_pcu_on.eq.3
```

```
Column containing HK parameter names[NAME]
Column containing HK parameter values[VALUE]
Column containing HK parameter times[TIME]
Flag, yes if HK format is compact[yes] no
```

Note that for analysis of faint sources, we recommend the additional expressions `(TIME_SINCE_SAA > 30 || TIME_SINCE_SAA < 0.0) && ELECTRON0 < 0.1`, which will filter out data within thirty minutes of the peak of SAA and data with high electron contamination. Note also that the current version of this tool is not case sensitive in the column names and that the last input has the default of 'yes' which must be changed to 'no' for XTE data.

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The ABC of XTE *is written and maintained by the RXTE GOF. Please email* `xtehelp@athena.gsfc.nasa.gov` *if you have any questions or comments. This particular page was last modified on Wednesday, 21-Oct-1998 15:14:35 EDT.*

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