The ABC of XTE

PCA Issues

- Introduction
- PCA & EDS: Structure and Properties
- EDS Configurations

Introduction

This chapter is not a substitute for the parts of the *Technical Appendix* that deal with the PCA (Proportional Counter Array) and the EDS (Experiment Data System). Rather, it covers those aspects of the PCA and EDS that pertain directly to data reduction, namely:

- **How the structure and operation of the PCA and EDS determine the overall structure of the data**
- **How the configuration determines the detailed structure of the data**
- **How the properties of the data determine how they should be reduced.**

Note that although the EDS and PCA are separate subsystems, it is often helpful to consider them as parts of the same thing. For data reduction purposes, *PCA data* means *PCA data that have been processed by the EDS*.

PCA & EDS: Structure and Properties

PCA Structure

The essential aspects of the PCA and how they determine the nature and overall structure of PCA data are as follows:

1. **The PCA comprises five identical coalligned gas-filled proportional counter modules.** Each module is referred to as a PCU, Proportional Counter Unit, numbered 0-4 (but sometimes, informally, 1-5). Depending on the configuration, the data files may contain either the signal summed from all PCUs or separate signals from one or more PCUs.

2. **Each PCU is split into two volumes,** the upper propane veto volume and the main xenon volume. Through these volumes run five layers of anode-wire grids (1 propane veto; 3 xenon, each split into two; 1 xenon veto layer). Below the xenon volume is mounted the Americium-241 calibration source. This arrangement yields a total of nine PCU signal chains:

```
VP        - All propane anodes connected together
XL1 & XR1 - 1st xenon layer of two interleaved sets of anodes
XL2 & XR2 - 2nd xenon layer of two interleaved sets of anodes
XL3 & XR3 - 3rd xenon layer of two interleaved sets of anodes
VX        - xenon veto layer
ALPHA     - events from the calibration source detector
```

   Depending on the configuration, the science data from each PCU may comprise signals from up to six signal chains (XL1-3, XR1-3).

3. **The top layer is the most sensitive.** If your data have anode ID, you'll find that selecting events from only the first layer (anodes XL1 & XL2) will yield higher signal-to-noise than the second layer, the third layer or any combination of layers. This is because significantly more X-ray events occur in the top layer than in the bottom two, whereas the instrumental background depends less on layer.

4. **Each PCU is equipped with a collimator.** This means that each PCU has approximately the same field of view. However, there are slight offsets between them. It also means that **the collimator response must be included in the instrument response**.

5. **Each PCU is covered by a thin window of aluminized mylar.** The effect of the window is to curtail the lower boundary of the pass band at around 2 keV.

6. The PCA team monitors the gain and offset values of the PCA energy-to-channel conversion by analyzing Standard-2 data which contain tagged events from the on-board calibration source. Updated values are sent to the EDS and applied to data in all configurations except the following:

   - Standard-1 & Standard-2,
   - Transparent and
   - GoodXenon

   Tools for generating the response matrices take account of whether the gain and offset have been applied by the EDS.

PCA Properties

The instrumental properties of the PCA are:

```
Energy range:       2 - 100 keV
Energy resolution:  < 18% at 6 keV
Time resolution:    1 microsec
```

```
Spatial resolution: collimator with 1 degree FWHM
Collecting area:    7000 square cm
Sensitivity:        0.1 mCrab
Background:         2 mCrab
```

What PCA Data Are Like Before Being Packaged By The EDS

Before reading about the EDS and its modes and configurations, it's a good idea to review briefly the nature of PCA data before they are packaged by the EDS.

PCA events are passed to the EDS as a series of 19-bit words (with additional start and stop bits) at a rate of ~4 MHz (**i.e. every 1/2**22 seconds**). The PHA information occupies 8 bits (**i.e 256 channels**), the remaining 11 bits being devoted to various discriminator and veto flags. More details in the PCA chapter of the *Technical Appendix*.

EDS Structure and Operation

The EDS takes the single stream of data flowing out of the PCA and processes it simultaneously in up to six different ways before it is telemetered, thereby allowing more than one instrument configuration to be run at one time. Your data tape will therefore contain the same PCA events packaged in up to six different ways.

The key elements of EDS structure and operation are as follows:

1. **The EDS has six EAs (Event Analyzers) devoted to the PCA** (the other two are for the ASM). **Each EA sees all the PCA data** - just as if the original incoming data stream were duplicated five times. The EDS has two identical halves, the "A" side and the "B" side, each with three EAs for the PCA.

2. **Each EA can run in any of seven basic "modes" which are further defined and tuned by a set of parameters (such as energy bin boundaries). The implementation of a mode with specific parameters is known as a "configuration"**. Understanding how the configuration determines the format of your data is very important and is discussed below.

3. **Two of the EAs always run in the "Standard-1" and "Standard-2" configurations. The other four EAs run in configurations specified by the PI on his or her original proposal.**

4. **The EDS, not the PCA, stamps events with their arrival times and performs background rejection.** (Note: "background rejection" is the sifting out of non-X-ray events by on-board electronics. "Background subtraction" is the derivation of the true net signal from a cosmic source, and is covered in its own chapter.)

Much more detail about the EDS can be found in the *Technical Appendix*.

EDS Configurations

EDS Modes

The EDS mode is the broad scheme for packaging PCA data, while the configuration is the specific implementation of the mode. When you work with PCA data, the configuration is more conspicuous than the mode itself - in XDF, for example, you'll specify "Standard-1" data to reduce rather than "Binned Mode" data. In fact, as a general rule, data in different configurations - even of the same mode - should not be reduced together. And of course, contemporaneous data in different configurations must never be combined since they're the same events!

Here, we've summarized the modes and provided links to detailed descriptions of their configurations listed below. These descriptions focus on the data reduction aspects of the configurations, and, where file formats and keywords are discussed, complement the more general information in the Data Files chapter. Given that your data set will include at most half-a-dozen configurations from the much larger number of possibilities, the descriptions are written to be complete and self-contained: you only need to read about your particular configurations:

1. **Event Encoded mode** yields data as a time-series of unevenly spaced events each described by arrival time, pulse height, PCU ID, etc. Configurations comprise:

   - Generic event, e.g. `E_31us_16M_50_1s`
   - Good Xenon
   - Transparent

2. **Binned Data mode** yields data in a time-series of regularly accumulated histograms of pulse height (energy), time and event type. Configurations comprise:

   - Generic binned, e.g. `B_250ms_128M_0_254`
   - Standard-1
   - Standard-2

3. **Single-Bit Code mode** generates a stream of ones and zeros representing events and clock ticks. Generic Single-Bit configurations have names like `SB_125us_0_249_1s`.

4. **Burst Catcher mode** uses two EAs: one to search data and generate a trigger (which may be activated by count rate, rate of change of count rate or hardness), and the other to collect data (which may be in binned or event modes). Configurations comprise:

   - Event Burst Catcher, e.g. `CE_1us_1M_0`
   - Binned Burst Catcher, e.g. `CB_2ms_64M_0_249`

5. **Delta-binned mode** yields data in a time-series of regularly spaced histograms of the times between events. Generic Delta-Binned configurations have names like `D_4us_0_249_1024_64s_F`.

6. **Fast Fourier Transform mode** accumulates simultaneously two channels of 256 time bins (e.g., two energy bands) and averages the power density spectrum and cross spectrum. Generic FFT configurations have names like `F_500us_0_12_249_64s`.

7. **Pulsar Fold mode** yields data in a time-series (counted in pulse periods) of regularly spaced histograms of pulse height (energy), pulsar phase and event type. There are no pre-programmed Pulsar Fold configurations - they must be specially created for each observation.

EDS Configurations: Generic Event

- General Description
- Detailed Description
- Time resolution
- Energy resolution and channel boundaries
- Reduction requirements and options
- Gain and offset

General Description

The generic event configurations are designated with a character string beginning with E, e.g. `E_1us_1M_0_1s`. Files containing Event data are in science event format. The science data occupy the `XTE_SE` extension in the form of individual time-stamped binary event words, one per line, which fill the `Event` column. The words themselves are strings of ones and zeros, the combinations of which define the properties of each event with respect to a template of all possible properties within the configuration. This template is broken up into sections which, depending on the particular configuration, refer to things like PCU ID, PHA channel band, etc. Thus, an individual event word, with its particular combination of ones and zeros, picks out, say, one PCU ID, one PHA channel band, etc. The time stamps occupy the `Time` column, but are also encoded in the event word.

Detailed Description

The naming convention of the configuration provides a summary of the properties of the data. For generic event data, the format

`E_ttt_ccX_ll_rr`

gives

E - mnemonic denoting a generic binned mode

ttt - the time bin size ("us" denotes microseconds)
cc - the number of energy channels
X - the code denoting the binning of the energy channels
ll - the lower channel boundary
rr - the readout time (either 8 s or 1 s)

For example, in the `E_31us_16M_50_1s` configuration, events are time-stamped with 31-microsec resolution, in 16 PHA channel bands with the "M" channel distribution/binning scheme starting at channel 50, and are read out every 1 second. For a complete list of available Event mode configurations, see the RXTE PCA Configurations page. For more details about the different event mode configurations, please consult the *Technical Appendix*.

The configuration name does not, however, give a complete description of the data. Rather, the key to understanding your Event data lies in "decoding" the event word template. The template itself occupies the `TEVTB2` keyword in the header of the `XTE_SE` extension. It is written in DDL - the Data Descriptor Language - and can be displayed on the screen using the ftool fkeyprint. But since the `TEVTB2` keyword can be somewhat long, it is often better to look first at the neighbouring - and complimentary - `TDDES2` keyword. Also written in DDL, the `TDDES2` keyword describes which events have been selected by the EDS. As an example, here is the value of `TDDES2` in the `E_1us_1M_0_1s` configuration:

```
D[0~4] & E[X1L^X1R^X2L^X2R^X3L^X3R] & C[0~249]
```

which, broken into its parts, means:

- **`D[0~4]`** –events come from detectors 0-4, i.e. PCUs 0-4 (DDL's ~ symbol denotes a range).

- **`E[X1L^X1R^X2L^X2R^X3L^X3R]`** – each event comes from only one of the the six detector elements per PCU, i.e. the six Xe anodes (DDL's ^ symbol denotes an exclusive or).

- **`C[0~249]`** –events come from channels 0-249.

Now let's look at the `TEVTB2` keyword for the same `E_1us_1M_0_1s` configuration:

```
(M[1]{1},D[0:4]{3},T[0.0:0.00390625;9.5367431640625e-07]{12})^
(M[127]{8},S[One5]{5},S[FirstFlag]{1},S[SpillFlag]{1},S[Zero1]{1})^
(M[1]{8},S[LostEvents0]{8})^
(M[2]{8},S[LostEvents1]{8})^
(M[4]{8},S[Zero]{7},S[Spillage]{1})^
(M[8]{8},S[Zero]{5},S[ModeSpecific]{3})
```

This looks intimidatingly verbose. However, the keyword actually contains six alternative templates, each denoted by a M-token (emboldened and rearranged here for clarity) which tells the RXTE software which of the six applies to the row. The last five are for various EDS error flags and are the equivalent in science event format of the Spillage and ModeSpecific columns. It is the first template, prefixed by `M[1]{1}`, which describes the science data. Looking at it in more detail, we have:

- **`D[0:4]{3}`** – Detectors 0-4, i.e. PCUs 0-4 (DDL's **:** symbol indicates a range). The `{3}` means that three bits are used to identify the PCU: 000 identifies PCU0, 001 PCU1, and so on.

- **`T[0.0:0.00390625;9.5367431640625e-07]{12}`** – Timing information. The `{12}` means that twelve bits are used to specify the time when the event occurred. This done by picking out one interval among the 4096 into which the 0.00390625-second "time mark interval" is divided, thereby yielding the resolution of 9.5367431640625e-07 seconds. The zero at the beginning of the token is the value of the offset to be added to the time. **When the original telemetry is converted on the ground to FITS, this timing information is decoded and written into the `Time` column.**

The `TEVTB2` keyword for an Event configuration with PCU *and* anode ID will contain a DDL string which includes a **Z-token**. These special tokens enumerate the combinations of PCU and anode and are explained in the DDL footnote.

Note that the readout time of the configuration has no influence on the structure or properties of Event mode data. Its role is to provide observers with telemetry choices. Note too that running fdump on an Event mode file will *not* provide an ASCII dump of the event words.

The header of the `XTE_SE` extension in generic Event files ends with a coda of keywords describing the status of the EDS.

Time resolution

The time resolution for Event configurations is the resolution of the time stamps. This is not necessarily the same as the number in the name of the configuration, which is an approximation. For example, in the `E_1ms_128M_0_8s` configuration, the step size is really 1/2**10 seconds, i.e. 0.9765625 milliseconds. To derive this number, work out the nearest inverse power of two from the configuration name.

Energy resolution and channel boundaries

The configuration name gives the number of channel bands, but not the channel boundaries themselves, which are denoted by a code letter. To derive the channel boundaries, either look them up in the *Technical Appendix*, or run fdump the data file and look at the header of the `Event` column. The value of the `TEVTB2` keyword gives the channel boundaries. The energy resolution also depends on the configuration: the bins in any spectrum you extract will be the same as the channel bands in the configuration

---

Reduction requirements and options

Spectra and light curves may be extracted from Event mode data using the ftool **seextrct**. Apart from adjusting screening criteria, your primary reduction options include:

- Selecting by applying a bitmask, in particular:
  - PCU IDs (depends on configuration - some do not have PCU ID)
  - anodes, i.e. layers (depends on configuration - some do not have anode ID)

    - channels (depends on configuration - some have only one channel)
- Binning the events into a light curve
- Binning the events into a spectrum (depends on configuration - some have only one channel)

For complete details on working with Event mode data, see the RXTE Cookbook recipe Reduction and Analysis of PCA Event-Mode Spectra.

Gain and offset

Gain and offset corrections *are* applied by the EDS to generic Event data.

EDS Configurations: Good Xenon

- General Description
- Detailed Description
- Time and energy resolution
- Reduction requirements and options
- Gain and offset

General Description

The Good Xenon configurations use two Event Analyzers simultaneously to provide detailed spectral and temporal information about every event that survives background rejection. There are two pairs of Good Xenon configurations:

1. `Good_Xenon1_2s` *with* `Good_Xenon2_2s` (the 1 and 2 denote the two EAs; the 2s is the readout time)

2. `Good_Xenon1_16s` *with* `Good_Xenon2_16s` (again, the 1 and 2 denote the two EAs; 16s is the readout time).

Before you reduce Good Xenon data, you must combine matched pairs of files from the two EAs. The Perl script **make_se** will accomplish this task. The description of the data files that follows assumes the combination has been completed.

Files containing Good Xenon data are in science event format. The science data occupy the `XTE_SE` extension in the form of individual time-stamped binary event words, one per line, which fill the `Event` column. The words themselves are strings of ones and zeros, the combinations of which define the properties of each event with respect to a template of all possible properties within the configuration. This template is broken up into sections - one for the PCU ID, one for the anode ID, and one for the PHA channel. Thus, an individual event word, with its particular combination of ones and zeros, picks out one PCU ID, one anode ID and one PHA channel. The time stamps occupy the `Time` column.

Detailed Description

The key to understanding and manipulating your Good Xenon data lies in "decoding" the event word template. The template itself occupies the `TEVTB2` keyword in the header of the `XTE_SE` extension and is written in DDL - the Data Descriptor Language. Its value for Good Xenon is:

```
(M[1]{1},S[Zero]{6},D[0:4]{3},E[0:63]{6},C[0:255]{8})
```

which, broken down into its parts, means:

- **`(M[1]{1}... )`** – Unlike other event mode configurations, each row in a Good Xenon file contains only one kind of event, namely, valid science events. Like other other event mode configurations, these science events are identified with an M-token, the value of which is `M[1]{1}`.
- **`S[Zero]{6}`** –Housekeeping check. Each valid bitmask is preceded by six zeroes.
- **`D[0:4]{3}`** – Detectors 0-4, i.e. PCUs 0-4 (DDL's `:` symbol indicates a range). The `{3}` means that three bits are used to identify the PCU: 000 identifies PCU0, 001 PCU1, and so on.
- **`E[0:63]{6}`** – Detector element, i.e. xenon anode. The `{6}` means that six bits are used to identify the Xe anode: 000001 identifies X1L, 000010 X1R, and so on. Note that some software, notably sefilter, requires the binary substring to be entered as a base-ten number, e.g. 1 identifies X1L, 2 X1R, 4 X2L, 8 X2R, and so on.
- **`C[0:255]{8}`** – PCU Channel. Good Xenon provides the full 256 channel range. The `{8}` means that eight bits are used to identify one of the 2**8 channels.

Note that the readout time of the configuration (2 or 16 seconds) has no influence on the structure or properties of Good Xenon data. Its role is to provide observers with two telemetry choices. Note too that running fdump on a Good Xenon file will *not* provide an ASCII dump of the bitmask.

Time and energy resolution

The resolution of the time stamps in Good Xenon is 1/2**20 seconds, i.e. 0.95367431640625 microsec. This is the value of the `TIMEDEL` keyword in the header of the `XTE_SE` extension. Good Xenon provides the full 256-channel pass band of the PCA.

Reduction requirements and options

Once **make_se** has been run on the Good_Xenon_1 and Good_Xenon_2 pairs,the resulting files are reduced as event files using **seextrct**. Apart from adjusting screening criteria, your primary reduction options include:

- Selecting (by applying a bitmask):
    - PCU IDs
    - anodes, i.e. layers
    - channels
- Binning the events into a light curve
- Binning the events into 256-channel spectra

For complete details on working with Event mode data and GoodXenon data, see the RXTE Cookbook recipe Reduction and Analysis of PCA Event-Mode Spectra.

A further option is to convert the data from their event-word format into the more understandable, but more expansive, event file format which has explicit columns for the PCU ID etc. - similar to ASCA and ROSAT event lists. The conversion is effected, when you merge the two EAs, by running xenon2fits with the `wrtparm=a` option. Note that you will have to use the extractor ftool rather than seextrct to extract events. You will, however, be able to read the entire events file into xronos which cannot handle bitmasks at the moment.

Gain and offset

Gain and offset corrections are *not* applied by the EDS to Good Xenon data.

EDS Configurations: Transparent

The Transparent configurations use three Event Analyzers simultaneously to provide detailed spectral and temporal information about every event in all nine signal chains without applying background rejection to the xenon events. They offer the closest thing to "straight from the cow" PCU events, and, as such, are not much use for astronomical observations. For further details, please consult the *Technical Appendix*.

EDS Configurations: Generic Binned

- General Description
- Detailed Description
- Reduction requirements and options
- Gain and offset
- Other features

General Description

The generic Binned configurations are designated with a character string beginning with B, e.g. `B_250us_2A_0_17_Q`. Files containing Binned data are in science array format. The science data occupy the `XTE_SA` extension in the form of histograms accumulated from good xenon events (i.e. those which survive background rejection, but sometimes including propane veto events) according to time, in two or more channel bands. The columns containing the histograms are preceded by the `Time` column which gives the time of the *start* of each accumulation.

Detailed Description

The naming convention of the configuration provides a summary of the properties of the data. For generic binned data, the format

`B_ttt_ccX_0_hh_b`

gives

B	- mnemonic denoting a generic binned mode
ttt	- the time bin size ("us" denotes microseconds)
cc	- the number of energy channels
X	- the code denoting the binning of the energy channels
hh	- the upper channel boundary
b	- the code denoting the number of bits used.

For example, in the `B_250us_2A_0_17_Q` configuration, two histograms with ~250-microsecond resolution are accumulated from channels 0 to 17, with the "A" channel distribution/binning scheme. "Q" means that there are 4 bits per bin, i.e. that up to 16 counts can be accumulated per ~250 microseconds without overflowing the telemetry. For a complete list of available Binned mode configurations, see the RXTE PCA Configurations page. For more details about the different binned mode configurations, please consult the *Technical Appendix*.

While the configuration name provides a summary of the properties of the data, further information is written in the file itself. This more detailed information is accessible via the ftools **fstruct**, **flcol**, **fdump** and **fkeyprint**. We recommend that you run these tools on sample files (one, say, per configuration), starting with fstruct, the least verbose. Here are the key pieces of information, and where to find them:

1. **What is the true time resolution?** The time resolution for Binned configurations is the step size of the histograms. This is not necessarily the same as the number in the name of the configuration, which is an approximation. For example, in the `B_250us_2A_0_17_Q` configuration, the step size is really 1/2**12 seconds, i.e. 244.140625 microseconds. To derive this number, work out the nearest inverse power of two from the configuration name.

2. **What are the channel boundaries and energy resolution?** The configuration name gives the number of channel bands, but not the channel boundaries themselves, which are denoted by a code letter. To derive the channel boundaries, either look them up in the *Technical Appendix*, or run fdump on the data file and look at the header of the second column, i.e. the one containing the science data. The value of the `2CPIX2` keyword gives the channel boundaries. For example, in the `B_250us_2A_0_17_Q` configuration, the value of `2CPIX2` is `'0~11,12~17'` which tells you that the two bands cover channels 0-11 and 12-17. Fkeyprint can also give the value of `2CPIX2`. The energy resolution depends on the configuration: the bins in any spectrum you extract will be the same as the channel bands in the configuration

3. **Are PCU combined or selectable? Is the propane layer included?** A few Binned configurations with "low" time resolution (500 ms, 62 ms) separate data by PCU. This is not directly apparent from the configuration name. To find out whether your data have PCU ID, or if they include the propane layer, you can either look up the configuration in the *Technical Appendix* or run flcol on the data file. For example, in the `B_500ms_46M_0_49` configuration, the column names are `Time`, `XeCntPcu0, XeCntPcu1, XeCntPcu2, XeCntPcu3, XeCntPcu4, VpCntPcu0, VpCntPcu1, VpCntPcu2, VpCntPcu3` and `VpCntPcu4` - clearly indicating that the data have PCU ID and include the propane veto layer. By contrast, in the `B_16ms_16B_0_49_H` configuration, the column names are just `Time` and `XeCnt`, indicating that all PCU are combined and that no propane data are present.

Note that the accumulation time of the histograms is *not* a key piece of information for most users, as it only dictates the arrangement of the data in the file, rather than their scientific properties. The RXTE ftool saextrct transparently extracts data without your having to know how many steps each histogram contains or how often the histograms are accumulated. However, if you intend to write your own data reduction software, the accumulation time is crucial. To determine it, use fkeyprint to look at the `DELTAT` keyword. For example, in the `B_250us_2A_0_17_Q` configuration, the value of `DELTAT` is 2 seconds.

The above information - time resolution, channel boundaries etc - is also available in one place in the data file, namely the DDL string which occupies the `TTDES2` keyword. DDL - Data Description Language - is a compact way of describing the properties of the data for downstream software. Although somewhat terse, it is not difficult to read. For example, the value of `TTDES2` for the `B_250us_2A_0_17_Q` configuration is:

```
D[0~4] & E[X1L^X1R^X2L^X2R^X3L^X3R] & C[0~11,12~17] & T[0.0;0.000244140625;8192]
```

which, broken down into its parts, means:

- **`D[0~4]`** –events come from detectors 0-4, i.e. PCUs 0-4 (DDL's ~ symbol denotes a range).

- **`E[X1L^X1R^X2L^X2R^X3L^X3R]`** – each event comes from only one of the six elements per PCU, i.e. the six Xe anodes (DDL's ^ symbol denotes EOR - exclusive or).

- **`C[0~11,12~17]`** two channel ranges, 0-11 and 12-17, are included.

- **`T[0.0;0.000244140625;8192]`** – time steps with zero offset, 0.000244140625 seconds wide, 8192 per histogram

---

Reduction requirements and options

Spectra and light curves are extracted from generic binned data using the ftool **saextrct**. Binned configurations with just a few channels will, of course, result in crude spectra. Apart from adjusting screening criteria, your primary reduction options will always include:

- Increasing the size of time bins when extracting a light curve
- Selecting a channel range when extracting a light curve (Note that saextrct specifies channel ranges according to the 0-255 scale.)

The RXTE Cookbook recipe Reduction and Analysis of PCA Spectra describes reduction of Standard 2 mode data, but also provides general guidelines for reducing any generic binned configuration.

Gain and offset

Gain and offset corrections *are* applied by the EDS to generic Binned data.

Other features

In common with other configurations in science array format, generic Binned files have two additional columns called Spillage and ModeSpecific, as well as a coda of keywords summarizing EDS status.

EDS Configurations: Standard-2

- Packaging of science data
- Time and energy resolution
- Reduction requirements and options
- Gain and offset
- Other features

Packaging of science data

The Standard-2 configuration is a type of binned mode which is run for all observations. Files containing Standard-2 data are in science array format. The science data occupy the first, `XTE_SA` extension and comprise thirty columns of pulse-height histograms (i.e. energy spectra), one for each anode of each PCU, accumulated every 16 seconds (2 seconds if the source is bright). The pulse-height histograms have 129 channels and are accumulated from "good" xenon events (i.e. those which survive background rejection). The columns containing the pulse-height histograms are preceded by the `Time` column which gives the time of the *start* of each 16-second accumulation. To see the column names, run the ftool **flcol** on a sample data file.

Time and energy resolution

The time resolution is 16 seconds (2 seconds if the source is bright). The actual value is stored in the **`DELTAT`** header keyword which you can view with the ftools **fdump** or **fkeyprint**.

The spectra have 129 channels, binned according to the following scheme: channels 1-4 (combined); channels 5-53 (unbinned); channels 54-135 (binned by a factor of 2); channels 136-237 (binned by a factor of 3); channels 238-249 (binned by a factor of 4); channels 250-255 (combined).

Reduction requirements and options

Spectra and light curves may be extracted from Standard-2 data using the ftool **saextrct**. Apart from adjusting screening criteria, your primary reduction options include:

- Selecting and/or combining data from the six anodes in each PCU
- Selecting and/or combining data from the five PCU
- Increasing the size of time bins when extracting a light curve
- Selecting a channel range when extracting a light curve
- Extracting 129-channel spectra

For complete details on using Standard-2 data, see the RXTE Cookbook recipe Reduction and Analysis of PCA Spectra.

Gain and offset

Gain and offset corrections are *not* applied by the EDS to Standard-2 data.

Other features

In addition to the xenon pulse height histograms, Standard-2 files also contain two other sets of data, namely:

1. Five columns of 33-channel pulse-height histograms from the propane veto layer, one for each PCU, accumulated every 16 seconds (shorter if the source is bright)

2. Background data comprising 29 columns of single-value count rates from various anodes, discriminators and veto flags. Details can be found in the *Technical Appendix*.

And in common with other configurations in science array format, Standard 2 files have two additional columns called Spillage and ModeSpecific, as well as a coda of keywords summarizing EDS status.

EDS Configurations: Standard-1

- Packaging of science data
- Time and energy resolution
- Reduction requirements and options
- Gain and offset
- Other features

Packaging of science data

The Standard-1 configuration is a type of binned mode which is run for all observations. The resulting files containing Standard-1 data are thus in science array format. The science data occupy the first, `XTE_SA` extension and comprise five columns of time histograms ("mini light curves"), one for each PCU, accumulated every 128 seconds and combined from all 256 channels. The histograms themselves have a step size of 0.125 seconds and are accumulated from "good" xenon events (i.e. those which survive background rejection). The columns containing the time histograms are preceded by the `Time` column which gives the time of the *start* of each 128-second accumulation.

The columns containing the science data are called `XeCntPcu0`, `XeCntPcu1`, `XeCntPcu2`, `XeCntPcu3` and `XeCntPcu4` (the ftool flcol will display column names). The histograms contain 1024 steps.

Time and energy resolution

The time resolution is 0.125 seconds. There is no energy resolution since all 256 channels are combined into one channel.

Reduction requirements and options

Light curves from Standard-1 data may be obtained by using the ftool **saextrct**. Apart from adjusting screening criteria, your primary reduction options include:

- Selecting and/or combining data from the five PCUs
- Increasing the size of time bins when extracting a light curve

---

Gain and offset

Gain and offset corrections are *not* applied by the EDS to Standard-1 data.

Other features

In addition to the time histograms, Standard-1 files also contain 256-channel spectra from the internal calibration source, accumulated every 128 seconds. There are 30 columns of calibration spectra, one for each signal chain (the five PCUs have six signal chains each). And in common with other configurations in science array format, Standard-1 files have two additional columns called Spillage and ModeSpecific, as well as a coda of keywords summarizing EDS status.

EDS Configurations: Generic Single Bit

- General Description
- Detailed Description
- Reduction requirements and options
- Gain and offset
- Other features

General Description

The generic Single Bit configurations are designated with a character string beginning with SB, e.g. `SB_500us_50_249_2s`. Files containing Single Bit data are in science array format. The science data occupy the `XTE_SA` extension in the form of single arrays of the time stamp and the counts accumulated within the time resolution. The column containing the arrays is called `XeCnt` and is preceded by the `Time` column which gives the time of the *start* of each accumulation. In addition, Single Bit configurations always:

- combine data from all five PCU and all anodes, and
- contain only one channel band.

The mode is called "single bit" because the Experiment Data System (EDS) onboard RXTE accumulates a stream of ones and zeroes from good xenon events (i.e. those which survive background rejection): a zero indicates a clock tick; a one indicates an event. The XTE Fits Formatter (XFF) converts this bit stream into a science array file which has the same format as binned data.

Detailed Description

The name of the configuration provides an almost complete summary of the properties of the corresponding data. For generic single bit mode data, the format

```
SB_ttt_ll_hh_rr
```

gives

SB - mnemonic denoting a generic binned mode
ttt - the time bin size ("us" denotes microseconds)
ll - the lower channel boundary
hh - the upper channel boundary
rr - the readout time

For example, in the `SB_500us_50_249_2s` configuration, data are accumulated with ~500-microsecond resolution, in one band from channels 50-249, every 2 seconds. For a complete list of available Single Bit mode configurations, see the RXTE PCA Configurations page. For more details about the different Single Bit mode configurations, please consult the *Technical Appendix*.

The only important property missing from the configuration name is the exact time resolution, which, for Single Bit mode, is the time between clock ticks. This is not necessarily the same as the number in the configuration name, which is an approximation. For example, in the `SB_31us_0_249_500ms` configuration, the clock really ticks every 1/2**15 seconds, i.e. 30.517578125 microseconds. To derive this number, work out the nearest inverse power of two from the configuration name.

Another place to find a description of the data properties is in the DDL string which occupies the `TTDES2` keyword. DDL - Data Description Language - is a compact way of describing the properties of the data for downstream software. Although somewhat terse, it is not difficult to read. For example, the value of `TTDES2` for the `SB_125us_18_35_1s` configuration is:

```
D[0~4] & E[X1L^X1R^X2L^X2R^X3L^X3R] & C[18~35] & T[0.0;0.0001220703125;8192]
```

which, broken down into its parts, means:

- **`D[0~4]`** –events come from detectors 0-4, i.e. PCUs 0-4 (DDL's ~symbol denotes a range).
- **`E[X1L^X1R^X2L^X2R^X3L^X3R]`** – each event comes from only one of the six elements per PCU, i.e. the six Xe anodes (DDL's ^ symbol denotes an exclusive or).
- **`C[18~35]`** –one channel range, 18-35, is included.
- **`T[0.0;0.0001220703125;8192]`** – clock ticks with zero offset, every 0.0001220703125 seconds, 8192 per array.

Note that the read-out or accumulation time only dictates the arrangement of the data in the file, rather than their scientific properties. The RXTE ftool **saextrct** transparently extracts data and assigns times without your having to know how many elements each array contains or how often the arrays are accumulated. However, if you intend to write your own data reduction software, the accumulation time is crucial. It is written in the `DELTAT` keyword, while the number of elements per array is in `TDIM2` keyword.

Reduction requirements and options

Single Bit data may be extracted in the same way as Binned data using the ftool **saextrct**. Note, of course, that because Single Bit data contains just one energy channel, only the light curve will be useful. However, several concurrent Single Bit files may be cobined into a single science array file using the ftool **sbmerge**.

Apart from adjusting screening criteria, the only data reduction option is to increasing the size of time bins when extracting a light curve.

Gain and offset

Gain and offset corrections *are* applied by the EDS to generic Single Bit data.

Other features

In common with other configurations in science array format, Single Bit files have two additional columns called Spillage and ModeSpecific, as well as a coda of keywords summarizing EDS status.

EDS Configurations: Event Burst Catcher

- General Description
- Detailed Description
- Triggers
- Reduction requirements and options
- Gain and offset

General Description

The generic Binned Burst Catcher configurations are designated with a character string beginning with CB, e.g. `CE_16us_64M_0`. Before describing the structure of Event Burst Catcher data, we review how the burst catching works.

Two Event Analyzers are required to catch bursts: one for the trigger, the other for the catcher. The Data Buffer in the catcher EA is divided into four equal parts, one per "Interval". If, say, the trigger is activated during Internal N, the trigger EA will discover this fact during Interval N+1 and the burst flag will be set. During Interval N+2, the flag causes the catcher EA to read into its memory the data for Interval N-1 (the oldest in the Data Buffer) while at the same time accumulating data from Interval N+2 in the appropriate quarter buffer. During the accumulation of N+3 data, the N data are read out, as are the post-onset N+1 and N+2 data. The readouts then cease, yielding a train of data comprising four quarters the second of which contains the burst onset. For more details about how Burst Catcher modes works, please consult the *Technical Appendix*.

Files containing Event data are in science event format. The science data occupy the `XTE_SE` extension in the form of individual time-stamped binary event words, one per line, which fill the `Event` column. The words themselves are strings of ones and zeros, the combinations of which define the properties of each event with respect to a template of all possible properties within the configuration. This template is broken up into sections which, depending on the particular configuration, refer to things like PCU ID, PHA channel band, etc. Thus, an individual event word, with its particular combination of ones and zeros, picks out, say, one PCU ID, one PHA channel band, etc. The time stamps occupy the `Time` column, but are also encoded in the event word.

Detailed Description

The name of the configuration provides a summary of the properties of the corresponding data. For Event Burst Catcher data, the format

`CE_ttt_ccX_l`

gives

CE - mnemonic denoting a event burst catcher mode
ttt - the time bin size ("us" denotes microseconds)
cc - the number of energy channels
X - the code denoting the binning of the energy channels
l - the lower channel boundary (usually 0)

As a special case, there are also GoodXenon1 and GoodXenon2 burst catchers.

For example, in the `CE_8us_32B_0` configuration, 32 histograms with ~8-microsecond resolution are accumulated from channels 0 to 256, with the "B" channel distribution/binning scheme. For a complete list of Binned Burst Catcher configurations, see the RXTE PCA Configurations page. For more details about these configurations, please consult the *Technical Appendix*.

The Event Burst Catcher mode captures 33,767 events (plus time markers) each time a trigger signal is recieved. If the trigger is high-priority, the data are immedidately transferred to the spacecraft. If the trigger is low-priority, the data from the current trigger is stored and data from the previous trigger is sent to the spacecraft.

The remainder of the details of the event burst catcher are the same as the generic event mode.

Burst Trigger Modes

The Event Burst Catcher modes are triggered by a second EA running a Burst Trigger Mode. The trigger EA is synchronized with the catcher EA, so the data have the same Intervals. The `ModeSpecific` column in the `XTE_SA` extension of the trigger data file contains the times of trigger activation. A zero denotes no activation. These configurations will also trigger HEXTE.

There are two flavors of Burst Triggers: High Priority and Low Priority. The corresponding configurations have names beginning with T, e.g. or `TLA_1s_10_249_1s_500_F` and `TLM_31us_0_249_500ms_QN`, respectively. The format for the High Priority Trigger is

```
TLA_ttt_ll_hh_rrr_ccc_b
```

gives

TLA - mnemonic denoting a high priority burst trigger mode
ttt - the time bin size
ll - the lower channel boundary (usually 10)
hh - the upper channel boundary (usually 249)
rrr - the read out time
ccc - the count threshold (in counts/bin)
b - the code denoting number of bits per bin

Low priority triggers are denoted TLM, THM, or TEM, for triggers based on count rate, hardness ratio, or edge, respectively.

For a complete list of Burst Trigger configurations, see the RXTE PCA Configurations page. For more details about these configurations, please consult the *Technical Appendix*.

Time resolution

The time resolution for Event configurations is the resolution of the time stamps. This is not necessarily the same as the number in the name of the configuration, which is an approximation. For example, in the `CE_8us_32B_0` configuration, the step size is really 1/2**17 seconds, i.e. 7.6293945 microseconds. To derive this number, work out the nearest inverse power of two from the configuration name.

Energy resolution and channel boundaries

The configuration name gives the number of channel bands, but not the channel boundaries themselves, which are denoted by a code letter. To derive the channel boundaries, either look them up in the *Technical Appendix*, or run fdump the data file and look at the header of the `Event` column. The value of the `TEVTB2` keyword gives the channel boundaries. The energy resolution also depends on the configuration: the bins in any spectrum you extract will be the same as the channel bands in the configuration

---

Reduction requirements and options

Spectra and light curves may be extracted from Event Burst Catcher mode data in much the same way as for Event mode data using the ftool **seextrct**. Apart from adjusting screening criteria, your primary reduction options include:

- Selecting by applying a bitmask, in particular:
  - PCU IDs (depends on configuration - some do not have PCU ID)
  - anodes, i.e. layers (depends on configuration - some do not have anode ID)
  - channels (depends on configuration - some have only one channel)
- Binning the events into a light curve
- Binning the events into a spectrum (depends on configuration - some have only one channel)

For complete details on working with Event mode data, see the RXTE Cookbook recipe Reduction and Analysis of PCA Event-Mode Spectra.

Gain and offset

Gain and offset corrections *are* applied by the EDS to generic Event data.

EDS Configurations: Binned Burst Catcher

- General Description
- Detailed Description
- Triggers
- Reduction requirements and options
- Gain and offset
- Other features

General Description

The generic Binned Burst Catcher configurations are designated with a character string beginning with CB, e.g. `CB_500us_4M_0_249_H`. Before describing the structure of Binned Burst Catcher data, we review how the burst catching works.

Two Event Analyzers are required to catch bursts: one for the trigger, the other for the catcher. The Data Buffer in the catcher EA is divided into four equal parts, one per "Interval". If, say, the trigger is activated during Internal N, the trigger EA will discover this fact during Interval N+1 and the burst flag will be set. During Interval N+2, the flag causes the catcher EA to read into its memory the data for Interval N-1 (the oldest in the Data Buffer) while at the same time accumulating data from Interval N+2 in the appropriate quarter buffer. During the accumulation of N+3 data, the N data are read out, as are the post-onset N+1 and N+2 data. The readouts then cease, yielding a train of data comprising four quarters the second of which contains the burst onset. For more details about how Binned Burst Catcher mode works, please consult the *Technical Appendix*.

Files containing Binned Burst Catcher data are in science array format. The science data occupy the `XTE_SA` extension in the form of histograms accumulated from good xenon events (i.e. those which survive background rejection) according to time, in one or more channel band. The column containing the histograms is called `XeCnt` and is preceded by the `Time` column which gives the time of the *start* of each accumulation. For Binned Burst Catcher mode, the accumulation time is the same as the Interval. This means that for each trigger activation, there will be a group of four contiguous Intervals - one per row. Binned Burst Catcher data always combine PCU.

Detailed Description

The name of the configuration provides a summary of the properties of the corresponding data. For Binned Burst Catcher data, the format

`CB_ttt_ccX_ll_hh_b`

gives

CB - mnemonic denoting a binned burst cather mode
ttt - the time bin size ("us" denotes microseconds)
cc - the number of energy channels
X - the code denoting the binning of the energy channels
ll - the lower channel boundary
hh - the upper channel boundary
b - the code denoting the number of bits per bin

For example, in the `CB_500us_4M_0_249_H` configuration, four histograms with ~500-microsecond resolution are accumulated from channels 0 to 249, with the "M" channel distribution/binning scheme. "H" means that there are 8 bits per bin, i.e. that up to 256 counts can be accumulated per ~500 microseconds without overflowing the telemetry. For a complete list of Binned Burst Catcher configurations, see the RXTE PCA Configurations page. For more details about these configurations, please consult the *Technical Appendix*.

The configuration name does not, however, give a complete description of the properties of the data. This key information is written in the file itself and is accessible via the ftools **fstruct**, **flcol**, **fdump** and **fkeyprint**. We recommend that you run these tools on sample files (one, say, per configuration), starting with fstruct, the least verbose. Here are the key pieces of information, and where to find them:

1. **What is the true time resolution?** The time resolution for Binned Burst Catcher configurations is the step size of the histograms. This is not necessarily the same as the number in the name of the configuration, which is an approximation. For example, in the `CB_250us_8A_0_249_Q` configuration, the step size is really 1/2**12 seconds, i.e. 244.140625 microseconds. To derive this number, work out the nearest inverse power of two from the configuration name.

2. **What are the channel boundaries and energy resolution?** The configuration name gives the number of channel bands, but not the channel boundaries themselves, which are denoted by a code letter. To derive the channel boundaries, either look them up in the *Technical Appendix*, or run fdump on the data file and look at the header of the second column, i.e. the one containing the science data. The value of the `2CPIX2` keyword gives the channel boundaries. For example, in the `CB_500us_4M_0_249_H` configuration, the value of `2CPIX2` is `'0~35,36~79,80~159,160~249'` which tells you that the four bands cover channels 0-35, 36-79, 80-159 and 160-249. Fkeyprint can also give the value of `2CPIX2`. The energy resolution also depends on the configuration: the bins in any spectrum you extract will be the same as the channel bands in the configuration

3. **What is the Interval time?** The Interval time for Binned Burst Catcher configurations is the same as the histogram accumulation time. It is not encoded in the configuration name. To determine it, use fkeyprint to look at the `DELTAT` keyword. For example, in the `CB_250us_2A_0_249_H` configuration, the value of `DELTAT` is 1 second, so each trigger activation will result in 4 seconds of data.

   Note, however, that while the Interval time determines the duration of the data train, it is otherwise unimportant. For the accumulation time of the histograms only dictates the arrangement of the data in the file, rather than their scientific properties. The RXTE ftool saextrct transparently extracts data without your having to know how many steps each histogram contains or how often the histograms are accumulated. However, if you intend to write your own data reduction software, the accumulation time is crucial.

The above information - time resolution, channel boundaries etc - is also available in one place in the data file, namely the DDL string which occupies the `TTDES2` keyword. DDL - Data Description Language - is a compact way of describing the properties of the data for downstream software. Although somewhat terse, it is not difficult to read. For example, the value of `TTDES2` for the `CB_250us_2A_0_249_H` configuration is:

```
D[0~4] & E[X1L^X1R^X2L^X2R^X3L^X3R] & C[0~35,36~79,80~159,160~249] &  T[0.0;0.000488
```

which, broken down into its parts, means:

- **`D[0~4]`** – events come from detectors 0-4, i.e. PCUs 0-4 (DDL's ~ symbol denotes a range).
- **`E[X1L^X1R^X2L^X2R^X3L^X3R]`** – each event comes from only one of the six elements per PCU, i.e. the six Xe anodes (DDL's ^ symbol denotes an exclusive or).
- **`C[0~35,36~79,80~159,160~249]`** – four channel ranges, 0-35, 36-79, 80-159 and 160-249, are included.
- **`T[0.0;0.00048828125;2048]`** – time steps with zero offset, 0.00048828125 seconds wide, 2048 per histogram.

Burst Trigger Modes

The Binned Burst Catcher modes are triggered by a second EA running a Burst Trigger Mode. The trigger EA is synchronized with the catcher EA, so the data have the same Intervals. The `ModeSpecific` column in the `XTE_SA` extension of the trigger data file contains the times of trigger activation. A zero denotes no activation. These configurations will also trigger HEXTE.

There are two flavors of Burst Triggers: High Priority and Low Priority. The corresponding configurations have names beginning with T, e.g. or `TLA_1s_10_249_1s_500_F` and `TLM_31us_0_249_500ms_QN`, respectively. The format for the High Priority Trigger is

```
TLA_ttt_ll_hh_rrr_ccc_b
```

gives

TLA - mnemonic denoting a high priority burst trigger mode
ttt - the time bin size
ll - the lower channel boundary (usually 10)
hh - the upper channel boundary (usually 249)
rrr - the read out time
ccc - the count threshold (in counts/bin)
b - the code denoting number of bits per bin

Low priority triggers are denoted TLM, THM, or TEM, for triggers based on count rate, hardness ratio, or edge, respectively.

For a complete list of Burst Trigger configurations, see the RXTE PCA Configurations page. For more details about these configurations, please consult the *Technical Appendix*.

Reduction requirements and options

Apart from adjusting screening criteria, your primary reduction options will always include:

- Increasing the size of time bins when extracting a light curve
- Selecting a channel range when extracting a light curve

Depending on the configuration, you may also be able to extract a spectrum (crude, though, for most configurations).

Gain and offset

Gain and offset corrections *are* applied by the EDS to Binned Burst Catcher data.

Other features

In common with other configurations in science array format, Binned Burst Catcher files have two additional columns called Spillage and ModeSpecific, as well as a coda of keywords summarizing EDS status.

EDS Configurations: Delta Binned

General Description

Files containing Delta-Binned data are in science array format. The science data occupy the `XTE_SA` extension in the form of histograms of the time-lags between successive events accumulated from good xenon events (i.e. those which survive background rejection). The column containing the histograms is called `XeLag` and is preceded by the `Time` column which gives the time of the *start* of each accumulation. Note that Delta-Binned configurations always:

- combine data from all five PCU and all anodes, and
- contain only one channel band.

Detailed Description

The naming convention of the configuration provides a summary of the properties of the data. For Delta-Binned mode data, the format

`D_ttt_ll_hh_bbbb_rrr_X`

gives

D - mnemonic denoting a delta-binned mode
ttt - the time bin size ("us" denotes microseconds)
ll - the lower channel boundary
hh - the upper channel boundary
bbbb - the number of bins
rrr - the readout time
X - code denoting the number of bits per bin

For example, in the `D_1us_0_249_1024_16s_F` configuration, histograms of time-lags with ~1-microsecond resolution are accumulated, in one band from channels 0-249, in 1024 steps every 16 seconds. "F" means that there are 16 bits per bin, i.e. that up to 65,536 events can be put in the same 1-microsecond-wide time-lag bin per without overflowing the telemetry. "H" would mean that there are 8 bits per bin.

The only important property missing from the configuration name is the true time resolution, which, for Delta-Binned mode, is the step size of the time-lag histograms. This is not necessarily the same as the number in the configuration name, which is an approximation. For example, in the `D_4us_0_249_1024_64s_F` configuration, the time-lag steps are really 1/2**18 seconds wide, i.e. 3.81469726562 microseconds. To derive this number, work out the nearest inverse power of two from the configuration name.

Another place to find a description of the data properties is in the DDL string which occupies the `TTDES2` keyword. DDL - Data Description Language - is a compact way of describing the properties of the data for downstream software. Although somewhat terse, it is not difficult to read. For example, the value of `TTDES2` for the `D_1us_0_249_1024_16s_F` configuration is:

```
D[0~4] & E[X1L^X1R^X2L^X2R^X3L^X3R] & C[0~249] & L[0.0;9.5367431640&625e-07;1024]
```

which, broken down into its parts, means:

- **`D[0~4]`** –events come from detectors 0-4, i.e. PCUs 0-4 (DDL's ~symbol denotes a range).
- **`E[X1L^X1R^X2L^X2R^X3L^X3R]`** – each event comes from only one of the six elements per PCU, i.e. the six Xe anodes (DDL's ^ symbol denotes an exclusive or).
- **`C[0~249]`** –one channel range, 0-249, is included.
- **`L[0.0;9.5367431640&625e-07;1024]`** – time-lags with zero offset, in steps 9.5367431640&625e-07 seconds wide, 1024 per histogram.

Note that the read-out or accumulation time only dictates the arrangement of the data in the file, rather than their scientific properties. The XTE ftool saextrct transparently extracts data and assigns times without your having to know how many steps each histogram contains or how often the histograms are accumulated. However, if you intend to write your own data reduction software, the accumulation time is crucial. It is written in the `DELTAT` keyword, while the number of steps per histogram is in `TDIM2` keyword.

Warning about overflow and wrap-around

The ability of a given Delta-Binned configuration to accommodate all events depends on the count rate of the source. Of course, once you have your data in hand, it's too late to change the configuration; however, it is important to know the constraints - just in case your observation exceeds them.

For bright sources, the first few bins are susceptible to overflow: the maximum number of time-lags per bin is 256 for configurations ending with "H" and 65,536 for configurations ending with "F".

For weak sources, long time-lags can be a problem. The time-lags themselves are calculated using a 14-bit number, which means that any lags longer than than 2**14 times the step size (time resolution) will wrap around.

Reduction requirements and options

The XTE GOF does not at present supply any software that can reduce or analyze Delta-Binned data.

Gain and offset

Gain and offset corrections *are* applied by the EDS to generic Delta-Binned data.

Other features

In common with other configurations in science array format, Delta Binned files have two additional columns called Spillage and ModeSpecific, as well as a coda of keywords summarizing EDS status.

EDS Configurations: Generic FFT

General Description

The generic FFT (Fast Fourier Transform) configurations are designated with a character string beginning with F, e.g. `F_500us_0_12_249_64s`. Files containing FFT data are in science array format. The science data occupy the `XTE_SA` extension in the form of histograms containing:

- power density spectra (PDS) for two energy bands in the `Pds` column,
- cross spectra (CS) between the two energy bands in the `Xcs` column, and
- the mean count rate in the two energy bands used in the calculation of the PDS and CS.

The PDS and CS are derived from good xenon events (i.e. those which survive background rejection). The columns containing the histograms are preceded by the `Time` column which gives the time of the *start* of each accumulation, i.e. the period over which the PDS and CS are calculated.

Packaging of science data - specific

The name of the configuration provides an almost complete summary of the properties of the corresponding data. For FFT mode data, the format

```
F_ttt_ll_mm_hhh_rr
```

gives

F - mnemonic denoting an FFT mode

ttt - the time bin size ("us" denotes microseconds)
ll - the lower bound of the lower channel
mm - the lower bound of the upper channel
hhh - the upper bound of the upper channel
rr - the readout time (either 16 s or 64 s)

For example, in the `F_500us_0_12_249_64s` configuration, PDS and CS are calculated over 64-second chunks from data with 500-microsecond resolution, in two bands from channels 0-11 and 12-249.

Missing from the configuration name is the fact that the PDS and CS histograms have 129 bins, regardless of the time resolution and accumulation time. In addition, the true time resolution is not necessarily the same as the number in the configuration name, which is an approximation. For example, in the `F_500us_0_12_249_64s` configuration, the PDS and CS are calculated from bins 1/2**11 seconds wide, i.e. 488.28125 microseconds. To derive this number, work out the nearest inverse power of two from the configuration name.

Reduction requirements and options

The XTE GOF does not presently supply any software that can reduce FFT mode data.

Gain and offset

Gain and offset corrections *are* applied by the EDS to generic FFT data.

Other features

In common with other configurations in science array format, FFT files have two additional columns called Spillage and ModeSpecific, as well as a coda of keywords summarizing EDS status.

EDS Configurations: Pulsar Fold

A description of the Pulsar Fold configurations will appear here later.

Please proceed to the *HEXTE Issues* chapter. Or return to the *Table of Contents.*

HEASARC Director: Dr. Nicholas E. White, white@adhoc.gsfc.nasa.gov
Technical Rep: Sherri Calvo, sherri.calvo@gsfc.nasa.gov