ASCA Getting Started Guide (for Revision 2 Data)

Version 6.1

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Contents

1 Introduction

This guide describes ASCA Revision 2 data distributions. Its purpose is to give you the information you need to start working with your data. Specifically, this guide will tell you:

- What is on Your Hardcopy
- How to Read or Obtain Your Data
- What Files are Included in a Distribution, and which ones are really necessary?"

Following these chapters there is a glossary.

This guide does *not* tell you how to reduce or analyze your data. For that we refer you to the

ASCA ABC Guide to Data Reduction and other documentation.

If you have old data processed under Revision 1, this guide may still be useful, but you may want to also consult the

Getting Started Guide for Revision 1 Data.

2 Highlights of Revision 2

This guide describes data processed under Revision 2 Data Processing (hereafter referred to as rev2) Below we highlight the major differences between rev2 and rev1, which preceded it.

You can tell which revision was used to process your data by looking at the processing header page included with your hardcopy. Processing script versions 7.0.0 and higher are rev2. Versions 5.9.9 and earlier are rev1. Versions 6.0.0 – 6.9.9 refer to rev1+ which is a hybrid of rev1 and rev2. Rev1+ employed the same software as rev2 and offered some of its advantages, but mostly mimicked the data products of rev1. Rev1+ data processing began August 30, 1996, and rev2 processing began June 18, 1997.

2.1 No More Raw Files

Rev1 included a large number of "raw" files which were FITS event files created by the ASCA telemetry reader `frfread`. In rev1 these were the basic starting point for data reduction. The problem was that `frfread` produced a new file every time ASCA made a slight change in mode. Since the spacecraft often switches between modes, it was not uncommon to have a thousand of these raw files for a single observation. This was cumbersome for both the users and the processing team. Rev2 does away with the raw files in favor of the unfiltered files, which are basically concatenations of the raw files. In FTOOLS 4.0 and later, `ascascreen` will read the ".unf" files by default. With earlier versions of the FTOOLS you must specify `ascascreen -e unf`.

2.2 Exposure Maps and Exposure-Corrected Images

Rev1 produced FITS format images for each screened event file in detector and sky coordinates. These have been replaced by exposure maps and exposure-corrected images which combine data for all event files from like detectors (i.e. one image for GIS2 and GIS3 and one image for SIS0 and SIS1). For more information on these see the descriptions of the contents of the images directory in the file descriptions section.

2.3 Source Detection

Rev2 runs a source detection algorithm which locates the bright points in ASCA's field of view. It then produces region filter files for each detected source which are used to extract spectra and light curves for each source. The details of the source detection algorithm can be found in the processing script documentation.

2.4 Spectra

Rev2 extracts spectra for each detected source. It then generates response matrices (RMFs and ARFs) for these spectra.

2.5 Light Curves

Rev2 extracts three kinds of light curves:

1. Binned light curves which combine data from all filtered event files and are useful for spotting interesting features in your first look at the data.

2. Housekeeping GIS L1 count rate monitor light curves produced by the `ghkcurve` FTOOL. These are useful for bright sources.

3. Unbinned light curves, which are essentially event files extracted for each source which can be used for fine timing analysis. Note that these files do not carry extraction region information, so spectra should not be extracted from them.

2.6 New Directory Structure

Rev1 distributed all files in six directories: "telem", "raw", "unscreened, "screened", "product" and "aux". The new data products in rev2 make it desirable to have a new directory structure. First, the "raw" directory has been eliminated, since there are no more raw files. Second, the "product" directory has been split into "images", "spectra", and "lcurves" directories to better accommodate the new data products. Finally, a separate "calib" directory is used to hold the calibration files which were formerly in "aux".

2.7 HTML Documentation

Rev2 produces a set of HTML web pages which document the observation, the way it was processed, and the files containing its data. These are much easier to read than the plain ASCII files formerly produced in rev1.

3 What is on Your Hardcopy

Several pages of hardcopy accompany most ASCA data distributions. These include summaries of the observation, the files included in the distribution, and any processing errors. There are also plots of housekeeping parameters, spectra and light curves. The PostScript and HTML files from which the hardcopy was printed are included in each distribution, and CD-ROM distributions allow you to view GIF and JPEG versions of all plots and images on a web browser.

You can find the following things among your hardcopy:

3.1 Processing Header Page

This page lists basic information about the observation including target name, observation date, processing version, and PI names and addresses.

3.2 List of Files

This page lists all the files in your distribution. It gives the size, parent directory, and a brief description of each file.

3.3 Event File Info

This page lists all filtered and unfiltered event files. It gives their exposure times and event counts, and lists all the FITS keywords which distinguish each file from others like it.

3.4 Processing Error Summary

This page lists all the errors encountered in processing. These errors are generally checked by the processing team and usually do not signify serious problems with the data. If you have any questions, contact
ascahelp@ascasrv.gsfc.nasa.gov

3.5 Filter File Plots

There are three plots of housekeeping information taken from the filter file(s). One plot shows parameters used to screen both GIS and SIS data, another shows additional parameters used to screen SIS data, and the third one shows the observing modes used. These are useful to determine the effect of screening criteria on the amount of exposure time. They also show the screening used to create the filtered event files.

3.6 Spectra

PI spectra are plotted for each instrument and source found in the field of view. The FITS format PI files for these spectra are included in your distribution and are useful for your initial analysis of the data.

3.7 Light Curves

Light curves are also plotted for each instrument and source. They will show any unusual flares or dropouts which may originate in the source or the instrument.

4 How to Read or Obtain ASCA Data

ASCA data are distributed to PIs on CD-ROM or magnetic tape. Both proprietary and public data may also be obtained by FTP.

All FITS files contain checksum keywords which may be used to verify that your files were not corrupted in transit. This can be done by using the `fchecksum` FTOOL. Use '`fhelp fchecksum`' for more details.

This chapter consists of three sections as follows:

- Reading Your CD-ROM
- Obtaining Data by FTP
- Reading your Magnetic Tape

5 Reading Your CD-ROM

With the start of AO5, the processing team has replaced most tape distributions with CD-ROMs. You can now analyze your data directly from the CD, without first having to load the data from tape to magnetic disk. CDs are also more reliable than tapes, and they contain a convenient HTML interface to your data and various useful documents.

5.1 Reading Your Disc

This can be as easy as putting the disc in the drive with the gold size up and green side down. On some systems you may need to ask your system administrator to mount the disc as a file system before you can access it.

The discs are written in the standard ISO 9660 format with the Rock Ridge Extensions which permit UNIX-style file names. If the names of the files on your disc are in all caps and are truncated to 8.3 characters (*e.g.*`HOME.HTM` instead of `home.html`), then you need to consult your system administrator about mounting the disc in a way which is compatible with the Rock Ridge Extensions. Most systems, including SunOS, Solaris, and DEC UNIX can do this.

If you have one of the rare systems which do not yet support the Rock Ridge Extensions, all is not lost. You can still access your data, but the file names will be changed. All FITS files hold their original file name in the "FNAME" keyword. However, the HTML links on the disc will not work, since they refer to the original file names. If you prefer, you can contact the processing team through

ascahelp@ascasrv.gsfc.nasa.gov, and we will provide your data by some other means.

5.2 What is on Your Disc

The top level directory on your disc contains one file (`home.html`) and two directories (one named `doc`, and the other named after the sequence number).

The `home.html` file is the top level "home page" for the HTML documentation on your disc. You can read it with your World Wide Web browser, usually by selecting the "open file" or "open local" option or by including the file name on the command line at startup. From the home page you can view all of the hardcopy which usually accompanies a distribution, all of the images and plots produced in processing, and extensive documentation of ASCA and your data.

The `doc` directory contains the documentation referred to by the home page. It is probably easiest to navigate the files and subdirectories below `doc` with your Web browser. They are all accessible by hyperlinks from `home.html`.

The directory named after your sequence number contains all of your data products. For more on these files see the ASCA Distribution Files chapter of this guide.

6 Network Transfer (FTP)

Starting with AO5, you can retrieve your proprietary data from the HEASARC archive. Your proprietary data rights are protected by encrypting your data. After a sequence is processed, the encryption key for that sequence is sent by e-mail to the PIs. This allows the PIs to obtain their data without waiting for postal delivery, to download reprocessed versions of their data, and to share data sets with Co-Is simply by giving them the encryption key.

6.1 How to Get your Encryption Key

After a sequence is processed, the encryption key is automatically e-mailed to the PIs. If you have received your data but have not received the key, the processing team probably does not have your correct e-mail address. You can contact them at

ascahelp@ascasrv.gsfc.nasa.gov to straighten this out.

6.2 How to Get your Data

You can obtain your data directly by FTP from

legacy.gsfc.nasa.gov in the directory /asca/data/rev2. Your data will be in a directory named after the sequence number. For other ways of retrieving your data see the ASCA GOF homepage and select "Archive".

6.3 How to Decrypt your Data

To do this, you need to have the freely available PGP encryption software installed on your system. For more information on obtaining and using PGP see

http://adfwww.gsfc.nasa.gov/asca/pgp/pgp.html.

7 Reading Your ASCA Tape

With the start of AO5 most data sets will be distributed on CD-ROM. However, if necessary, we can still distribute data on Exabyte (8mm) or DAT (4mm) tape. Magnetic tape is often troublesome and requires a large amount of disk space to hold your data.

7.1 Tape Format

ASCA data tapes are in FITS tape format. This means that every file is a FITS file with a record size of 2880 and a block size of 28800. The text, PostScript, and GIF files included on the tape have been converted to FITS format (*i.e.*, FITS wrapped). The first file on each tape is a FITS ASCII table catalog of the files on the tape.

The ASCA/GSFC tapes were created using the Unix command `dd` with the parameter `obs` set to `28800` (see Unix man pages for more information). They should be readable on any system supporting simple blocked data with no labels.

7.2 Reading Your Tape

Your tape is best read with the `ascatape` FTOOL. The IRAF `t2d` program, the Unix `dd` and VMS `copy` utilities will also work, but assigning file names and unwrapping non-FITS files will be up to you. The ASCA processing team and GOF do not support these methods.

The `ascatape` tool allows you to read some or all of the files on your tape and can set up the recommended directory structure. Since ASCA data sets can occupy hundreds of megabytes, `ascatape` can also report the size of a data subset before reading the tape to disk. This will help you keep from exceeding your available disk space.

`ascatape` assigns file names according to a file catalog on the tape. You can consult the FNAME keyword in the primary header of most FITS files to confirm that the files have been named properly.

For more information consult the `ascatape` help page by typing '`fhelp ascatape`'.

7.3 Potential Tape Reading Problems

The Processing Team verifies that all tapes are readable before they are sent. However, tape drives are intrinsically troublesome, and problems can still occur. Below we discuss the most common problems and how to correct them.

Dirty tape drive: Tape drives commonly misread tapes or report I/O errors because their heads are dirty. This is the cause of nearly all tape reading problems. To fix, simply clean the drive heads with a tape cleaning cartridge.

Incorrect read/write permissions: Files from the tape cannot be loaded onto disk unless you have permission to read from the tape drive and write to the file system. Make sure you have permission to do both, and if not, consult your system administrator.

Not enough disk space: If the tape read fails part way through, you have probably run out of disk space. If so, you can use `ascatape` to report the amount of disk space required and either clear some space or select a smaller file set. Also, on Unix systems `ascatape` allows you to spread the files over several partitions by creating the subdirectories as links before the tape is read.

Quirky drive: Some drives don't work right or don't "like" certain tapes. If you can, try reading your tape in a different drive.

Software trouble:`ascatape` has been widely tested and has been stable for several years. Even so, some problems may occur. Make sure that the correct operating system flags were set when compiling `ascatape`. This can be a problem when upgrading from SunOS to Solaris.

Incompatible format: Tape drives can write in different density and compression modes, and larger capacity formats may not be compatible with all drives. Before Summer 1996, sequences which were too large to fit on a low density tape were written in high density. Currently we split such sequences onto more than one low density tape. We never use compression. If you are reading an old tape, tape density may a problem, and you can contact the processing team for a new tape.

Corrupt data tape: All tapes are verified before being sent. However, tapes may still be corrupted in shipping. If none of the above seem to be the problem, contact the processing team and we will send you a new tape.

8 ASCA Distribution Files

Typically there are a few hundred files in an ASCA distribution with a total size of a few hundred megabytes.

This chapter consists of two sections as follows:

- File Names
- File Descriptions

9 Which Files Do I Really Need?

The simple answer is that you need the Unfiltered Event Files which contain all the calibrated but unreduced data, and the Filter File(s) Which contain information needed to filter bad exposure time from the data. These are the only files absolutely needed to run `ascascreen` and begin your data reduction and analysis. Note that if you are using version 3.6 or earlier of the FTOOLS you will need to run "`ascascreen -e unf`" to specify that you are using these files. With FTOOLS versions 4.0 and higher you can just run "`ascascreen`".

If you are a novice ASCA user it would be a good idea for you to read over the File Descriptions section to become familiar with all of the data products. There are many reduced data products which could save you considerable effort at least for your first look at the data.

10 File Name Conventions

Most ASCA file names have one of two forms. The first is a date and time based format used for telemetry files and files derived directly from them. The other is a sequence number based file name, with additional components describing the conditions under which the data were taken. Most files have the sequence number based format.

10.1 Date-Based File Names

Telemetry, attitude, housekeeping, gain history, and filter files all follow a date and time based format (e.g. `ft930415_2053_0240.mkf`). Their names have five parts:

1. A prefix - '`fa`' for attitude files and '`ft`' for all other files.
2. The starting date of the data in the file in 'yymmdd' format.
3. The starting time (UT) of the data in the file in 'hhmm' format.
4. The ending time (UT) of the data in the file, also in 'hhmm' format. Note that files may go past midnight, so the ending time may be smaller than the starting time.
5. An extension specifying the file type (see the descriptions of the individual files).

The example file name given above covers data starting on April 15, 1993 at 8:53 PM UT, and ending at 2:40 AM UT, probably on the following day.

10.2 Sequence Number Based Filenames

Most file names have a sequence number based format (e.g. ad51011020s100102h.unf, ad51011020g210170_0.pi, ad51011020gis25670_hi.totsky). This format has several parts as follows:

1. The string '`ad`' which stands for "Astro-D". This is the pre-launch name for ASCA.
2. The eight-digit sequence number unique to this observation. Some of its digits have special significance. The first digit of the sequence number gives the target type as follows:

- '`1`' - Calibration and Targets of Opportunity.
- '`2`' - Stars
- '`3`' - Cataclysmic Variables
- '`4`' - X-Ray Binaries
- '`5`' - Supernova Remnants and Galactic Diffuse Emission
- '`6`' - Galaxies
- '`7`' - Active Galactic Nuclei
- '`8`' - Clusters of Galaxies and Superclusters
- '`9`' - X-Ray background, Deep Survey, and other

   For non-calibration sequences, the second digit gives the AO number, with '`0`' used for PV phase data. Multiple observations for the same proposal will generally have sequence numbers which differ only in their second-to-last digit.

3. Instrument name. This can be one of '`s0`', '`s1`', '`g2`', or '`g3`' for SIS0, SIS1, GIS2, or GIS3, respectively. Also '`sis`' is used to refer to data which combine SIS0 and SIS1, and '`gis`' is used to refer to data which combines GIS2 and GIS3.

4. Index. This is a three digit number mostly used to keep file names unique. In general a file will have the same index as the file from which it was derived. For image and source list files, the index refers to the number of pixels across the image.

5. Observing mode. This is a two digit code specifying the instrument mode as follows:

   - `01` for SIS Faint mode data.
   - `02` for SIS Bright mode data.
   - `12` for SIS Bright2 mode data.
   - `03` for SIS FAST mode data.
   - `70` for GIS PH mode data.
   - `71` for GIS MPC mode data.

6. Bitrate. This is the single character '`h`', '`m`', or '`l`' for high, medium or low bitrate, respectively. Some of the data products such as images, spectra, and binned light curves may combine data of different bitrates, and therefore do not have a bitrate designation.

7. Source number. Products such as spectra and light curves are extracted for individual sources within the field of view of the instruments. The source number is a single digit separated from the rest of the file name by an underscore. Source '`_0`' is used to refer to the entire field of view with all detected sources excluded.

8. Extension. File names will generally have additional characters separated by an underscore or dot which indicate the file type. See the descriptions of individual file types for more information.

11 File Descriptions

ASCA distributions have a standard directory structure. This structure is present on ASCA CD-ROM distributions and in the HEASARC ASCA archive. When reading data from tape, the `ascatape` FTOOL sets up the standard directory structure automatically.

Below we describe all of the files included in an ASCA distribution, organized by the standard directory in which they reside. The following directories are used for rev2 data:

1. telem
2. unscreened
3. screened
4. images
5. spectra
6. lcurves
7. aux
8. calib

11.1 The "telem" Directory

This directory contains the telemetry files.

11.1.1 Telemetry Files

- **Name:**ft[date-base]
- **Example:** ft930415_2053.024
- **Description:** The raw information as it was transmitted to the ground. These files contain all the scientific and housekeeping information, but in a hard to read format. There is usually only one telemetry file, but some early observations had two or more. Telemetry files are sometimes called "FRFs" or "First Reduction Files". It is unlikely that you will need the raw telemetry, but it is distributed for completeness.

11.2 The "unscreened" Directory

The unscreened directory contains the unfiltered event files.

11.2.1 Unfiltered Event Files

- **Name:**ad[base][bitrate].unf
- **Example:**ad10012000g200170h.unf
- **Description:** These files contain all of the useful data from the telemetry files in a format readable by ascascreen, the FTOOLS, and xselect. These files contain all of the bad data which must be removed before they will yield scientific results. If you wish to fine-tune the selection criteria for reducing the data (common for in-depth analysis), you should start with these files. For FTOOLS 3.6 or earlier you will need to run `ascascreen -e unf` to do this. Separate files contain data taken with different instruments, or when the spacecraft was in different states. The event file list gives a descriptive list of each of these files.

11.3 The "screened" Directory

The screened directory contains the filtered event files.

11.3.1 Filtered Event Files

- **Name:**ad[base][bitrate].evt

- **Example:**`ad10012000g200170h.evt`
- **Description:** These files are the result of passing the unfiltered event files through `xselect` with a standard set of choices for throwing away bad data. The selection criteria used are described in the

  processing documentation, and the specific criteria for each file are given in the processing log. The filtered event files are useful for your initial analysis of the data or if you wish to apply stricter selection criteria than those used to create these files. All of the data products in an ASCA distribution are derived from the screened event files.

11.4 The "images" Directory

This directory contains images and lists of all sources detected in the field of view.

11.4.1 Exposure Maps

- **Name:**`ad[base].totexpo`
- **Example:**`ad51011020gis25670.totexpo`
- **Description:** An exposure map summed over all the filtered event files and over both instruments of a given type (*i.e.* both GIS2 and GIS3 or both SIS0 and SIS1). The exposure maps give exposure times in seconds and do not account for vignetting.

11.4.2 Summed Sky Images

- **Name:**`ad[base]_[all/lo/hi].totsky`
- **Example:**`ad51011020sis32002_hi.totsky`
- **Description:** Counts image summed in the same way as the exposure maps. These files are divided into three energy ranges:
  - '`lo`' means <2keV
  - '`hi`' means >2keV
  - '`all`' means all energies.

11.4.3 Smoothed, Exposure Corrected Images

- **Name:**`ad[base]_[all/lo/hi].smooth`
- **Example:**`ad51011020gis25670_all.smooth`
- **Description:** Images constructed from the summed sky images, and the exposure maps. They have been smoothed with a variable size box-car filter whose size is adjusted so that it smoothes over a minimum of 50 counts. The counts image has been divided by the identically smoothed exposure map. These files are used for source detection in processing.

11.4.4 Source Image

- **Name:**`ad[base]_source.ps`
- **Example:**`ad51011020sis32002_source.ps`
- **Description:** A color PostScript format image showing the smoothed, exposure corrected images with energy bands assigned to colors as follows:
  - red `lo` (<2keV)
  - blue `hi` (>2keV)
  - green `all` (all energies)

  The images are scaled logarithmically with the brightest pixel in each color receiving full intensity and with 2.5 decades of dynamic range. Celestial coordinates (FK5 J2000) and the extraction regions of all detected sources are overlaid on the image. These images are used as the covers for CD-ROM distributions.

11.4.5 GIF Format Images

- **Name:**`ad[base].gif`
- **Example:**`ad51011020gis25670.gif`
- **Description:** Images produced from the `all` energy summed sky images and the exposure maps using ximage. These images have been only minimally smoothed, so they retain more scientific content than the source images.

11.4.6 Source Catalogs

- **Name:**ad[base].src
- **Example:**ad51011020sis32002.src
- **Description:** FITS BINTABLE listing all of the sources detected in the field of view, with their sky coordinate locations, extraction radii, and a flag for whether they are compact or extended sources.

11.4.7 Source Region Files

- **Name:**ad[base]_[source].reg
- **Example:**ad51011020g225670_0.reg
- **Description:** SAOimage/xselect-style region files used to extract data products for each detected source. These regions are indicated on the source images. Although sources are detected in sky coordinates, these region files are in detector coordinates. The coordinates are converted by extracting events near the source peak in sky coordinates, and calculating their centroid in detector coordinates. Detector coordinates are used in the region files in order to extract spectra for which accurate ARFs may be generated. Note that there is no guarantee that these region files will not include off-detector regions (e.g. interchip gaps or areas excluded by area discriminators). These must be accounted for by following these region filters with other region filters which exclude these areas. Source '0' refers to the entire field of view with all detected sources removed. Spectra and light curves are not extracted for the source '0' regions unless there are no detected sources.

11.5 The "spectra" Directory

This directory contains spectra extracted for each source plus response matrices for each spectrum.

11.5.1 PI Spectra

- **Name:**ad[base]_[source].pi
- **Example:**ad51011020g200170_1.pi

- **Description:** Pulse Invariant (PI) spectra readable by xspec. Spectra are extracted for each source from the filtered event files. Data from the event files are combined whenever they would produce a spectrum with the same response matrices. The response matrix keywords (RESPFILE and ANCRFILE) have been set to the corresponding response matrices, but the background keywords (BACKFILE) remain unset. The PI spectra have been grouped to at least 40 events per bin. GIS spectra have been dead-time corrected using the `deadtime` FTOOL.

11.5.2 Spectrum Plots

- **Name:**`ad[base]_[source]_pi.ps`

- **Example:**`ad51011020g200170_1_pi.ps`

- **Description:** PostScript plots of each PI spectrum created with xspec. No background subtraction has been applied to these spectra.

11.5.3 Response Matrix Files

- **Name:**`ad[base]_[source].rmf` or `[instrument][version].rmf`

- **Example:**`ad51011020s010102_0.rmf` -or- `gis2v4_0.rmf`

- **Description:** Detector response matrix. GIS RMFs are epoch independent and have been fairly stable over the course of the mission. SIS response matrices must be generated for each spectrum, due to aging and surface variation of the CCDs. RMFs are necessary for fitting models to spectra.

11.5.4 Ancillary Response Files

- **Name:**`ad[base]_[source].arf`

- **Example:**`ad51011020g200170_1.arf`

- **Description:** The effective area as a function of energy for the x-ray telescopes. ARFs are necessary for fitting models to data.

11.5.5 SIS Area Discriminator Region Files

- **Name:**`ad[base]_[source].discrim`
- **Example:**`ad51011020s010102.discrim`
- **Description:** SAOimage/xselect region filters which exclude areas masked off by the SIS area discriminators. These region filters should not remove any data, but they have been used to ensure that the spectra have proper WMAPS for the `ascaarf` FTOOL.

11.6 The "lcurves" Directory

This directory contains light curves extracted for each source from the filtered event files and light curves from ASCA's on-board count-rate monitors.

11.6.1 Binned Light Curves

- **Name:**`ad[base]_[source].lc`
- **Example:**`ad51011020g200070_1.lc`
- **Description:** Binned light curves combining data from all filtered event files. The binning is set to give a mean of at least 50 counts per bin but to be no smaller than the coarsest time resolution of the parent event files. GIS light curves have been dead-time corrected using the `ldeadtime` FTOOL.

11.6.2 Light Curve Plots

- **Name:**`ad[base]_[source]_lc.ps`
- **Example:**`ad51011020g200070_1_lc.ps`
- **Description:** PostScript format plots of each binned light curve as produced by xronos. The error bars represent one-sigma Poisson errors.

11.6.3 GIS L1 Count Monitor Light Curves

- **Name:**`ft[date-base][G2/G3]HK.lc`
- **Example:**`ft940408_1555_1729G3HK.lc`

- **Description:** Light curves generated from the GIS on-board L1 count rate monitors. These light curves represent counts from the entire visible field of view, but they have a much higher saturation count rate than light curves extracted from events transmitted to the ground. They are therefore useful for very bright objects. One file is extracted from each GIS Housekeeping File The dead-times for these data are very small and have not been corrected for.

11.6.4 Unbinned Light Curves

- **Name:**`ad[base][bitrate]_[source].ulc`

- **Example:**`ad51011020g225670h_1.xtr`

- **Description:** Event files extracted for each source which may be read by xronos. There is one unbinned light curve for each filtered event file. These files are useful for finer timing analysis than is possible with the binned light curves. Note that no region filtering information is contained in these files, so they should not be used to to extract spectra. Doing so will result in inaccurate ARFs.

11.7 The "aux" Directory

This directory contains miscellaneous files produced in processing. The most useful of these are the filter files.

11.7.1 Filter Files

- **Name:**`ft[date-base].mkf`

- **Example:**`ft930415_2053_0240.mkf`

- **Description:** A time history of the condition of the spacecraft and instruments. `xselect` uses this file to filter out bad data from the science files. Filter files are essential for data reduction. There is one filter file for each telemetry file. These are sometimes referred to as "MKF" or "makefilter" files.

11.7.2 Filter File Plots

- **Name:**`ft[date-base]_mkf[c/m/s].ps`

- **Example:**ft940408_1555_1729_mkfc.ps
- **Description:** PostScript plots of important quantities in the filter files and the screening criteria applied to create the filtered event files. The characters in the file name extension have the following meanings:
  - 'c' - Screening criteria common to both SIS and GIS.
  - 'm' - A time history of the instrument modes
  - 's' - Additional screening criteria for SIS instruments.

11.7.3 Attitude Files

- **Name:**fa[date-base]
- **Example:**fa930415_2053.0240
- **Description:** Files specifying the pointing of the spacecraft as a function of time. You will need these files if you want to run the ascalin FTOOL to recalibrate your data. There is one attitude file for each telemetry file.

11.7.4 Gain History Files

- **Name:**ft[date-base].ghf
- **Example:**ft930415_2053_0240.ghf
- **Description:** A time history of the GIS gain derived from measurements of the detector temperatures. You will need these files if you want to run the ascalin FTOOL to recalibrate your data. There is one gain history file for each telemetry file.

11.7.5 Dark Frame Error File

- **Name:**ad[sequence]_[s0/s1].dfe
- **Example:**ad34005000_s0.dfe
- **Description:** A table of dark frame error values collected from all faint mode unfiltered event files. The information in this file is also stored in the filter file.

11.7.6 Processing Header File

- **Name:**ad[sequence]_[ver]_hdr_page.html
- **Example:**ad10012000_001_hdr_page.html
- **Description:** A basic description of the observation and processing. This is the "home page" for the HTML pages generated in processing.

11.7.7 HTML List of Files

- **Name:**ad[sequence]_[ver]_file_info.html
- **Example:**ad51011020_056_file_info.html
- **Description:** A descriptive list of all the files in the distribution.

11.7.8 Event File List

- **Name:**ad[sequence]_[ver]_event_info.html
- **Example:**ad51011020_056_event_info.html
- **Description:** A descriptive list of all filtered and unfiltered event files. This will answer the question, "How is this event file different from that one?".

11.7.9 Processing Log Index

- **Name:**ad[sequence]_[ver]_index.html
- **Example:**ad51011020_056_index.html
- **Description:** An index to make accessing the processing log easier.

11.7.10 Processing Error Index

- **Name:**ad[sequence]_[ver]_errors.html
- **Example:**ad51011020_056_errors.html
- **Description:** A list of all errors encountered in processing. These are usually checked by the processing team and do not indicate serious problems with the data.

11.7.11 Processing Log

- **Name:**`ad[sequence]_[ver]_joblog.html`
- **Example:**`ad51011020_056_joblog.html`
- **Description:** A detailed log of everything done to produce the distributed files. This can be useful for tracking down problems which may have occurred in processing. This log is very verbose, so the processing log index and the processing error index can be helpful for navigating this file.

11.7.12 Job Parameter File

- **Name:**`ad[sequence]_[ver]_job.par`
- **Example:**`ad51011020_056_job.par`
- **Description:** IRAF/FTOOLS-style parameter file used by processing and containing information specific to this observation.

11.7.13 Processing Parameter File

- **Name:**`ad[sequence]_[ver]_process.par`
- **Example:**`ad51011020_056_process.par`
- **Description:** IRAF/FTOOLS-style parameter file used by processing which contains information specific to the processing script version.

11.7.14 Distribution Table of Contents

- **Name:**`ad[sequence]_tape.cat`
- **Example:**`ad10012000_tape.cat`
- **Description:** FITS ASCII table listing all the files in the distribution. For tape distributions this file is used by the ascatape FTOOL. All of the information in this file is also contained in the HTML file list.

11.7.15 Housekeeping Files

- **Name:**`ft[date-base][S0/S1/G2/G3/CM]HK.fits`
- **Example:**`ft930415_2053_0240S0HK.fits`
- **Description:** Files containing a time history of the spacecraft status. There is one file specific to each instrument (`S0`, `S1`, `G2`, and `G3`) and one common file for all four instruments (`CM`). Most of the information contained in these files is in the filter files, so you will probably not need the housekeeping files.

11.7.16 Orbit Files

- **Name:**`frf.orbit.[version]`
- **Example:**`frf.orbit.160`
- **Description** File containing the orbital elements for the spacecraft at the time of the observation. Orbit files include information all the way back to the start of the mission, so newer orbit files will work for older observations.

11.8 The "calib" Directory

This directory contains all of the calibration files used to process the data. These are not necessarily the best files to use when reprocessing your data. The most recent versions of each of these files can be obtained from the ASCA GOF.

11.8.1 Rigidity Table

- **Name:**`rigidity.data.[version]`
- **Example:**`rigidity.data.1.23`
- **Description:** A table used to calculate COR parameter values for the filter file. Low values of the COR parameter imply a higher level of charged particle background.

11.8.2 Leap Second Correction Table

- **Name:**leapsec.fits
- **Description:** Contains a list of leap second events that are used to correct the spacecraft time to actual time for additional conversion (as into UT).

11.8.3 Telescope Calibration Files

- **Name:**[s0/s1]_teldef_ascalin.fits or [gis2/gis3]_ano_[on/off][flf/pow2]_[version].f
- **Example:**s0_teldef_ascalin.fitsgis3_ano_on_flf_180295.fits
- **Description:** Calibration information used by the ascalin FTOOL to convert from raw coordinates to detector coordinates.

11.8.4 CTI Calibration File

- **Name:**sisph2pi_[version].fits
- **Example:**sisph2pi_290296.fits
- **Description:** Calibration file used by ascalin for converting PHA into linearized PI. "CTI" stands for charge transfer inefficiency.

11.8.5 Faintdfe Calibration File

- **Name:**faintdfe.tbl
- **Description:** Calibration file used for calculating SIS dark frame error.

11.8.6 Gain History Calibration File

- **Name:**gis_temp2gain.fits
- **Description:** Calibration file used to create the Gain History File. It contains information describing the long term variation in the GIS gain.

11.8.7 GIS Standard Region Filters

- **Name:** `[GIS2/GIS3]_[REGION/CALSRC][pixels].[version]`
- **Example:** `GIS2_REGION256.3` or `GIS2_REGION256_OFF.3`
- **Description:** SAOimage/xselect-style region files used to either exclude the GIS calibration sources and noisy outer ring of the detector, or to select the calibration sources. These are used to produce the filtered event files or the calibration source spectra. These filters contain only exclusion regions, so they may be appended to source extraction regions which extend outside of the standard extraction region to extract spectra for which accurate ARFs may be extracted.

11.8.8 SIS Standard Region Filters

- **Name:** `[SIS0/SIS1]_OFFCHIP.[version]`
- **Example:** `SIS0_OFFCHIP.1` or
- **Description:** SAOimage/xselect-style region files which mask off the regions not occupied by any of the four chips in a detector. These will not remove any events, but can be needed for extracting spectra from source regions which are not contained within a single chip.

11.8.9 SIS Chip Mask Region Filters

- **Name:** `[SIS0/SIS1]_NOTCHIP[chip].[version]`
- **Example:** `SIS0_NOTCHIP0.1` or
- **Description:** SAOimage/xselect-style region files which mask off one of the four chips in a detector. These can be used in combination to select data from a single CCD chip, as must be done when generating RMFs for sources which span multiple chips. They may also be used to mask off inactive chips to produce correct WMAPS in spectra. Note that the SIS CCD chips are numbered `0`, `1`, `2`, `3`.

11.8.10 Echo Secular History File

- **Name:** `sisechos_[version].fits`
- **Example:** `sisechos_290296.fits`

- **Description:** Calibration file used to generate SIS response matrix files.

11.8.11 Residual Dark Distribution History File

- **Name:**`sisrddis_[version].fits`
- **Example:**`sisrddis_290296.fits`
- **Description:** Calibration file used to generate SIS response matrix files.

11.8.12 ECD Data File

- **Name:**`sis[c0/c1/c2/c3][p40/p20]_[version].fits`
- **Example:**`sis0c0p40_290296.fits`
- **Description:** Calibration file used to generate SIS response matrix files.

11.8.13 X-ray Telescope Effective Area File

- **Name:**`xrt_ea_[version].fits`
- **Example:**`xrt_ea_v1_1.fits`
- **Description:** Calibration file used for creating ancillary response files.

11.8.14 X-ray Telescope Point Spread Function File

- **Name:**`xrt_psf_[version].fits`
- **Example:**`xrt_psf_v1_0.fits`
- **Description:** Calibration file used for creating ancillary response files.

11.8.15 GIS Beryllium Thickness File

- **Name:**`[s2/s3]be[version].fits`
- **Example:**`s2bev1.fits`
- **Description:** Calibration file used for creating GIS ancillary response files.

11.8.16 GIS Grid File

- **Name:**`[s2/s3]grid[version].fits`
- **Example:**`s2gridv3.fits`
- **Description:** Calibration file used for creating GIS ancillary response files.

12 Glossary

Terms and acronyms used in this guide are defined below. For information about any of the FTOOLS try using the `fhelp` FTOOL by typing `fhelp`*program name*.

ASCA — **A**dvanced **T**elescope for **C**osmology and **A**strophysics.

Astro D — The pre-launch name for ASCA

bit-rate — The speed with which information was sent from ASCA to the ground. Can be either "high", "medium", or "low".

Bright mode — A mode for the SIS detectors which groups the nine pixels around an event together and rejects some events based on the pattern of excited pixels.

Bright2 mode — A simulated mode created on the ground from Faint mode data. It is similar to Bright mode except that corrections have been made for dark frame error and echo effect.

detector coordinates — The raw position information for an event.

Faint mode — A mode for the SIS which sends information for each pixel separately.

FITS — **F**lexible **I**mage **T**ransport **S**ystem. The standard file format for information exchange in astronomy.

FTOOLS — a set of programs which manipulate FITS files.

flickering pixels — Pixels which give intermittent false signals.

FRF — **F**irst **R**eduction **F**iles the raw files from Japan before any processing is done on them.

gain — The relationship between the energy of an incoming photon and the PHA response.

hot pixel — An SIS pixel which gives a false signal all the time.

GIF — **G**raphics **I**nterchange **F**ormat. A standard format for bit-map images for which there are many viewers such as `xv` and World Wide Web browsers.

GIS — **G**as **I**maging **S**pectrometer. A type of detector on ASCA. There are two GISs called GIS2 and GIS3.

GO — **G**uest **O**bserver. This means *you*.

GOF — **G**uest **O**bserver **F**acility. A group of people at GSFC in charge of helping you.

GSFC — **G**oddard **S**pace **F**light **C**enter. The NASA center where your tape was made.

IRAF — An astronomical data analysis package.

ISAS — **I**nstitute of **S**pace and **A**stronautical **S**cience. The Japanese organization in charge of ASCA.

MPC — A GIS mode which optimizes timing information, but throws away spatial information.

PH — The normal GIS mode.

PHA — **P**ulse **H**eight **A**nalyzer. The device which measures the energy of a photon, often used to refer to the raw numbers measured by the device.

PI — **P**ulse **I**nvariant. PHA values corrected for spatial and temporal changes in gain. Also **P**rincipal **I**nvestigator.

PPM — Another graphics file format.

sequence number — An eight digit number which identifies an observation.

SIS — **S**olid **S**tate **I**maging **S**pectrometer. A type of detector on ASCA. There are two SISs called SIS0 and SIS1.

Universal Time — Similar to Greenwich Mean Time

XANADU — The official data analysis package for ASCA including `xspec`, `ximage`, and `xronos`