URL: http://cxc.harvard.edu/ciao3.3/publications.html
Last modified: 27 January 2006

Chandra Publications

Postscript versions of Chandra−related publications, grouped by subject, are available for download here (note that the files are `gzip`−compressed). Clicking on the title will reveal the abstract for the paper.

SDP | Instruments | Analysis: CIAO * Misc | Miscellaneous || *Sherpa*

Citing CIAO in a Publication

If you are writing a paper and would like to cite the CIAO software, we recommend the following:

> ***Chandra Interactive Analysis of Observations (CIAO), http://cxc.harvard.edu/ciao/***

The specific version of CIAO and CALDB used for the analysis should be mentioned as well.

Standard Data Processing

On the Fly Bad Pixel Detection for the Chandra X−ray Observatory's Aspect Camera
M. Cresitello−Dittmar, T. Aldcroft, D. Morris
flybadpixel.ps.gz, 4 pages

Kalman Filtering in Chandra Aspect Determination
R. Hain, T. Aldcroft, R. Cameron, M. Cresitello−Dittmar, M. Karovska
kalman.ps.gz, 4 pages

An Object Oriented Design for Monitoring the Chandra Science Instrument X−Ray Background
J.G. Petreshock, S.J. Wolk, M. Cresitello−Dittmar, T. Isobe
01−30.ps.gz, 4 pages

The Chandra Automatic Data Processing Infrastructure
D. Plummer and S. Subramanian
ap.ps.gz, 4 pages

The Chandra Automatic Processing/Archive Interface
D. Plummer and S. Subramanian
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A Flexible Object Oriented Design for Page Formatting
N. RA. Wolk
P1−16_2.ps.gz, 4 pages

Instruments

Improving Chandra High Resolution Camera Event Positions via Corrections to Crossed−Grid Charge Detector Signals
M. Juda, *et al.*
SPIE Proceedings 4140, August 2000
ringing.ps.gz, 11 pages

Composition of the Chandra ACIS contaminant
H. L. Marshall, *et al.*
astro−ph/0308332
aciscontam.ps.gz, 12 pages

The Absolute Effective Area of the Chandra High Resolution Mirror Assembly
D. A. Schwartz, *et al.*
hrmaArea.ps.gz, 13 pages

Simulating CCDs for the Chandra Advanced CCD Imaging Spectrometer
L. K. Townsley, *et al.*
astro−ph/0111003
ccdmodel.ps.gz, 42 pages

Improvement of the Spatial Resolution of the ACIS Using Split−Pixel Events
H. Tsunemi, *et al.*
ApJ, 554:496, 2001.
tsunemiSplit.ps.gz, 9 pages

Analysis

CIAO

The Sliding−Cell Detection Program for Chandra X−Ray Data
T. Calderwood, A. Dobrzycki, H. Jessop, D. E. Harris
slidingcell.ps.gz, 4 pages

ASC Data Analysis Architecture
M. Conroy, W. Joye, J. Herrero, S. Doe
ADASS VI, ASP Conference Series, Vol. 125, 1997
architecture.ps.gz, 4 pages

Interactive Analysis and Scripting in CIAO 2.0
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astro−ph/0601306, 9 pages

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ASC Data Model Abstract Design
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AXAF Science Center internal memo, Feb 1998
dmdesign.ps.gz, 59 pages

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Legacy 7, 64 (1998)

Elements of The Chandra Data Analysis System
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Miscellaneous

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chart_1.ps.gz, 4 pages)

The Formal Underpinnings of the Response Functions used in X−Ray Spectral Analysis
J. E. Davis
underpinnings.ps.gz, 22 pages

ASC Coordinate Transformation − The Pixlib Library
H. He, J. McDowell, M. Conroy
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pixlib1.ps.gz, 4 pages

ASC Coordinate Transformation − The Pixlib Library, II
H. He, J. McDowell, M. Conroy
ADASS VII, ASP Conference Series, Vol. 145, 1998
pixlib2.ps.gz, 4 pages

On the Discrepancy of Chandra and XMM Profiles for A1835
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TEBC: A Multi−mission Time, Ephemeris, and Barycenter Correction Package
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Miscellaneous

Binary Table Extension to FITS
W. D. Cotton, D. Tody, W.D. Pence
A&AS, 113, 1995
cotton.ps.gz, 8 pages

The CIAO Website Unveiled
E. C. Galle, D. J. Burke, C. Stawarz, A. Fruscione
ADASS XIV, 2004
ciaosite.ps.gz, 5 pages

The ASC Data Archive for the AXAF Ground Calibration
P. Zografou, S. Chary, K. DuPrie, P. Harbo, K. Pak
ADASS VII, ASP Conference Series, Vol. 145, 1998
groundcal.ps.gz, 4 pages

Standard Data Processing

On the Fly Bad Pixel Detection for the Chandra X−ray Observatory's Aspect Camera
M. Cresitello−Dittmar, T. Aldcroft, D. Morris

The Chandra X−Ray Observatory uses an optical CCD in its aspect camera. As with all space−based CCD detectors, radiation damage will accrue with time and substantially increase the dark current of individual pixels, resulting in "warm pixels". In order to obtain the most accurate aspect solution possible, it is necessary to identify and compensate for these regions when processing the guide star images. If a warm pixel is included in a guide star image, it will bias the centroid location for that image. As the spacecraft dithers, this bias will introduce a wobble to the star location that translates to a wobble in the aspect solution. Special dark current calibration observations can be taken to provide a full−frame dark current map, however, it is not operationally feasible to obtain a new map for each observation.

The CXC data systems group has developed software to analyze the star image data and identify warm pixels as part of standard processing. This "on the fly" determination allows us to adjust for variations in CCD conditions between dark current calibration observations and provides useful information for identifying bad regions on the Aspect camera CCD.

Download flybadpixel.ps.gz (4 pages)

Kalman Filtering in Chandra Aspect Determination

R. Hain, T. Aldcroft, R. Cameron, M. Cresitello−Dittmar, M. Karovska

The ability of the Chandra X−Ray Observatory to achieve unprecedented image resolution is due, in part, to the ability to accurately reconstruct the spacecraft attitude history. This is done with a Kalman filter and Rauch−Tung−Striebel (RTS) smoother, which are key components of the overall aspect solution software. The Kalman filter/RTS smoother work by combining data from star position measurements, which are accurate over the long term but individually noisy, and spacecraft rate information from on−board gyroscopes, which are very accurate over the short−term, but are subject to drifts in the bias rate over longer time scales. The strengths of these two measurement sources are complementary. The gyro rate data minimizes the effects of noise from the star measurements, and the long−term accuracy of the star data provides a high−fidelity estimate of the gyro bias drift. Analysis of flight data, through comparison of observed guide star position with expected position and examination of the reconstructed X−ray image point spread function, supports the conclusion that performance goals (1.0 arcsecond mean aspect error, 0.5 arcsecond aspect error spread diameter) were met.

Download kalman.ps.gz (4 pages)

An Object Oriented Design for Monitoring the Chandra Science instrument X−Ray Background

J.G. Petreshock, S.J. Wolk, M. Cresitello−Dittmar, T. Isobe

The Monitoring and Trends Analysis (M&TA) System for the Chandra X−Ray Observatory consists of multiple software threads designed to monitor and visualize spacecraft behavior. The Science Instrument (SI) background monitoring is one such thread that is designed to compile a temporally and spatially ordered table of the observed flux and energy spectrum in detector coordinates. In this paper we describe the design of the tools, and applications of the data products generated, and the output product flexibility.

Download 01−30.ps.gz (4 pages)

The Chandra Automatic Data Processing Infrastructure

D. Plummer, S. Subramanian

The requirements for processing Chandra telemetry are very involved and complex. To maximize efficiency, the infrastructure for processing telemetry has been automated such that all stages of processing will be initiated without operator intervention once a telemetry file is sent to the processing input directory. To maximize flexibility, the processing infrastructure is configured via an ASCII registry. This paper discusses the major components of the Automatic Processing infrastructure including our use of the STSciI OPUS system. It describes how the registry is used to control and coordinate the automatic processing.

Download ap.ps.gz (4 pages)

The Chandra Automatic Processing/Archive Interface

S. Subramanian, D. Plummer

The Chandra Automatic Data Processing System (AP) requires quick access to previously generated data. Potential inefficiencies are avoided by introducing a layer between the pipelines and the archive. This archive interface layer includes an archive request queue, a data archiving server (darch), and an archive "cache". The design and functional operation of each of these components is the focus of this paper.

Download latha.ps.gz (4 pages)

A Flexible Object Oriented Design for Page Formatting

N. RA. Wolk

The Chandra Standard Data processing now includes a group of summary pages that offer a synopsis of the observation. Chandra's instrument and grating combinations form many different spacecraft configurations. For each configuration, a specific summary of the observation is required. We need a flexible and expandable page formatter to handle this situation. One result of this development is the sum_format_page tool. This C++ tool is build on object oriented design principals and contain the flexibility to produce multiple output file formats. Here we discuss the motivations for the tool, the design and implementation, and future enhancements that need to be considered.

Download P1−16_2.ps.gz (4 pages)

Instruments

Improving Chandra High Resolution Camera Event Positions via Corrections to Crossed−Grid Charge Detector Signals

M. Juda, et al.

SPIE Proceedings 4140, August 2000

The High Resolution Camera (HRC) on−board the Chandra X−ray Observatory (CXO) provides the highest resolution X−ray images of celestial sources ever taken. Unfortunately, ringing in the electronics compromises the position readout signals for some of the events. The compromised signals affect the angular resolution that can be achieved. We present an empirically derived algorithm that can be used in ground processing of the data to minimize the impact of the ringing on the calculated event positions.

Download ringing.ps.gz (11 pages)

Composition of the Chandra ACIS contaminant

H. L. Marshall, et al.

astro−ph/0308332

The Advanced CCD Imaging Spectrometer (ACIS) on the Chandra X−ray Observatory is suffering a gradual loss of low energy sensitivity due to a buildup of a contaminant. High resolution spectra of bright astrophysical sources using the Chandra Low Energy Transmission Grating Spectrometer (LETGS) have been analyzed in order to determine the nature of the contaminant by measuring the absorption edges. The dominant element in the contaminant is carbon. Edges due to oxygen and fluorine are also detectable. Excluding H, we find that C, O, and F comprise >80%, 7%, and 7% of the contaminant by number, respectively. Nitrogen is less than 3% of the contaminant. We will assess various candidates for the contaminating material and investigate the growth of the layer with time. For example, the detailed structure of the C−K absorption edge provides information about the bonding structure of the compound, eliminating aromatic hydrocarbons as the contaminating material.

Download aciscontam.ps.gz (12 pages)

The Absolute Effective Area of the Chandra High Resolution Mirror Assembly (HRMA)

D. A. Schwartz, et al.

The Chandra X−ray Observatory was launched in July 1999, and is returning exquisite sub−arcsecond X−ray images of star groups, supernova remnants, galaxies, quasars, and clusters of galaxies. In addition to being the premier X−ray observatory in terms of angular and spectral resolution, Chandra is the best calibrated X−ray facility ever flown. We discuss here the calibration of the on−axis effective area of the High Resolution Mirror Assembly. Because we do not know the absolute X−ray flux density of any celestial source, this must be based primarily on ground measurements and on modelling. We use celestial sources which may be assumed to have smoothly varying spectra, such as the the BL Lac object Markarian 421, to verify the continuity of the area calibration as a function of energy across the Ir M−edges. We believe the accuracy of the HRMA area calibration is of order 2%.

Download hrmaArea.ps.gz (13 pages)

Simulating CCDs for the Chandra Advanced CCD Imaging Spectrometer

L. K. Townsley, et al.

astro−ph/0111003

We have implemented a Monte Carlo algorithm to model and predict the response of various kinds of CCDs to X−ray photons and minimally−ionizing particles and have applied this model to the CCDs in the Chandra X−ray Observatory's Advanced CCD Imaging Spectrometer. This algorithm draws on empirical results and predicts the response of all basic types of X−ray CCD devices. It relies on new solutions of the diffusion equation, including recombination, to predict the radial charge cloud distribution in field−free regions of CCDs. By adjusting the size of the charge clouds, we can reproduce the event grade distribution seen in calibration data. Using a model of the channel stops developed here and an insightful treatment of the insulating layer under the gate structure developed at MIT, we are able to reproduce all notable features in ACIS calibration spectra. The simulator is used to reproduce ground and flight calibration data from ACIS, thus confirming its fidelity. It can then be used for a variety of calibration tasks, such as generating spectral response matrices for spectral fitting of astrophysical sources, quantum efficiency estimation, and modeling of photon pile−up.

Download ccdmodel.ps.gz (42 pages)

Improvement of the Spatial Resolution of the ACIS Using Split−Pixel Events
H. Tsunemi, et al.
ApJ, 554, 2001.

The position accuracy of X−ray photons on a CCD detector is generally believed to be limited by the CCD pixel size. While this is true in general, the position accuracy for X−ray events which deposit charge in more than one pixel can be better than that of the CCD pixel size. Since the position uncertainty for corner events is much better than the pixel size, we can improve the Chandra ACIS spatial resolution by selecting only these events.

We have analyzed X−ray images obtained with the Chandra ACIS for six point−like sources observed near the optical axis. The image quality near the optical axis is characterized by a half power diameter (HPD) of 0:0066 that is a convolution of the PSF of the HRMA and the CCD pixel shape (24 m square). By considering only corner events the image quality is improved to 0:00 56 (HPD), which is very close to the image quality of the HRMA alone. We estimated the degradation of the image quality obtained by using all events, compared to that obtained using only corner events, to be 0:00 33, which coincides with that expected from the pixel size. Since the fraction of the corner events is relatively small, this technique requires correspondingly longer exposure time to achieve good statistics.

Download tsunemiSplit.ps.gz, 9 pages)

Analysis

CIAO

The Sliding−Cell Detection Program for Chandra X−Ray Data
T. Calderwood, A. Dobrzycki, H. Jessop, D. E. Harris

The Chandra X−Ray Observatory provides large advances in field−of−view, collecting area, and spatial resolution over previous X−Ray missions. With these advancements, different and/or improved detection algorithms are a necessity for Chandra data analysis. We here present an overview of *Celldetect*, a source detection program for Chandra. Celldetect is descendent from *Einstein* and *ROSAT* data analysis programs (Harnden, et al, 1984)(DePonte & Primini, 1993). It is part of the Chandra Interactive Analysis of Observations (CIAO) software package and is also used in automated processing of Chandra data.

Download slidingcell.ps.gz (4 pages)

ASC Data Analysis Architecture
M. Conroy, W. Joye, J. Herrero, S. Doe
ADASS VI, ASP Conference Series, Vol. 125, 1997

The AXAF Science Center (ASC) is using an ``open architecture'' approach to develop its data analysis environment. The system is a loosely coupled environment consisting of several major applications: visualizer, browser, fitter/modeler, as well as the data analysis tool−box. The ASC Data Model and Interprocess Communications (IPC) provide the data interface between applications and tools. The Navigator, CLI, and Profile Editor provide the user with different control methods to access these components. The modular design provides a flexible, configurable environment in which the user can create customized applications from the standard components.

Download architecture.ps.gz (4 pages)

Interactive Analysis and Scripting in CIAO 2.0

S. Doe, M. Noble, R. Smith

Interpreted scripting languages are now recognized as essential components in the programmer's (and user's) tool chest, and as amply demonstrated at ADASS 1999, have infiltrated the scientific community with great effect.

In this paper we discuss the utilization of the S−Lang interpreted language within the Chandra Data Analysis System (CIAO, or Chandra Interactive Analysis of Observations). In only a few months, with substantial reuse and comparatively little manpower and code bloat, this effort has increased by an order of magnitude the analytical power and extensibility of CIAO.

We summarize our design and implementation, and show brief fitting, modeling, and visualization threads that demonstrate capabilities roughly comparable with those of commercial packages. Finally, we present a beta version of the CIAO spectroscopic analysis module, GUIDE − largely a collection of S−Lang scripts, glued with C++ enhancements to Sherpa and ChIPS − to illustrate in more depth the range of new functionality and the rapid prototyping now available in CIAO.

Download scripting.ps.gz (4 pages)

ASMOOTH: A simple and efficient algorithm for adaptive kernel smoothing of two−dimensional imaging data

H. Ebeling, D.A. White, F.V.N. Rangarajan

astro−ph/0601306

An efficient algorithm for adaptive kernel smoothing (AKS) of two−dimensional imaging data has been developed and implemented using the Interactive Data Language (IDL). The functional form of the kernel can be varied (top−hat, Gaussian etc.) to allow different weighting of the event counts registered within the smoothing region. For each individual pixel the algorithm increases the smoothing scale until the signal−to−noise ratio (s.n.r.) within the kernel reaches a preset value. Thus, noise is suppressed very efficiently, while at the same time real structure, i.e. signal that is locally significant at the selected s.n.r. level, is preserved on all scales. In particular, extended features in noise−dominated regions are visually enhanced. The ASMOOTH algorithm differs from other AKS routines in that it allows a quantitative assessment of the goodness of the local signal estimation by producing adaptively smoothed images in which all pixel values share the same signal−to−noise ratio above the background.

We apply ASMOOTH to both real observational data (an X−ray image of clusters of galaxies obtained with the Chandra X−ray Observatory) and to a simulated data set. We find the ASMOOTHed images to be fair representations of the input data in the sense that the residuals are consistent with pure noise, i.e. they possess Poissonian variance and a near−Gaussian distribution around a mean of zero, and are spatially uncorrelated.

Download the paper from astro−ph

A Wavelet−Based Algorithm for the Spatial Analysis of Poisson Data

P. E. Freeman, V. Kashyap, R. Rosner, D. Q. Lamb

ApJS, Vol. 138, 2002

Wavelets are scalable, oscillatory functions that deviate from zero only within a limited spatial regime and have average value zero, and thus may be used to simultaneously characterize the shape, location, and strength of astronomical sources. But in addition to their use as source characterizers, wavelet functions are rapidly gaining currency within the source detection field. Wavelet−based source detection involves the correlation of scaled wavelet functions with binned, two−dimensional image data. If the chosen wavelet function exhibits the property of vanishing moments, significantly nonzero correlation coefficients will be observed only where there are high−order variations in the data; e.g., they will be observed in the vicinity of sources. Source pixels are identified by comparing each correlation coefficient with its probability sampling distribution, which is a function of the (estimated or a priori known) background amplitude.

In this paper, we describe the mission−independent, wavelet−based source detection algorithm ``WAVDETECT," part of the freely available Chandra Interactive Analysis of Observations (CIAO) software package. Our algorithm uses the Marr, or ``Mexican Hat" wavelet function, but may be adapted for use with other wavelet functions. Aspects of our algorithm include: (1) the computation of local, exposure−corrected normalized (i.e., flat−fielded) background maps; (2) the correction for exposure variations within the field of view (due to, e.g., telescope support ribs or the edge of the field); (3) its applicability within the low−counts regime, as it does not require a minimum number of background counts per pixel for the accurate computation of source detection thresholds; (4) the generation of a source list in a manner that does not depend upon a detailed knowledge of the point spread function (PSF) shape; and (5) error analysis. These features make our algorithm considerably more general than previous methods developed for the analysis of X−ray image data, especially in the low count regime. We demonstrate the robustness of WAVDETECT by applying it to an image from an idealized detector with a spatially invariant Gaussian PSF and an exposure map similar to that of the Einstein IPC; to Pleiades Cluster data collected by the ROSAT PSPC; and to simulated Chandra ACIS−I image of the Lockman Hole region.

Download wavelet.ps.gz (34 pages)

The AXAF Data Analysis System: Infrastructure and New Features

A. Fruscione

Data Analysis in Astronomy, Proceedings of the Fifth Workshop, 1997

The new AXAF data analysis system, under development at the Smithsonian Astrophysical Observatory/AXAF Science Center, is facing the challenge of fully exploiting the unique AXAF data set. We present here a general view of the system infrastructure and describe in more detail some of its key elements.

Download infrastructure.ps.gz (6 pages)

Enhancements of MKRMF

X. H. He, M. Wise, K. Glotfelty

MKRMF, a data analysis tool of the Chandra X−ray Science Center (CXC), has evolved to more effectively create response matrix files (RMF). It provides new and enhanced features: uniform binning syntax, all−inclusive FITS embedded function (FEF) file extraction, and nonlinear EBOUNDS calculation. This paper describes the algorithm, application interfaces and highlights of the future development.

Download P3−05.ps.gz (4 pages)

ASC Data Model Abstract Design

J. McDowell

AXAF Science Center internal memo, Feb 1998

The Science Data Systems Group at the AXAF Science Center (ASC) has been studying the problems and limitations of current astronomy data analysis systems. The result of that study is a proposed generic Data Model for astronomical data. The ASC Data Model describes the common structure for the data to be analysed by our interactive analysis tools. The same structure should also be used for pipeline processing. In this document I present the proposed ASC Data Model from the science requirements point of view.

Download dmdesign.ps.gz (59 pages)

AXAF Data and Data Manipulation Software: The ASC Data Model

J. McDowell, M. Noble, M. Elvis

Legacy 7, 64 (1998)

AXAF, the Advanced X−ray Astrophysics Facility, is scheduled for launch in December 1998. The AXAF Science Center (ASC), located in Cambridge, Massachusetts at SAO and MIT, is developing software for the analysis of AXAF data. While this software can be used as a set of FTOOLS−like programs or as IRAF tasks, it also has built into it additional infrastructure that makes data analysis easier, especially for the rich data cubes that the AXAF CCD Imaging Spectrometer (ACIS) will provide. The ASC software infrastructure builds on heritage from the IRAF−based PROS analysis system and on ideas from the FTOOLS package. Programs access this infrastructure via a new data I/O library, the 'ASC Data Model' (ASCDM) library.

View this paper online.

Elements of The Chandra Data Analysis System

M. Noble

ADASS IX, ASP Conference Proceedings, Vol. 216, 2000

The Chandra X−Ray Observatory was launched on July 23, 1999, with the first a public release of the data analysis system (CIAO: Chandra Interactive Analysis of Observations) made availabile on October 4, 1999. This paper presents several of the more novel components of CIAO, including FirstLook, FilterWindow, ChIPS, Prism, and ToolAgent. The functionality is discussed in the context of two issues plaguing modern software − increasing complexity and insufficient reuse − and what approaches were taken with CIAO to mitigate the situation. Chief among these are intuitive GUIs, a thoughtful commingling of both GUI and command line tools, and the development of homogeneous interfaces to libraries and applications already in wide use.

Download elements.ps.gz (4 pages)

Miscellaneous

How to Piece Together Diffracted Grating Arms for AXAF Flight Data

A. Alexov, W. McLaughlin, D. Huenemoerder

ADASS VII, ASP Conference Series, Vol. 145, 1998

The Advanced X−ray Astrophysics Facility's (AXAF) High and Low energy transmission gratings (HETG, LETG) data require new tools and data structures to support x−ray dispersive spectroscopy. AXAF grating data files may be a hundred megabytes (MB) in size, however, they will typically only be a few MB. We are writing data analysis software which can efficiently process the data quickly and accurately into wavelengths, orders and diffraction angles for each event. Here we describe the analysis procedure as well as some of the technical constraints we had to overcome in order to process the tasks efficiently.

Download piecearms.ps.gz (4 pages)

ChaRT: The Chandra Ray Tracer

C. Carter, M. Karvoska, D. Jerius, K. Glotfelty, S. Beikman

In this paper we present the Chandra Ray Tracer (*ChaRT*), a distributed remote−computing application developed by the Chandra X−ray Center (CXC) to simulate the High Resolution Mirror Assembly (HRMA) Point Spread Functions (PSFs). We will discuss the overall system architecture and the programmatic flow. This approach may be used as a prototype for other projects where either the software cannot be distributed and/or the system resources to run the software would be prohibitive for the general user.

Download chart_1.ps.gz (4 pages)

The Formal Underpinnings of the Response Functions used in X−Ray Spectral Analysis

J. E. Davis

This work provides an in−depth mathematical description of the response functions that are used for spatial and spectral analysis of X−ray data. The use of such functions is well−known to anyone familiar with the analysis of X−ray data where they may be identified with the quantities contained in the Ancillary Response File (ARF), the Redistribution Matrix File (RMF), and the Exposure Map. Starting from first−principles, explicit mathematical expressions for these functions, for both imaging and dispersive modes, are arrived at in terms of the underlying instrumental characteristics of the telescope including the effects of pointing motion. The response functions are presented in the context of integral equations relating the expected detector count rate to the source spectrum incident upon the telescope. Theirapplication to the analysis of several source distributions is considered. These include multiple, possibly overlapping, and spectrally distinct point sources, as well as extended sources. Assumptions and limitations behind the usage of these functions, as well as their practical computation are addressed.

Download underpinnings.ps.gz (22 pages)

ASC Coordinate Transformation − The Pixlib Library
H. He, J. McDowell, M. Conroy
ADASS VI, ASP Conference Series, Vol. 125, 1997

We describe a coordinate library for AXAF data analysis. The library handles transformations between celestial coordinates and instrumental (mirror, focal plane, detector pixel) coordinate systems. The need for careful transformations is driven by the accuracy of the detectors and the attitude determination system. The coordinate systems are characterized by parameter files generated from experimental and calibration data. Transformation calculations are performed by matrix−representation routines for maximum flexibility. This library is implemented in ANSI C, and uses the SAO IRAF−compatible parameter interface.

Download pixlib1.ps.gz (4 pages)

ASC Coordinate Transformation − The Pixlib Library, II
H. He, J. McDowell, M. Conroy
ADASS VII, ASP Conference Series, Vol. 145, 1998

Pixlib, an AXAF Science Center (ASC) coordinate library, has been developed as the continuing effort of (He 1997). Its expansion includes, handling of the High Resolution Mirror Assembly (HRMA) X−ray Detection System (HXDS) stage dither and the five−axis mount (FAM) attachment point movements, correction of misalignments of the mirror mount relative to X−ray calibration facility (XRCF) and to the default FAM axes, as well as solution of sky aspect offsets of flight, etc. In this paper, we will discuss the design and the configuration of the pixlib system, and show, as an example, how to integrate the library into ASC data analysis at XRCF.

Download pixlib2.ps.gz (4 pages)

On the Discrepancy of Chandra and XMM Profiles for A1835
M. Markevitch
astro−ph/0205333

This short technical note addresses a large discrepancy between the temperature profiles for the galaxy cluster A1835 derived by Schmidt et al., (2001) using *Chandra* and Majerowicz et al., (2002) using *XMM*. The causes of this discrepancy may be instructive for the *Chandra* and *XMM* cluster analyses in general. The observation used by Schmidt et al. was affected by a mild background flare that could not be identified by the usual technique. This flare biased upwards the measured temperatures at large radii. The remaining discrepancy appears to be due to the *XMM* PSF scattering that was not taken into account in the published analyses. While the *XMM* PSF is narrow, the surface brightness of a typical cluster also declines very steeply with radius. For the moderately distant, cooling flow cluster A1835, about 1/3 of the observed *XMM* brightness *at any radius* is due to the PSF scattering from the smaller radii. As a result, the contamination from the bright cool cluster center biases low the measured temperatures near the core, and in general, any temperature gradients are underestimated.

Download acisbg_clustermodeling.ps.gz (4 pages)

Computational Currency in X−Ray Image Restoration
M. Noble

This paper surveys the extent to which parallelism may be employed to speed up Richardson−Lucy (RL) deconvolution in astronomical image analysis. First a brief background of imaging in astronomy is given, followed by a presentation of the classic imaging equation and the attendant mathematical machinery leading to the RL method. We then discuss how concurrency can enhance the RL computation and mention previous work that focused upon visible image restoration. Finally an outline of how RL can be applied to X−ray astronomy is presented, as well as plans for implementation of a concurrent solution using MPI, first on an SGI Origin2000 MPP, and later on a network cluster of workstations.

Download compcurr.ps.gz (10 pages)

TEBC: A Multi−mission Time, Ephemeris, and Barycenter Correction Package

A. Rots

TEBC is provided as a service to missions and observatories that all have to deal with issues of time and space.

Written in ANSI C, TEBC has five main components/tools to: perform conversions between various time scales (TT, TAI, ET, UTC, TDB); generate solar system ephemerides in FITS format; compute barycenter corrections; perform phase−binning of pulsar observations; calculate absolute phase for pulsars.

In addition, there is a related, though separate, C++ library that provides Time−related classes with an extensive repertoire of time transformation methods.

The TEBC package is based on a FITS−ified version of the JPL DE200 and DE405 solar system ephemerides and includes the code to convert the orginal JPL files to this format. It was originally written to provide a high−precision barycenter tool for the RXTE mission, but support for Chandra has been included, other missions can easily be added, and the functionality of the package has been extended.

Download TEBC.ps.gz (4 pages)

Miscellaneous

Binary Table Extension to FITS

W.D. Cotton, D. Tody, W.D. Pence

This paper describes the FITS binary tables which are a flexible and efficient means of transmitting a wide variety of data structures. Table rows may be a mixture of a number of numerical, logical and character data entries. In addition, each entry is allowed to be a single dimentioned array. Numeric data are kept in binary formats. The definition of the binary tables contained in this paper has been approved by a formal vote of the IAU FITS Working Group, and is a part of the IAU FITS standards.

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The CIAO Website Unveiled

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ADASS XIV, 2004

The Chandra Interactive Analysis of Observations (CIAO) website is the primary resource for users of the CIAO software package. Several hundred pages of content are written in XML, allowing for a baseline set of text from which many types of documentation may be created. Development and production (i.e. public) HTML versions of the site are generated from the XML via conversion scripts and XSL stylesheets. We present an overview of the back−end of the CIAO website, including custom markup tags, stylesheets, and CSS. The success of the project led to the use of this system in maintaining five websites at the Chandra X−ray Center (CXC).

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The ASC Data Archive for the AXAF Ground Calibration

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ADASS VII, A.S.P. Conference Series, Vol. 145, 1998

A data archive is near completion at the ASC to store and provide access to AXAF data. The archive is a distributed Client/Server system. It consists of a number of different servers which handle flat data files, relational data, replication across multiple sites and the interface to the WWW. There is a 4GL client interface for each type of data server, C++ and Java API and a number of standard clients to archive and retrieve data. The architecture is scalable and configurable in order to accommodate future data types and increasing data volumes. The first release of the system became available in August 1996 and has been successfully operated since then in support of the AXAF calibration at MSFC. This paper presents the overall archive architecture and the design of client and server components as it was used during ground calibration.

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URL: http://cxc.harvard.edu/ciao3.3/publications.html
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