Chandra ACIS Background

Terrance J. Gaetz

Chandra X-ray Center/Smithsonian Astrophysical Observatory

IACHEC 2017
ACIS Quiescent Background Rates (all grades)

rate, cts/s/chip

year (−2000) [Updated: 2017 mid Mar]
### Background Periods

**“Blank sky” (sources-removed)**

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ACIS Quiescent Background Rates (all grades)

T. Gaetz (CXC/SAO)

Chandra
ACIS Quiescent Background Rates (all grades)
ObsID selection:

- only **VFAINT** mode observations
- ACIS-I aimpoint: at least I0, I1, I2, I3 on
- ACIS-S aimpoint: at least S2, S3 on
- standard adu limits
- \( \text{EXPOSURE} \geq 30 \text{ ks} \)
- \( |b_{ii}| \geq 20^\circ \)
- RASS R4+R5 < 200
New Issues

- more observations with elevated focal plane temp (part or all of the observation)
  - use observations with Focal Plane temperature within a few degrees of -120 C (“do no harm”)
  - TBD: study whether high focal plane temperature affects background
- more deep pointings (or multiple visits with the same pointing/role)
  - “burns in” the sources - harder to fill in excluded source regions using other observations
  - Avoid deep pointings with same pointing and roll, or use only a fraction of the data (cuts down on amount of usable data)
- thermal limitations: less data for additional chips
  - period G: still respectable I2 and I3 background for S aimpoint
  - not enough S3 data for I aimpoint \( \Rightarrow \) no new background for that combination
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Generation of the Blank Sky Backgrounds

Procedure

- locate sources and diffuse emission (partially automated)
- sources punched from event list (using source regions)
• make source mask in chip coords (apply inverse dither to source regions)
combine source masks for each chip (source mask for S3 in chip coordinates)
select a culling level based on source mask:
- randomly remove events; retained events based on culling level and source mask
- new effective source mask flat (or depressions up to ~ 10%)
- if depressions remain, fill in the holes randomly using nearby data with similar chipx, chipy

- remove CALDB bad columns/pixels (which may have been filled in by previous step)
- sort events by chipx, chipy
- remove columns: time, tdetx, tdety, pha_ro
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Resulting S3 sky background (chip coordinates)
Sky Background Epochs

rate, cts/s/chip

AB C D E F G

S2 S3

BSKY STOWED

00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17

year

Chandra ACIS Background
Period G Exposure times

<table>
<thead>
<tr>
<th>aimpoint</th>
<th>ccd</th>
<th>exposure</th>
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<tr>
<td>ACIS-I</td>
<td>I0</td>
<td>~ 1 Ms</td>
</tr>
<tr>
<td>ACIS-I</td>
<td>I1</td>
<td>~ 1 Ms</td>
</tr>
<tr>
<td>ACIS-I</td>
<td>I2</td>
<td>~ 1 Ms</td>
</tr>
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<td>ACIS-I</td>
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<tr>
<td>ACIS-I</td>
<td>S2</td>
<td>~ 350 ks</td>
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<tr>
<td>ACIS-S</td>
<td>S1</td>
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<td>S2</td>
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Subject to revision during V&V of the backgrounds
new blank sky background covering 2012 to 2015 in preparation
finalizing V&V of the data, examine spectra, etc.
released for CALDB testing imminent
Background Features (ACIS “stowed”)

- particle-induced background (continuum)
- fluorescent lines

**Diagram:**

- **Rate [count s⁻¹ keV⁻¹ chip⁻¹]**
- **Energy [keV]**

- **Period E (Stowed)**
- **No VF Filtering**

- **Lines:** Al Kα, Si Kα, Au Mα, Au Mβ, Ni Kα, S1, S3, 023, 023 (Legend)
Background Features (ACIS “stowed”)

- particle-induced background (continuum)
- fluorescent lines

![Graph showing energy vs. rate for different periods and elements]
Background Spatial/Spectral Variation (ACIS “stowed”)
FI Chips – I0, I2, I3

ACIS-I023 Background Spectrum: \textit{chipy} Variation (no VF cleaning)
Background Spatial/Spectral Variation (ACIS “stowed”)
FI Chips – I0, I2, I3

ACIS-I023 Background Spectrum: \textit{chipy} Variation (with VF cleaning)
ACIS-S3 Background Spectrum: \texttt{chipy} Variation (no VF cleaning)
Background Spatial/Spectral Variation (ACIS “stowed”)
BI Chip – S3

ACIS-S3 Background Spectrum: chipy Variation (with VF cleaning)