Timing Mode low-energy background (OCR-1762)

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Motivation (status June 2006):

• for analysis of serendipitous science (not only!) or faint spectral features there should be detailed knowledge on camera background (e.g., in onon-optimum instrument mode set-up)

• camera background obtained with Closed filter

• minimum accumulated time per mode: length of maximum exposure (i.e. 1 revolution)

• LW mode: 136 ks, SW mode: 174 ks, TI mode: 57 ks so far

• use one calibration observation with a subject not useful otherwise for EPIC-pn for a TI mode Closed filter observation

• next “possible” case: NRCO-63: MOS-1 filter check, Omega Cen: has already been observed after (0307_011220101_PNS003) the EPIC-pn micrometeorite event (0156_0095810401_PNS003), no obvious (!) indication of damage of the Medium filter
Main idea: calibration measurement without loss of scientific observing time i.e. no additional load on calibration budget

Take a serendipitous (non EPIC-pn) calibration observation: NRCO-63: 1227_0412780101 (2006-08-21), 20 ks

TI mode Closed filter exposure: normal set-up (lower threshold 40 adu \sim 200 \text{ eV}): 10 ks

TI mode Closed filter exposure: changed set-up (lower threshold 36 adu \sim 180 \text{ eV}): 10 ks

within SAS both exposures can be treated the same: parameter lowerthreshold=40 in task epframes

information from non-standard set-up “for free” (i.e., low-energy background)

no additional offset map calculation in between

Lower threshold: 40 [adu] (A1_CMLOTH0: F1615=552) \rightarrow 36 [adu] (A1_CMLOTH0: F1615=548): OCR needed
0644_0125321001_PNS010: TI Closed, 12.8 ks, 40 adu

- total rate (incl. MIPs, important for telemetry): 77.5 cts/s
- parameterization of low-energy spectrum by:
  - power-law (index $\alpha = -2.79$ (fit to channel range 70 – 200 adu), and Gaussian (40 – 51 adu).
- Extrapolating from 40 adu to 36 adu: expected total rate: 194 cts/s
- maximum rate without counting mode: $> 400$ cts/s

$\rightarrow$: 1227_0412780101_PNU002: 187 cts/s
**TI mode: overview of Closed filter exposures**

<table>
<thead>
<tr>
<th>Observation-ID</th>
<th>Time [s]</th>
<th>Obs-Start</th>
<th>Rate_40 [cts/s]</th>
<th>Rate_36 [cts/s]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0503_0125910901_PNS014</td>
<td>10998</td>
<td>2002-09-07T20:11:32</td>
<td>75.5</td>
<td>180.2</td>
</tr>
<tr>
<td>0598_0105262401_PNS003</td>
<td>8603</td>
<td>2003-03-15T14:51:07</td>
<td>79.2</td>
<td>192.4</td>
</tr>
<tr>
<td>0644_0125321001_PNS010</td>
<td>12790</td>
<td>2003-06-15T08:44:58</td>
<td>77.5</td>
<td>194.1</td>
</tr>
<tr>
<td>0683_0154150401_PNS003</td>
<td>5184</td>
<td>2003-09-01T05:28:19</td>
<td>83.8</td>
<td>228.8</td>
</tr>
<tr>
<td>0817_0165160201_PNS003</td>
<td>9686</td>
<td>2004-05-26T21:40:02</td>
<td>86.5</td>
<td>175.2</td>
</tr>
<tr>
<td>0820_0165160301_PNS003</td>
<td>9684</td>
<td>2004-05-31T11:51:37</td>
<td>89.2</td>
<td>211.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>56945</strong></td>
<td></td>
<td>~ 82</td>
<td>~ 200</td>
</tr>
</tbody>
</table>
EPIC-pn: Timing mode raw spectra (no pattern recognition)

0644_0125321001_PNS010 Closed: raw (black), fit to power-law component (red), residual (blue), Gauss low-energy component (green). N132D (dashed magenta), Vela X-1 (dashed cyan), yellow: EPIC-pn FM1 (PANTER, 1 adu $\sim 5.3$ eV).
Spectrum and two-component low-energy fit for 0503_0125910901_PNS014.
Measured total rate (40 adu), extrapolations for lowered thresholds 39 ... 30 adu.
TI mode: 0644_0125321001_PNS010

OBS = 0125321001
AN_LOTH = 40 : SUM = 991128.9 : RATE = 77.5
AN_LOTH = 39 : SUM = 1182243.1 : RATE = 92.4
AN_LOTH = 38 : SUM = 1483928.4 : RATE = 114.5
AN_LOTH = 37 : SUM = 1877762.8 : RATE = 146.8
AN_LOTH = 36 : SUM = 2462400.8 : RATE = 194.1
AN_LOTH = 35 : SUM = 3359568.0 : RATE = 262.7
AN_LOTH = 34 : SUM = 4621718.0 : RATE = 361.4
AN_LOTH = 33 : SUM = 6421624.0 : RATE = 502.1
AN_LOTH = 32 : SUM = 8964210.0 : RATE = 700.9
AN_LOTH = 31 : SUM = 12520752.0 : RATE = 978.9
AN_LOTH = 30 : SUM = 17445680.0 : RATE = 1364.0
TI mode: 0820_0165160301_PNS003

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OBS = 0165160301
AN_LOTH = 40 : SUM = 965502.1 : RATE = 89.2
AN_LOTH = 39 : SUM = 1015388.8 : RATE = 104.8
AN_LOTH = 38 : SUM = 1238556.8 : RATE = 127.9
AN_LOTH = 37 : SUM = 1566069.0 : RATE = 161.7
AN_LOTH = 36 : SUM = 2044510.1 : RATE = 211.1
AN_LOTH = 35 : SUM = 2739908.8 : RATE = 282.8
AN_LOTH = 34 : SUM = 3738661.8 : RATE = 386.1
AN_LOTH = 33 : SUM = 5106811.5 : RATE = 533.5
AN_LOTH = 32 : SUM = 7186618.5 : RATE = 742.1
AN_LOTH = 31 : SUM = 1001662.0 : RATE = 1034.3
AN_LOTH = 30 : SUM = 13940528.0 : RATE = 1439.5
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TI mode: 1227_0412780101_PNS001

![Graph showing spectrum vs. PN channel with data points and fit line]

- OBS = 0412780101
- AN_LOTH = 40 : SUM = 1209288.8 : RATE = 106.7
- AN_LOTH = 39 : SUM = 1356350.8 : RATE = 119.9
- AN_LOTH = 38 : SUM = 1572391.8 : RATE = 138.7
- AN_LOTH = 37 : SUM = 1875553.1 : RATE = 165.5
- AN_LOTH = 36 : SUM = 2308489.0 : RATE = 203.5
- AN_LOTH = 35 : SUM = 29166827.5 : RATE = 257.4
- AN_LOTH = 34 : SUM = 3778509.2 : RATE = 333.2
- AN_LOTH = 33 : SUM = 4979138.0 : RATE = 439.3
- AN_LOTH = 32 : SUM = 6648438.0 : RATE = 586.6
- AN_LOTH = 31 : SUM = 8945903.0 : RATE = 789.4
- AN_LOTH = 30 : SUM = 120796834.0 : RATE = 1065.9
TI mode: 1227_0412780101_PNU002

→: movie
OCR-1762: summary + conclusions

- OCR-1762 1227_0412780101_PNU002 successful!
- Count rates (dominated by low-energy spectral part) as expected [187 vs. 194 cts/s]
- No unexpected increase of background below default threshold
- Maybe general trend, that background increases with time: increasing power-law normalization (solar minimum?)