EPIC-pn Large Window Mode fast-shift CTI correction

Status report on NRCO-31

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- EPIC-pn window modes: CTI correction
- Measurements at Panter with FM1
- Non-routine calibration observation (N132D) with FS
- Results
EPIC-pn window modes: integration, shift, read-out

- only parts of CCD used
- integration of 100 (64) rows, 45.14 (3.93) ms
- fast shift of window area toward CAMEX, in 0.072 (0.098) ms
- read-out as in full frame mode, 2.45 (1.64) ms
- fast shift of read-out area
EPIC-pn window modes: CTI correction function
EPIC-pn: pinhole measurements: design

- pinhole mask in X-ray beam, fixed (2 mm Al), in front of EPIC-pn spare camera
- 3 holes: 1 mm, 2 mm, 4 mm diameters (27.5′′, 55′′, 110′′), CCD: 9.6 mm × 30 mm
- move EPIC-pn camera up and down behind mask to avoid possible beam effects (like energy dispersion of monochromator etc.)
- holes disjunct in RAWX and RAWY projections so that they can be considered as independent
- avoid one bad column piece
- observe (gain-corrected) line positions [adu] of monochromatic input as function of position
- derive charge losses from one position to another, e.g. for LW mode:
  - $Y > 100 : \text{PHA}(Y) = \text{PHA}_0 \times CTE_{\text{fast}}^{100} \times CTE_{\text{slow}}^{Y-100}$
  - $Y < 100 : \text{PHA}(Y) = \text{PHA}_0 \times CTE_{\text{slow}}^{Y}$
  - $\rightarrow \frac{\text{PHA}(Y)}{\text{PHA}(Y-100)} = CTE_{\text{fast}}^{100}$
EPIC-pn: pinhole measurements: FF mode
EPIC-pn: pinhole measurements: eFF mode
EPIC-pn: pinhole measurements: LW mode
EPIC-pn: pinhole measurements: SW mode
EPIC-pn: pinhole measurements: TI mode
Reminder: pinhole measurements: design
Pinhole measurements: all modes, Al-K
Pinhole measurements: all modes, Cu-Kα
Pinhole measurements: all modes, Cu-L
Pinhole measurements: all modes, O-K

corrections: gain, no CTI

O-K Peak [adu.]

RAWY [pix]
# EPIC-pn CTI losses for FM1: adu/pixel

<table>
<thead>
<tr>
<th></th>
<th>Cu-K</th>
<th>Al-K</th>
<th>Cu-L</th>
<th>O-K</th>
<th>C-K</th>
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<tbody>
<tr>
<td><strong>all</strong></td>
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<tr>
<td>eFF</td>
<td>0.625</td>
<td>0.182</td>
<td>0.134</td>
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<td>FF</td>
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<td>0.203</td>
<td>0.150</td>
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<td>LW</td>
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<td>0.244</td>
<td>0.181</td>
<td>0.149</td>
<td>0.149?</td>
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<tr>
<td>TI</td>
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<tr>
<td>FF</td>
<td>0.699</td>
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<td>LW</td>
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<td>0.221</td>
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<tr>
<td>SW</td>
<td>0.523</td>
<td>0.118</td>
<td>0.078</td>
<td>0.039</td>
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### EPIC-pn CTI jumps for FM1: adu

<table>
<thead>
<tr>
<th>LW</th>
<th>Cu-K</th>
<th>Al-K</th>
<th>Cu-L</th>
<th>O-K</th>
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<tbody>
<tr>
<td>Loss</td>
<td>67.13</td>
<td>22.09</td>
<td>12.56</td>
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<td>Jump</td>
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<td>func.</td>
<td>0.72</td>
<td>0.52</td>
<td>0.23</td>
<td>0.38</td>
</tr>
</tbody>
</table>
EPIC-pn: pinhole measurements: LW mode
NRCO-31: spectra of N132D

Counts

Energy [eV]
Conclusions

- Method can be used to derive calibration parameters for FM1
- Gain seems to be mode-dependent (→ SAS-6.1)
- Calibration parameters for FM1 differ from implementation for FS
- In-orbit calibration (NRCO-31):
  e.g. N132D in nominal position and in ”-100”
- Repeat NRCO-31 observation with:
  – small coordinate adjustment
  – low background ;-)