First attempt to derive deadtime of EPIC-pn from FIFO reset counters

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Overview

- Introduction
- Data readout chain
- Test setup
- Measurements
- First results
- Summary and outlook
Introduction to FIFO resets

FIFO reset leads to loss of data
- In orbit:
  - possible explanation: maximum ionizing particle leads to saturation of on-chip amplifier stage
- On ground:
  - Effect was seen by illumination with radioactive Am-source (5 MeV Alpha)
- Complete column is above lower energy threshold
- FIFO in readout chain is filled with events from row additionally to normal events
- FIFO overflow can occur, causing reset
- How many frames are lost due to the reset?

Working plan:
- Look for correlation between Ax_Pmode counter and number of lost frames
- Correction factor on time for each mode (FF, eFF, SW, LW, Timing)
- Estimate dead time → correct effective time on source
Data readout chain

EPIC-pn event data input

- Event word 1
- Event word 2
- Time word 1
- Time word 2

FIFO (1024 x 16 bit)
max. 511 events
& time word

FIFO reset
Reset FIFO
FIFO full

CPU & electronics

FIFO reset to prevent data corruption

Time word is needed to trigger CPU processing

EPIC Cal Meeting 26-27.10.2006
Test Setup I

@ IAAT
lab-model of EPIC-pn
flight level hard and
software revisions

BUT
operating just one CCD

force FIFO overflow
by illuminating pn-CCD
with LED pulse
**Comparison between frame times (FT) in flight and at IAAT**

(FT are given in ms)

<table>
<thead>
<tr>
<th>Mode</th>
<th>EPIC-pn FT</th>
<th>IAAT-pn FT</th>
<th>ΔT/FT</th>
</tr>
</thead>
<tbody>
<tr>
<td>FF</td>
<td>73.4</td>
<td>72.0</td>
<td>-1.4%</td>
</tr>
<tr>
<td>eFF</td>
<td>199.2</td>
<td>170.0</td>
<td>-15%</td>
</tr>
<tr>
<td>LW</td>
<td>47.7</td>
<td>43.0</td>
<td>-10%</td>
</tr>
<tr>
<td>SW</td>
<td>5.7</td>
<td>5.7</td>
<td>0%</td>
</tr>
<tr>
<td>TM</td>
<td>6.0</td>
<td>6.0</td>
<td>0%</td>
</tr>
<tr>
<td>BU</td>
<td>Not yet tested</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

EPIC-pn deadtime from FiFo Resets

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Recording of the FiFo status

Click here for trigger menu
Measurements

LED pulsed with Agilent AWG
Square pulse with external trigger

Amplitude: 2-6V
Period: 1 sec
Pulse width: 0.5-1msec
# of pulses: 100

1. HK-files processed with IDL-progamme (@go)
2. Extract time words and search for irregularities
3. Check if found # of time gaps equals # of pulses
4. Get the time difference of gaps
5. Compute # of lost frames
6. Get conversion factor from Ax_Pmode counter
### First Results

<table>
<thead>
<tr>
<th>Mode</th>
<th># FIFO Resets (Ax_Pmode)</th>
<th>Missing Frames</th>
<th>Conversion Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>FullFrame</td>
<td>613</td>
<td>613</td>
<td>1</td>
</tr>
<tr>
<td>eFullFrame</td>
<td>600</td>
<td>613</td>
<td>1.0217</td>
</tr>
<tr>
<td>Large Win</td>
<td>582</td>
<td>602</td>
<td>1.0344</td>
</tr>
<tr>
<td>Small Win</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Timing</td>
<td>634</td>
<td>1241</td>
<td>1.9574</td>
</tr>
</tbody>
</table>

Dead time = # FIFO Resets * CF * frame time
Summary and Outlook

• First attempt to estimate dead time looks promising
• Larger data sets are needed
• Investigate strange behavior of Small Window mode
• Test with EPIC-pn flight spare model at MPE PANTER facility needed for verification