Status of the EPIC long term cal plan

M.G.F. Kirsch

European Space Agency
### Current Calibration Situation

<table>
<thead>
<tr>
<th>Effect</th>
<th>Max Error</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astrometry</td>
<td>1-2 arcsec</td>
<td>done</td>
</tr>
<tr>
<td>PSF</td>
<td>2 % on axis</td>
<td>off axis pending</td>
</tr>
<tr>
<td>Rel. effective area</td>
<td>+/- 5 %</td>
<td>ok</td>
</tr>
<tr>
<td>Abs. effective area</td>
<td>+/- 10 %</td>
<td>systematic low/high energy differences</td>
</tr>
<tr>
<td>Energy scale</td>
<td>+/- 10 eV</td>
<td>for some modes NOT</td>
</tr>
<tr>
<td>Relative timing</td>
<td>&lt; 3E-8</td>
<td>done</td>
</tr>
<tr>
<td>Absolute timing</td>
<td>&lt; 100 E-6 sec</td>
<td>done (some GS issues to be checked)</td>
</tr>
<tr>
<td>Cross cal RGS</td>
<td>+/- 15 %</td>
<td>still time dep. effects</td>
</tr>
<tr>
<td>Cross cal Chandra</td>
<td>+/- 20 %</td>
<td>?</td>
</tr>
</tbody>
</table>
The EPIC consortium together with the XMM-SOC will start a major (cross)-calibration campaign in order to try to resolve pending calibration issues and to bring the EPIC calibration to the next higher level of quality.

- set of objectives
- local MOS and pn cal meetings
- be-weekly telecons
• Objective O1: Solve flux discrepancies
• Objective O2: Provide off axis calibration
• Objective O3: Refine energy correction
• Objective O4: Clarify timing situation
• Objective O5: Calibrate slow slew mode
• Objective O6: Calibrate MOS timing mode
**Objective O1: Solve flux discrepancies**

- **task O11:** redistribution for line rich sources need to be checked and refined (main topic for January CAL WS)
  --> MOS CCF for redistribution for Off axis to be issued now
  --> pn work ongoing
- **task O12:** for testing purposes MOS will provide a QE/redistribution fudge to be aligned with pn (SS by 31.12.2006)
  --> new qe file tested (QE 50) MOS now consistently ~ 7% higher than pn
- **task O13:** implement pn FIFO overflow correction (MJF, RS, EK, CCF by 15.01.2007, SW by end Feb 2007)
- **task O14:** High energy flux lower than MOS, mirror measurements soon at PANTER (MJF, EK MID 2007)
- **task O15:** Chandra XMM flux comparison (MS by 31.01.2007) DONE
- **task O16:** IACHEC inputs on cross calibration (all)
- **task O17:** REFINE ON-AXIS PSF AT HIGH ENERGIES (AMR BY 31.02.2007)
• **Objective O2: Provide off axis calibration**
  - task O21: provide off axis PSF (AMR by 15.02.2007)
  - task O22: Spatial dependence of very low energy response of MOS
  - task O23: Spatial variation of low energy QE (SFS BY 31.03.2007)
  - task O24: Astrometry: possible residual in the position angle rotation (Euler ? angle) of the order of 0.1 deg. (considered to be low priority)
Objective O3: Refine energy correction

- task O31: provide MOS column dependent CTI (DB, MST by 31.01.2007)
- task O33: refine pn Burst Mode CTI/Gain (MK by 31.12.2006) DONE
  --> test FRAME NUMBER treatment versions in SAS (GS)
- task O34: refine pn eFF Mode CTI/Gain (MK by 15.01.2007) DONE
- task O35: implement temperature dependent CTI/Gain (KD, MK by 15.01.2007)
  --> observation needed
  --> value from CC is 0.43,, not confirmed by Eta Carinae (but doubtful obs)
  consistent with 1e0102
  --> archive CAS should be check to available with different temperatures
- TASK 036: REPORT ON MOS RATE DEPENDENT CTI EFFECT USING
  DEDICATED VELA DATA AND OTHER RELEVANT OBSERVATIONS (???)
- task O37: Special CTI due to vent hole (KD report on next CAL meeting Palermo)
- task O38: special CTI for various double events (KD ???)
- task O39: refine pn Burst rate dependent CTI (FH via GS by 31.02.2007)
- task o39b INVESTIGATE SMALL NUMBER OF MOS OBSERVATIONS WHICH
  SHOW GAIN SHIFTS (DB, MSt by 31.01.2007 --> TBD with MSt)
• **Objective O4: Clarify timing situation**
  - task O41: time jump detection refinement (MK, MJF, RS by 31.01.2007)
  - task O42: further investigation of pn absolute timing (systematic < 100 microsec)
  - task O43: MOS rel and absolute timing evaluation (MK after June 2007)

• **Objective O5: Calibrate slow slew mode**
  - task O51: Vela PWN nebula observation of 50 ks to check QE/pattern setting for pn: SW medium filter

• **Objective O6: Calibrate MOS timing mode**
  - task O61: calibrate "no gatti" effects (DB by 31.03. 2007)
  - task O62: provide statistics on flux instabilities (MST by 31.05. 2007)
  - task O63: Analyze MOS timing with respect to pn (MK by End 2007)
future calibration issues and timescale

• 2007 (CAL accuracy 10 %)
  - cal campaign as described
  - build up Suzaku cross cal + more CHANDRA cross cal

• 2008–2010 (Goal: Cal accuracy ~ statistical uncertainty)
  - pn new redistribution and rate dependent CTI
    --> deeper investigation and SAS development
  - MOS patch calibration currently rather crude
    --> deeper investigation and SAS development
  - full EPIC off axis calibration
    --> deeper investigation and SAS development
  - pn double effect behaviour + pn-vent hole effects
    --> deeper investigation and SAS development

⇒ sufficient expertise in SAS support in combination with calibration is needed at least till 2011 (ESAC: 2.5 FTE EPIC calibration + 1 FTE EPIC SAS)

• as of 2011
  - routine instrument monitoring (CTI, BAD PIX, offset)
    --> routine CAL updates (CTI, BAD PIX, offset)
  - contingency calibration....(if possible at all?)