LATEST NEWS ON XMM-NEWTON CALIBRATIONS AND OPERATIONS

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[with contributions by: Pedro Calderon, Ignacio de la Calle, Konrad Dennerl, Michael Freyberg, Rosario Gonzalez-Riestra, Aitor Ibarra, Frank Haberl, Andy Pollock, Andy Read, Pedro Rodriguez-Pascual, Simon Rosen, Richard Saxton, Maria Santos-LLeo, Steve Sembay, Michael Smith, Martin Stuhlinger, Antonio Talavera, Mike Watson]
Main calibration changes over the last year

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- ELLBETA PSF as default in the SAS (as of SASv12)
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- Correction to the RGS $\lambda$-scale via correlation with the Solar Angle (SASv13)
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- Novel software for the calibration of EPIC-MOS gain/CTI

[SASv12 = 23rd May 2012, post SAS-12; SASv13 = 1st April 2013; post SASv13]
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[Bold = discussed in this presentation]
Astrometry

Distribution of normalised position separations between XMM-Newton and SDSS for 2XMM-DR3 and 3XMM

Distribution of statistical positional errors (as produced by the SAS task \texttt{emldetect})

\[ r_{\text{sig}} = \text{Separation/total error} = \frac{r}{\sigma} \]

Main improvements:
- **ELLBETA PSF** (Read et al., 2011, A&A, 534, 34)
- Various astrometry improvements with SASv12
- Time-dependent boresight (Talavera et al., 2012, XMM-CCF-REL-286)
- Correction to the ELLBETA centroiding and the SAS handling of the plate scale (SASv13)
Empirical correction to the seasonal dependency of the star tracker vs. instrument axis alignment

(Talavera et al., 2012, XMM-CCF-REL-286)
RGS λ-scale

(Gonzalez-Riestra, 2012, XMM-CCF-REL-0290)

<table>
<thead>
<tr>
<th>Wavelength shifts (average shift per spectrum , in mÅ)</th>
<th>a</th>
<th>b</th>
<th>c</th>
</tr>
</thead>
<tbody>
<tr>
<td>RGS1 1st order</td>
<td>5 ± 7</td>
<td>2 ± 6</td>
<td>0 ± 5</td>
</tr>
<tr>
<td>RGS2 1st order</td>
<td>9 ± 7</td>
<td>8 ± 6</td>
<td>0 ± 5</td>
</tr>
<tr>
<td>RGS1 2nd order</td>
<td>4 ± 3</td>
<td>2 ± 3</td>
<td>1 ± 3</td>
</tr>
<tr>
<td>RGS2 2nd order</td>
<td>5 ± 3</td>
<td>3 ± 4</td>
<td>0 ± 3</td>
</tr>
</tbody>
</table>

a: SAS 12 before 26/9/2012 : Fixed Boresight

b: SAS 12 after 26/9/2012 : Time-dependend Boresight

c: SAS 13: Variable Boresight +Heliocentric velocity correction + Solar Angle correction
**EPIC pile-up correction**

EPIC pile-up correction scheme in SASv13, based on the “added event” method

- Start from an event file
- Add one new event into each frame
  - in PSF-weighted pixels
  - with a trial PI channel
  - with pattern chosen from calibrations
- Calculate what happens to the event
- Produce a distribution of the output event PIs for each input PI
- Option in `rmfgen`

Method currently tested on the XMM-Newton cross-calibration blazar sample for inclusion in SASv13

(Courtesy R. Saxton, N. Schartel, I. de la Calle)
Pixel-by-pixel CTI variation correction in EPIC-pn

Refinement of the CTI variation over the CCD on a pixel-by-pixel basis (espatialcti)

\[
<E_{\text{OVII}(f)}> = 566.5 \pm 2.5 \text{ to } 562 \pm 1 \text{ eV}
\]

[nominal 561 eV]

Table 2: Improvement of the spatial homogeneity of the absolute energy scale, determined by \(1 - \sigma_{\text{after}} / \sigma_{\text{before}}\).
X-Ray Loading correction in EPIC-pn Timing Mode

XRL in EPIC-pn Fast modes: *ubiquitous* source contamination during the “dark field” (offset map) prior to each EPIC-pn exposure:

As of May 2012 EPIC-pn Burst and Timing Mode offset maps are calculated in *CLOSED* filter to prevent XRL

More on the re-calibration of EPIC-pn Timing Mode energy scale in the **CCD Working Group**
Refinement to RGS response

(Courtesy A.Pollock & A.Ibarra)
The MOS1-CCD3 event

- Event registered in MOS1 at ~06:51UTC on 11th December 2012 (Rev.#2382)
- Bright flash of light causing data buffer overflow across the whole focal plane
- Likely micro-meteoroid impact
- CCD3 unusable for science since
- Several hot and defective columns in other CCDs (namely, #4 and #7) masked
- Integration time increased from 2.6s to 2.7s in Full Frame Mode to avoid frame time doubling
- Otherwise, nominal instrument operation, calibration accuracy and pipeline processing
- No measurable impact on MOS2, PN, RGS

Future work

- EPIC-MOS effective area refinement
  - Session IV, Thermal SNR WG, 26th March, 09:00-12:30: S. Sembay, “Trend analysis of EPIC-MOS 1ES0102 data”

- EPIC cross-calibration refinement
  - Session V, Effective Area WG, 26th March, 14:00-17:30: A. Read, “XMM-Newton EPIC cross-calibration”

- EPIC-pn Timing Mode energy scale
  - Session V, CCD WG, 26th March, 14:00-17:30: M. Guainazzi, “Novel scheme to calculate the energy scale in EPIC-pn Timing Mode”

- RGS contamination
  - Session VIII, WD & INS WG, 27th March, 14:00-17:30: A. Pollock, “Variability or otherwise of RXJ1856-3754”
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