

Meeting date	03.-05. 10 2005	ref./réf. XMM-SOC-CAL_EPIC-MIN-0015	page/page 1 / 8
<i>date de la réunion</i>			
Meeting place	ESAC	chairman	S. Sembay
<i>lieu de la réunion</i>		<i>président</i>	
Minute's date	18.10. 2005	<i>dates de minute</i>	<b>Participant</b> Andy Read Eckhard Kendziorra Frank Haberl Konrad Dennerl Michael Freyberg Vadim Burwitz Wolfgang Pietsch Steve Sembay Ulrich Briel Marcus Kirsch Matthias Ehle Martin Stuhlinger Tony Abbey Darren Baskill Bruno Altieri Maria P. Esquej Leo Metcalfe Richard Saxton Isabel Cabalero Jenny Carter Michael Smith
Subject/objet	EPIC CAL Meeting 15	copy/copi	Minutes by M.Kirsch <i>F.Jansen</i>

## **1 EPIC-pn**

### **1.1 Adjustment of spatial gain variations of EPIC-pn (KD)**

- gain factors for all 64x12 pn channels
- implementation will be general and may not fit perfectly some special cases (no time dependence)
- some columns develop and change from observation to observation (this will for the time being not be implemented)
- even after correction still some small systematical residuals

### **1.2 Long term behaviour of the CTI for EPIC pn (KD)**

- pn is not affected by solar flares → no steps
- pn follows quadratic time behaviour implemented in the SAS
- extended FF mode degrades slower than FF
- for other modes difficult to find (CAL source can not be used)

### **1.3 The EPIC response, Items for improvement after SAS 6.5 (FWH)**

- CTI over correction in timing mode at O-edge (3 % effect, already implemented correction by MK is not strong enough)
- Lower- Threshold effect modelling (needs SAS change to be implemented, ongoing no action at SOC required)
- Redistribution fine tuning at 450 eV and 900 eV
- Mirror areas above 6 keV ( Crab spectra from Burst mode and not piled-up Timing mode give indications for flux deficit, smaller effect for 3C273 visible, more cases are needed to revise the mirror areas)
- Influence of high source flux pn CTE (CTE model capture and release times should be tried to be modified to get better agreement for very high rates)
- Energy resolution at Fe K-alpha (from Eta Carinae data) shows line with of 100 eV, but high-energy gratings show narrow line. This results in a change of the DRM of 30 eV. CCF parameters for rmf at high energies are ready to be implemented for FF, eFF and SW data. Needs to be modified with e.g. N132D → **NRCO of Eta Car needed**

### **1.4 Soft response of pn using observations of super soft sources (VB)**

- WD with steady H-burning on their surface
- Modelled by BB spectra in the ROSAT era
- RGS and Chandra LETG spectra point to much more complicated spectra
- Sources can be used to test the soft X-ray response of EPIC-pn in the energy range common with RGS
- Candidates for low energy cross calibration for RGS, Chandra and EPIC, ROSAT, FUSE

### 1.5 NRCO-47 (NRCO31) EPIC-pn LW mode fast shift CTI correction (MJF)

- NRCO 31 had to be repeated due to radiation and not perfect pointing ( see XMM-SOC-CAL\_EPIC-Min-0014)
- NRCO-47 was also effected by flares, however could still be used
- Analysis is still ongoing
- Non SAS S/W is used for data analysis
- NRCO 47 data are sufficient to perform analysis
- Calibration parameters will be available end of 2005
- → NRCO can be closed

### 1.6 NRCO-49 SW low energy background (MJF)

- Low energy excess in spectral modelling, mostly visible in SW mode
- Possible reason: high internal BG below lower threshold may cause pile-up with XUV/X-rays
- PANTER measurements have been performed for all modes to measure BG (noise) below threshold
- NRCO was performed in slew time
- In orbit spectrum is slightly different form the ground data
- No increase of BG below default threshold
- Need instead e.g. threshold effect modelling (see FWH presentation)
- → NRCO can be closed

## 2 EPIC-MOS

### 2.1 Implementation of the MOS spatial/temporal drm: Does it work (SS)

- 3 regions, 2 cameras, 9 epochs
- release of matrices for revs greater than 370
- CCFs are currently not compatible with SAS 6.1, only with 6.5
- New CCFs are already in DT to be released with new SAS (using an algo ID to make them backwards compatible with all SAS versions)
- CCFs for revs below 370 will also be released only with that new SAS
- zeta Pup was used to model line response at 450 keV
- 3C273 (18 observations) was used to model instrumental edges and cross calibration. nH was fixed to 1.79E20 (ratio (model/data) versus time and energy 3 dimensional plot used to show quality of drm)
- RXJ1856 was used to model low energy response
- There seem to be still problems in normalization when the source is affected by a bad column, arfgen needs to be checked for the correct setting and if it is able at all to cope with that situations
- problems at very low energies and late epochs off patch in reproducing spectral shape
- Inconsistency for off axis spectral parameters (kT) and on axis pointing in some occasions
- Summary:
  - line response at 450 eV reasonable but unacceptable resolution around O edge

- late observations show stronger residuals around Si in MOS2, indicating energy scale problem
- 10 % difference in returned flux between MOS 1 and MOS2 at low energies
- Returned flux from MOS2 in agreement with pn
- very low energy response differences between M1 and M2 can be resolved if we have an agreed physical model for RXJ 1856

## 2.2 MOS CTI/Gain calibration update (DB)

- Glued slew data can be used for CTI determination
- Indication that some epochs of certain CCDs need to be updated
- Strange FWHM raise of MOS2 CCD 4 at Al
- CTI column offset correction addressing spatial CTI variations → needs new CCF and new S/W

# 3 Cross calibration and general issues

## 3.1 The Crab with all modern X-ray instruments (MK)

- Most of the instruments that have their main sensitivity range above 2 keV cannot be used efficiently to constrain the absorption towards the Crab and have been calibrated to fit canonical Crab parameters.
- XMM-Newton may revise the X-ray absorption of the Crab
- Photon index and normalization provided by EPIC agree within the errors of the Toor and Seward values taking also into account the systematic errors of EPIC on the photon index (0.05).
- Further work needs to be carried out to combine the RGS results of the under-abundances with the EPIC results.
- XMM-Newton may soon provide the best calibrated spectrum of the Crab. The current discrepancy between EPIC-pn and MOS in photon index is comparable to the scatter among all instruments.
- For energies above 30 keV the Crab is definitely difficult to use as calibration source. Since its spectrum is no longer a single power law no consensus obtains on the proper model of the spectrum, which should be used for calibration tests. Different results may well be caused by the more complex character of these instruments which are generally difficult to calibrate and have a large intrinsic background that increases with energy
- As much need in the X-ray domain for a set of objects to serve as photometric or spectrometric standards as at longer wavelengths The X-ray equivalents are much harder to define, not least because variability is a very common property of X-ray sources.
- Crab nebula has served as a reference which in common with other fainter SNRs is confidently expected to be constant, but may be too bright for future missions
- XMM-Newton has repeatedly observed a small set of objects that have been judged to serve as X-ray standards with the intention of both monitoring the evolution of instrument performance and providing straightforward comparisons with other instruments.

- strong need for a set of standard calibration sources for the X-ray regime. Luxury situation of having 6 satellites (XMM-Newton, Chandra, RXTE, Swift, Integral, Astro-E2) in orbit that are having X-ray instruments as their payload for the coming years we strongly recommend to found an international calibration group that may steer the cross calibration efforts

### 3.2 Cross-Cal (MST)

- Changes from SASv6.1 to SASv6.5:
  - new MOS rmf: spatial and time dependent
  - improved arfgen: flux correction for more than one bad column
  - embadpixfind: better algorithm avoids flagging of non-bad columns/pixels
- New EPIC pn redistribution CCFs public since May 2005: flattens general S-shape residuals at lowest energies.
- Spectral parameters of RXJ1856-3754 measured by pn are stable
- Low energy (0.4-0.8 keV) time stability of MOS rmfs compared to pn:
  - MOS2 in average fits very good to pn
  - MOS1 fluxes about 5% lower than MOS2 ones and 3% below the pn from begin of the mission.
  - decrease of MOS1/2 fluxes by 5% over the mission.
- Cross-Cal XMM-Newton/Chandra:
  - below 1 keV, ACIS/LETG has higher normalisation than EPICs
  - above 2 keV, ACIS/HEG shows flatter slope, pn the steepest slope and ACIS/MEG and MOSes in between.
- Cross-Cal XMM-Newton/Swift H1426-428:
  - good agreement in 0.6-3 keV range
  - above 3 keV, Swift returns significant steeper spectral slope
  - large discrepancies below 0.6 keV.

### 3.3 EPIC rel timing analysis (IC)

- Rel timing analysis for Crab is better than E-8
- PSRB0540 and PSRB1509 still show rel. timing accuracy of only E-5 E-6 → NRCO needed to check these two pulsars best in parallel with RXTE and radio
- Absolute timing analysis needs geocentring of XMM data or barycentring of radio data (M. Ehle will ask in radio community)

### 3.4 Status of the XMM-Newton Slew Survey (PE)

- pn exposures in FF, eFF, LW modes and Medium filter used
- Source searching independently in three different bands: soft band (0.2-2.0 keV), hard band (2.0-12.0 keV) and total band (0.2-12.0 keV)
- 220 slew observations processed giving 4177 sources in the total band (2750 and 844 sources in the soft and hard bands respectively).
- Sky coverage: ~6300 square degrees (~15% of the sky)
- Source density: ~0.65 sources per square degree

- ~56% of the sources (non-extended and  $\text{det\_ml} > 10$ ) have a RASS counterpart within 60 arcsec.
- XMM-Slew positional accuracy ~8 arcsec
- Spurious sources are flagged in different categories
- Soft band detection limit close to the ROSAT BS catalogue and hard band detection limit deepest ever
- Aim to issue the first slew catalogue (XMMSL1) by the end of 2005

### 3.5 Report from the EPIC BG working group (AMR)

- UG recommended to EPIC to progress in BG description and treatment
- Setting up of EPIC-BG working group
  - Define requirements
  - Place BG material on SOC web pages
  - Primary actions set up (proton screening tool, script for BG blank sky data analysis, set up prototype WEB page at SOC)

## 4 AOB

### 4.1 Telemetry reallocation (MST)

- Work underway to reduce MOS telemetry rate for the benefit of pn
- Telemetry is estimated by analysing all archive data in collaboration with the operations team (GB)

### 4.2 Dates:

- **Next CROSS-CAL Workshop: early Feb 2006 ESAC**
- **Next EPIC-CAL meeting: 4/5 May MPE**
- **Next EPIC BG working group: 24/25 November at MPE**

## 5 Long term calibration plan

- MOS:
  - Redistribution for line rich sources not yet perfect in lines
  - High energy flux higher than pn
  - CTI update
  - CTI for special column areas
  - column dependent CTI correction (NO)
  - Spatial dependence of very low energy response of MOS (lab testing at LUX in 2006)
- pn:
  - Redistribution for line rich sources not yet perfect in lines
  - High energy flux lower than MOS, mirror measurements soon at PANTER (Feb 2006)
  - pn energy refinement for fast modes mode (CTI(energy, rate)), possibly NRCO needed
  - Fast modes drm

- Random jumps in pn energy scale of <20 eV
- Special CTI due to vent hole (can only be checked after implementation of column gain refinement)
- usage of the FIFO-reset-counter for improving the integration time (lab measurements at IAAT, possible check also at PANTER in 2006)
- Check of the rel timing accuracy with NRCOs in 2006
- Investigation of double event behaviour (within 2 years)
- Column gain refinement
- Time jumps + timing document
- general:
  - Cross Cal document
  - BG generation tool
  - PSF: additional gauss
  - Astrometry: possible residual in the position angle rotation (Euler ? angle) of the order of 0.1 deg.
  - Off axis PSF

## **6 Actions items**

- AI\_EPIC\_CAL\_15\_01: Provide update of MOS drm parameter files (SS)
- AI\_EPIC\_CAL\_15\_02: Provide eff mode CTI degradation parameters to SOC (KD)
- AI\_EPIC\_CAL\_15\_03: Implement mode dependent pn CTI-degradation into SAS (MK, RS)
- AI\_EPIC\_CAL\_15\_04: NRCO on Eta Carinae in SW and FF mode, observation time like rev 115,  
Ask for Chandra Cross (HETG) (MK,MST)
- AI\_EPIC\_CAL\_15\_05: MOS-CTI update, to sort out responsibility (MK, SS)
- AI\_EPIC\_CAL\_15\_06: Update MOS CTI CCFs (DB, MST)
- AI\_EPIC\_CAL\_15\_07: Provide input for column region dep CTI (DB)
- AI\_EPIC\_CAL\_15\_08: Implement column region dep. CTI into SAS (RS, MK)
- AI\_EPIC\_CAL\_15\_09: NRCO for Pulsar timing PSRB0540 PSRB1509 checks simultaneous with  
RXTE and radio (MK, MST, ME)
- AI\_EPIC\_CAL\_15\_10: 0.75 sec star tracker delay to get into system (MK, RS)
- AI\_EPIC\_CAL\_15\_11: Track implementation of 'switch all 1 CCD slews for pn to CLOSED', Specify  
date for implementation by end of October (MS)
- AI\_EPIC\_CAL\_15\_12: Describe feature of off axis badpixfind behaviour for pn at the (TBD) appropriate  
place (MST, WNP)
- AI\_EPIC\_CAL\_15\_13: Get in contact with Suzaku for RXJ1856 cross calibration (MST)

## **7 Open old action items**

- AI\_EPIC\_CAL\_11\_5: Frank, Marcus to verify pn QE with the Crab
- AI\_EPIC\_CAL\_14\_1: Additional time column with other 0 point for OHL (RD, MK, MJF)
- AI\_EPIC\_CAL\_14\_2: MK to update frame times according to analysis presented in 1.1
- AI\_EPIC\_CAL\_14\_3: MK to implement time jump in a Qcheck type procedure in the long term
- AI\_EPIC\_CAL\_14\_5: MS to implement KDs values into CCF

## **8 Closed old action items in period of last Cal\_meeting to this CAL-meeting**

- AI\_EPIC\_CAL\_14\_4: KD to provide new gain values for refinement of the column dep. pn gain correction
- AI\_EPIC\_CAL\_14\_6: MK to put warning on energy accuracy in for doubles with input from KD
- AI\_EPIC\_CAL\_14\_7: MK open new NRCO for pn LW CTI determination with N132D, request low BG time
- AI\_EPIC\_CAL\_14\_8: SS to provide RS with newest RMF parameters to be implemented in CCF (SS, RS)
- AI\_EPIC\_CAL\_14\_9: AA to provide diagnostics proposal