esa

MEETING

Meeting date *date de la réunion*	**04.-05. 05 2006**	ref./*réf.* XMM-SOC-CAL_EPIC-MIN-0016	page/*page* 1/11

Meeting place *lieu de la réunion*	**MPE**	chairman *président*	S. Sembay
Minute's date *dates de minute*	15.05. 2006	Participant	Martin Turner 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 Gloria Sala Leo Metcalfe Richard Saxton Marcella Brusa Steve Snowden Herman Marshal Michael Smith Hermann Brunner Jenny Carter Pili Esquej Stephane Rives (partly) Guillermo Buenadicha (partly) Neil Cheek (partly)
Subject/*objet*	EPIC CAL Meeting 16	copy/*copi*	Minutes by M.Kirsch *A.Parmer*

1 EPIC-pn

1.1 Update of the pn CTE (K. Dennerl)

- Inner CCDs show slightly different behaviour than outer, probably due to optical light effect shining on the detector
- Still the usual unexplained gain excursions of typically 1 ADU

1.2 The "fast-shift-CTE": Results from Neuried and in-orbit (M.Freyberg)

- Fast shift has been evaluated using FS model at Panter and NRCO 47 on N132D using FM in orbit
- Results can be implemented in CCF and do not need a SAS change only CCF

1.3 Energy Calibration Refinement proposal of pn Burst Mode (M. Kirsch)

- Proposal to refine energy calibration by observation of Cas-A
- 55 ks NRCO observation agreed by EPIC

1.4 pn-noise below 0.25 keV: Comparison between LW and FF (K. Dennerl)

- more noise in LW mode due to faster read out
- temporal changes in noise behaviour
- goal is to provide *epreject* special flavour to correct LW mode data
- noise enhancement in all modes at CCD boundaries
- noise suppression for Full Frame should be done after pattern recognition, this will need rearranging of CCF and SAS implementation

1.5 The problem with the pn double events (M. Brusa)

- Different energy position of doubles in shift forward and backward direction depending on y-position
- Most differences in backwards double
- LEFT/RIGHT doubles similar to singles
- Forward doubles no systematic trend
- Amplitude in Al smaller than in Mn
- → energy and spatial corrections needed

1.6 The pn detector stability (F. Haberl)

- Low energies RXJ 1856, Med energies 1E0102, High energies (resolution) Eta Carinae
- Low energies:
  - No significant change at low energies
  - (spill off: problems in STDGTI can cause overestimation of exposure, causing up to 10 % discrepancies in normalization, is caused by many short GTIs)
  - Cross calibration using RXJ1856 for various instruments showing contour plots for (kT-NH/ radius/NH)
- Medium energies:

  - Small CTI refinements will be needed as a result of the 1E0102 analysis
  - Thin1 and Thin2 two filters for pn are different. CCF is available for thin2 and should be tested by MPE
  - Dependence on readout mode of 1E0102 normalization caused by pile-up effects
- High energies:
  - Eta carinae observation in same binary orbital phase (5.5 years difference)
  - linking various lines to one free energy
  - Result: 6694 eV (2000), 6658 eV (2006), (expected value: 6699 eV)
    line width is within errors → no evidence for energy resolution degradation, energy position change consistent with the random scatter observed by the calclosed data. (During the calclosed observations just before the Eta Car observation which had a low Mn-line position the RGS were off. Therefore the lower values are probably caused by lower quadrant box temperature. Also the Eta Car observation had a 5 deg C lower temperature than the rev 115 observation, so a part (~12 eV) can come from that.)

1.7 pn residuals above 6 keV: an update (F. Haberl)

- residuals above 6 keV possibly caused by wrong mirror effective area
- improves chi^2 for various sources
- however power law slopes only change by 0.003-0.007
- flux changes above 6 keV of 5-10 %
- explanations:
  - different thickness in Au layer would require much to small thickness (10 nm with respect to requirement of 100 nm)
  - difference in density of Au layer would cause not observed shape in change
  - → theoretical models can not explain the effect satisfactory
  - we simply may need to fudge

2 EPIC-MOS

2.1 Calibration of MOS column offset (D. Baskill)

- Offset in different columns changing over time
- These offsets are grouped into segments of a column
- Extreme offsets up to 30 ADU
- Most offsets within +/-10 ADU
- Not energy dependent
- Correction will improve line width of around 15 %
- CCFs will contain: column number, offset, segment

3 XMM internal Cross Calibration

3.1 The effective area of EPIC (S. Sembay)

- Flux from 17 AGN from orbit 63-683 analysed for 4 different energy bands
- Differences (MOS1/2-pn)/pn:
  - 0.50-0.85 keV: -5.4 %, -1.6 %
  - 0.85-1.50 keV: 2.4 %, 4.1 %
  - 1.50-4.00 keV: 6.8 %, 7.3 %
  - 4.00-10.0 keV: 11.4 %, 7.4%
- no systematical differences over time and filters
- possible problem still with the PSF in combination with very large radii
- possible reason: QE measurements at low energies give margin for changes in 4 energy bands
- This would leave us with an overall 6 % flux differences between MOS and pn
- Would need to decrease the MOS global effective area or increase the pn
- This change would require a complete reworking of the MOS rmf

3.2 XRT point spread function issues (A. Read)

- Room for PSF changes at high energies
- King plus gaussian would require new software
  - < 1 % energy dependent effect on effective area for MOS
  - not required in pn
  - very low priority project
- first work on off axis PSF
  - three off-axis sources in detail, at 4, 5.5 and 7 arcmins.
  - There are problems with pile-up and undetectably slight extensions in some sources.
  - off axis PSF is wider, flatter, more extended
- Shifts in PSF centroid with increasing energies << 1 arcsec

3.3 RGS Calibration update (M. Kirsch)

- Effective area changes implemented in dev track reducing the RGS-EPIC discrepancy from 30-40 to 10-20 %

4 Cross Calibration with other missions

4.1 XMM-Chandra Cross Calibration (H. Marshall)

- Cal talk to Chandra User Group
- Web pages on Cross Calibration on both Chandra and XMM side to go alive before summer
- Comparing indices is difficult → provide unfolded spectra
- Chandra Cal page: http://space.mit.edu/ASC/calib/crosscal
- XMM Cal cal page (only available on internal webpage http://xmm.esac.esa.int/~xmmdoc/internal/int_cal_instr_supp/cross_cal/index.php):
- Investigation to achieve chi2=1 by local adjustments to data.
    - Test cases to Chandra data using Gaussian functions for local adjustment.
    - Chi2 reduced, but chi2=1 not fully achieved
    - Possibly more Gaussians or different basis functions needed

4.2 Cross-calibration results from observations of the INS RXJ1856, and the WDs HZ 43 and Sirius B (V. Burwitz)

- Absolute flux calibration using WD models and data from LETG + HRC-S, EUVE, Rosat and XMM
- 3 objects are used: RXJ1856, and the WDs HZ 43 and Sirius B
- till now: extrapolation from optical and UV data spectra to X-ray regime leads to an accuracy in the X-ray regime with a normalization factor of 1.3
- Result: improved model parameters for all sources refining the LETG calibration
- sources may be used as kind of standard candles for low energy X-ray regime

5 Slew and BG

5.1 The XMM Slew Survey (R. Saxton)

- Slew catalogue released 03.05.2006
- Attitude problem related to 0.75 sec star tracker offset solved
- Sky coverage : 15 %
- Clean (2713) and full catalogue
- Sensitivity limits :
    - 0.2 -12 keV: 1.1 x 10^{-12} erg/s/cm^2
    - 2.0 -12 keV: 3.71 x 10^{-12} erg/s/cm^2
    - 0.2 -2.0 keV: 5.71 x 10^{-12} erg/s/cm^2
- Future plans:
    - provide slew S/W in next SAS
    - upper limit searcher

5.2 Calibration aspects of the slew survey (M. Freyberg)

- Details on calibration for slew survey concerning
  - Optical loading
  - Internal FIFO overflows
  - Stray light
  - Particle background

5.3 Report from the Background Working Group (A. Read)

- BG page available at the SOC providing by End of May:
  - All available information concerning BG components
  - ESAS scripts to perform flare screening and BG modelling for MOS
  - New Blank sky files
  - Accumulated CLOSED data
- Page is mirrored at Goddard
- Future topics:
  - Provide ESAS for pn
  - Implement ESAS into SAS
- For details of the BGWG meetings see: http://www.src.le.ac.uk/projects/xmm/technical/

6 AOB

6.1 Dates:

- **Next CROSS-CAL Workshop: 7-8 September, ESAC**
- **Next EPIC-CAL meeting: 26-27 October, Mallorca**
- **Next EPIC BG working group: 25 October, Mallorca**

7 Long term calibration plan

- MOS:
  - CTI/Gain for special column areas
  - Re-check redistribution for line rich sources not yet perfect in lines
  - Still flux differences of ~ 10 % compared to pn
  - Spatial dependence of very low energy response of MOS (lab testing at LUX in 2006)
  - Spatial variation of low energy QE. Situation in SAS and CCF ?
  - Outer CCD calibration regarding QE, off axis PSF,
  - Rate dep. CTI model (some Vela data in combination with Calsource are already available)
- pn:
  - pn energy refinement for fast modes (CTI(energy, rate)), possibly NRCO needed
  - Fast modes arf
  - Redistribution for line rich sources not yet perfect in lines
  - High energy flux lower than MOS, mirror measurements soon at PANTER (in 2006)
  - Random jumps in pn energy scale of <20 eV (NRCO on PKS2155 in July)
  - Detector noise in different modes
  - 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
  - Absolute/relative timing monitoring at ESAC
  - Investigation of double event behaviour (ongoing at MPE)
  - Time jumps + timing document
- general:
  - PSF: off axis PSF (possible raster point NRCO needed in 2007, in combination with SW mode test on the outer CCDs),
    additional gauss (low priority),
  - Astrometry: possible residual in the position angle rotation (Euler ? angle) of the order of 0.1 deg. (considered to be low priority)
  - Thin and medium filter: not worth spatial calibration, but check thin1 versus thin2 filters

8 Actions items

AI_EPIC_CAL_16_01: Implement LW CTI refinement into CCF before August (MK, MJF)
AI_EPIC_CAL_16_02: MK to initiate NRCO for Burst mode energy cal refinement and carry through calibration changes (MK)
AI_EPIC_CAL_16_03: Implement column dependent CTI/Gain correction (RS, DB)
AI_EPIC_CAL_16_04: Change energy binning of MOS DRM from 15 to 5 eV (RS)
AI_EPIC_CAL_16_05: Provide estimate for the need of additional MOS CLOSED observations (SSn)
AI_EPIC_CAL_16_06: Create CAL functionality and CCF to deal with FIFO reset effect (RS)

9 Open old action items

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_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_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)

10 Closed old action items in period of last Cal_meeting to this CAL-meeting

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) Chandra not possible (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_09: NRCO for Pulsar timing PSRB0540 PSRB1509 checks simultaneous with RXTE and radio (MK, MST, ME)
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)
AI_EPIC_CAL_11_5: Frank, Marcus to verify pn QE with the Crab
AI_EPIC_CAL_14_5: MS to implement KDs values from column dep. pn gain correction into CCF

11 Splinter meetings

Note that Action items set in the splinter meetings are not tracked in the official EPIC CAL minutes

11.1 EPIC-pn Time-Jump Splinter (MK, EK, MJF, RS, Minutes: MJF)

1) in an email MJF -> MK the correct new clock numbers of the EPIC-pn submodes are given, and for all modes except SW mode also the correct conversion to nominal frames times in [ms] is given (i.e. multiplied by nominal oscillator period of 40 ns). In SW mode the given time (not the clock number) it is too large by 1 clock-equivalient, i.e. 40ns. It should be checked, which numbers went into the 5 new CCF, i.e. whether MK just put in MJFs' time values ;-)

-> AI on MJF + MK (independently ;-)

2) It has been observed that there are cases where there is more than one likely amount of time for correction of the time jump, i.e. the then remaining fractional difference in units of frame times is equally small, and smaller than the uncorrected value. EK suggested that a histogram of the time jumps in the data of a well understood (i.e. corrected) mode like the FF mode should give a good indication, which jump size is the most likely on and to use this as a tie-breaker criterion. This is due to the fact that the external trigger to increment the seconds counter does not know about the EPIC-pn mode and the effect should thus be mode-independent.

Question of the minutes' author: I cannot remember by heart whether the external trigger just increments the full seconds counter and what triggers the reset of the sub-seconds counter ??

MK is working on SAS-corrected times, MJF on uncorrected AUX-derived times, therefore it was concluded that MJF should accumulate this histogram.

-> AI on MJF

3) MJF explained that only a limited set cases of time differences with non-integer multiple of the frame time can occur. The deviation can be due to the fact that a FTFINE unit in the PNAUX1 extension is 512 clocks while the cycle sequence is not an integer multiple of 512 clocks. This introduces some jitter (non-cumulative).
Between two events ...
... within the same FTCOARSE second: all fractional differences must be smaller than 1 FTFINE unit
... between different FTCOARSE seconds: it has been found that also 2 FTFINE units can (and normally do) occur. EK mentioned that in each of the seconds the jitter can be effective and thus at a full-second transition the effect can be twice as large.
... between different FTCOARSE seconds: the external time trigger (full-second increment, sub-second reset ? see above) introduces an

time external to the intrinsic oscillator clocks. If the actual oscillator frequency is not 40ns (which can happen in the case of temperature changes etc., see Freyberg et al, MPE report 288) then a cumulative effect can occur as then the intrinsic seconds may deviate from external seconds and thus frames at second boundaries are then systematically longer (or systematically shorter) than 1 FT.

It should be checked which parts are implemented and what margin in the OAL is really effective. MK observed that changing the margin SAS environment variable (OAL in DT) did not show the expected behaviour. This should be checked in more detail.

-> AI on MK and RDS

4) As MJF, MK, and EK are not extremely familiar with C++ (and thus the OAL code) it was found useful to have some kind of "pseudo-code" that explains what steps are performed and in what order/priority to deal with the time jump correction in the OAL.
RDS explained that UL had documented the relevant code quite well and that it would not be too difficult to provide this. This is related to point "3" above.

-> AI on RDS

11.2 EPIC-pn FIFO Splinter (FH, EK, MJF, RS, Minutes MJF)

1) MJF has seen for bright (optical) sources in the XMM-Newton Slew Survey that in FF mode it takes 3-4 (empty) frames to recover from a FIFO overflow, and in eFF mode even longer. For the TI mode Burwitz et al, SPIE 5165 (XMM-SOC-CAL-TN-0064), have shown that this time constant is of the order of 0.1s (i.e. significantly shorter).

FH has seen in observations of not extremely bright isolated neutron stars (assumed to be constant sources in terms of spectrum and flux) that between two exposures the normalisations do not agree, and that one of the two exposure times seem to be significantly overestimated.

As now the overall EPIC-pn calibration is good enough so that such small effects become visible, it was put into the long-term calibration plan to investigate this effect further, at IAAT and then at PANTER (as the FIFOs are identical).
-> AI on EK

2) RDS suggested to raise an SPR on the SAS to document this issue (i.e. possible overestimate of the exposure). MJF replied that a feature is already foreseen and implemented via command line parameter to epframes (fifogtithresh withfifogti), but the the relevant values have to be calibrated and that the default value is apparently not the optimum for other modes than TI mode.

It was agreed that the calibration should provide 6 values (one for each mode) describing the average deadtime after a FIFO reset.
-> AI on EK

Furthermore, the least code change is to store these values in MISCDATA rather than to create a new component. The CAL needs to be slightly modified to provide these quantitites.

-> AI on RDS

Finally, RDS asked MJF to submit an SCR on the CAL with the above matter.

-> AI on MJF [closed on "Fri May 5 19:35:22 2006" (UT) with SOC-SCR-213]

Well, we do not have a name yet for this CCF entry, perhaps something like FIFO_DEADTIME_FF (_EF, _LW, _SW, _TI, _BU) ? The last change to
the MISCDATA have been the size and coordinates of the masked window.

-> AI on MJF, RDS, EK

3) Currently, the FIFO deadtime loss is only output via a message in the SAS task epframes and written to the EXPOSURE extensions as keyword FIFOLOSS [in s]. This quantity is derived from the PMH values in the columns F1936 F1937 F1938 F1939 for quadrants 0 1 2 3, respectively. The time resolution there is 8s. Moreover, epframes also looks into the PNAUX2 extensions and checks for differences Nabove - Ndefa, if non-zero, then this is also interpreted as FIFO deficiency, and the number of such occurences is reported via keyword FIFODEFI to the events file. If this difference is greater or equal 512 this is interpreted as FIFO overflow instead and the corresponding value written to the FIFOOVER keyword. Nothing is applied to the FRACEXP column yet.

Moreover, in an offline analysis (FH+MJF) it was seen that the FFFF occurence in the PNAUX1 extensions is coupled with a number of 3-4 missing frames in that file (FF mode). For weaker sources there is a higher probability that a certain number of consecutive empty (i.e. apparently missing) frames occur, so the deadtime cannot be uniquely be *derived* from here, only the *start* time can be determined.

It has to be decided after the calibration of the FIFO deadtime which indicator (PMH F1936 etc, NABOVE-NDEFA, FFFF) is the proper one.

-> AI on EK

If the calibration is successful anad a unique indicator is defined, then the corresponding exposure loss should be applied to the FRACEXP column in the EXPOSURE extension, either directly if the exact time can be identified (FFFF) or statistically over 20 frames (NABOVE-NDEFA) or 8s (F1936+x). This may then be associated with an SPR on epframes.
-> AI on MJF