XMM-Newton CCF Release Note

XMM-CCF-REL-222

Update of EPIC MOS2 gain epoch revs. 446-533

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1 CCF components

Name of CCF	VALDATE (start of val. period)	EVALDATE (end of validity period)	List of Blocks changed	CAL VERS.	XSCS flag
EMOS2_ADUCONV_0042	2002-05-16T05:00:01	2002-11-07T05:00:00	OFFSET_GAIN		NO

2 Changes

The new MOS2 ADUCONV CCF issue 42 has been created together with a MOS2 CTI CCF issue 30. This new CCF replaces the previous MOS2 ADUCONV CCF issue 36 (see XMM-CCF-REL-207) and covers the same time period 2002-05-16 to 2002-11-07 (revs. 446-533).

Using CCF EMOS2_CTI_0024.CCF it was found that low energy images of MOS2 CCD4 were incomplete; high RAWX columns were not present in the images. There was also a RAWX/PI dependence — as the upper PI selection threshold was lowered the area of blank CCD increased (see XMM-CCF-REL-221 for details). Beside of this low energy cut-off, the interaction of CTI and ADUCONV parameters took care that the energy reconstruction of the events were correct. The energy positions of the internal calibration lines were accurate by better than 5 eV at Al-K and Mn-K. The replacement of EMOS2_CTI_0024.CCF necessitates an update of the corresponding ADUCONV CCF.

These new gain parameters have been tuned to suppress the residuals present in the energy scale using the old CCFs. The replacement CCFs, as with their previous versions, assume a linear relationship between the charge deposited inside a pixel and the energy of the detected X–ray:

$$E_{\mathrm{eV}} = \mathrm{gain} \times E_{\mathrm{charge}} + \mathrm{offset}$$

The new gain and offset values have been calculated from observations of the on-board calibration sources, which offer three spectral lines: Al Kα at 1486.57 eV (Suresh et al 2000, J. Phys. B. At. Mol. Opt. Phys. 33), Mn Kα at 5895.75 eV and Mn Kβ at 6489.97 eV (Holzer et al 1997, Phys. Rev. A, 56, 6). The derived gain and offset values used in each CCF are averaged values taken from the calibration observations made during the corresponding CCF time period. Starting at rev. 918, the MOS calclosed observations are performed during slews. For the analyses, several slew calclosed observations were combined to achieve reasonable statistics.

However, observations during eclipse seasons have been neglected, since the cooler EPIC MOS Analogue Electronics (EMAE) require a smaller gain correction. This effect is most notable in the calibration observations, since these were performed immediately after the end of the eclipses; by the time science observations commence, the EMAE has returned to its nominal temperature and so this temperature variation during eclipse has no impact on science observations.

Calculating the linear gain term, further spurious points that deviate from the mean value by more than 5 times the average error of the points are also rejected; such rejection is not required for the constant offset term.

3 Scientific Impact of this Update

For all CCDs and all time periods, the energy scale is now reconstructed to about 5 eV or better for the entire energy range. The improvement of this new gain on existing data is expected to be less than 5-10 eV at 6 keV, and less than 5 eV at 1.5 keV.

The new EMOS2_ADUCONV_0042.CCF was released together with the new EMOS2_CTI_0030.CCF

(see XMM-CCF-REL-221), since the new cti with old gains, and old cti with new gains may give unexpected results!

4 Estimated Scientific Quality

CCD4 shows a slight enhanced offset of up to 7 eV at higher energies (6 keV). As the calibration team is currently working on an update of the complete CTI/ADUCONV CCFs sets, this small offset (about 1 per mill) of an outer CCD is accepted by the calibration team.

The energy scale accuracy is better or about 5 eV (except CCD4) on the whole energy range for i) not too bright sources and ii) outside of eclipse seasons (at the start of revolutions). In this two cases, as explained in XMM-CCF-REL-124, the energy scale can be significantly over-corrected.

5 Test procedures & results

The new ADUCONV CCFs have been tested with the SASv7.0. No RAWX/PI dependence in low energy images was found any more. The results for the energy positions of the internal calibration lines using the new CCF are presented in Fig. 1 to Fig. 2.

6 Expected Updates

The calibration team is currently working on a column dependent CTI which can take into account different CTI behaviour of the individual columns as well as different behaviour of sections within a single column. These new set of CTI CCFs will also require an update for the ADUCONV CCFs for all epochs.

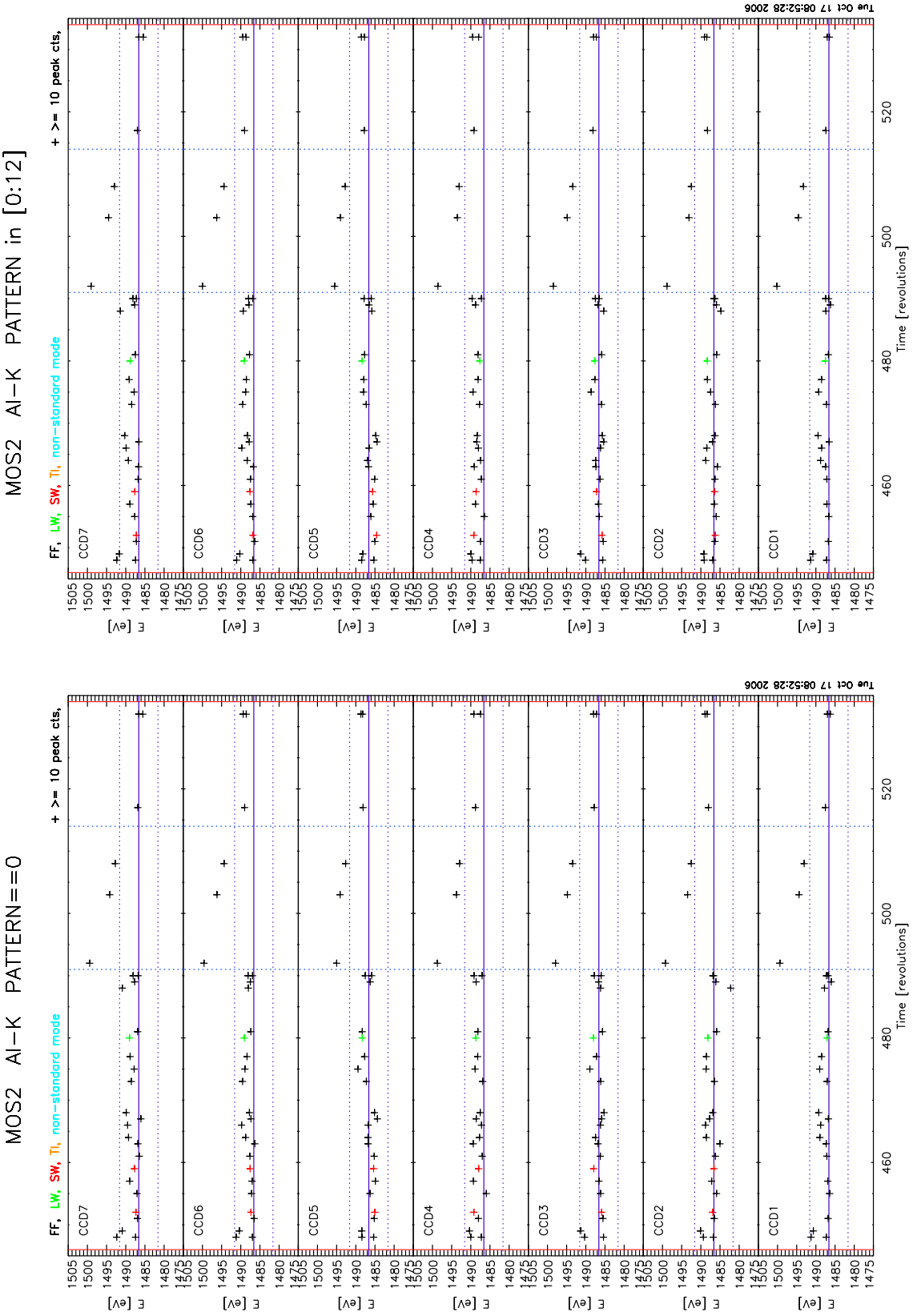

Figure 1: MOS2 Al K_α line energy scale using the new EMOS2_ADUCONV_0042.CCF. Eclipse seasons are indicated by vertical blue lines, CCF epochs by red lines. The horizontal solid line represents the laboratory line energy, the dotted lines the ± 5 eV deviations.

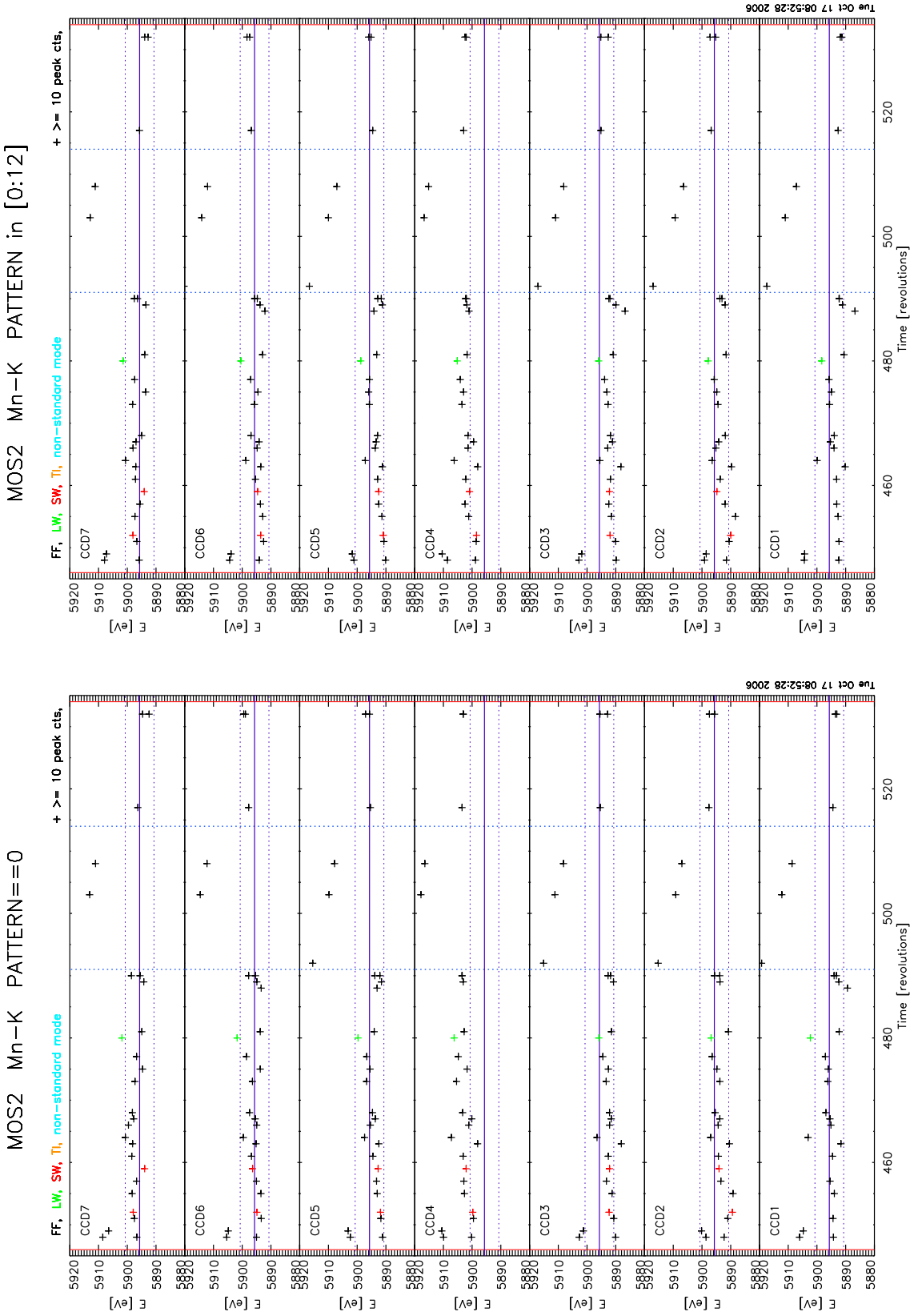

Figure 2: MOS2 Mn K_α line energy scale using the new EMOS2_ADUCONV_0042.CCF. Eclipse seasons are indicated by vertical blue lines, CCF epochs by red lines. The horizontal solid line represents the laboratory line energy, the dotted lines the ±5 eV deviations.