XMM-Newton CCF Release Note

XMM-CCF-REL-364

Update of EPIC MOS gain

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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
EMOS1_ADUCONV_0111	2017-06-10T17:00:01		OFFSET_GAIN		NO
EMOS2_ADUCONV_0115	2017-06-10T17:00:01		OFFSET_GAIN		NO

2 Changes

A new epoch of CTI/ADUCONV CCF has been defined for the MOS taking into account the latest measured drop of reconstructed line energies in the monitoring of the on-board calibration lines. New ADUCONV CCFs have been generated which include updated values for the gain parameters.

The new epoch CCFs partially replace the previous most recent epoch for times of rev. 3206 onward (MOS1 issue 110, MOS2 issue 114). The epoch start is identical for MOS1 and MOS2.

These new gain parameters have been tuned to suppress the residuals present in the energy scale using previous 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:

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

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 at 1.5 keV and 10 eV at 6 keV or better for most sources (not too bright). The improvement of this new gain on existing data is expected to be up to 15 eV at 6 keV and up to 5 eV at 1.5 keV for the most recent epoch.

The new of ADUCONV CCFs are released together with a new CTI CCFs (MOS1 issue 99, MOS2 issue 103, see XMM-CCF-REL-363), since the new CTI with old gains, and old CTI with new gains may give unexpected results!

4 Estimated Scientific Quality

The energy scale accuracy is better or about 5 eV over the whole energy range for i) not too bright sources and ii) outside of eclipse seasons (at the start of revolutions).

In the latter 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 SASv17.0. Illustration examples of the drop in line energies using the previous CCFs are shown in Fig. 5 and Fig. 6. The presented effect is similar in MOS1 and MOS2 for Al and Mn lines in most CCDs.

The results of the new CCFs are presented in Fig. 1 to Fig. 4.

6 Expected Updates

None.

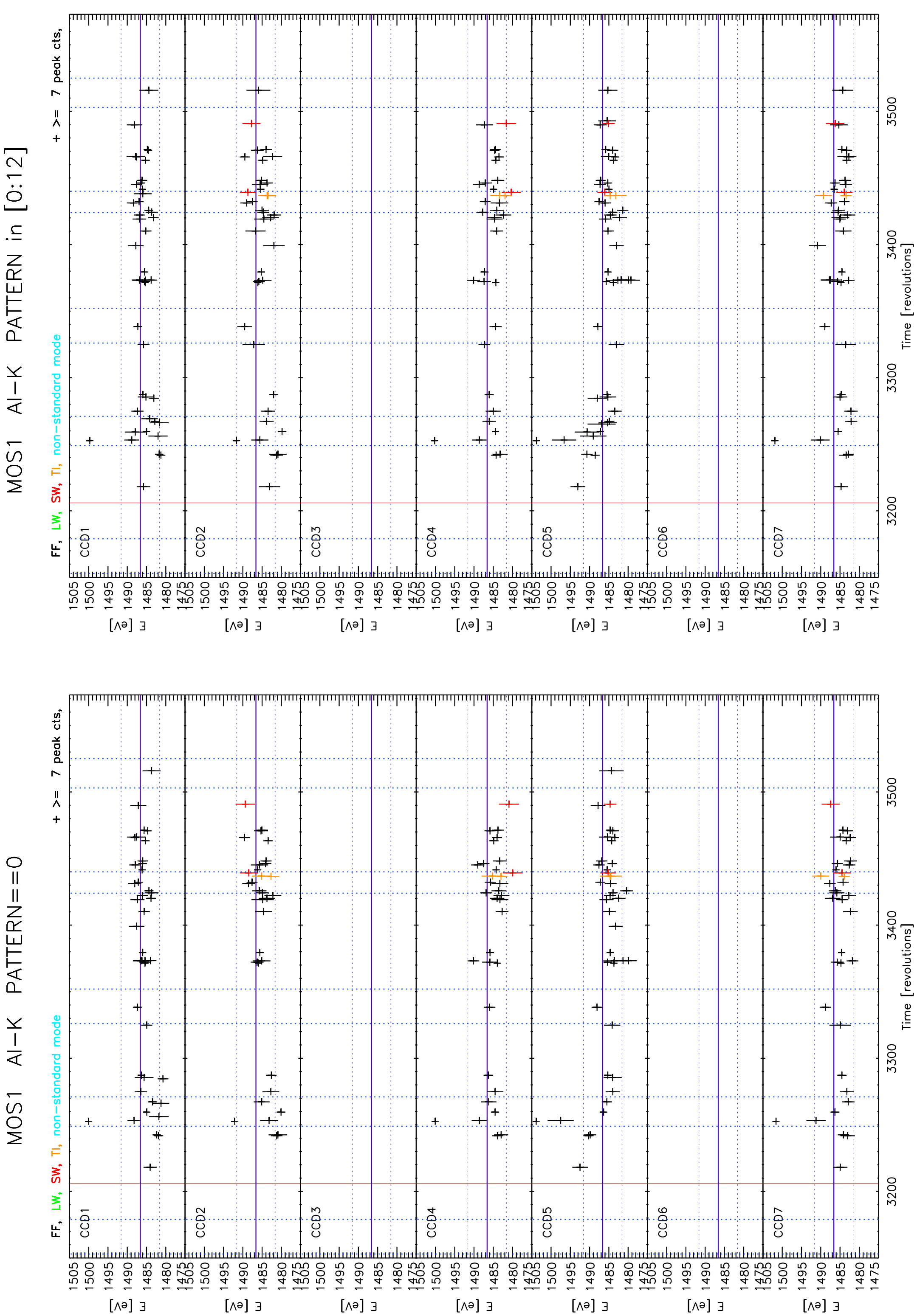

Figure 1: MOS1 Al K_α line energy scale using the new CTI+ADUCONV CCFs. Eclipse seasons are indicated by vertical blue lines, CCF epochs by red lines. The horizontal solid line represents the laboratory line energy, the dotted lines the ±5 eV deviations.

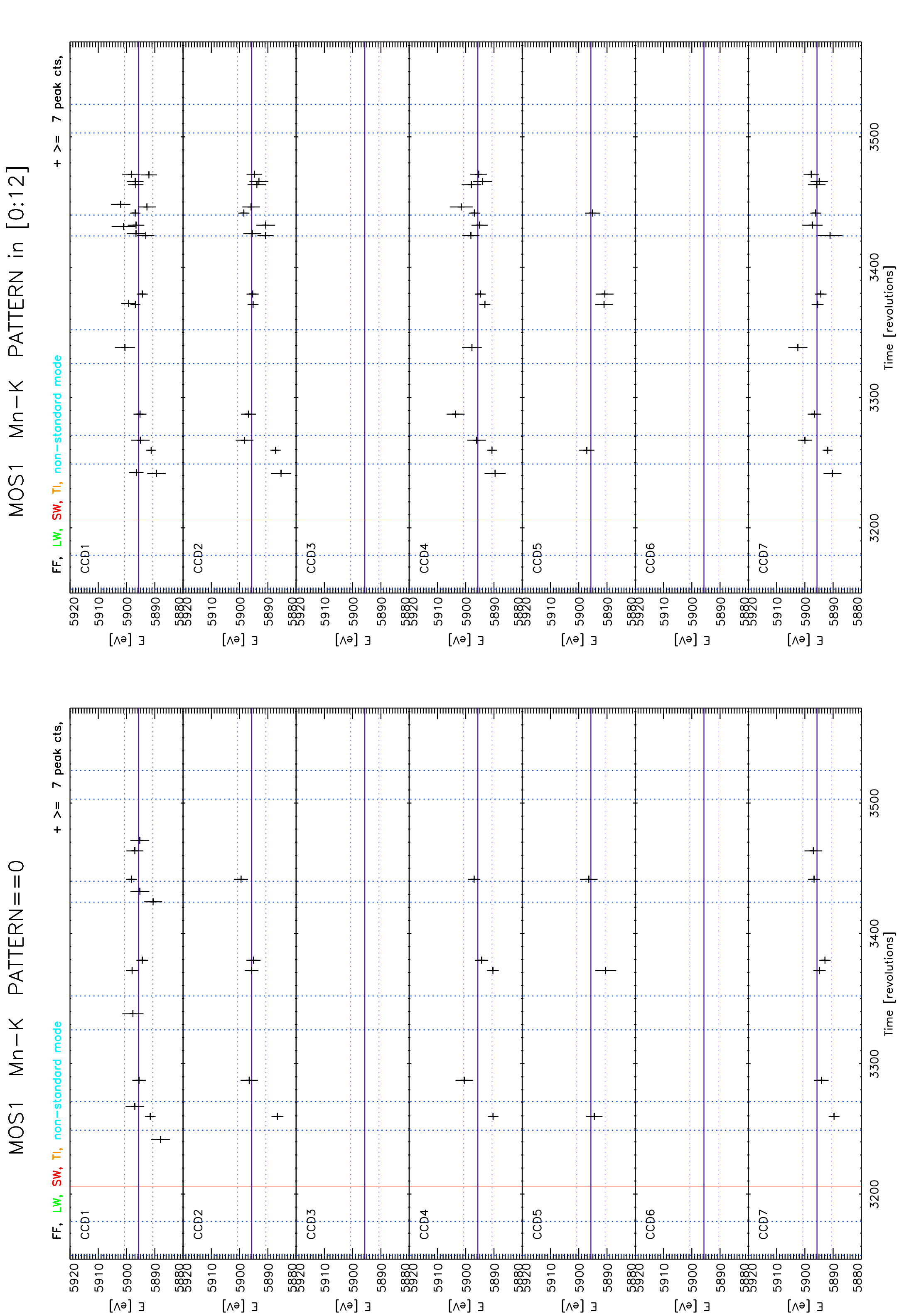

Figure 2: MOS1 Mn K_α line energy scale using the new CTI+ADUCONV CCFs. Eclipse seasons are indicated by vertical blue lines, CCF epochs by red lines. The horizontal solid line represents the laboratory line energy, the dotted lines the ±5 eV deviations.

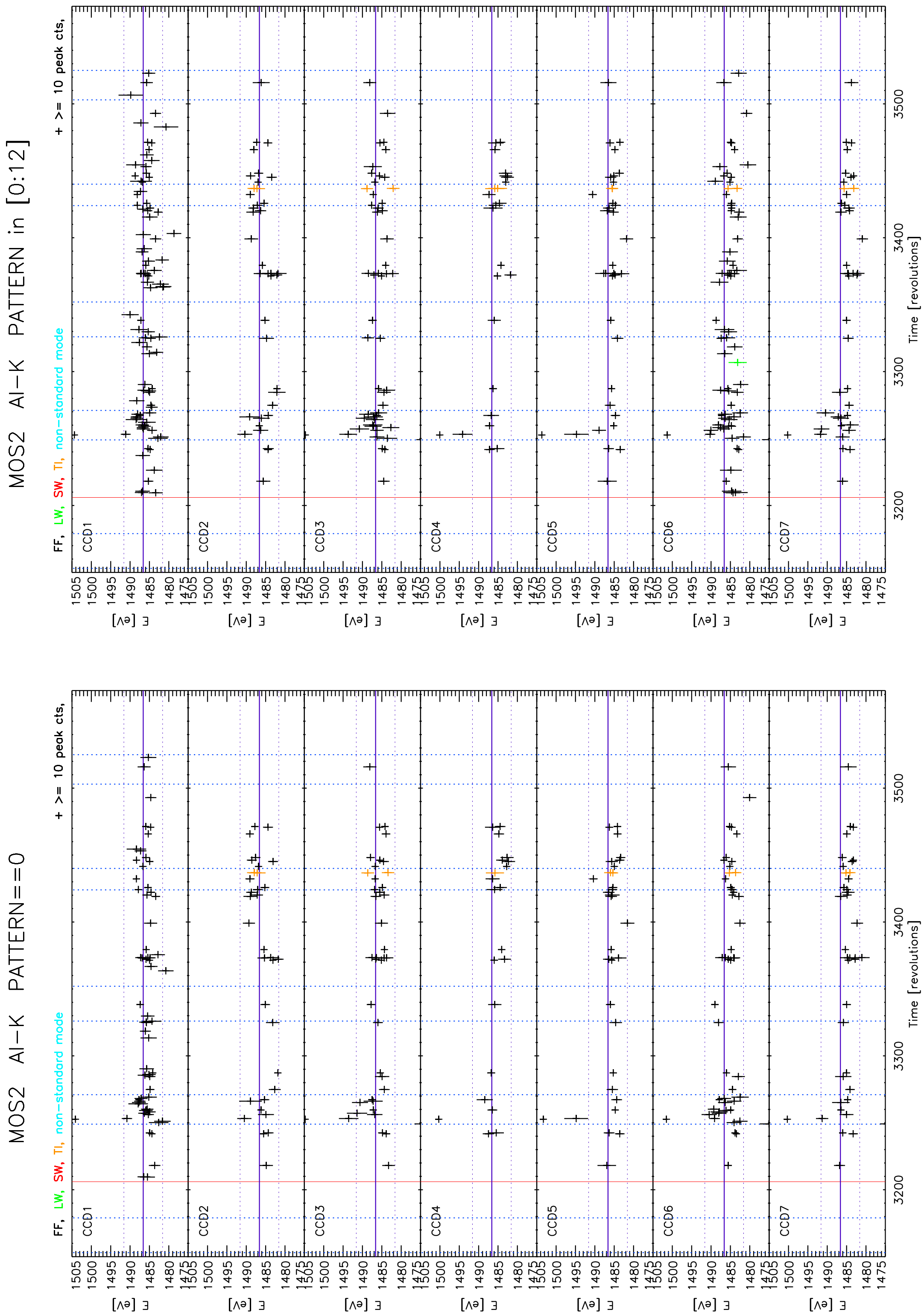

Figure 3: MOS2 Al K_α line energy scale using the new CTI+ADUCONV CCFs. Eclipse seasons are indicated by vertical blue lines, CCF epochs by red lines. The horizontal solid line represents the laboratory line energy, the dotted lines the ± 5 eV deviations.

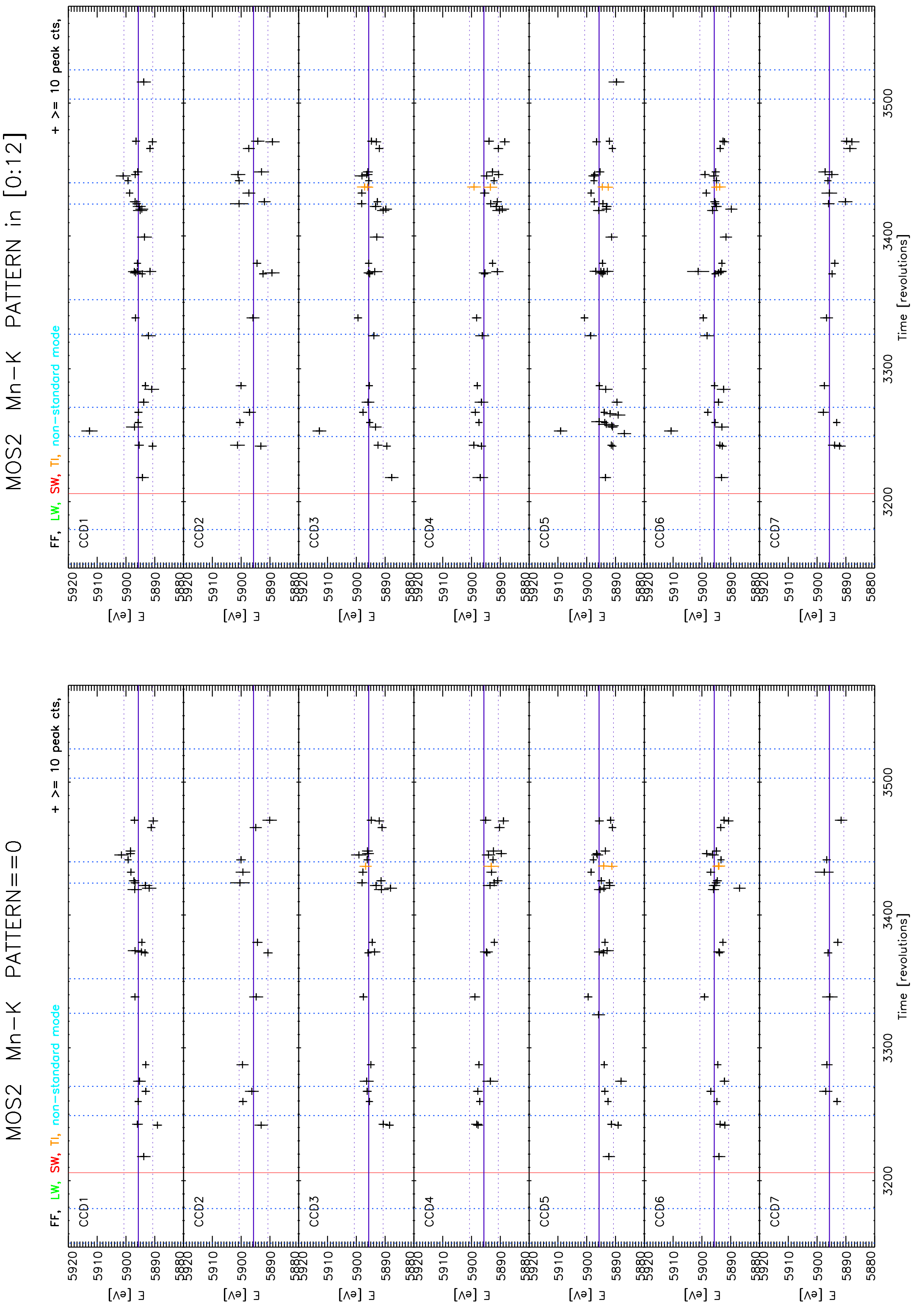

Figure 4: MOS2 Mn K_α line energy scale using the new CTI+ADUCONV CCFs. Eclipse seasons are indicated by vertical blue lines, CCF epochs by red lines. The horizontal solid line represents the laboratory line energy, the dotted lines the ±5 eV deviations.

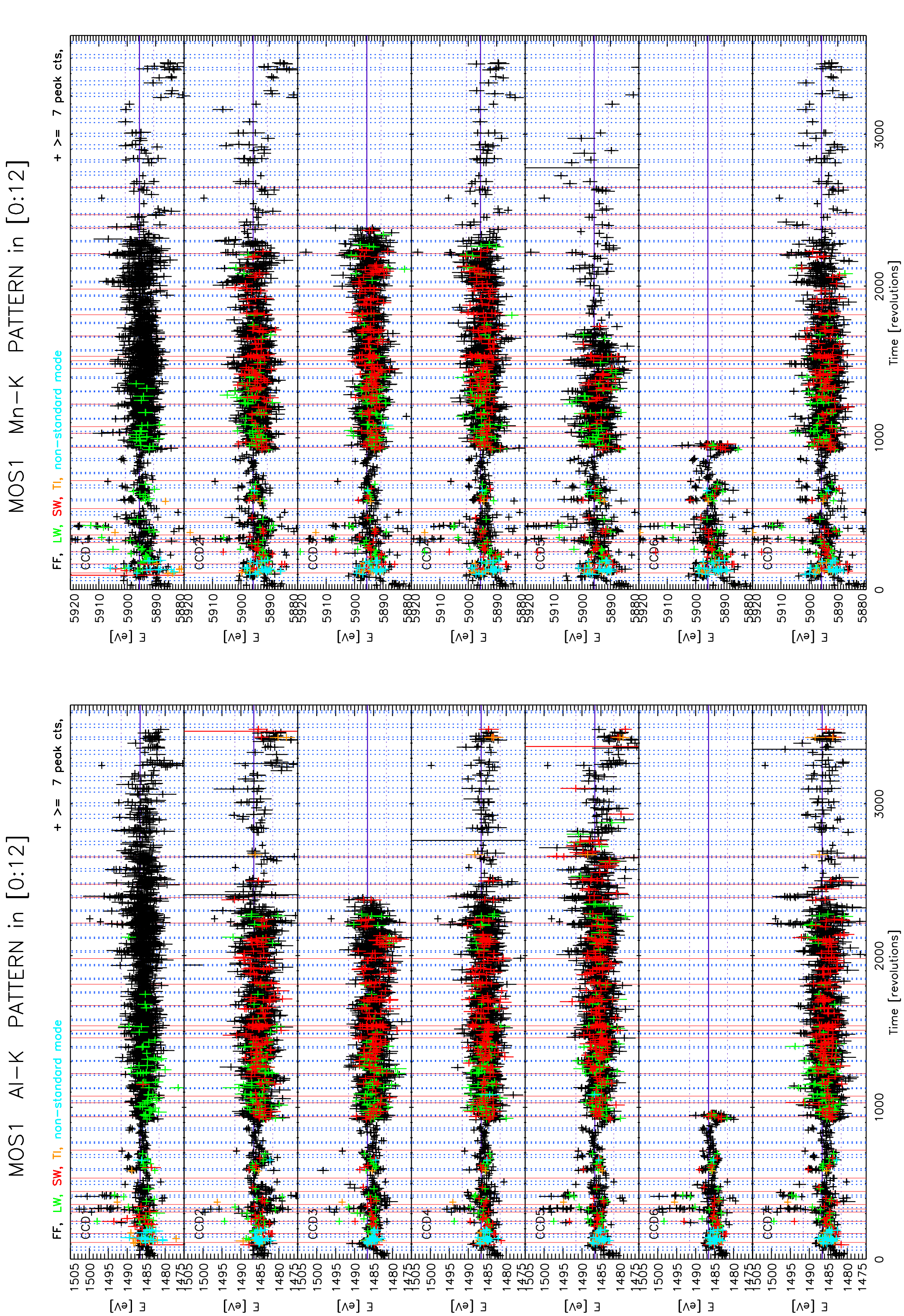

Figure 5: Al K_α and Mn K_α line energy scale for MOS1 using the previously public ADUCONV CCFs, showing a drop in line energies for most CCDs which enforced the new epoch. Eclipse seasons are indicated by vertical blue lines, CCF epochs by red lines. The horizontal solid line represents the laboratory line energy, the dotted lines the ± 5 eV deviations.

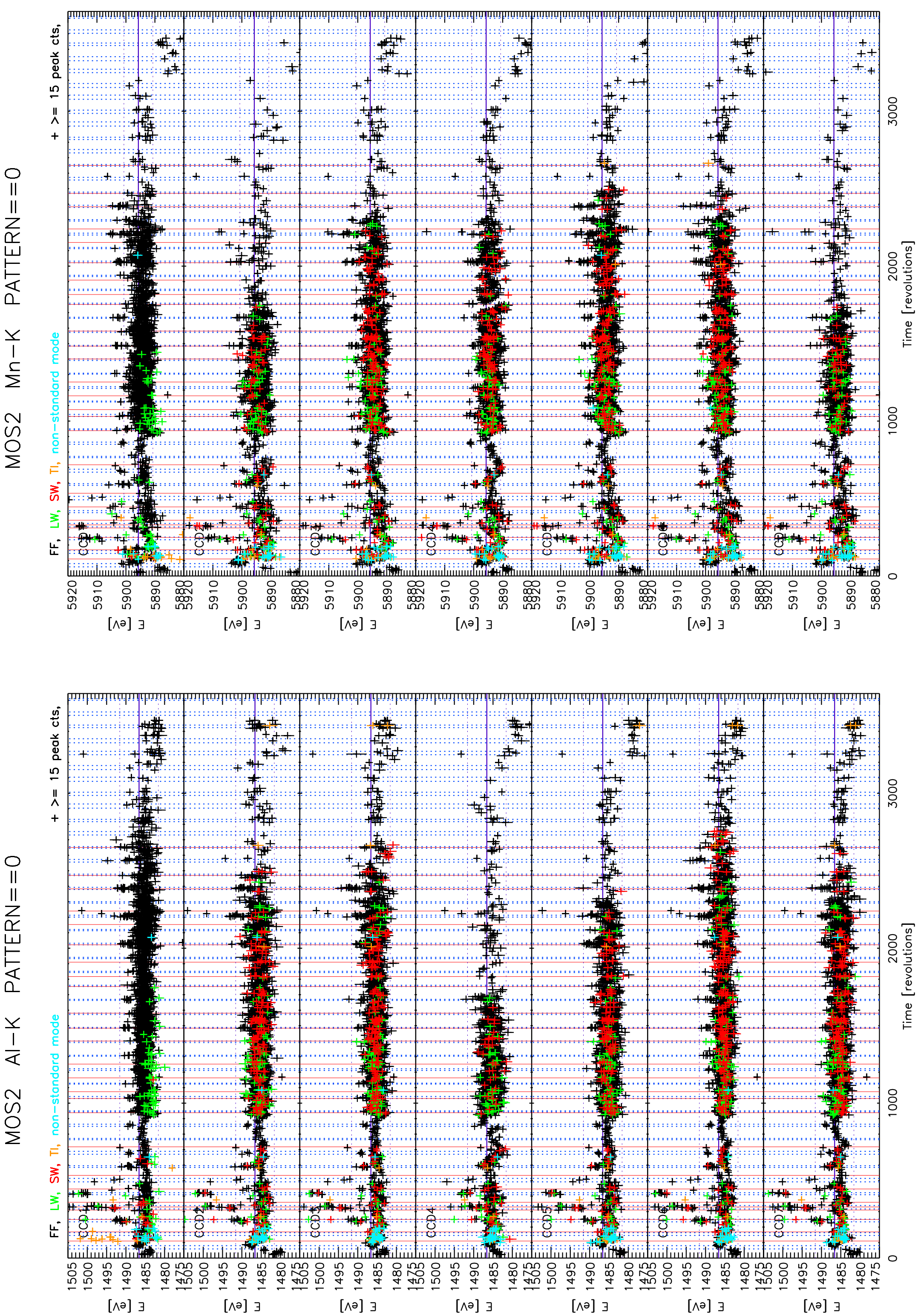

Figure 6: Al K_α and Mn K_α line energy scale for MOS2 using the previously public ADUCONV CCFs, showing a drop in line energies for most CCDs which enforced the new epoch. Eclipse seasons are indicated by vertical blue lines, CCF epochs by red lines. The horizontal solid line represents the laboratory line energy, the dotted lines the ± 5 eV deviations.