XMM-Newton CCF Release Note

XMM-CCF-REL-317

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_0086	2012-12-12T10:00:01		OFFSET_GAIN		NO

Name of CCF	VALDATE (start of val. period)	EVALDATE (end of validity period)	List of Blocks changed	CAL VERS.	XSCS flag
EMOS2_ADUCONV_0087	2010-01-18T10:00:01		OFFSET_GAIN		NO

2 Changes

A new ADUCONV CCF has been generated which contains updated values for the gain parameters. This new CCF defines a new epoch and replaces for the most recent time period the previous ADUCONV CCF (MOS1 issue 85, MOS2 issue 86).

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:

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

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 up to 15 eV at 6 keV at the most recent epoch, and less than 5 eV at 1.5 keV.

The new ADUCONV CCF is released together with a new CTI CCF (MOS1 issues 74, MOS2 issues 75, see XMM-CCF-REL-316), 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 CCF has been tested with SASv13.5. The results of the new CCF are presented in Fig. 1 to Fig. 4.

6 Expected Updates

None.

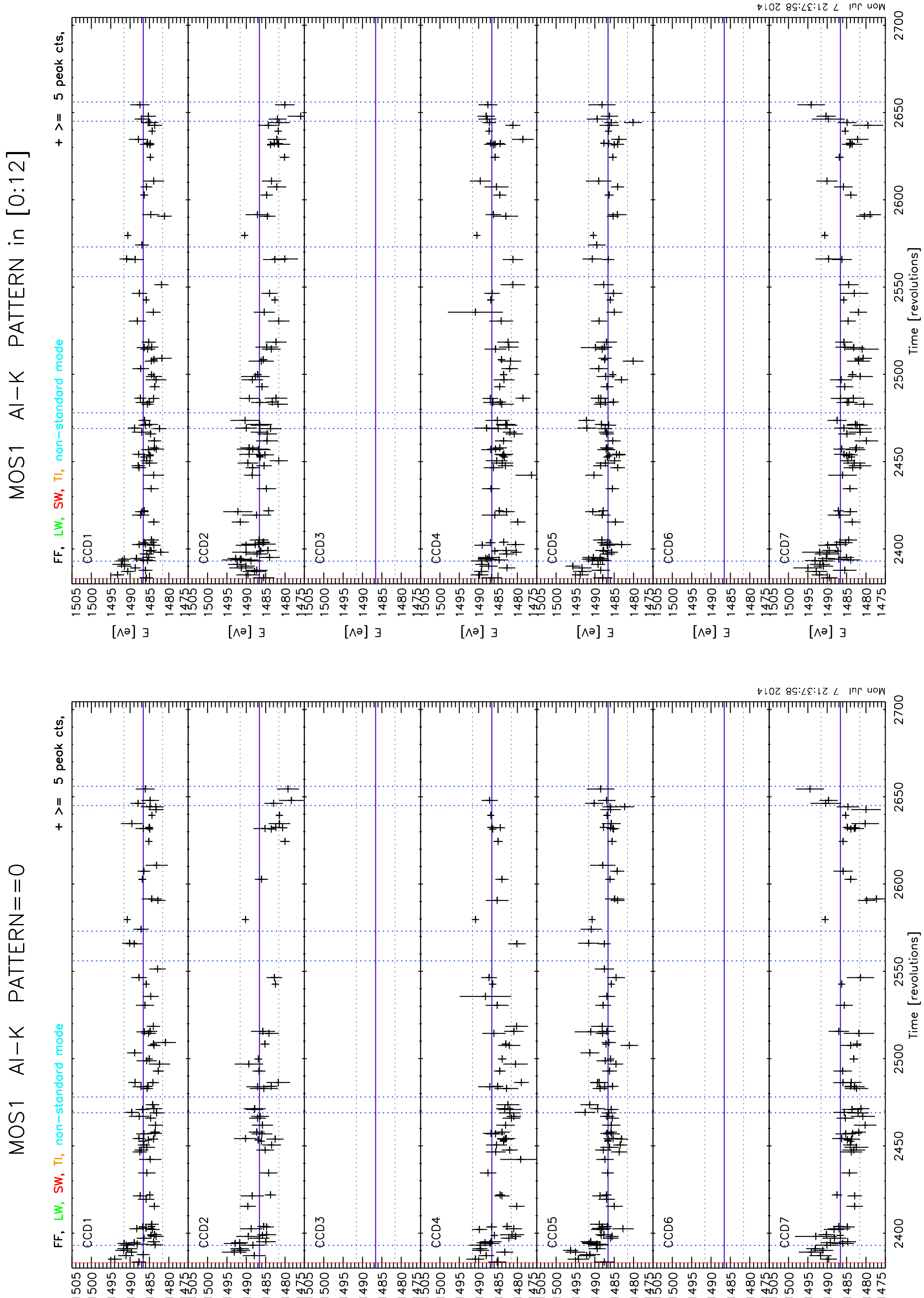

Figure 1: MOS1 Al K_α line energy scale using the new CTI+ADUCONV CCF. Eclipse seasons are indicated by vertical blue lines, CCF epochs by red lines. The horizontal solid line represents the laboratory line energy, the dotted lines the ±5 eV deviations.

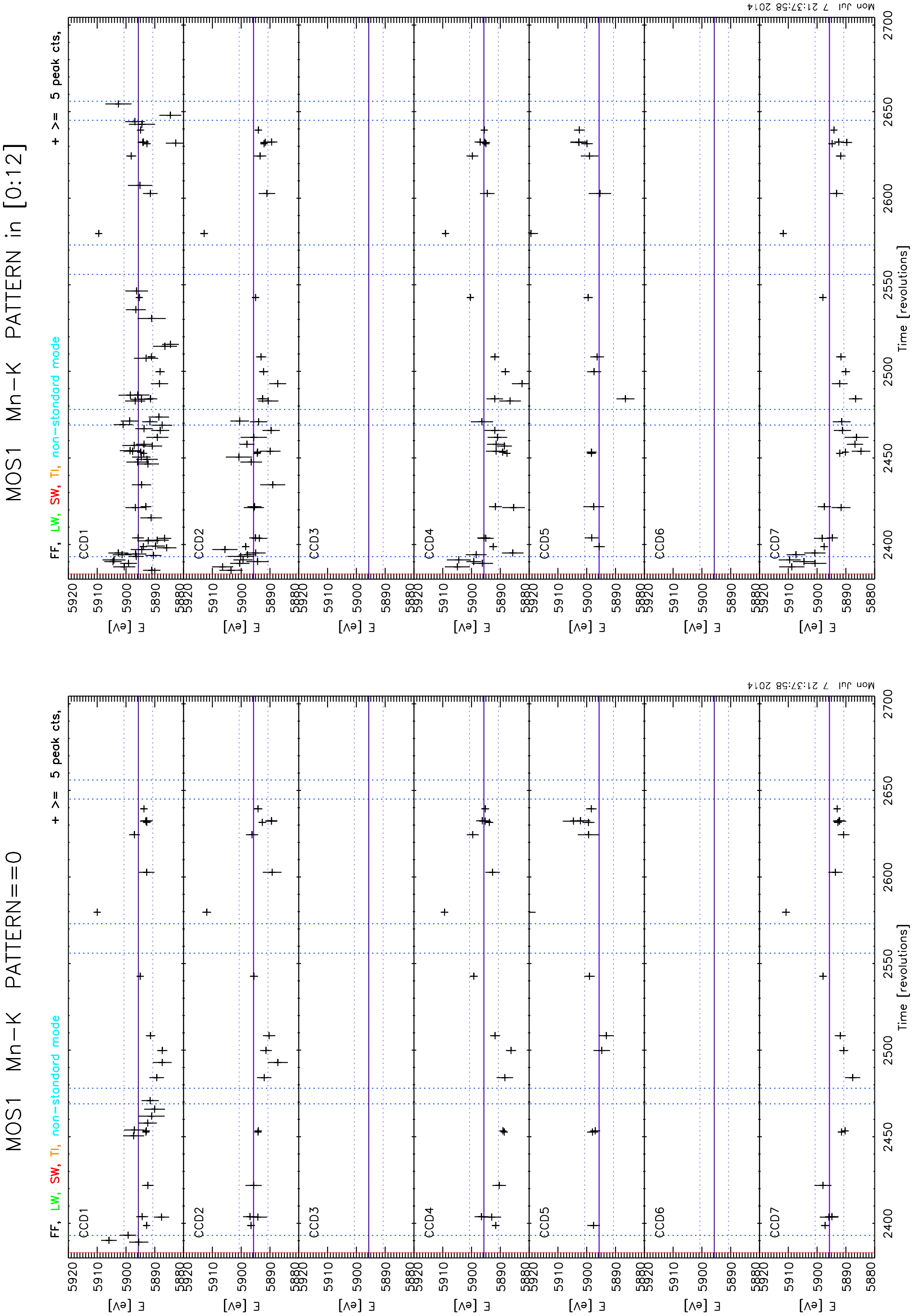

Figure 2: MOS1 Mn K_α line energy scale using the new CTI+ADUCONV CCF. Eclipse seasons are indicated by vertical blue lines, CCF epochs by red lines. The horizontal solid line represents the laboratory line energy, the dotted lines the ±5 eV deviations.

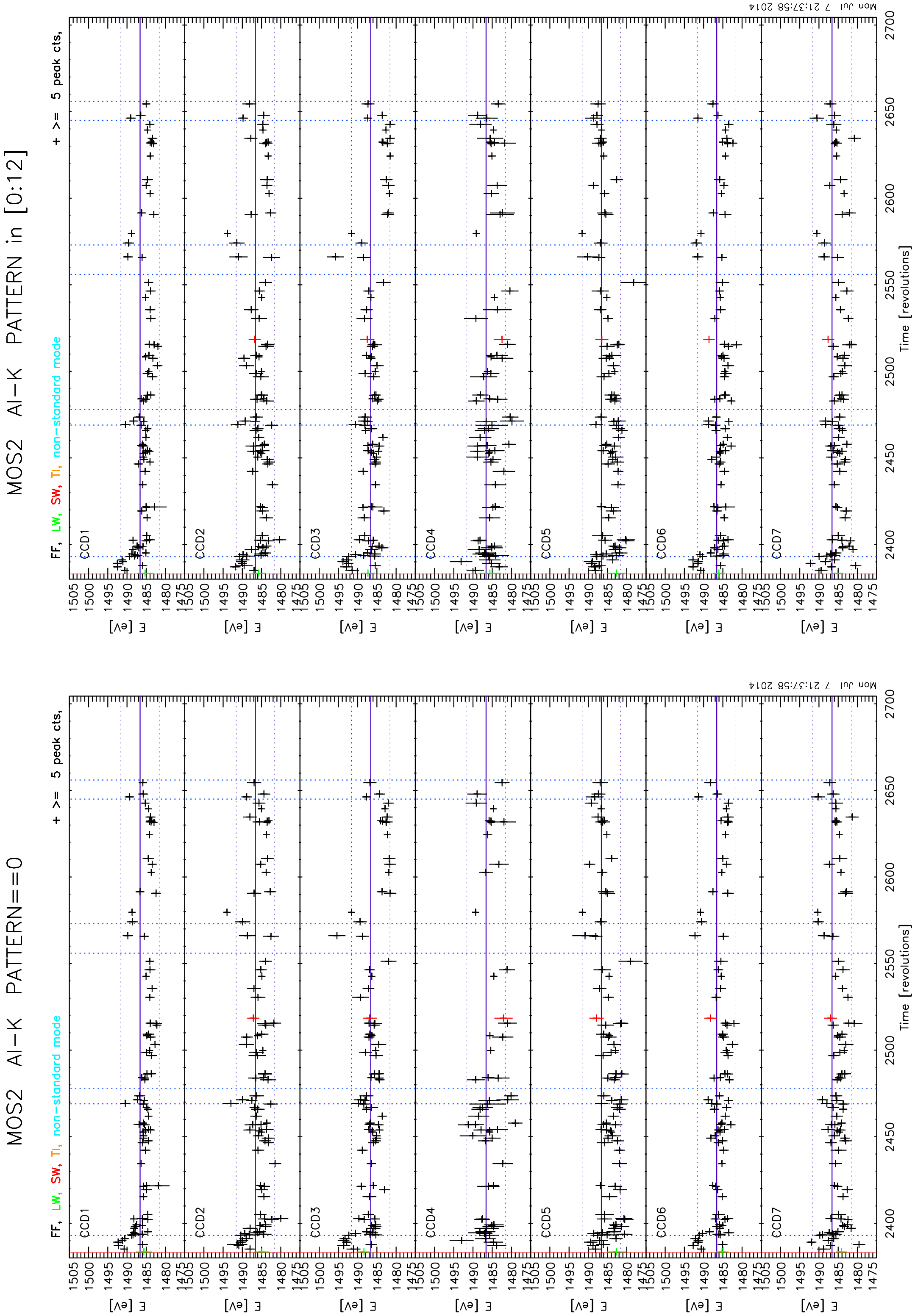

Figure 3: MOS2 Al K_α line energy scale using the new CTI+ADUCONV CCF. Eclipse seasons are indicated by vertical blue lines, CCF epochs by red lines. The horizontal solid line represents the laboratory line energy, the dotted lines the ± 5 eV deviations.

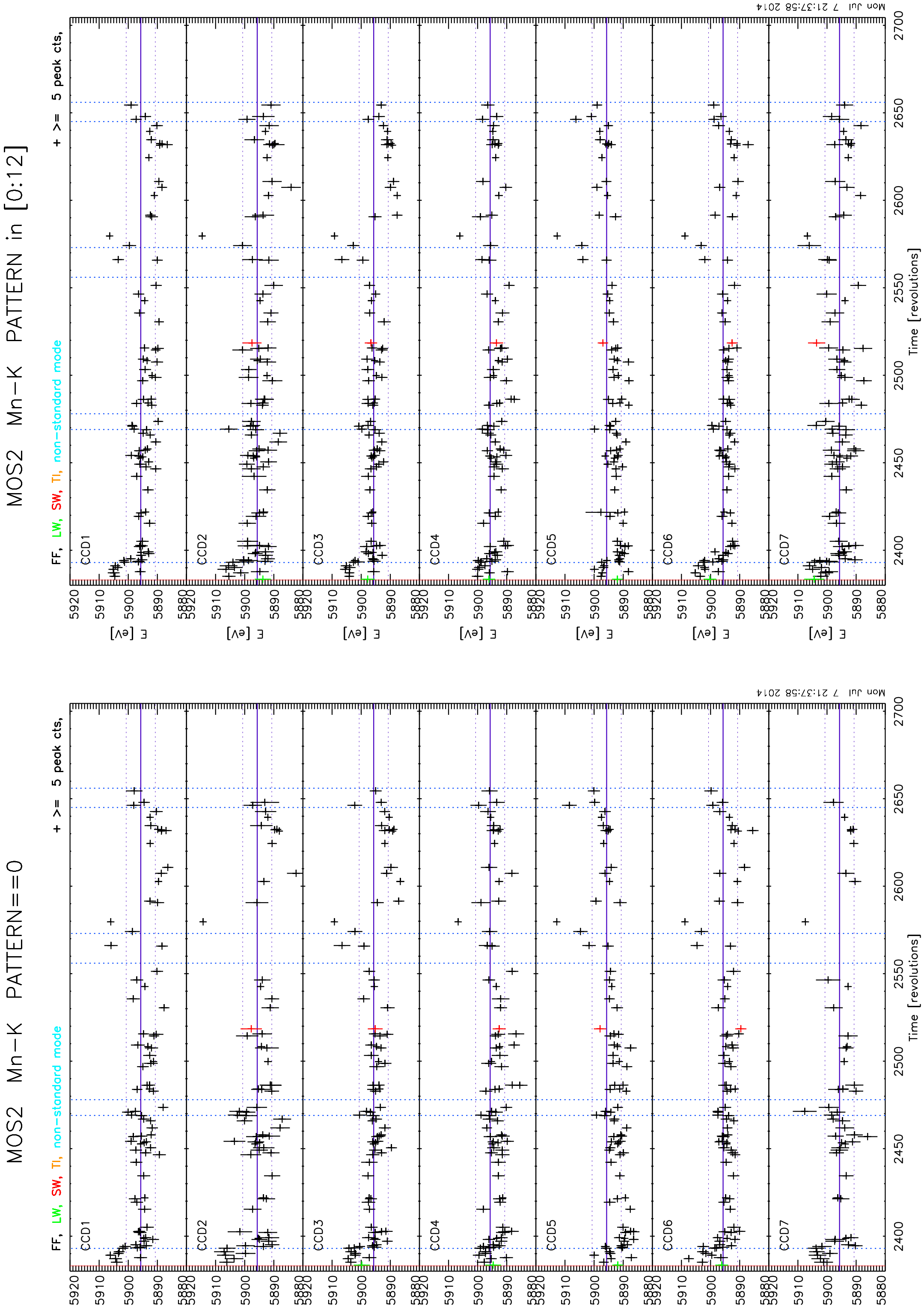

Figure 4: MOS2 Mn K_α line energy scale using the new CTI+ADUCONV CCF. Eclipse seasons are indicated by vertical blue lines, CCF epochs by red lines. The horizontal solid line represents the laboratory line energy, the dotted lines the ±5 eV deviations.