XMM-Newton CCF Release Note

XMM-CCF-REL-161

Update of the EPIC MOS gain

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1 CCF components

Name of CCF	VALDATE (start of valid period)	EVALDATE (end of valid period)	List of Blocks changed	CAL VERS	XSCS flag
EMOS1_ADUCONV_0020	1999-12-10T00:00:00	2000-07-15T12:00:00	OFFSET_GAIN		NO
EMOS1_ADUCONV_0021	2000-07-15T12:00:01	2000-11-09T12:00:00	OFFSET_GAIN		NO
EMOS1_ADUCONV_0022	2000-11-09T12:00:01	2001-04-18T00:00:00	OFFSET_GAIN		NO
EMOS1_ADUCONV_0023	2001-04-18T00:00:01	2001-08-18T00:00:00	OFFSET_GAIN		NO
EMOS1_ADUCONV_0024	2001-08-18T00:00:01	2001-09-26T22:00:00	OFFSET_GAIN		NO
EMOS1_ADUCONV_0025	2001-09-26T22:00:01	2001-11-25T12:00:00	OFFSET_GAIN		NO
EMOS1_ADUCONV_0026	2001-11-25T12:00:01	2002-11-07T05:00:00	OFFSET_GAIN		NO
EMOS1_ADUCONV_0027	2002-11-07T05:00:01		OFFSET_GAIN		NO
EMOS2_ADUCONV_0020	1999-12-10T00:00:00	2000-07-15T12:00:00	OFFSET_GAIN		NO
EMOS2_ADUCONV_0021	2000-07-15T12:00:01	2000-11-09T12:00:00	OFFSET_GAIN		NO
EMOS2_ADUCONV_0022	2000-11-09T12:00:01	2001-04-18T00:00:00	OFFSET_GAIN		NO
EMOS2_ADUCONV_0023	2001-04-18T00:00:01	2001-08-18T00:00:00	OFFSET_GAIN		NO
EMOS2_ADUCONV_0024	2001-08-18T00:00:01	2001-09-26T22:00:00	OFFSET_GAIN		NO
EMOS2_ADUCONV_0025	2001-09-26T22:00:01	2001-11-25T12:00:00	OFFSET_GAIN		NO
EMOS2_ADUCONV_0026	2001-11-25T12:00:01	2002-11-07T05:00:00	OFFSET_GAIN		NO
EMOS2_ADUCONV_0027	2002-11-07T05:00:01		OFFSET_GAIN		NO

2 Changes

A new set of ADUCONV CCF files have been generated which include updated values for the gain parameters. This new set of CCFs covers the same 8 time periods as the previous ADUCONV CCFs (issues 12 to 19; see XMM-CCF-REL-125) and the MOS CTI CCFs (issues 8 to 15; see XMM-CCF-REL-124)

These new gain parameters have been tuned to suppress the residuals present in the energy scale with the old CCFs. The replacement CCFs, as with their previous version, assume a linear

relationship between the charge detected from an event and the energy of the detected X-ray (hence $E_{eV} = gain \times E_{charge} + offset$). The new gain and offset values have been calculated from observations of the on-board calibration sources, which consist of three spectal lines (Al at 1486.57 eV, see 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, see Holzer *et al* 1997, Phy. Rev. A, 56, 6). The derived gain and offset used in each CCF are the averaged values taken from the calibration observations made during each CCF time period. However, observations made 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 are made 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 eclipses has only a minor effect on science observations. In calculating the linear gain term, further spurious points that deviate away from the mean value by greater 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 better than 5eV for the entire energy range. The improvement of this new gain on existing data is expected to be less than 10-15 eV at 6 keV, and less than 3 eV at 1.5 keV.

4 Estimated Scientific Quality

The energy scale accuracy is better than 5 eV for the entire energy range for all observations, with the possible exceptions of very bright sources and those science observations made at the start of an XMM orbit during the eclipse seasons. In these 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 SAS v5.4.1, the results of which are shown in figures 1 to 4.

6 Expected Updates

None.

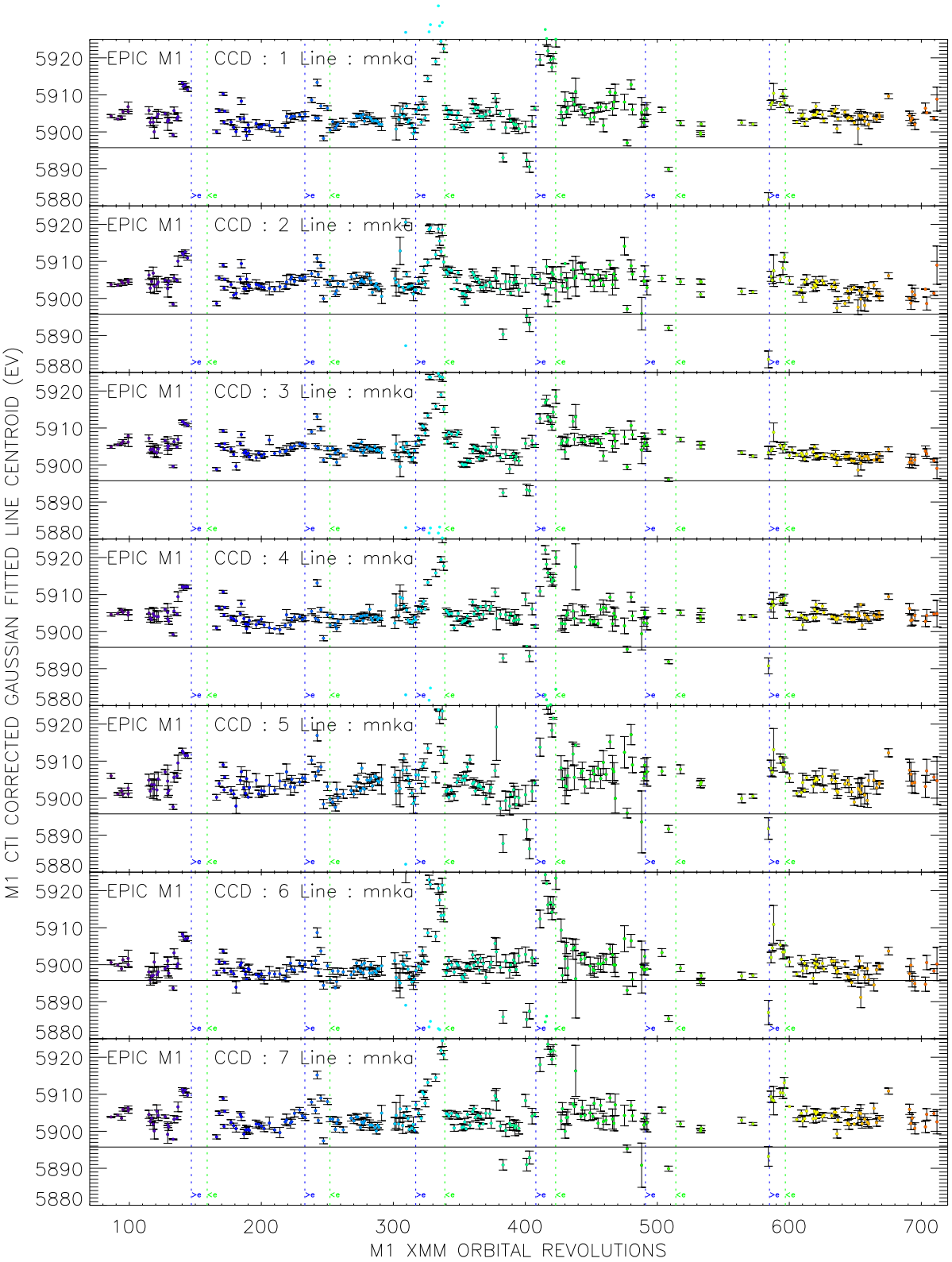

Figure 1: Using the old ADUCONV CCFs gain values to calculate the Mn Kα line energy for each of the calibration observations using the MOS1 CCDs, pattern 0 only. The horizontal line indicates the true energy of Mn Kα, showing deviations of up to 10 eV with the calculated line energy. The blue and green vertical lines (labelled ">e" and "<e") indicate the beginning and end of the eclipse seasons respectively (see text for more details).

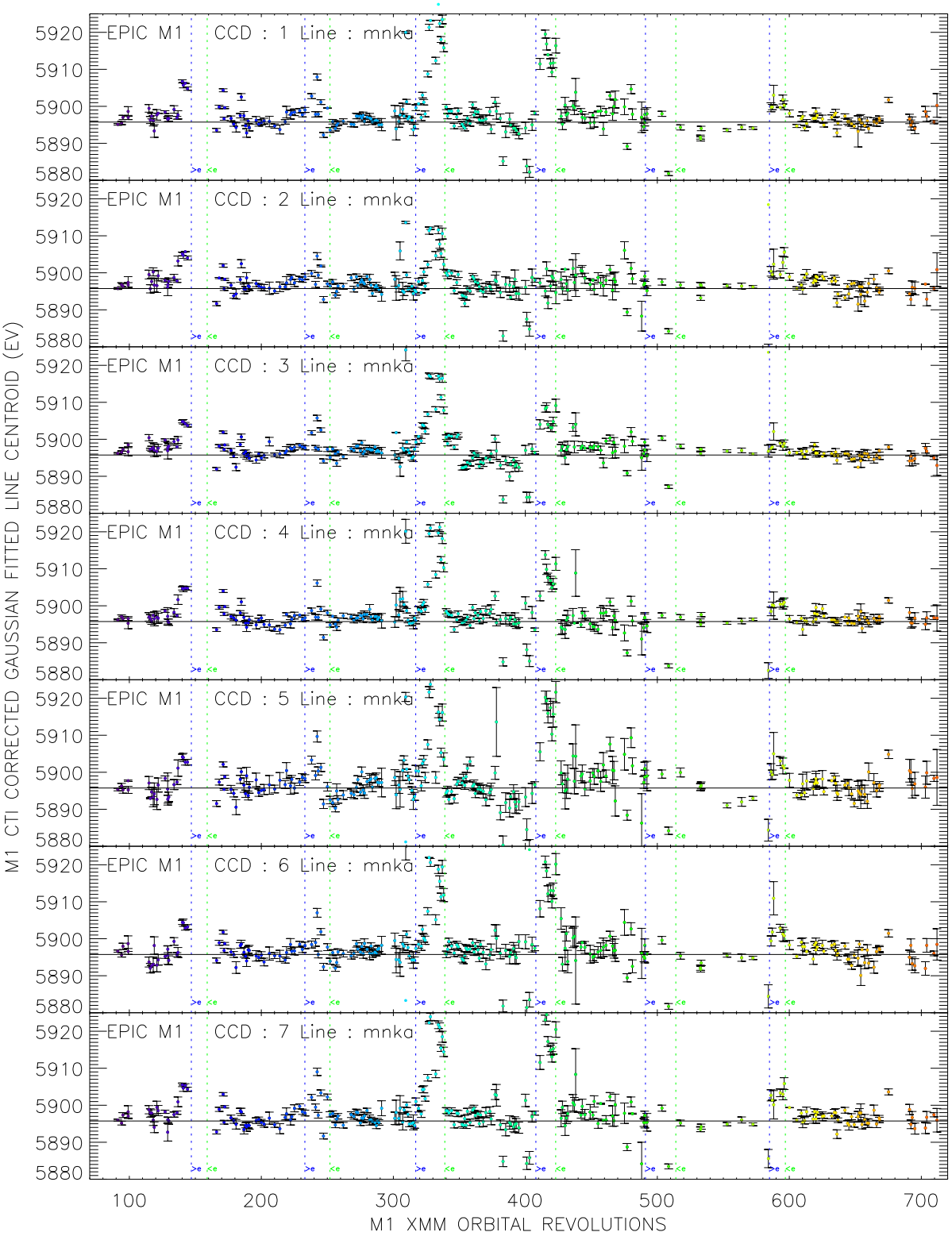

Figure 2: Using the new ADUCONV CCFs gain values to calculate the Mn Kα line energy for each of the calibration observations using the MOS1 CCDs, pattern 0 only. The horizontal line indicates the true energy of Mn Kα, showing smaller deviations and hence an improvement in the calculated energy scale.

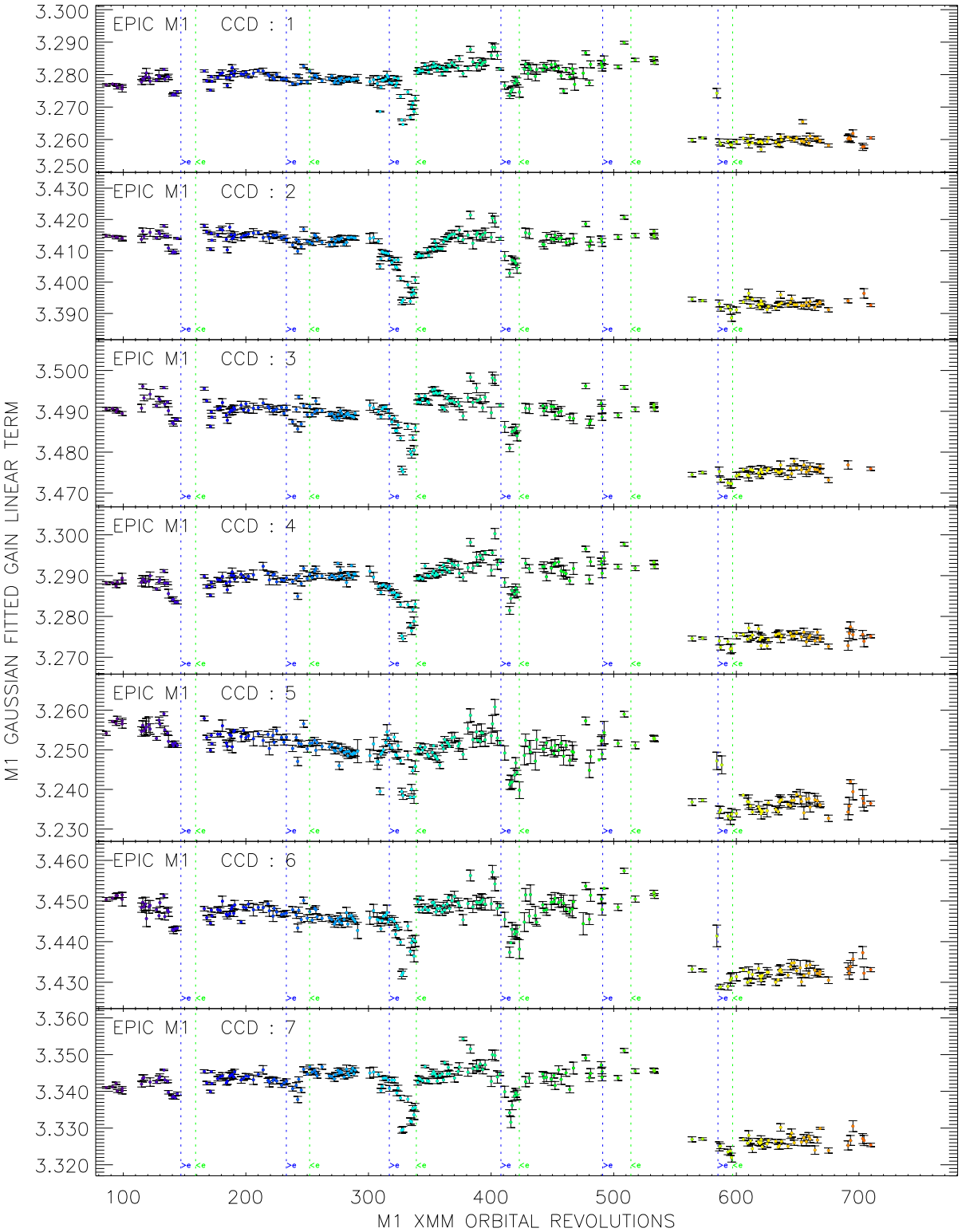

Figure 3: A straight line is fitted between the measured ADU and the known line energy of the three calibration lines, for each calibration observation. The resulting best-fit linear term for each observation is shown in this figure, for MOS1 and pattern 0 events. The large change in the gain linear term in revolution 534 is due to the cooling of the EPIC MOS cameras, when the instruments were cooled from the operating temperature of -100^{o}C to -120^{o}C.

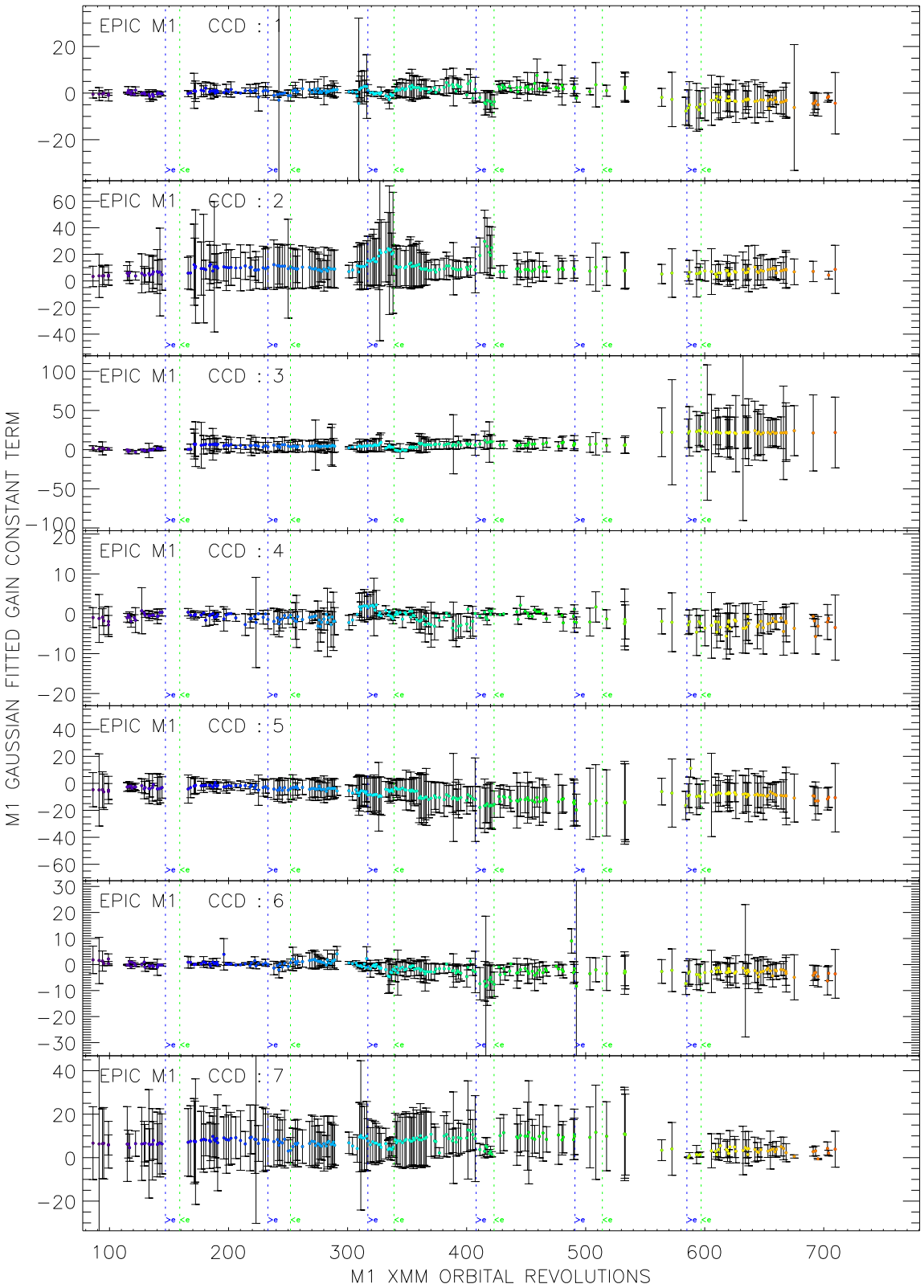

Figure 4: As figure 3, but with the gain constant offset plotted on the abscissa.