

# XMM-Newton CCF Release Note

XMM-CCF-REL-257

## Update of EPIC MOS CTI

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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 VERSION	XSCS flag
EMOS1_CTI_0043	1999-12-10T00:00:00	2000-07-15T12:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS1_CTI_0044	2000-07-15T12:00:01	2000-11-09T12:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS1_CTI_0045	2000-11-09T12:00:01	2001-04-18T00:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS1_CTI_0046	2001-04-18T00:00:01	2001-08-18T00:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS1_CTI_0047	2001-08-18T00:00:01	2001-09-26T22:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS1_CTI_0048	2001-09-26T22:00:01	2001-11-25T12:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS1_CTI_0049	2001-11-25T12:00:01	2002-05-16T05:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS1_CTI_0050	2002-05-16T05:00:01	2002-11-07T05:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS1_CTI_0051	2002-11-07T05:00:01	2003-11-09T18:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS1_CTI_0052	2003-11-09T18:00:01	2005-01-21T18:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS1_CTI_0053	2005-01-21T18:00:01	2005-07-24T01:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS1_CTI_0054	2005-07-24T01:00:01	2005-10-19T19:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS1_CTI_0055	2005-10-19T19:00:01	2006-08-12T23:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS1_CTI_0056	2006-08-12T23:00:01	2007-09-07T20:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS1_CTI_0057	2007-09-07T20:00:01		CTI_EXTENDED CTI_COLUMN		NO



Name of CCF	VALDATE (start of val. period)	EVALDATE (end of validity period)	List of Blocks changed	CAL VERSION	XSCS flag
EMOS2_CTI_0044	1999-12-10T00:00:00	2000-07-15T12:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS2_CTI_0045	2000-07-15T12:00:01	2000-11-09T12:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS2_CTI_0046	2000-11-09T12:00:01	2001-04-18T00:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS2_CTI_0047	2001-04-18T00:00:01	2001-08-18T00:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS2_CTI_0048	2001-08-18T00:00:01	2001-09-26T22:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS2_CTI_0049	2001-09-26T22:00:01	2001-11-25T12:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS2_CTI_0050	2001-11-25T12:00:01	2002-05-16T05:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS2_CTI_0051	2002-05-16T05:00:01	2002-11-07T05:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS2_CTI_0052	2002-11-07T05:00:01	2003-11-09T18:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS2_CTI_0053	2003-11-09T18:00:01	2005-01-21T18:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS2_CTI_0054	2005-01-21T18:00:01	2005-07-24T01:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS2_CTI_0055	2005-07-24T01:00:01	2005-10-19T19:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS2_CTI_0056	2005-10-19T19:00:01	2006-08-12T23:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS2_CTI_0057	2006-08-12T23:00:01	2007-09-07T20:00:00	CTI_EXTENDED CTI_COLUMN		NO
EMOS2_CTI_0058	2007-09-07T20:00:01		CTI_EXTENDED CTI_COLUMN		NO

## 2 Changes

A new set of CTI CCFs have been derived for the MOS taking into account the latest measured degradation rate of the parallel CTI. This new set of CCFs covers the same time periods as the previous CTI CCFs (MOS1 issue 30–43, MOS2 issue 31–44, see XMM-CCF-REL-224). The previously latest epoch (MOS1 issue 43, MOS2 issue 44) has been divided into three new epochs.

The serial CTI is also updated, even though it remains nearly constant since cooling.

## 3 Scientific Impact of this Update

The use of this set of CCFs will improve the MOS energy scale reconstruction and also marginally the energy resolution, for all observations, although mainly for those performed in after cooling epochs (i.e. post revolution 534).



The new set of CTI CCFs are released together with a new set of ADU CONV CCFs (MOS1 issues 55-69, MOS2 issues 56-70, see XMM-CCF-REL-258), since using the new CTI CCFs with the old ADU CONV CCFs, or the old CTI CCFs with new ADU CONV CCFs, may give unexpected results!

## 4 Estimated Scientific Quality

This issue ensures that the MOS energy scale remains within 5 eV at 2keV, and 10 eV for most sources (not too bright), for all observations (see a more detailed discussion in XMM-CCF-REL-124).

It is recalled that since SASv5.4 the MOS parallel CTI is modelled with the simple formula of the CTI loss per transfer:

- $CTIY(E, t) = (A + B * t) * E^\alpha$

where A is a constant, B the degradation rate (slope),  $\alpha$  a power index (all 3 parameters take different values for different CCDs and different time periods), E the event energy in ADUs and t the time since launch. Note that the serial CTI is also modelled with the same formula but is mostly constant since launch. Since SASv7.0, the energy correction uses an additional offset term:

- $E_{corr} = E + RAWY * CTIY + RAWX * CTIX - OFFSET(RAWX, RAWY)$

This algorithm allows an energy scaling of the CTI that fits very well the Mn and Al lines of the internal calibration source.

## 5 Test procedures & results

The new CTI CCFs have been tested with the SASv9.0. The results are presented in Fig. 1 to Fig. 8.

Plots of the line monitoring are presented in the accompanying release note XMM-CCF-REL-258 of the corresponding updated MOS ADU CONV CCFs.

## 6 Expected Updates

None.

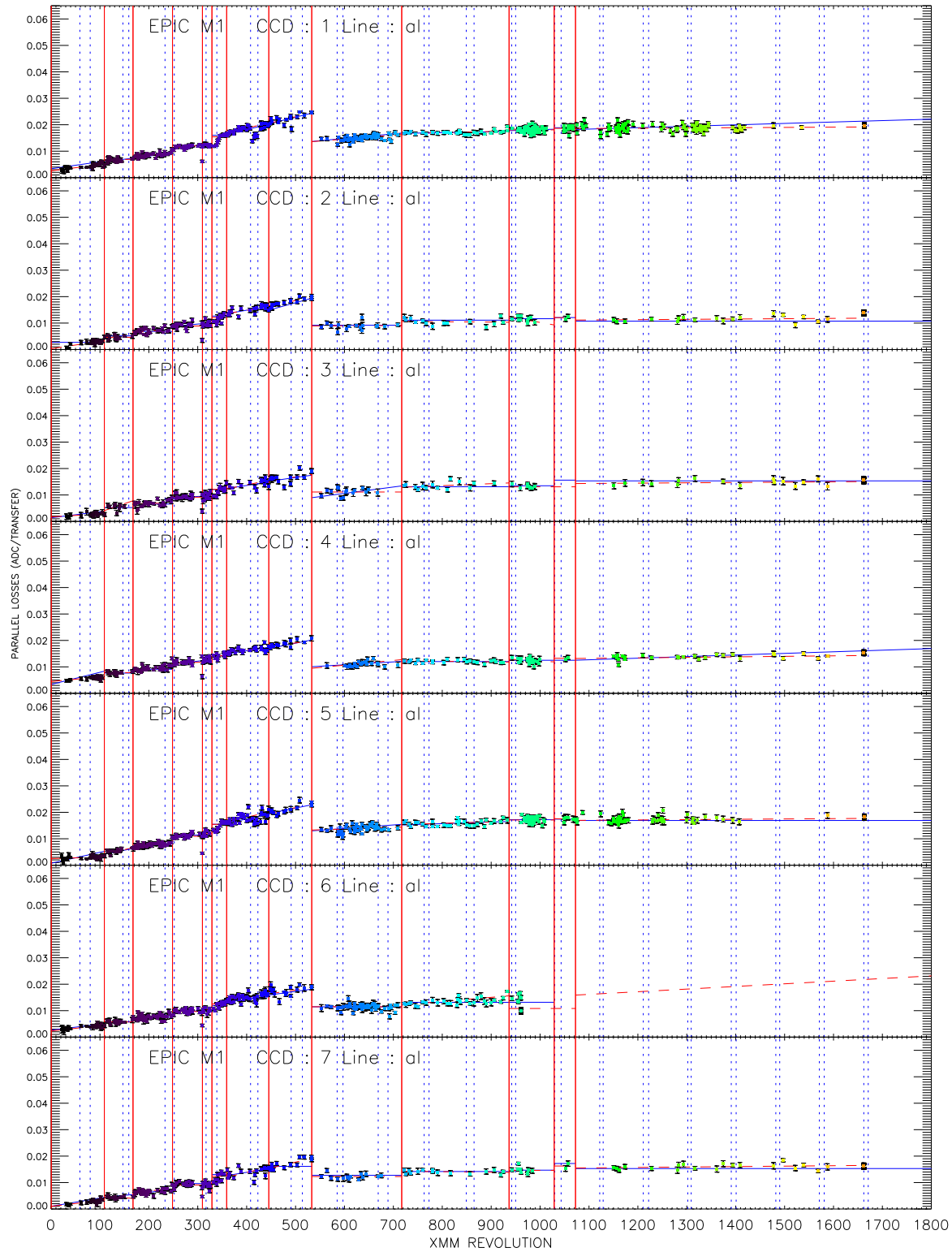


Figure 1: MOS1 parallel transfer losses since launch at 1.5 keV, the energy of the Al calibration line, for CCD1 to CCD7 (top to bottom), overlaid with the CTI models as parametrised in the new set of CCFs. The CCF epochs are indicated as solid vertical lines, the eclipse seasons as vertical dashed lines.

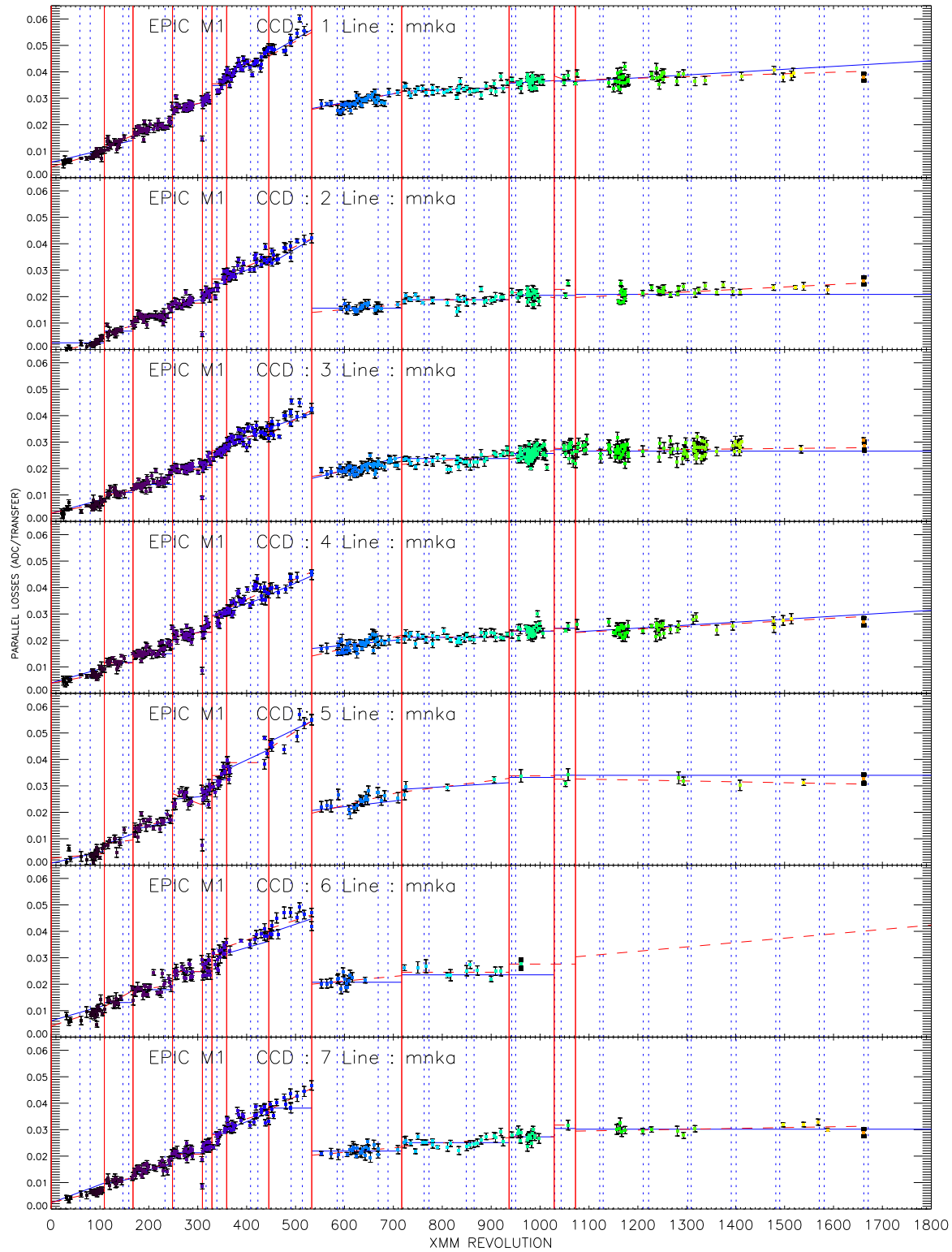


Figure 2: MOS1 parallel transfer losses since launch at 5.9 keV, the energy of the Mn  $K\alpha$  calibration line, for CCD1 to CCD7 (top to bottom), overlaid with the CTI models as parametrised in the new set of CCFs. The CCF epochs are indicated as solid vertical lines, the eclipse seasons as vertical dashed lines.

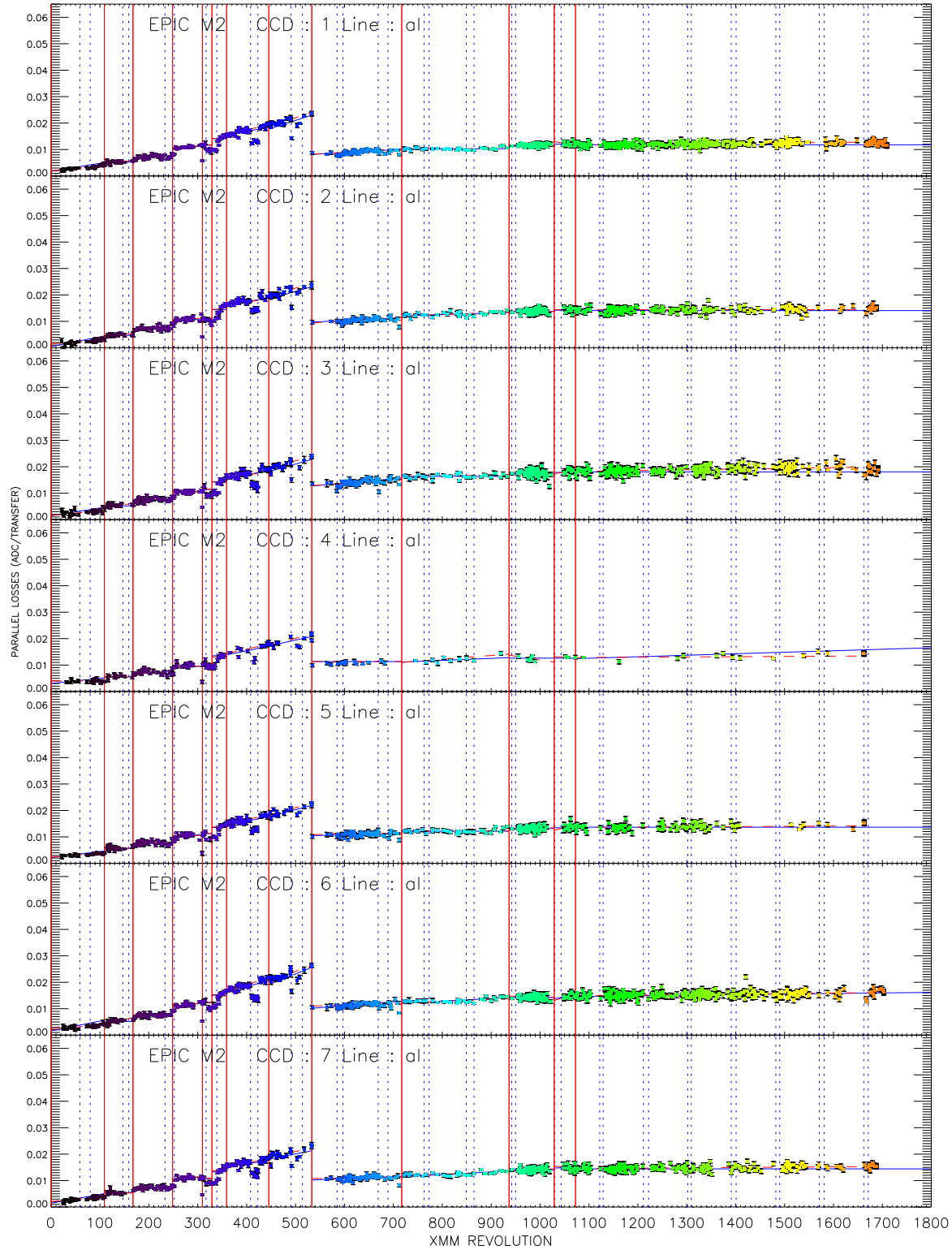


Figure 3: MOS2 parallel transfer losses since launch at 1.5 keV, the energy of the Al calibration line, for CCD1 to CCD7 (top to bottom), overlaid with the CTI models as parametrised in the new set of CCFs. The CCF epochs are indicated as solid vertical lines, the eclipse seasons as vertical dashed lines.

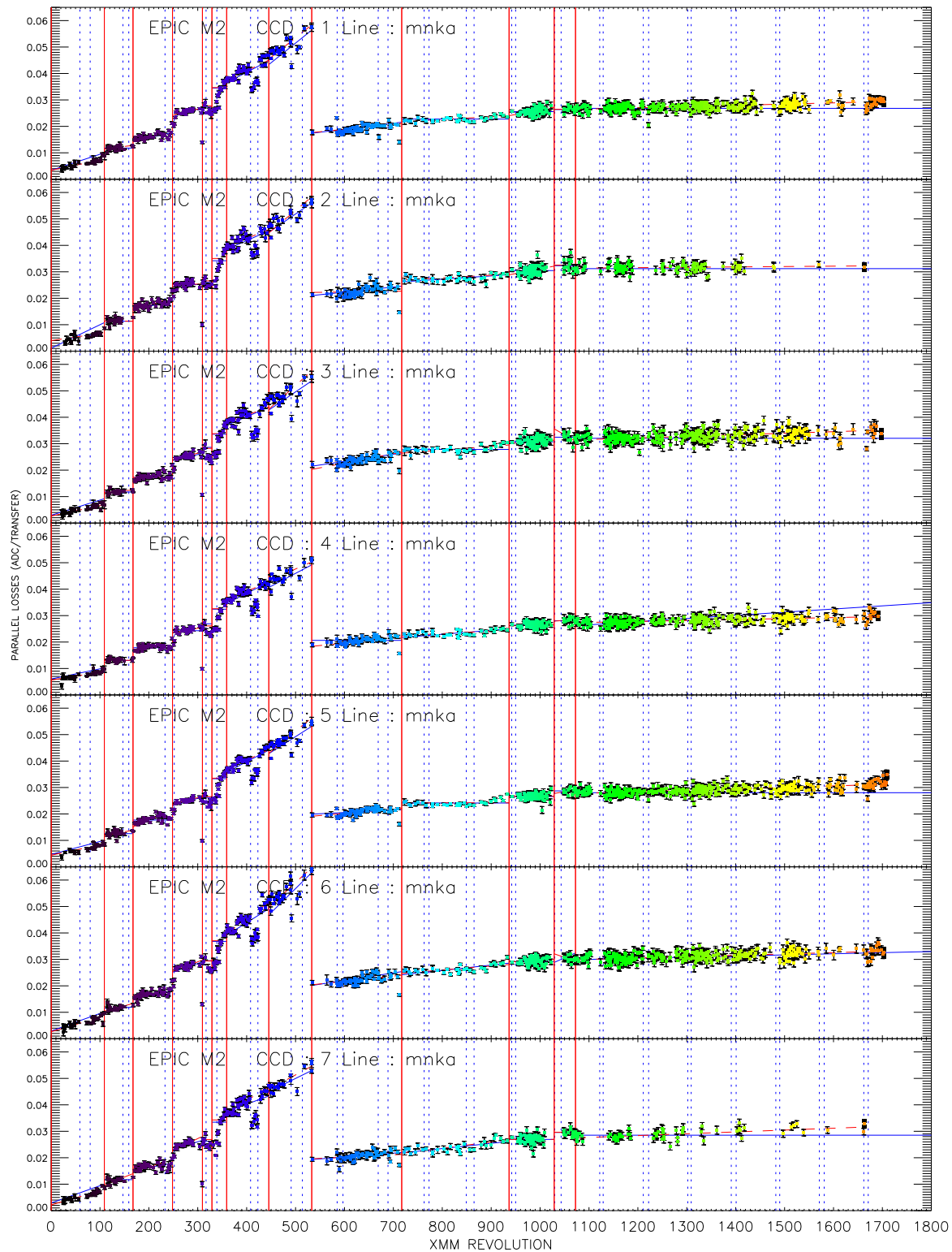


Figure 4: MOS2 parallel transfer losses since launch at 5.9 keV, the energy of the Mn  $K\alpha$  calibration line, for CCD1 to CCD7 (top to bottom), overlaid with the CTI models as parametrised in the new set of CCFs. The CCF epochs are indicated as solid vertical lines, the eclipse seasons as vertical dashed lines.

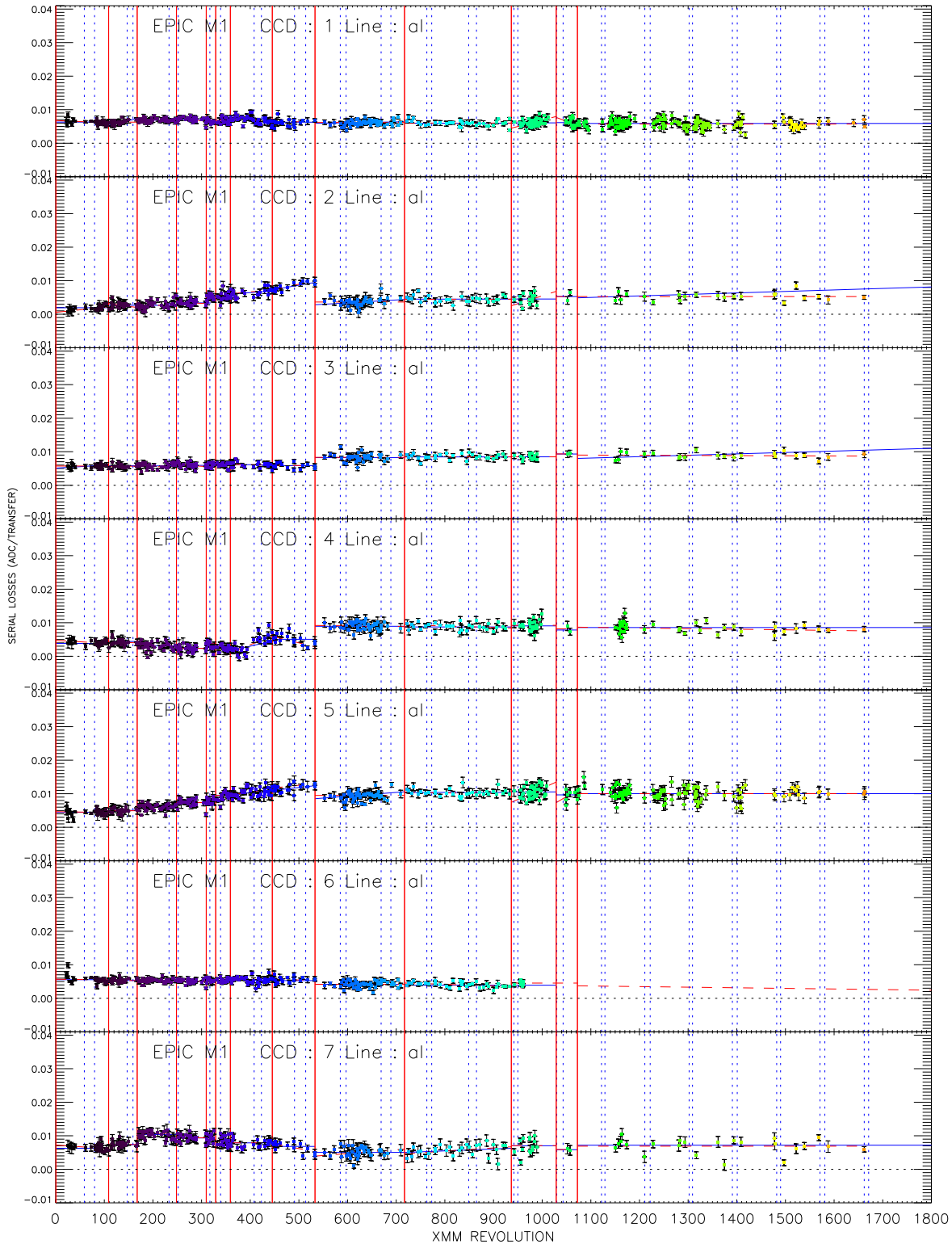


Figure 5: MOS1 serial transfer losses since launch at 1.5 keV, the energy of the Al calibration line, for CCD1 to CCD7 (top to bottom), overlaid with the CTI models as parametrised in the new set of CCFs. The CCF epochs are indicated as solid vertical lines, the eclipse seasons as vertical dashed lines.



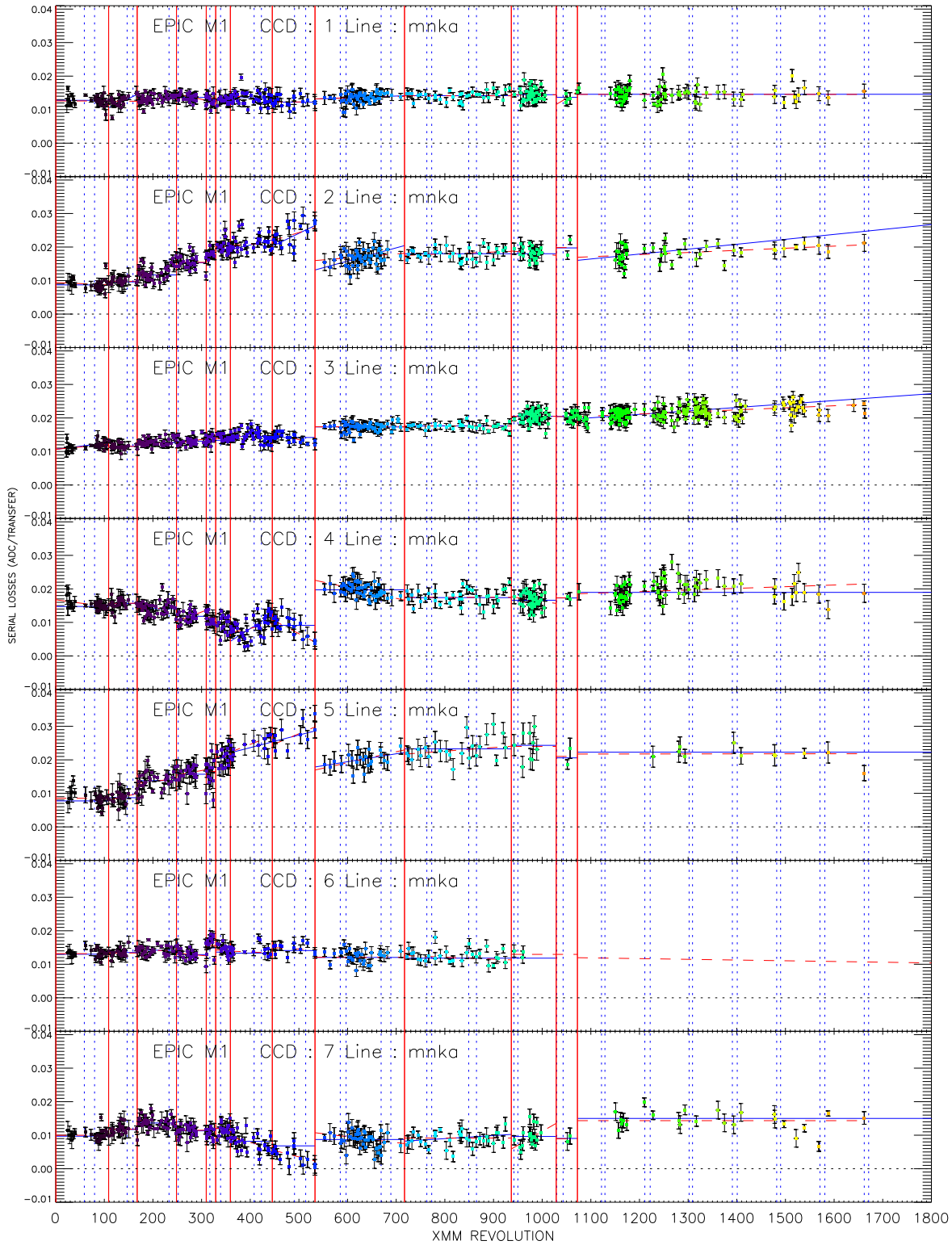


Figure 6: MOS1 serial transfer losses since launch at 5.9 keV, the energy of the Mn  $K\alpha$  calibration line, for CCD1 to CCD7 (top to bottom), overlaid with the CTI models as parametrised in the new set of CCFs. The CCF epochs are indicated as solid vertical lines, the eclipse seasons as vertical dashed lines.

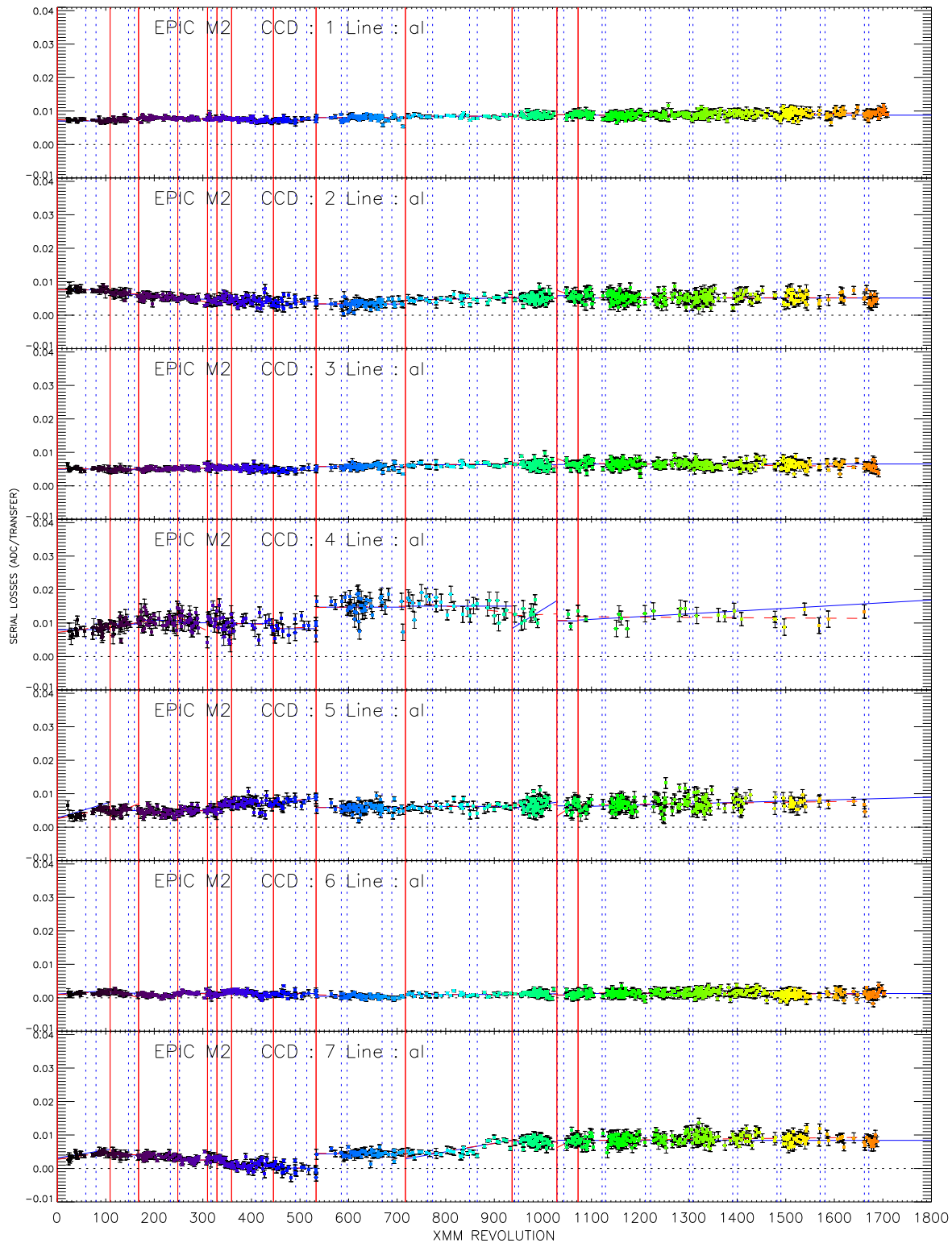


Figure 7: MOS2 serial transfer losses since launch at 1.5 keV, the energy of the Al calibration line, for CCD1 to CCD7 (top to bottom), overlaid with the CTI models as parametrised in the new set of CCFs. The CCF epochs are indicated as solid vertical lines, the eclipse seasons as vertical dashed lines.

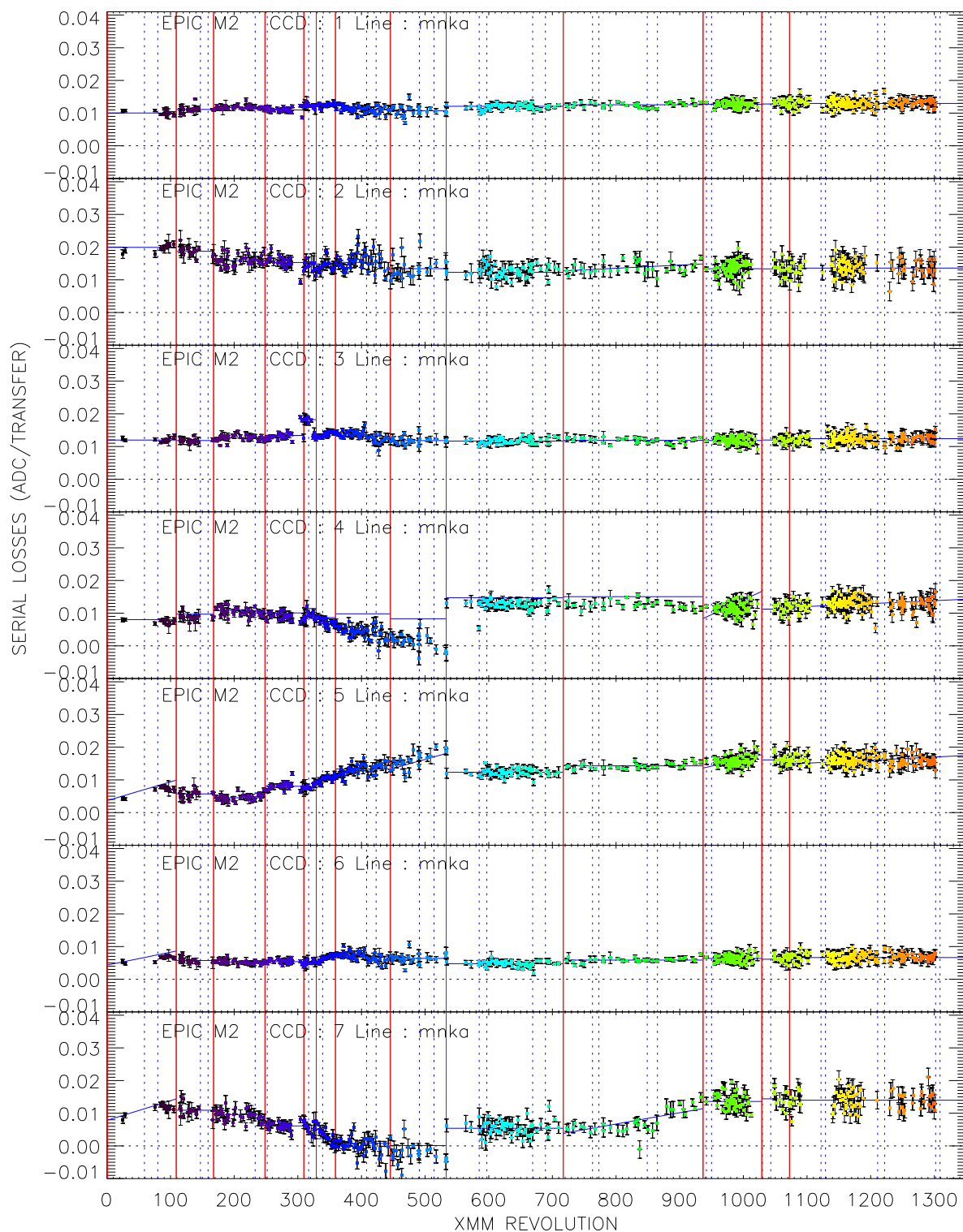


Figure 8: MOS2 serial transfer losses since launch at 5.9 keV, the energy of the Mn  $K\alpha$  calibration line, for CCD1 to CCD7 (top to bottom), overlaid with the CTI models as parametrised in the new set of CCFs. The CCF epochs are indicated as solid vertical lines, the eclipse seasons as vertical dashed lines.