XMM-Newton CCF Release Note

XMM-CCF-REL-331

Update of the RGS Gain and CTI (August 2007 - December 2009)

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1 CCF components

Name of CCF	VALDATE	EVALDATE	List of Blocks changed	XSCS flag
RGS1_ADUCONV_0026	2007-08-01T06:00:00	2009-12-31T23:59:59	OFFSET_GAIN	NO
RGS2_ADUCONV_0033	2007-08-17T02:00:00	2009-12-31T23:59:59	OFFSET_GAIN	NO
RGS1_CTI_0014	2007-08-01T06:00:00	2009-12-31T23:59:59	CTI CTI_EXTENDED XCTI CTIY1-9	NO
RGS2_CTI_0015	2007-08-17T02:00:00	2009-12-31T23:59:59	CTI CTI_EXTENDED XCTI CTIY1-9	NO

2 Changes

It has been recently reported that in some RGS observations the signal from the calibration lamps is systematically displaced with respect to the position of the masks in the Beta(Lambda)/PI plane (see an example in Fig. 1). Further investigation has shown that this happens in data taken in the period August 2007 - December 2009. This has led to the re-evaluation (done by C. de Vries) of the ADUCONV and CTI CCFs for this epoch.

The new files discussed in this Release Note replace RGS1[2]_ADUCONV_0022[25] and RGS1[2]_CTI_0010[11] described in [1].

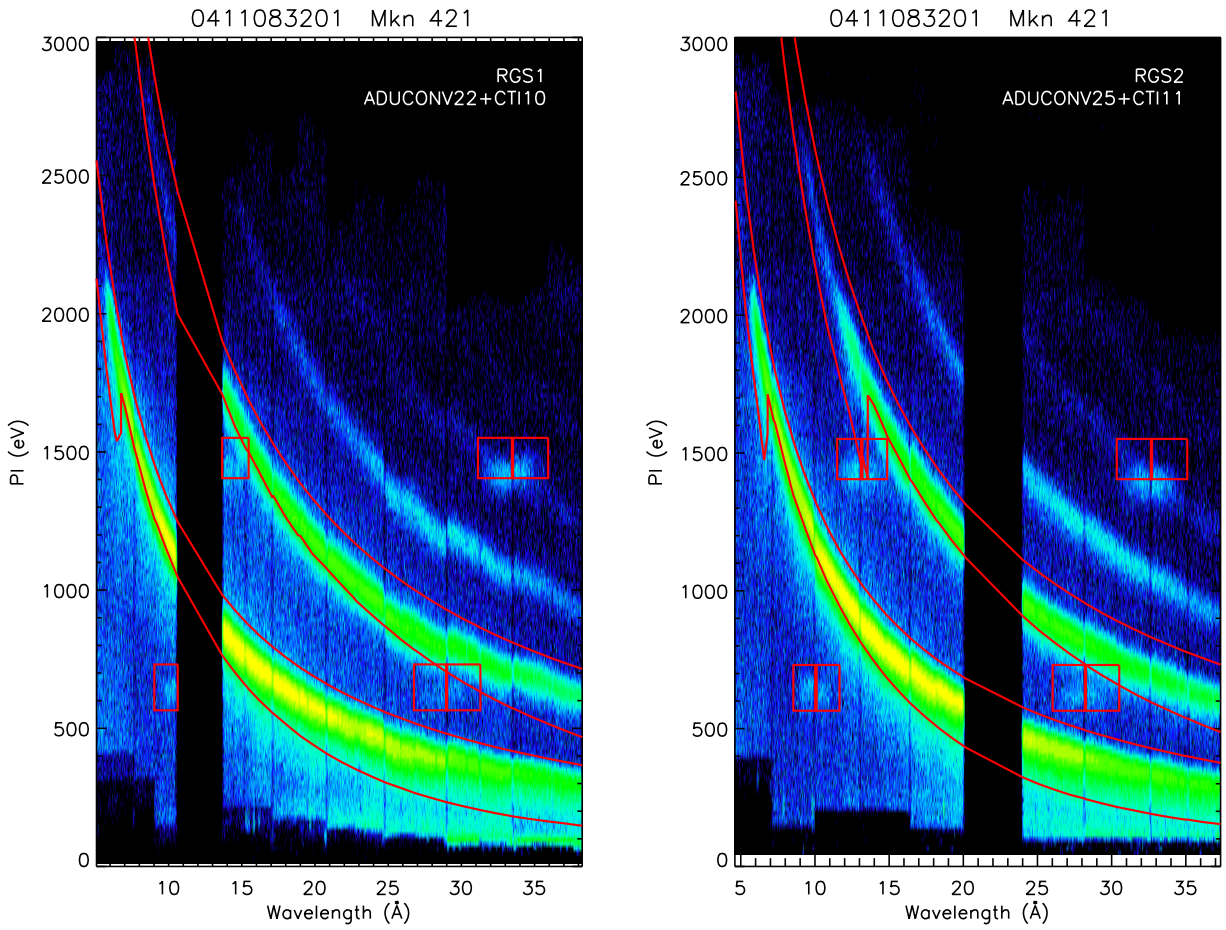

Figure 1: Example of the incorrect placement of the extraction masks for an observation processed with the current versions of CTI and ADUCONV.

3 Scientific Impact of this Update

An incorrect placement of the extraction masks can lead to a loss of source events. This effect can be seen in Fig. 1, where the 1st and 2nd spectra are partly below the extraction regions, in particular at high energies.

Several datasets taken during this epoch have been processed with both sets of calibration files (current and new), and the results have been compared.

The results of the comparison can be summarised as follows:

- Extraction masks

  The energy of the events processed with the new files show a noticeable difference in energy. With the new calibration the spectral data are now better placed within the spectral extraction masks (Fig. 2).

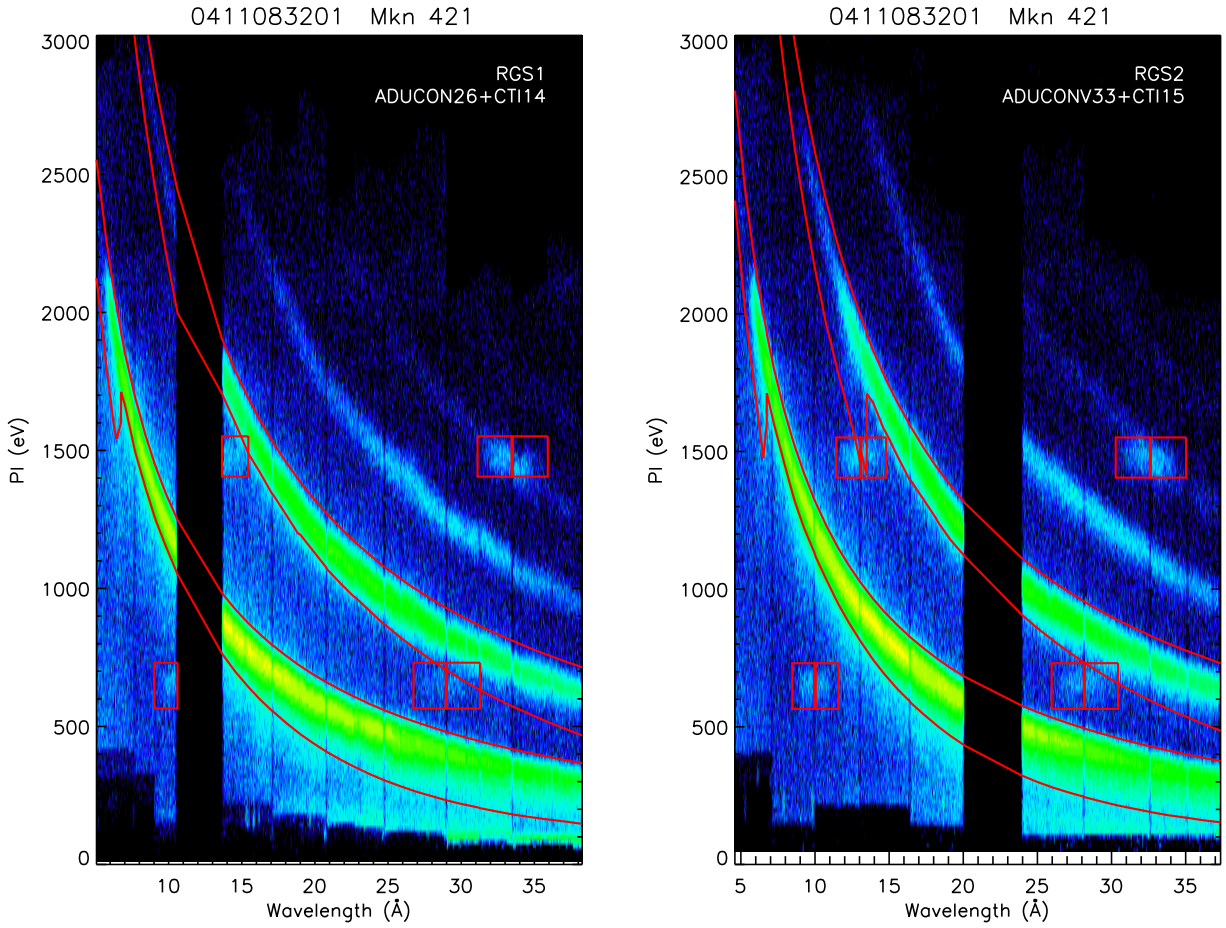

Figure 2: Result of processing the observation of Mkn 421 shown in Fig. 1 with the new CCFs.

- Number of events

  As a consequence of the previous point, the spectra extracted from events file processed with the new files have more events.

  For the datasets considered, the number of events increases by 2-3% and by 8-10% in first and second order spectra, respectively. In first order, the largest differences are in CCDs 7, 8 and 9, and in second order, in CCDs 3 to 8 (see Table 3).

- Position of the lamps

  Due to new energy calibration, the measured energy of the lamps increases, more for the Al-Kα lamp: up to 60 eV in RGS1, and between 50 and 80 eV in RGS2 (see Table 4).

4 Test procedures & results

- The fits viewer `fv` has been used to inspect the new CCFs, their structure, validity dates and contents.

Table 1: Ratio of number of events in extracted spectra (New/Current)

Object	Obsid	Rev	RGS1 o1	RGS1 o2	RGS2 o1	RGS2 o2
PKS 2155-304	0411780301	1543	1.02	1.08	1.02	1.08
Mkn 421	0560980101	1640	1.02	1.08	1.02	1.08
Mkn 421	0560983301	1732	1.02	1.08	1.02	1.08
PKS 2155-304	0411780401	1734	1.03	1.09	1.02	1.08
Mkn 421	0411083201	1820	1.02	1.08	1.02	1.10

Table 2: Measured energy of the calibration lamps

RGS 1

		F Kα	Al Kα	
Object	Rev	CCD8	CCD1	CCD2
PKS 2155-304	1543	653 (21)	1445 (-1)	1480 (61)
Mkn 421	1640	656 (21)	1443 (-1)	1487 (62)
Mkn 421	1732	625 (-5)	1440 (-1)	1483 (62)
PKS 2155-304	1734	653 (21)	1445 (-1)	1481 (61)
Mkn 421	1820	669 (31)	1434 (0)	1492 (65)

RGS 2

		F Kα		Al Kα			
Object	Rev	CCD7	CCD8	CCD1	CCD2	CCD6	CCD7
PKS 2155-304	1543	651 (22)	680 (8)	1469 (73)	1475 (-)	1471 (54)	
Mkn 421	1640	649 (18)	670 (-)	1468 (74)	1484 (84)		
Mkn 421	1732		652 (7)		1484 (84)		
PKS 2155-304	1734	647 (21)	656 (8)	1467 (73)	1478 (82)	1466 (54)	1480 (50)

Line energy is given in eV. Numbers in brackets are the differences with respect to the current calibration.

- The SAS task `cifbuild` has been run to confirm that the right CCFs version is selected.
- Several observations of bright BL Lac objects taken in this period of time have been processed with the new CCFs and the results have been examined. In all cases the spectra fall well within the extraction masks, and the lamps are in the correct position.

For completeness, we include three figures showing the temporal evolution of the Gain and the CTI, similar to those shown in [2] including the new values in the CCFs described in this RN.

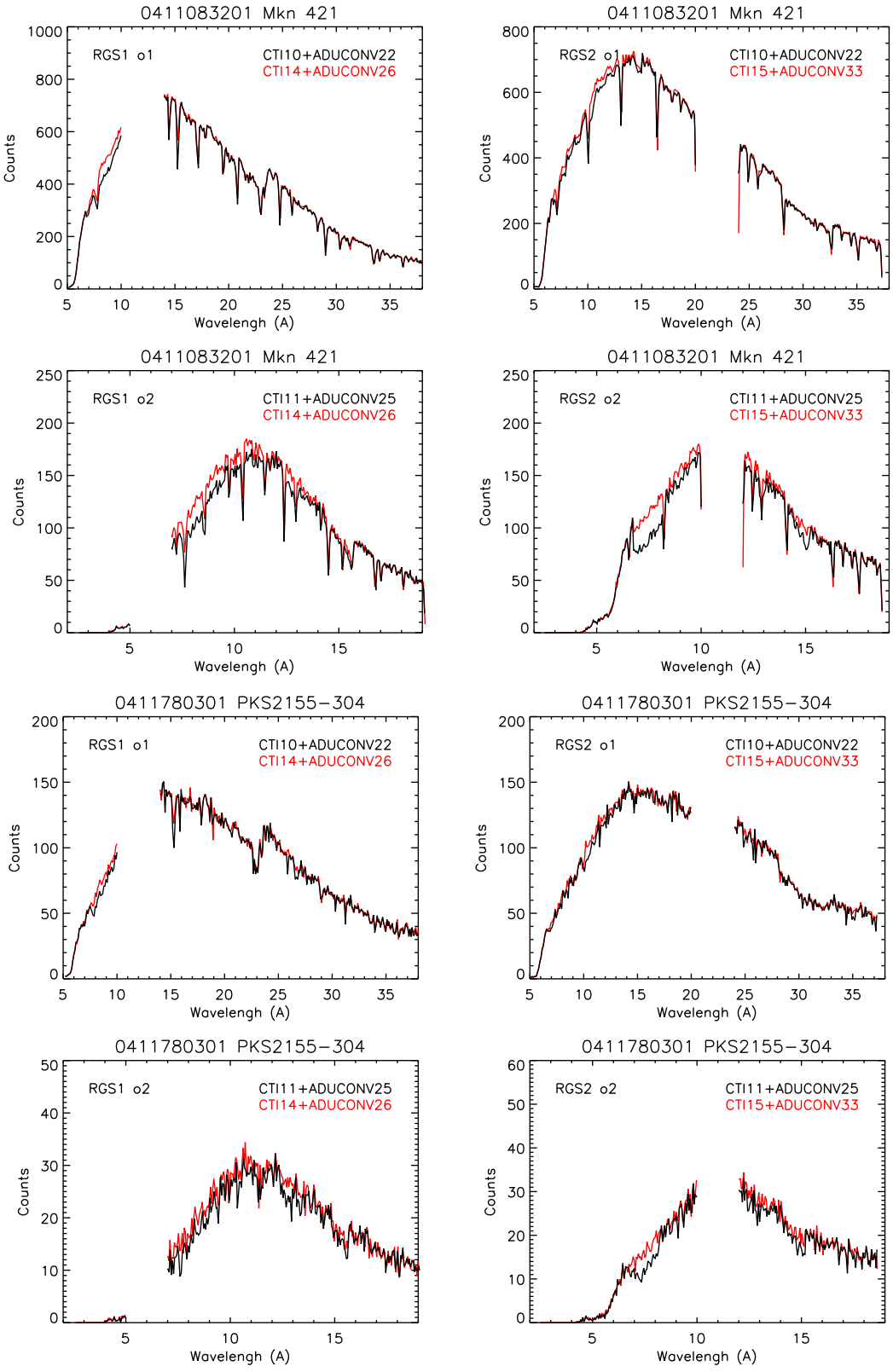

Figure 3: Example of extracted spectra of Mkn 421 and PKS 2155+305 obtained with current (black) and new (red) CCFs.

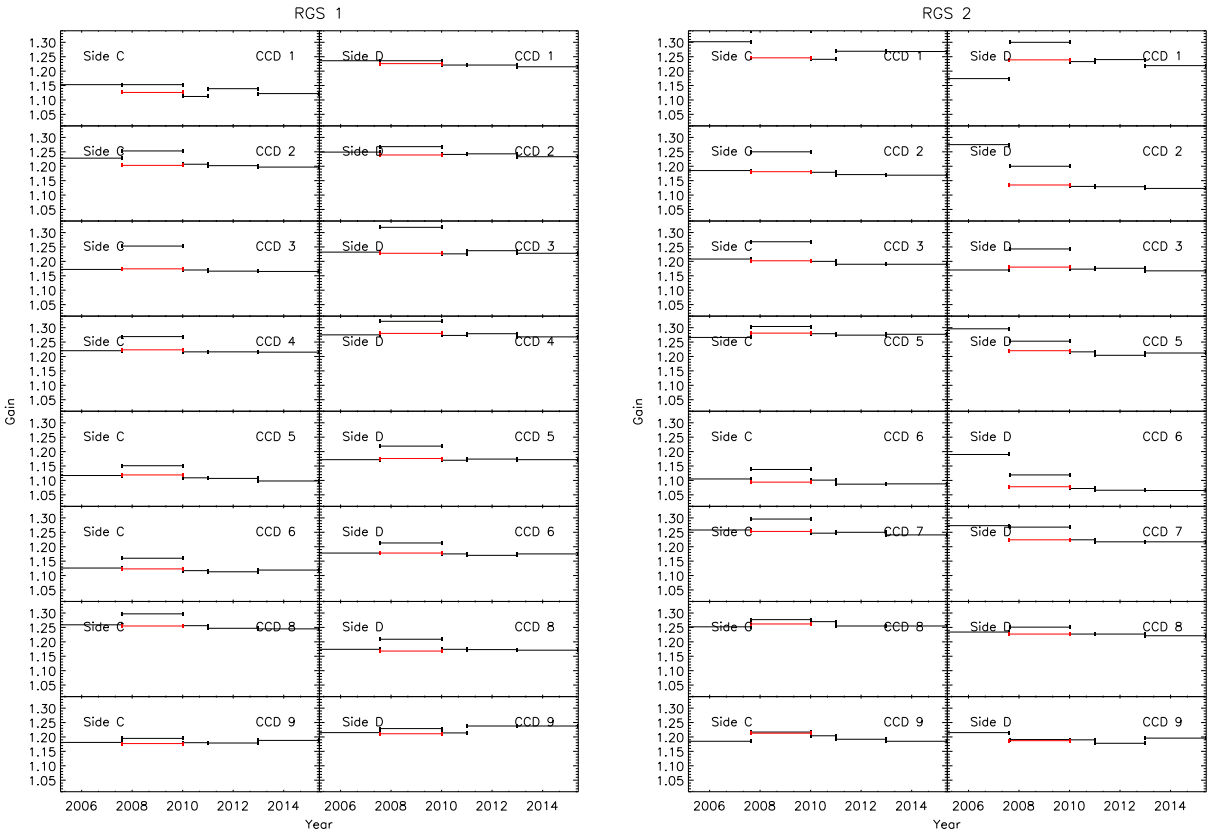

Figure 4: Evolution of the Gain (left RGS1, right RGS2). The new values are shown as red lines.

5 Expected Updates

Both CCFs should be revised regularly to evaluate the degradation due to radiation. Observations of a bright continuum source off axis in the cross-dispersion direction must be performed every two years to monitor the parallel CTI.

6 References

[1] "Recent evolution of RGS gain and CTI", A. Pollock, XMM-CCF-REL-289, July 2012 (http://xmm2.esac.esa.int/docs/documents/CAL-SRN-0289-1-0.ps.gz)

[2] "Update of the RGS Gain and CTI", R. González-Riestra and C. de Vries, XMM-CCF-REL-319, July 2014 (http://xmm2.esac.esa.int/docs/documents/CAL-SRN-0319-1-0.pdf)

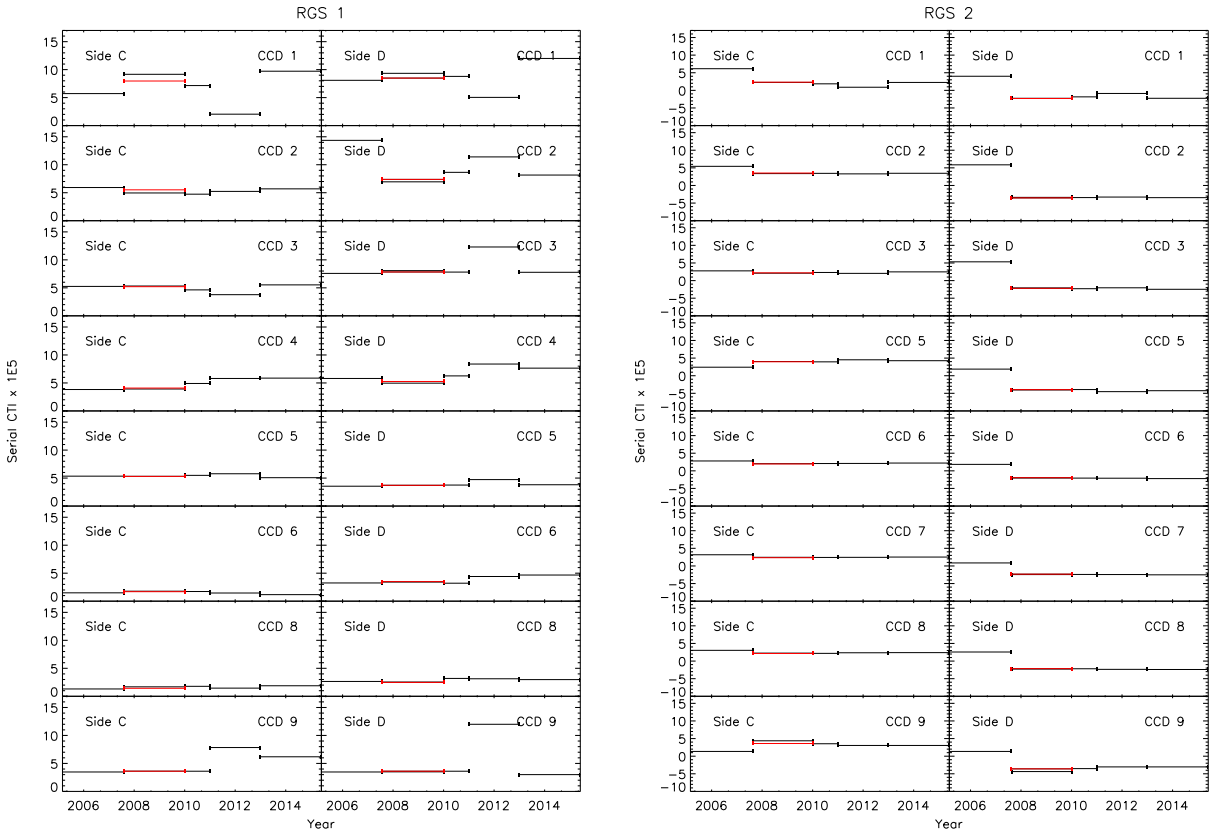

Figure 5: Evolution of the Serial CTI (left RGS1, right RGS2). RGS2 started to be read through a single node (C) in August 2007. Since then, the serial CTI for RGS2 (formerly) node D is simply the negative of the node C values. The new values are shown as red lines.

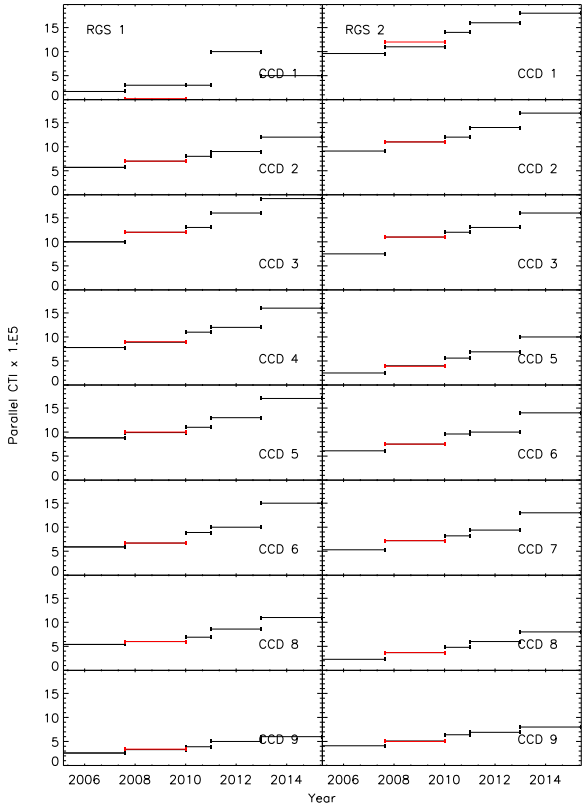

Figure 6: Evolution of the Parallel CTI (left RGS1, right RGS2). The points represented are the CTI values at centre of the chip. The new values are shown as red lines.