XMM-Newton CCF Release Note

XMM-CCF-REL-184

EPIC MOS response

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1 CCF components

Name of CCF	VALDATE	EVALDATE	Blocks changed	XSCS flag
EMOS1_REDIST_0043.CCF	1999-12-10	2000-07-15	CCD_REDISTRIBUTION-n	NO
EMOS1_REDIST_0044.CCF	2000-07-15	2000-11-09	CCD_REDISTRIBUTION-n	NO
EMOS1_REDIST_0045.CCF	2000-11-09	2001-04-18	CCD_REDISTRIBUTION-n	NO
EMOS1_REDIST_0046.CCF	2001-04-18	2001-08-18	CCD_REDISTRIBUTION-n	NO
EMOS1_REDIST_0047.CCF	2001-08-18	2001-09-26	CCD_REDISTRIBUTION-n	NO
EMOS1_REDIST_0048.CCF	2001-09-26	2001-11-25	CCD_REDISTRIBUTION-n	NO
EMOS1_REDIST_0049.CCF	2001-11-25	2002-05-01	CCD_REDISTRIBUTION-n	NO
EMOS1_REDIST_0050.CCF	2002-05-01	2002-11-07	CCD_REDISTRIBUTION-n	NO
EMOS1_REDIST_0051.CCF	2002-11-07	-	CCD_REDISTRIBUTION-n	NO
EMOS2_REDIST_0043.CCF	1999-12-10	2000-07-15	CCD_REDISTRIBUTION-n	NO
EMOS2_REDIST_0044.CCF	2000-07-15	2000-11-09	CCD_REDISTRIBUTION-n	NO
EMOS2_REDIST_0045.CCF	2000-11-09	2001-04-18	CCD_REDISTRIBUTION-n	NO
EMOS2_REDIST_0046.CCF	2001-04-18	2001-08-18	CCD_REDISTRIBUTION-n	NO
EMOS2_REDIST_0047.CCF	2001-08-18	2001-09-26	CCD_REDISTRIBUTION-n	NO
EMOS2_REDIST_0048.CCF	2001-09-26	2001-11-25	CCD_REDISTRIBUTION-n	NO
EMOS2_REDIST_0049.CCF	2001-11-25	2002-05-01	CCD_REDISTRIBUTION-n	NO
EMOS2_REDIST_0050.CCF	2002-05-01	2002-11-07	CCD_REDISTRIBUTION-n	NO
EMOS2_REDIST_0051.CCF	2002-11-07	-	CCD_REDISTRIBUTION-n	NO

2 Changes

The last release of EPIC-MOS current calibration files (CCFs) which describe the redistribution function of the MOS detectors, i.e.,

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EMOS1_REDIST_0035.CCF up to EMOS1_REDIST_0042.CCF and
EMOS2_REDIST_0035.CCF up to EMOS2_REDIST_0042.CCF
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made public on 25/08/2004, contains errors. Response matrices (rmfs) for MOS timing mode spectra, generated by rmfgen using these parameter files, are highly inaccurate. MOS imaging mode rmfs contain a much smaller error.

Corrected canned timing and imaging response matrices were made available on the XMM SOC website on 15/10/2004. This release contains a new set of CCFs which enable rmfgen to generate the correct rmfs. The problems with the CCFs 0035 to 0042 are detailed below.

TIMING MODE

Figure 1 shows an example of the old and corrected timing mode rmf for an input energy of 1 keV. The old rmf peaks at the wrong energy and has the wrong shape and would produce large errors if used for spectral analysis.

IMAGING MODE

Figure 2 shows an example of the old and corrected imaging mode rmf for an input energy of 1 keV. The problem here was a mis-setting of the level of the redistribution "shelf". This shelf is created by photons interacting near the inactive/active layer between the surface silicon-dixode electrode structure and the active silicon region below. Events can lose up to 100% of their energy here. This is modelled by a shelf which at 1 keV contains about 1% of the area under the normalised rmf. The shelf parameter was inadvertantly set a factor of ten too low. In practice, spectral fitting of low-absorption continuum sources would not be seriously affected by this error as the area under the shelf is relatively low. It is noticeable in high absorption sources if the user plots his spectra below the energy at which the absorbing column would be expected to block all of the source flux.

In addition to the functional changes an extra epoch, from 01/05/2002 to 07/11/2002, has been introduced for both cameras.

3 Scientific Impact of this Update

Figure 3 shows a MOS1 spectral fit to the galactic source, 1E 2259+586. This source has an apparent column of around 9.0×10^{21} cm^{-2}. The underprediction of the shelf in the old rmf is apparent, although the returned column densities in a simple absorbed thermal model are 8.84×10^{21} cm^{-2} and 9.04×10^{21} cm^{-2} for the old and corrected rmfs respectively, i.e. a difference of about 2%.

Figures 4 and 5 show spectral fits with the corrected rmfs to the MOS1 and MOS2 spectra of PKS 0745-19 and again 1E 2259+586. In the latter observation MOS2 was in full frame mode and as the source was piled-up, a larger region of the core was extracted. Hence the apparent difference in source count rate between MOS1 and MOS2 in Figure 5. In both observations the same model parameters were fit to both MOS1 and MOS2.

PKS 0745-19, an extragalactic source, has a lower apparent column of around 5.0×10^{21} cm^{-2}. The larger difference between MOS1 and MOS2 in the predicted shelf levels in 1E 2259+586 may indicate that a further refinement is required in either the energy dependence or the epoch dependance of the level of the shelf. Calibration of this and other epoch-dependent effects within the rmf is an ongoing process.
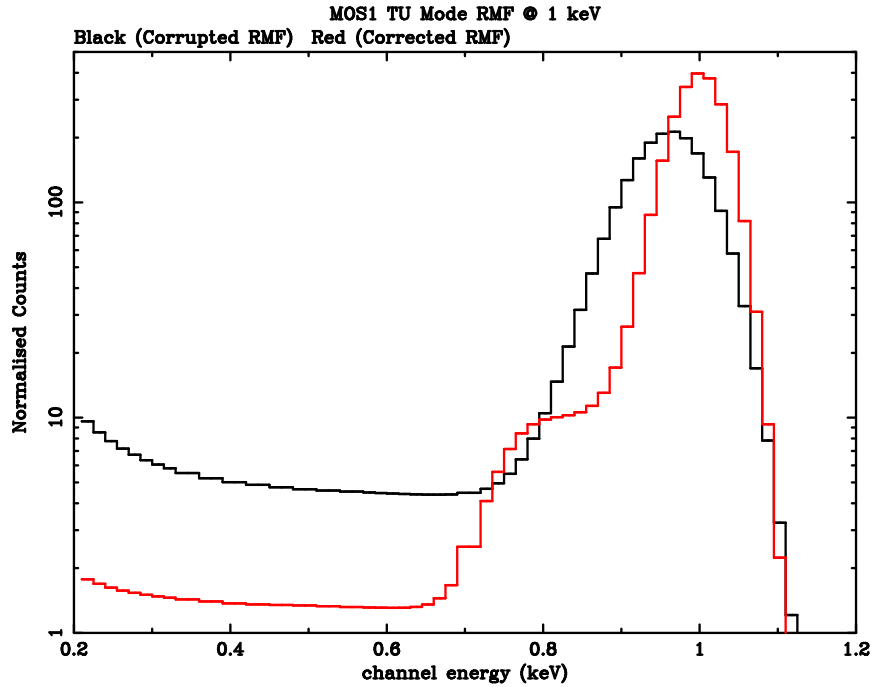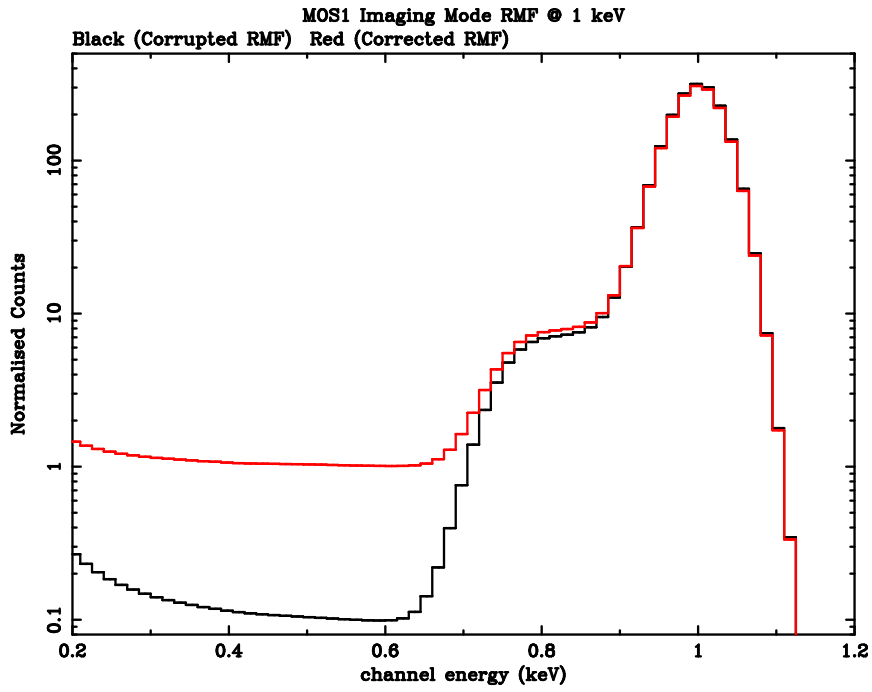
Figure 1: A comparison of the response functions for a 1 keV narrow line observed in Timing mode using the old (EMOS1_REDIST_0035.CCF; black) and new (EMOS1_REDIST_0043.CCF; red) CCFs.

4   Estimated Scientific Quality

This update restores the redistribution to that intended with the previous release [1]. Derived columns should be accurate to a few times 10^{19} cm^{-2}

5   Expected Updates

The calibration of the MOS redistribution function is an ongoing process and further updates are likely.

6   Test procedures and results

The new CCF files were used to produce redistribution matrices using rmfgen for imaging and timing mode and several different epochs. These were compared with canned matrices produced by the MOS instrument team and were seen to be nearly identical in all cases.

References

[1] Saxton, R.D. & Sembay, S. 2004, XMM-SOC-CAL-SRN-0169.

Figure 2: A comparison of the response functions for a 1 keV narrow line observed in Imaging mode using the old (EMOS1_REDIST_0035.CCF; black) and new (EMOS1_REDIST_0043.CCF; red) CCFs.
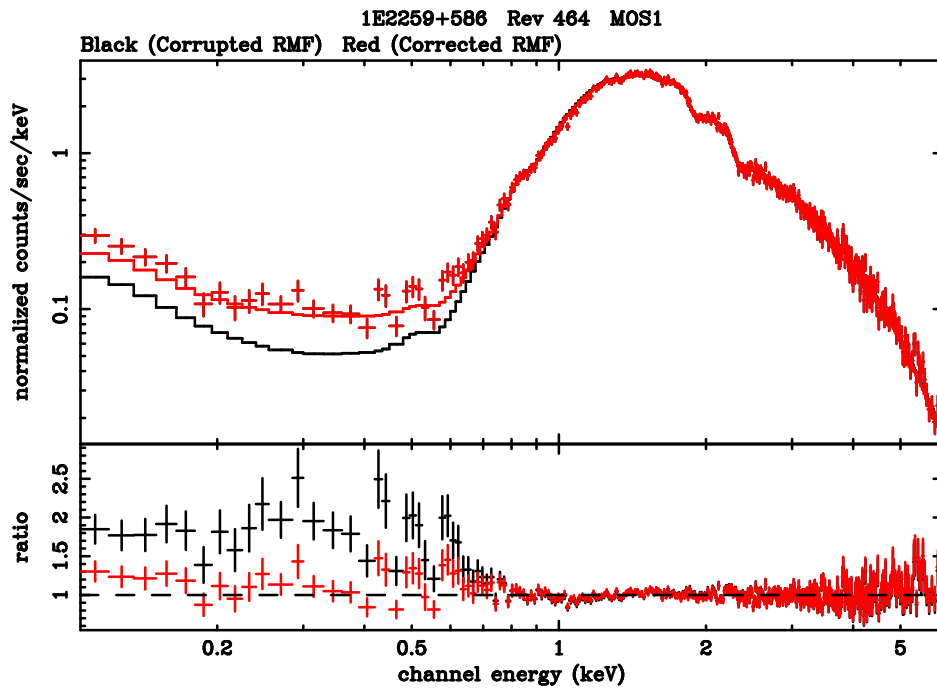
Figure 3: A fit to the strongly absorbed MOS-1 (Full Frame mode) spectrum of 1E 2259+586 using the old (EMOS1_REDIST_0035.CCF; black) and new (EMOS1_REDIST_0043.CCF; red) CCFs.
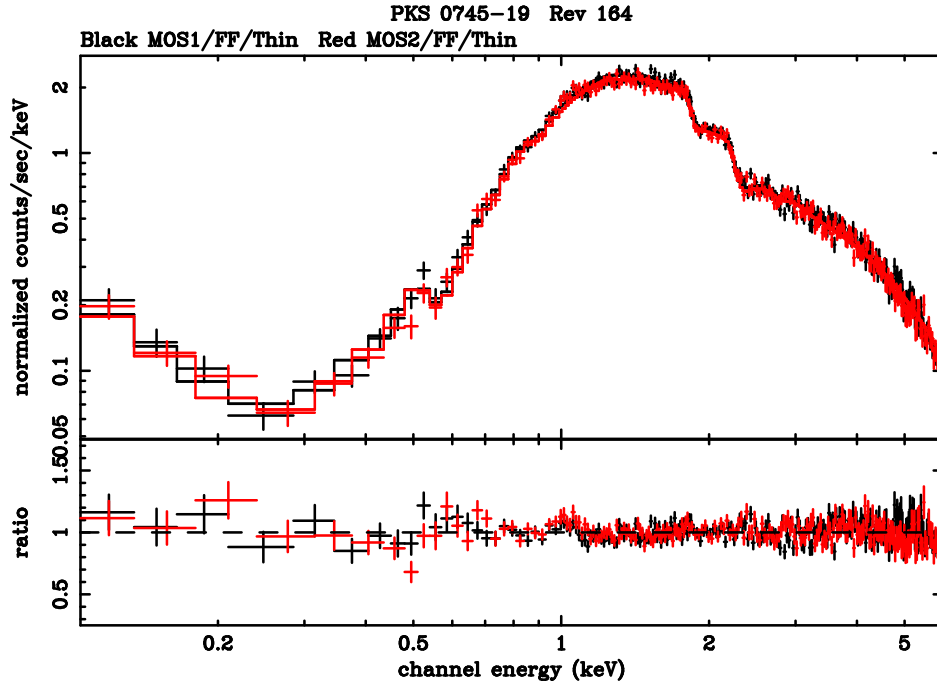
Figure 4: A combined MOS-1 and MOS-2 spectral fit (both cameras in Full Frame mode) to PKS 0745-19 using the new redistribution function
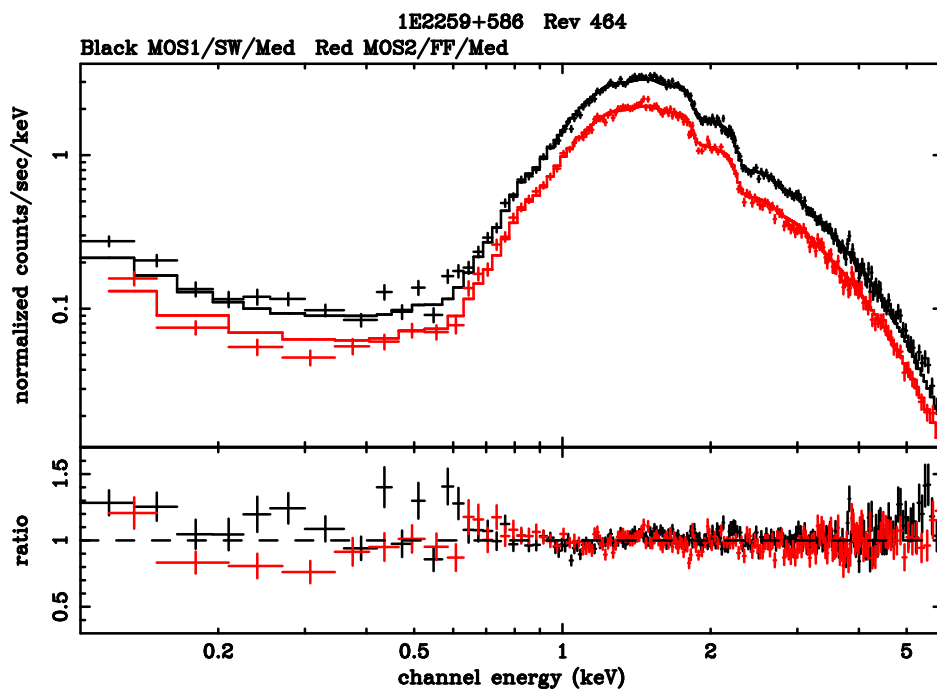
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Figure 5: A combined MOS-1 (small window mode) and MOS-2 (Full Frame mode) spectral fit to 1E 2259+586 using the new redistribution function

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