XMM-Newton CCF Release Note

XMM-CCF-REL-169

EPIC MOS low energy response and Quantum Efficiency

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1 CCF components

Name of CCF	VALDATE	EVALDATE	Blocks changed	XSCS flag
EMOS1_QUANTUMEF_0016.CCF	2000-01-01		QE_TOTAL	NO
EMOS2_QUANTUMEF_0016.CCF	2000-01-01		QE_TOTAL	NO
EMOS1_REDIST_0035.CCF	1999-12-10	2000-07-15	CCD_REDISTRIBUTION-n	NO
EMOS1_REDIST_0036.CCF	2000-07-15	2000-11-09	CCD_REDISTRIBUTION-n	NO
EMOS1_REDIST_0037.CCF	2000-11-09	2001-04-18	CCD_REDISTRIBUTION-n	NO
EMOS1_REDIST_0038.CCF	2001-04-18	2001-08-18	CCD_REDISTRIBUTION-n	NO
EMOS1_REDIST_0039.CCF	2001-08-18	2001-09-26	CCD_REDISTRIBUTION-n	NO
EMOS1_REDIST_0040.CCF	2001-09-26	2001-11-25	CCD_REDISTRIBUTION-n	NO
EMOS1_REDIST_0041.CCF	2001-11-25	2002-11-07	CCD_REDISTRIBUTION-n	NO
EMOS1_REDIST_0042.CCF	2002-11-07	-	CCD_REDISTRIBUTION-n	NO
EMOS2_REDIST_0035.CCF	1999-12-10	2000-07-15	CCD_REDISTRIBUTION-n	NO
EMOS2_REDIST_0036.CCF	2000-07-15	2000-11-09	CCD_REDISTRIBUTION-n	NO
EMOS2_REDIST_0037.CCF	2000-11-09	2001-04-18	CCD_REDISTRIBUTION-n	NO
EMOS2_REDIST_0038.CCF	2001-04-18	2001-08-18	CCD_REDISTRIBUTION-n	NO
EMOS2_REDIST_0039.CCF	2001-08-18	2001-09-26	CCD_REDISTRIBUTION-n	NO
EMOS2_REDIST_0040.CCF	2001-09-26	2001-11-25	CCD_REDISTRIBUTION-n	NO
EMOS2_REDIST_0041.CCF	2001-11-25	2002-11-07	CCD_REDISTRIBUTION-n	NO
EMOS2_REDIST_0042.CCF	2002-11-07	-	CCD_REDISTRIBUTION-n	NO

2 Changes

As part of the calibration program for the SWIFT project, which is using the same CCDs as Epic-MOS, the quantum efficiency (QE) of the detectors has been recalibrated (Fig. 1). These extra ground calibration data have given new information about the low-energy QE of the MOS CCDs and allow us to improve the QE curves below 1.0 keV for the central CCD.

In-orbit calibration data has been reanalysed in the light of the improved QE and small tweaks have been made to the redistribution function for the two MOS cameras to improve the agreement at low-energies.

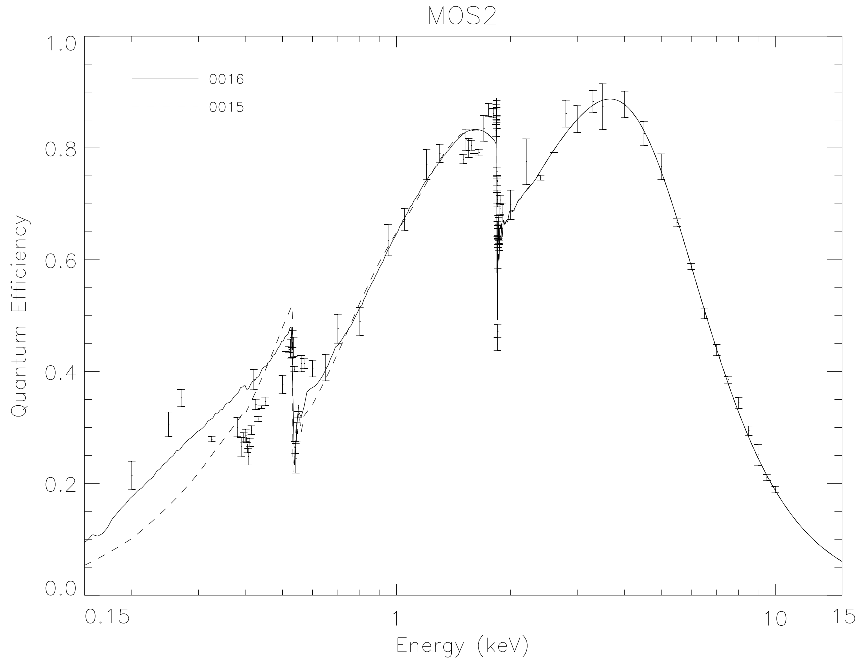

Figure 1: The measured quantum efficiency from EPIC ground based synchrotron measurements of a CCD from the same batch as the central CCD of MOS-2. Overlayed are the model QE derived from fitting to the ground based EPIC data (EMOS2_QUANTUMEF_0015.CCF) and also the model QE (EMOS2_QUANTUMEF_0016.CCF) derived from calibration of an EPIC type device used in the SWIFT project. Note that the ground based EPIC measurements below 1 keV show large non-statistical variations indicating a considerable systematic uncertainty in individual measurements.

3 Scientific Impact of this Update

The change has been tested on a very soft source, the isolated neutron star RX0720.4-3125, to investigate whether the extracted spectral parameters agree with those found by other instruments. An observation of the source, from revolution 534, was fit with an absorbed black-body spectrum and the resultant fit parameters (Table 1.) are found to be in reasonably good agreement with those measured by the RGS from the same observation [1]. A Chandra LETG observation made three years ealier shows a consistent value of N_H but a lower temperature [2]. This agrees with the RGS discovery that the temperature of this target is evolving with time [1].

The residuals to the MOS spectral fits show no major deviations from the model at low energies (Fig. 2), whereas the same model folded through MOS response matrices generated with the previous CCF shows an excess below 0.2 keV. This excess was responsible for small underestimates of the Galactic absorption column.

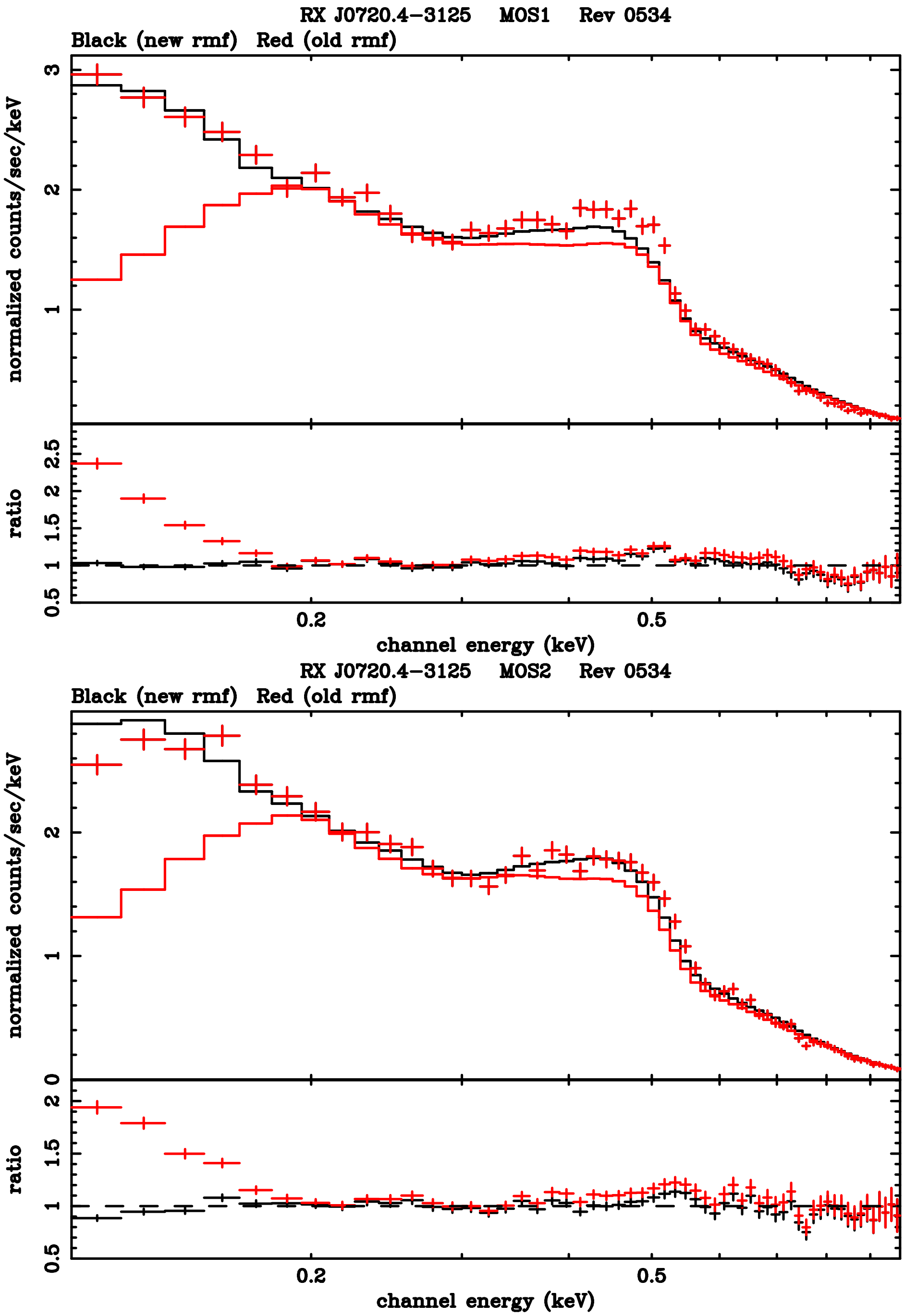

Figure 2: The residuals to the best fit of an absorbed black-body spectrum to the MOS spectra of RX0720.4-3125 (rev 534) with the old (red) and new (black) QE and redistribution CCF files. The improvement in the MOS-1 (top) and MOS-2 (bottom) fits below 0.2 keV is clear.

Table 1: **Mos and Chandra fits to RX0720.4-3125**

Detector	N_h $10^{20}cm^2$	Temperature eV
MOS-1	1.33 ± 0.07	89.0 ± 4.0
MOS-2	1.30 ± 0.07	88.5 ± 4.0
RGS	1.41 ± 0.07	84.0 ± 0.4
Chandra/LETG	1.32 ± 0.14	81.4 ± 1.3

4 Estimated Scientific Quality

The change in QE and rmf has the biggest impact for spectral analysis on soft or low column density sources. For sources with a column density less than 5.0×10^{20} cm^{-2}, it is recommended that the MOS spectra be fit down to around 150 eV. The accuracy of the derived column in these instances is expected to be a few times 1.0×10^{19} cm^{-2}. For sources with column densities higher than around 5.0×10^{20} cm^{-2} it is recommended that the minimum included energy in spectral fitting be determined by the low energy cut-off of the probable incident spectrum. Observed counts below the cut-off energy are almost all redistribution from higher energies.

5 Test procedures and results

The new CCF files have been used in an extensive cross-calibration excercise [3] and have been found to be compatible with the SAS.

References

[1] Vries et al. 2004, A&A, 415L, 31D

[2] Kaplan et al. 2003, Apj, 590, 1008m

[3] Altieri, B., Kirsch, M., Pollock, A., Saxton, R., Chen, B., Smith, M. "XMM-Newton instruments cross-calibration", XMM-SOC-CAL-TN-0052.