XMM-Newton CCF Release Note

XMM-CCF-REL-139

EPIC pn quantum efficiency

R. D. Saxton

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1 CCF components

Name of CCF	VALDATE	Blocks changed	XSCS flag
EPN_QUANTUMEF_0012.CCF	2000-01-01	QE_TOTAL, FRACTION_ENERGY, QE_CCDn, FRACTION_CHANNEL, CHBINS_FRACTION	NO

2 Changes

The total quantum efficiency (QE) for the Epic-pn detector has been revised following a re-analysis of the ground calibration data. The effect is rather small giving a reduction in the depth of the Oxygen edge of about 2% and an increase in the QE at high energies, rising from $\sim$ 1% at 8 keV to $\sim$ 4% at 14 keV. This is applied to the QE_TOTAL extension.

Parallel adjustments have been made to the CTI correction , particularly for Small Window mode observations, and to the low-energy redistribution function. These changes have led to small adjustments being needed to the pattern fraction ratios both in energy and channel space. These have been applied to the FRACTION_ENERGY and FRACTION_CHANNEL extensions.

The arrays QE_0 and QE_1 in the QE_CCDn extensions have been updated correspondingly.

This release includes calibrated pattern fractions for Timing and Burst modes for the first time. Previously these were simply copies of the FullFrame mode fractions.

An additional extension, CHBINS_FRACTION, has been added to quantify the PI channels over which the FRACTION_CHANNEL array is defined. This extension has the column PI_CHAN.

3 Scientific Impact of this Update

This update, in conjunction with changes to the CTI correction for PN data, results in a marked improvement to spectral fits around the Oxygen edge. With the previous calibration, there appeared to be too much flux between 0.5 and 1.0 keV giving rise to unfeasibly low values for the galactic absorption in spectral fits. This is now much better; fits to isolated neutron stars, expected to have a simple thermal spectrum, show little excess flux now around the Oxygen edge.

Timing and Burst mode data can now be fit with realistic effective area files (ARF) generated by the task *arfgen*.

4 Estimated Scientific Quality

This update of the quantum efficiency is intimately linked to the CTI changes described in XMM-CCF-REL-128 . That document gives two examples of the improvement in spectral fits due to the combination of QE and CTI changes. These examples also show that the previous significant mismatch between the PN and MOS from 0.5 to 1.0 keV has largely been resolved.

5 Expected Updates

6 Test procedures

The changes introduced here are primarily used within arfgen, rmfgen and calview. The integrity of the release can be verified by:

1. Compare a PN timing mode RMF, generated by *rmfgen* using this CCF element, against the canned RMF epn_ti40_sdY9.rmf.

2. Compare a timing mode RMF and ARF generated by the SAS using this CCF file against the canned response file, epn_ti40_sdY9_medium.rsp.

7 Test results

Figure 1 shows that the Timing mode RMF produced by the SAS reproduces, almost perfectly, the canned response. Similarly, the ratios of the SAS and canned effective areas are shown to agree to well within 1% below 10 keV (Fig 2.). At the highest energies the

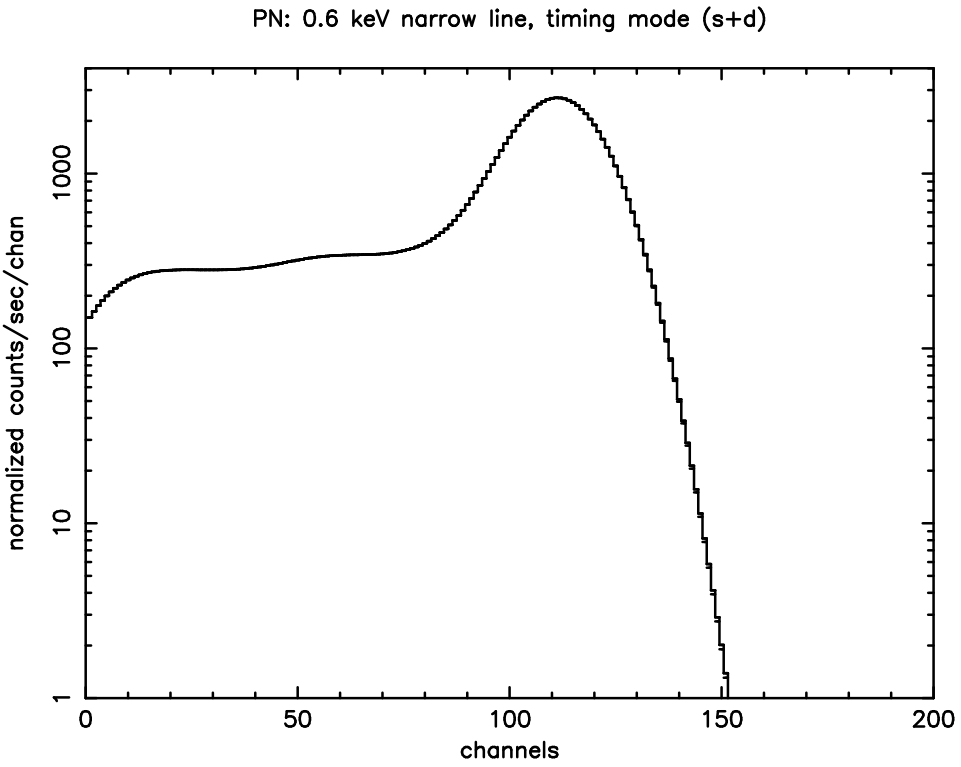

Figure 1: Comparison of the SAS and canned redistribution functions for a narrow line at 0.6 keV observed in Timing mode

discrepancy is higher due to a known difference in interpolation techniques over sharp edges which is seen in all observing modes.

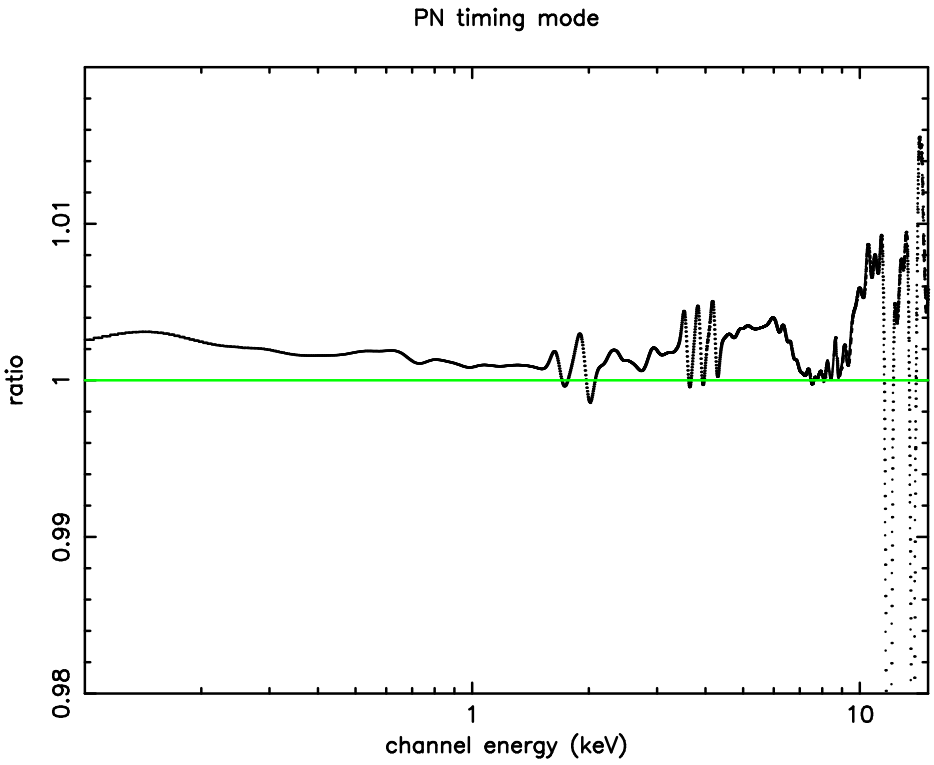

Figure 2: The ratio of the SAS generated response to the canned response epn_ti40_sdY9_medium.rsp, for a power-law spectrum of slope 1.5, observed in timing mode.