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# Correction of SSC pipeline EPIC source list fluxes

## Revision History

Issue Number	Issue Date	Author(s)	Comments
1.1	14-08-01	Julian Osborne	Original version with minor corrections
2.0	18-10-01	Julian Osborne	More appropriate MOS thick response used, open filter ECFs added, pattern selection corrections included
3.0	16-04-03	Richard Saxton Julian Osborne	Updated response for latest calibration and event selection. Separate ECFs derived for MOS-1 and MOS-2

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## 1 Introduction

The EPIC source detection tasks can accept energy conversion factors (ECFs) to relate observed count rates to implied fluxes, these fluxes are included in the output source lists.

The new ECFs listed here will be introduced in the first pipeline following version 02000050/20021220.132037 (which was introduced on 20 Dec 2002).

These will:

- Update values for the latest quantum efficiency (QE) calibration.
- Derive individual ECFs for MOS-1 and MOS-2.
- Update values for PN band 1 images which are created from pattern 0 events only.
- Exclude corrections due to event pattern selection, as the images will now have the selection appropriate to the response matrices used.

This note sets out the correct ECFs to be used. Please see earlier issues of this technical note for the relationship between fluxes derived in earlier pipeline versions.

## 2 Event pattern selection and files used

From pipeline **nn? JO awaiting response from DJF**, PN band 1 images have been made using the selection of pattern 0 events only (before this, pattern 0–4 events were used). All other PN images are made using patterns 0–4. The MOS images will be made using patterns 0–12 from pipeline version following 02000050/20021220.132037 (before this, all patterns in the event list were used).

Because these pattern selections correspond to the standard response matrices, no correction is required between the pipeline image count rate and the count rate input to the response matrices. Previously such corrections were necessary in calculating the ECFs for both MOS and PN in the pipeline.

The redistribution matrix files (RMF) used are listed in Table 1. These have been used in conjunction with ARFs for the thin, medium, thick and open filters, created by the task `arfgen-1.45.8` using the CCF current on March 1, 2003<sup>1</sup>.

RMF
<code>epn_ff20_sY9.rmf</code>
<code>epn_ff20_sdY9.rmf</code>
<code>m11_im_all_2001-04-18.rmf</code>
<code>m21_im_all_2001-04-18.rmf</code>

Table 1: *Redistribution files used to calculate the flux / count rate ratios.*

## 3 Energy Conversion Factors

New calculations have been made of the Energy Conversion Factors (ECF) required to convert count rates to fluxes. As before, absorbed fluxes and count rates were compared for the pipeline image energy bands using `xspec` with a power law spectrum of photon index of 1.7 and an absorbing column of  $3.0 \times 10^{20}$ .

The flux/count rate ratios are given in Table 2.

The ECFs required by the SAS source detection tasks are  $\text{ECF} = (\text{count rate} / \text{flux})$  in units of  $1\text{e}11 \text{ counts.cm}^2.\text{erg}^{-1}$ . Derived from Table 2, these are given in Table 3.

The ECFs in Table 3 will be applied in the first pipeline following version 02000050/20021220.132037. The pipeline version used in creating pipeline products is recorded in the FITS keyword `PPSVERS`. The history of the pipeline versions can be seen at <http://xmmssc-www.star.le.ac.uk/pipeview/prod>

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<sup>1</sup>Specifically, `EMOS1_QUANTUMEF_0014.CCF`, `EMOS2_QUANTUMEF_0014.CCF`, `EPN_QUANTUMEF_0012.CCF`

Band (keV)	PN			
	OPEN	THIN	MEDIUM	THICK
0.2-0.5	6.365e-13	1.1061e-12	1.2484e-12	2.0039e-12
0.5-2.0	1.3328e-12	1.5161e-12	1.5523e-12	1.8816e-12
2.0-4.5	5.0410e-12	5.1192e-12	5.1813e-12	5.4129e-12
4.5-7.5	1.0621e-11	1.0628e-11	1.0644e-11	1.0790e-11
7.5-12	4.1690e-11	4.1654e-11	4.1670e-11	4.1842e-11
XID (.5-4.5)	2.0291e-12	2.2585e-12	2.3053e-12	2.7039e-12
Band (keV)	MOS-1			
	OPEN	THIN	MEDIUM	THICK
0.2-0.5	3.292e-12	5.6949e-12	6.3932e-12	1.0162e-11
0.5-2.0	4.543e-12	5.0499e-12	5.1590e-12	6.1660e-12
2.0-4.5	1.3290e-11	1.3459e-11	1.3651e-11	1.4237e-11
4.5-7.5	3.7747e-11	3.7826e-11	3.7888e-11	3.8443e-11
7.5-12	3.6045e-10	3.6065e-10	3.6080e-10	3.6236e-10
XID (.5-4.5)	6.5909e-12	7.1132e-12	7.2495e-12	8.3587e-12
Band (keV)	MOS-2			
	OPEN	THIN	MEDIUM	THICK
0.2-0.5	3.266e-12	5.6438e-12	6.3329e-12	1.0061e-11
0.5-2.0	4.553e-12	5.0586e-12	5.1677e-12	6.1745e-12
2.0-4.5	1.3228e-11	1.3431e-11	1.3586e-11	1.4167e-11
4.5-7.5	3.6008e-11	3.6083e-11	3.6143e-11	3.6671e-11
7.5-12	3.3428e-10	3.3448e-10	3.3462e-10	3.3607e-10
XID (.5-4.5)	6.5437e-12	7.1138e-12	7.2497e-12	8.3556e-12

Table 2: Flux/count rate ratios calculated using the response matrices of Table 1, ARFs created by `arfgen` and the spectrum described in the text

		PN			
Band (keV)	OPEN	THIN	MEDIUM	THICK	
0.2-0.5	15.711	9.041	8.010	4.990	
0.5-2.0	7.5030	6.596	6.442	5.315	
2.0-4.5	1.9837	1.953	1.930	1.847	
4.5-7.5	0.9415	0.941	0.9394	0.927	
7.5-12	0.2399	0.2401	.0.2400	0.2390	
XID (.5-4.5)	4.9282	4.4277	4.3378	3.6984	
		MOS-1			
Band (keV)	OPEN	THIN	MEDIUM	THICK	
0.2-0.5	3.0377	1.756	1.564	0.984	
0.5-2.0	2.2011	1.980	1.938	1.622	
2.0-4.5	.75244	0.741	0.7325	0.7024	
4.5-7.5	.26492	0.2644	0.2639	0.260	
7.5-12	.02774	0.02773	0.02772	0.02760	
XID (.5-4.5)	1.5172	1.4058	1.3794	1.1964	
		MOS-2			
Band (keV)	OPEN	THIN	MEDIUM	THICK	
0.2-0.5	3.0618	1.772	1.579	0.994	
0.5-2.0	2.1963	1.977	1.935	1.620	
2.0-4.5	.75597	0.7445	0.7361	0.7059	
4.5-7.5	.27772	0.2771	0.2767	0.2727	
7.5-12	.029915	0.02990	0.02988	0.02976	
XID (.5-4.5)	1.5282	1.4057	1.3794	1.1968	

Table 3: *ECF* values derived from Table 2 in units of  $10^{11} \text{ counts.cm}^2.\text{erg}^{-1}$  as required by the detection tasks.