# XMM-Newton CCF Release Note

# XMM-CCF-REL-141

# EPIC MOS pattern fractions

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## 1 CCF components

| Name of CCF | VALDATE | Blocks changed | XSCS flag |
|---|---|---|---|
| EMOS1_QUANTUMEF_0014.CCF | 2000-01-01 | FRACTION_CHANNEL | NO |
| EMOS2_QUANTUMEF_0014.CCF | 2000-01-01 | FRACTION_CHANNEL | NO |

## 2 Changes

In earlier releases the pattern fractions in channel space have been modelled as a fifth order polynomial. This is adequate for RMF generation but does not model sharp discontinuities in the curve, such as the Silicon edge, with sufficient accuracy for use in epatplot.

Here, the channel pattern fractions have been calculated by convolving the pattern fractions in energy space with the redistribution function. The energy space pattern fractions were measured during ground calibration runs at Orsay. To take into account pixel thresholding a tapering function has been applied to the fractions below channel 26. The calculation has been performed for MOS-1 and applied to MOS-2. It is not expected that these fractions will vary significantly between the cameras. The calculated values are relevant for all the MOS imaging modes but are not appropriate for Timing mode.

## 3 Scientific Impact of this Update

With this accurate modelling of the channel fractions, the task *epatplot* may be used to investigate pile-up issues with a MOS observation.

The pattern fractions do affect the MOS RMF, calculated by *rmfgen*, particularly at low-energies. However, the previous pattern fractions were rather similar at low-energies and so there should be no significant effect on spectral fits.

# 4 Estimated Scientific Quality

The point of this release is to provide a standard curve which can be compared with real data to check whether an observation is affected by pile-up. A full frame, MOS-1, observation of the SNR G21.5-09, 0060/0122700101, was compared with the standard curve using *epatplot* (Fig. 1.) This shows a good agreement indicating that this observation has no pile-up problem.

Figure 2 shows the epatplot output for a small window mode, MOS-1, observation of 3C273, 0277/0136550101. This shows events extracted from a circle of radius 40 arcseconds about the source and clearly diverges from the optimum curve above 1.5 keV. This divergance is resolved by excising the central 15 arcseconds of the core of the source (Fig. 3).

Data from the same observation of 3C273 by MOS-2, extracted from an annulus of 10–60 arcseconds also matches the standard curve very well (Fig. 4).

# 5 Expected Updates

The pattern fractions in channel space for Timing mode have been set to be the same as for full frame mode. In reality they differ markedly due to the Pattern 0, Timing mode events actually being composed of Pattern 0,1 and 3 events. The curves will need to be calculated and included in a future release of these CCF files.

# 6 Test procedures and results

The analyses of section 4 show that the pattern fractions are sufficiently accurate for performing pile-up checks. The effect on the RMF should also be checked at a low and high photon energy to ensure that no serious modification to the RMF has been introduced.

The Previous and new RMFs are compared at 0.3 and 8.0 keV in Figs 5 and 6. In the low energy curve it can be seen that the blue wing of the line is depressed in the new version. At the higher energy there is little difference between the two versions. These small differences will not significantly influence spectral fits.
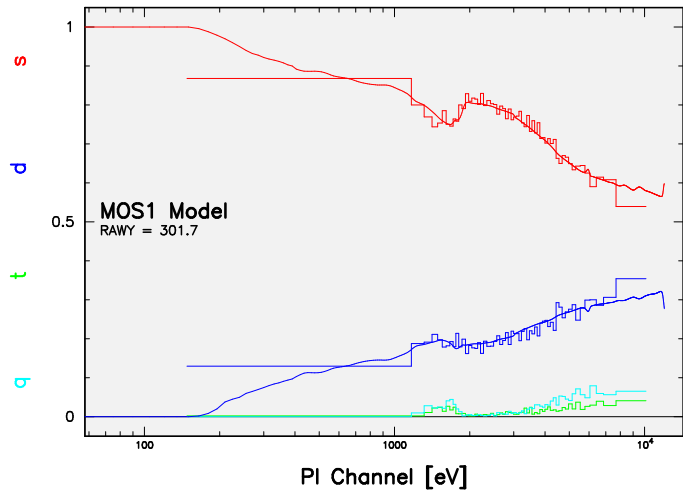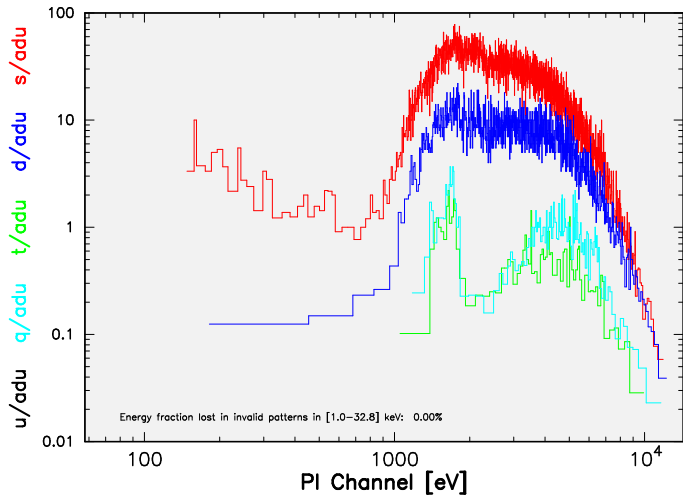
**References**

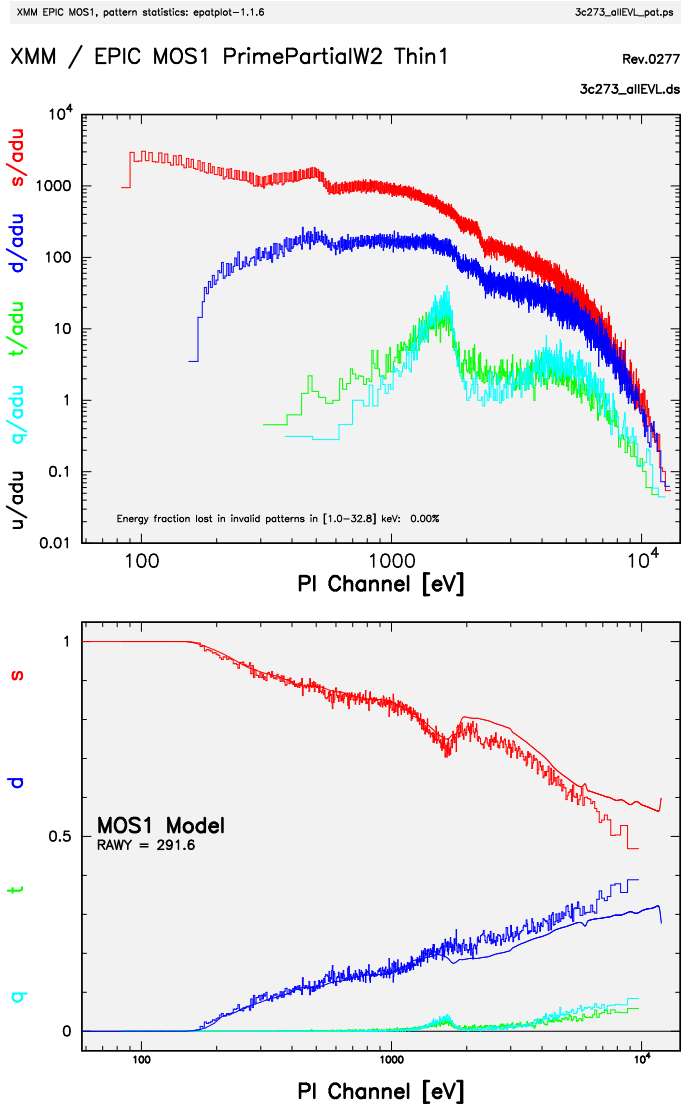Figure 1: An *epatplot* comparison of the pattern fractions from a full frame observation of G21.5-09.

Figure 2: A comparison of the pattern fractions of events extracted from a circle about a MOS-1, small window mode observation of 3C273. Pile-up is clearly seen by the divergance of the data from the standard curve.
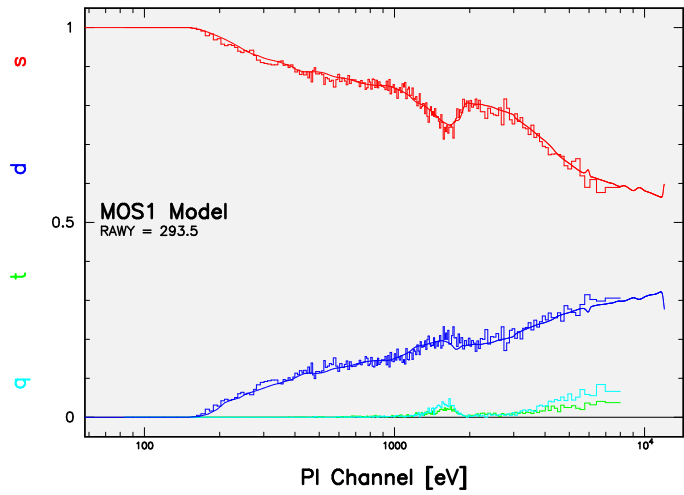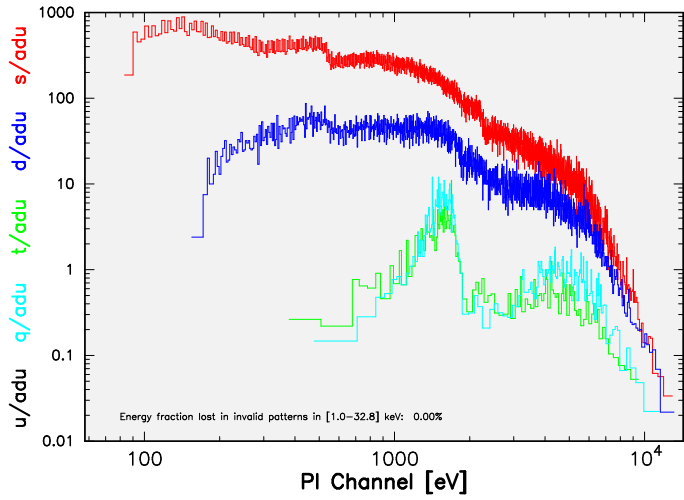
Figure 3: The pattern fractions of events extracted from a 15–60 arcsecond radius about a MOS1, small window observation of 3C273.
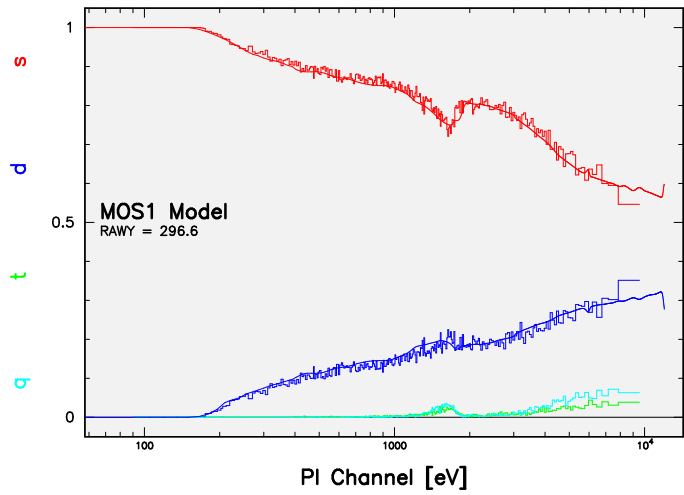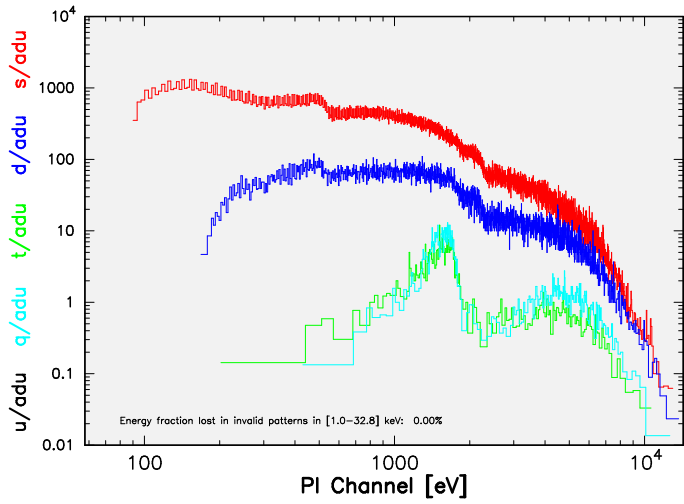
Figure 4: The pattern fractions of events extracted from a 10–60 arcsecond about a MOS-2, small window observation of 3C273.
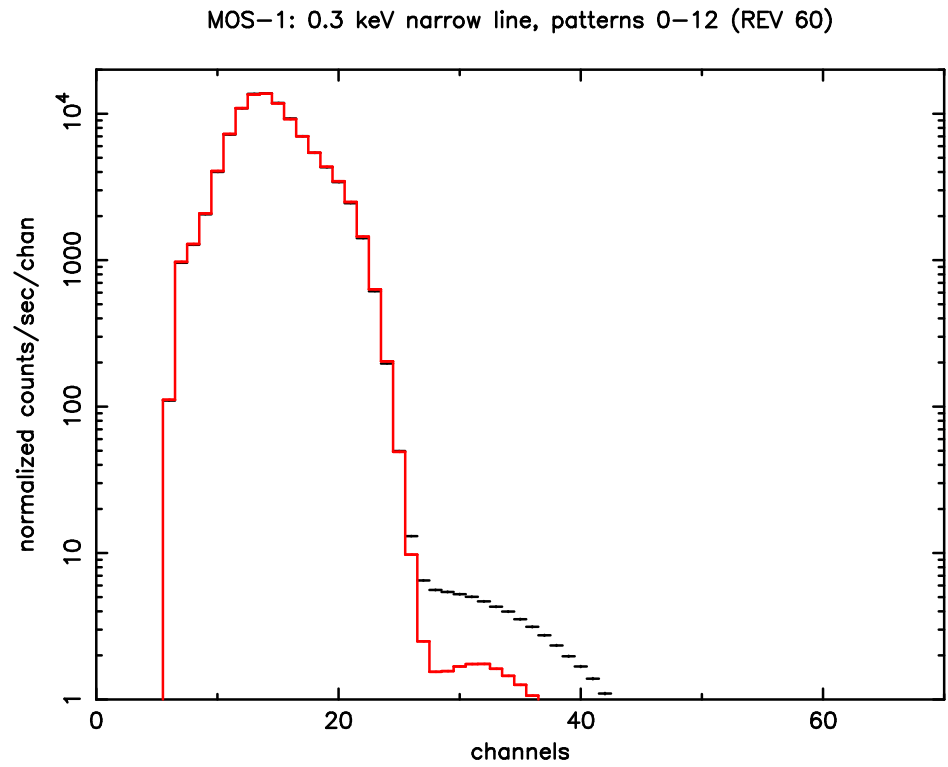
Figure 5: A comparison of the redistribution function for MOS-1, at 0.3 kEV with the new (red) and old (black) pattern fractions.
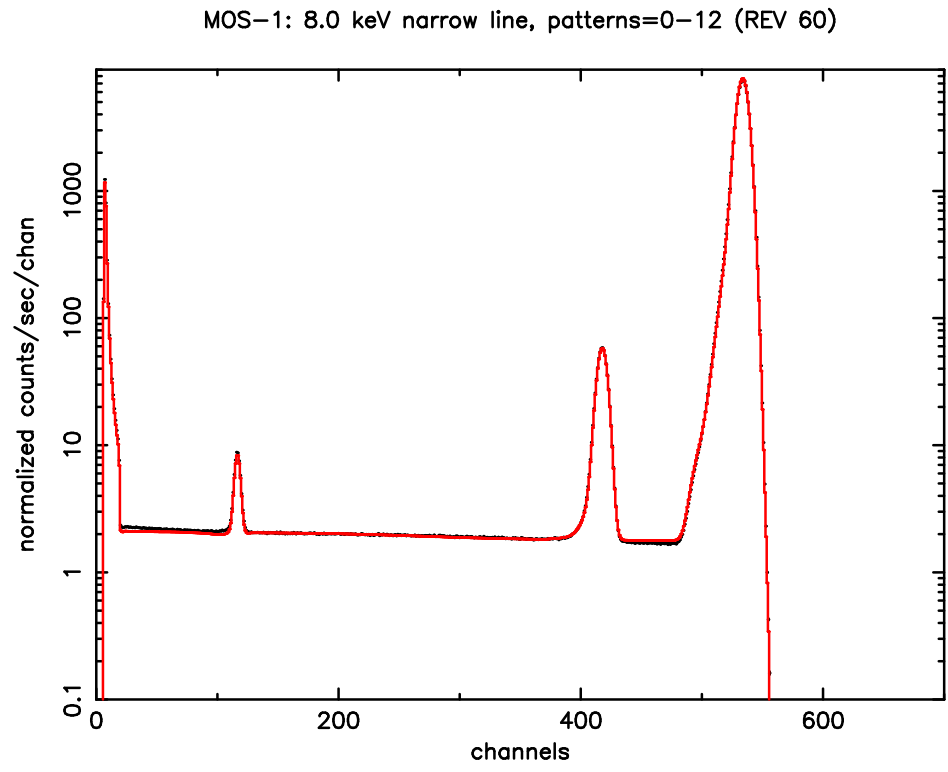
Figure 6: A comparison of the redistribution function for MOS-1, at 8.0 kEV with the new (red) and old (black) pattern fractions.