**XMM-Newton (cross-)calibration**


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**Latest improvements**

**MOS redistribution**

Due to the discovery of the existence of the pitch in the MOS, the redistribution function of the MOS has already been modified in order to solve the effect that this pitch produces at low energies. This updated redistribution, modeled in 8 different epochs, must now be used in order to cover different areas of the detector. In the present paper, the response may be divided into three discrete areas: a core, of radius 15", central upon the observed patch whose response degraded gradually with time but stabilized around r=70", a wings area, modeled as an annulus about the core region of outer radius 40", which is not as strongly affected as the core but whose response continues to evolve and an outer area, defined as the rest of the detector which has experienced a slow and still changing evolution.

Extended CCFs, constructed to define the multi-parameter response space, are being constructed and will be interfaced with SAS 6.5. Naturally a typical extraction region will overlap more than one of the response areas and so redistribution will be upgrade to calculate a flux averaged RMF in SAS 6.5.

**EPIC flux stability on SNRs**

The flux of the SNR S132D in the soft band 0.4-0.8 keV was computed for all EPIC cameras, giving the following results for that energy range (see Fig. 3):

- The response of the pn camera is extremely stable, there is no variation of the observed flux for a given mode (~5% lower flux for the LW mode with respect to the SW due to a pre-spike effect).
- The MOS response shows a decreasing trend of ~5% up to resolution 800.
- The MOS flux is lower than that of MOS2 by ~5%.
- The lower flux of the MOSs to the flux of the pn is probably due to pile-up in the MOS LW mode (all MOS observations plotted here have been performed in this mode).

**Open problems**

- EPIC-pn observations with very high statistical precision show residuals at the silicon edge around 0.5 keV.
- Analysis of the pattern distributions in EPIC-pn has shown that charge is more often observed to be split along readout direction than perpendicular to it, which may introduce a systematic error in the energy.

**Low-energy flux with SAS 6.1**

Conclusions

The spectral response of the MOS detectors has been now discovered to be spatially dependent, and not uniform as believed previously. The only explanation consistent with this evidence is that a small patch on each detector has degraded over time in a way which broadens the redistribution function at energies below 0.5 keV. Using the SNR as a test, it is found that the position of the patch on the detector is not transparent (Fig. 6). It is seen to be real in shape and be coincident with the non-detection region of sources which placed at the pn and RGS bore sight. In fact it is coincident with the peak in received photon density of the detector.

**pe redistribution**

For the first time, values of the pe redistribution close to the ground calibration measurements were adopted. As a result, in SAS 6.1 the agreement between EPIC-pn and MOSs and RGSs at low energies was improved, and analysis of Zen Poppo also showed a good modeling of its spectral lines. However, analyzing the very soft sources RX1516-3754, RX2155-304 using old rmfs showed a soft excess with respect to the MOS model below 0.4 keV, and the column density was not quite correct and expected a fit with broken power-law model, actually a consistent set of residuals (Fig. 10 bottom) indicating that the modeling of the redistribution function is still not perfect.

Using these residuals as a starting point, an energy-dependent re-working of the RMF has been made which flattens the residuals (Fig. 10 bottom). These new RMFs improve the fit to other continuum sources such as RX1516-3754 (giving a fit to MOS closer to that of Chandra) and importantly bring the pn and MOS cameras into better agreement.

**Improvements in EPIC calibration**

- **pn telescope effective area:** the effective area around the gold edge at 2.2 keV has been altered resulting in the improvement of the residuals around that edge in the pn-spectrum.
- **Point Spread Function (PSF):** the best model of the point spread function (PSF) for the flat field illumination can now be performed at high flux levels.
- **Spatial bins in the calibration:** the EAC cannot be separated from the PSF. This parameterisation was good, however it was noticed that the energy dependence of the PSF model was not sufficiently captured and extracts the spectrum of a point source using circles and annuli of different radii gives inconsistent results. With the acquisition of long, clean observations of bright, but not piled-up, point sources (Fig. 4), the modelling of the energy dependence has been significantly improved. The release of the new PSF models, (described in A.M.T. et al 2005) now allow spatial parameters to be reliably calculated independent of the extraction region (Fig. 5).

**Selected MOS observations**

- **Small Window (SW) and Large Window (LW) modes:** the effect of the low-resolution correction of the SW of the SW mode below 350 and 700 eV has been reduced. The LW mode CTI was adjusted to this SW CTI for energies below 500 eV, which improves the residuals in the fitted spectra.
- **Extended Full Frame (EFF) mode:** the extended Full Frame mode showed an over-correction of the energy for the internal calibration source by up to 15 eV for the MOS-LW mode position with respect to the Full Frame (FF) mode related to imperfect CTI correction. A special calibration observation of the SNR Cas-A was analysed and used to derive a correction function of the energy for the EFF mode which leads to the agreement of energy line positions between EFF and FF modes with an accuracy of 0.3%.
- **Long-term calibration:** The long-term CTI behaviour of all modes is now modelled with an additional quadratic term to tail off the time dependence, affecting all modes.

**Calibration status: SAS 6.1**

**Extended CCFs**

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