XMM-Newton CCF Release Note

XMM-CCF-REL-0398

EPIC Scale Factors

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1 CCF components

Name of CCF	VALDATE	List of Blocks changed	Change in CAL HB
XMM_SCALEFACTORS_0001.CCF	2000-01-01	INSTRUMENT, FILTER, IDXBAND POWERIDX, SCALFCS	NO

2 Initial Release

When combining images from different detectors, it is necessary to scale them to the same effective area. The SCALEFACTORS CCF provides the required values to scale the MOS1 and pn images to the same effective area as the MOS2 image, as a function of the `pimin` and the `pimax` of the image. Of course, if the image was made in a broad band, the scaling will depend upon the spectral shape of the emission in the image. Scale factors are provided for three spectral shapes:

- a power law of index 2.4 absorbed by an N(H)=2×10^{20} cm^{-2}, which is appropriate for most thermal sources.
- a power law of index 1.7 absorbed by an N(H)=2×10^{20} cm^{-2}, which is appropriate for typical AGN.
- a power law of index 1.0 absorbed by an N(H)=2×10^{20} cm^{-2}, which would be a very hard source indeed, and might be appropriate

These three spectral models span the range of typical (gross) spectral shapes.

The scale factors are utilized by the `combimage` routine, which takes as input the power law index of the spectrum the user wishes to use to represent the mean emission in the FOV, and interpolates to that index using the three tabulated spectral shapes in the CCF.

Each line in this CCF consists of the detector, the filter, the name of the "spectrum" to be used, the index of that spectrum, and a 240 by 240 element array of scale factors. The scale factors are the value of the model flux in MOS2 (medium filter) divided by the model flux of the detector and filter of interest. Each element of the array (i, j) provides the scale factor for an energy band from (i-1)*50+25 eV to (j-1)*50+25 eV. The array of scale factors thus covers the range from 25 eV to 11975 eV in 50 eV steps. (Also note that only the upper diagonal half plane is populated as `pimax` must be greater than `pimin`.)

The scale factors were calculated using PIMMS, the RMF and ARF appropriate for the full FOV, and assuming a total flux of 10^{-14} ergs cm^{-2} s^{-1}. (This last does not matter since, for all but MOS2, medium filter values, all the quantities are ratios.) The entries for MOS2, medium filter contain the fluxes rather than the ratios (which would all be unity). Knowledge of this array structure is built into the `combimage`, `binadapt`, and `binadaptmerge` routines.

3 Scientific impact of this update

This CCF is the initial release for the inclusion of the `combimage`, `binadapt`, and `binadaptmerge` routines in SAS 21. The content is identical to the scale-factors-s.fits.gz, scale-factors-m.fits.gz, and scale-factors-h.fits.gz that were used in the ESAS routines before they were incorporated into SAS.

4 Estimated scientific quality

To be considered

5 Test procedure and results

The original scale factor arrays were produced for the stand-alone ESAS software. The CCF was constructed from the original ESAS calibration files. Tests with the new `combimage` routine in SAS using the CCF produced the same results as the old `combimage` routine in ESAS using the original files. The orientation of the arrays was a particular problem that should be carefully scrutinized for future modifications.

6 Future changes

This CCF could be updated for changes in the effective areas.

7 References

Kuntz, K. D. & Snowden, S. L. (2008) A&A 478, 575.
Kuntz, K. D. & Snowden, S. L. (2023) Cookbook for Analysis Procedures for *XMM-Newton* EPIC Observations of Extended Objects and the Diffuse Background.