XMM-Newton CCF Release Note

XMM-CCF-REL-0397

EPIC SWCX Vignetting Maps

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1 CCF components

Name of CCF	VALDATE	List of Blocks changed	Change in CAL HB
XMM_SWCX_0001.CCF	2000-01-01	INSTRUMENT, LINE, ENERGY, SWCXMAP	NO

2 Initial Release

The SWCX CCF provides a mapping of the vignetting function for photons due to solar wind charge exchange (SWCX) lines. This CCF was developed as part of the Extended Source Analysis Software (ESAS), whose functionality is now included within SAS itself. The purpose of the ESAS routines was to provide tools for determining the contribution of various non-cosmic backgrounds/foregrounds, and constructing images of those components so that they may be correctly subtracted from a raw image. This CCF allows the images of the SWCX emission to be constructed given the strengths of the SWCX lines using the SAS routine `swcx`.

This CCF contains a vignetting map for each SWCX line (currently five lines) for each detector. Each vignetting map was constructed as an exposure map using the `eexpmap` : `eexpmap imageset=image.ds attitudeset=atthk.fits expimageset=ovii-exp.fits withdetcoords=yes withvignetting=yes usefastpixelization=no usedlimap=no attrebin=4 pimin=XXXX pimax=XXXX`. The input template image (image.ds) was in detector coordinates and was binned as the standard ESAS 780 by 780 pixel image[1]. The SWCX lines covered and the `pimin` and `pimax` for each SWCX line are given as the interval in the table below. The narrow energy bands for the 0.560 and 0.650 keV lines make sense.

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[1]Given that ESAS is intended for faint diffuse emission, there is no need to allow overly small binning of the images. As a result, ESAS relies on all images to be produced either in detector coordinates with evselect parameters `imagedatatype='Int32' squarepixels=yes withxranges=yes withyranges=yes xcolumn='DETX' ximagesize=780 ximagemax=19500 ximagemin=-19499 ycolumn='DETY' yimagesize=780 yimagemax=19500 yimagemin=-19499` or in sky coordinates with evselect parameters `imagedatatype='Int32' squarepixels=yes ignorelegallimits=yes withxranges=yes withyranges=yes xcolumn='X' ximagesize=900 ximagemax=48400 ximagemin=3401 ycolumn='Y' yimagesize=900 yimagemax=48400 yimagemin=3401`.
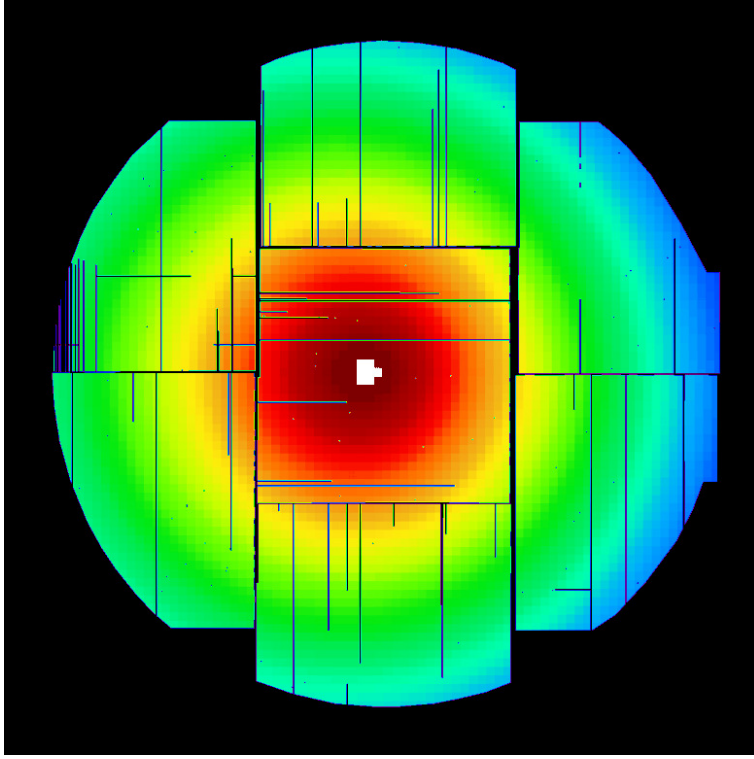
Figure 1: An example vignetting map, that for the MOS1 detector and the O VII line.

SWCX Line	Line Energy	Interval
O VII	0.560 keV	0.550-0.570 keV
O VIII	0.650 keV	0.640-0.660 keV
O VIIIb	0.810 keV	2.0-4.5 keV
Ne IX	0.920 keV	2.0-4.5 keV
Mg XI	1.350 keV	2.0-4.5 keV

Each line in this CCF consists of the detector, the SWCX line (as in the table above), the energy of the line, and the 780 by 780 vignetting map.

3   Scientific impact of this update

This CCF is the initial release for the inclusion of the `swcx` routine in SAS 21. The contents of this file is identical to that of the swcx-im.fits.gz file used by ESAS before it became part of SAS.

4   Estimated scientific quality

Not Applicable

5 Test procedure and results

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

6 Future changes

The next update will use a constant energy band width for all lines. This will change the vignetting function for the O VIIIb, Ne IX, and Mg XI lines by ~ 12 percent. In the future there may be a need to implement C VI (0.37 keV), C VI (0.46 keV), and Ne IX (1.02 keV), however they have not yet been needed.

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.