XMM-Newton CCF Release Note

XMM-CCF-REL-277

2-D PSF spoke parameterization

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1 CCF components

Name of CCF	VALDATE	List of Blocks changed	Change in CAL HB
XRT1_XPSF_0013.CCF	2000-01-01	ELLBETA_PARAMS	YES
XRT2_XPSF_0013.CCF	2000-01-01	ELLBETA_PARAMS	YES
XRT3_XPSF_0013.CCF	2000-01-01	ELLBETA_PARAMS	YES

2 Change

The elliptical beta, 2-D PSF model (ELLBETA) consists of an elliptical King function plus a central narrow Gaussian to model the core plus spoke structures (see [1] and CAL-SRN-0263 for a fuller description). The spoke structure has been reworked in this release to vary the intensity along the spokes such that

1. The spokes start at a radius, RTHRESH=4.4”. For smaller radii the spoke strength is zero.
2. The spoke strength increases linearly until reaching a peak at RLO=44”.
3. It then decreases linearly until attaining zero intensity at RHI=159.5”. The spoke strength is zero beyond this radius.

These values are stored as keywords in the header of the ELLBETA_PARAMS extension. In addition some, previously hardcoded, values have been written as keywords into the same extension, to allow possible future changes to be made within the CCF. The full list of added keywords is:

- RTHRESH - minimum radius to start azimuthal filtering (arcsec)

- RLO - radius at which the spoking peaks (arcsec)
- RHI - radius at which the spoking tails to zero (arcsec)
- NSP - number of spokes = 16
- CHNGFRAC - fraction of image to be filtered (0[none]-1[all]) which defines the strength of the spoke = 0.375
- SECFRAC - strength of secondary spokes = 0.035
- OPHI - origin (offset) angle of primary spoke (degrees) = 11.25
- U - azimuthal spoke filtering shape parameter = 0.165
- V - azimuthal spoke filtering shape parameter = 0.165
- M1FRAC - strength of MOS1 pentangle shape = 0.13
- M2FRAC - strength of MOS2 triangle shape = 0.45

For a full description of these parameters, see [1].

Note that the keywords related to the spoke structure currently have the same values for the three cameras.

3 Scientific impact of this update

This change has been produced in response to a technical note [2] where the fidelity of the ELLBETA PSF image was investigated by comparing it with a number of very bright piled-up sources. The spoke structure, as represented in XRTn_XPSF_0012.CCF, was found to be too strong. In this release the spoke intensity, controlled by the parameter *CHNGFRAC*, has been reduced and made radially-dependent. This matches better with real sources and hence leads to a reduction in the number of spurious detections which are found in the wings of bright point sources during source detection runs.

4 Estimated scientific quality

An analysis of the quality of this CCF has been presented in [3]. The conclusions are that the on-spoke/off-spoke ratio now gives a much improved fit to real data.

Nevertheless, in this reanalysis, it was found that one of the sources used for the comparison had an X-ray scattering halo which biased the final results. A further tuning of the spoking parameters will be necessary in a future CCF release to account for this.

5 Test procedure and results

The new CCFs have been used within `calview`, `psfgen` and `eregionanalyse` to test that they produce the correct PSF images and encircled energy values.

The modified SAS code needed to take advantage of the new CCF structure is not yet public. To ensure that these changes do not adversely affect the current public SAS (v11.0) the same three tasks, `calview`, `psfgen` and `eregionanalyse` were executed from the current SAS using the new CCF elements. No problems were seen.

6 References

[1] Read, A., Rosen, S., Saxton, R. & Ramirez, J. 2011, A&A, 534, 34
[2] Owen, R. & Ballet, J. 2011, SSC-CEA-TN-1001, v1.1.
[3] Owen, R. & Ballet, J. 2011, SSC-CEA-TN-1001, v2.1. (http://xmm2.esac.esa.int/documents/CAL-SSC-CEA-TN-1001-2.1.ps.gz)