XMM-Newton CCF Release Note

XMM-CCF-REL-116

PSF of the X-ray telescopes

R. D. Saxton

14 May 2002

1 CCF components

Name of CCF	VALDATE	List of Blocks changed	CAL VERSION	XSCS flag
XRT3_XPSF_0004.CCF	2000-01-01	KING_PARAMS		NO

2 Changes

A new parameterisation of the EPIC-pn (XRT3) telescope point spread function (PSF) has been produced by Simona Ghizzardi. This follows earlier work performed, using the same method, on the XRT1 and XRT2 PSFs [1].

The new values replace an earlier parameterisation of the PSF, which was only valid on-axis. They are stored in the KING_PARAMS extension of the CCF tabulated against ENERGY and THETA (off-axis angle) [2].

3 Scientific Impact of this Update

The PSF is described by a King function whose parameters, core radius and index, are themselves functions of energy and off-axis angle. The current work has used many bright point sources both on and off axis to determine the energy dependent PSF. This should produce more reliable results than the previous implementation which was based on a few on-axis sources.

The parameterisation is:

```
core_radius = 6.636 - 0.305 * energy - 0.175 * offax
                            - 0.0067 * energy * offax
```

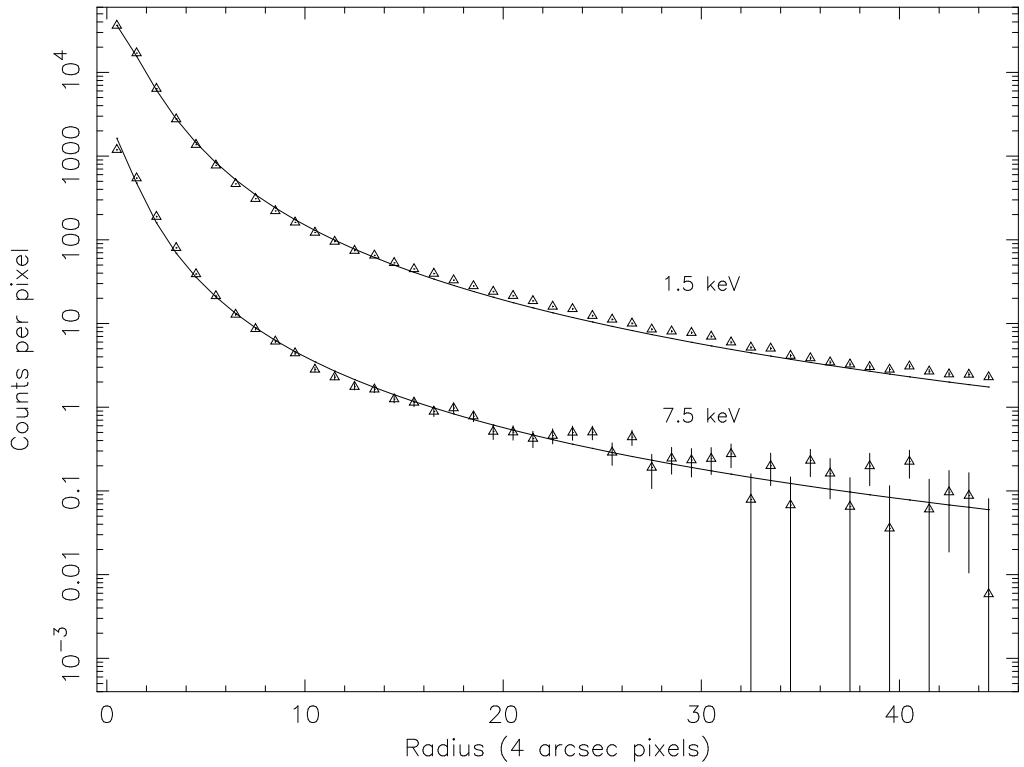

Figure 1: Comparison of the SAS PSF with a composite PN radial profile

```
index = 1.525 - 0.015 * energy - 0.012 * offax
                               - 0.0010  * energy * offax
```

where *energy* is the photon energy in keV and *offax* is the off-axis angle in arcminutes.

4 Estimated Scientific Quality

The PSF has been compared against a composite radial profile in Figure 1. This radial profile has been created for the PN camera by combining many bright sources observed on-axis. The core of the radial profile has been taken from long observations of non piled-up sources whereas the wings are taken from observations of very bright sources but at radii where pile-up ceases to be a problem.

It can be seen that the parameterised PSF is a good representation at both low and high photon energies out to three arcminutes.

5 Expected Updates

None are forseen.

6 Test procedures

The changes introduced here directly affect the encircled energy correction which is applied by the SAS task `arfgen`. The output of `arfgen` should be checked to ensure that this correction is as expected. Corrections should be measured for a number of energies, off-axis angles and circle radii.

7 Test results

The EEF correction at 1.5 keV for an on-axis PN source within a circle of radius 20 arcseconds is 72.1% which is as expected from an integration of the PSF. The correction at 12.1 keV at 10 arcminutes off-axis for a 40 arcsecond radius circle is 82.5% which is also as expected.

References

[1] S. Ghizzardi, "In-flight calibration of the on-axis and near off-axis PSF for the Mos-1 and Mos-2 cameras", EPIC-MCT-TN-011.

[2] C. Erd, P. Gondoin, D. Lumb, R. Much, U. Lammers, G. Vacanti and Richard Saxton. *Calibration Access and Data Handbook. XMM-PS-GM-20, issue 2.2.*