XMM-Newton CCF Release Note

XMM-CCF-REL-12

RGS Effective Area

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1 CCF components

Name of CCF	VALDATE	List of Blocks changed	CAL VERSION	XSCS flag
RGS1_QUANTUMEF_0006	1998-01-01T00:00:00	CCD_DESC, SI1, SI2, SI3, SI4, SI5, SI6, SI7, SI8, SI9, RGA_EFF, RGA_INTERCEPT, RGA_OBSCURATE	—	NO
RGS2_QUANTUMEF_0006	1998-01-01T00:00:00	CCD_DESC, SI1, SI2, SI3, SI4, SI5, SI6, SI7, SI8, SI9, RGA_EFF, RGA_INTERCEPT, RGA_OBSCURATE	—	NO

2 Changes

This is the initial version that is distributed to the public.

Description of contents:

`CCD_DESC` The thicknesses of all passive materials Al, MgF_2, Si-oxide and Al-oxide layers are stored. The numbers are taken from the component data sheets that were provided by the supplier.

The oxide layers are set $= 0$ for the time being and will be updated later, one there is better knowledge about the contamination levels.

`SI1--9` contain the thicknesses of the CCD's and list the respective values of the at the center of the CCD's. Additionally for CCD's 5–9 of both cameras, the thickness were also measured by an interferometer and are stored as relative variation from the center thickness.

`RGA_EFF` The reflectivity of the grating plates is stored based on electro-magnetic calculations of the interactions on the surface. This table is known as `new_efficiency_7-8_35.table` and is corrected for effects of large angle scattering. Starting point for these data are measurements taken at the BESSY synchrotron and at NEVIS labs. The instrumental setup at the synchrotron had a detector of limited angular size, and thus the measured reflections from the grating plates had to be corrected for scatter [1, 2, 3, 4].

`RGA_INTERCEPT` The interception is based on ray-tracing done by Columbia and is accurate to within a few percent.

`RGA_OBSCURATE` The obscuration was generated with SciSim 2.1a20000427, using the configuration files `telescope-1.cfg` & `telescope-2.cfg` that are part of the standard SciSim distribution.

The obscuration is only effecting EPIC MOS. The function is energy dependent with a dip of about 4% at 7 keV.

The table is estimated to be correct to a few percent. The data only contain the on-axis obscuration. This is used by the CAL function `CAL_getRGAObscure` [5] which scales the obscuration as a function of the dispersion axis component of the off-axis angle. No scaling is performed along the cross-dispersion direction, and the obscuration by the RGA is assumed constant as a function of cross-dispersion off-axis angle. The effect of this simplification is estimated to be $< 3\%$ (see also [6]).

3 Scientific Impact of this Update

First release.

4 Estimated Scientific Quality

The thicknesses of the CCD material layers are accurate to about 10%. The thickness of the CCD's was measured for CCD's 5,6,8,9 of both RGS to an accuracy of 140 nm (one interferometer fringe), and varies acoress the surface of the CCD's by about 10%. For the remainder of the CCD's an average thickness is implemented, which therefore is accurate to about 10%.

An open issue is the thicknesses of the oxide layers and users should be aware that these are not provided at this point in time.

A broad absorption feature at oxygen has been seen in the data, which is not yet understood (see Figure 1).

The differential changes of the quantum efficiency of the CCD's as a function of surface (XDET / YDET) could not yet be calibrated with X-rays, and therefore there is a residual uncertainty

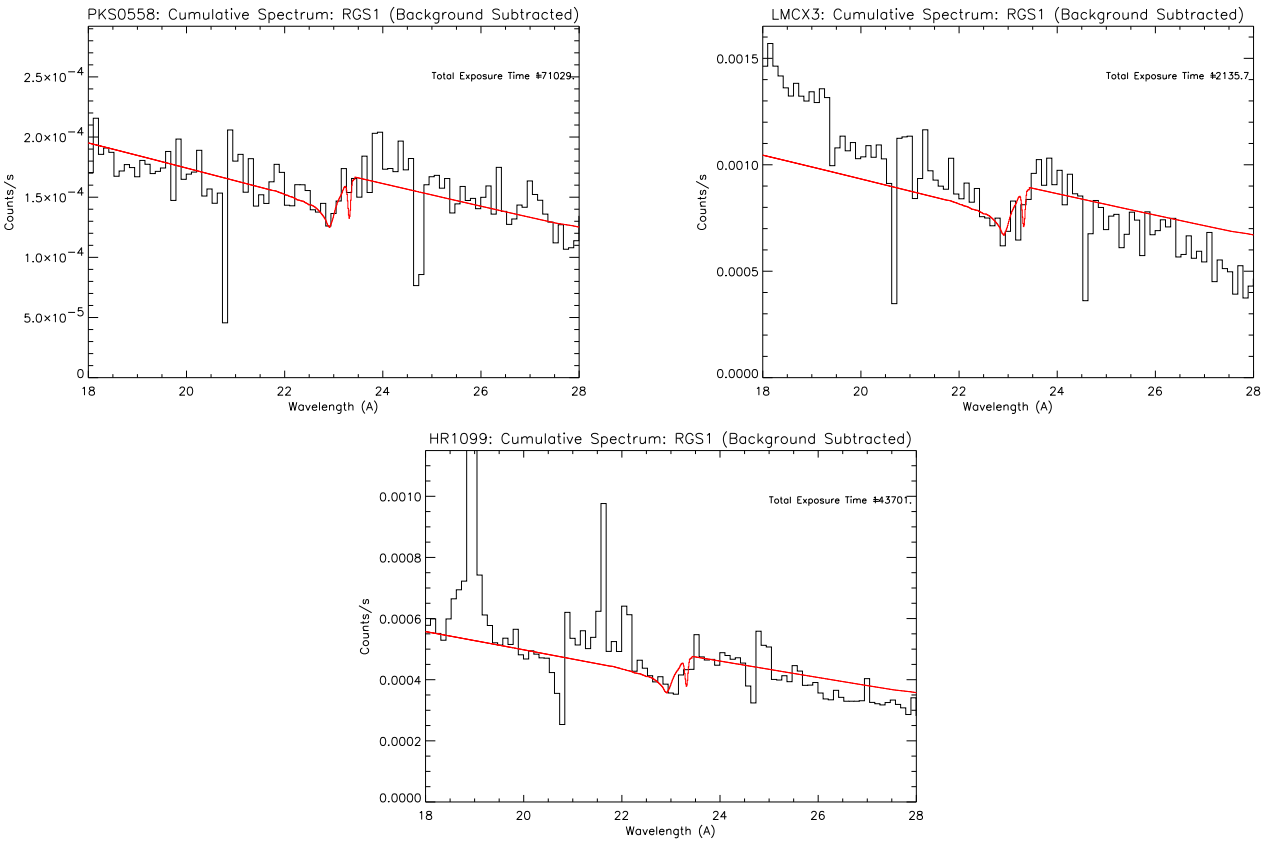

Figure 1: Evidence for Oxygen absorption edge in RGS [7]

of the effective area as a function of dispersion element which is estimated to be about 1%. The effect of this uncertainty, however, is small, as the counts in each bin of the dispersion spectrum are averaged over several CCD elements in the cross-dispersion direction.

There were some indications noted during the calibrations that the quantum efficiency of CCD2 of RGS2 is overestimated by the CCF's. This is currently under investigations.

The results from comparisons of the effective area with EPIC and with the Chandra spectrometers are not yet available. From comparisons with ground calibrations it is expected that the effective area is accurate at about 10%. Larger uncertainties (estimated at about 20%) are expected for wavelengths < 7 Å.

4.1 Effects on the Effective Area of MOS1 & MOS2

The simplification of the azimuthal variation of the obscuration by the RGA may result in overestimates of the effective area of the MOS cameras at energies > 10 keV. This overestimate is gradually increasing with increasing energy up to 20%.

References

[1] Jean Cottam. *Final Model of the RGS Grating Efficiency.* RGS-COL-CAL-99005, Columbia University, May 1999. http://xmm.astro.columbia.edu/cal_files/cal99005.ps.

[2] Jean Cottam. *New Model of the RGS Grating Efficiency.* RGS-COL-CAL-98023, Columbia University, 1998. http://xmm.astro.columbia.edu/cal_files/cal98023.ps.

[3] Jean Cottam. *How to Use the RAW-EFFICIENCY.TABLE file.* RGS-COL-CAL-97003, Columbia University, 1997. http://xmm.astro.columbia.edu/cal_files/cal97003.ps.

[4] Jean Cottam. *Preliminary Model of the RGS Grating Efficiency.* RGS-COL-CAL-97001, Columbia University, 1997. http://xmm.astro.columbia.edu/cal_files/cal97001.ps.

[5] Christian Erd, Phillipe Gondoin, David Lumb, Rudi Much, Uwe Lammers, and Giuseppe Vacanti. *Calibration Access and Data Handbook.* XMM-PS-GM-20, issue 1.0, ESA/SSD, September 2000.

[6] Christian Erd. *Transmission of the RGA — A Simulation with SciSim.* XMM-PS-TN-38, ESA/SSD, August 2000. http://xmm.vilspa.esa.es/calibrations/docs/rgs/RGA_transmission.ps.gz.

[7] Jean Cottam. *An Instrumental Oxygen Edge on RGS.* RGS-COL-CAL-00006, Columbia University, March 2000. http://xmm.astro.columbia.edu/cal_files/cal00006.ps.