XMM-Newton CCF Release Note

XMM-CCF-REL-395

Update of the correction to the RGS Effective Area

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April 5, 2023

1 CCF components

Name of CCF	VALDATE	List of Blocks changed	XSCS flag
RGS1_EFFAREACORR_0015	2000-01-01T00:00:00	AREACORR_1	NO
		AREACORR_2	NO
RGS2_EFFAREACORR_0015	2000-01-01T00:00:00	AREACORR_1	NO
		AREACORR_2	NO

2 Changes

The time and wavelength dependent correction to the RGS effective area was first implemented at the beginning of 2017. It has been updated twice, first to allow extrapolation of the correction after revolution 2816 (April 2015), see González-Riestra (2017), and later to add data until revolution 3516 (February 2019) and improve further the algorithm (Kaastra et al. 2018, González-Riestra, 2019).

This third update includes data taken until end 2022, that is then the formal end of the validity period. No extrapolation is done beyond that date.

3 Scientific Impact of this Update

The RGS effective area correction was first derived based on results of the work by Kaastra et al. (2015). These authors have used a large sample of observations of bright blazars taken from the beginning of the mission until October 2014. Each spectrum was fitted to an absorbed broken power-law, and the residuals (in bins of 0.05 Å) as a function of time were fitted according to the expression given in Kaastra et al. (2015) and González-Riestra (2016).

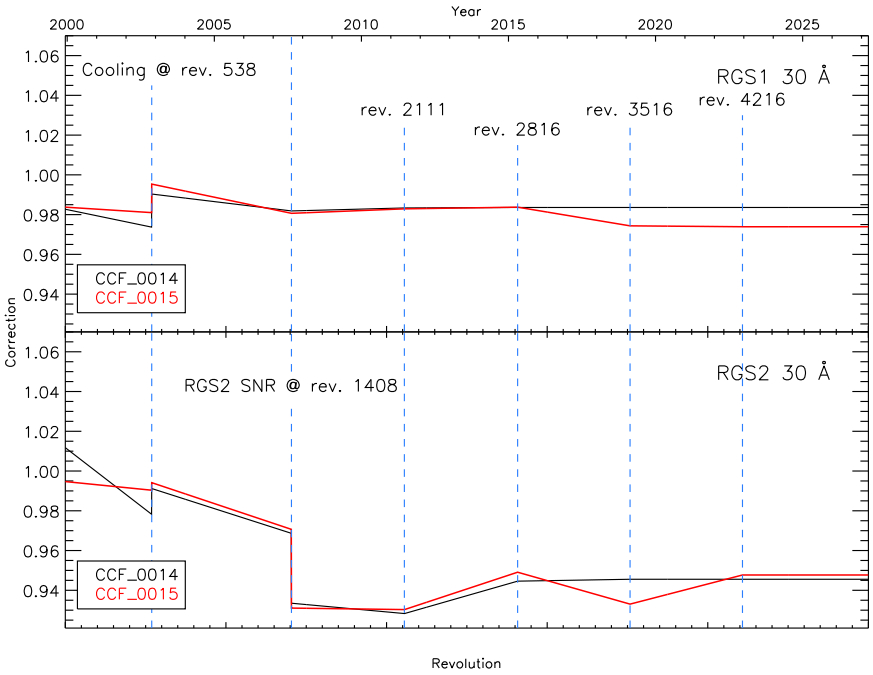

Figure 1: Example of the parametrisation used for the fit to the residuals. The figure shows the average correction in a 1 Å wide band around 30 Å for RGS1 and RGS2, first order. The black line represents the previous correction, and the red line the new one.

In this update, the parameters have been derived for six different time intervals: before revolution 538 (instrument cooling), between revolutions 538 and 1408 (change to RGS2 Single-Node-Readout mode), between revolutions 1408 and 2112, between revolutions 2112 and 2816, between revolution 2816 and 3516, and between revolutions 3516 and 4216 No extrapolation is made beyond the last date. Instead, the values corresponding to rev. 4216 are used for later dates. Figure 1 shows the different epoch defined for the parametrisation of the correction.

4 Estimated Scientific Quality

With this new calibration files, the effective area correction is formally valid until end 2022. Beyond that date, the values are kept constant. The correction at five different epochs is shown in Figure 2.

5 Caveat

The ISM absorption model used in the fit to the BL Lac spectra is the same as in 2019, i.e. cold neutral gas plus dust. This choice is particularly important for the Oxygen edge region.

This model has been updated recently to include additional charge exchange processes for the ionisation balance, and produces roughly 50% O I and 50% O II at T=0.5 meV. Therefore, instead

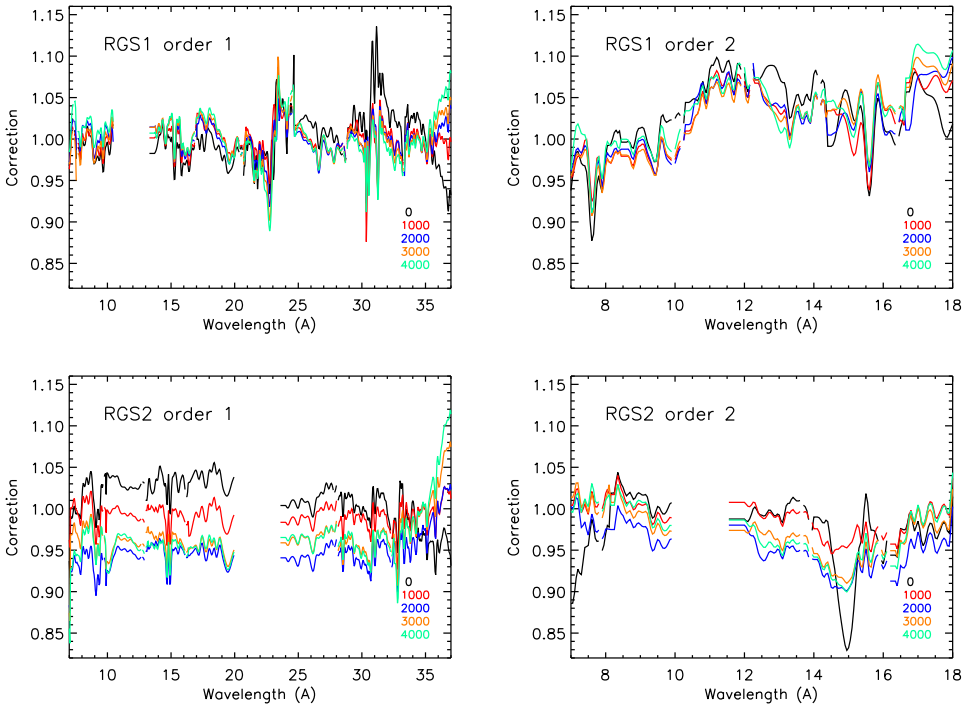

Figure 2: Corrections for both RGS and orders at different revolutions, as labelled in the figure.

of only the O I line at 23.5 Å there are now two absorption lines in the model, O I at 23.5 Å and O II at 23.3 Å. The presence of these two lines is likely the reason for a feature at 23.4 Å in the fits to the parameters of RGS1 CCD4. This needs more investigation. Users should be warned that the correction in the 23.3 to 23.5 Å region may have some uncertainties (Kaastra, private communication).

6 Test procedures & results

The new CCFs have been fully tested in SASv20.

- The fits viewer `fv` has been used to inspect the new CCFs, their structure, validity dates and contents
- The SAS task `cifbuild` has been run to confirm that the right CCFs version is selected.

7 Expected Updates

This is the third update of this correction. The time evolution of the effective area should be closely monitored, and new records will be added (or the existing ones modified) to cope with potential

changes.

Other potential improvement to be implemented in future versions of the correction is the update of the ISM model, in particular in the regions of the Oxygen and Nitrogen edges.

8 References

[1] "Effective area calibration of the RGS", J. Kaastra, C. de Vries, J.W. den Herder, SRON-RGS Internal Report, August 2015.

[2] "Correction to the RGS Effective Area", R. González-Riestra, XMM-CCF-REL-340, December 2016.

[3] "Extrapolation of the correction to the RGS Effective Area", R. González-Riestra, XMM-CCF-REL-349, June 2017.

[4] "Effective area calibration of the RGS", J. Kaastra, C. de Vries, J.W. den Herder, XMM-SOC-CAL-TN-0219, June 2018.

[5] "Update of the correction to the RGS Effective Area", R. González-Riestra, XMM-CCF-REL-371, June 2019.