XMM-Newton CCF Release Note

XMM-CCF-REL-314

The RGS effective area: update of the contamination correction

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1 CCF components

Name of CCF	VALDATE	List of Blocks changed	XSCS flag
RGS1_EFFAREACORR_0009	2001-01-01T00:00:00	EFFAREACORR	NO
RGS2_EFFAREACORR_0009	2001-01-01T00:00:00	EFFAREACORR	NO

2 Changes

A correction to the RGS effective area for contamination on the detectors was first implemented in SAS in 2007 [1]. Observations of sources assumed to be constant (the neutron star RX J1856-3754 and the Vela Pulsar) showed a steady decrease in flux that could be explained by the accumulation of a carbon layer on the detectors, whose thickness was increasing linearly with time.

Subsequent observations showed that the flux of these two sources started to increase. This pointed to an over-estimation of the correction, indicating that the thickness of the contamination layer was growing at a slower rate than at the beginning of the mission.

The contamination model was changed to an exponential law, with the thickness of the layer parametrised as:

$$\texttt{Thickness (nm) = slope} \times \texttt{T}_{\rm decay} \times \texttt{(1-e}^{\frac{-t}{T_{\rm decay}}}\texttt{)}$$

with $\texttt{t}$ in revolutions, $\texttt{slope}$ = 0.210 and $\texttt{T}_{\rm decay}$ = 1050 revolutions [2].

The purpose of these new CCFs is twofold:

- To update the contamination model with a refined value of $\texttt{T}_{\rm decay}$, 1090 revolutions, as derived

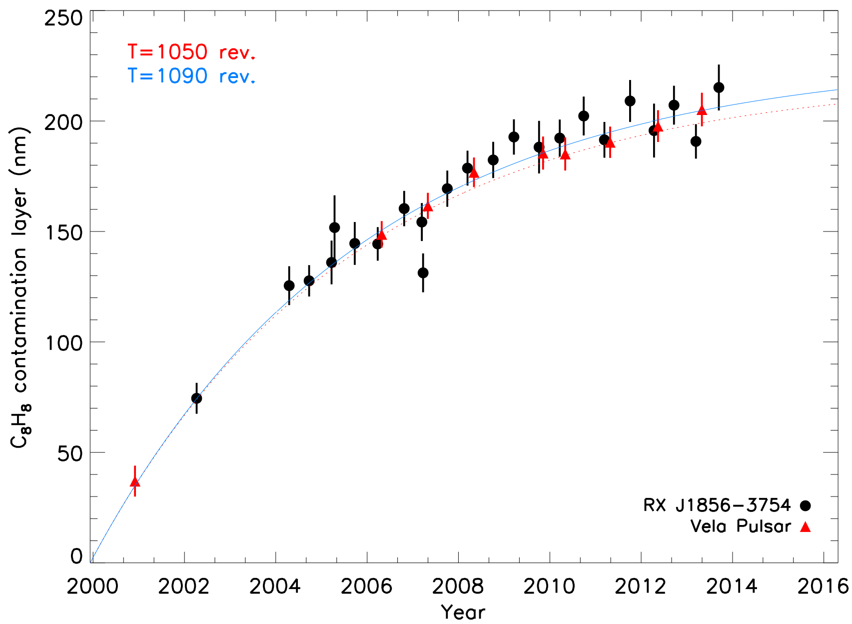

Figure 1: Evolution of the thickness of the carbon layer. Points derived from observations of the neutron star RX J1856-3754 are shown as black circles, and those derived from observations of the Vela Pulsar, as red triangles. The red-dotted line is the model used in previous CCFs (with a decay time of 1050 revolutions). The blue line shows the updated model, with a decay time of 1090 revolutions. Data have been kindly provided by C. de Vries

from all data available until 2014 (See Fig.1).

- To extend the extrapolation of the correction until 2030 (while the previous CCFs covered only until March 2014).

3 Scientific Impact of this Update

These CCFs were derived using a new parametrisation of the contamination model. They are applicable to all epochs since the beginning of the mission. It is then important to quantify the difference between this correction and the previous one in order to decide if a given observations need to be re-calibrated.

Fig. 2 shows the ratio between old and new correction factors as a function of wavelength and time.

- The difference in the correction never exceeds 2%.
- Below 27 Å, the difference never exceeds 1%, and above this wavelength, it is larger than 1% only for data taken after mid-2006.

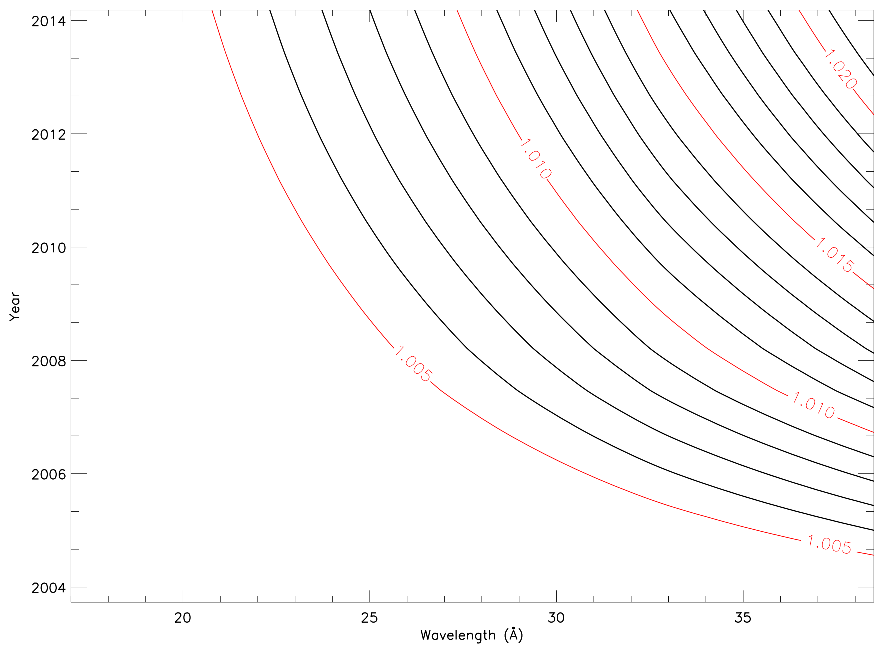

Figure 2: Ratio between new and previous contamination corrections, as a function of wavelength and epoch. For wavelengths shortward 27 Å, the difference in flux using either of the corrections is less than 1%. For longer wavelengths, it is above 1% only for observations taken after mid 2006.

- Below 32 Å, the difference never exceeds 1.5%, and above this wavelength, it is larger than 1.5% only for data taken after 2009.
- Only for wavelengths above 36 Å and for observations taken after 2012, the change in flux would be larger than 2%.

4 Estimated Scientific Quality

The implementation of the updated contamination model will led to a more accurate correction of the RGS effective area, as recent data were starting to diverge from the assumed model.

5 Test procedures & results

The new CCFs have been fully tested in SASv13.5. Effective areas and fluxed spectra have been generated for all the available observations of RX J1856-3754. Comparison with the results obtained with the previous version of the CCFs shows the expected differences, in total agreement with the difference in the contamination models.

6 Expected Updates

The Vela Pulsar and the neutron star RX J1856-3754 are regularly observed (one and two times per year, respectively). The depth of the contamination layer is derived from these observations, and compared to the current contamination model. If a significant different is found, the model will be refined and implemented in new CCFs. So far, there is no evidence for differences in the contamination rates of both RGSs. Should both instruments start to behave differently, independent contamination models would be used.

7 References

[1] "An improved model of the RGS effective area based on the build-up of Carbon contamination", A. Pollock, XMM-CCF-REL-238, August 2007
(http://xmm2.esac.esa.int/docs/documents/CAL-SRN-0238-1-0.ps.gz)

[2] "The RGS effective area incorporating exponential contamination and a mechanism for rectification", A. Pollock, XMM-CCF-REL-262, April 2010
(http://xmm2.esac.esa.int/docs/documents/CAL-SRN-0262-1-1.ps.gz)