XMM-Newton CCF Release Note

XMM-CCF-REL-262

The RGS effective area incorporating exponential contamination and a mechanism for rectification

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1 CCF components

Name of CCF	VALDATE	List of Blocks changed	XSCS flag
RGS1_EFFAREACORR_0006	2001-01-01T00:00:00	EFFAREACORR	NO
		RECTIFICATION	NO
RGS2_EFFAREACORR_0006	2001-01-01T00:00:00	EFFAREACORR	NO
		RECTIFICATION	NO

2 Changes

Epoch-dependent empirical RGS effective area corrections were introduced in 2006 based on a set of observations of Mkn421, whose spectrum was assumed to be a simple power-law subject to constant galactic absorption. A year later, it was shown that the time-variable component of the effective area could be modelled by a linearly increasing layer of carbon contamination. Through regular 6-monthly monitoring of RXJ1856-3754 and the Vela Pulsar Wind Nebula, it has become clear that the build-up of contamination is now slower than the linear model. As shown in Fig. 1, an exponential model gives a good fit. This has been combined with the previous constant polynomial correction to provide a new epoch-dependent correction. The finer temporal resolution requires SAS v10.

SAS v10 also contain new methods to exploit a further correction in the so-called RECTIFICATION extension constructed identically to the EFFAREACORR extension. In this initial release, the tables are filled with unit values.

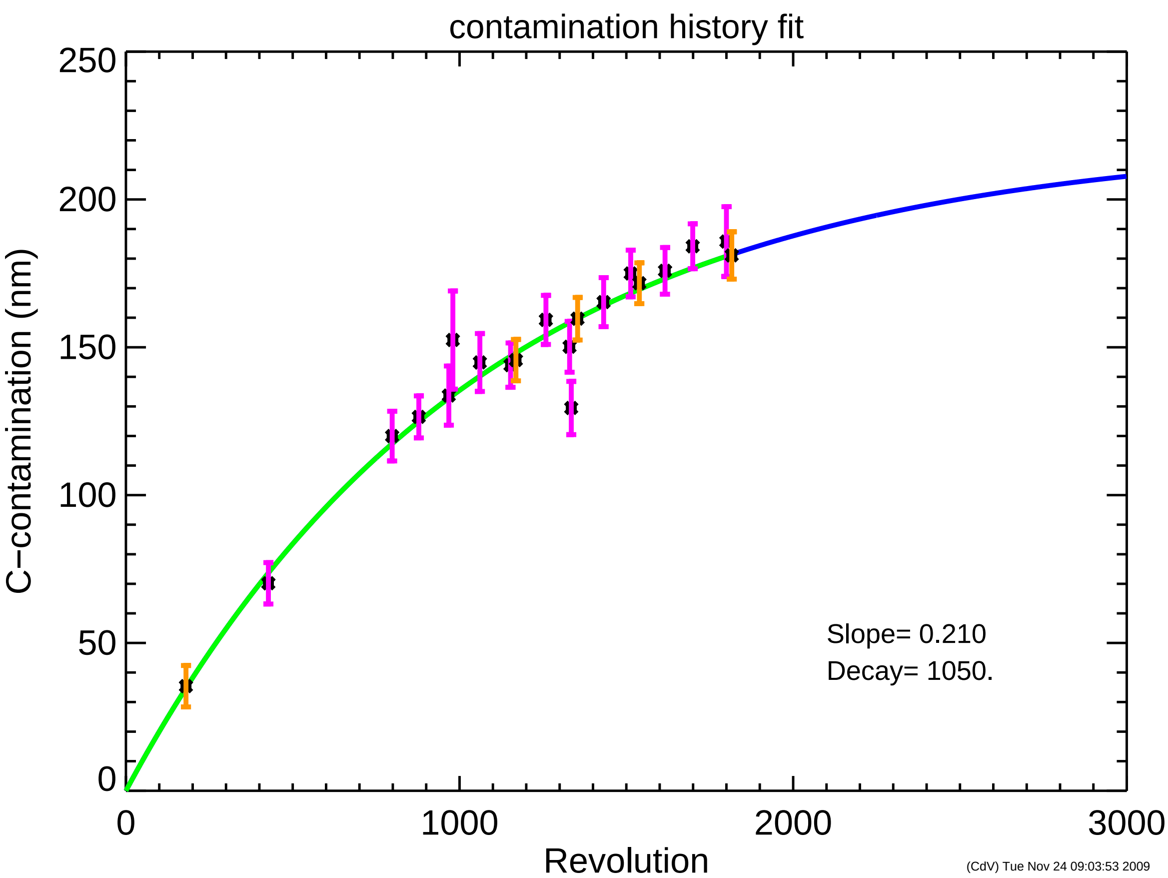

Figure 1: The thickness of the layer of carbon contamination implied by differences in the RGS fluxed spectra of the neutron star RXJ1856-3754 (pink) and the Vela Pulsar Wind Nebula (orange), both of which are effectively constant. An exponential fit now accounts for the time-variable part of the model of the RGS effective area. Extrapolation into the future is shown by the blue line.

3 Scientific Impact of this Update

This release should contribute to continuing efforts to reconcile the RGS and EPIC instruments.

4 Estimated Scientific Quality

This CCF allows broadband fluxes to be measured at the few percent level and provides a more reliable extrapolation into the future of the evolution of the RGS effective area.

5 Test procedures & results

During their construction, many RGS RMFs have been calculated with the new CCFs including their application to the 13 observations in the XCal archive of RXJ1856-3754 throughout the mission shown in Fig. 2. The normalisation of the first order spectra of RGS1 and RGS2 is shown for the following `XSPEC` model fit jointly to all the first order RGS data only, with the following best-fit parameters with their formal errors.

`TBabs nH` $= 6.1 \times 10^{18}$ cm^{-2} fixed
`bbody kT` $= 61.67 \pm 0.12$ eV
`bbody norm` $= 3.190 \times 10^{-4}$
`C-statistic` $= 73900.8$ for 69885 PHA bins

The contamination history shown in Fig 1 is only sensitive to differences in the detected spectra of RXJ1856-3754 and the Vela PWN. The good agreement between the RGS black-body temperature and the corresponding independent values of EPIC and *Chandra* demonstrates the reliability of the overall effective area model for which the polynomial correction is particularly important in a spectrum as soft as this.

6 Expected Updates

Updates are expected on an annual basis as the evolution of the RGS contamination is monitored. A decision regarding use of the RECTIFICATION extension is expected following the XMM Users Group meeting next month.

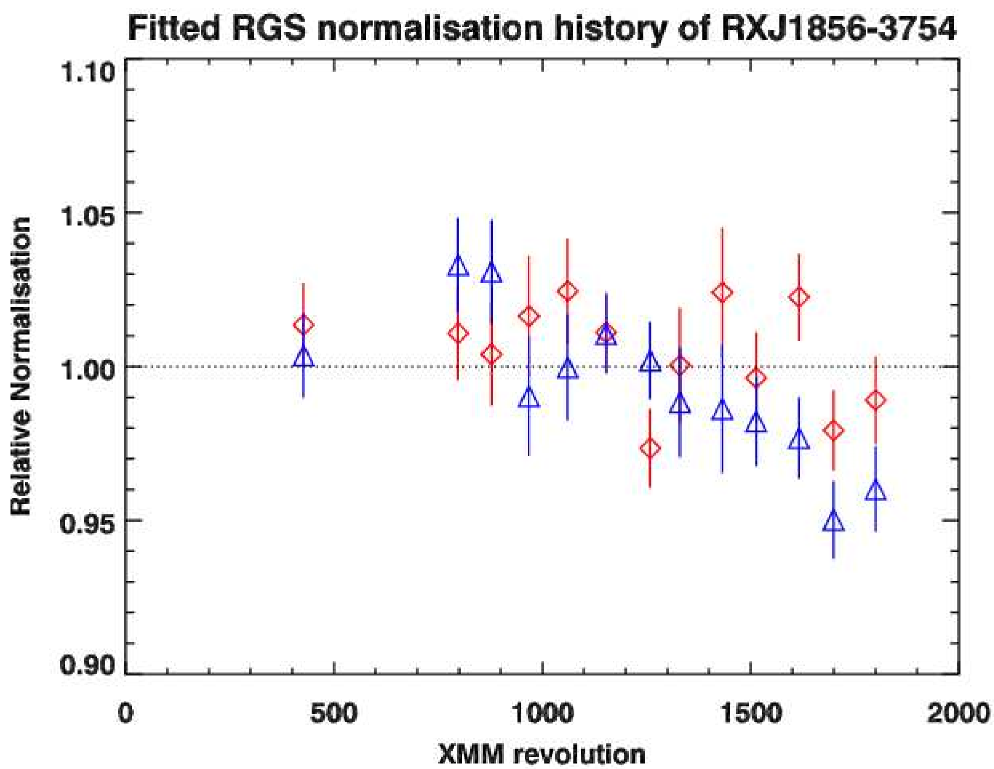

Figure 2: The relative normalisation of RXJ1856-3754 RGS1 (red) and RGS2 (blue) 1st order spectra throughout the mission with the exponential RGS calibration model..