XMM

XMM-Newton SAS scientific validation - add for SAS V5.2

XMM-SOC-USR-TN-0007 Issue 1.0

C.Gabriel[1], C.Erd[2], M.Guainazzi[1], M.Denby[3], J.Osborne[3]

November 8, 2001

1) XMM-Newton Science Operation Center, VILSPA, ESA, Apartado 50727, E-28080 Madrid, Spain

2) XMM-Newton Science Operation Center, ESTEC, ESA, 2200AG Noordwijk, Netherlands

3) XMM-Newton Science Survey Center, Department of Physics & Astronomy, University of Leicester, Leicester LE1 7RH, UK

Contents

1 Introduction

SAS V5.2 was released publicly on September 20, 2001. Detailed release notes pointing to all the differences to V5.1 are given in the SAS documentation page (http://xmm.vilspa.esa.es/sas/documentation/releasenotes/xmmsas_5.2.0.shtml). The main aims of the new release were:

- ability to process PN data in extended Full Frame mode,
- backward compatibility of RGS processing, so that "old" event files produced with former SAS versions than V5.1 could be used as entry point,
- fixing of the problems related to the RGS response matrix generation, affecting largely RGS data above 1 keV.

This document addresses the checks done previously to the public release of SAS V5.2. For all the items not covered by the present document, the reader is referred to Gabriel et al. 2001.

2 Input data

Several datasets with PN data (under proprietary rights) in extended Full Frame mode have been processed through the pipeline and found OK by data screening.

In addition, Mkn421 RGS data processed with pipeline SAS V5.0 were taken for interactive analysis to prove the backward compatibility of SAS V5.2.

Mkn421 RGS data processed with pipeline V5.1 were taken for checking the response matrix generation. Since this happens outside the pipeline processing it was not necessary to re-process the raw data with SAS V5.2.

3 Backward compatibility

The results using the recipe provided in the watchout pages of the SAS documentation http://xmm.vilspa.esa.es/sas/documentation/watchout/rgs_backwards.shtml were completely satisfactory.

The basic steps are to convert all the event lists using a new task "rgsevconvert", to convert all the source lists using the task "rgssources", to delete ("dsrm") and regenerate the background region extension using "rgsregions" and finally to run "rgsspectrum" on the corresponding source in the source list for extracting spectra for the orders desired.

A comparison of the results achieved using converted SAS V5.0 data and SAS V5.1 produced data of the same Mkn421 observation showed remarkable differences in the response matrices. This was expected due to slightly different data selections as a consequence of new calibration information in the pipeline processing. However, the final spectra were almost identical, both for first and second order of RGS1 and RGS2 data, proving the backward compatibility.

4 RGS response matrix generation checks

As a first test, we have checked the new version of the rgsrmfgen task against carefully constructed and checked reference matrices. These were derived with a development SAS version based on SAS V5.0. The overlap of these and the interactively derived response matrices running rgsrmfgen on a different data set was very good for both RGSs in first and second order, as shown in Figs.**??** and 2.

The Mkn421 data reduced with the pipeline corresponding to SAS V5.1 were re-analyzed with XSPEC using response matrices derived with SAS V5.2. The results of fitting simultaneously RGS1 and RGS2 data with a broken power law model leaving normalisation free between both are shown in Fig.3. In the best fit a 10% larger normalisation factor for RGS1 data is forced by the data corresponding to the low energy end. This is reflected in the large discrepancies seen in the high energy part of the spectrum. This is consistent with findings of the RGS instrument team. To solve the RGS1-RGS2 differences a phenomenologically β dependent correction to the RGS1 data has been proposed, ranging from 1.00 at the high energy end of the spectrum to 1.25 at the lower end, which should compensate for the observed lower efficiency. This correction is expected to be part of the improvements in the SAS V5.3 version.

In the detailed comparison of the low energy part of the spectrum we see that there is no discontinuity in RGS2 data between $E = 0.37keV$ and $E = 0.44keV$. This discontinuity, shown in the SAS V5.1 validation report (Gabriel et al. 2001) was due actually to the use of a wrong calibration file. The calibration defect behind this artifact (as seen and reported in the validation of SAS V5.0, Ehle et al. 2001) could be understood as an additional SiO layer on CCD2 of RGS2 and actually fixed previously to the SAS V5.1 release.

Another defect clearly seen in the plotted data is the instrumental O-edge at 0.55 keV. This has been by now calibrated in detail by the RGS instrument team and it is also expected to be fixed in the SAS V5.3.

References

Ehle et al (2001), XMM-SOC-USR-TN-0003, available at
`ftp://xmm.vilspa.esa.es/pub/odf/data/sv/0099280101/0099280101_report.pdf.gz`

Gabriel et al (2001), XMM-SOC-USR-TN-0004, available at
`ftp://xmm.vilspa.esa.es/pub/odf/data/sv2/SAS51_report.ps.gz`

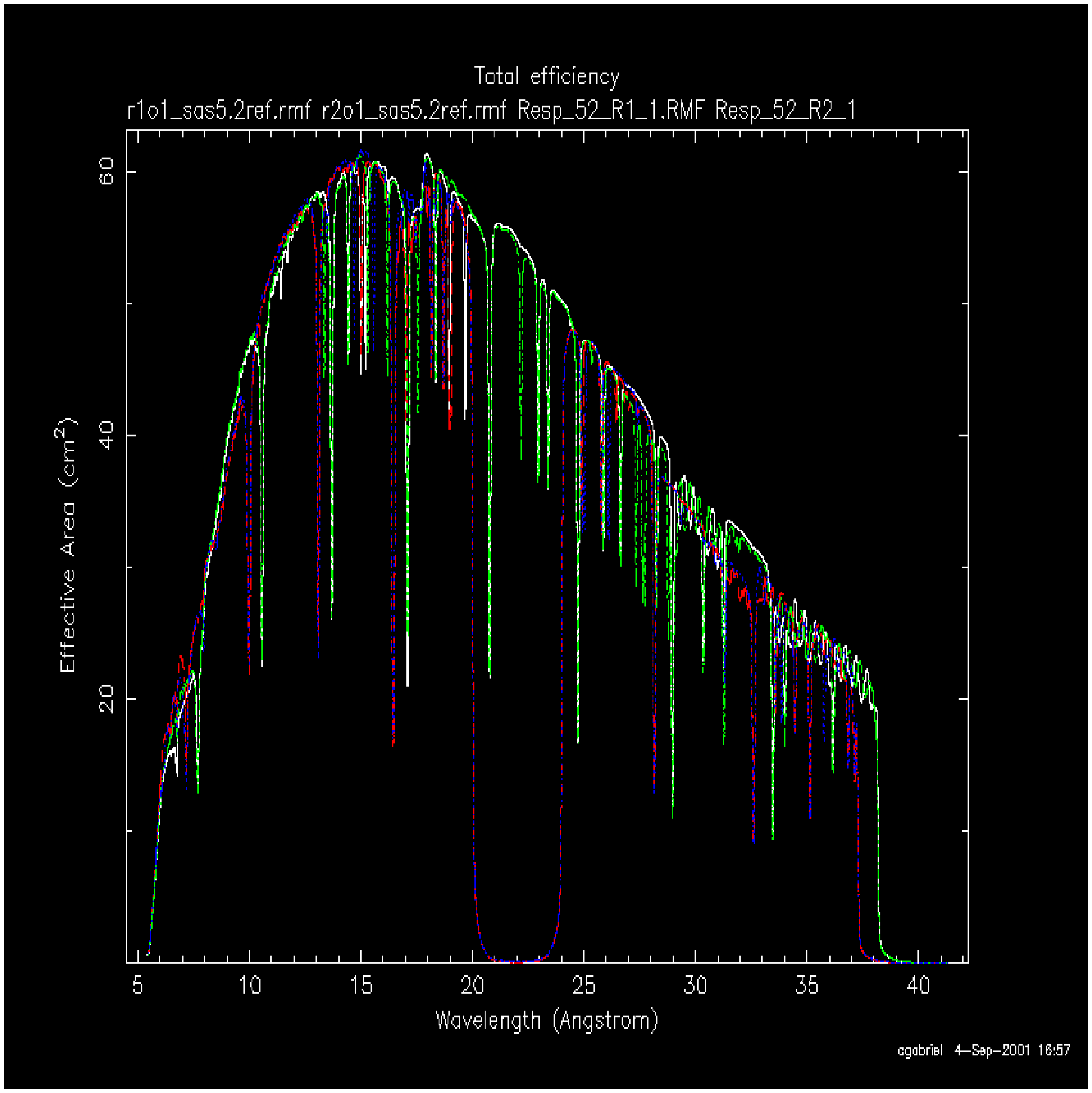


Figure 1: Comparison of reference and interactively derived 1st order spectral responses. In white and red the RGS1 and RGS2 reference efficiencies, in green and blue the corresponding distributions derived from the Mrk 421 data set

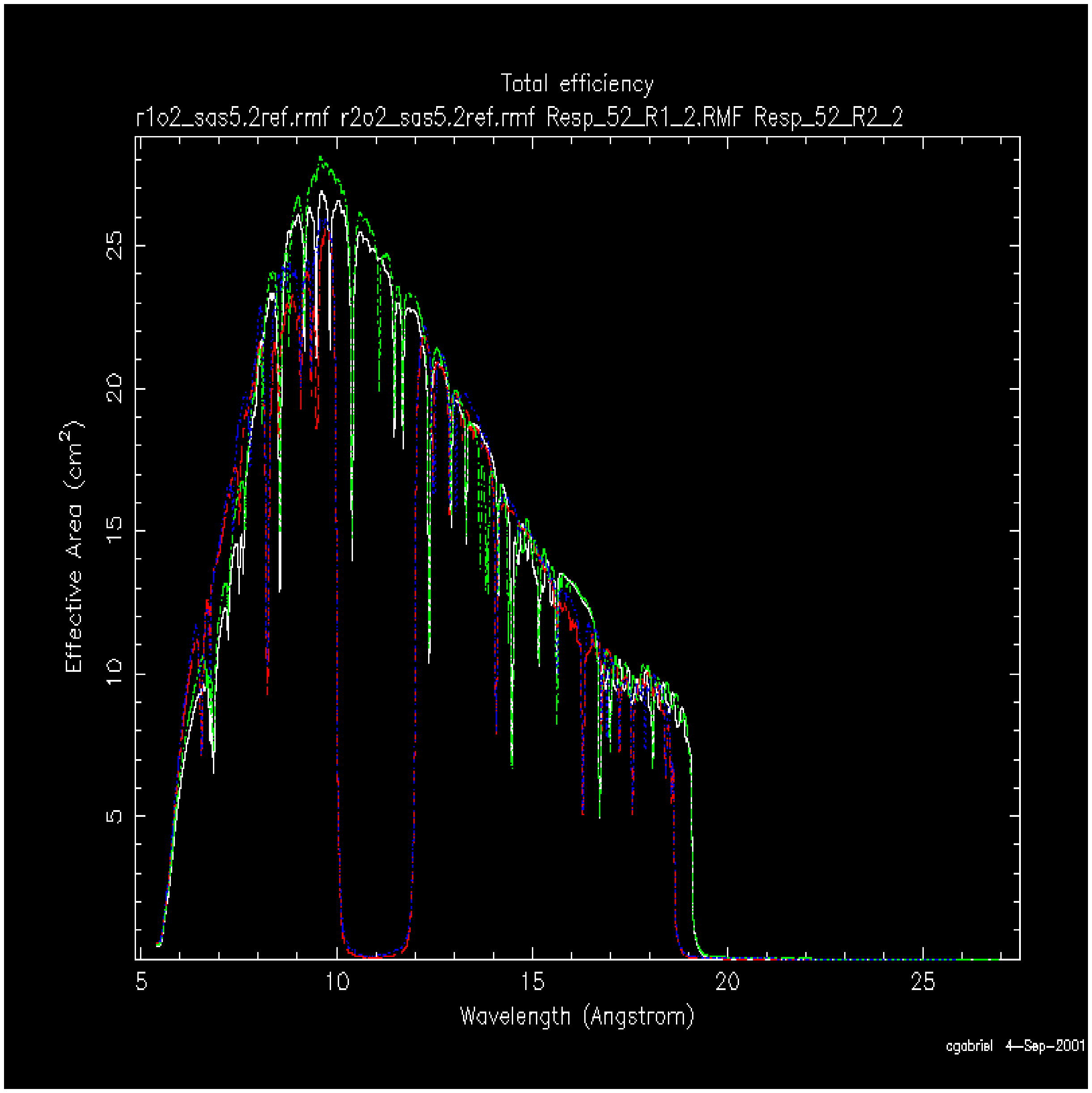
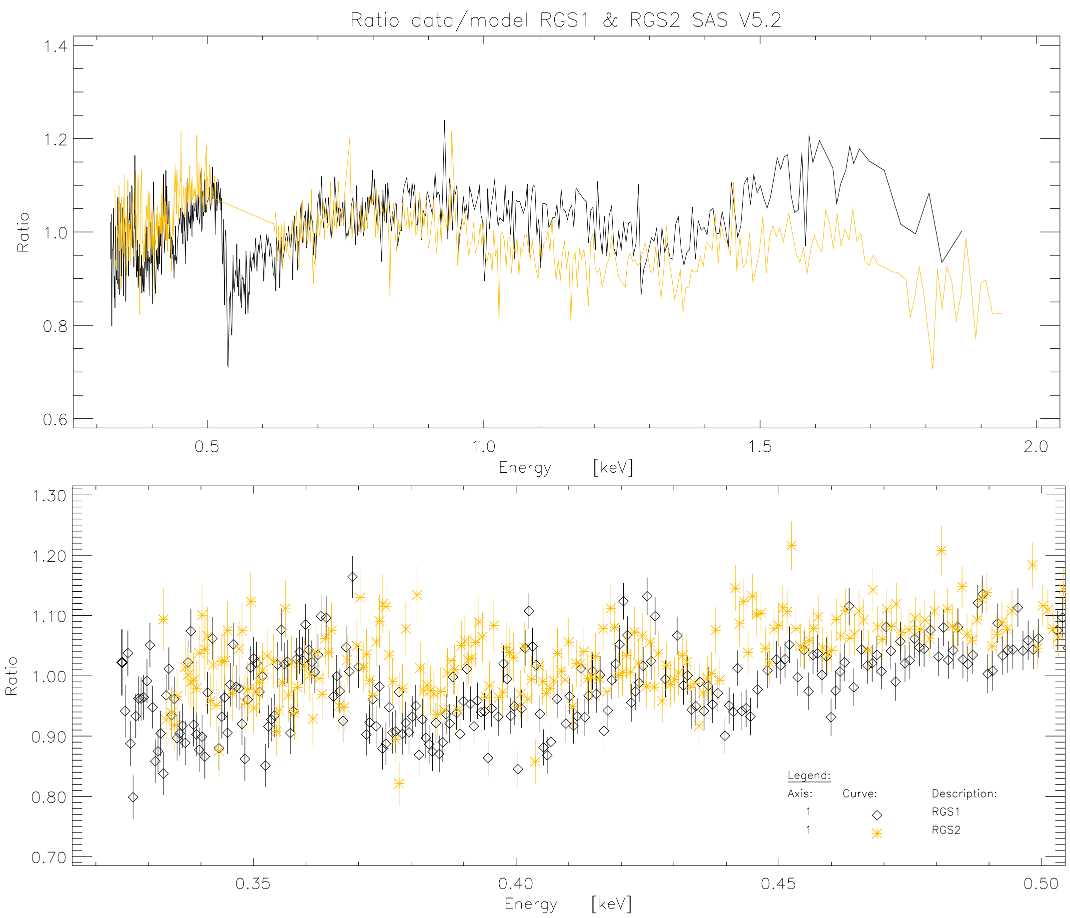


Figure 2: Comparison of reference and interactively derived 2nd order spectral responses. In white and red the RGS1 and RGS2 reference efficiencies, in green and blue the corresponding distributions derived from the Mrk 421 data set



.

Figure 3: Mrk 421: RGS1 and RGS2 data / model ratio from simultaneous fitting, covering the whole 1st order spectra (above) and the low energy part zoomed in (below)