XMM-Newton CCF Release Note

XMM-CCF-REL-171

RGS Instrumental Flourine Absorption

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1 CCF components

Name of CCF	VALDATE	List of Blocks changed	XSCS flag
RGS1_EXAFS_0004	1999-01-01T00:00:00	MgF2-P-CCD1 MgF2-P-CCD2 MgF2-P-CCD3 MgF2-P-CCD4 MgF2-P-CCD5 MgF2-P-CCD6 MgF2-P-CCD7 MgF2-P-CCD8 MgF2-P-CCD9	NO
RGS2_EXAFS_0004	1999-01-01T00:00:00	MgF2-P-CCD1 MgF2-P-CCD2 MgF2-P-CCD3 MgF2-P-CCD4 MgF2-P-CCD5 MgF2-P-CCD6 MgF2-P-CCD7 MgF2-P-CCD8 MgF2-P-CCD9	NO

2 Changes

When statistics are high enough, RGS spectra show a weak but definite instrumental absorbtion feature near 17.9Å due to MgF_2 in the CCDs. Data have been incorporated in the instrument model in order to prevent the feature from being mistaken as of cosmic origin. The RGS EXAFS CCFs have been modified accordingly.

In general, elemental X-ray absorptions are stored in the XMM_ABSCOEF CCF that contains the Henke scattering factors tabulated on a fixed energy grid. In the CAL these data are accessed when computing the transmission probabilities which enter the formula for the RGS quantum efficiencies as described in the CAL Handbook. It later became clear that certain RGS edge absorption features could not be modelled accurately enough using the Henke data so the EXAFS structures were introduced to improve the Henke data where necessary. The EXAFS do not contain the scattering factors but the mean absorption lengths in cm tabulated against energy in eV. For this MgF_2 layer, the tabulation is the same for all CCDs and covers the range $652.8 \leq E(eV) \leq 729.2$ in 206 steps of 0.4eV.

The SAS recognizes materials in the EXAFS table names that match the naming scheme

```
CompoundName-[P|A]-CCD[1-9]
```

where CompoundName is one of the following hardcoded composite material names :

```
char *absMaterial[] = { "MgF2", "Al", "Al2O3", "SiO2", "Si", "H2O", "Si" };
bool  passive[]     = { true,   true, true,    true,   true, true, false };
```

These names appear as part of the case-senstive extension names so, for example, "MgF2-P-CCD1" is needed to define the EXAFS data for Fluorine in the passive MgF_2 layer on CCD1. "P" stands for "Passive" as opposed to "A" for "Active". These details also need to be added to the CAL Handbook.

3 Scientific Impact of this Update

Little or no risk of confusing an instrumental feature with absorption in the intergalactic medium, for example.

4 Estimated Scientific Quality

Systematic flux uncertainties near the Flourine edge reduced to the few percent level that applies through most of the RGS waveband.

5 Test procedures & results

The equivalent width of the instrumental Fluorine feature is quite low and thus not easy to see in single observations of even strong sources. For example, Fig. 1 shows RGS 1st-order spectra of

Mkn421 during one of its brighter episodes along with power-law models made with and without the deeper feature in the new CCF. In RGS2, the feature is nearly masked by noise. Several detector defects are also visible.

Greater detail can be seen in Fig. 2 which shows a similar comparison of `rgsfluxer` fluxed spectra calculated with old and new CCFs for all Mkn421 data except those obtained during the cooling campaign in November 2002. The new CCFs successfully remove the instrumental absorption feature.

6 Expected Updates

None expected.

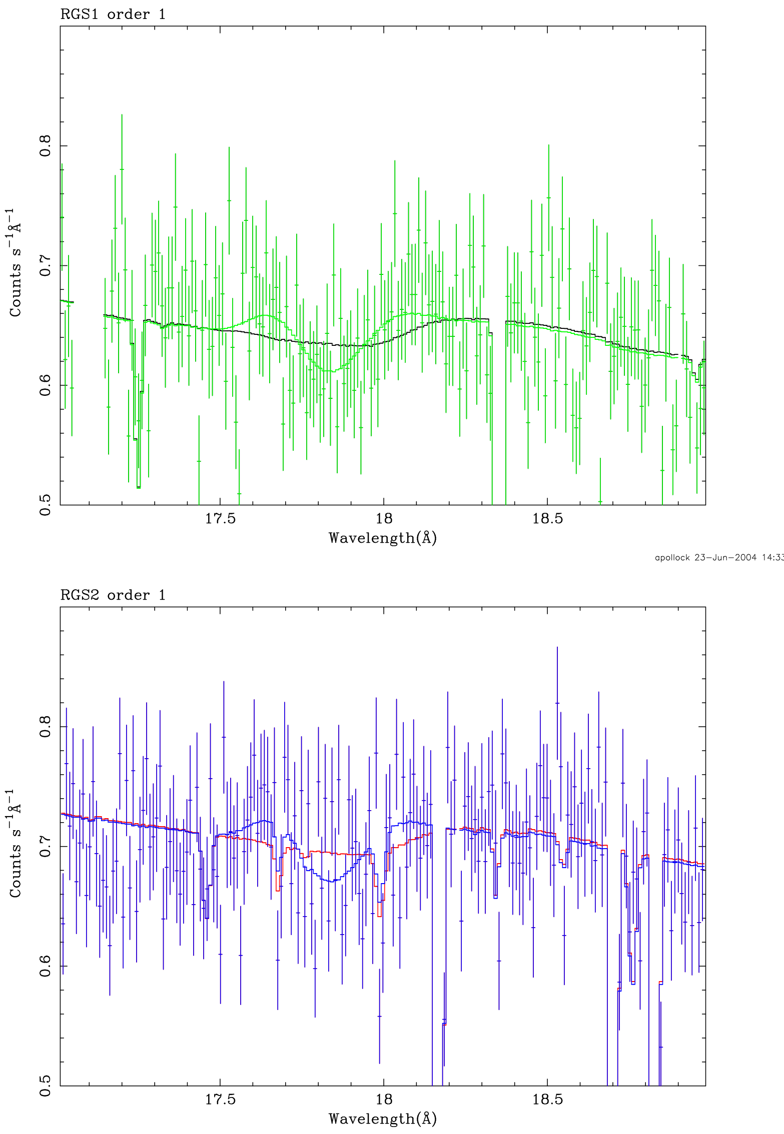

Figure 1: Details of models of RGS first-order spectra of Mkn421 in 0259_0136540101. Identical RGS1 and RGS2 data were analysed with response matrices with and without improved instrumental absorption by MgF_2 provided by the new RGS_EXAFS CCFs. Several features due to bad pixels have not changed.

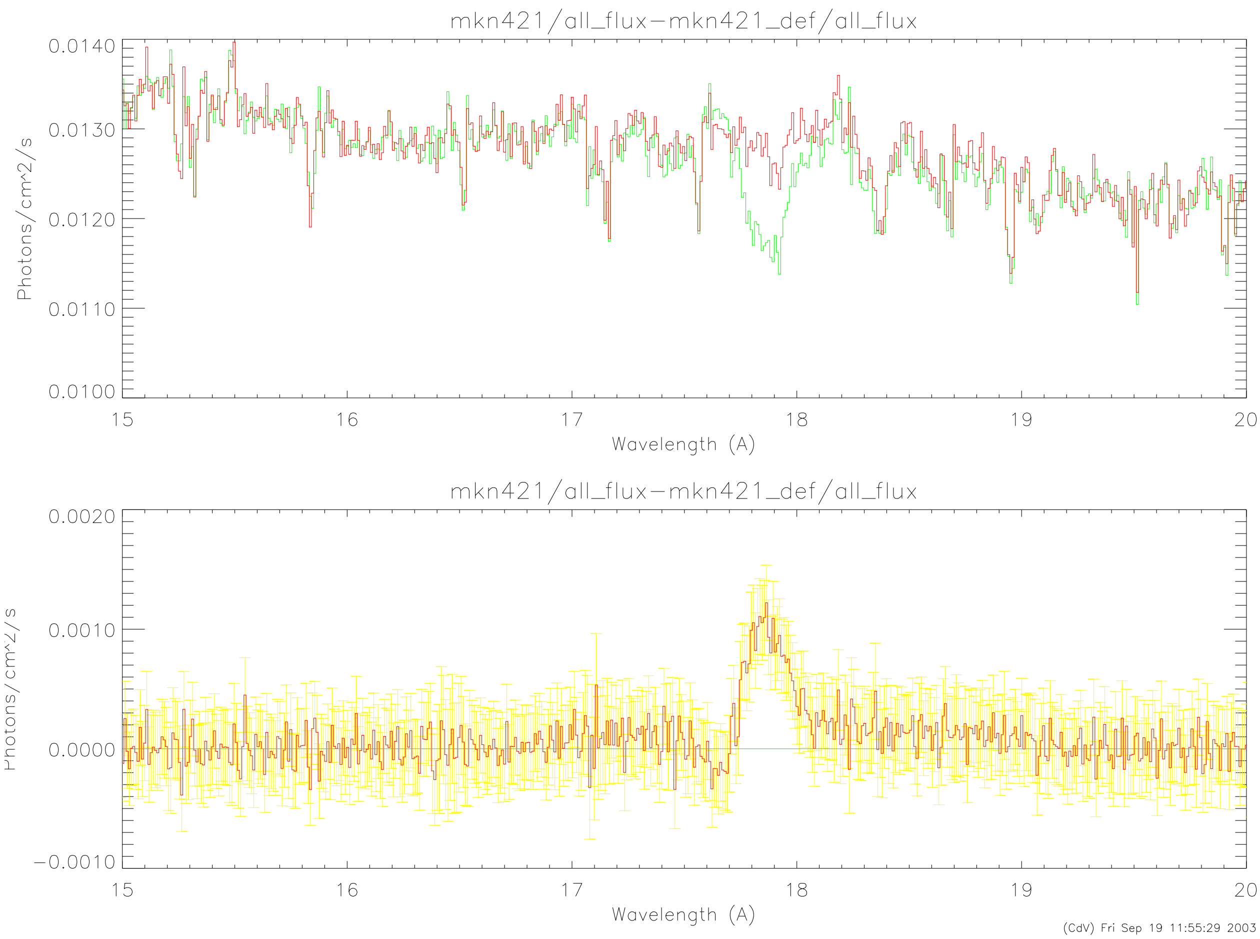

Figure 2: Details of the RGS spectrum of Mkn421 with and without the improved description of instrumental absorption by MgF_2 provided by the new RGS_EXAFS CCFs. At the top in green the old CCF with a clear feature at 17.9Å, due to an inadequate description of the F-edge. Several features due to bad pixels have not changed. The red line shows the result with the new CCFs with no feature. The lower plot shows the difference between the two with error bars in yellow. The new EXAFS tables range between 17 and 19 Å, at the ends of which there is no jump to be seen. This means that Mg absorption was also properly included in the CCFs.