SRON
Netherlands Institute for Space Research

Title : **Stability of the RGS effective area**

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1 Introduction

This report looks at various aspects of possible changes in the effective area of RGS, notably the variations in contamination. In addition differences between RGS1 and RGS2 are beeing looked into.

2 Contamination model and effective earea calibration

Lately the RGS carbon contamination model was updated from a linear model to an exponential decay model. Large scale effective area corrections (Chebichev polynomials) were derived from a set of Mkn421 observations, asuming the source to behave like a (changing) power law. At that time the Mkn421 observations assumed the old linear contamination model. The final power law, which might include a residual carbon contamination, was derived from the Crab observation in revolution 1138. Also this observation assumes the different carbon layer of the old linear model as opposed to the current exponential model. Figure 1 shows this difference to be 16 nm. This difference has to be taken into account in the new CCF EFFAREACORR file. The new model has to be shifted by 16 nm in order to keep the Carbon layer at the same level with the old model for the Crab revoution (1138).

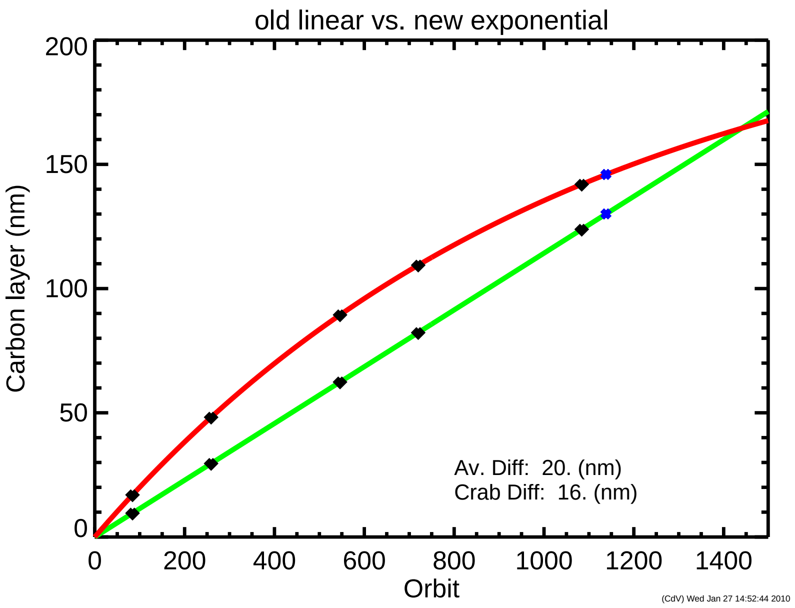

Figure 1: Difference between the old linear contamination model (green line) and the new exponential decay model (red line) for the points in time used to model the chebichev corrections (black points). The point in time at which the overall power law is fixed (Crab observations) is indicated with the blue dots. At this point in time the difference is 16 nm of carbon.

3 Differences between RGS1 and RGS2

Changes in differences between RGS1 and RGS2 were investigated. Figures 2 to 5 show the differences. The change in RGS2 to single node readout caused a shift from no difference to about 5% difference between RGS1 and RGS2. This shift was approximately constant, ever since the change to the single node readout. In theory this shift will depend on the count rate of Mkn421 (which is variable), but by accident, the count rate does not differ too much between the observations of similar type (single/double node) shown.

Thus it can be concluded that the only differences between RGS1 and RGS2 is due to pileup in the single node RGS2 readout. No changes associated with e.g. contamination differences are observed.

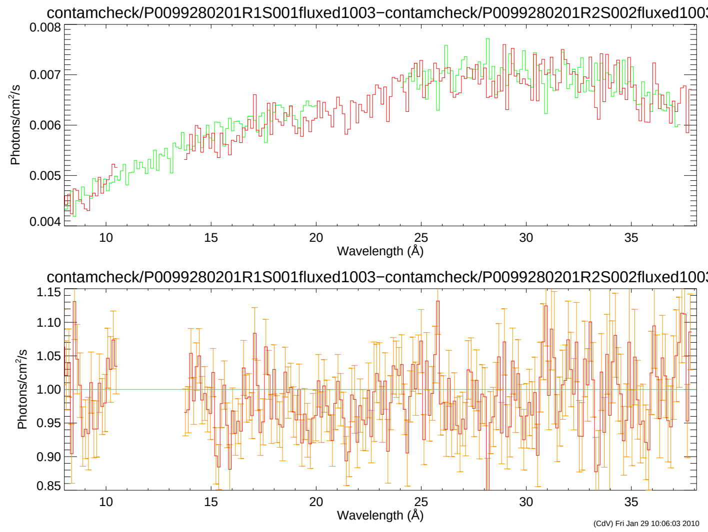

Figure 2: Difference between RGS1 and RGS2 for revolution 165. There is zero difference across the wavelength range

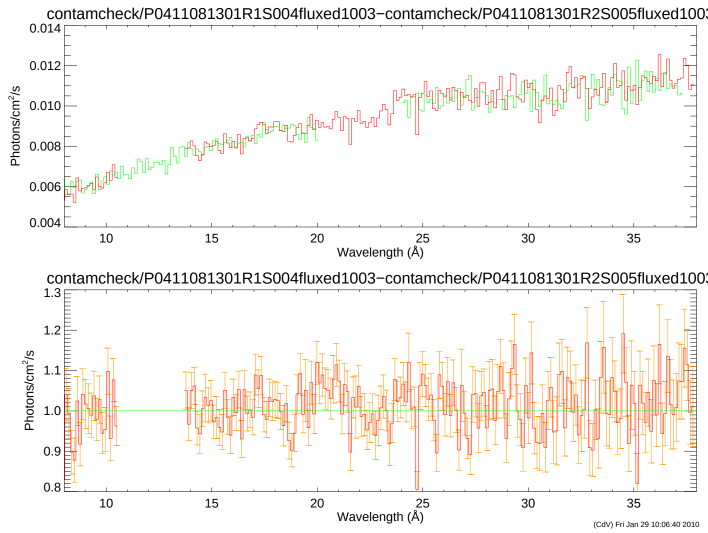

Figure 3: Difference between RGS1 and RGS2 for revolution 1358. Still zero difference across the wavelength range (cmp figure 2)

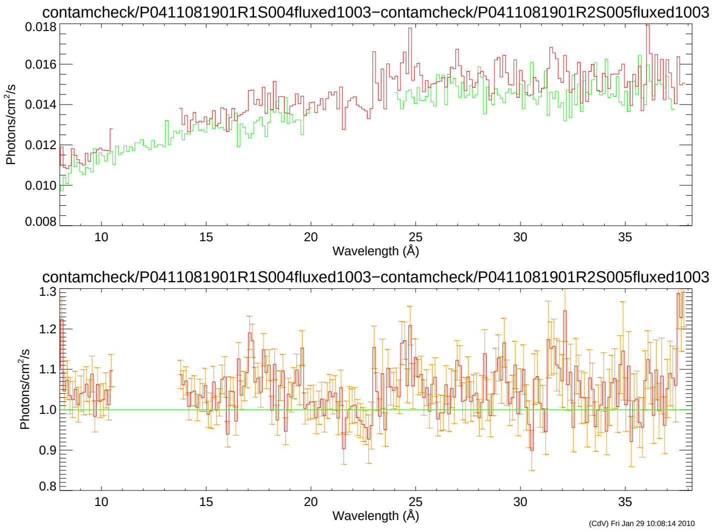

Figure 4: Difference between RGS1 and RGS2 for revolution 1455, just after the RGS2 changed to single node readout. Now there is about 5% difference towards the short wavelengths. (cmp figure 3). This is due to increased pileup in RGS2 due to the single node readout.

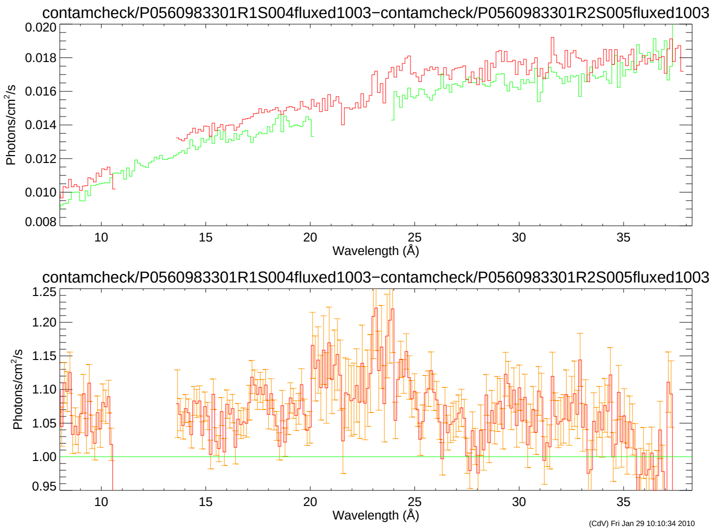

Figure 5: Difference between RGS1 and RGS2 for revolution 1732. Still about 5% difference towards the short wavelengths. (cmp figure 4). Comparing figures 2 to this figure this means that the only difference between RGS1 and RGS2 is due to change in pileup because of the single node readout of RGS2. There are no differences in effective area between RGS1 and RGS2.

4 Changes in instrumental Oxygen

It was checked whether the instrumental oxygen edge changes over time. Figure 6 shows the difference around the oxygen edge between revoutions 165 and 1732. An oxygen edge was fitted to this difference. The observed change in oxygen is 6 ± 8 nm. This is consistent with zero change. Thus, at this moment there is not need to assume a change in the instrumental oxygen edge over the course of the mission so far.

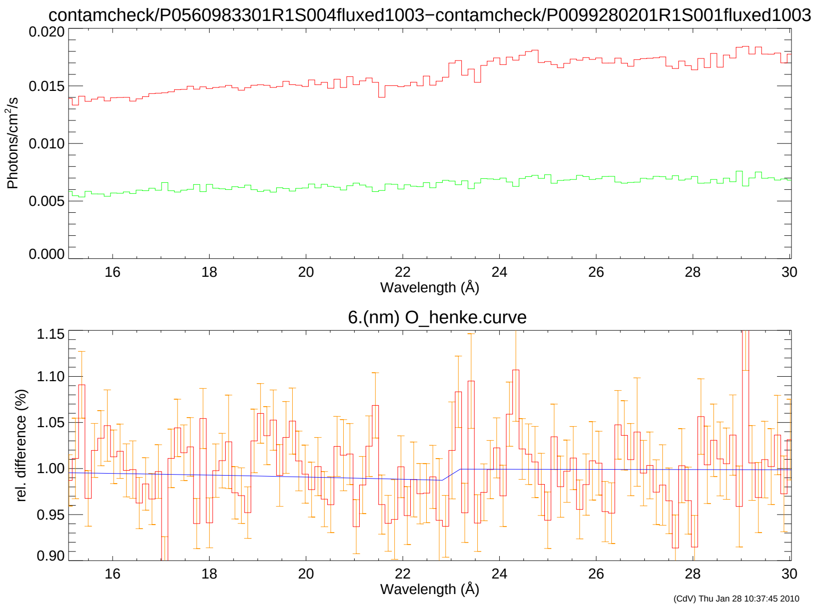

Figure 6: Difference in oxygen edge between the Mkn421 observations of revolution 0165 and 1732. The difference amounts to 6 ± 8 nm, and is consistent with no change during the course of the mission.

5 Conclusions

The following conclusions were reached:

- The EFFAREACORR CCF has to take into account a difference of 16 nm of carbon contamination, between the old model and the new at the time of the power law effective area corrections based on the Crab.
- There is no systematic difference between RGS1 and RGS2, other than the difference in pileup due to the single node readout mode of RGS2.
- The fitted change in the instrumental Oxygen edge over the mission life time is consistent with zero.