**Center for Astrophysics**

Harvard College Observatory
Smithsonian Astrophysical Observatory

**MEMORANDUM**

October 28, 1999

**To:** M. Zombeck

**From:** Almus Kenter

**Subject:** Degap Corrections for HRC-I and HRC-S detectors

# 1 Introduction

I have generated degap corrections for the HRC-I and the HRC-S detectors. For the HRC-I I used the on-board Fe-55 Calibration source data. For the HRC-S I used ground calibration data, in particular the flat field illumination from the Al target in the Manson model 5 X-ray source. The Al flat field illumination was used as it had $> 2 \times 10^6$ events per segment,the Al X-rays were little modulated by the UVIS structure and the Al pha spectrum was close in shape to the pha shape at other energies.

The basic idea of my technique is outlined in my memo of March 1 1999. I have included that memo as an appendix. These values (and perhaps this technique) should be considered as an interim solution, untill a technique based on more "analytical" methods is refined. This more analytical approach will use the shape of the MCP charge cloud to determine the true postion of an event eliminating the need for a seperate degap procedure.

# 2 HRC-I

I have used a 5th order degap. The degap correction values are seperate for each U and V coarse position and for positive and negative fine positions. The degap corrections consist of $four$ ascii files:

- U correction for positive fine positions:

  `hrci_cal_2_good_flatpu_deg.cor`

- U correction for negative fine positions:

  `hrci_cal_2_good_flatmu_deg.cor`

- V correction for positive fine positions:

  `hrci_cal_2_good_flatpv_deg.cor`

- V correction for negative fine positions:

  `hrci_cal_2_good_flatmv_deg.cor`

The data is in tabular form in each file:

```
cp      a      b     c     d     e
```

cp is coarse position $(a)$ is linear term. $(b)$ is quadratic term etc etc.

The position should be found by the following:

$$fpi = \frac{C - A}{A + B + C} \times 256 \tag{1}$$

Where $fpi$ is the initial fine position and $A, B, C$ are the appropriate fine position ADCs. **Note** the factor of 256 which is just a scale factor. The final fine position, $fpf$ for positive $fpi$ is then:

$$fpf = a \times fpi + b \times fpi^2 + c \times fpi^3 + d \times fpi^4 + e \times fpi^5 \quad (2)$$

The final fine position, $fpf$ for negative $fpi$ is then:

$$fpf = a \times fpi - b \times fpi^2 + c \times fpi^3 - d \times fpi^4 + e \times fpi^5 \quad (3)$$

**Note** the sign change on the even power terms.

The final position in pixels is then obtained by combining coarse and fine positions:

$$position = cp * 256 + fpf + 128 \quad (4)$$

The final addition of the 128 is just an arbitrary translation; it eliminates negative values for $cp = 0$ (which in reality would not happen) and it makes the final positions agree with previous position determinations.

# 3 HRC-S

The degap method is *identical* for the HRC-S detector, however since the HRC-S detector consists of three seperate MCP stacks there are twelve data files; four for each segment.

Each MCP segment has its own four files so for segment 0 (v coarse positions 64-126) use the files:

Segment 0.

- `hrcs_seg0_mu_deg.cor`
- `hrcs_seg0_pu_deg.cor`
- `hrcs_seg0_mv_deg.cor`
- `hrcs_seg0_pv_deg.cor`

The p and m refer to whether the fine position is negative (minus) or positive.

The same goes for the other segments:

Segment +1

(v coarse positions 0-63) use the files:

- `hrcs_seg+1_mu_deg.cor`
- `hrcs_seg+1_pu_deg.cor`
- `hrcs_seg+1_mv_deg.cor`
- `hrcs_seg+1_pv_deg.cor`

Segment -1

(v coarse positions 127-192) use the files:

- `hrcs_seg-1_mu_deg.cor`
- `hrcs_seg-1_pu_deg.cor`
- `hrcs_seg-1_mv_deg.cor`
- `hrcs_seg-1_pv_deg.cor`

The above ranges for v coarse positions are the maximum possible for each of the segments. In examining the data for the degaps, I noted that the following v coarse positions don't provide meaningful degap correction values as such I take them as indicative of the transitions.

```
0,1,2,3,4

64,65,66  transition between +1 and 0

126,127,128  transition between 0 and -1

        186---> end
```