

Improving the ACIS-S3 Spectral Resolution via a Grade-Dependent Correction?

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ANALYSIS

In Figs 1, 2, and 3, we present the G0, G2, G3, G4, and G6 grade distributions from OBSID 62895 @ 1.5 keV, @ 4.5 keV, and @ 5.9 keV, respectively. A Gaussian was fit to each spectrum and their fit parameters are tabulated in Table 1. The G2-36 distributions for both the CXC data and the PSU CTI corrected data (Townsend, et al. 2000) were adjusted so that their line peaks coincided with the G0 line peak. The adjusted G02346 spectra were then re-summed @ each line energy and are presented in Figs 4, 5, and 6 (dashed lines). The original CXC and CTI corrected G02346 spectra are also plotted (solid lines). Each summed spectrum was also fit with a Gaussian. Their fit parameters are listed on each plot. By comparing the fit parameters from the modified G02346 spectrum against the original spectrum for both the CXC and the CTI corrected data, no significant differences are found. The line sigma in the CTI corrected data are 4%, 9%, and 11% smaller @ 1.5 keV, 4.5 keV, and @ 5.9 keV.

RESULTS

We have analysed ACIS data of the external calibration source to determine the stability of the S3 gain as well as to characterise the grade-dependent spectral resolution of the ACIS-S3 CCD. Preliminary results from a work-in-progress are presented. We find that the computed line peak in PI space has shifted downwards by ~1 PI channel @ 1.5 keV, 1.6 PI channels @ 4.5 keV, and 1.8 PI channels @ 5.9 keV over a 3.25 year time period. We find that this shift can be corrected by applying "corr_gain". This tool is available from the CXC. Over this time period, the line sigma has changed by ~ 5%, 4%, and 5% at 1.5 keV, 4.5 keV, and 5.9 keV, respectively, due to CTI. This can be largely corrected by applying the Pennsylvania State University (PSU) CTI corrector. While the line peaks in the CTI corrected data are at lower PI channels, this is presumably accounted for in the PSU response matrices. We have also attempted to improve the spectral resolution of S3 by investigating the G0, G2, G3, G4, and G6 grade distributions. We find no significant change in line peak nor line width by such a correction when data from the entire CCD are summed. We are in the process of investigating the position dependency of this effect. Only modest improvements are expected.

TIME DEPENDENCE OF S3 GAIN

The same analysis that was performed for OBSID 62895 was repeated for OBSID 62847, another observation of the external calibration source taken on May 30, 2003. The G02346 grade distributions for both the CXC and the CTI corrected data are presented in Figs 7, 8, and 9. Each spectrum was again fit with a Gaussian (see Table 2), and the line peaks adjusted so as to coincide with the G0 line peak. The G02346 spectra were then re-summed and are presented in Figs. 10, 11, and 12 for comparison with the original G02346 spectrum as derived from the CXC and the CTI corrected event list. Notice that the line peaks from OBSID 62847 are shifted slightly to the left of the line peaks from OBSID 62895. Clearly, the temporal evolution of the S3 gain over 3+ yrs is small. Nevertheless, this shift can be corrected by applying "corr_gain" - a gain correction tool available via the contributed software page* at the CXC and also included in the CIAO V3.0 release. The "corr_gain" line sigma are only slightly modified.

OBSID 62895 - Feb. 20, 2000

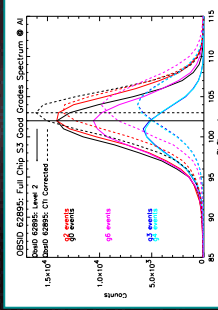


Figure 1: Grade Distribution @ 1.5 keV

Table 1: Gaussian Fits to OBSID 62895 Grade Distributions

Grade	CXC Level 2/CTI Corrected	Norm	PI Shift
0	101.0102.8	2.38E+08	1.38E+11.6004
2	102.0103.3	3.05E+07	1.40E+11.3264
3	103.0103.8	2.98E+07	1.40E+11.3264
4	104.0104.3	2.98E+07	1.40E+11.3264
6	101.0103.8	3.19E+07	1.05E+10.3063

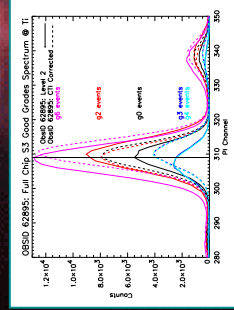


Figure 2: Grade Distribution @ 1.5 keV

OBSID 62847 - May 30, 2003

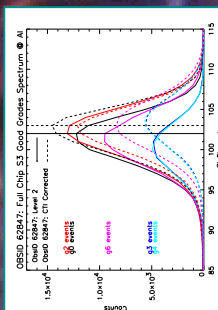


Figure 7: Grade Distribution @ 1.5 keV

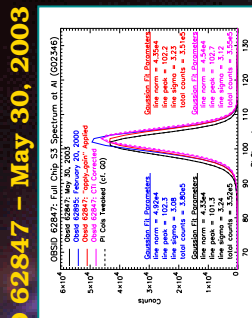


Figure 8: Full Chip Spectrum @ 1.5 keV

Table 2: Gaussian Fits to OBSID 62847 Grade Distributions

Grade	CXC Level 2/CTI Corrected	Norm	PI Shift
0	101.0102.8	2.38E+08	1.38E+11.6004
2	102.0103.3	3.05E+07	1.40E+11.3264
3	103.0103.8	2.98E+07	1.40E+11.3264
4	104.0104.3	2.98E+07	1.40E+11.3264
6	101.0103.8	3.19E+07	1.05E+10.3063

(Please see Figs. 1, 2, & 3)

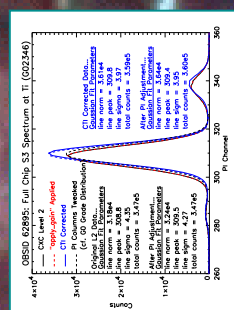


Figure 4: Full Chip Spectrum @ 4.5 keV

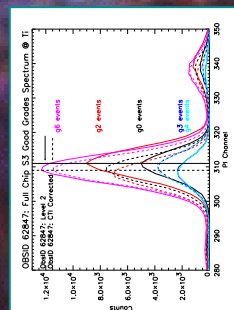


Figure 9: Grade Distribution @ 4.5 keV

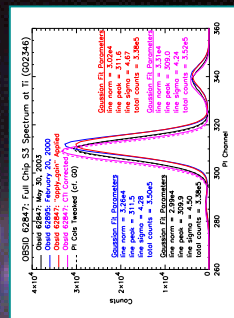


Figure 10: Full Chip Spectrum @ 4.5 keV

OBSID 62895 - Feb. 20, 2000

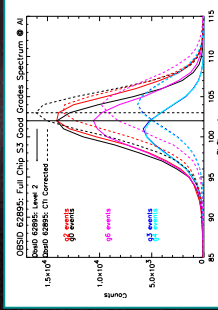


Figure 1: Grade Distribution @ 4.5 keV

Table 2: Gaussian Fits to OBSID 62895 Grade Distributions

Grade	CXC Level 2/CTI Corrected	Norm	PI Shift
0	101.0102.8	2.38E+08	1.38E+11.6004
2	102.0103.3	3.05E+07	1.40E+11.3264
3	103.0103.8	2.98E+07	1.40E+11.3264
4	104.0104.3	2.98E+07	1.40E+11.3264
6	101.0103.8	3.19E+07	1.05E+10.3063

(Please see Figs. 1, 2, & 3)

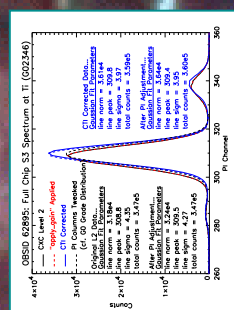


Figure 5: Full Chip Spectrum @ 4.5 keV

OBSID 62847 - May 30, 2003

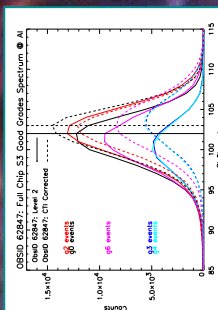


Figure 7: Grade Distribution @ 4.5 keV

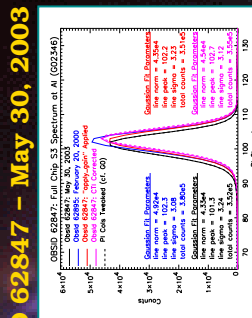


Figure 8: Full Chip Spectrum @ 4.5 keV

Table 2: Gaussian Fits to OBSID 62847 Grade Distributions

Grade	CXC Level 2/CTI Corrected	Norm	PI Shift
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(Please see Figs. 1, 2, & 3)

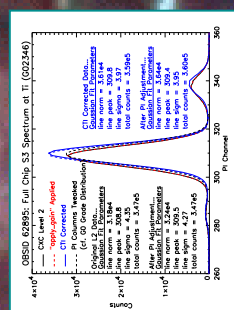


Figure 9: Grade Distribution @ 4.5 keV

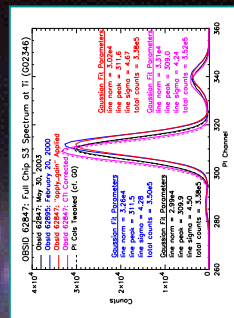


Figure 10: Full Chip Spectrum @ 4.5 keV

OBSID 62895 - Feb. 20, 2000

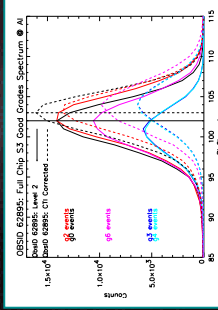


Figure 1: Grade Distribution @ 5.9 keV

Table 2: Gaussian Fits to OBSID 62895 Grade Distributions

Grade	CXC Level 2/CTI Corrected	Norm	PI Shift
0	101.0102.8	2.38E+08	1.38E+11.6004
2	102.0103.3	3.05E+07	1.40E+11.3264
3	103.0103.8	2.98E+07	1.40E+11.3264
4	104.0104.3	2.98E+07	1.40E+11.3264
6	101.0103.8	3.19E+07	1.05E+10.3063

(Please see Figs. 1, 2, & 3)

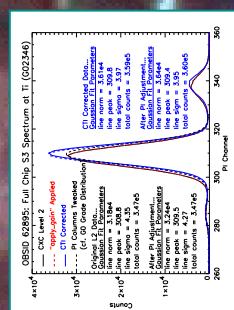


Figure 5: Full Chip Spectrum @ 5.9 keV

OBSID 62847 - May 30, 2003

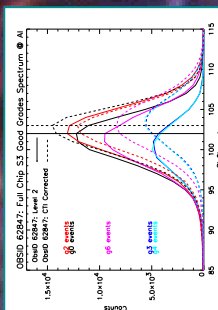


Figure 7: Grade Distribution @ 5.9 keV

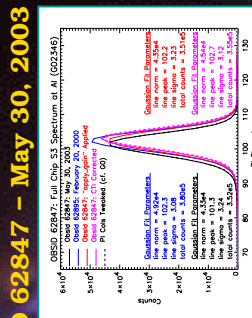


Figure 8: Full Chip Spectrum @ 5.9 keV

Table 2: Gaussian Fits to OBSID 62847 Grade Distributions

Grade	CXC Level 2/CTI Corrected	Norm	PI Shift
0	101.0102.8	2.38E+08	1.38E+11.6004
2	102.0103.3	3.05E+07	1.40E+11.3264
3	103.0103.8	2.98E+07	1.40E+11.3264
4	104.0104.3	2.98E+07	1.40E+11.3264
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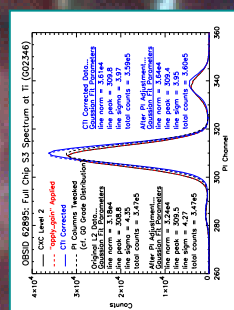


Figure 9: Grade Distribution @ 5.9 keV

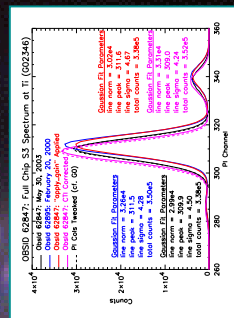


Figure 10: Full Chip Spectrum @ 5.9 keV