ACIS Calibration Status
29 June 2001

- Existing response matrices (encoded in Fits Encoded Function files, FEFs) are modeled as up to 3 Gaussians at each energy (one each for main peak, escape peak, Si fluorescence peak).
- New BI Response Matrices/FEFs: Approaching completion. We expect to release the S3 matrices for both -120 and -110°C in the next release of the CALDB, currently scheduled for late July 2001. S1 matrices will also be released at this time, or soon thereafter.
- CXC in collaboration with the PI teams will be implementing software to perform correction for charge transfer inefficiency (CTI) effects, as a post-processing step in the ground software. The use of these corrected data will require new calibration products.
- New FI Response Matrices/FEFs: In conjunction with the implementation of a method for correction of user data for charge transfer inefficiency (CTI), we will develop new response products for the front illuminated chips as well. Timeframe: late Fall, 2001.
- Quantum Efficiency Uniformity (QEU) products are in order for -120°C. The -110°C QEU files will be updated later this summer.
- Quantum Efficiencies (QEs) are good to better than 10% above about 1.0 keV. The discrepancy below 1.0 keV between BI and FI chips noted last winter is still present, and still not understood.

Sample Fits with new BI Response Files

- Fit to Supernova Remnant E0102, obsid 1311, on S3 near the aimpoint (middle S3c1), in PHA space, using the 15 June 2001 FEFs.
- Model is 24 Gaussians of width zero at known energies of lines, plus thermal Bremsstrahlung, absorbed with both Galactic and SMC abundance `wabs` model. $\chi^2_\nu = 1.48$; no large systematics in residuals.
- Also shown is the same model convolved with the released (CALDB 2.0) S3 response, showing that this model has a gain which is too high and lines which are too narrow. The best fit spectrum is also shown using the released matrix. $\chi^2_\nu = 6.93$ and the fit parameters are significantly different.
- Fit to cluster MS 2137 on S3 in PHA space, using 15 June 2001 FEFs. (McNamara & Wise 2001, in preparation) Model is absorbed hot plasma; $N_{\rm H}$ fit is reasonable. Instrument model includes new C edge adjustment in the 284–1000 eV regime.

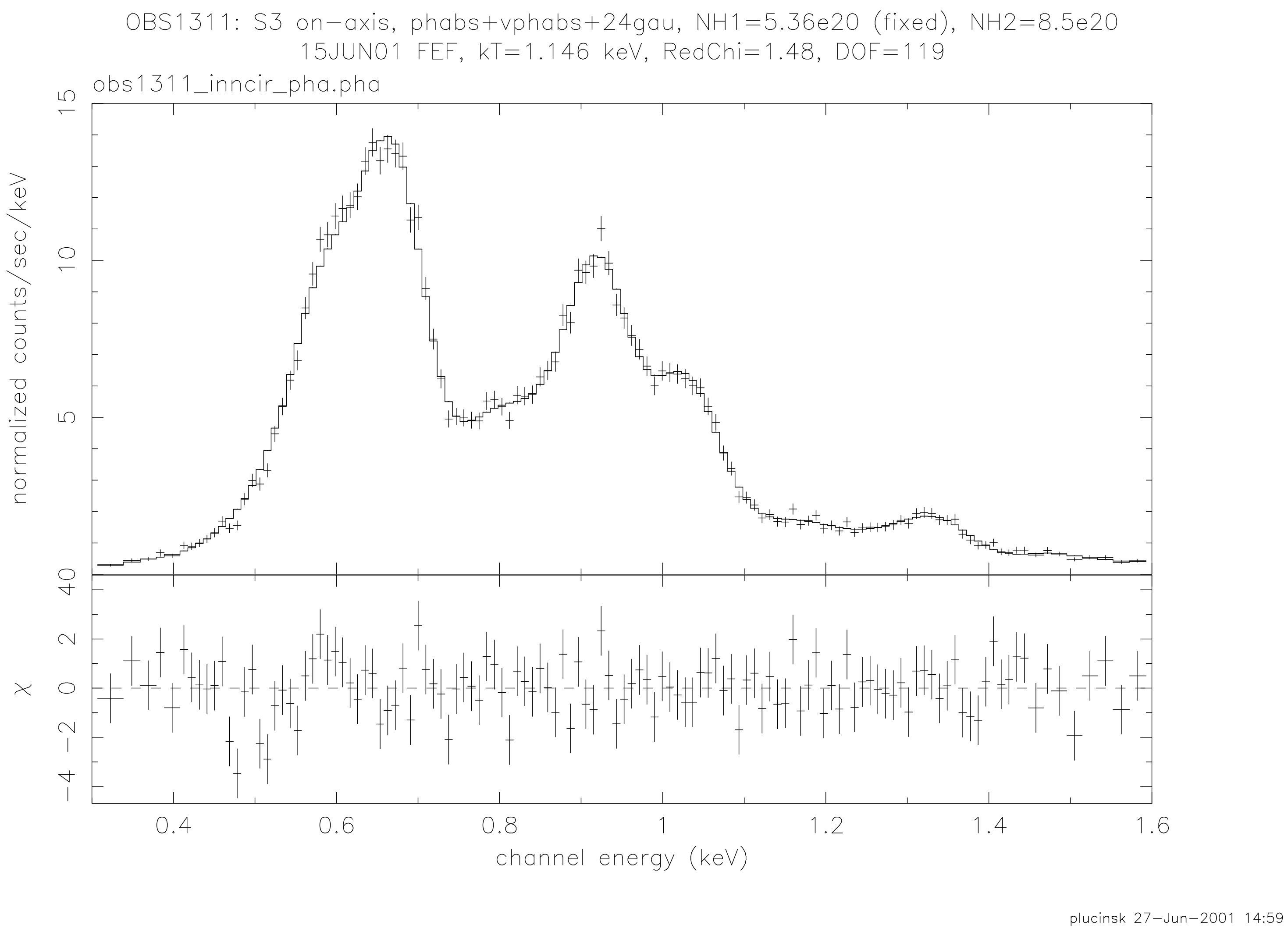

Figure 1: Fit to E0102 SNR spectrum at S3 aimpoint with Jun 15 PHA FEFs

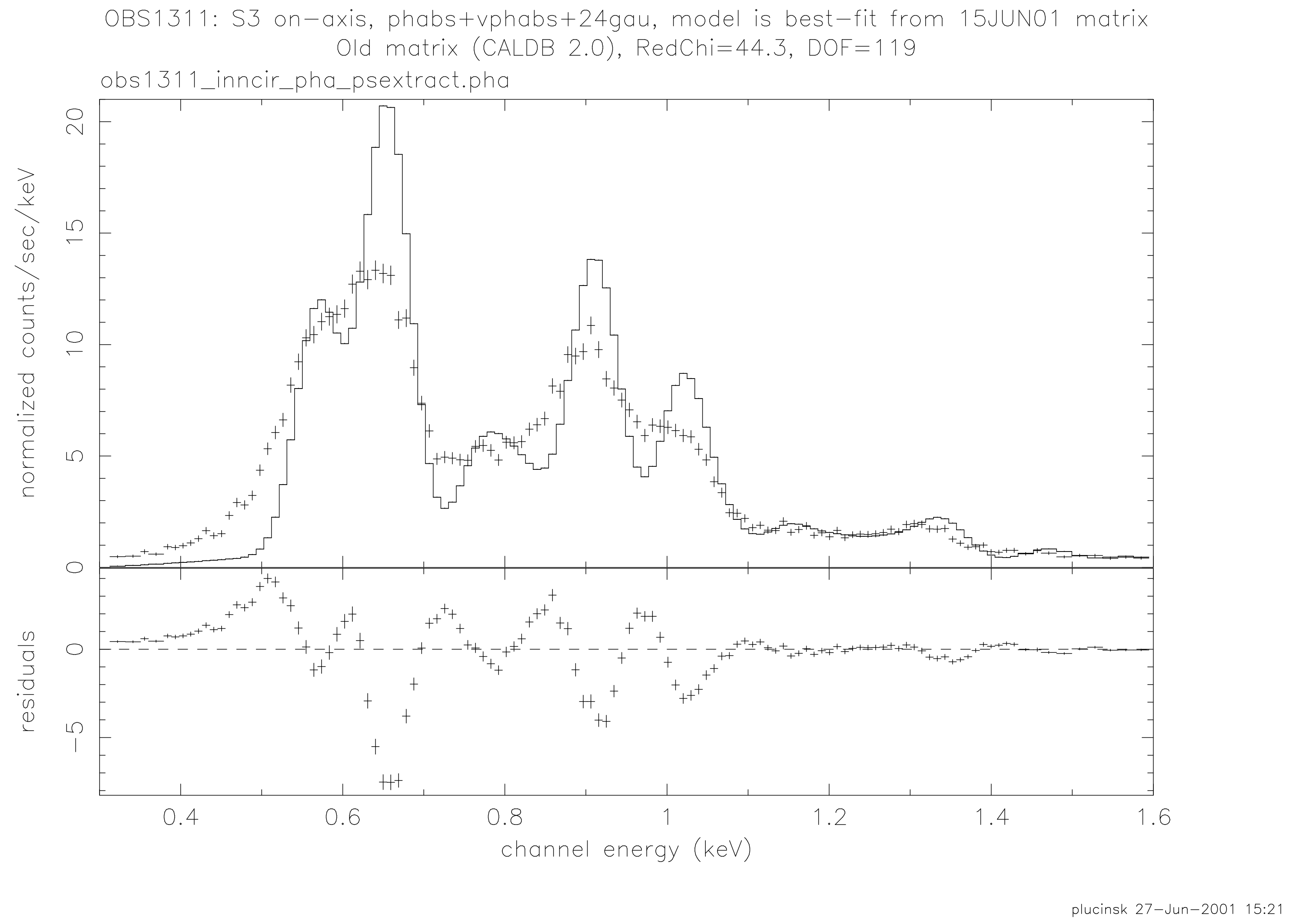

Figure 2: Same E0102 SNR model with old (CALDB 2.0) S3 FEFs

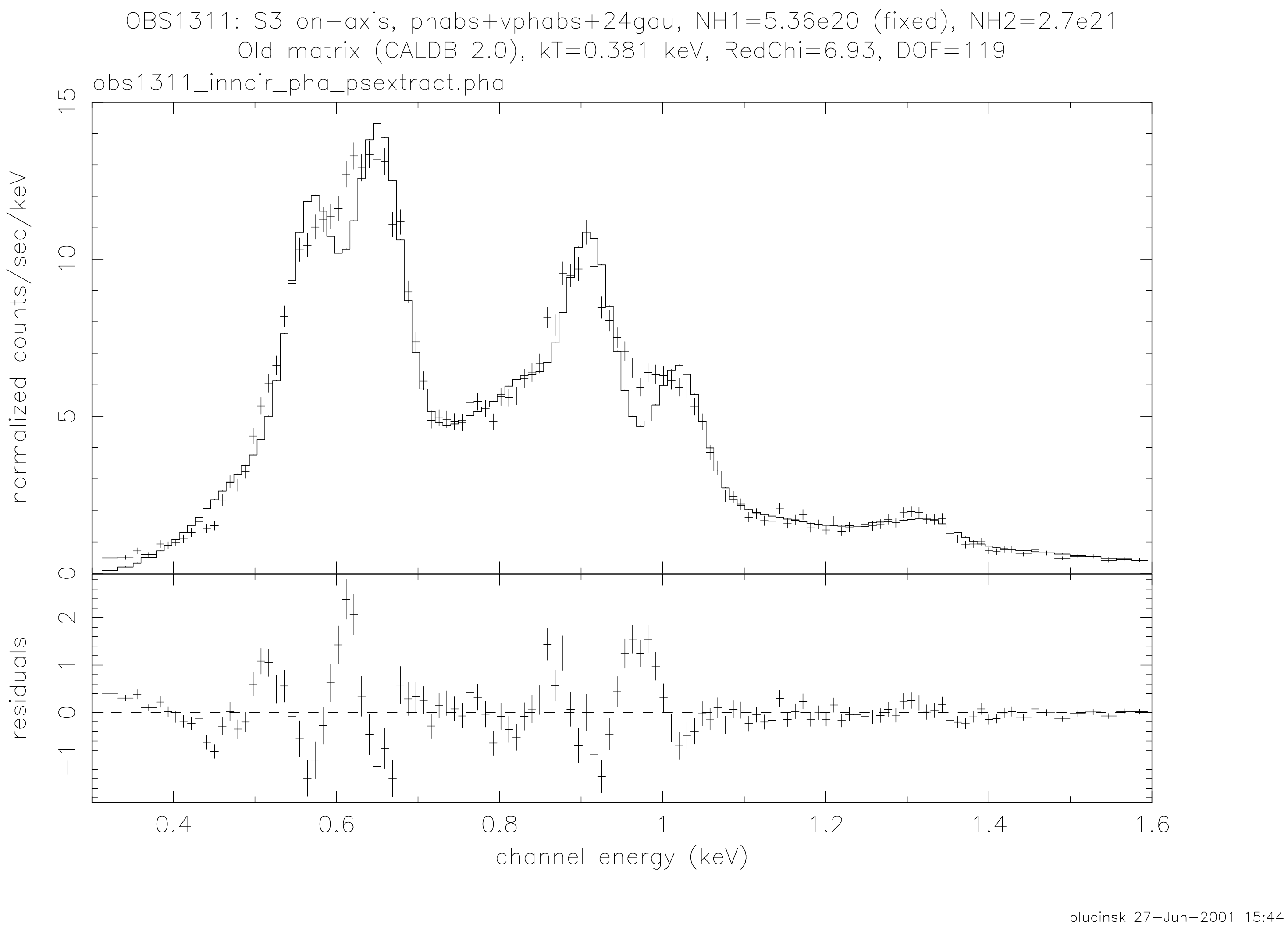

Figure 3: Best fit to E0102 SNR model with old (CALDB 2.0) S3 FEFs

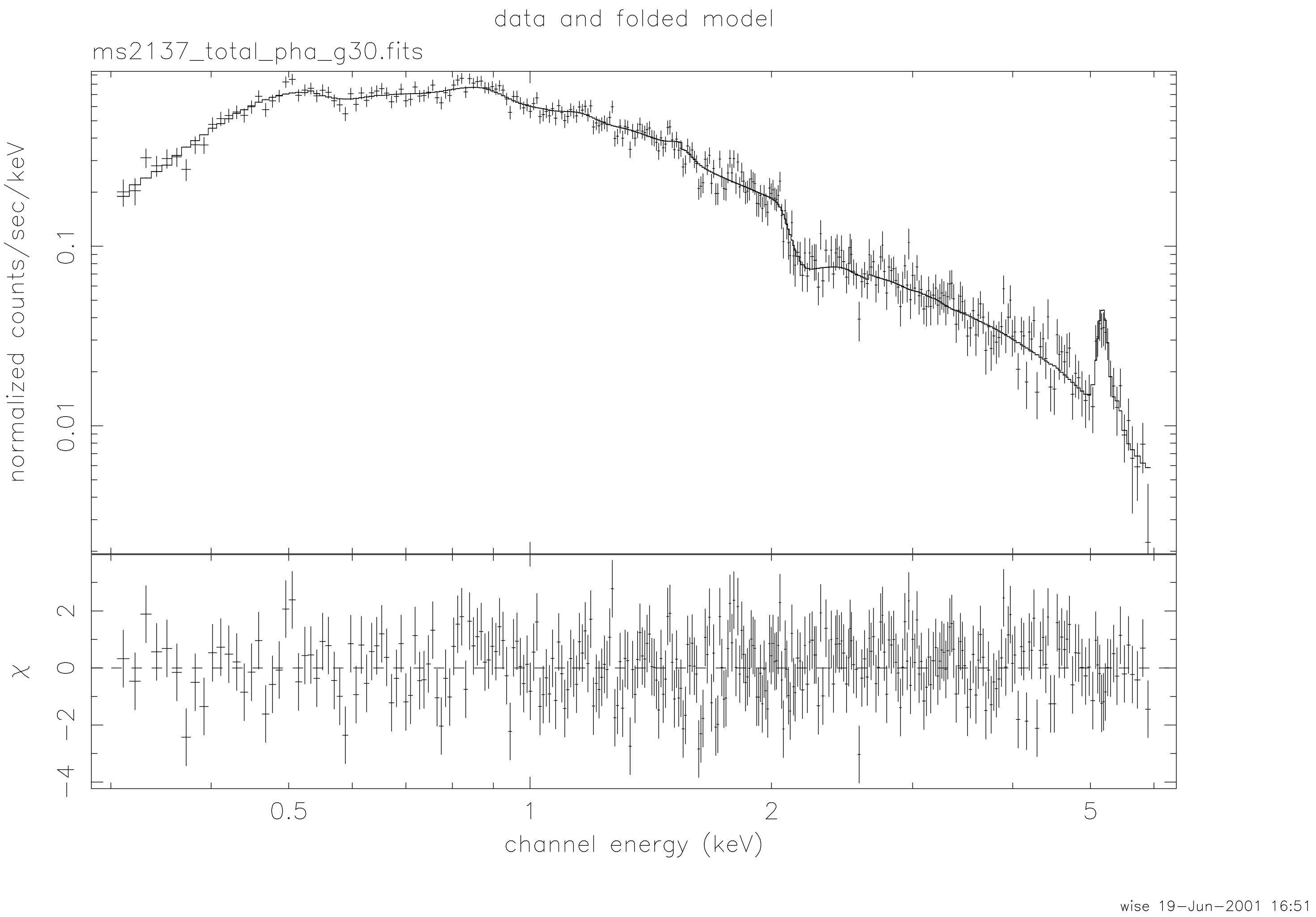

Figure 4: Fit to MS 2137 cluster spectrum at S3 aimpoint with Jun 7 −110°C PHA FEFs

ACIS RMF Generation Procedure
29 June 2001

1. $\sim 10^8$ model events were run with Gregory Prigozhin's MIT CCD simulator at 57 energies.
2. If for FI chip with CTI correction, run CTI corrector.
3. These were sorted into 32×32 pixel "tiles", and histograms were made.
4. The resulting 14,492 pulse height distributions were fit to a model consisting of up to 10 Gaussians.
5. A sample fit for the central region of S3c1, energy=650.787 eV is shown.
6. Electron Charge Distribution files were prepared, and transformed into FEFs (FITS Encoded Function files).
7. Gains (all Gaussian centroids & mean PHA) adjusted to match released ECDs.
8. The onboard calibration source data (containing lines Al K–α, Ti K–α, Ti K–β, Mn K–α, Mn K–β, and a few weaker lines) were fit using the resulting RMFs. Gain corrections were obtained and fed back into the ECDs. A sample fit is shown.
9. Compare to astrophysical sources (E0102, Cas A, others).
10. Iterate until energy scale good to less than 0.3% at all fitted energies.
11. For a second temperature, or another chip, start at step 7.

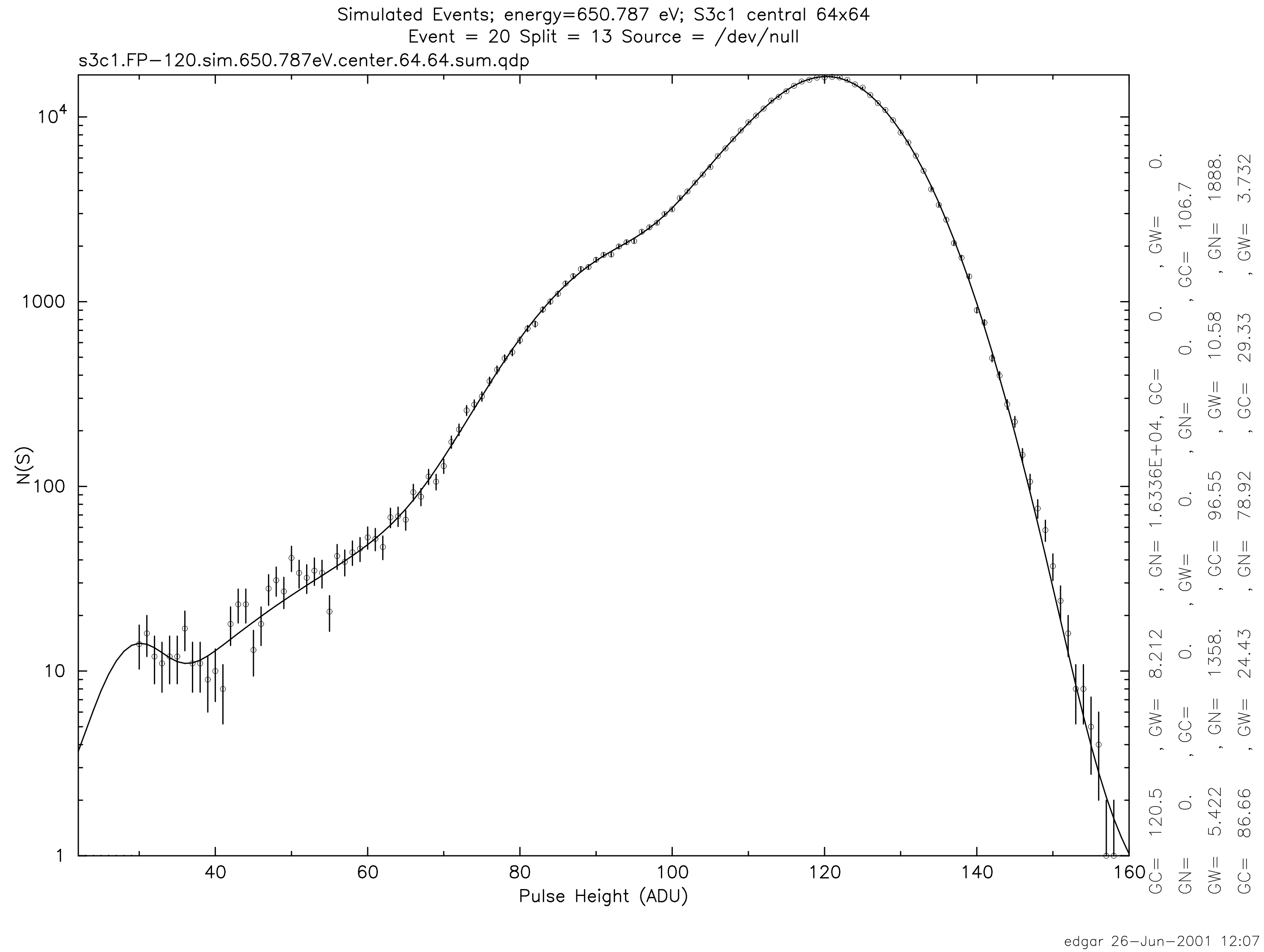

Figure 5: Fit to model PH distribution, central 64×64 pixel region, S3 quadrant 1, energy=650.787 eV

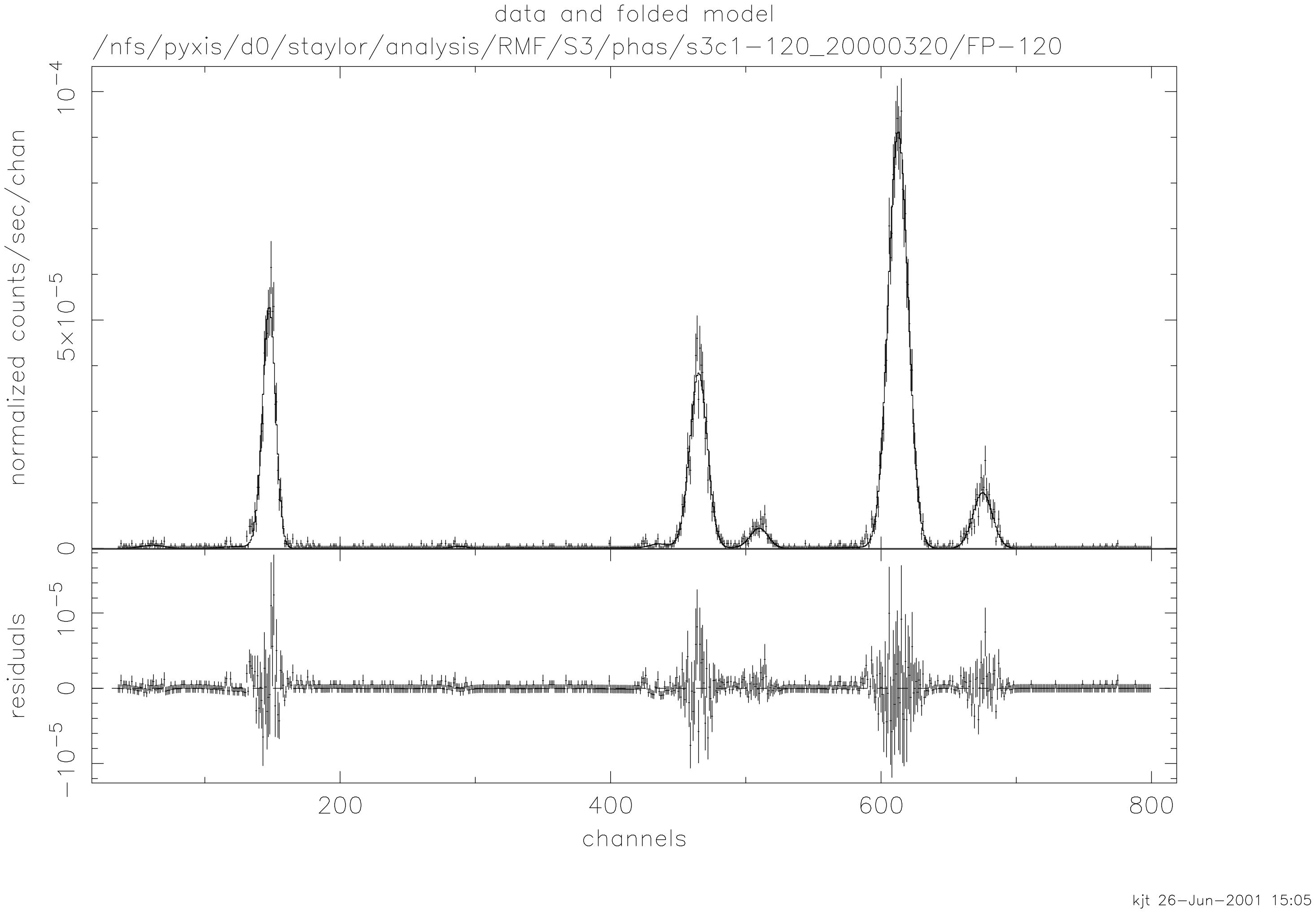

Figure 6: Fit to single tile of S3 external calibration source data

ACIS RMF Generation ***Dramatis Personae***
29 June 2001

- MIT PI team: Mark Bautz, Gregory Prigozhin, Catherine Grant, Bev Lamar, Peter Ford
- PSU PI team: Liesa Townsley, Pat Broos
- CXC/MIT: Norbert Schulz, Sarah-Anne Taylor, Kevin Tibbetts, Mike Wise, Glenn Allen
- CXC/SAO: Steven Buczkowski, Dick Edgar, Mike Raley, Paul Plucinsky, Dan Schwartz
- apologies to anyone I've left out...

ACIS RMF Generation & CTI Correction: Further Reading
29 June 2001

- Townsley, L. K.; Broos, P. S.; Garmire, G. P.; Nousek, J. A., 2000, ApJ, 534, L139. "Mitigating Charge Transfer Inefficiency in the Chandra X-Ray Observatory Advanced CCD Imaging Spectrometer"
- Townsley & Broos 2000

  http://www.astro.psu.edu/users/townsley/cti/I3memo/
- Townsley & Broos 2001 "Modelling Charge Transfer Inefficiency in ACIS"

  ftp://ftp.astro.psu.edu/pub/townsley/method_memo.ps
- Broos & Townsley 2001 "Notes on RMF Generation"

  ftp://www.astro.psu.edu/pub/townsley/rmf.ps
- MIT Internal ACIS notes page:

  http://space.mit.edu/ACIS/iacis.html
- Grant, Townsley, et al 2001: "ACIS CTI Correction Approaches"

  http://space.mit.edu/ACIS/ctireport.html
- Bautz, et al. 2001: "ACIS CTI correction"

  http://space.mit.edu/ACIS/cticor.html

ACIS RMF Generation & CTI Correction: Further Reading
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- CXC/Cal/ACIS page:

  http://asc.harvard.edu/cal/Links/Acis/acis/WWWacis_cal.html