New FI Response Matrix Products

ACIS-I and S2 -120°C, with CTI correction

- For use with the CXC CTI-corrector (an option in `acis_process_events`)
- New files to be released Nov 2002 in CALDB 2.18:
  - CTI-corrected FEFs:
    - `$CALDB/data/chandra/acis/cpf/fefs/acisD2000-01-29fef_pha_ctiN0001.fits`
  - Gain file to match the above FEFs:
    - `$CALDB/data/chandra/acis/bcf/gain/acisD2000-01-29gain_ctiN0001.fits`
  - Trap-map file for use with `acis_process_events` :
    - `$CALDB/data/chandra/acis/bcf/cti/acisD2000-01-29ctiN0002.fits`
- Quantum Efficiencies (QEs) and Uniformity Maps (QEUs) have not been changed with this release

ACIS RMF Generation *Dramatis Personae*

- **MIT PI team: Mark Bautz, Gregory Prigozhin, Catherine Grant, Bev LaMarr, Peter Ford, Steve Kissel**
- **PSU PI team: Leisa Townsley, Pat Broos, John Nousek, Gordon Garmire, George Chartas, Eugene Moskalenko, George Pavlov**
- **CXC/MIT: Norbert Schulz, Sarah-Anne Taylor, Kevin Tibbetts, Mike Wise, Glenn Allen**
- **CXC/SAO: Alexey Vikhlinin, Dick Edgar, Mike Raley, Paul Plucinsky, Dan Schwartz, Eli Beckerman, Dale Graessle**
- **apologies to anyone I've left out...**

ACIS RMF Generation & CTI Correction: Further Reading

CXC/Cal/ACIS page:

`http://asc.harvard.edu/cal/Acis/WWWacis_cal.html`

Select "ACIS Response Matrices"

ACIS RMF Generation Procedure

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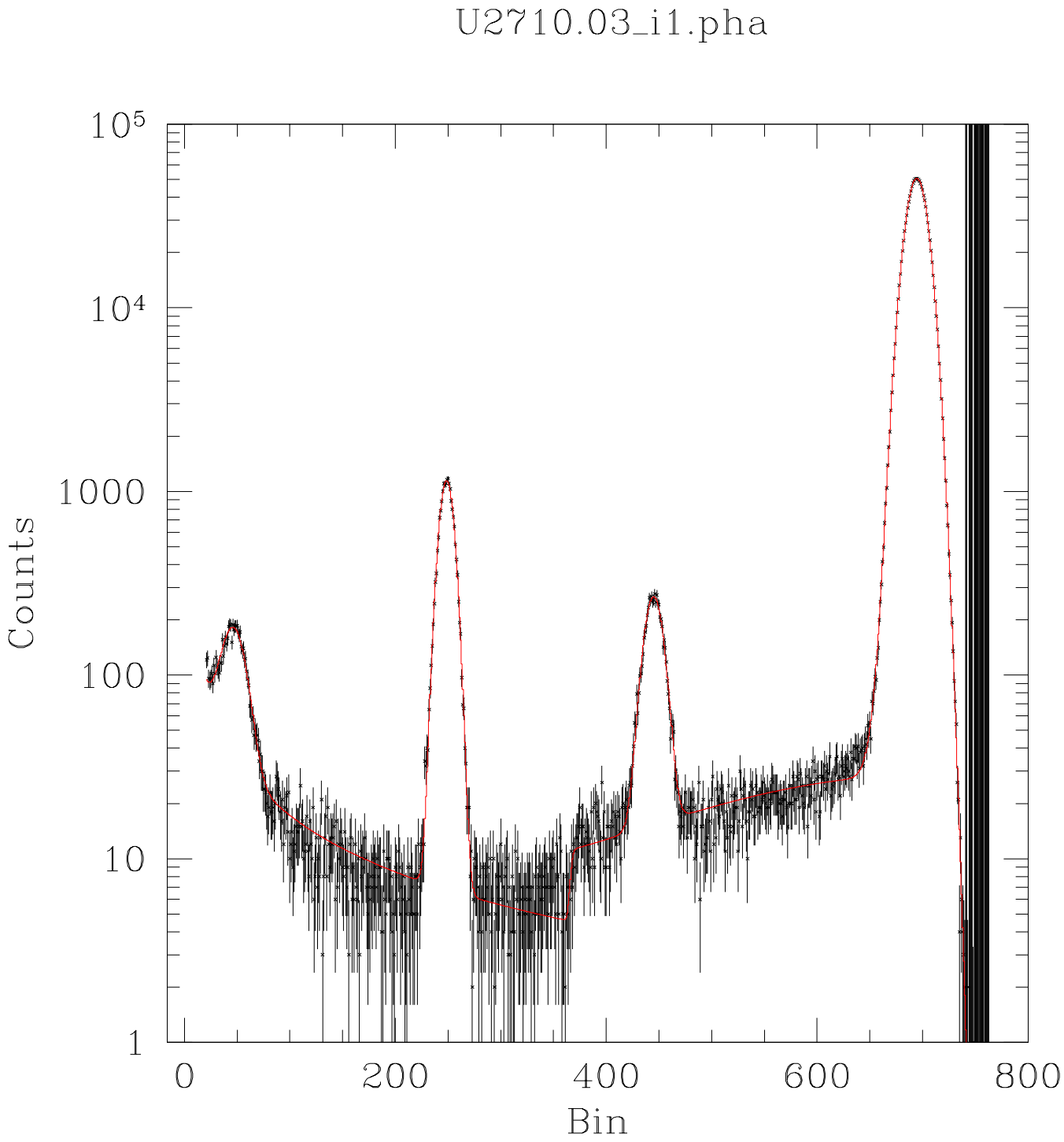
1. **$\sim 10^8$ model events were run with Gregory Prigozhin's MIT CCD simulator at 89 energies from 100 eV to 12 keV.**
2. **Run the MIT provided addcti-pro to simulate the effect of CTI.**
3. **Run CXC CTI corrector.**
4. **Sort events into 256×32 pixel "tiles", and make histograms.**
5. **The resulting pulse height distributions at each energy for tiles closest to the readout were fit to a model consisting of 5 Gaussians, plus a continuum consisting of a broad Gaussian, a power law, and erf and erfc cutoffs.**
6. **A sample fit for the readout region of I3, energy=2710 eV is shown.**
7. **CTI effects were modeled with two Gaussians for each energy for each tile region. This function was then convolved analytically with the lines from the CCD response fit. (See Vikhlinin talk, this meeting.)**
8. **FITS Encoded Function (FEF) files are prepared, containing the parameters of the fit functions.**
9. **The on board calibration source data (containing lines Al K–α 1.486 keV, Ti K–α 4.50 keV, Mn K–α 5.90 keV, and a few weaker lines) were fit using the resulting RMFs. Gain corrections for each tile were obtained and fed back into the FEFs. (See Schulz talk, this meeting.)**
10. **Compare to astrophysical sources (E0102, Cas A, others).**
11. **Iterate until energy scale good to less than 0.3% at all fitted energies on all tiles.**


U2710.03_i1.pha
Counts
Bin
10^5
10^4
1000
100
10
1
0
200
400
600
800

ACIS Calibration Status

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- **Here follow some plots showing fits to the external calibration source using the new (N0002) S3 FEFs at $-120°$C.**

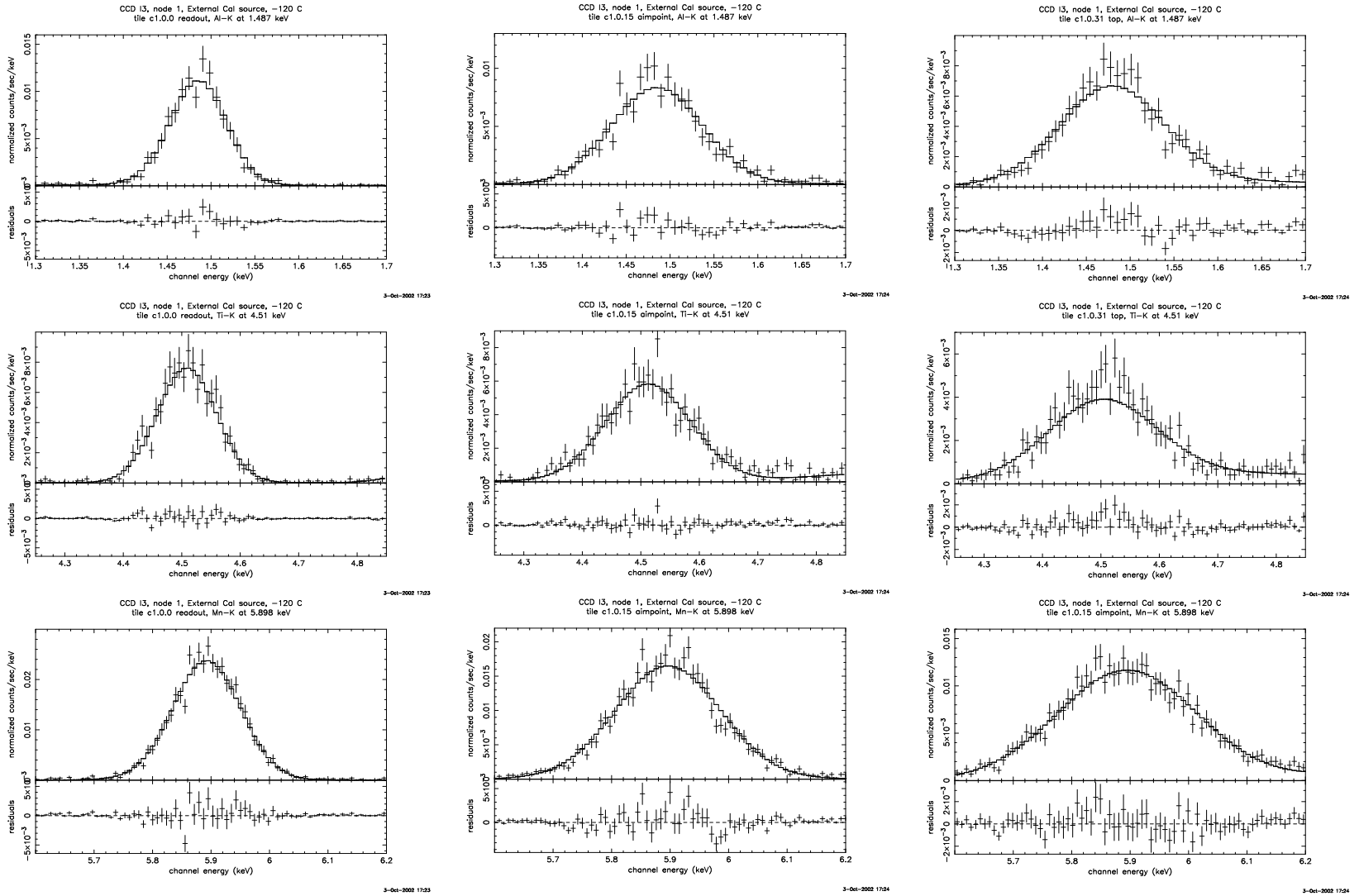

Figure 2: Fits to external calibration source lines: I3 c1, chipy=[1:32] (left), [481:512] (center), and [993:1024] (right)

Astronomical Source Fits using New S3 FEFs

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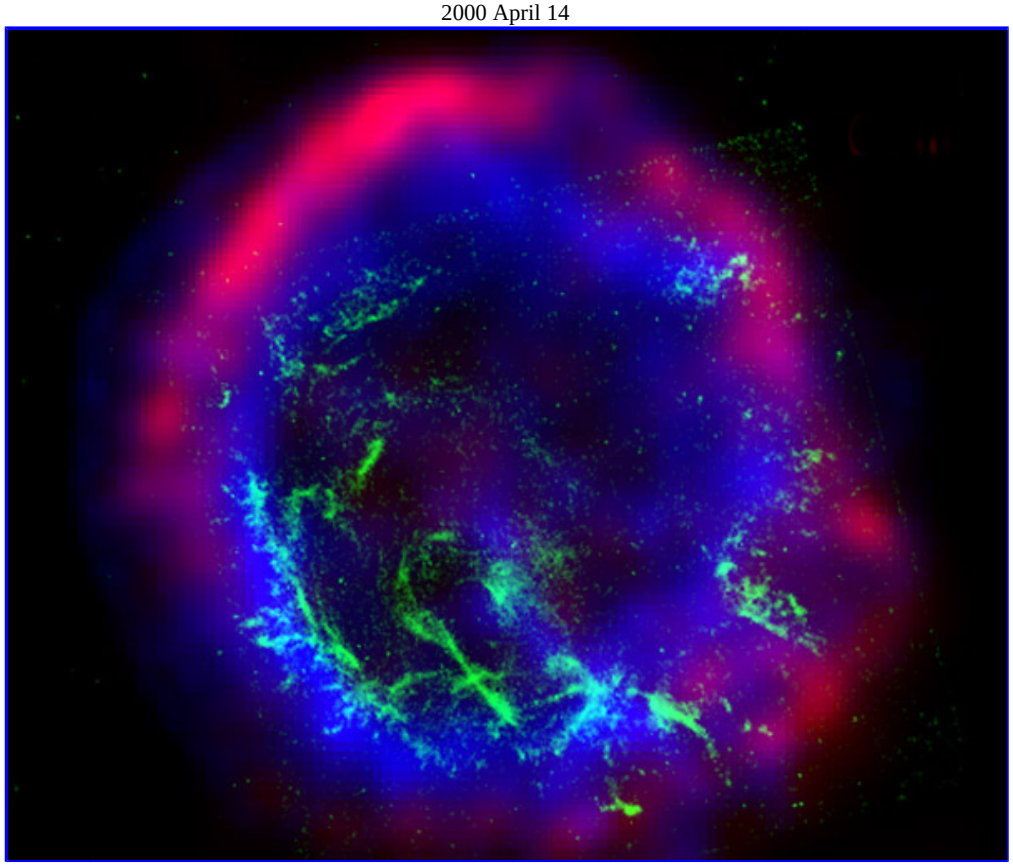
- **Here follow a few plots concerning fits to E0102 spectra.**
- **Note the spectral resolution at the readout is much better than near the ACIS-I aimpoint (top of chip)**
- **1E0102-72.3 is an oxygen rich supernova, a few thousand years old, in the SMC. The bright x-ray ring is the reverse shock, propagating into the oxygen-neon layer of the supernova ejecta. There is little (no?) iron in this gas.**

Astronomy Picture of the Day

Discover the cosmos! Each day a different image or photograph of our fascinating universe is featured, along with a brief explanation written by a professional astronomer.

2000 April 14



Supernova Remnant E0102-72 from Radio to X-Ray
Credit: X-ray (NASA/CXC/SAO); optical (NASA/HST); radio: (ATNF/ ATCA)

Explanation: Not all stars form a big Q after they explode. The shape of supernova remnant E0102-72, however, is giving astronomers a clue about how tremendous explosions disperse elements and interact with surrounded gas. The above image is a composite of three different photographs in three different types of light. Radio waves, shown in red, trace high-energy electrons spiraling around magnetic field lines in the shock wave expanding out from the detonated star. Optical light, shown in green, traces clumps of relatively cool gas that includes oxygen. X-rays, shown in blue, show relatively hot gas that has been heated to millions of degrees. This gas has been heated by an inward moving shock wave that has rebounded from a collision with existing or slower moving gas. This big Q currently measures 40 light-years across and was found in our neighboring SMC galaxy. Perhaps we would know even more if we could buy a vowel.

Tomorrow's picture: Surveyor Hops

Figure 3: E0102 spectrum 7' off axis (near readout)

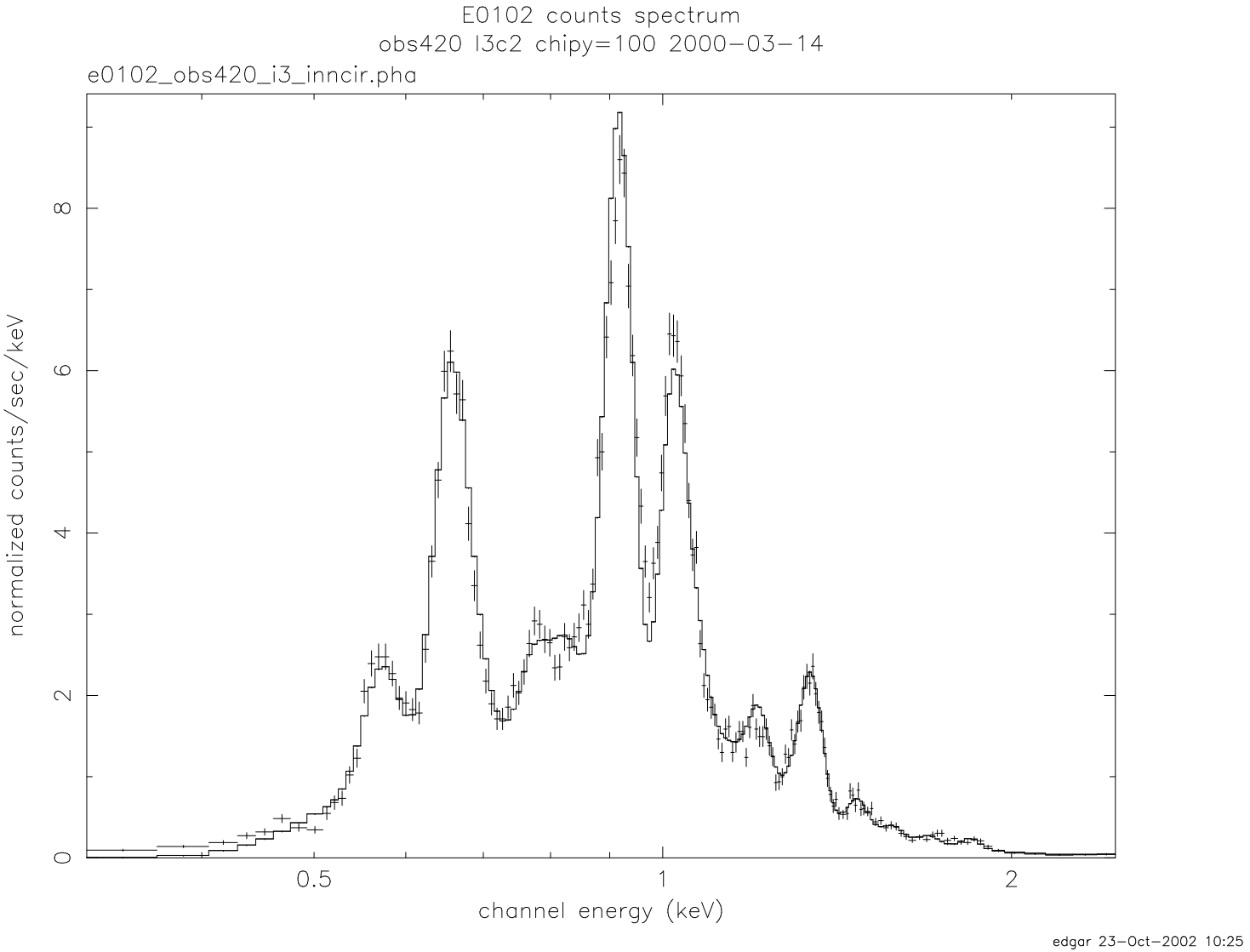


Figure 4: E0102 spectrum 7' off axis (near readout)

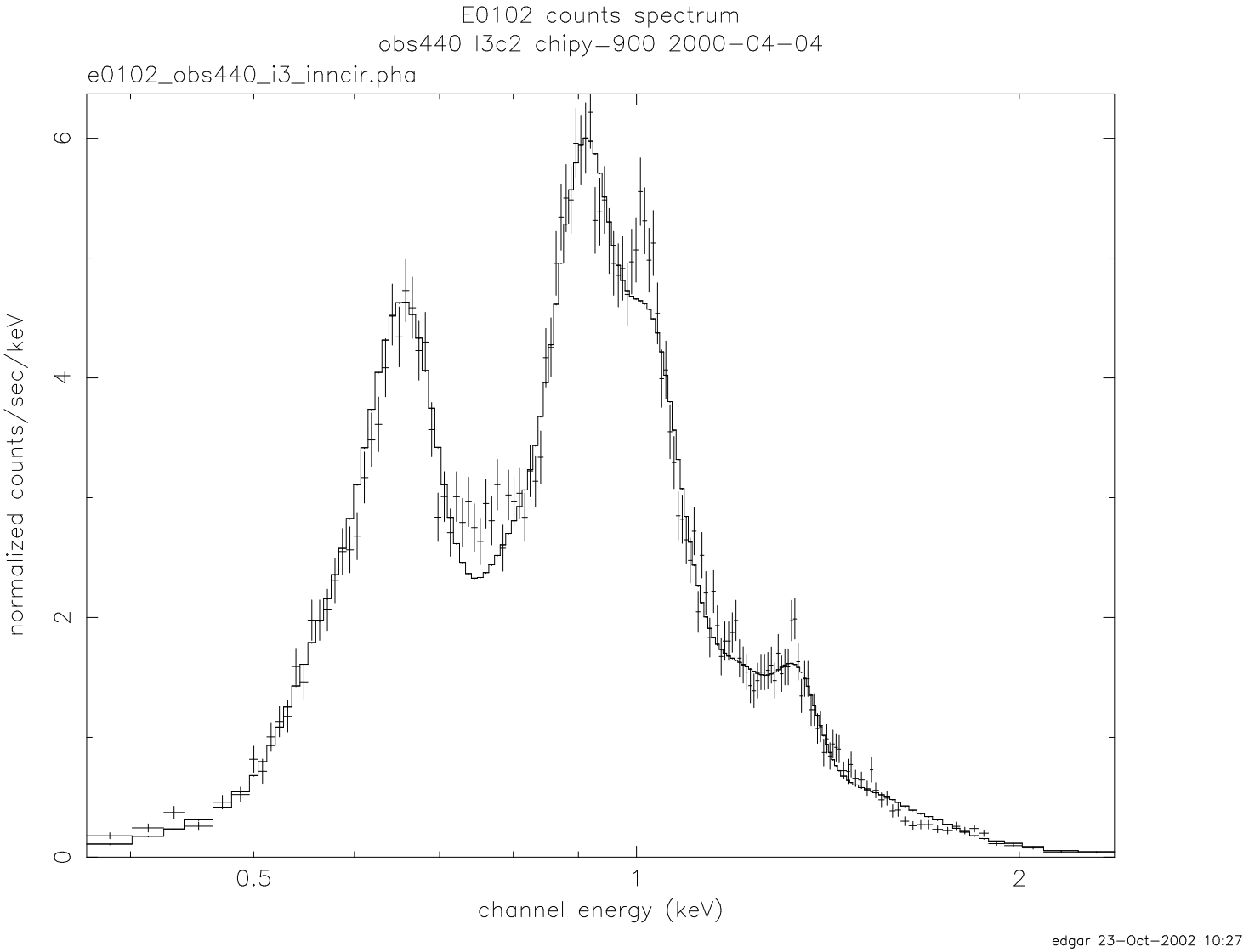


Figure 5: E0102 spectrum at aimpoint (top of chip)

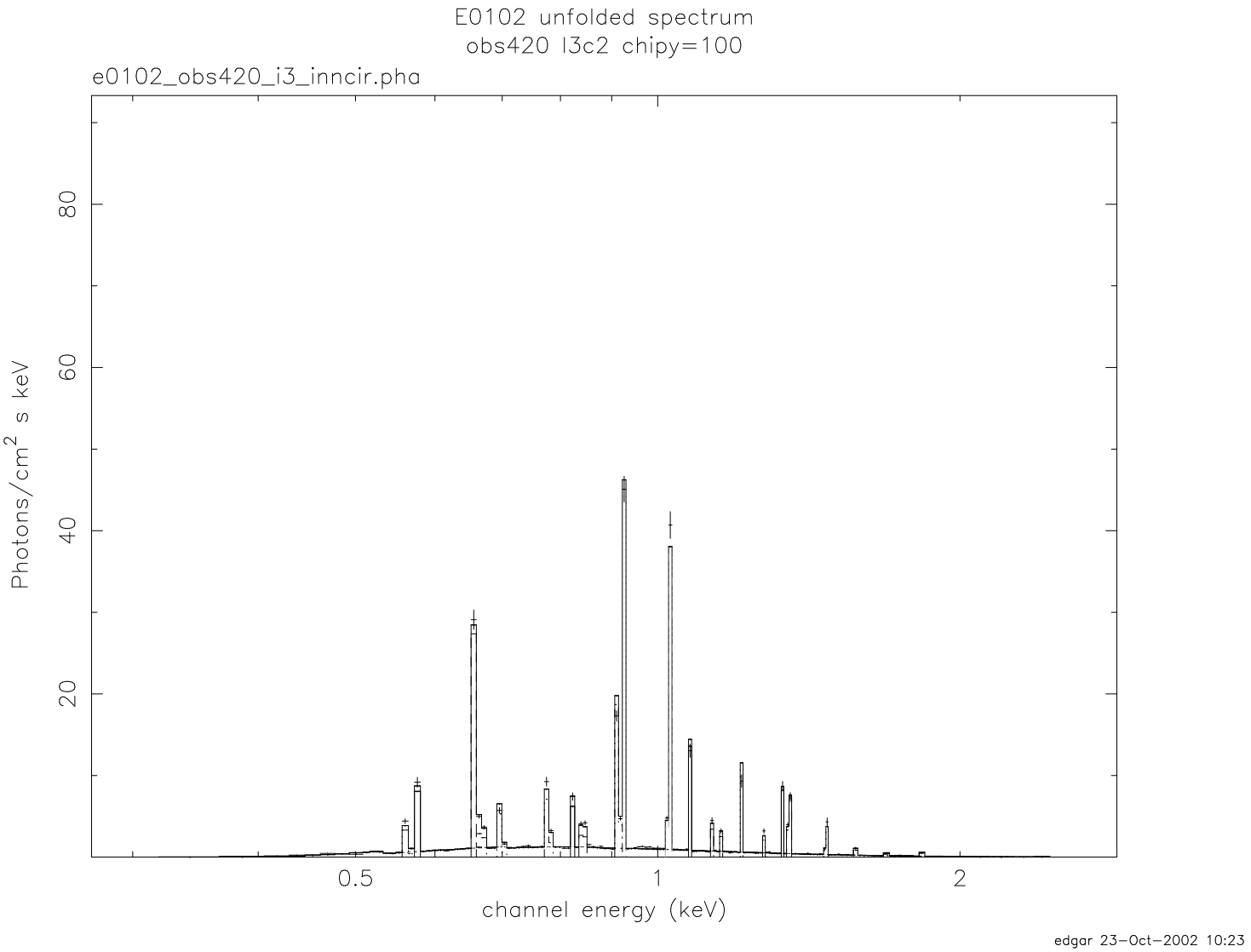


Figure 6: Derived model spectrum of E0102. Line ratios based on K. Flanagan, A. Fredricksen, et al. (2002, private communication) HETG data.

Astronomical Source Fits using New S3 FEFs

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- **Here follow a few plots concerning fits to cluster of galaxies cl0016+16.**
- **CTI-corrected and uncorrected matrices produce very similar results.**

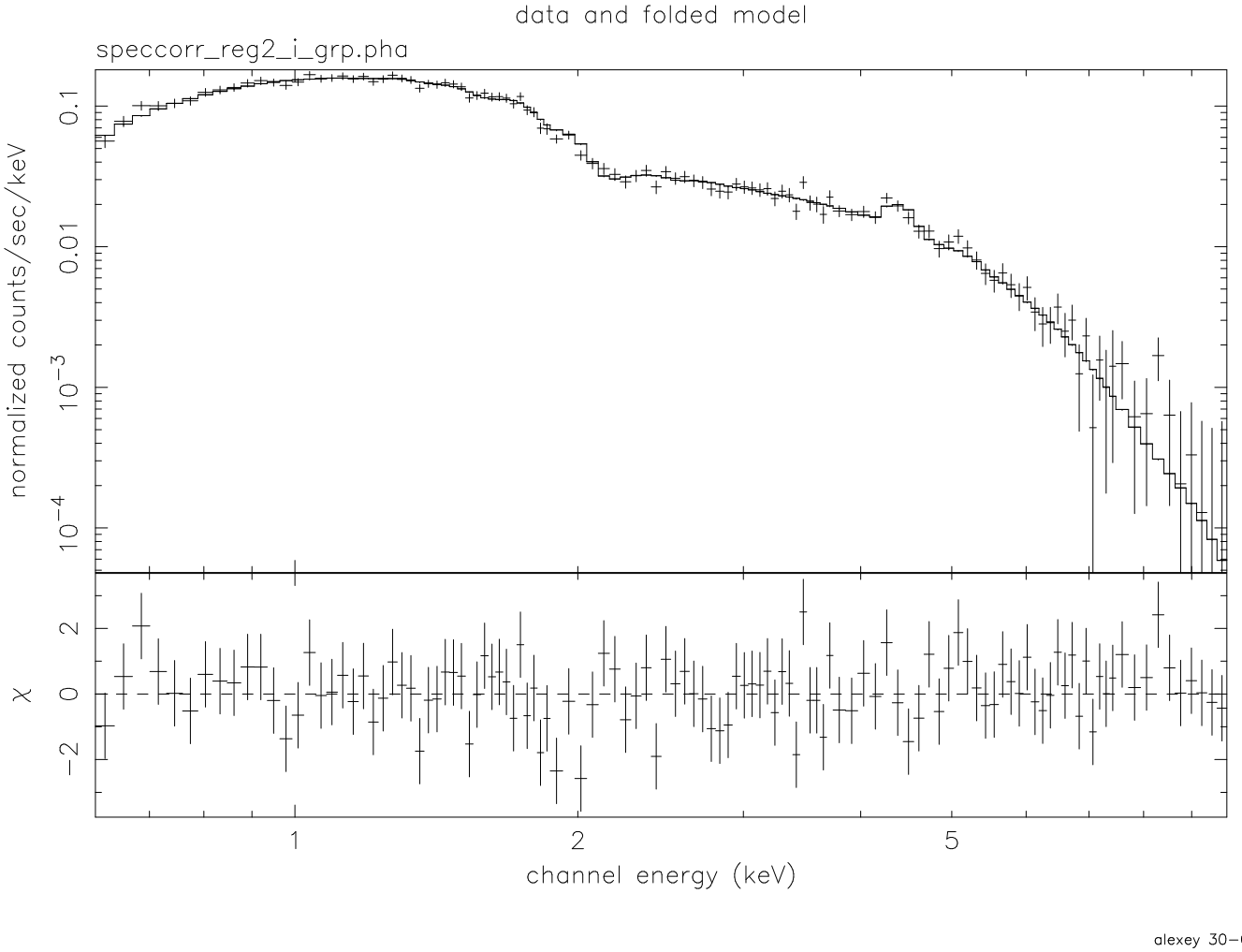

Figure 7: Best PI fit to distant cluster cl0016+16 with CTI-corrected FEFs. The region extends over 15 tiles and two nodes, I3c2 and I3c3. $\chi^2_\nu = 0.88$.

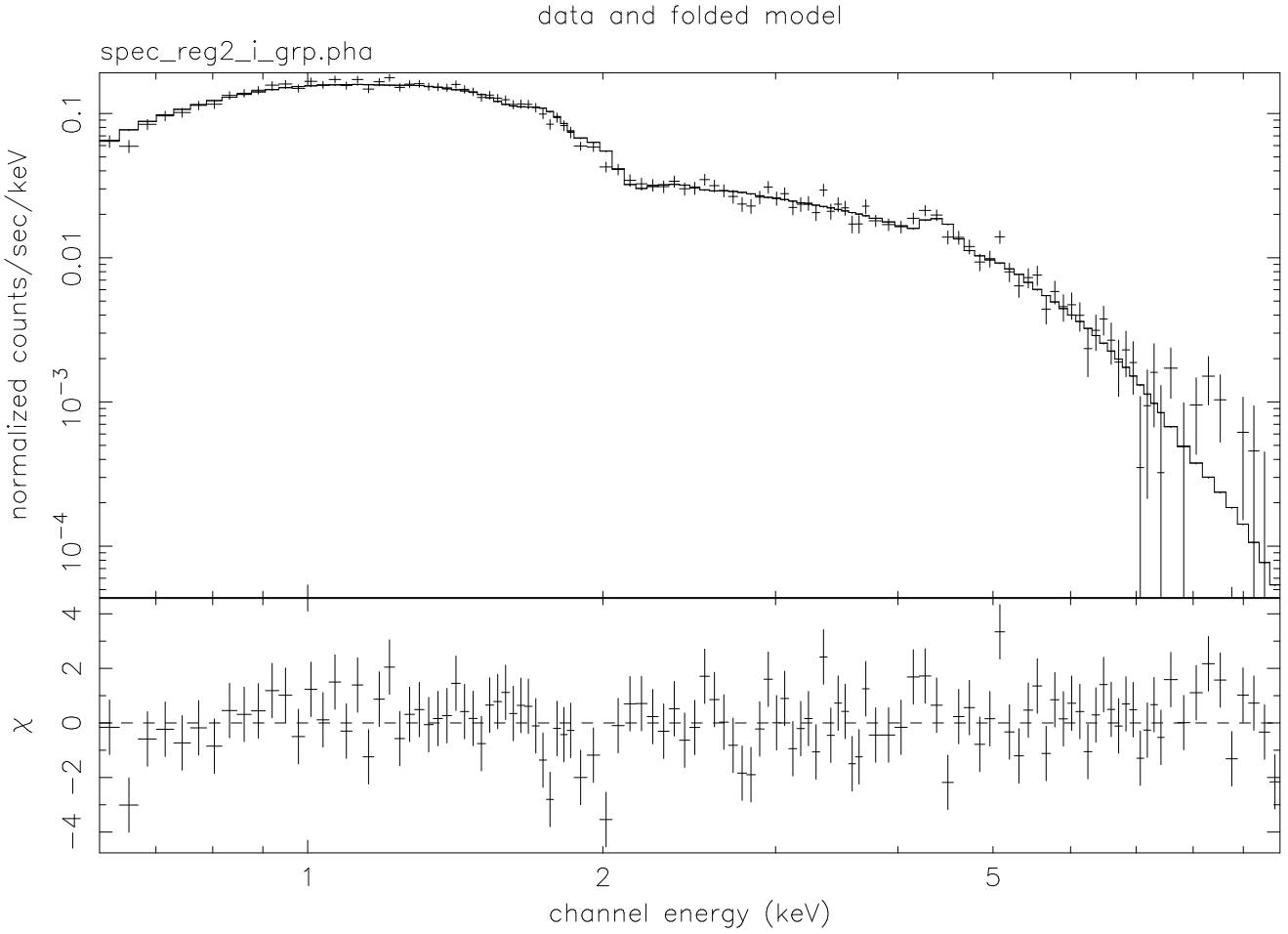

Figure 8: Best PI fit to distant cluster cl0016+16 with existing, released, non-CTI-corrected FEFs. $\chi^2_\nu = 1.29$.