SPATIAL DISTRIBUTION OF THE ACIS CONTAMINATION

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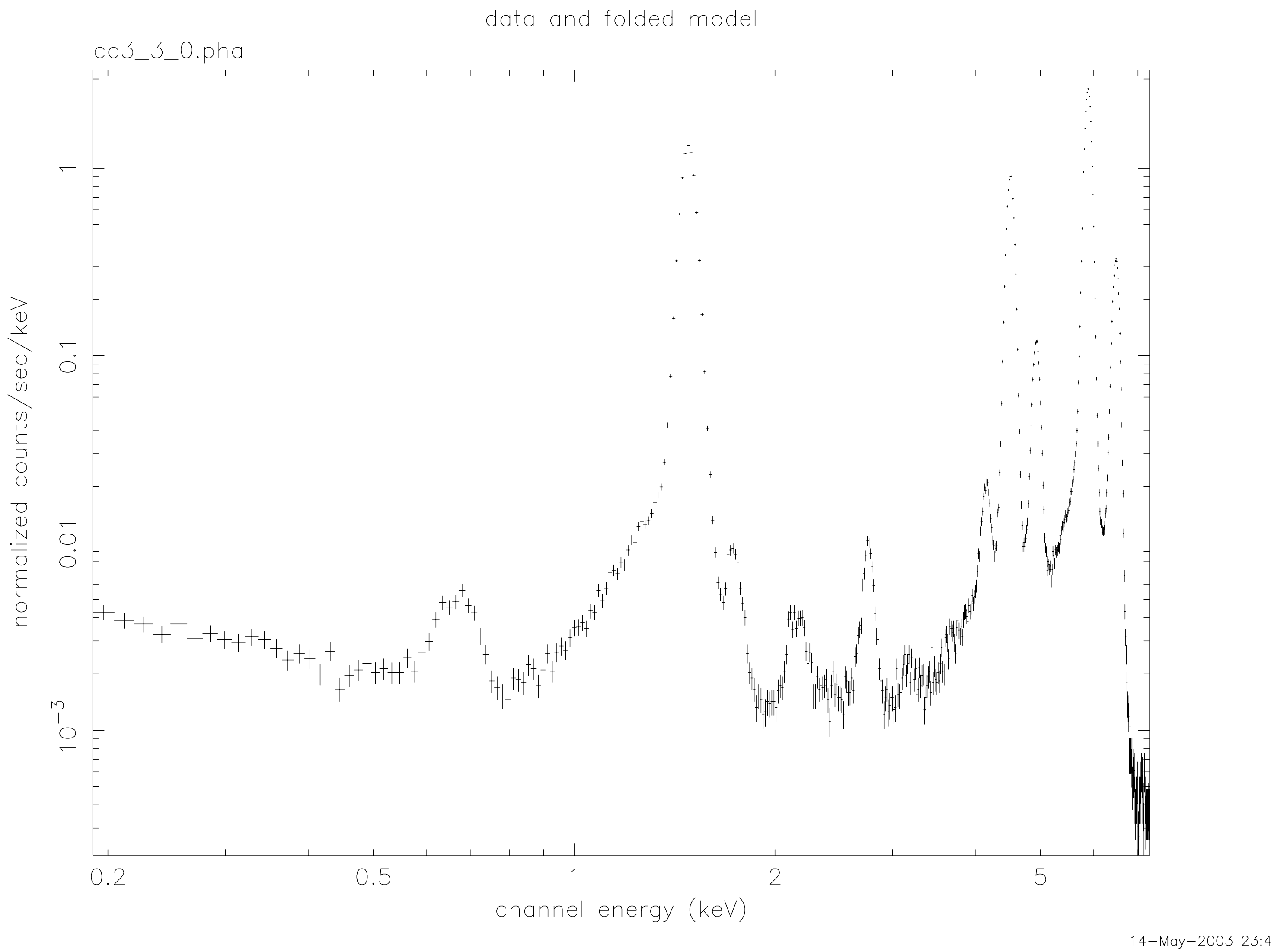
Data

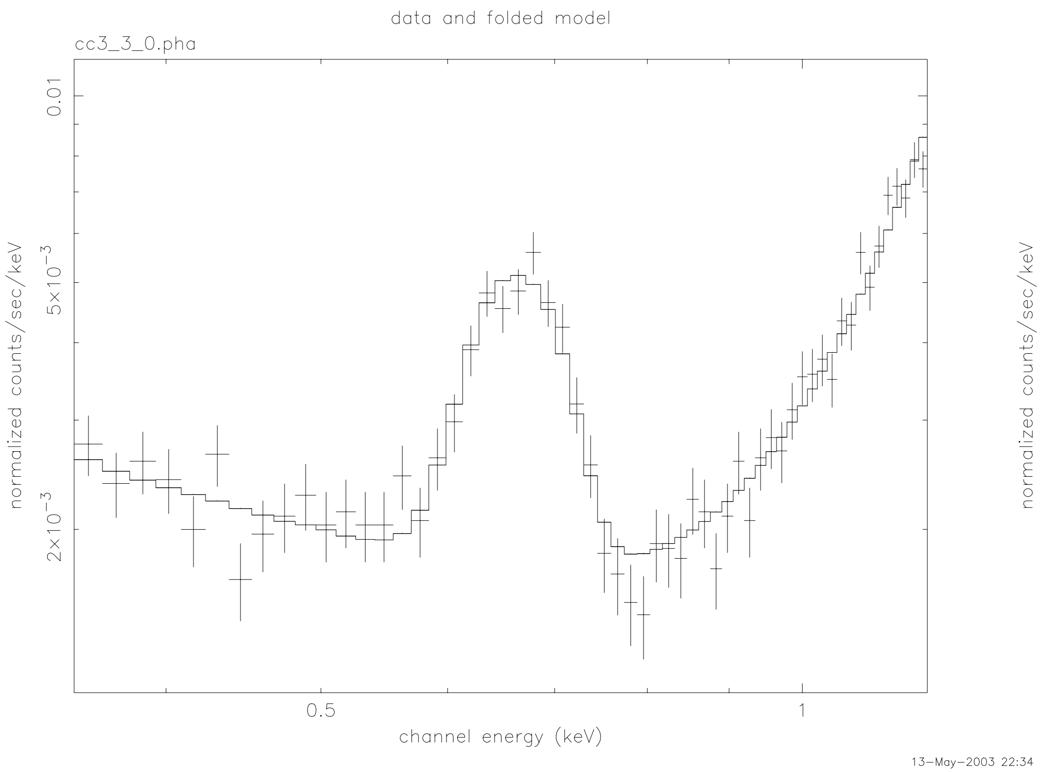
- External cal. source data accumulated over the 3-month periods since January 2000, (Feb-Apr 2000, May-Jul 2000 and so on). 1-month periods in 1999.
- CTI correction applied to the FI chips.
- `tgain` correction
- use ARF (QE, QEU but no mirror) and RMF approapriate for each region.

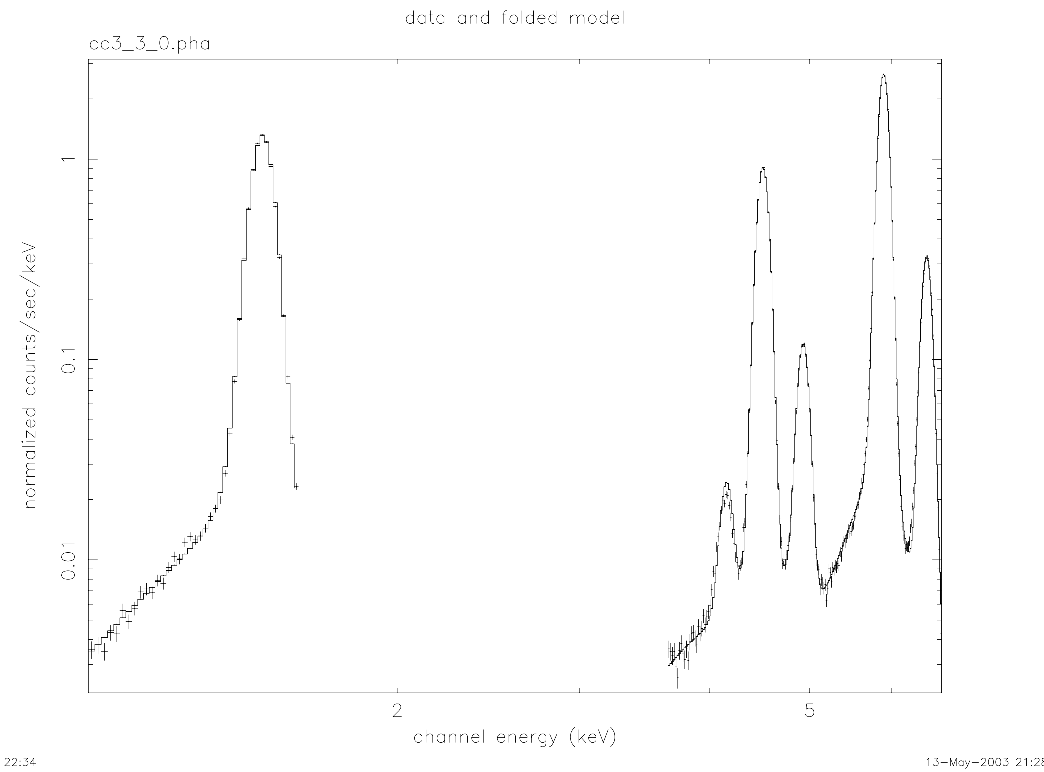
Spectral model



1. Power law representing the low energy tails of the bright Mn and Ti and also
2. Exponential, $\exp(-(1.487 - E)/\delta E)$, representing the tail of the Al-K line.
3. Two gaussians of equal flux with central energies allowed to vary between 0.62 and 0.72 keV and internal widths constrained to be $\sigma < 20$ eV.
4. Gaussian+exponential tail for high-energy lines

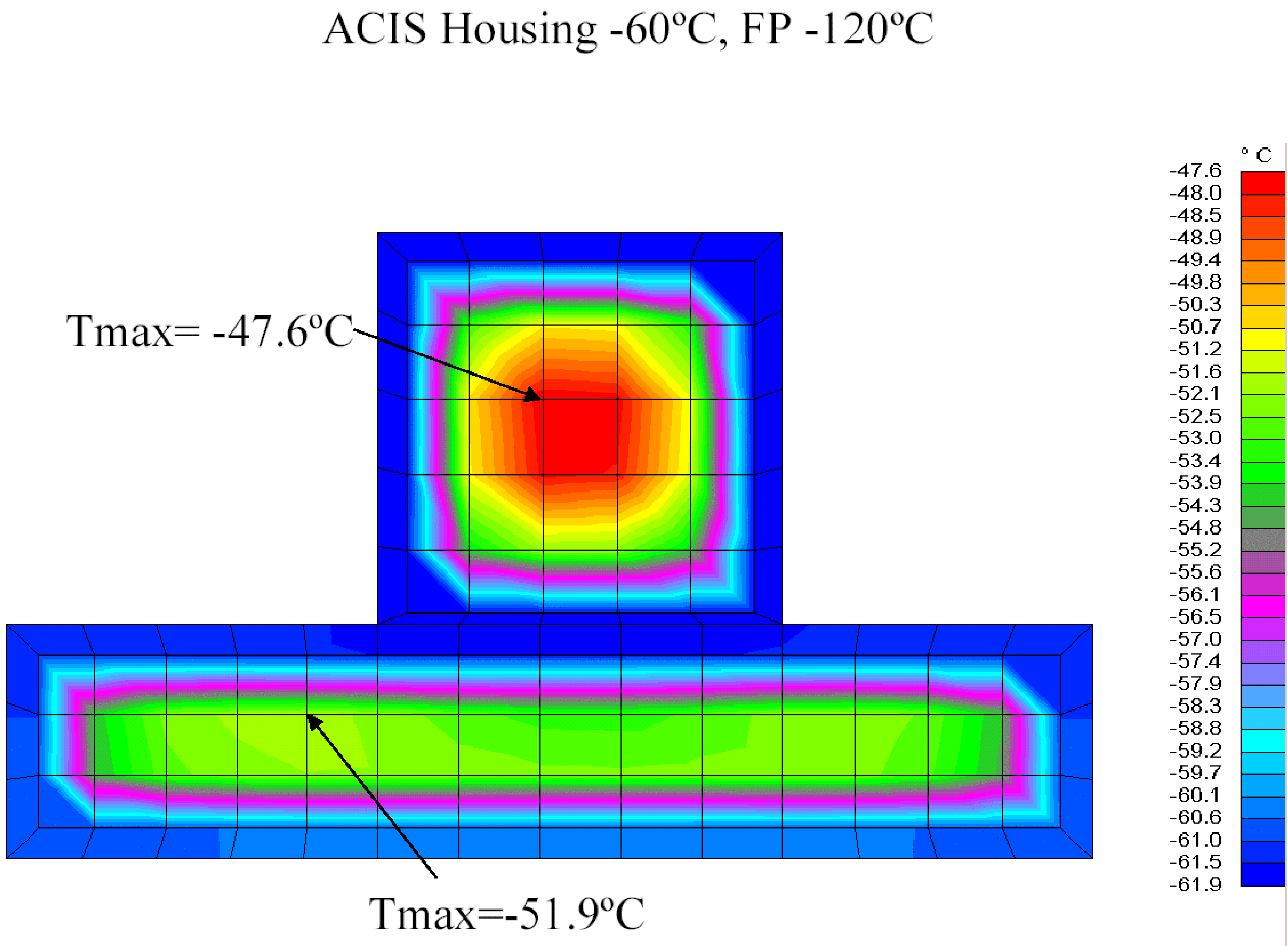
Fit examples





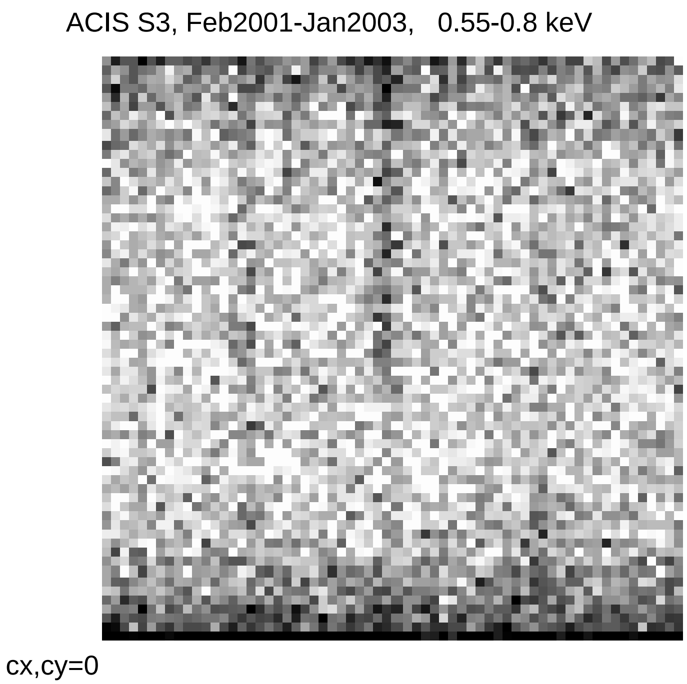
- Multiply L/K flux ratio by the ratio of nominal quantum efficiencies at 5.89 and 0.67 keV (takes out CTI-induced QE non-uniformities)
- $\tau = \ln(L/K)_{\mathrm{pre-launch}} - \ln(L/K)$

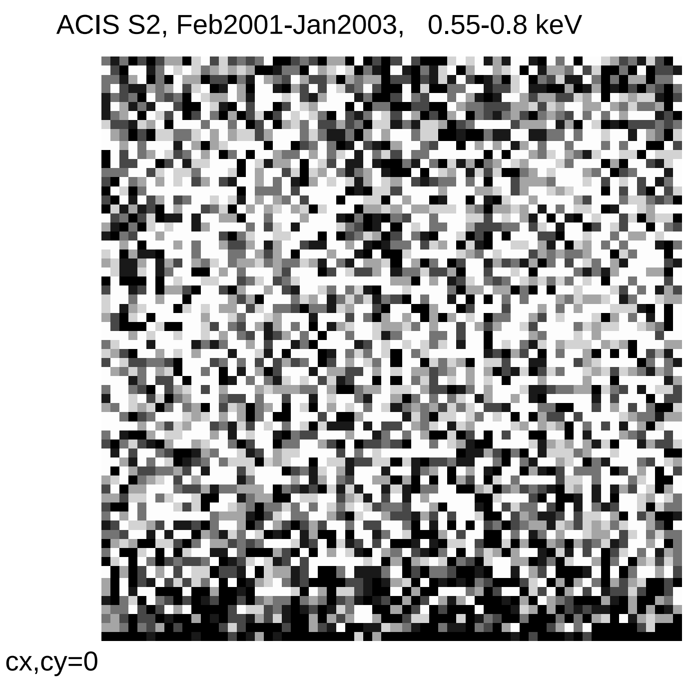
NB. OBF Temperature model



Spatial structure

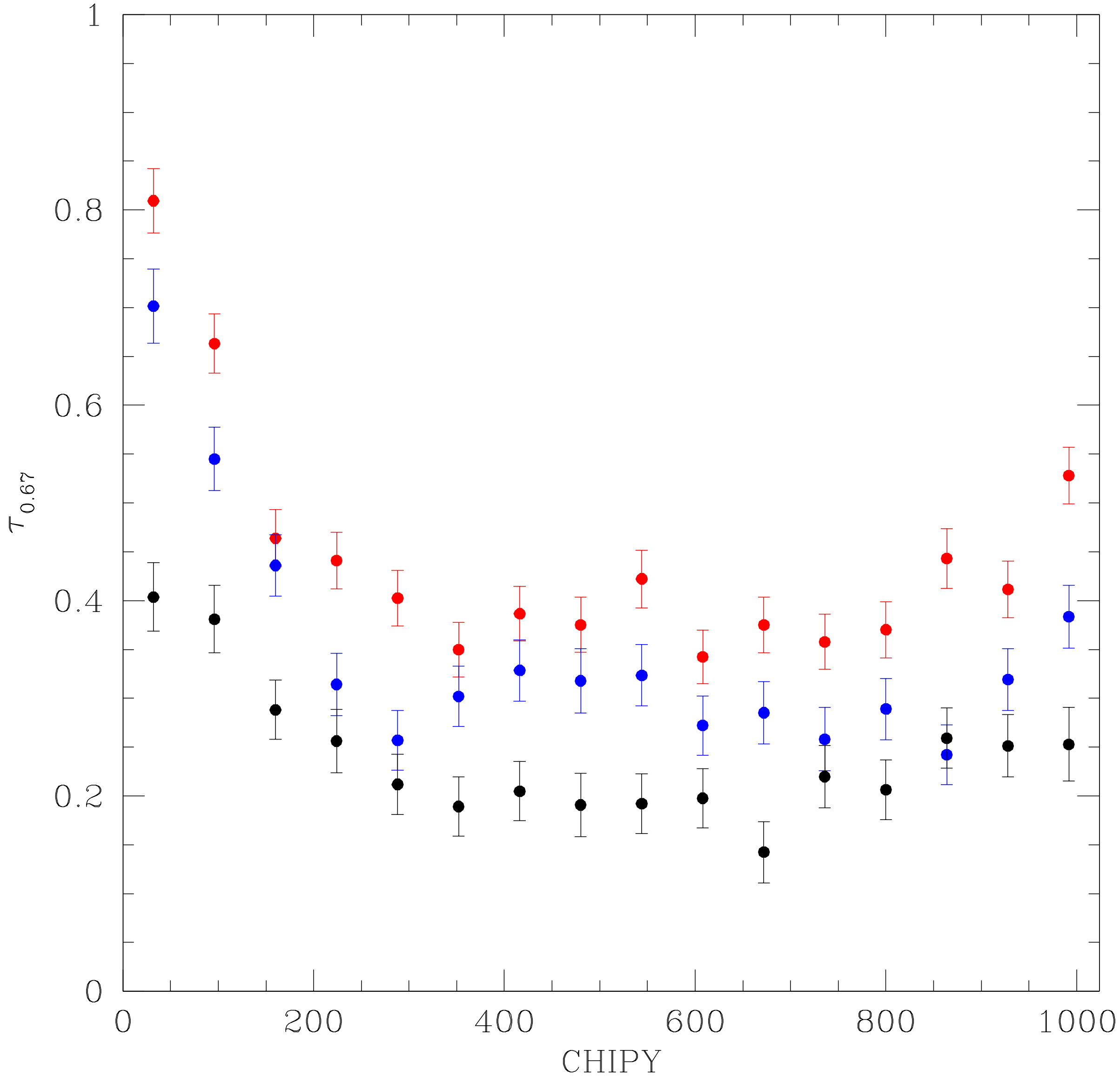
ACIS-S





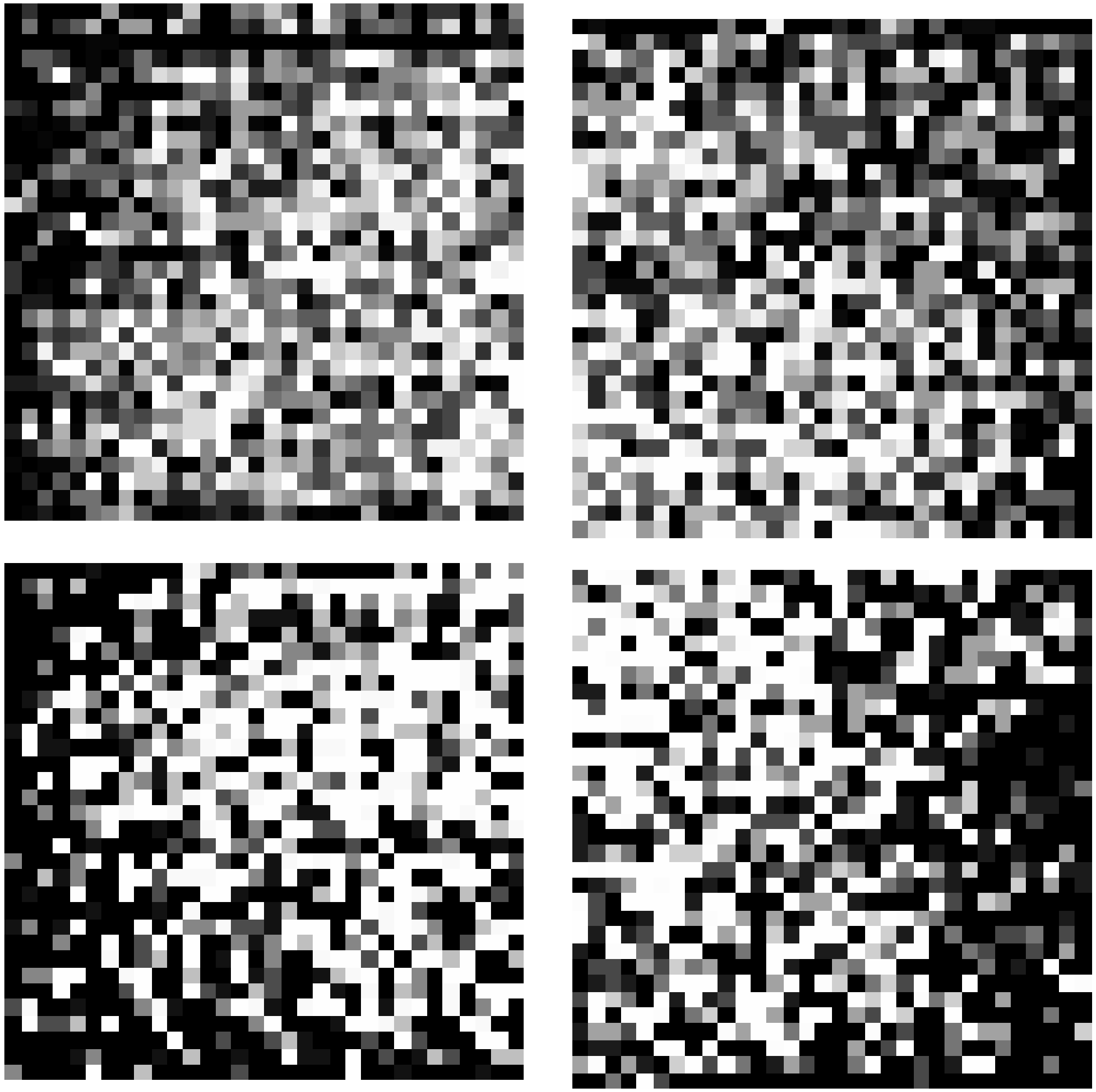
External cal source image in S3 and S2 in the 0.55–0.8 keV band (the Mn/Fe L complex) over Feb 2001 – Jan 2003.

τ(CHIPY) in ACIS-S



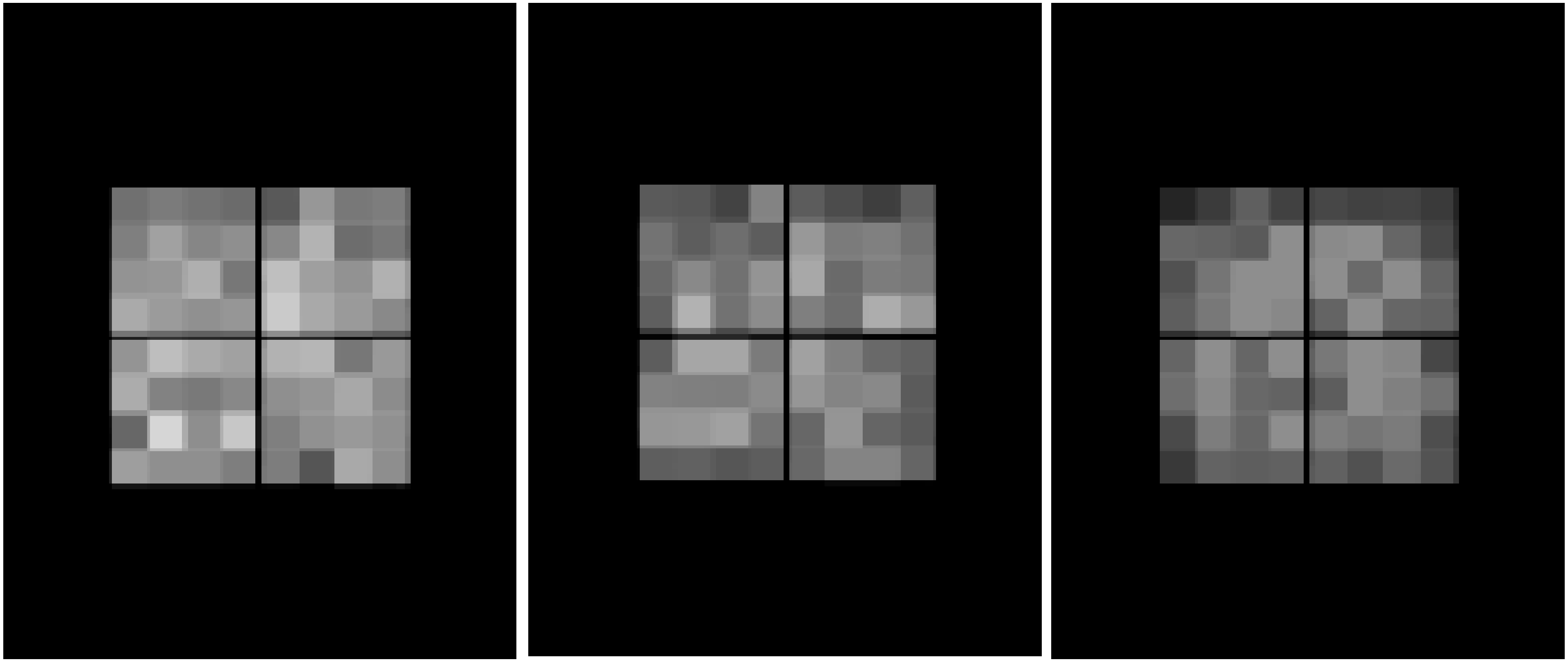
Black: Feb-Jul 2000, Blue: Aug2000-Jul2001, Red: Aug2001-Jul2002.

ACIS-I



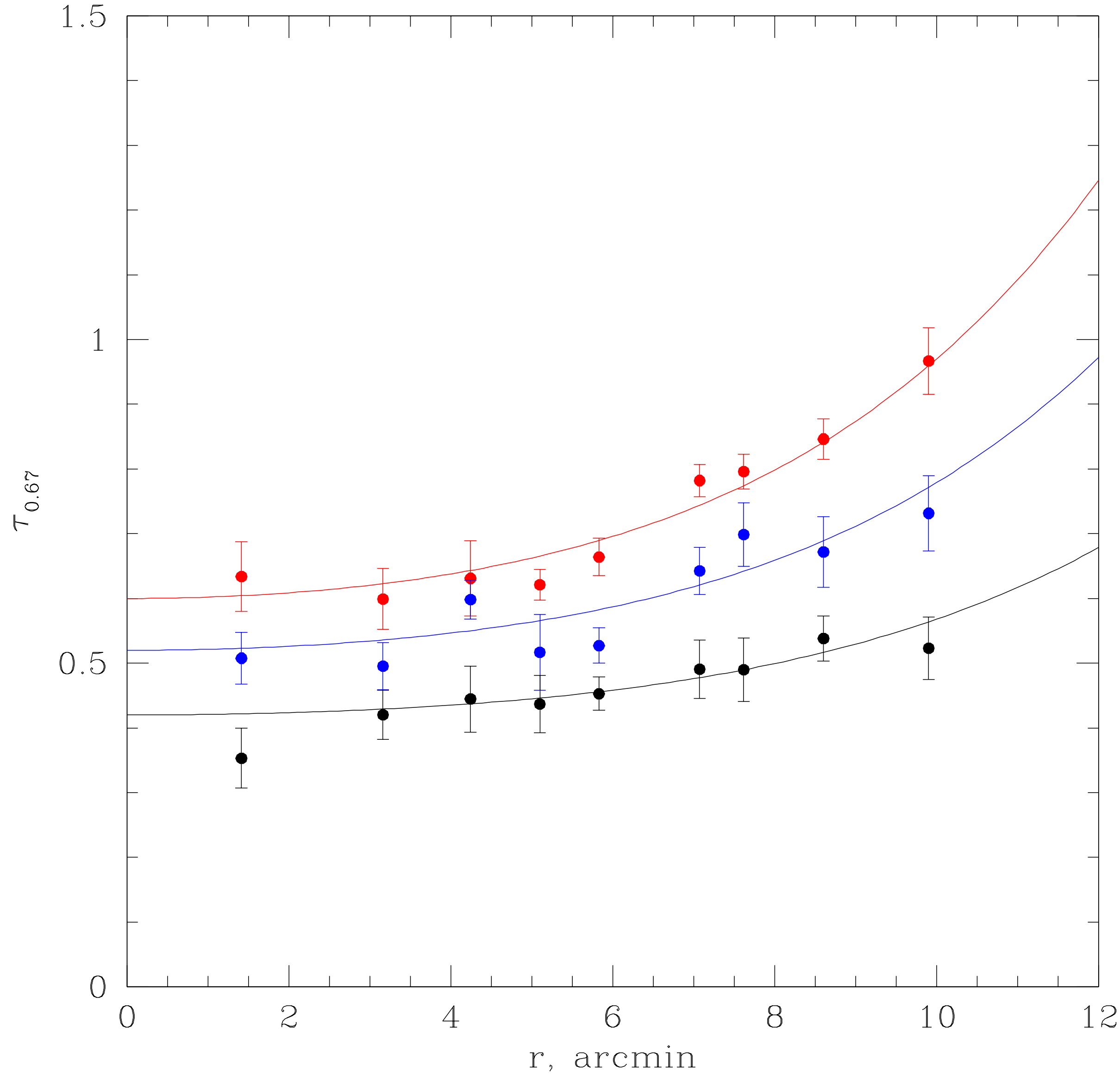
External cal source image in ACIS-I in the 0.55–0.8 keV band over Feb 2001 – Jan 2003. I0 is top-left, I1 is top-right, I2 is bottom-left, and I3 is bottom-right.

$\tau(\mathbf{x}, \mathbf{y})$ in ACIS-I



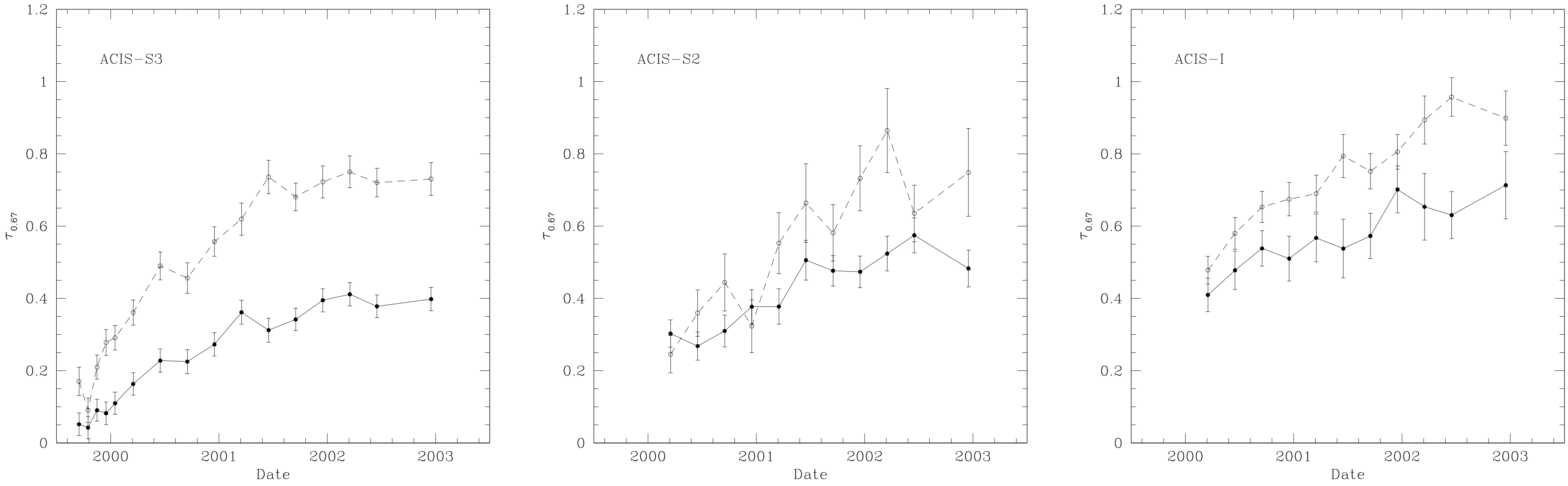
Feb-Jul 2000 (left), Aug2000-Jul2001 (middle), and Aug2001-Jul2002 (right).

$\tau(r)$ in ACIS-I



Feb-Jul 2000 (black), Aug2000-Jul2001 (blue), and Aug2001-Jul2002 (red). The analytic models are in the form $\tau = A + B(r/10.8')^5$.

Time dependence



Filled circles: center, Open circles: border. For ACIS-S, the center is $256 < CHIPY < 768$ and border is $CHIPY < 128$. For ACIS-I the border region is the 256 pixels wide frame along the border of the array, and center is an $8' \times 8'$ square centered on the aim point.

Further work

- Differences in τ between ACIS imaging and HETG/LETG measurements (contamination in S1, different growth rate for C and O?)
- Differences between S2 and S3.
- Software:
  - make $\tau_{0.67}(x, y)$ maps for each epoch
  - use $\tau(E)$ from `contamarf`
  - compute corrections and verify with available data (E0102-37, Cas-A, some clusters).

Summary

- Significant spatial variations of the Mn,Fe-L and Mn-Ka flux ratio suggest that the contamination buildup in non-uniform.
- There is less contaminant in the centers of both CCD arrays where the filter temperature is higher.
- The optical depth grows faster near the readout of ACIS-S and along the border of ACIS-I.
- L/K ratio in the centers of ACIS-I and ACIS-S2 indicates that there is more contaminant on the I-array, $\Delta\tau(0.67\text{keV}) = 0.15$.