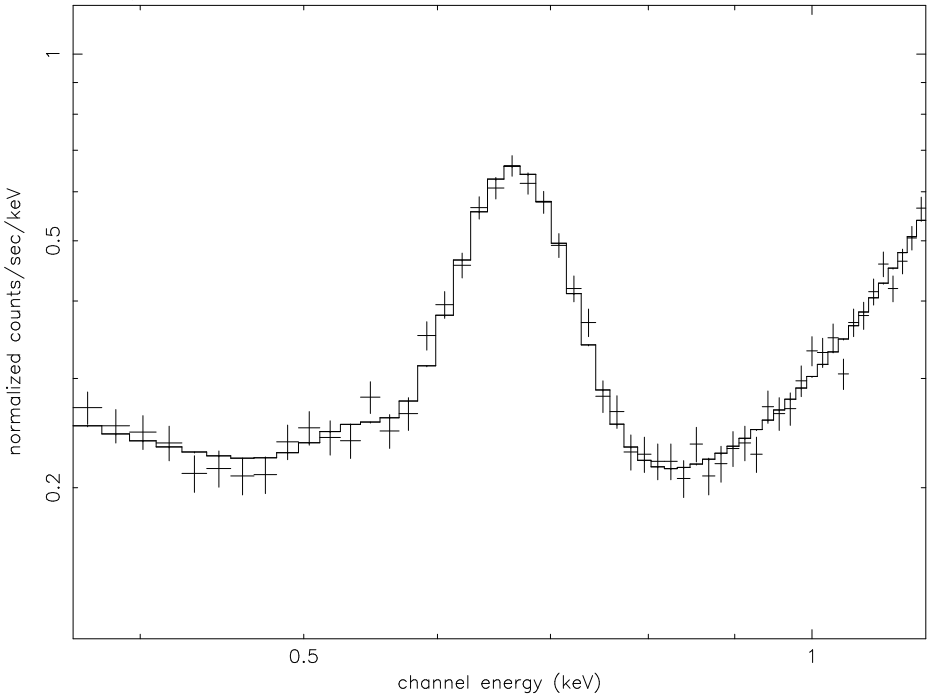
SPATIAL STRUCTURE

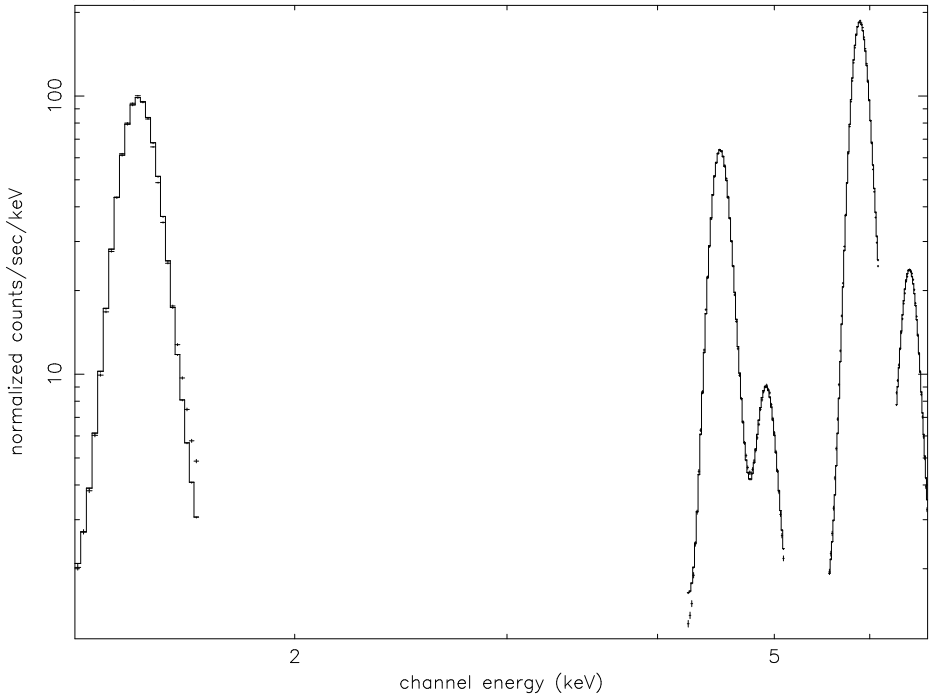
OF ACIS CONTAMINATION

Scope

- **Flux ratio for Mn-K and (Mn+Fe)-L gives τ near 700 eV**
- **Results presented many times since 2002**
- **This talk:**
  - **final report (hopefully)**
  - **science tests using A1795 pointings**

Data





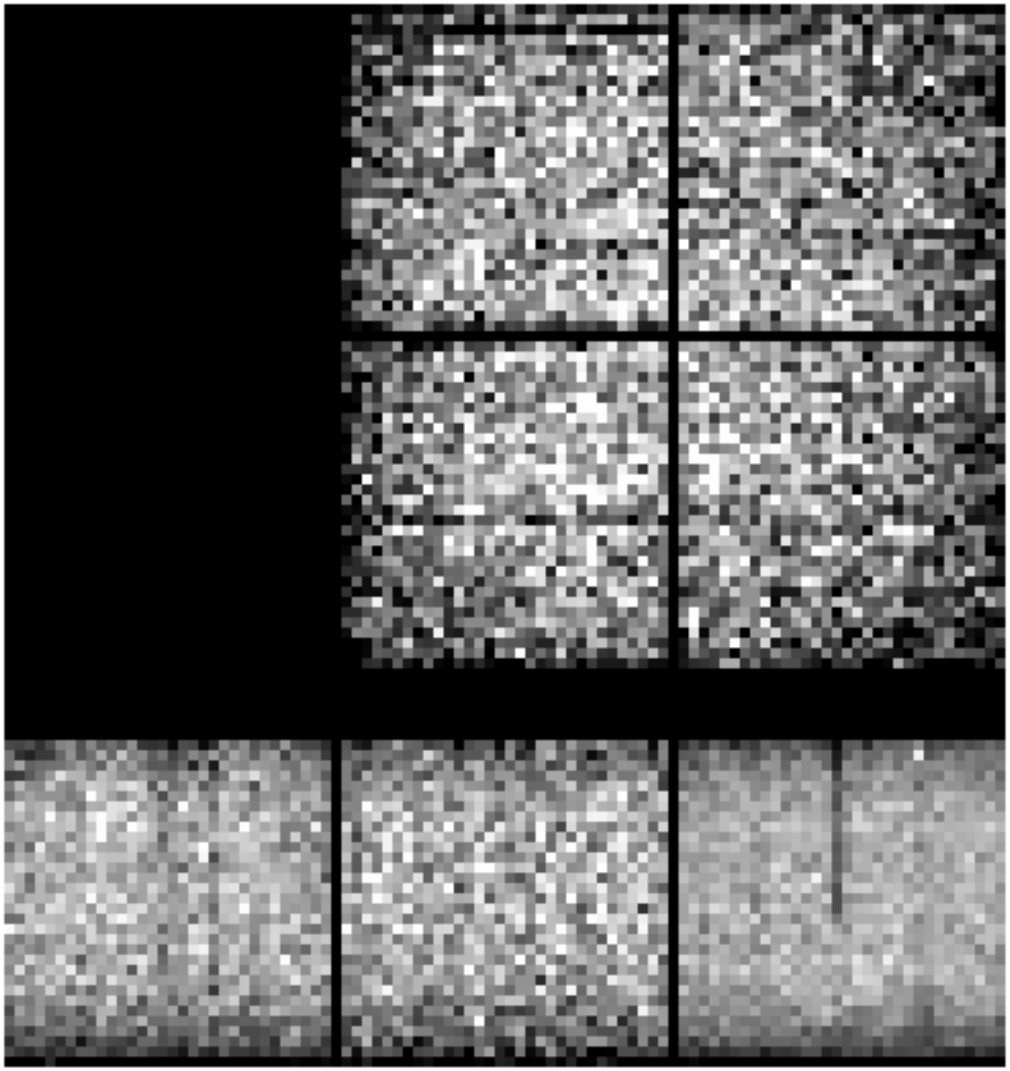
- **ECS data over 3 months (t-dependence) or 1 year (x,y-dependence)**
- **flux =** $\dfrac{\text{Observed cnt/s}}{\text{QE} \times \text{OBF transmission} \times \text{QEU}}$

$$\tau_L = -4.687 - \log(f_L / f_{\text{Mn-Ka}}) \qquad \text{for S3}$$

$$\tau_L = -4.925 - \log(f_L / f_{\text{Mn-Ka}}) \qquad \text{for ACIS-I and S2}$$

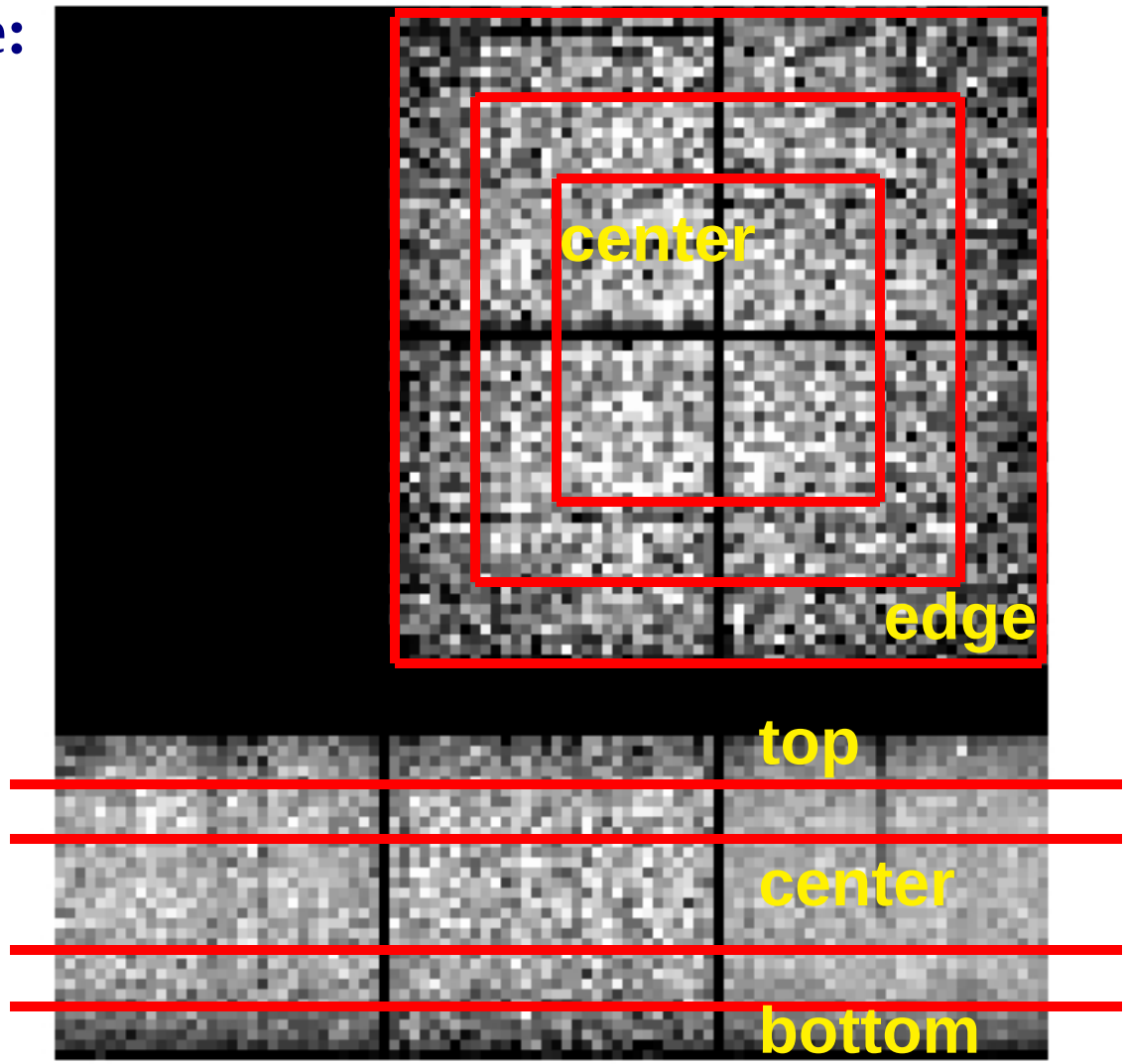
Qualitative spatial distribution

ACIS, L-line image:

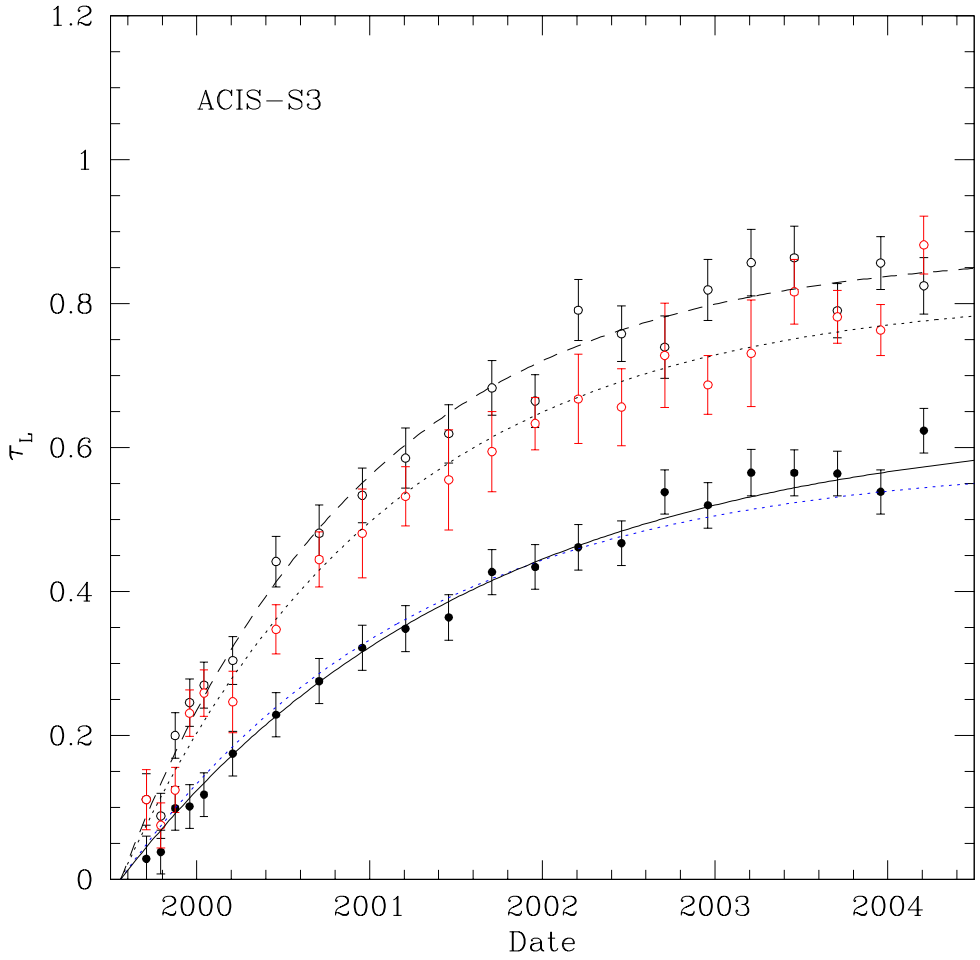


Qualitative spatial distribution

ACIS, L-line image:



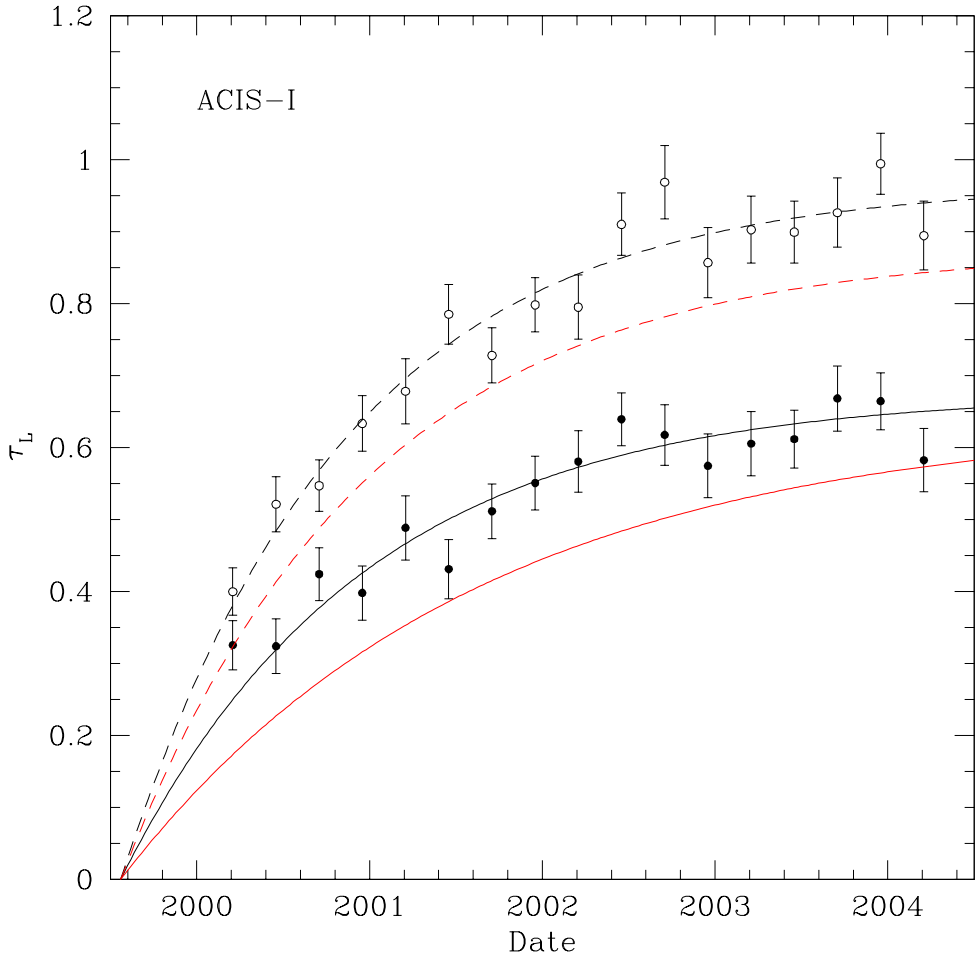
Time dependance, S3



● center ○ bottom ○ top

- fits of the form $\tau = \tau_\infty\left(1 - \exp(-t/T)\right)$
- ··· — fit to chip-averaged data (C. Grant)

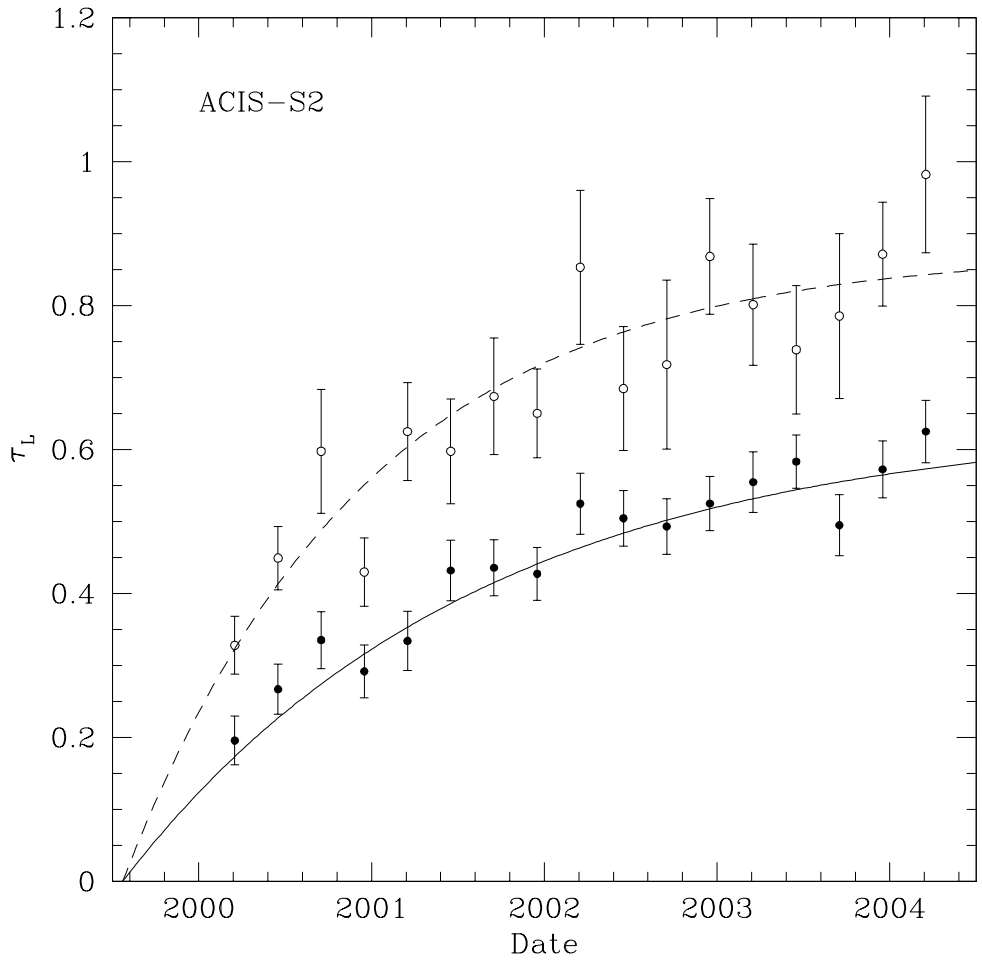
Time dependance, ACIS-I



● center ○ edge ——— fits to S3 data

➢ **stronger contamination in ACIS-I ($\Delta\tau_L \simeq 0.08$)**

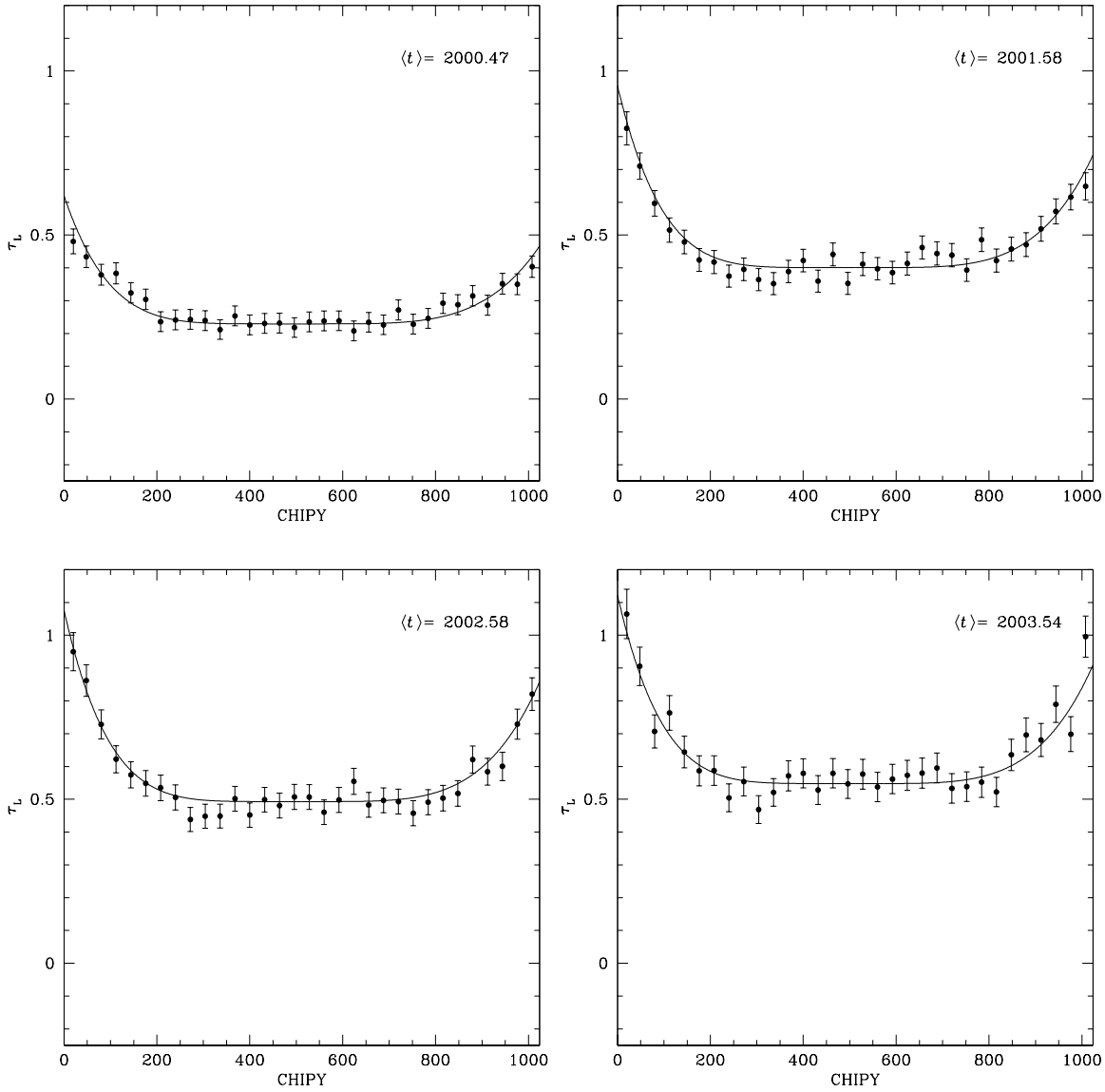
Time dependance, S2



● **center** ○ **bottom** ——— **fits to S3 data**

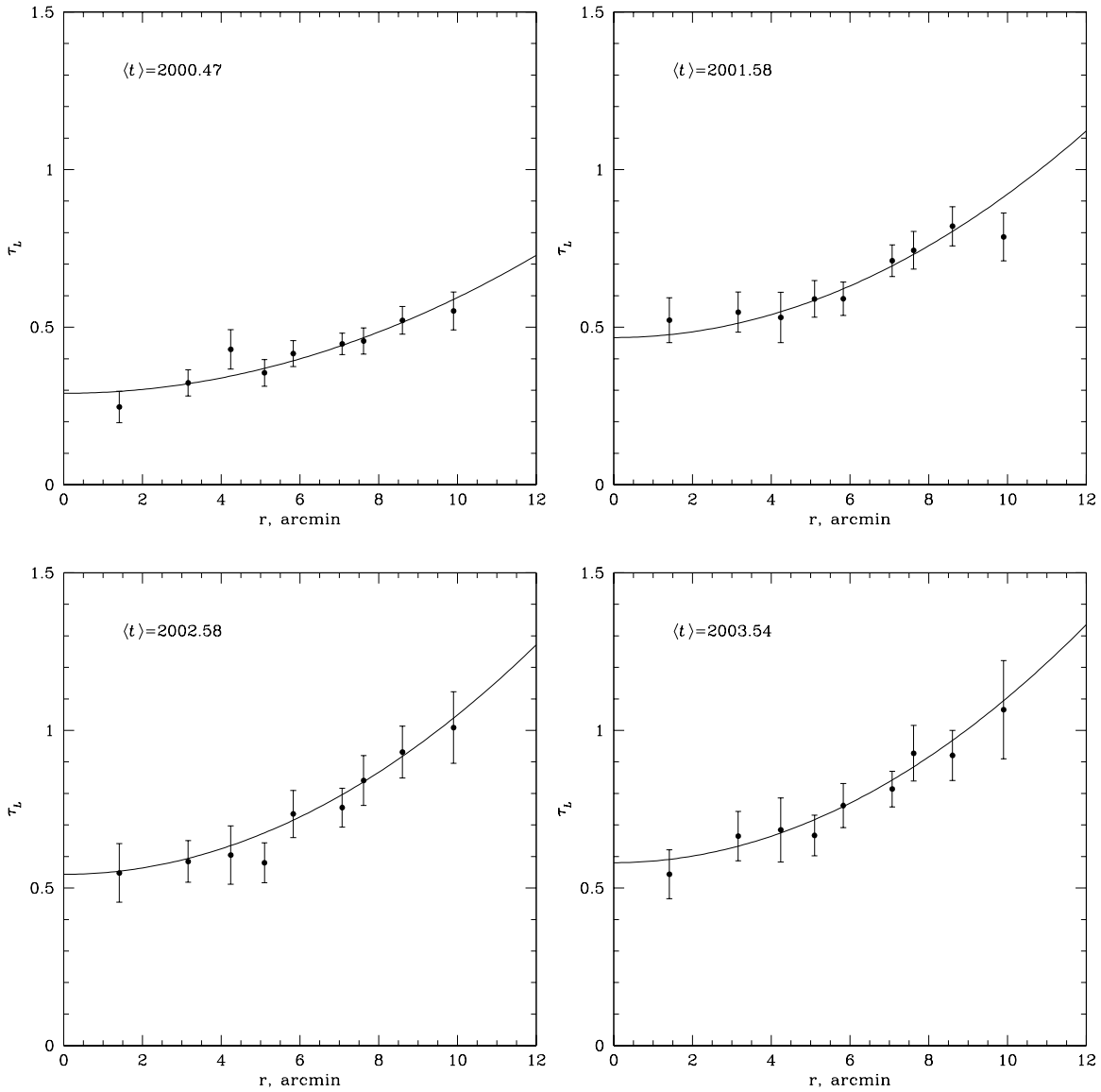
➢ **(S3 vs. I difference not due to FI/BI crosscalibration)**

Spatial dependence, S3



fits of the form $\tau(y) = \tau_0 + \tau_1 |y - 512|^{\alpha}$, with τ_0, τ_1 from t-dependence

Spatial dependence, S3



fits of the form $\tau(y) = \tau_0 + \tau_1 r^{2.0}$, with τ_0, τ_1 from t-dependence

How to go from τ_L to $\tau(E)$

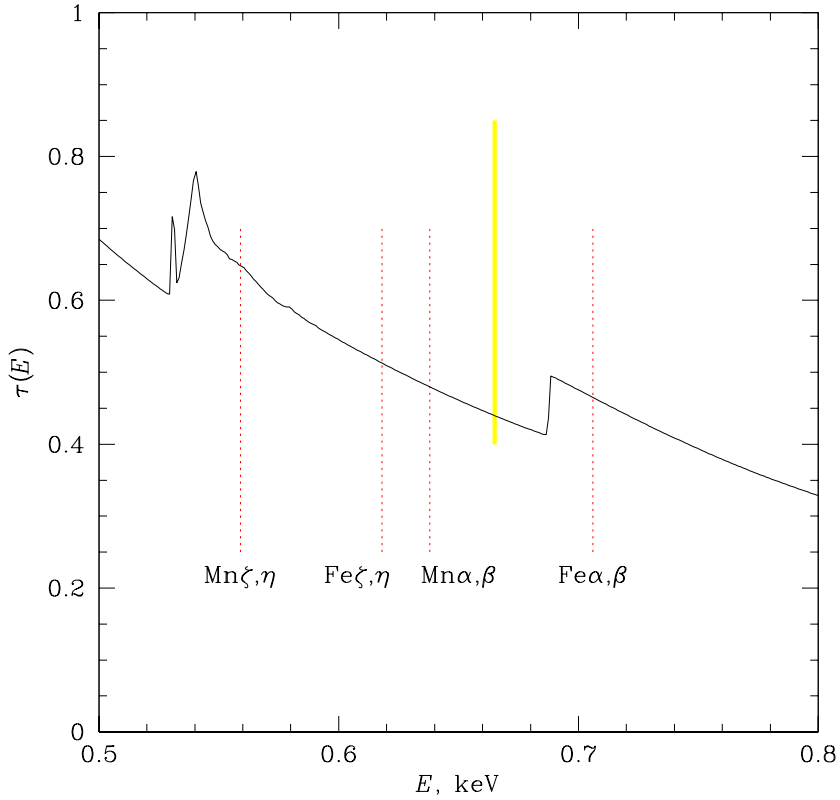
- ECS gives model for $\tau_L(x, y, t)$
- we want $\tau(E, x, y, t)$
- procedure: $\tau(E, x, y, t) = \tau_{\text{grat}}(E) \times A$

  A adjusted so that $\tau_L(x, y, t)$ is reproduced

Structure of the L-complex

From central energy of L-line:

Line group	E, keV	f(FI)	f(BI)
Fe α,β	0.706	39%	33%
Mn α,β	0.638	54%	58%
Fe ζ,η	0.618	2%	3%
Mn ζ,η	0.559	5%	6%
Empirical fit			
X α	0.665	93%	
X ζ	0.535	7%	



$$A = \frac{\tau_L(x, y, t)}{\sum f_i \, \tau_{\text{grat}}(E_i)}$$

Final model

1) $\tau(E)$ from grating measurements

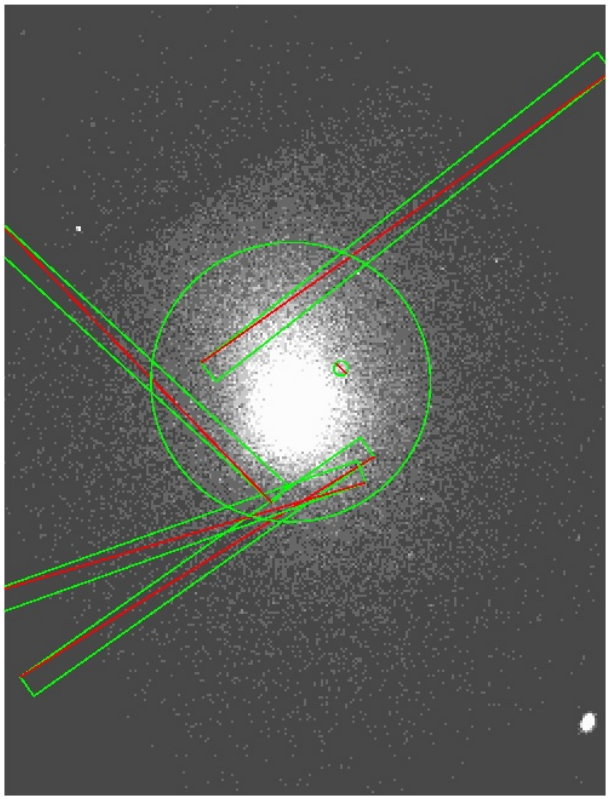
2) $\tau_L(x, y, t)$ from ECS data

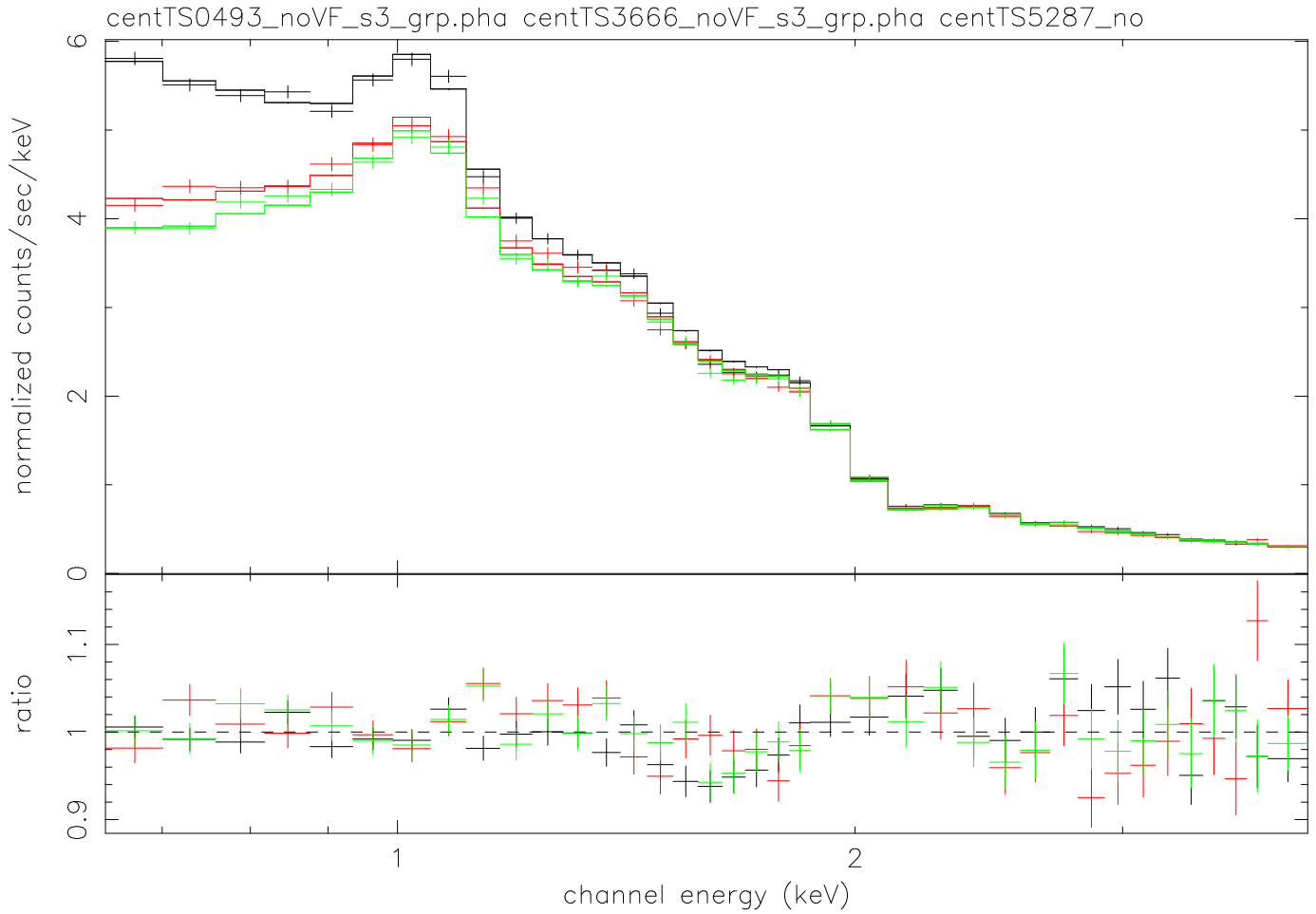
3) $\tau(E, x, y, t)$ from renormalization of $\tau(E)$ to match $\tau_L(x, y, t)$

- Model should be at $E \gtrsim 0.6$ keV (above L-line)
  can be inaccurate near C-K edge until $\tau(E)$ finalized

- TEST: multiple observations of A1795:
  - 4 times in the center of S3
  - pointings to bottom & top of S3, center & edge of ACIS-I

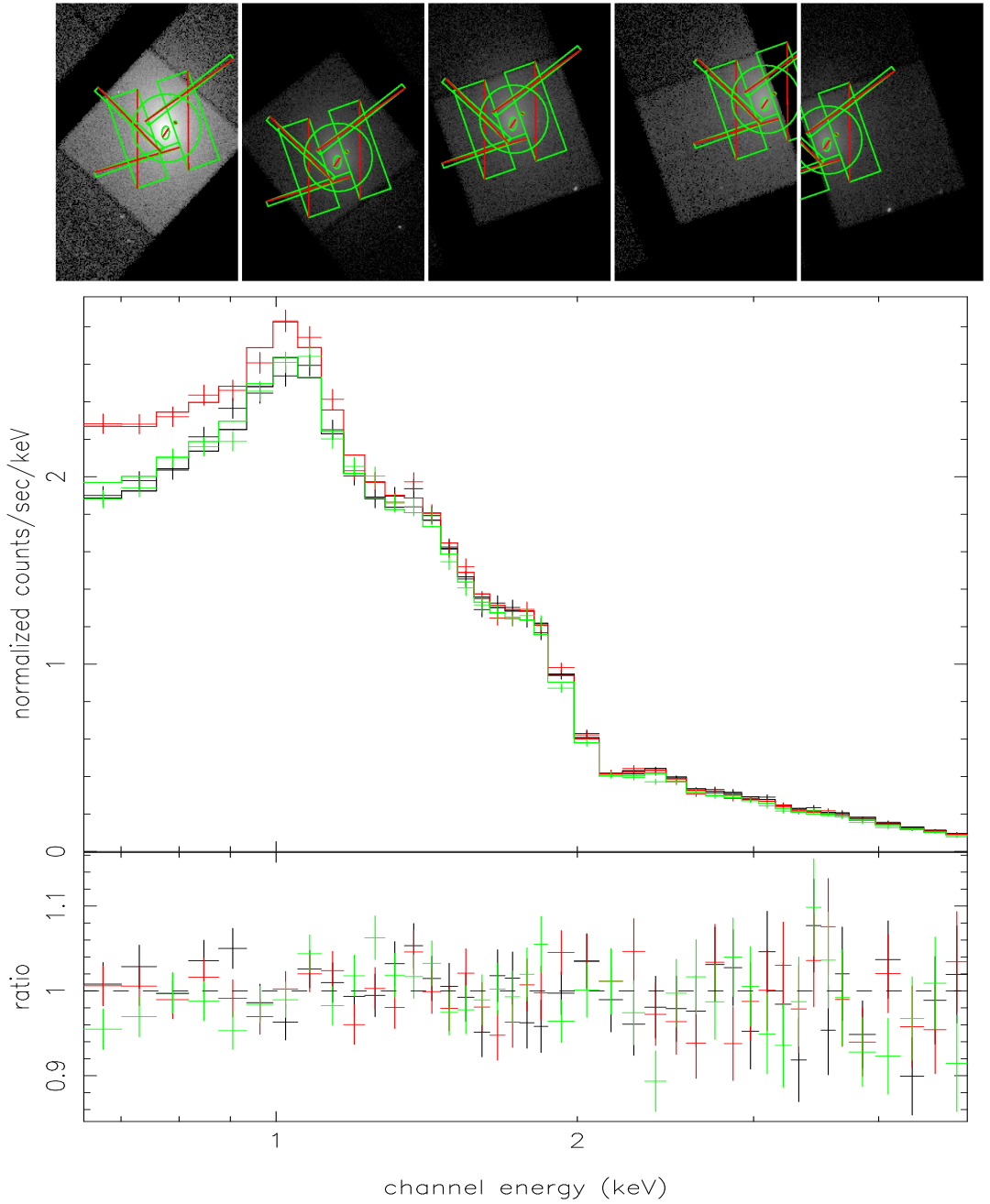
A1795: t-dependence in S3





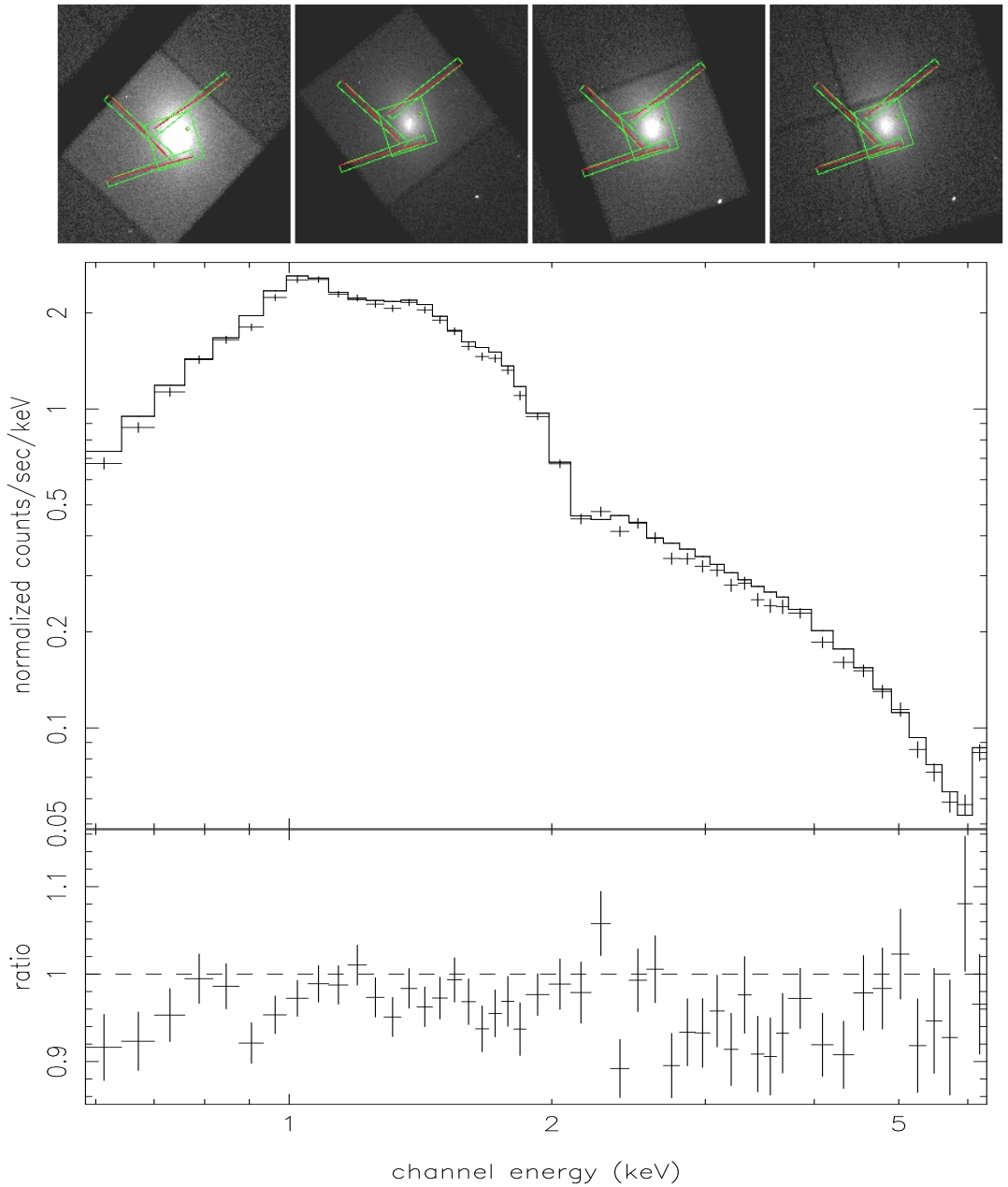
< 3% residuals, time span 4 years

A1795: spatial dependence in S3



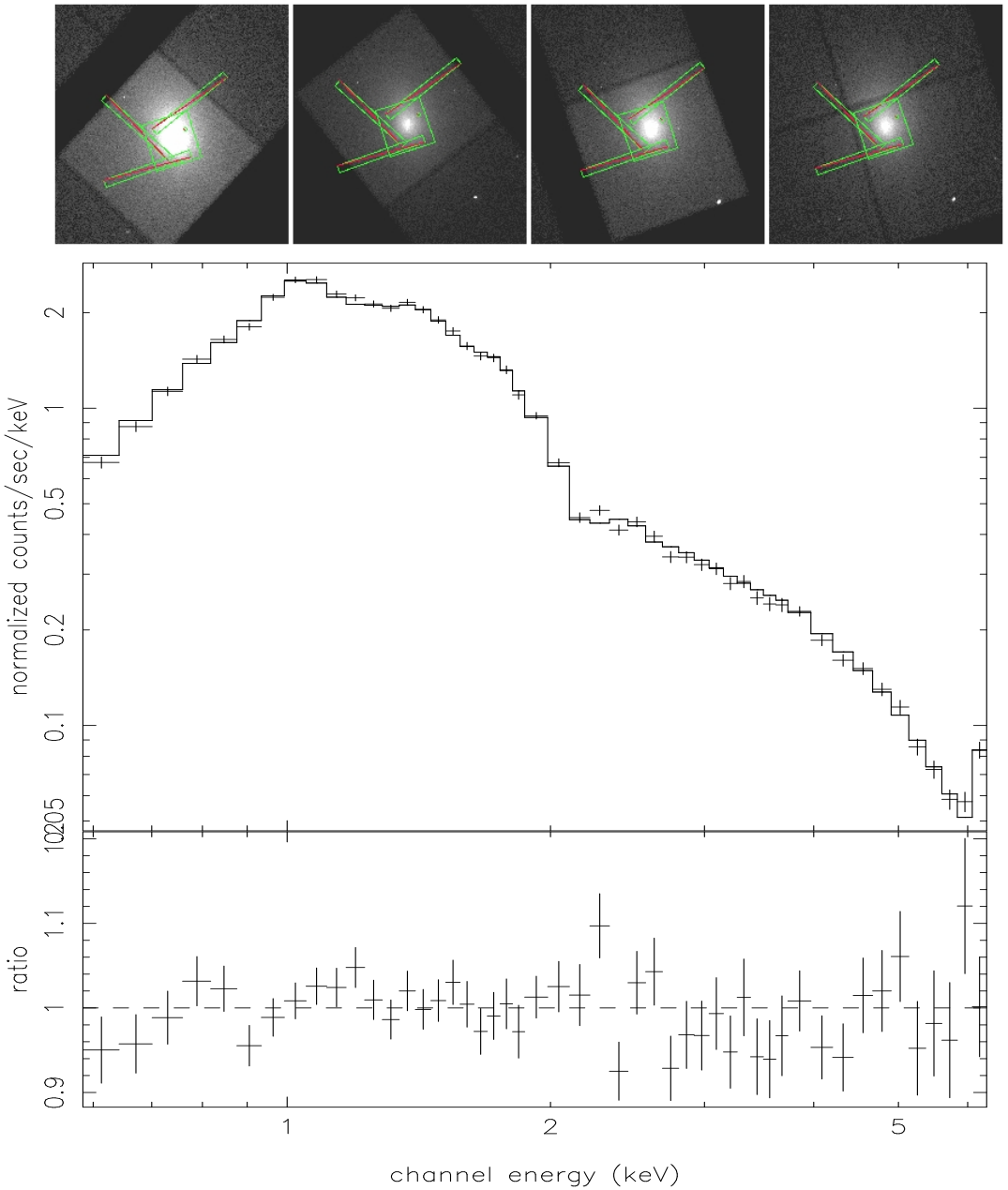
(reference fit from all pointings to S3-center)

A1795: cross-calibration between ACIS-S and ACIS-I



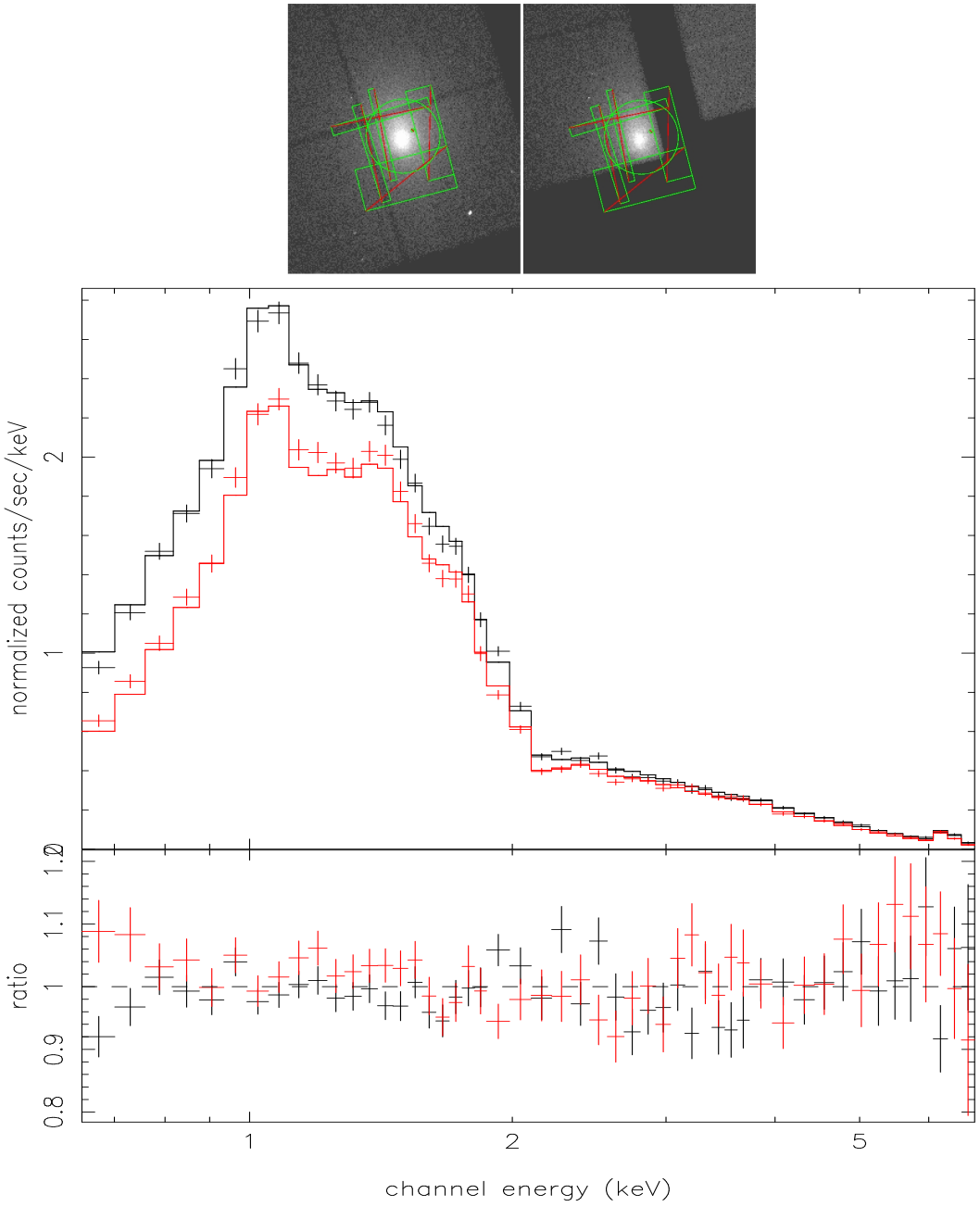
reference fit from all pointings to S3-center

A1795: cross-calibration between ACIS-S and ACIS-I



reference fit from all pointings S3-center, corrected for 3% dead area

A1795: spatial dependence in ACIS-I



(joint fit to center and edge data)

Conclusions

- **Accurate contamination model for ACIS imaging**

  (< 2 – 3% uncertainties above 0.6–0.7 keV)

- **(A1795 data also confirms cross-calibration of FI/BI QE and QEU)**