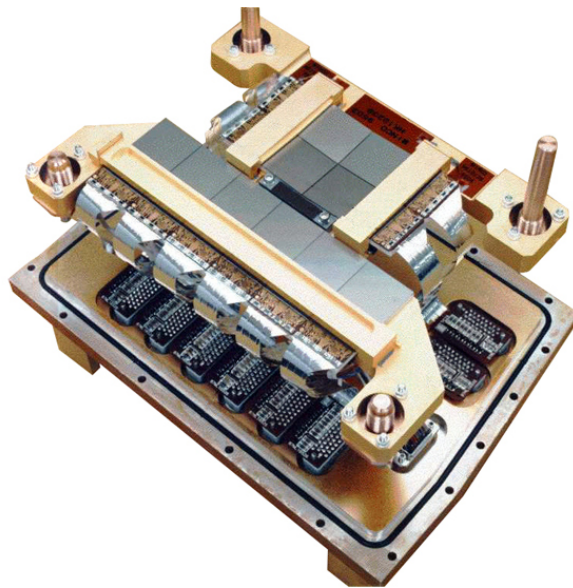


Time Dependence of ACIS Contamination

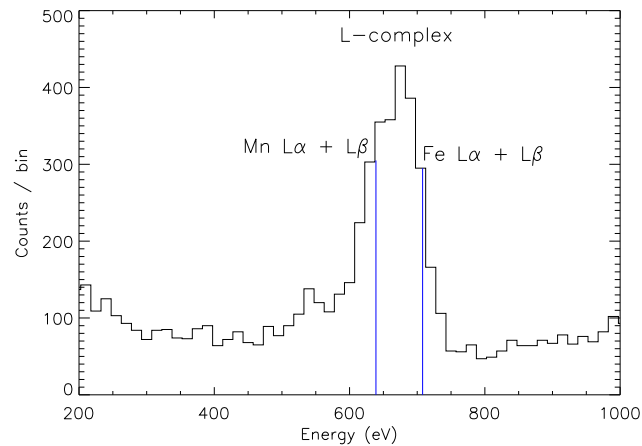
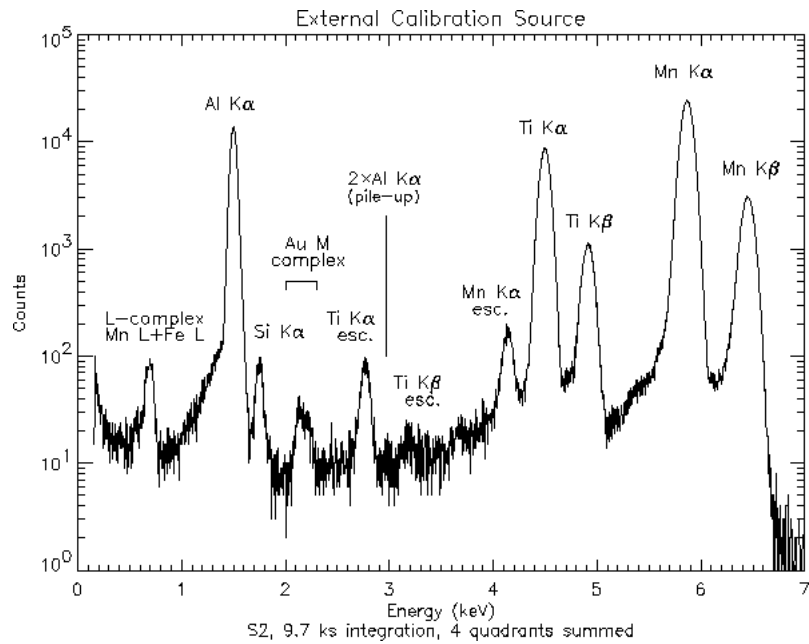
Chandra Calibration Workshop
27 October 2003

Catherine Grant (MIT CSR)
and the ACIS Instrument, Operations and Calibration teams



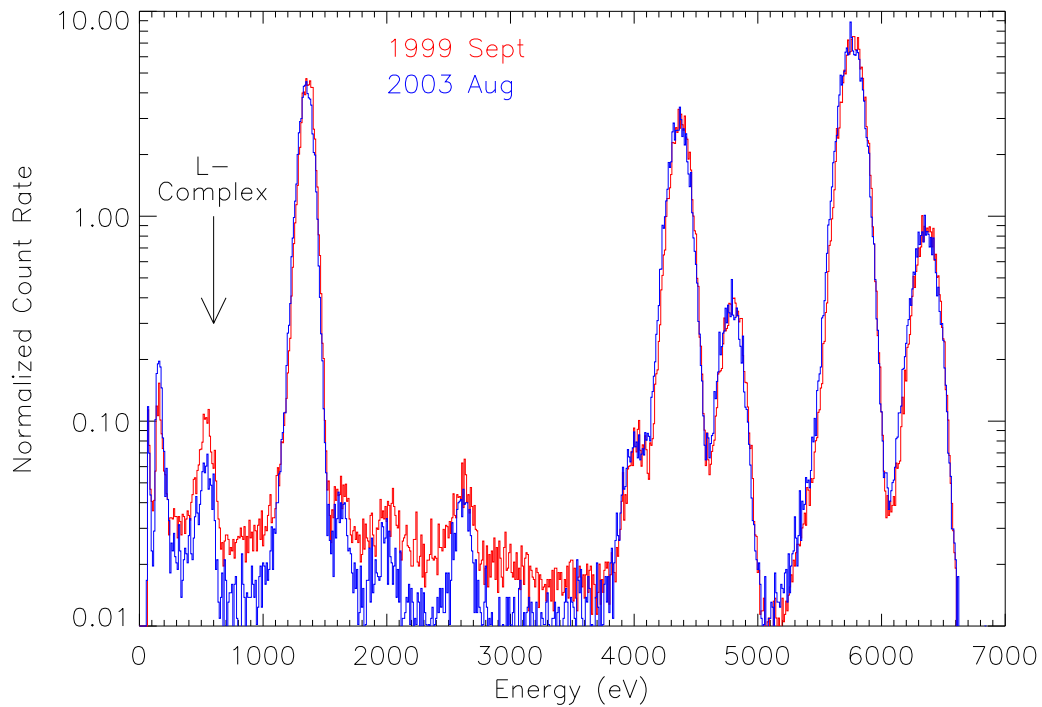
- The ACIS External Calibration Source
- Measuring the decay
- Monitoring contamination with the ECS
- Models of ECS time dependence
- Monitoring contamination with the LETG
- Agreement between models

ACIS External Calibration Source



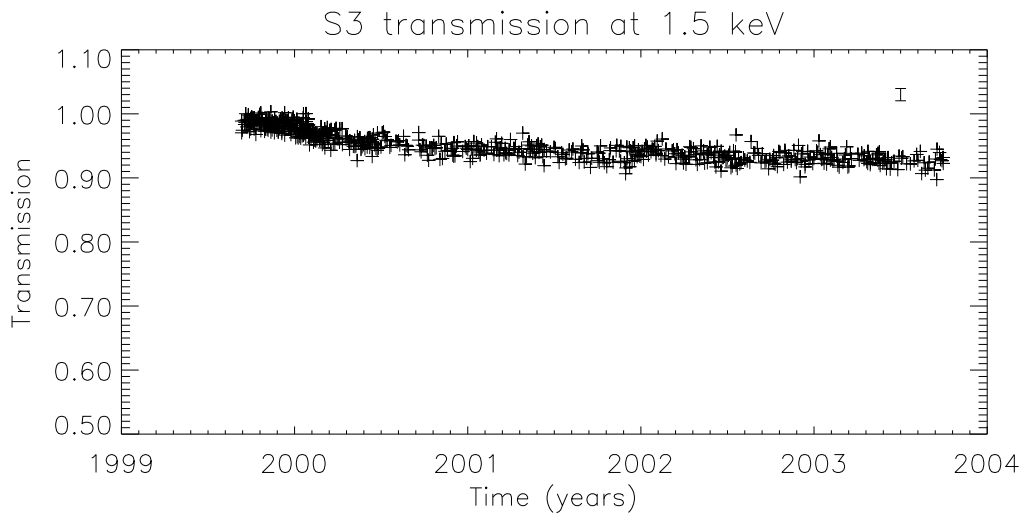
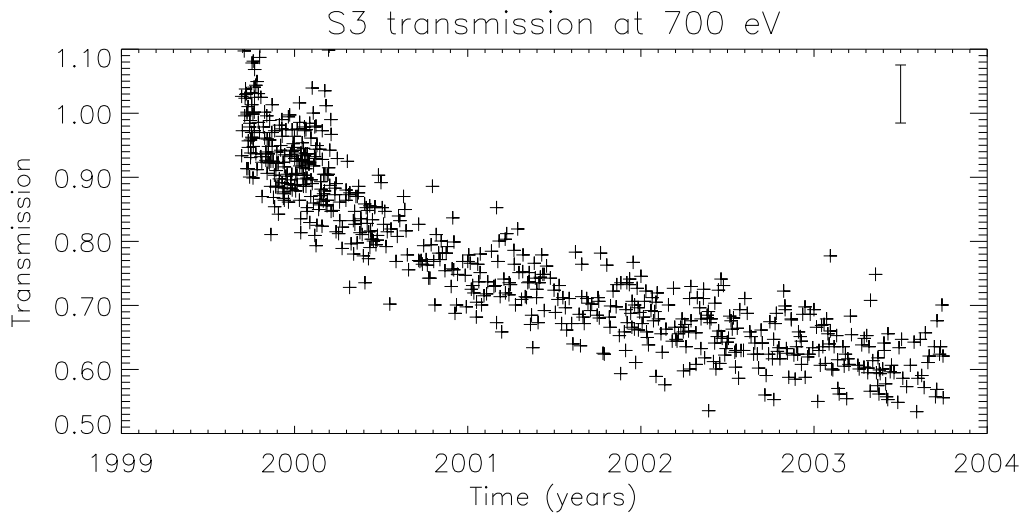
- Viewable by ACIS when HRC-S is at the HRMA focus
- Observed on ingress and egress from radiation belts
- Strong K-shell lines from Mn, Ti and Al
- Weak unresolved L-shell lines of Mn and Fe

Measuring the Decay



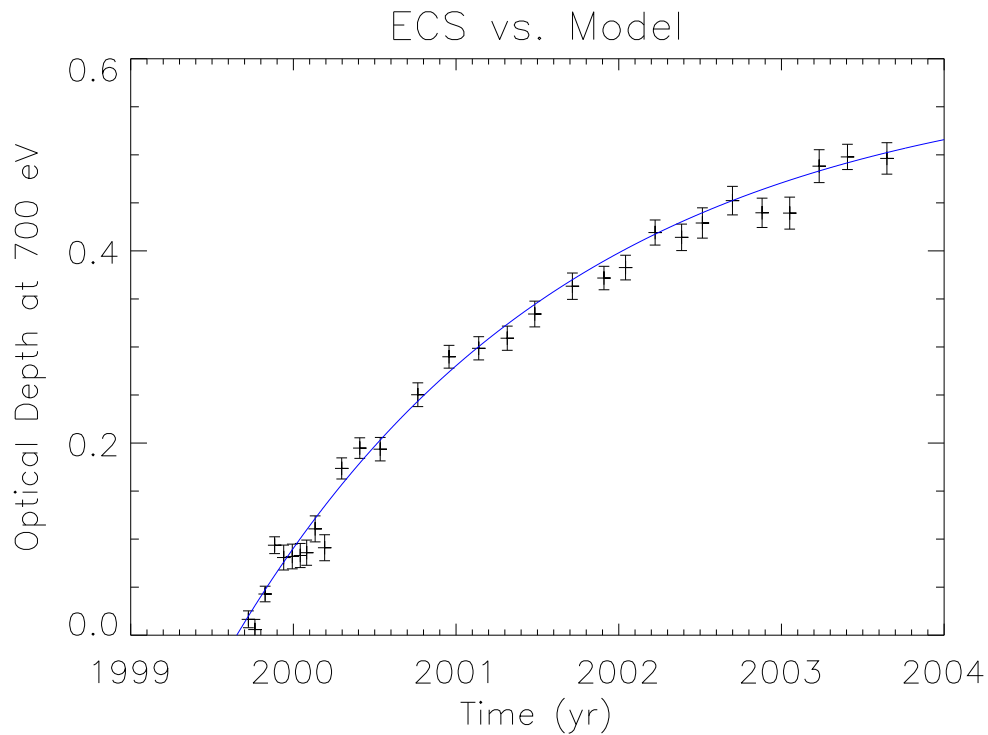
- Each spectrum is a single S3 ECS observation of ~ 10 ksec
- Countrate normalized to remove source decay (half-life of 2.7 yrs)
- QE drop at 700 eV is measurable even for single observations
- Small drop at 1.5 keV as well

Monitoring Contamination with the ECS



- For each ECS observation
 - Fit single Gaussians to the L-complex, Al-K and Mn-K α lines
 - Ratio of L-complex or Al-K to Mn-K α removes source decay
 - Normalize to ratio measured before launch

Models of ECS Time Dependence



- Model for time dependence proposed by Allyn Tennant/Steve O'Dell
- Exponentially decreasing rate of change of τ

$$\tau(t) = \tau_{\infty}(1 - e^{-t/t_1})$$

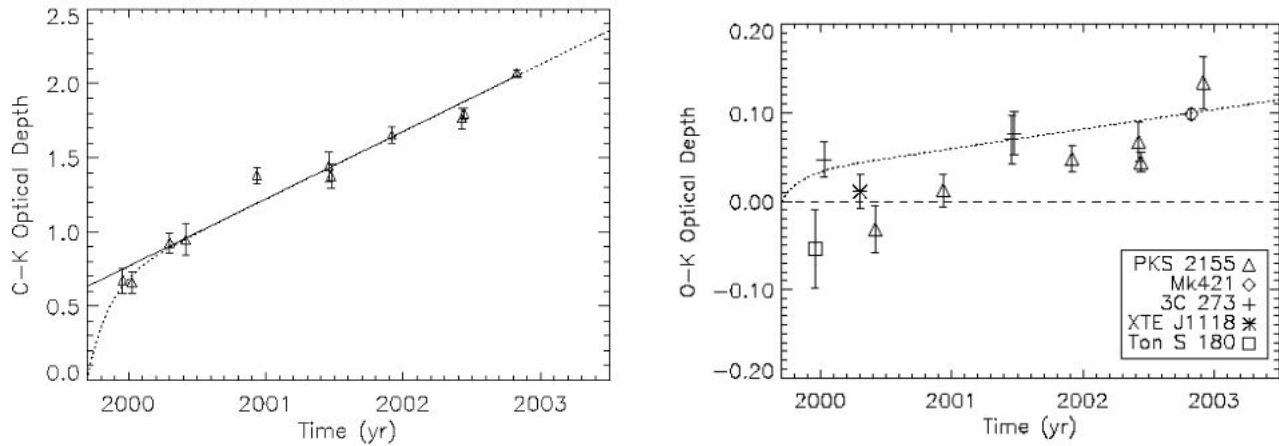
where

τ_{∞} is the optical depth at infinite time

t_1 is the e-folding time for the buildup

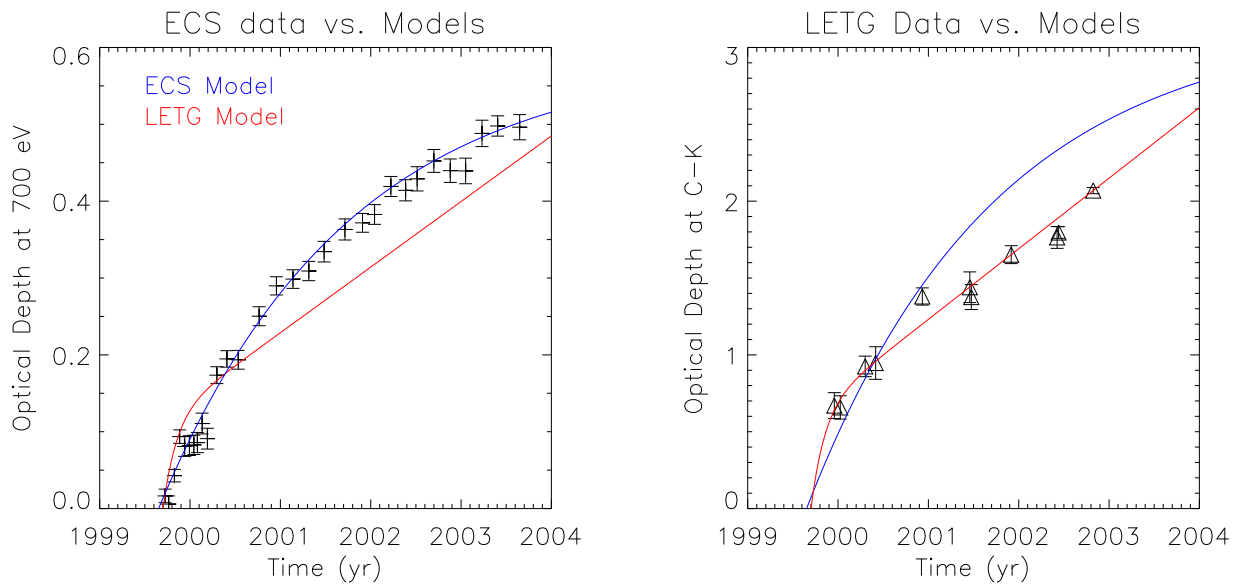
- $\tau_{\infty} \sim 0.59$, τ (Oct 2003) ~ 0.51
- Implies that 92% of the total possible QE loss has already occurred

Monitoring Contamination with the LETG



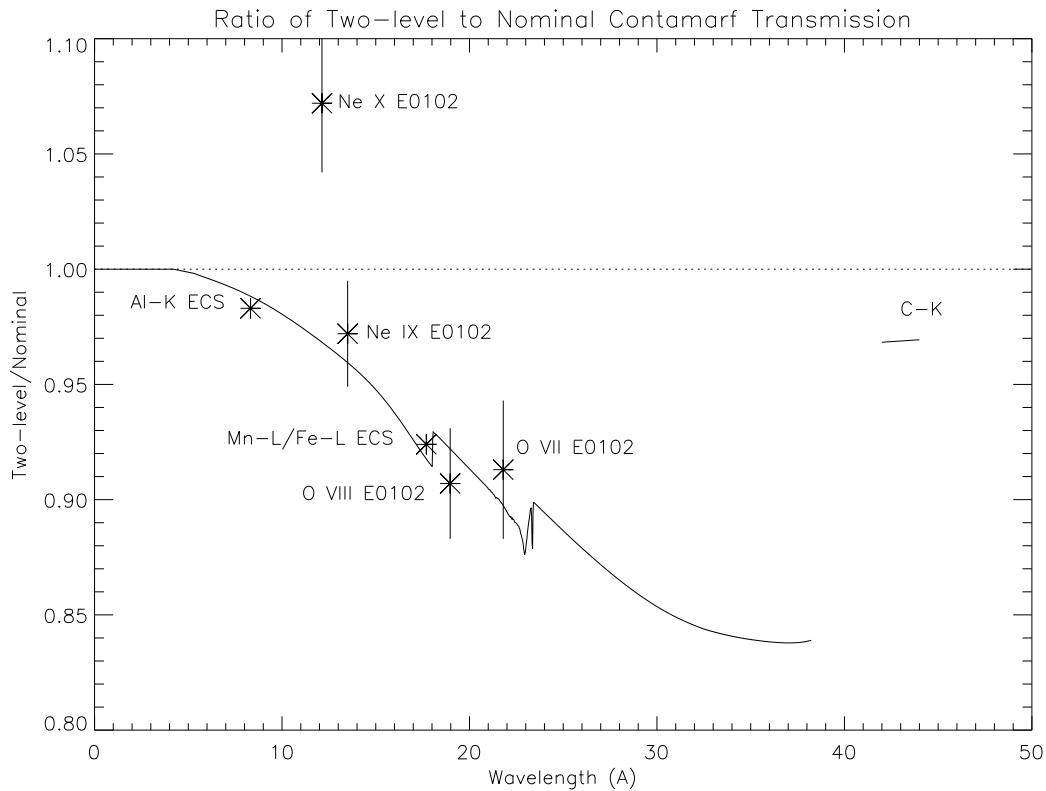
- LETG observations of continuum sources
- Well-measured C-K edge, weaker O-K edge
- Optical depth determined by the flux decrement at the edge
- Analysis will be discussed by Herman Marshall
- Linear fit to C-K edge, assume a drop to zero at launch

Agreement between Models



- Two models of the time-dependence are similar
- Maximum disagreement in transmission at 700 eV is 8%
- LETG model (red) has been released in CONTAMARF
- ECS model (blue) has been released in ACISABS
- No known systematic or detector effect is sufficient

“Fluffy” Contaminant?



- A new model recently suggested by Dan Dewey, motivated by comparison of E0102-72 HETG data taken Sept 99 and Dec 02
- Contaminant could be non-uniform on small scales
- C-K edge measurements are sensitive to the thin regions
- Absolute absorption measurements depend on the filling factors and the thick regions as well
- Currently under study. If successful, will be incorporated into CONTAMARF