Time Dependence of ACIS Contamination

Chandra Calibration Workshop
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- 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 $\sim 10$ ksec
- Count rate 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-Kα lines
  - Ratio of L-complex or Al-K to Mn-Kα 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 $\tau$

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

where
- $\tau_\infty$ is the optical depth at infinite time
- $t_1$ is the e-folding time for the buildup

- $\tau_\infty \sim 0.59$, $\tau$ (Oct 2003) $\sim 0.51$
- 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
• 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