Understanding and Correcting for the ACIS Contaminant

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Overview

• Grating and external cal source (ECS) data disagree at 10% level, reconciled by adding fluffium

• Correcting for the ACIS contaminant is good to <3%

• The contaminant is still being monitored

• No new observations are planned to test models of the contaminant
ECS Results Summary
(from Alexey Vikhlinin)

• Optical depth uncertainties $\tau \sim 0.03$
• $2002-4: d\tau/dt \sim 0.06 \pm 0.025$ per year
• Significant spatial variations up to 50%
• Correcting for contaminant is good to $\sim 3$

  • Set $\tau(t)$ at 700 eV using ECS
  • Set $\tau(E)$ using grating fits & fluffium
  • Correction above 600 eV is robust
  • Below 600 eV, correction is less certain
LETG/ACIS Analysis Summary

- Twenty observations analyzed over 5 years fit to double PL spectra
  - $\tau$(C-K) is good to about 0.07 (mostly systematic error)
  - ACIS QE systematics are corrected
  - Pileup, Ir-M edge are corrected
  - Residual systematics across spectrum are < 5%
- Composition: > 70% C and ~5-10% O & F
- $d\tau_{C-K} = 0.45 \pm 0.03$ per year
- $\tau$(700 eV) varies < 5% with model
Time Dependence

- Fix contaminant composition, giving 1-parameter fits
- Absorption model gives estimate of 700 eV optical depth
- Comparison to ECS still shows discrepancy — fluffium needed
Reconciling ECS and ACIS/LETG Spectra

- Multiple optical depth (fluffy) material can have different edge depth dependences on thickness
- Model allows larger o.d. at high E, without affecting C-K
- Approximate model with “element” fluffium, a fake spectral component
- Time dependence is pegged to ECS results
- CIAO decontamination scripts use fluffium calibration files in caldb
- A.P. Hitchcock (McMaster U.): thickness variations should not be expected — model is unphysical
Spatial Variation

- Dithering around row 35 near readout samples various optical depths
- Compute optical depth gradients vs. energy
- Gradients are larger than expected but within uncertainties from ECS
- Gradients change with time as contaminant pattern varies
- Gradient is not responsible for varying optical depth of “fluffium”
Plans to Improve Contaminant Modeling

- Refit all LETG/ACIS data with released fluffium model
- Determine gradients for other observations to refine the spatial nonuniformity model
- Quantify limits to spatial and temporal composition variations
- Compare global fits to LETG/HRC and XMM-Newton fits
- Track C-K and O-K edge structure
  - 510 eV O I feature should be distinguishable from ISM
  - 285 eV C=C feature is now evident in contaminant
  - Features may track a second component of contaminant