Chandra Calibration Status

CUC Meeting Sep. 29, 2015
Calibration products released over the past year

**ACIS**

- Quarterly gain corrections for ACIS-I and ACIS-S
- Update to the low energy ACIS-S1 gain table ($E < 500\text{eV}$)

**HRC**

- Yearly gain corrections for the HRC-I and HRC-S
- Update to the HRC-S de-gap map
- Updates to the HRC-I QE, HRC-S QE and QE map
- Updates to the extracted count fractions in LETG/HRC-S spectra
Contamination Build-Up on the ACIS Filters

Abell 1795

Blazars
- Mkn 421
- PKS 2111-304

E0102-72
Contamination Build-Up on the ACIS Filters

Big Dither LETG/ACIS-S Observations of Mkn 421

Recent Observations
Mar. 2015
Jul. 2015
Nov. 2015

ACIS-S1
Contamination Build-Up on the ACIS filters

Components of the ACIS contamination model
- Time-dependence
- Spatial variations
- Chemical composition C, O and F
Contamination Build-Up on the ACIS filters

Evidence for multiple sources of contamination

O/C Ratio

F/C Ratio
Contamination Build-Up on the ACIS filters
Contamination Build-Up on the ACIS filters

Comparison of March and July 2015 ACIS-S observations of Abell 1795

March 2015
July 2015

0.5-2.0 keV
Contamination Build-Up on the ACIS filters

ACIS-S Observations of E0102-72
Contamination Build-Up on the ACIS filters

ACIS-S observations of E0102-72

Mid-chip

High-chip
Adjustments to S1 Low Energy Gain

Comparison of photon energies computed from the detector gain and LETG dispersion relation.
LETG/HRC-S vs LETG/ACIS-S Cross-Calibration

Mkn 421 Observation

Old S1 detector gains

New S1 detector gains
HRC-I Calibration Status

Soft X-Ray Source

Hard X-ray Source
LETG/HRC-S Calibration Status

Time-dependent tilt correction
LETG/HRC-S Observations

Enclosed count fractions

Old

New
LETG/HRC-S and LETG/ACIS-S Cross-Calibration

- Old LETG EFFRAC file
- Old ACIS-S1 gain
Adjustments Required to Preserve Cross-Calibration

- New ACIS-S1 gain file improves the cross-calibration between LETG/HRC-S and LETG/ACIS-S data
- New LETG/HRC-S EEFRACS file requires an adjustment to the HRC-S QE to maintain LETG/HRC-S vs. LETG/ACIS-S cross-calibration
- New HRC-S QE requires an adjustment to the HRC-I QE to maintain HRC-S vs. HRC-I cross-calibration
Empirical Chandra PSF Library

PSF Library

Our plan for generating an empirical PSF "library":

- Due to pile-up effects in the ACIS detectors, generating an as-observed PSF is difficult:
  - must co-add many faint known point sources

Current efforts center on the on-axis HRC-I PSF

Have several deep HRC-I observations of known isolated point sources

- High count rate, high S/N observations
- Essentially no energy resolution; may get low/mid/high bands
- PSF is count-rate dependent (tailgate effect)
- We have an empirical model of the tailgate effect
  - We are developing a tool for users which identifies affected events.
- Background as a function of chip location and PI can be determined from HRC stowed background.
PSF Library Products

- PSF Library will consist of events extracted from multiple observations
- Two event lists will be provided:
  - HRC: All of the events, unfiltered, positions in HRC sky pixels
  - ACIS: Tailgate and high flux (flare) filtered, positions in ACIS sky pixels.
- Each event will have the following information
  - Time
  - Normalized sky position
  - Position relative to optical axis
  - HRC $\texttt{amp.sf}$ (for gain correction and degap filtering)
  - PI (for background reduction and soft/hard source discrimination)
  - Tailgate status
  - Probability that it is a background event
  - QEU correction
A set of Epoch G ACIS blank sky images are presently being compiled
Calibration Schedule

**ACIS**

- Release revised ACIS contamination model with updated elemental ratios (C, O and F) and spatial distribution.
- Determine if the contamination rate has been affected by turning on the ACIS detector housing heater.
- Release new ACIS QE maps (these are generated about every two years).
- Release a set (Epoch G) of ACIS blank sky background images for the period 2012-2015.

**Gratings**

- Perform a cross-calibration study between LEG, HEG and MEG gratings data.
- Perform a cross-calibration study of the transmission efficiency of all HEG and MEG orders.

**HRC**

- Update the HRC-I QE map using recent calibration observations of the Coma cluster.
- Release an empirical PSF library.