OVERVIEW OF CHANDRA ACIS CALIBRATION

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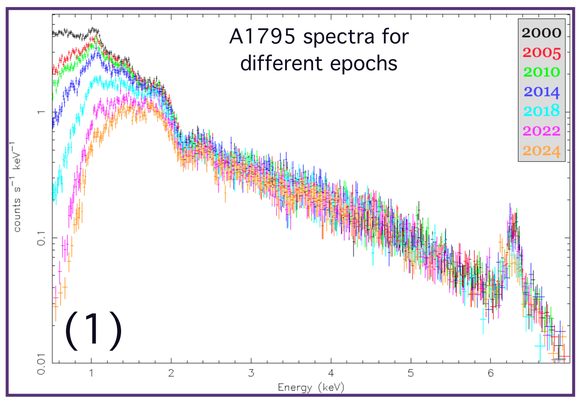
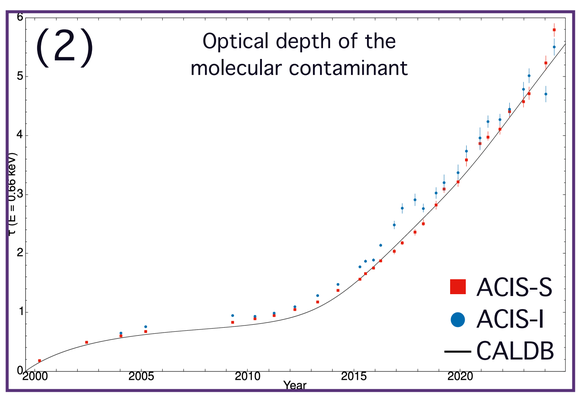
Molecular Contamination

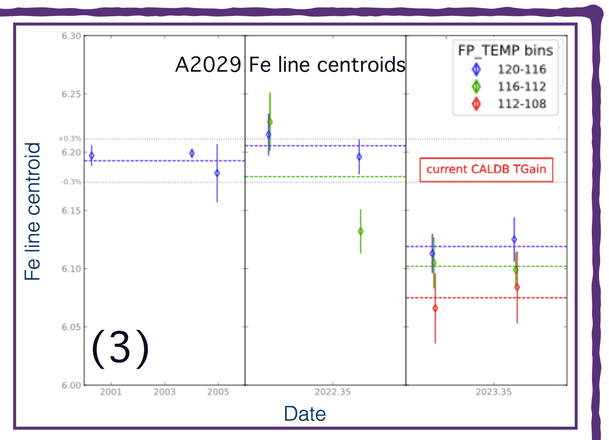
- The ACIS effective area below 2 keV has been declining due to the build-up of outgassed material on the cold ACIS optical blocking filters (Fig. 1).
- Astronomical observations and data from the External Calibration Source (ECS) are used to monitor the contaminant.
- The CALDB contamination model is periodically updated to account for changes in: 1) the build-up rate; 2) the spatial distribution; and 3) the chemical composition of the molecular contaminant.
- The current contamination model provides accurate corrections (Fig. 2).

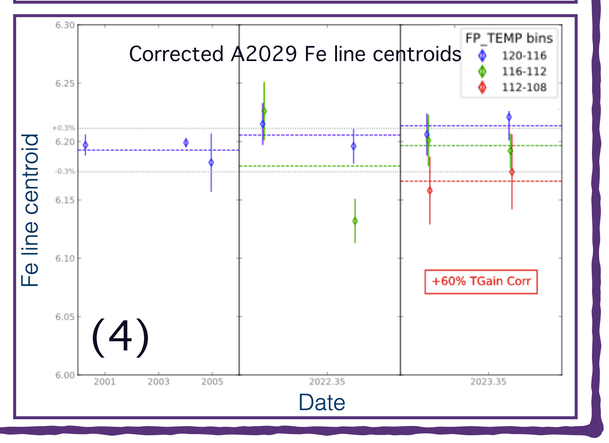




Gain shift with recent ACIS data

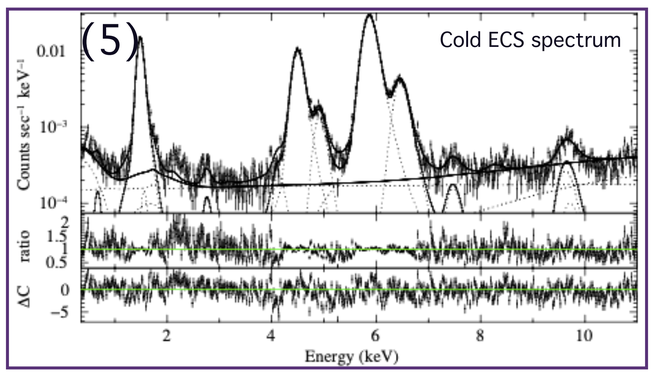
- ACIS observations from 2022 to 2024 suggest a gain shift up to 1% (Fig. 3).
- This gain shift is primarily observed in the ACIS-I data of hard X-sources and is less significant in ACIS-S data.
- The shift is attributed to the rapidly declining ACIS background rates and the linear extrapolation performed by CIAO between tgain (time-dependent gain correction) epochs.
- The Calibration Team is testing a correction to account for the declining gain, which will be released as part of the CALDB (see the corrected gain in Fig. 4).

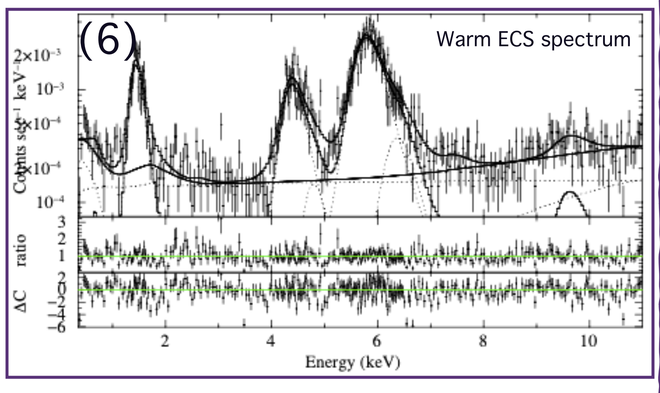




RMF at warm focal plane temperatures

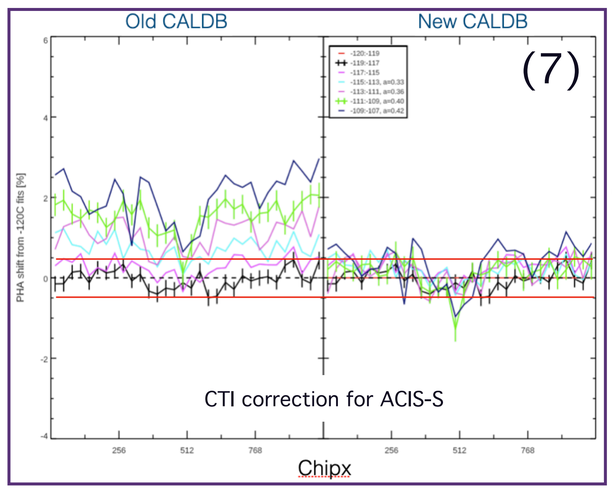
- At warm focal plane temperature, the energy resolution of ACIS broadens.
- The Calibration Team Team has developed a set of temperature-dependent RMF files.
- The updated RMF files were calibrated by binning ECS data into 7 temperature bins, from -120°C to -107°C.
- The widths of the Al, Ti, and Mn lines are fit in each temperature bin to construct new temperature-dependent RMFs, which will be released as part of the CALDB (Figs. 5–6).

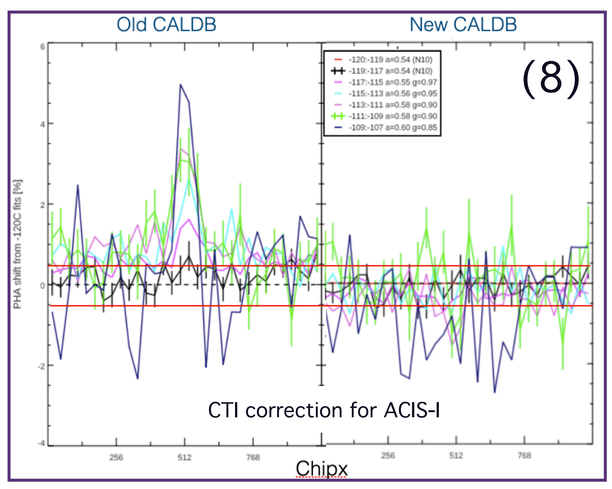




Temperature dependent CTI correction

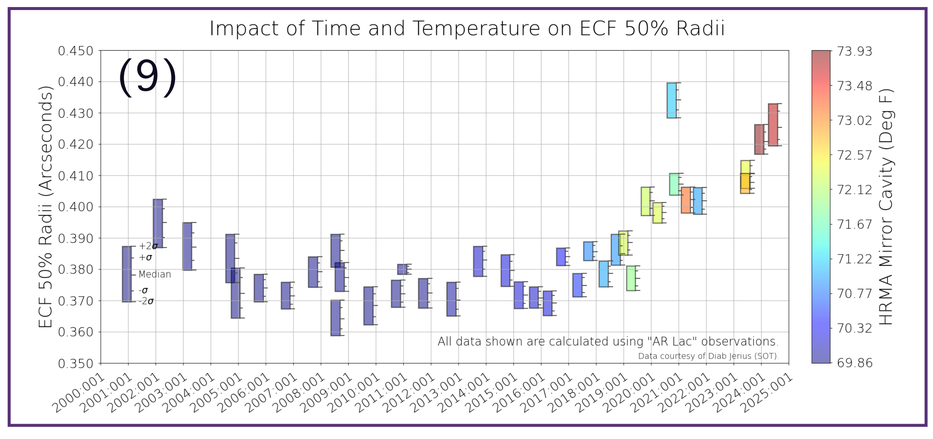
- The Charge Transfer Inefficiency (CTI) increases with focal plane temperature, affecting detector gain and energy resolution.
- The ACIS CTI correction has three main components: temperature, energy, and spatial variation.
- Temperature-dependent CTI calibration products improve the accuracy in the gain calibration to within ±0.5% for observations at warm focal plane temperatures (Figs. 7–8).





Tracking the Long-Term Behavior of the Chandra PSF

- The Point Spread Function (PSF) of the Chandra High-Resolution Mirror Assembly (HRMA) has been monitored with yearly HRC-I observations of AR Lac since launch
- Since 2020, a slight increase in the PSF has been observed at a rate of 0.01” per year (Fig. 9)
- This small broadening does not significantly impact Chandra's performance, and Chandra will remain the best X-ray imaging telescope for the foreseeable future.



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