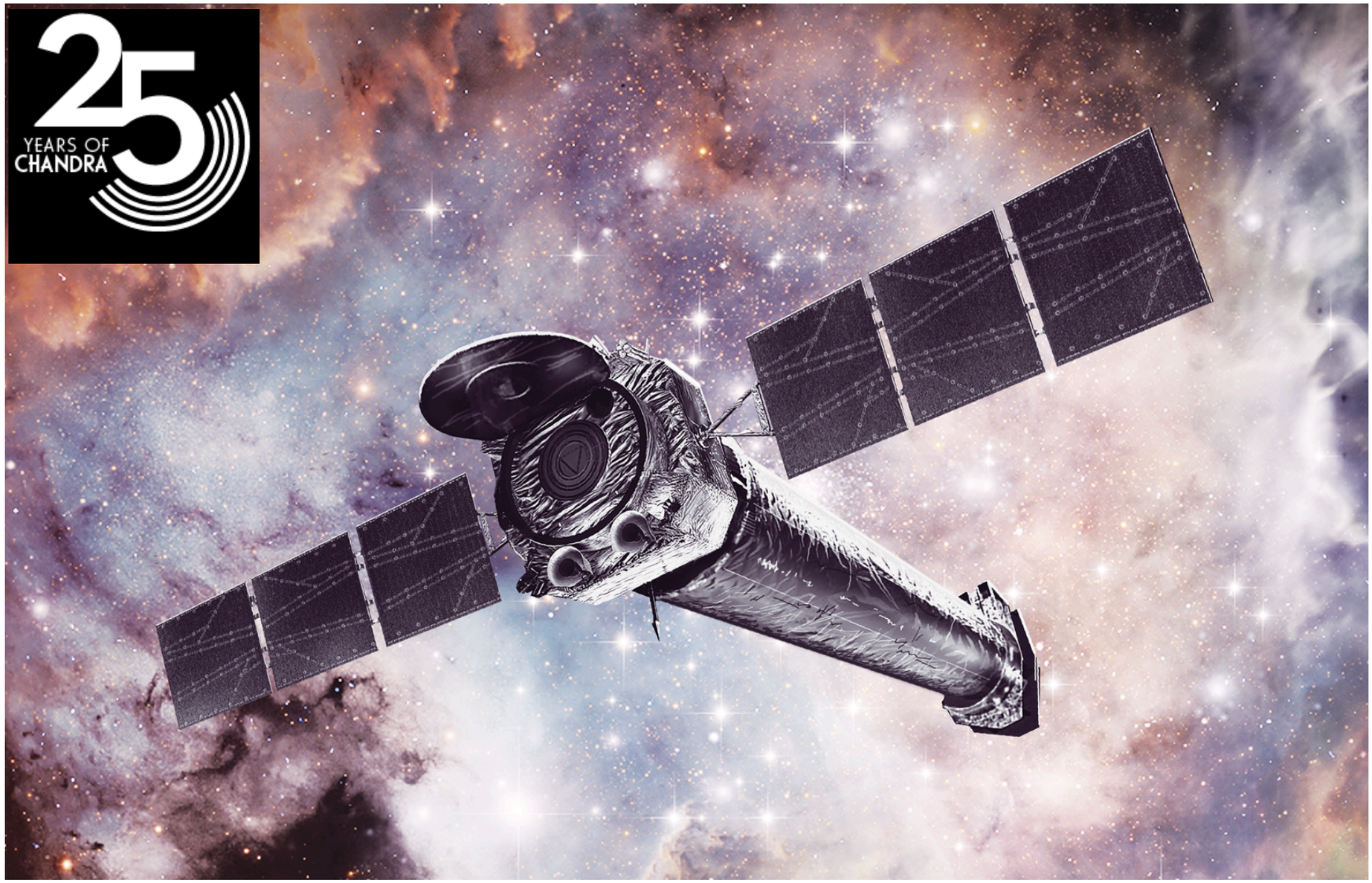
Chandra Calibration Status

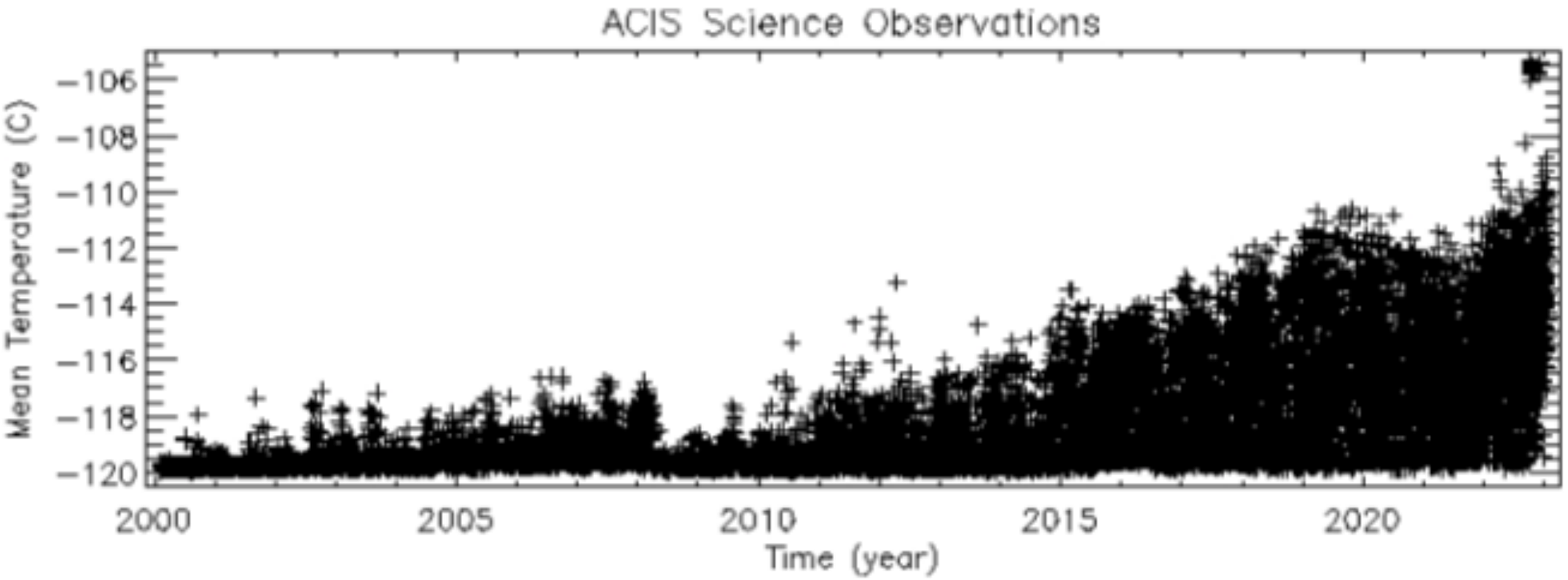


Akos Bogdan

On behalf of the Chandra Calibration Team

IACHEC - May 13, 2024

Improving the ACIS CTI Correction at Warm Focal Plane Temperatures



Charge Transfer Inefficiency (CTI) increases with temperature which affects the detector gain and energy resolution

The ACIS CTI Correction Procedure

CTI correction ~ (temperature)(energy)(spatial)

1) Temperature-dependence:

Old Method: Uses a linear function of temperature.
New Method: Uses a quadratic function of temperature

2) Energy-dependence:

Old Method: Uses a single power-law for the energy-dependence at all temperatures (i.e. $\Delta Q \sim PHA^{a}$).
New Method: Uses different power-law indices at different temperatures (i.e., a=f(T)).

3) Spatial-dependence:

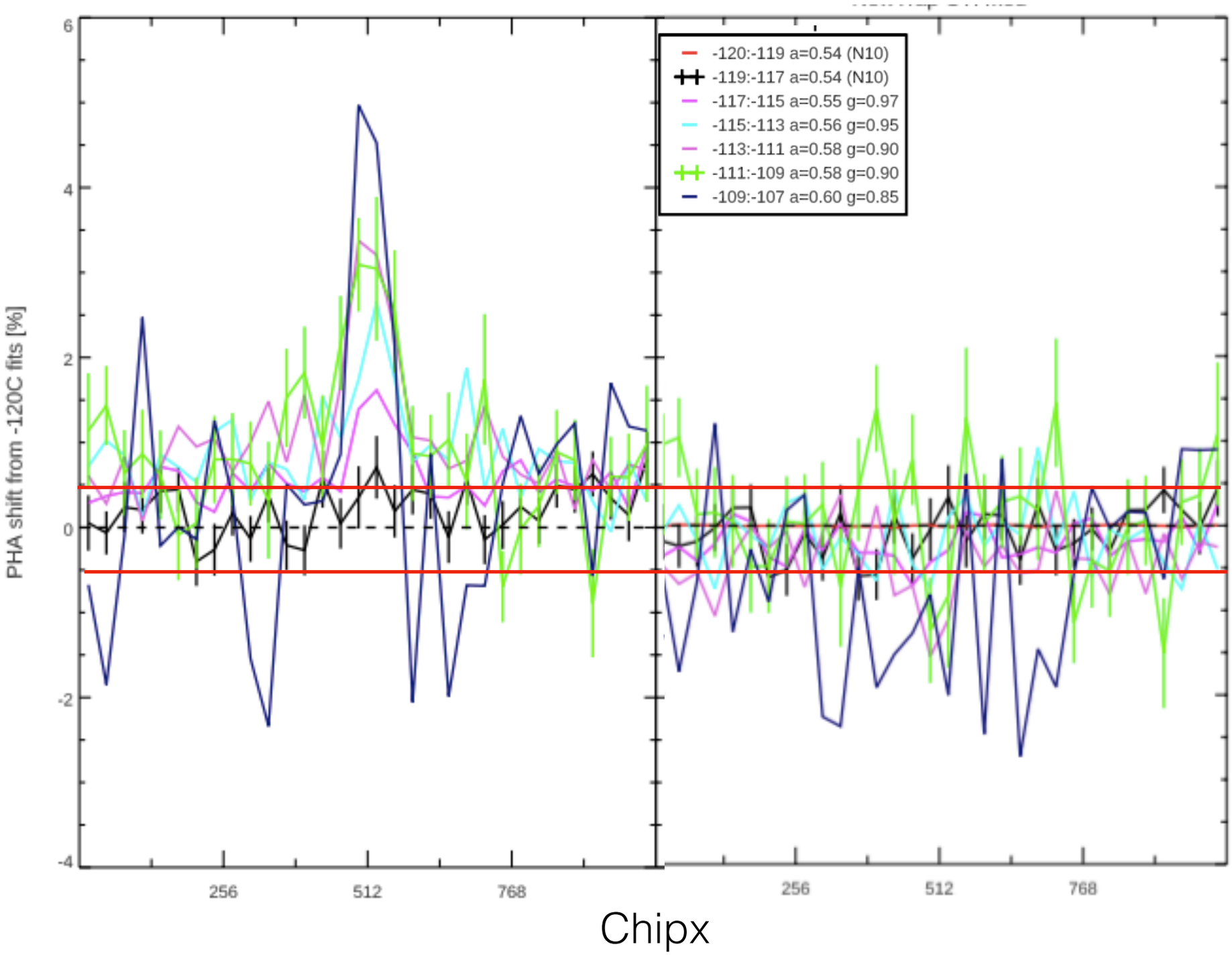
Old Method: Applies the same trap map at all temperatures.
New Method: Applies different trap maps at different temperatures.

Updated CTI Correction for I3

ECS data at Al-Ka and chipy=769:1024

Old CALDB

New CALDB (4.11.1)



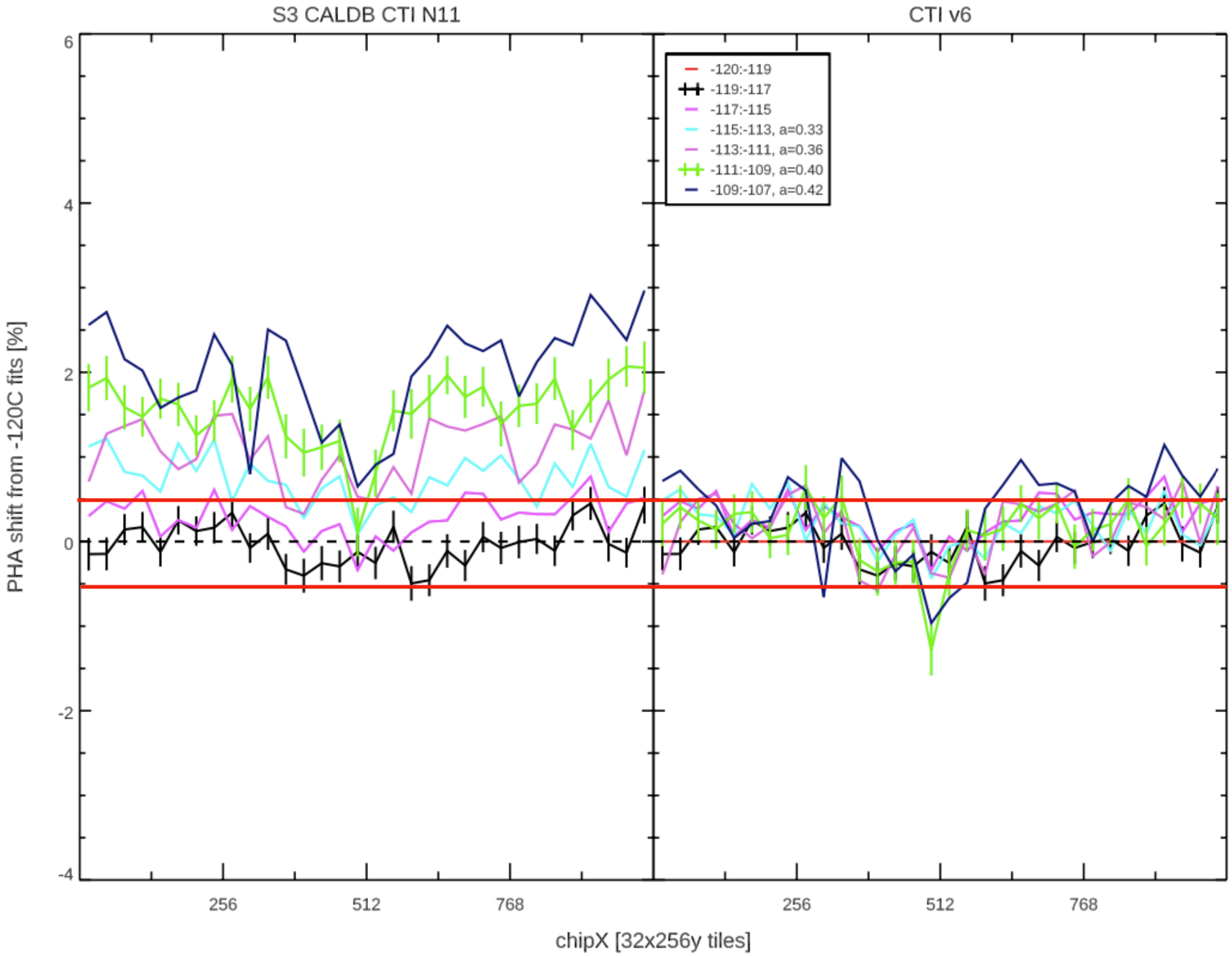
+- 0.5%

Updated CTI Correction for S3

ECS data at Al-Ka and chipy=769:1024

Old CALDB

New CALDB (4.11.1)

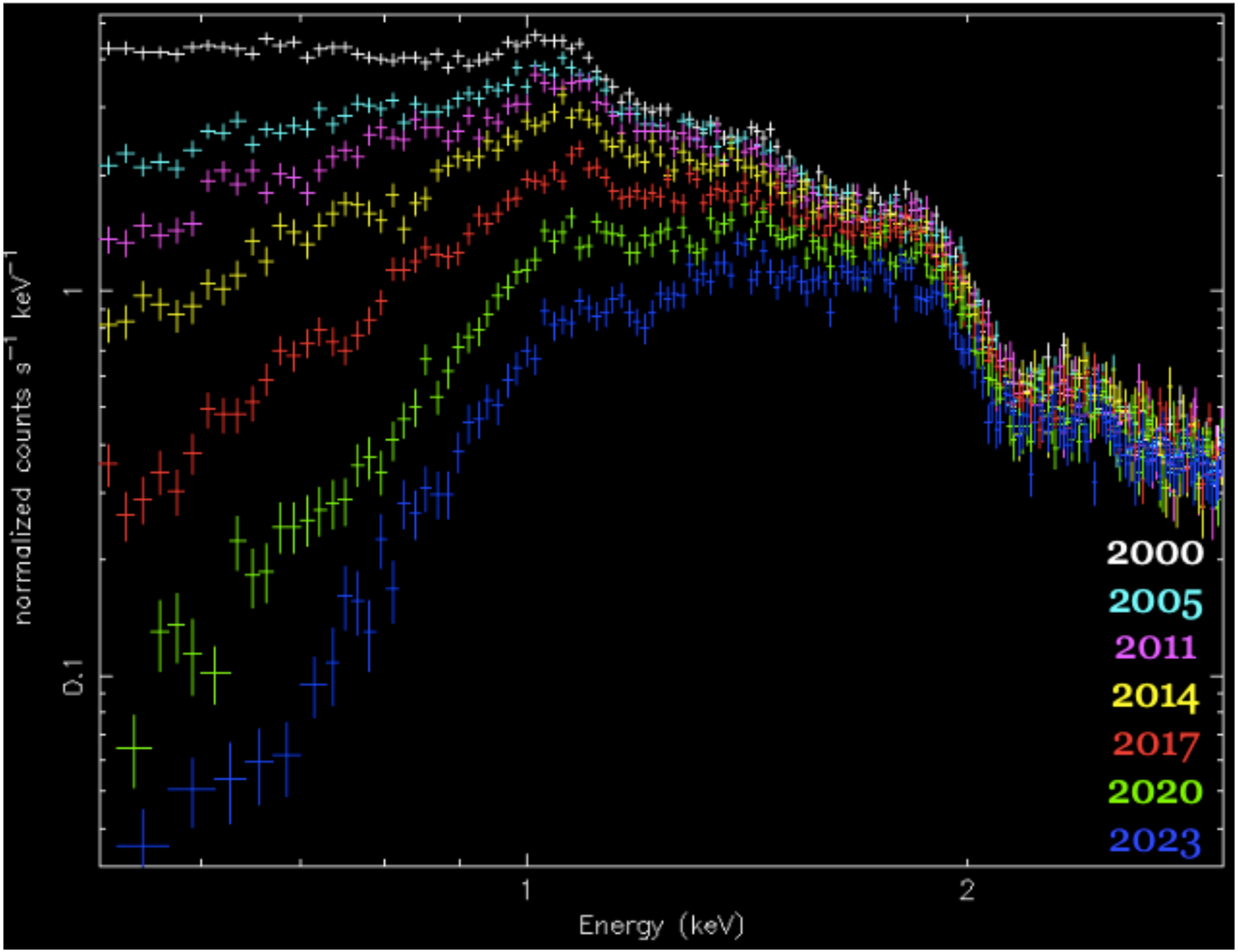


+- 0.5%

Note: the improved gain calibration allows for higher S/N observations at warmer FP temperatures

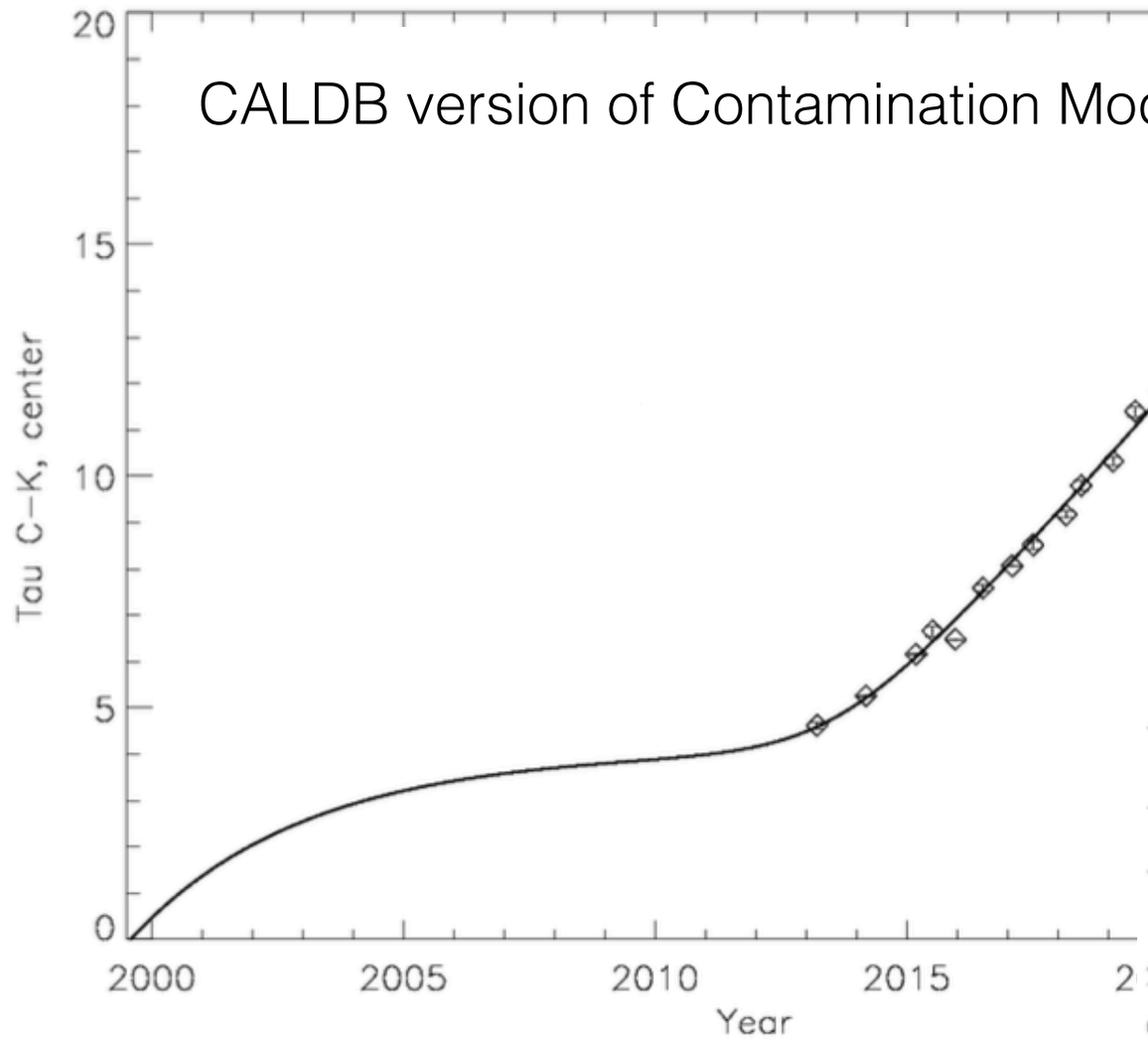
ACIS Contamination

Observations of Abell 1795 Over the Course of Mission

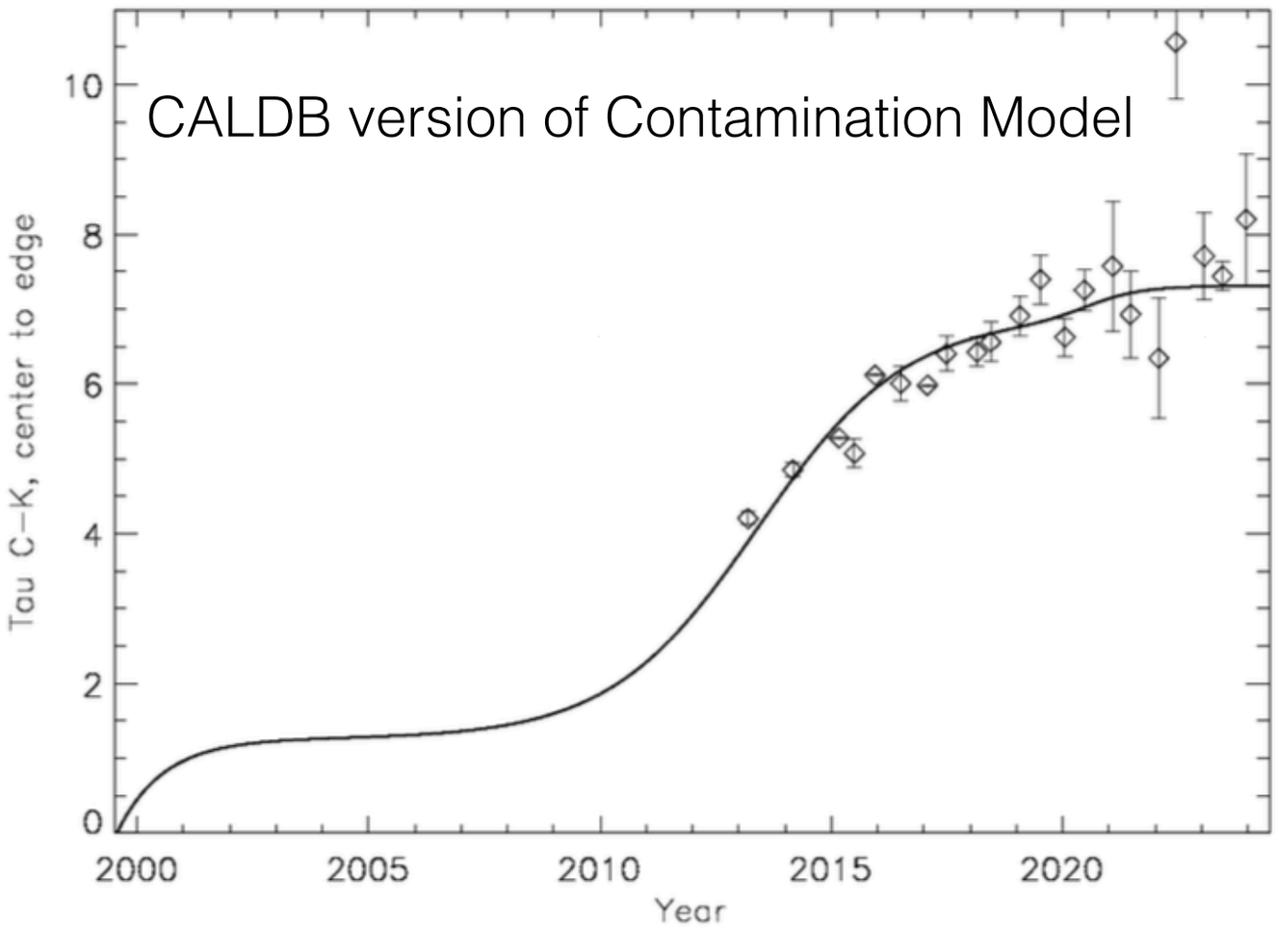


LETG/ACIS-S Big Dither Observations of Mkn421

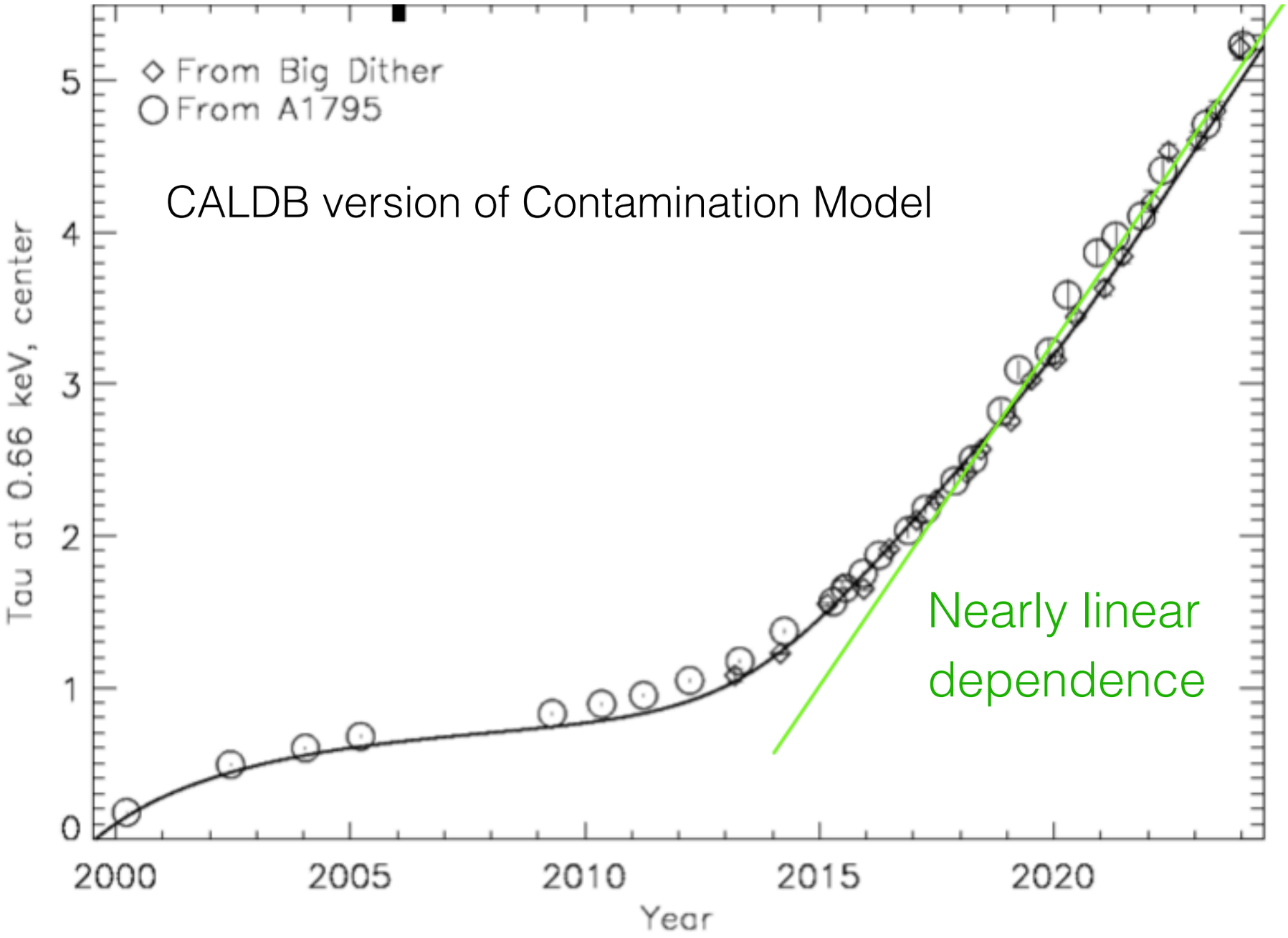
Optical depth at the C-K edge at the center of the ACIS-S array



Center to edge difference in the optical depth at the C-K edge



Optical Depth at 0.66 keV at the center of the ACIS-S array from Big Dither and A1795 Observations



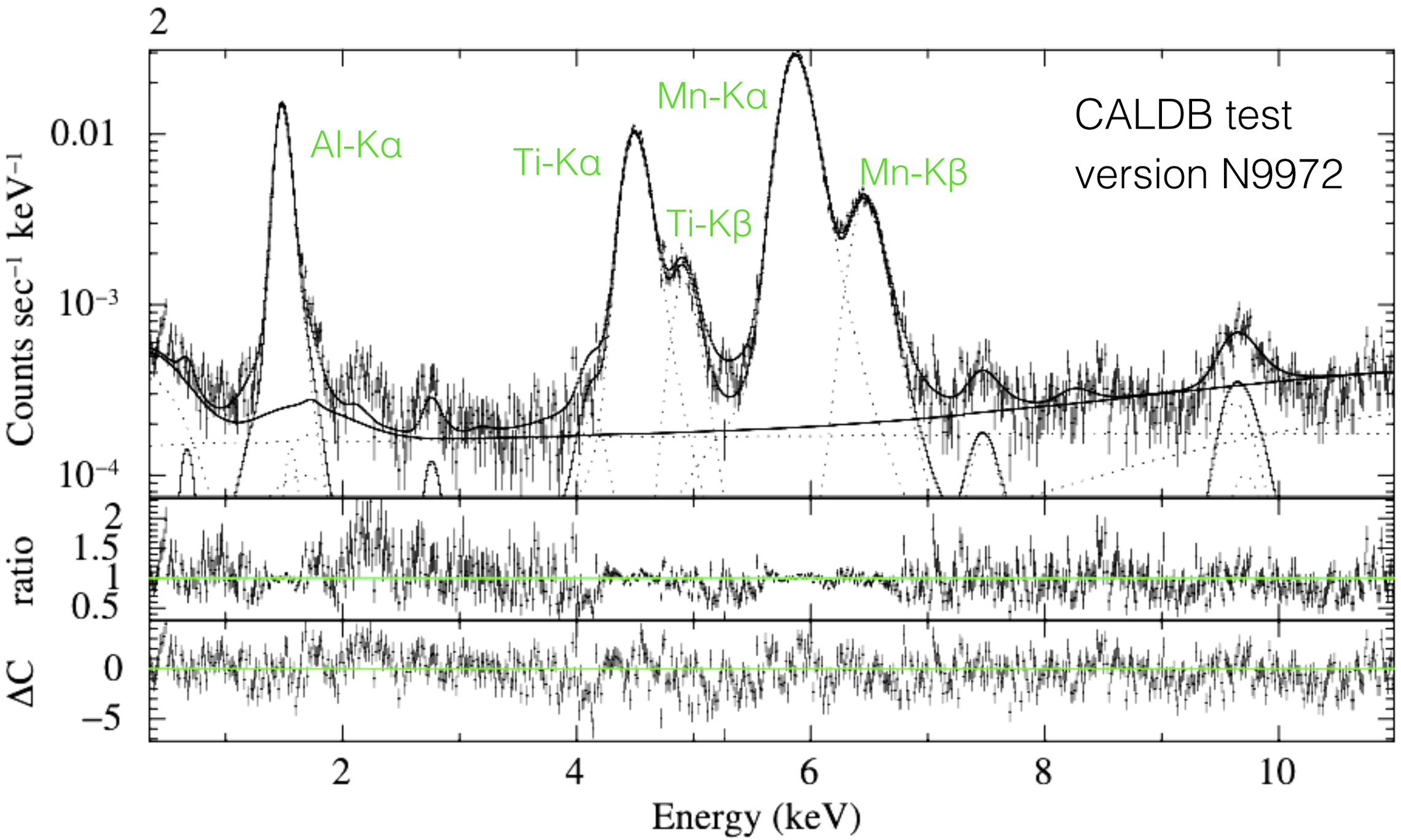
Conclusion: No need to update the ACIS contamination model at the present time.

Spectral Response at warmer Focal Plane Temperatures

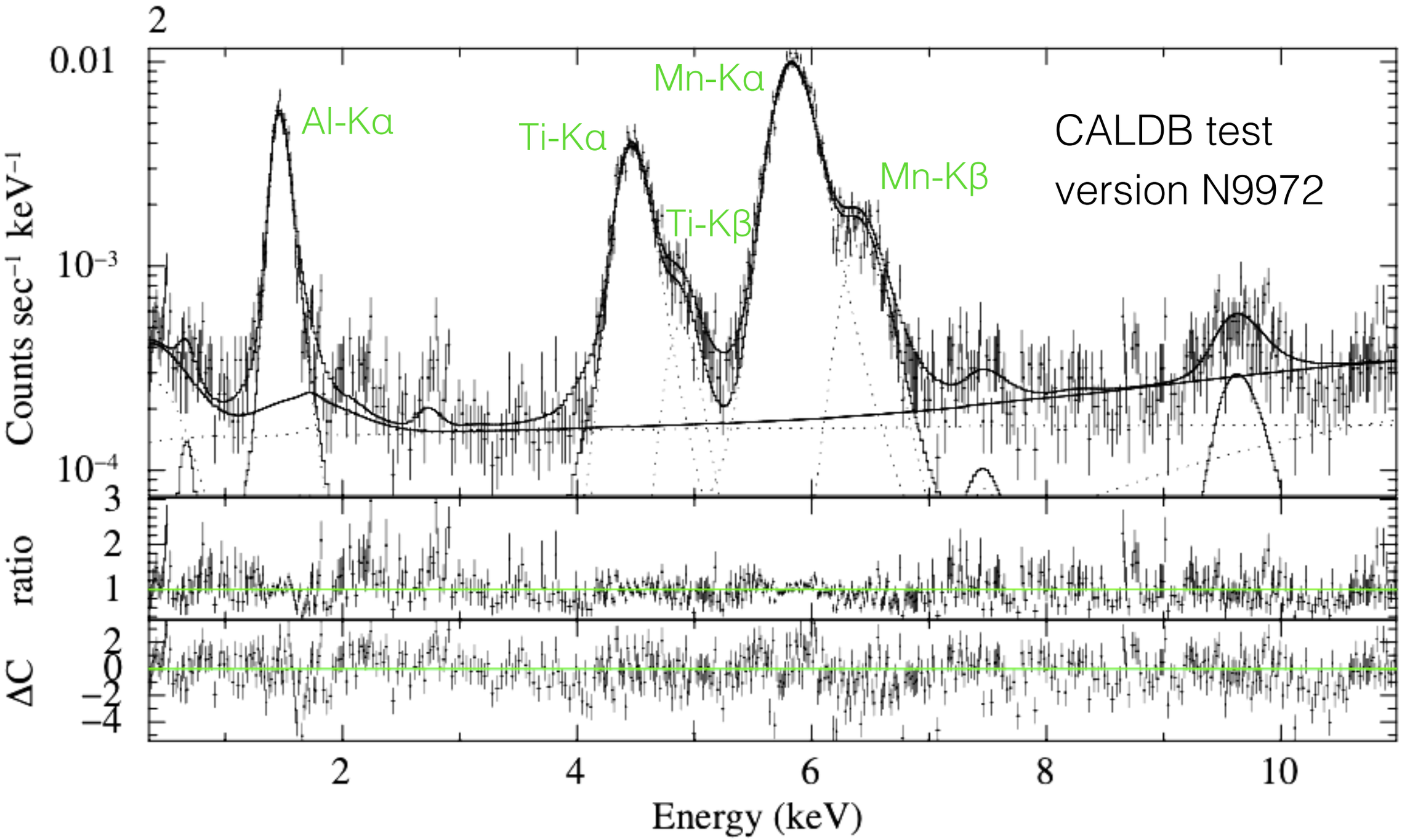
Procedure:

- Co-add ECS data from epochs 40-97 (approximately 15 years of data)
- Divide ECS data into 7 FP temperature bins between -120 and -107 C
- Bin data into 32 by 32 pixel regions
- Fit widths of Al-Kα, Ti-Kα, and Mn-Kα lines in each spatial region and temperature bin

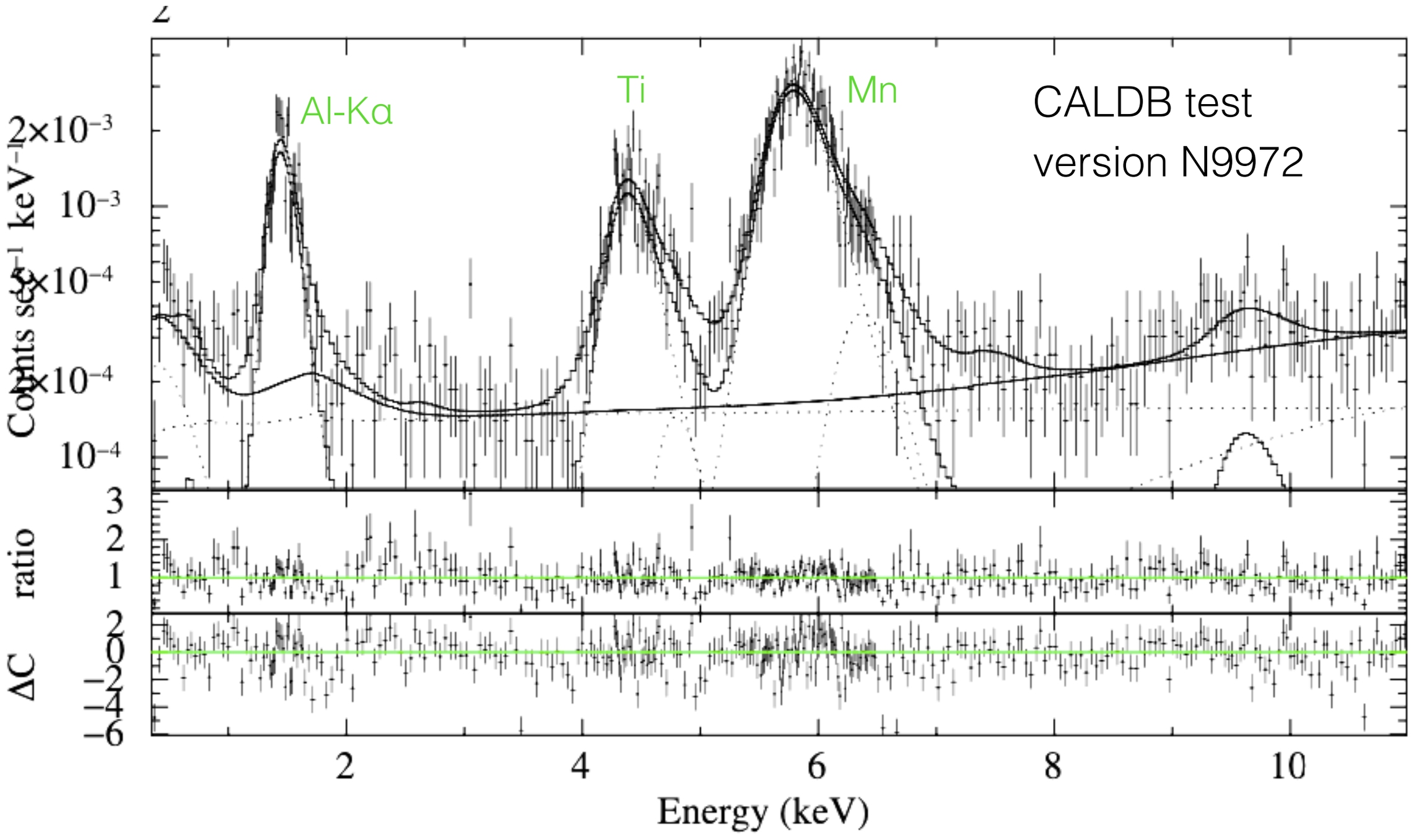
I3 ECS spectra with FP temps from -120 to -119 C



I3 ECS spectra with FP temps -115 to -113 C



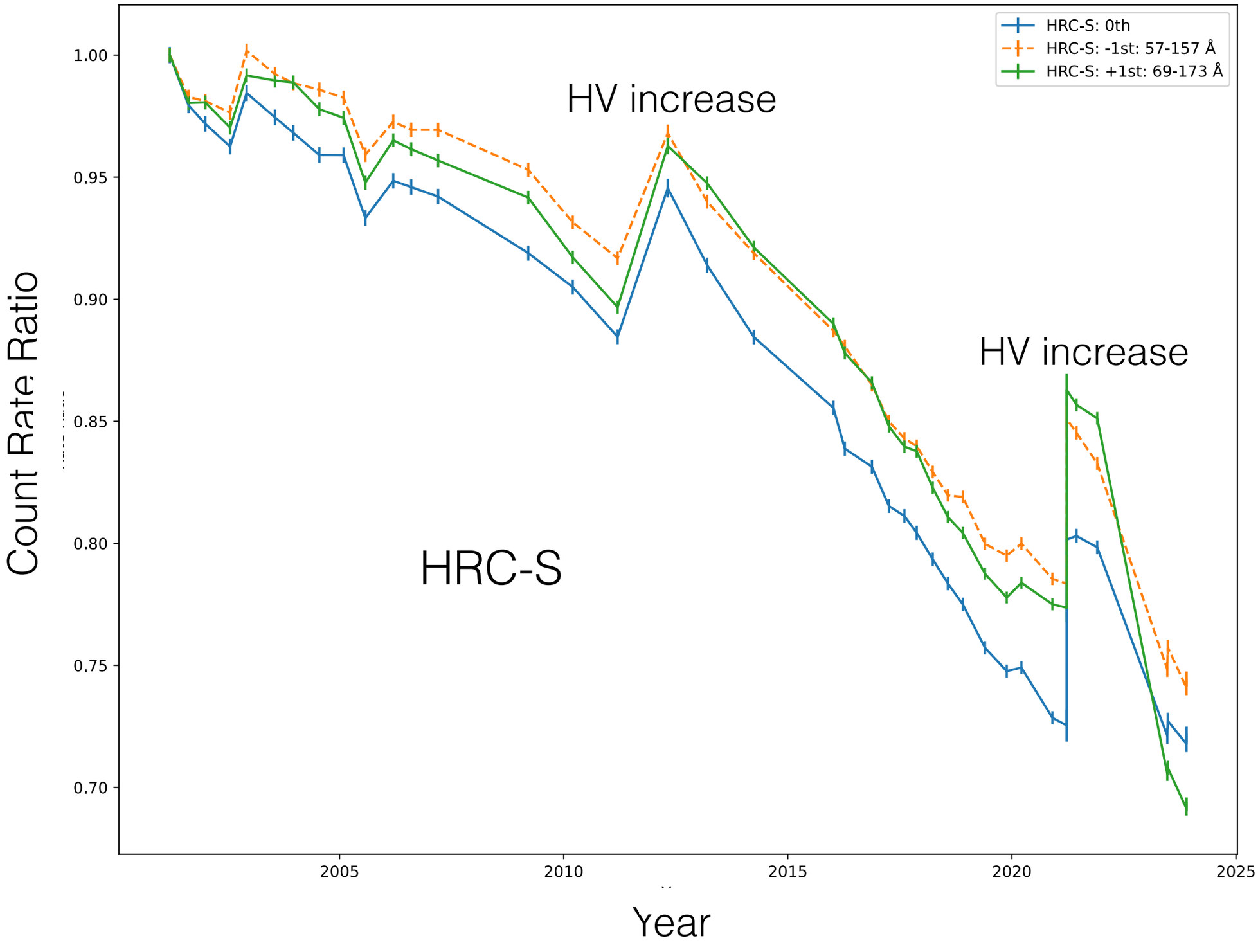
I3 ECS spectra with FP temps -111 to -109 C



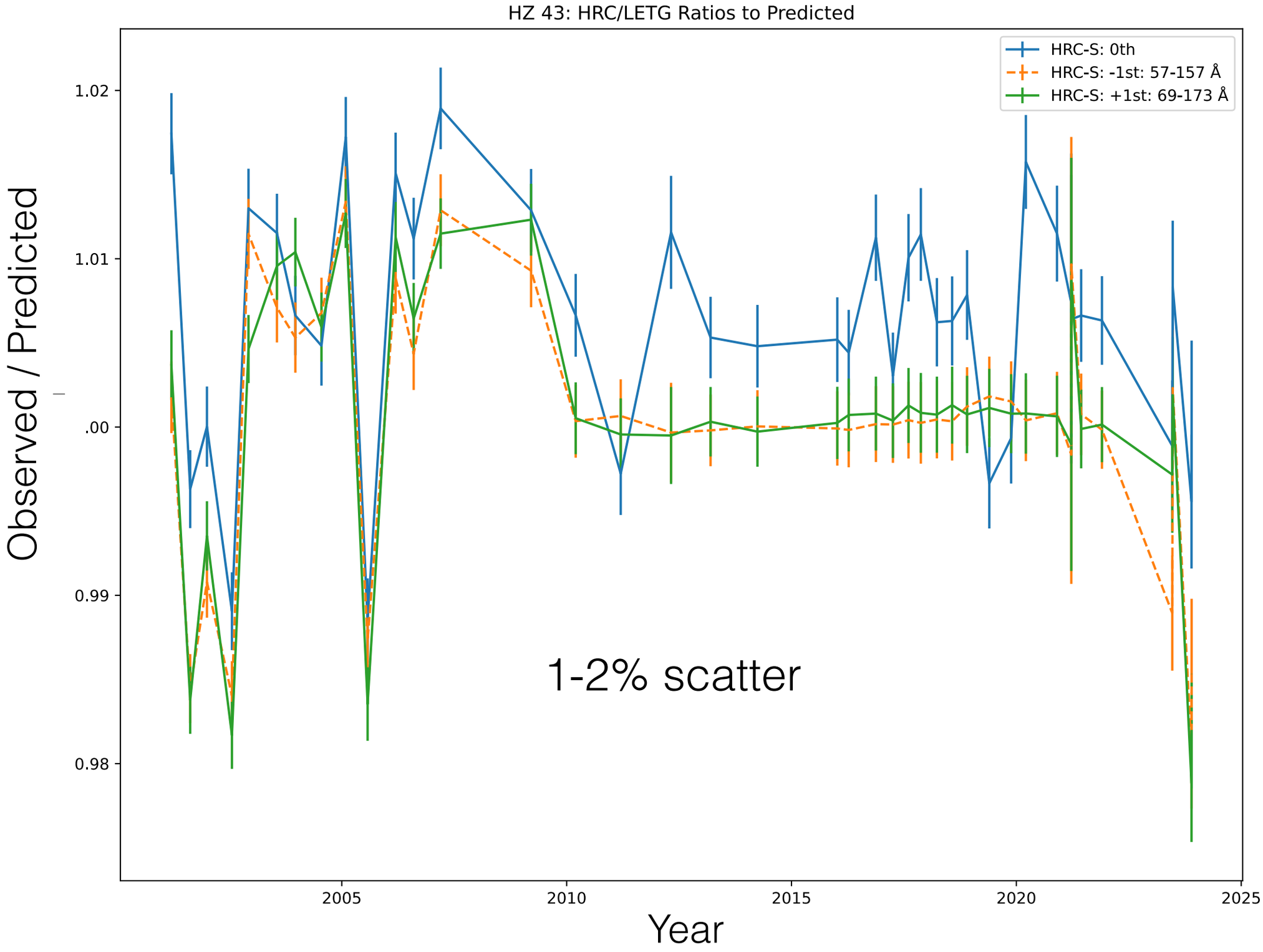
Note: A new temperature-dependent CALDB file will be released to the public within the next couple of months.

Low Energy Response of the HRC-S

LETG observations of HZ43 with the HRC-S have been performed annually over the course of the mission.

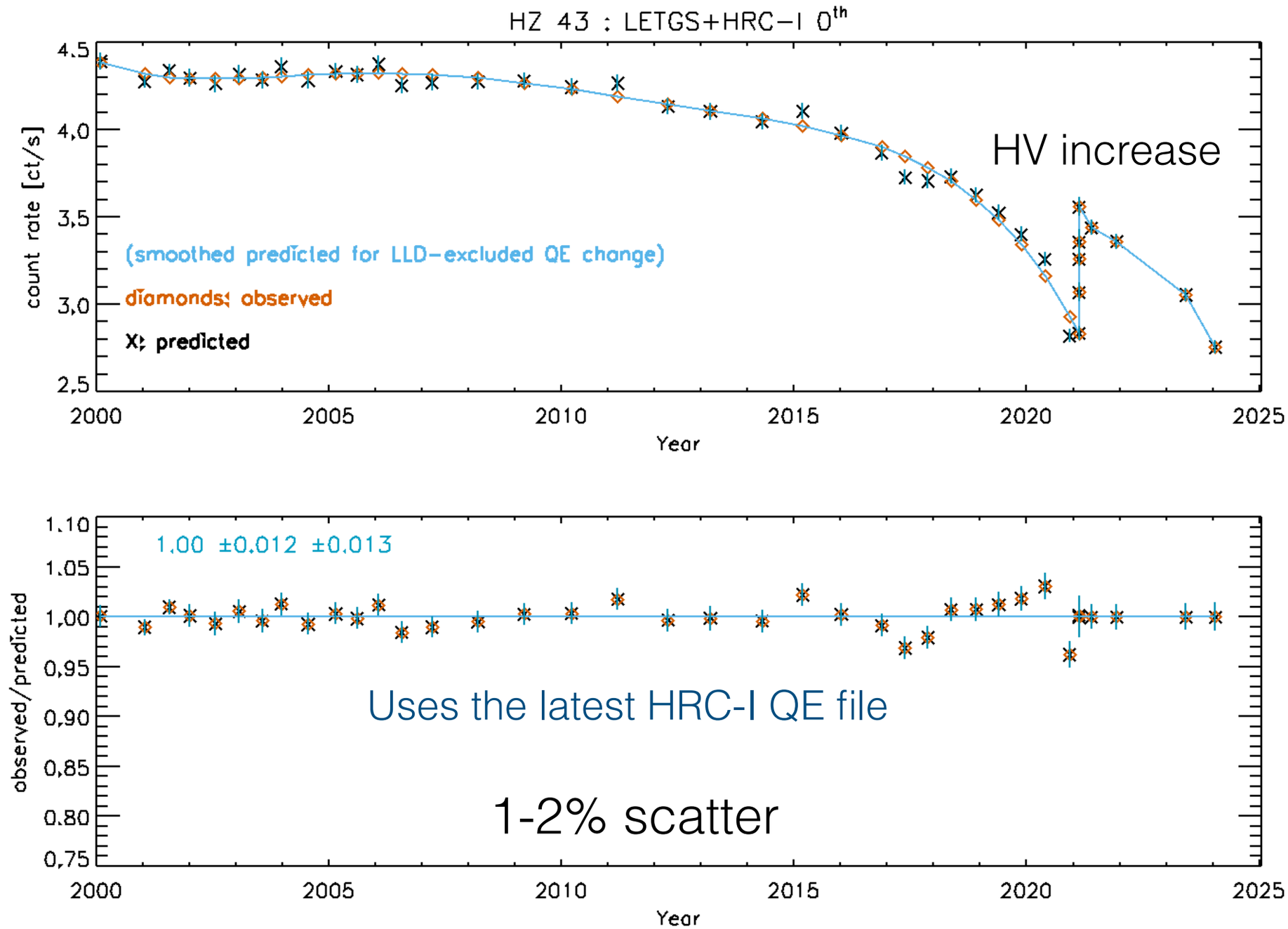


Fluxed HRC-S/LETG spectra of HZ43 with the newly released HRC-S QEU file



Low Energy Response of the HRC-I

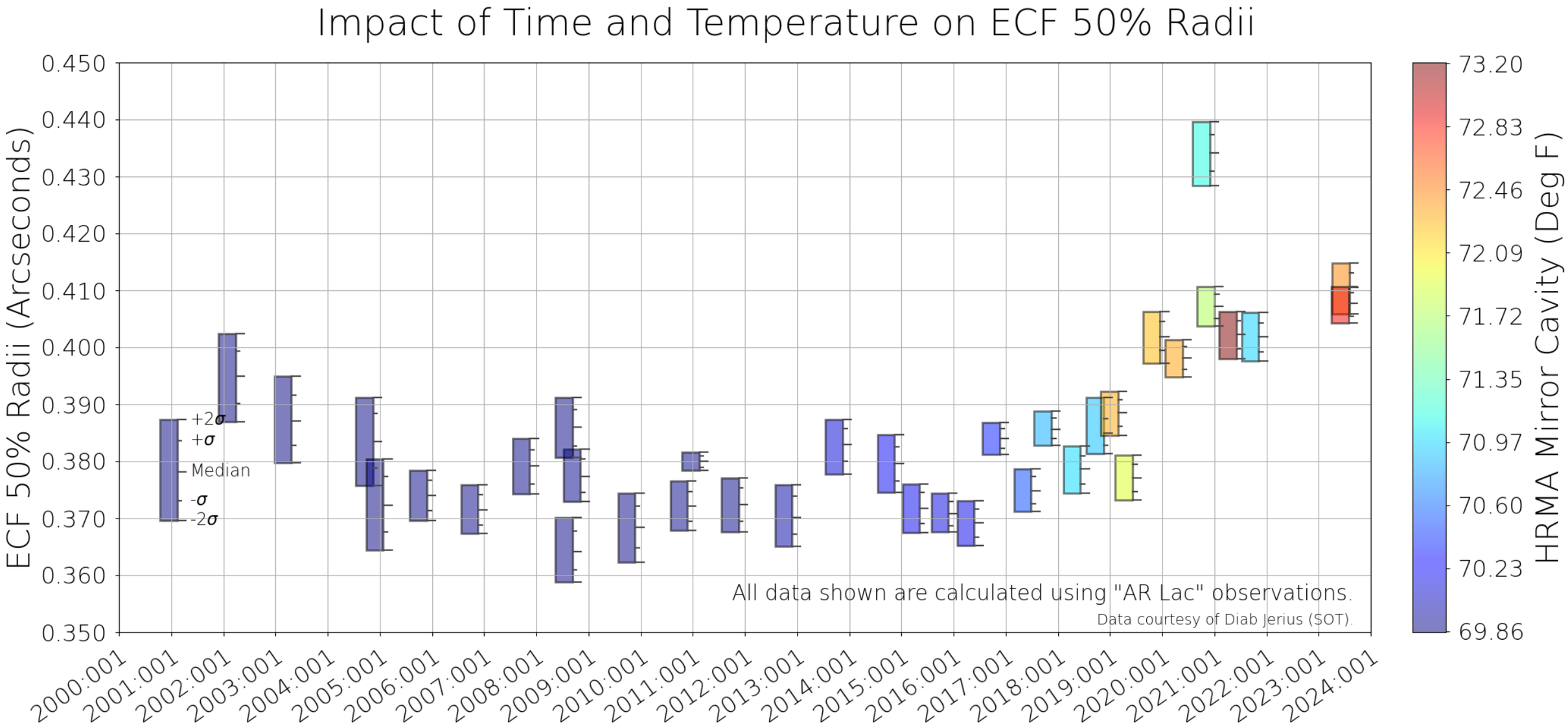
LETG observations of HZ43 with the HRC-I have been performed annually over the course of the mission.



Note: the HV of the HRC-I and HRC-S is scheduled to be increased in July-August, 2024

HRMA PSF Monitoring

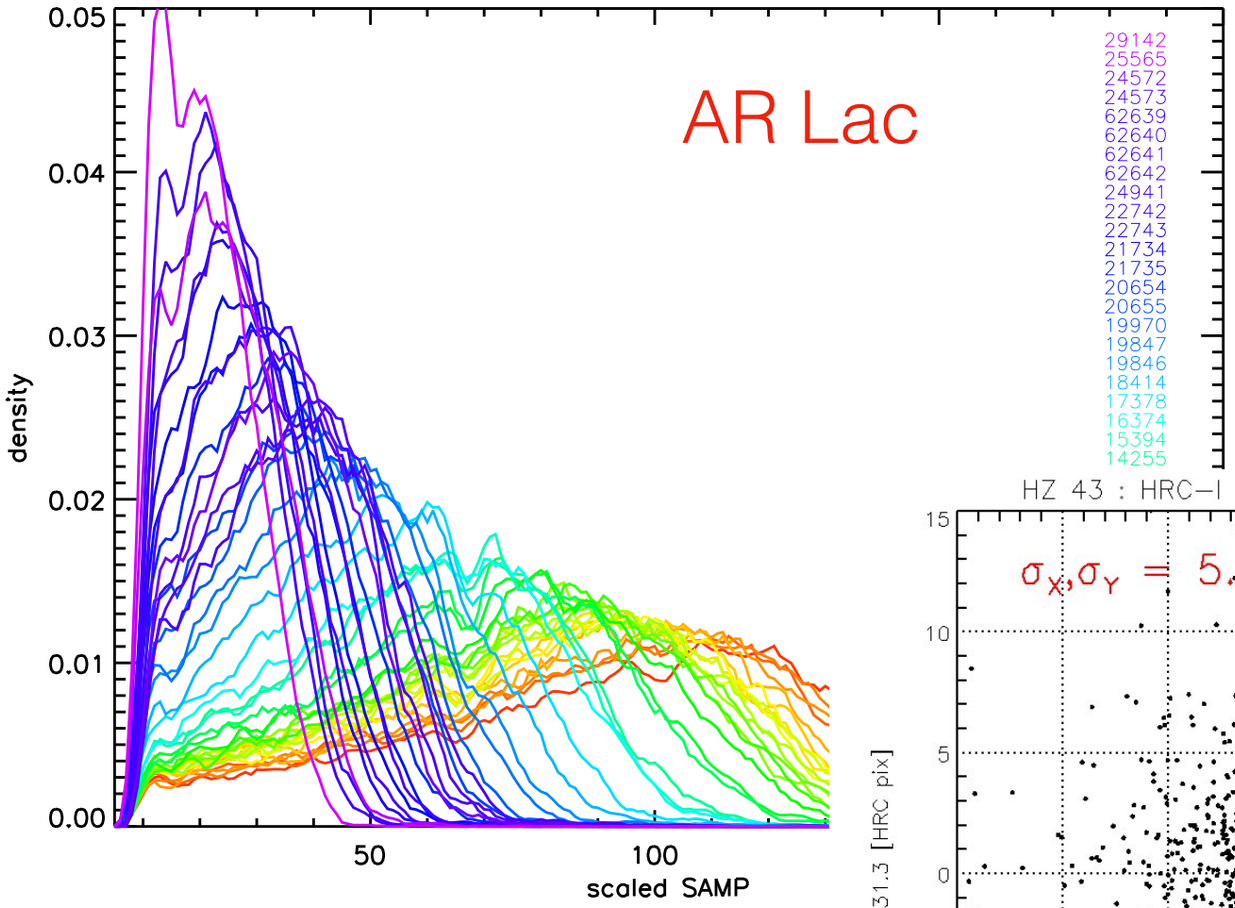
AR Lac has been observed at least once per year on-axis with the HRC-I since launch.



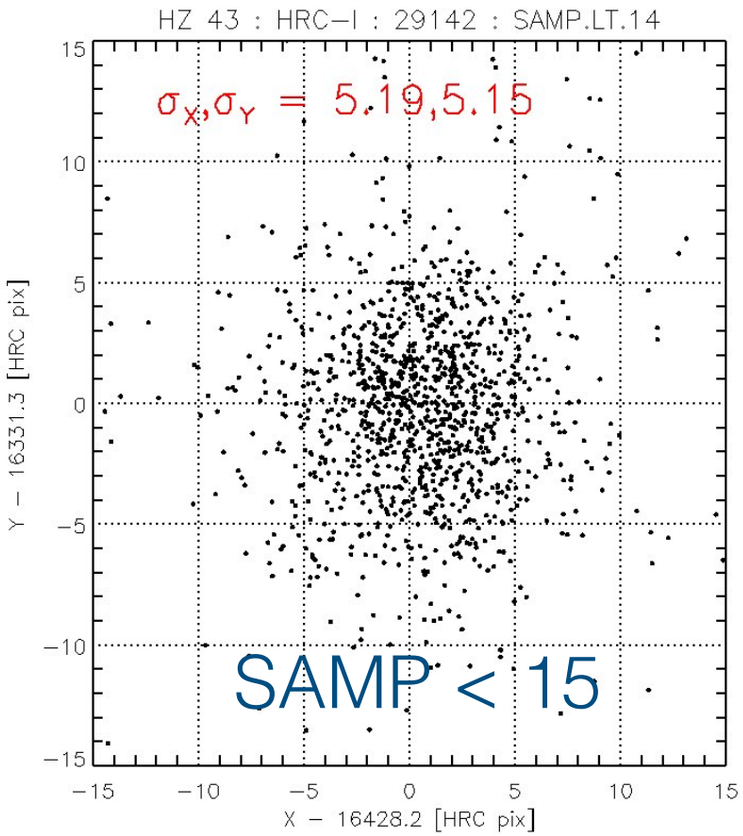
A slight increase of 0.03” (1/4 of a HRC pixel 1/16 of an ACIS pixel) over the past four years.

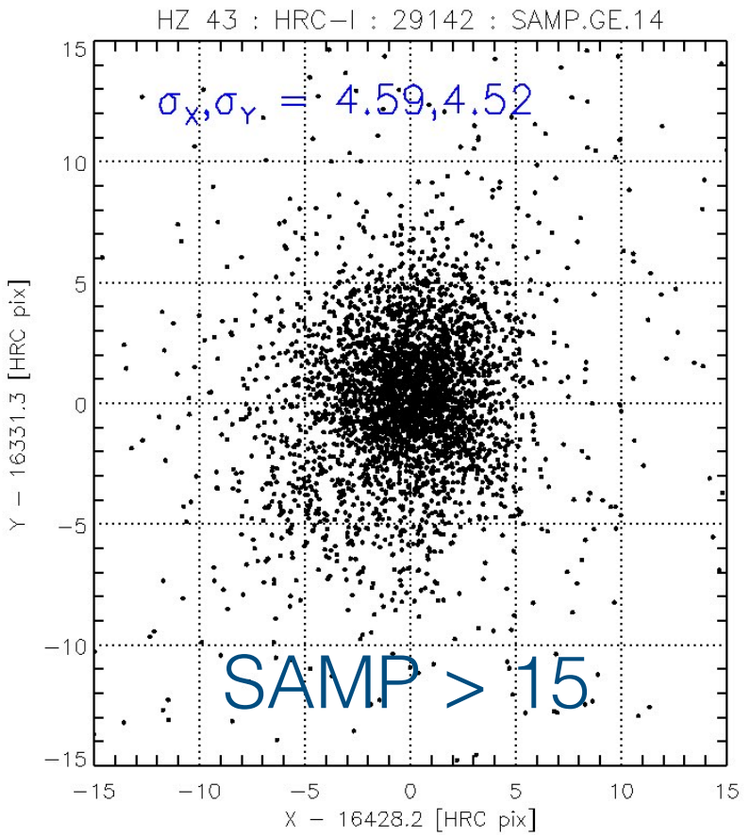
Is the Broadening of the PSF a HRMA or HRC issue?

- Steady decline in the mean SAMP with time
- Recent observations show a low SAMP peak



Low SAMP events have a broader PSF





Note: This work suggests that the declining HRC gain is responsible for the broadening of the PSF, but a more thorough investigation is still needed.

Future Calibration Plans

ACIS

- Release a temperature-dependent p2_resp file (i.e., the CALDB file used by CIAO to generate rmfs)
- Develop a time-dependent gain correction file based on Cas A and Perseus data
- Continue to monitor the contamination on the ACIS filters

HRC

- Increase the HV of the HRC-I and HRC-S in July-August, 2024
- Release updated QE files for the HRC-I and HRC-S based on the new HV settings

HETG

- Post updates to the higher order transmission efficiencies

Optics

- Determine if the broadening of the PSF is due to the decline in HRC gain