

CTI evolution and its impact on spectral resolution in different orbital environments



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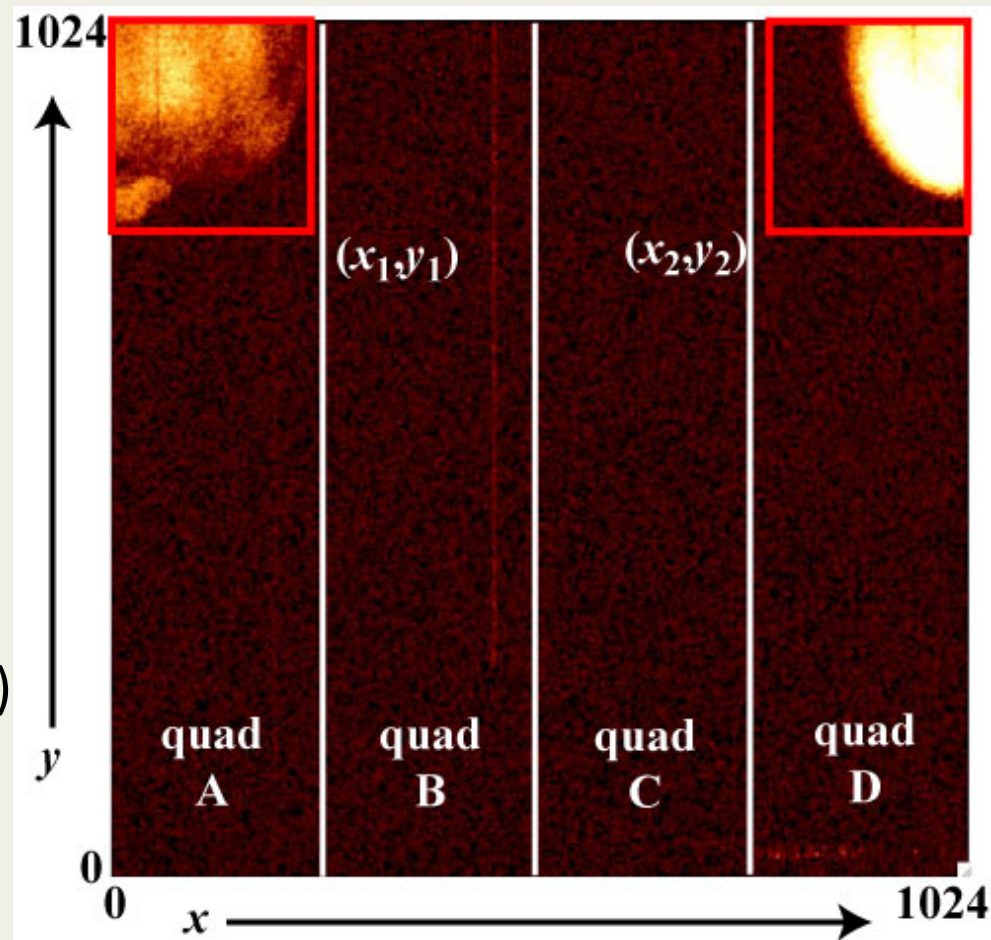


Outline

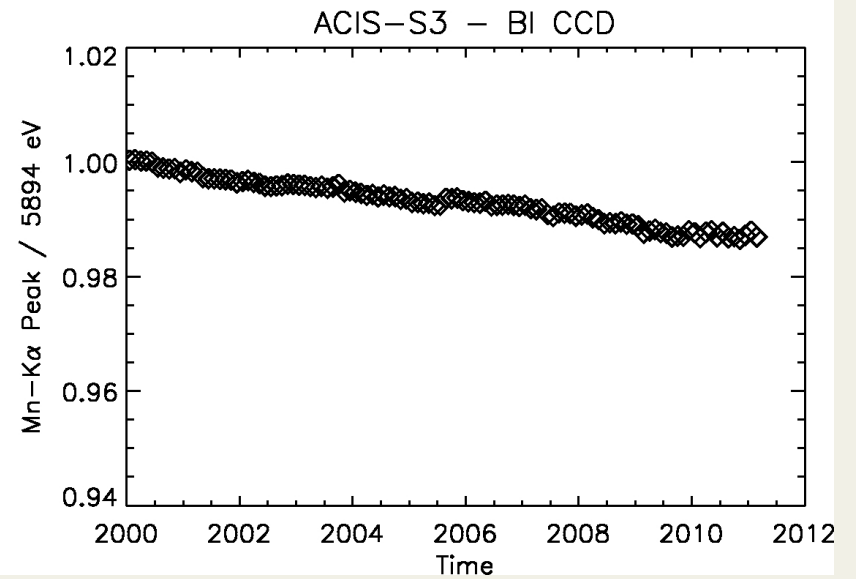
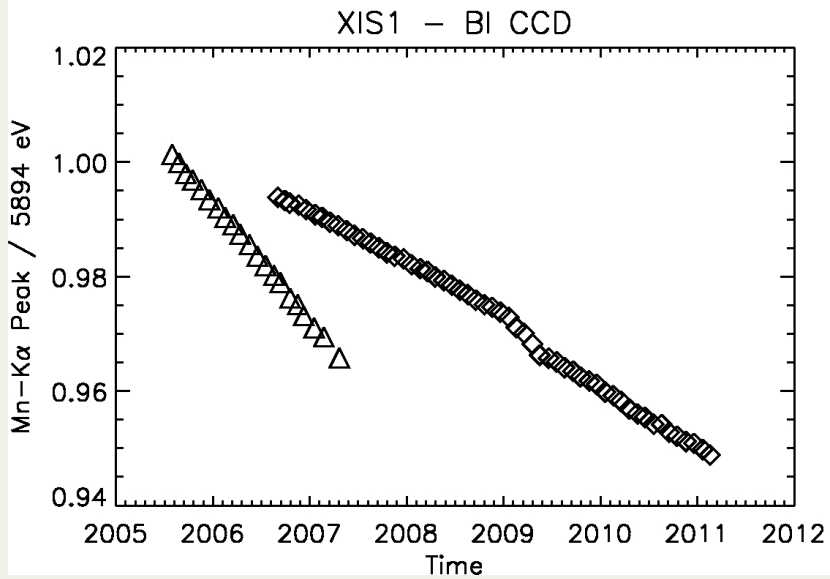
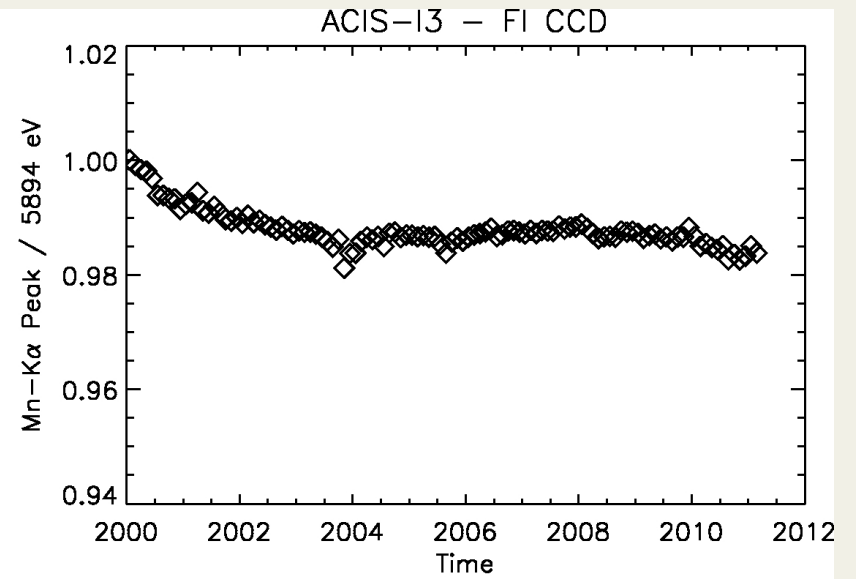
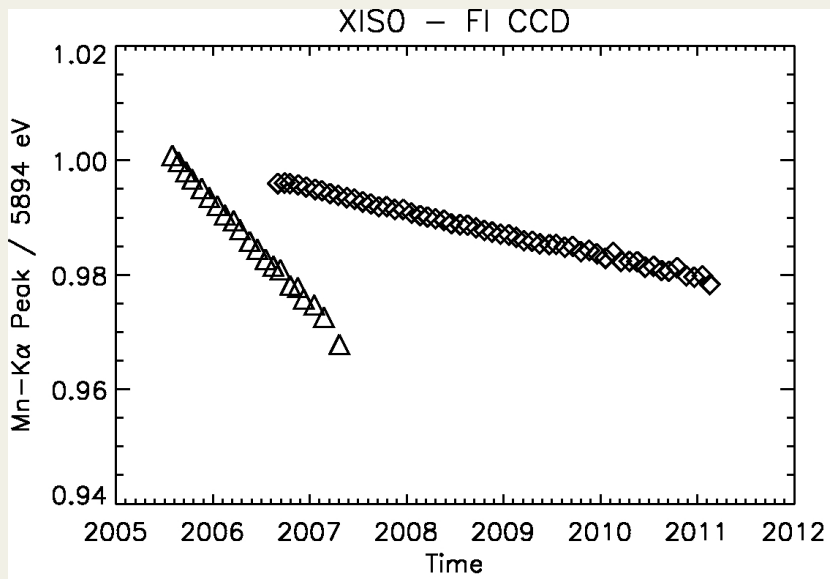
- Compare on-orbit CTI and FWHM evolution of ACIS and XIS
 - Important to duplicate measurement methodology
- Both use related CCDs
 - Pixel sizes, device dimensions
- Operational differences
 - Transfer speeds, frame times (3.2s vs 8s), temperature (-120C vs -90C), charge injection
- Particle backgrounds very different (low vs high Earth orbit)
- Use differences and similarities to help explain CTI and FWHM evolution

On Calibration Sources and Data

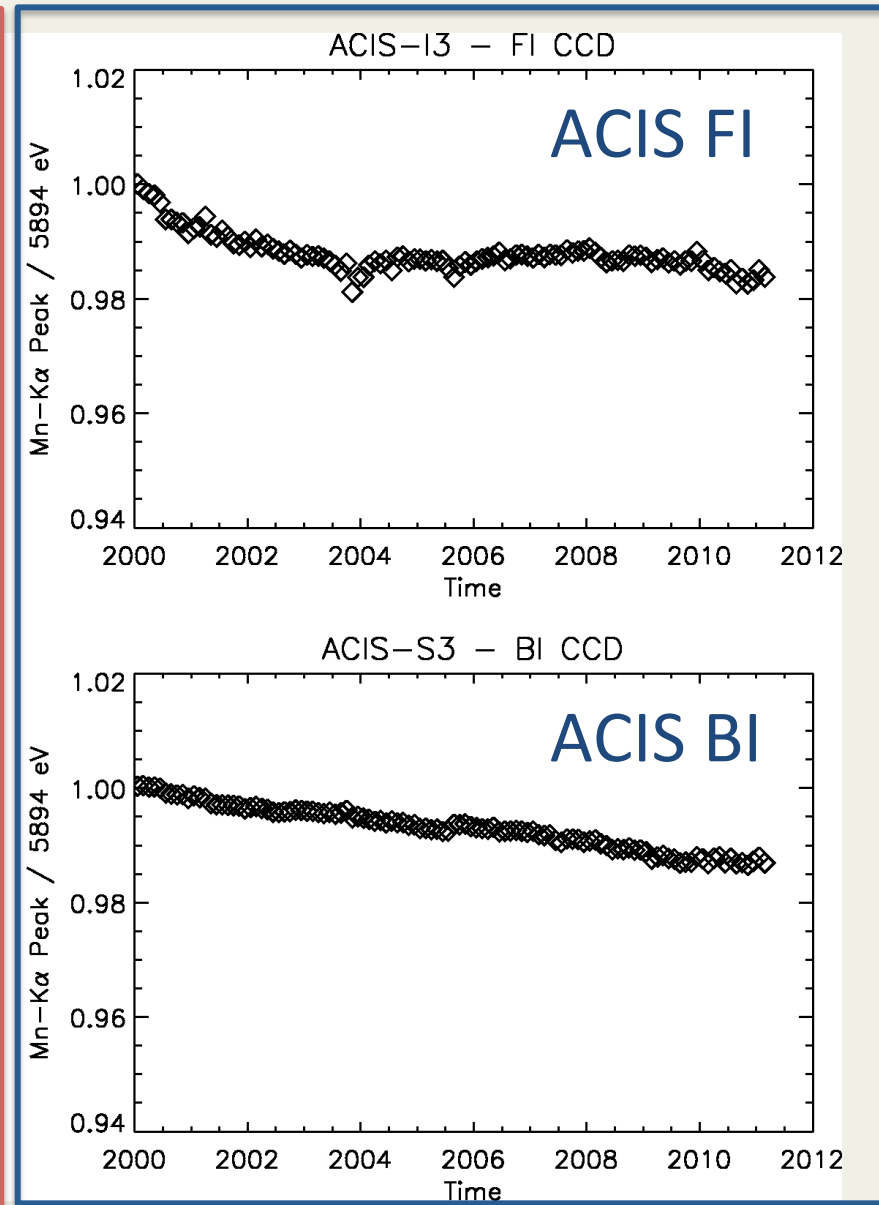
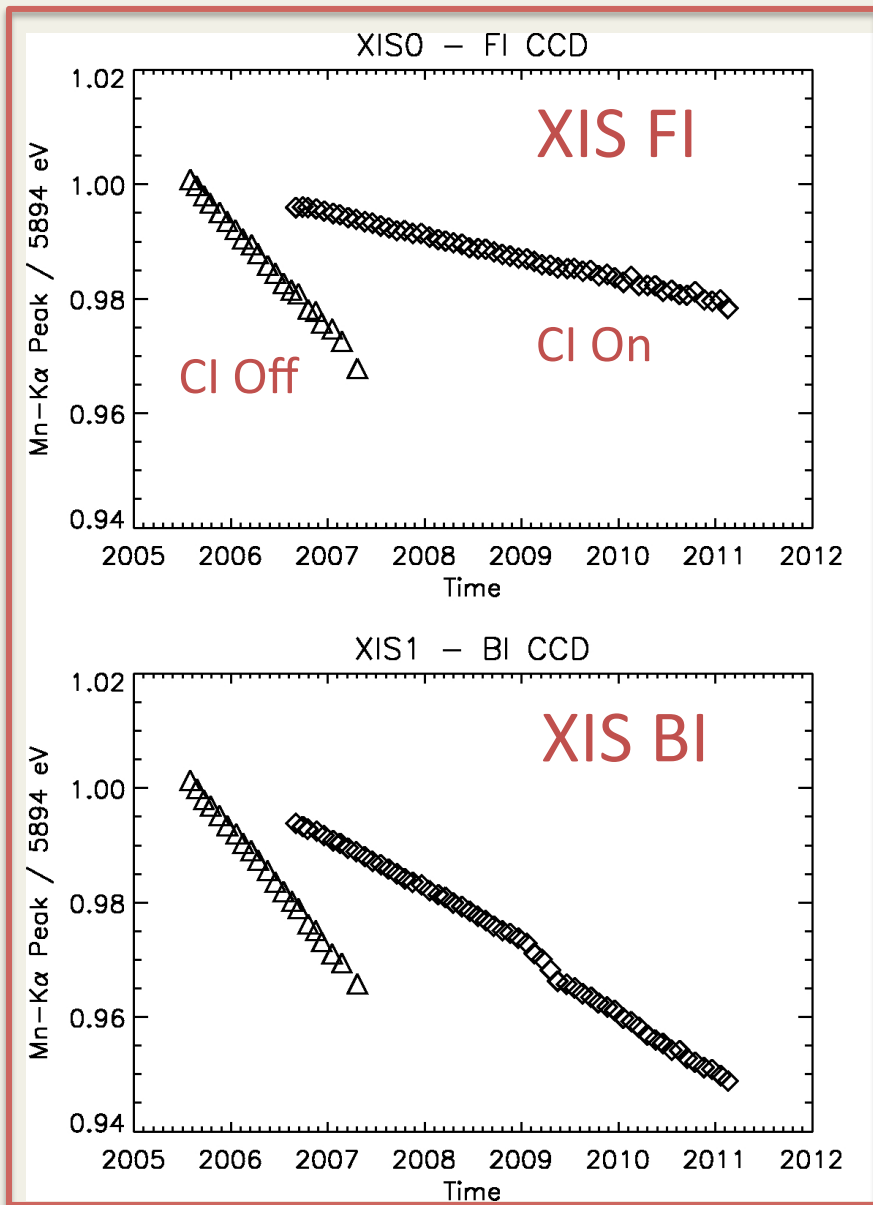
- Both are Fe-55
 - Comparing Mn-K α lines
- Suzaku sources illuminate upper corners, ACIS is uniformly illuminated
 - Using Suzaku regions
- Doesn't allow for true CTI measurement, comparing line centroid and width
- Standard grade filter (G02346)
- Unprocessed eventlists
 - No CTI or gain correction



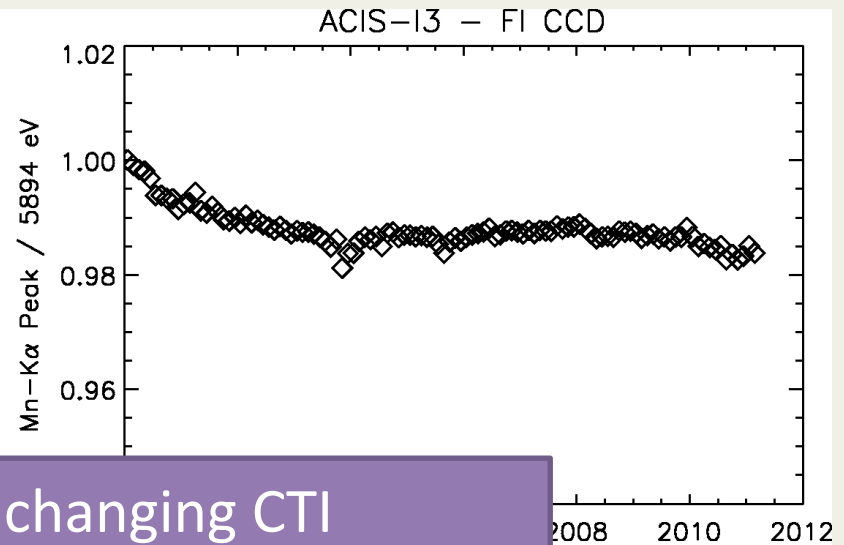
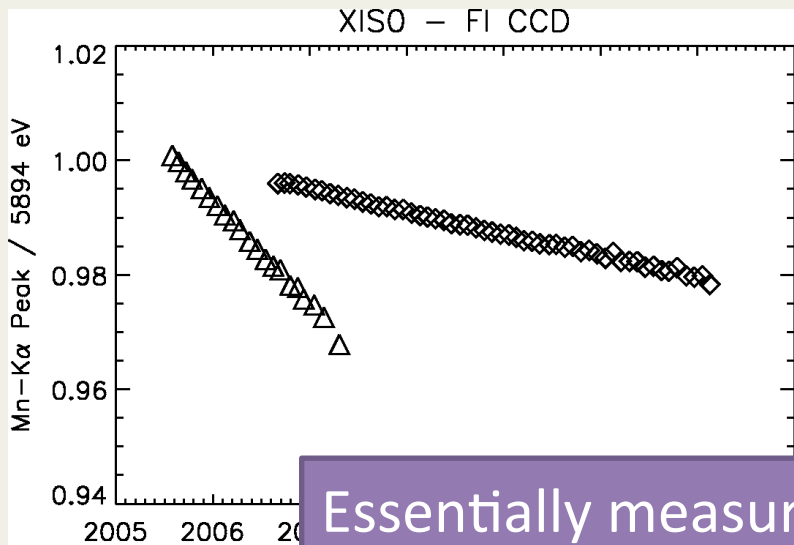
Line Center Evolution



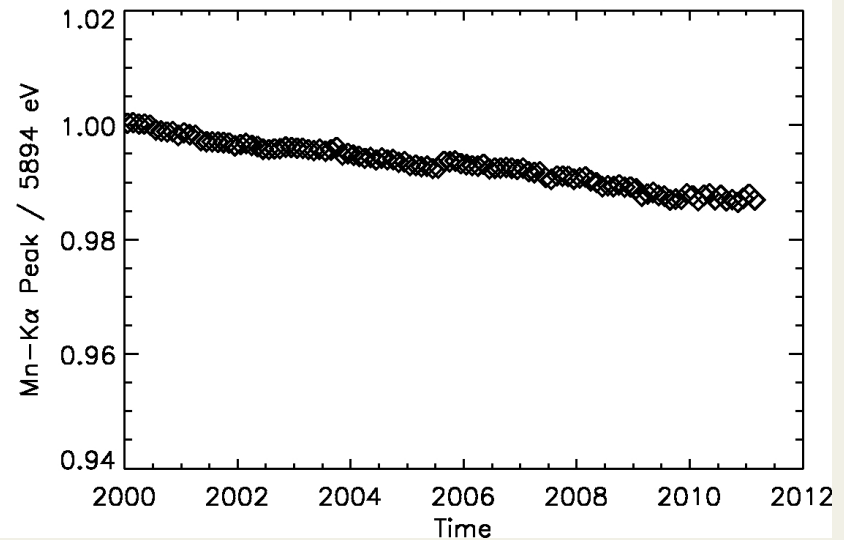
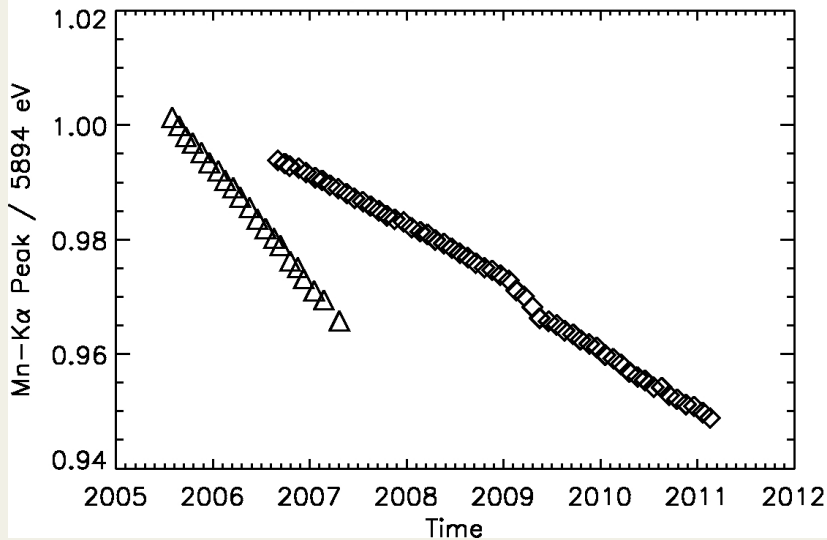
Line Center Evolution



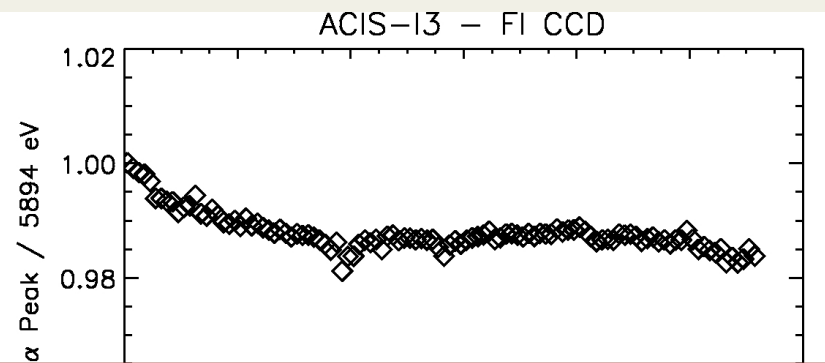
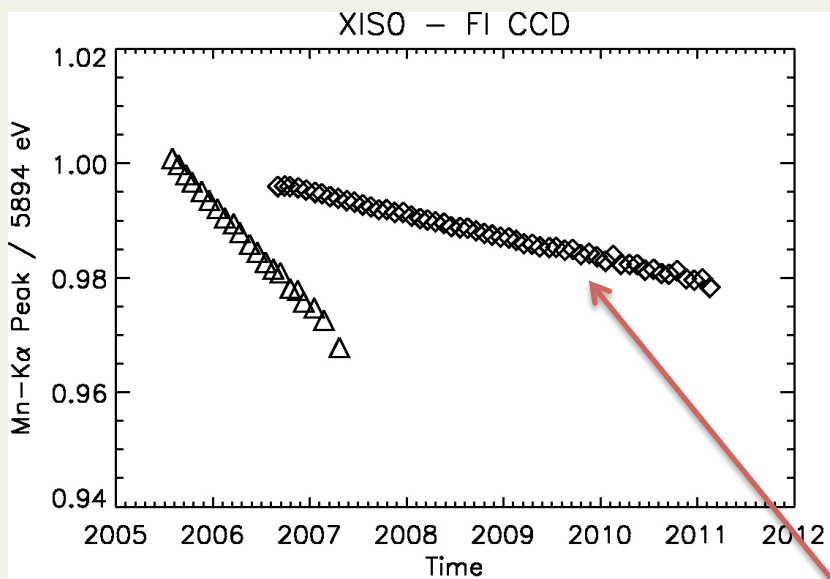
Line Center Evolution



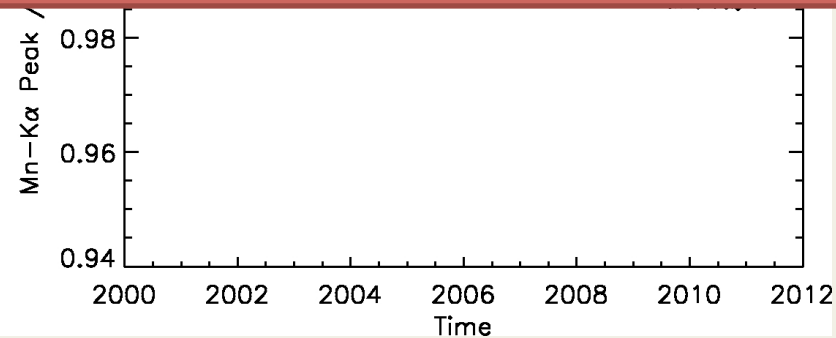
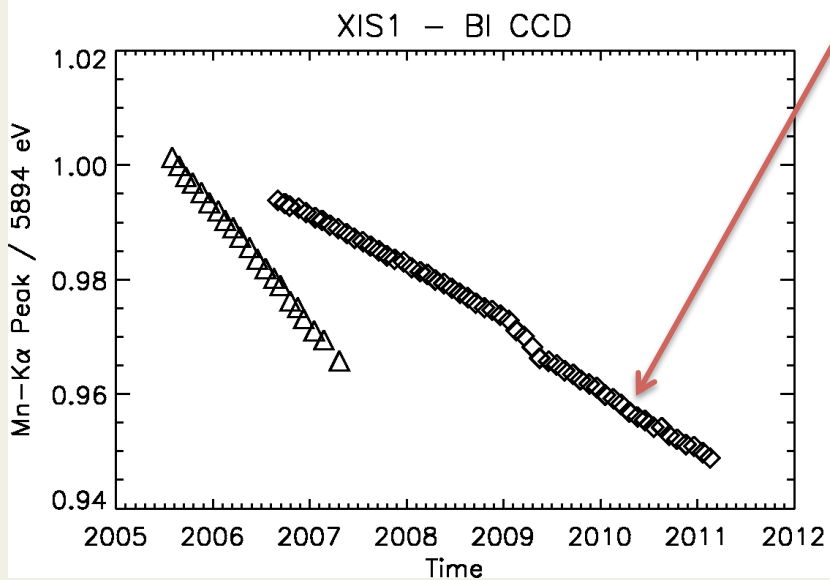
Essentially measures changing CTI
(Ignore gain changes from other sources)



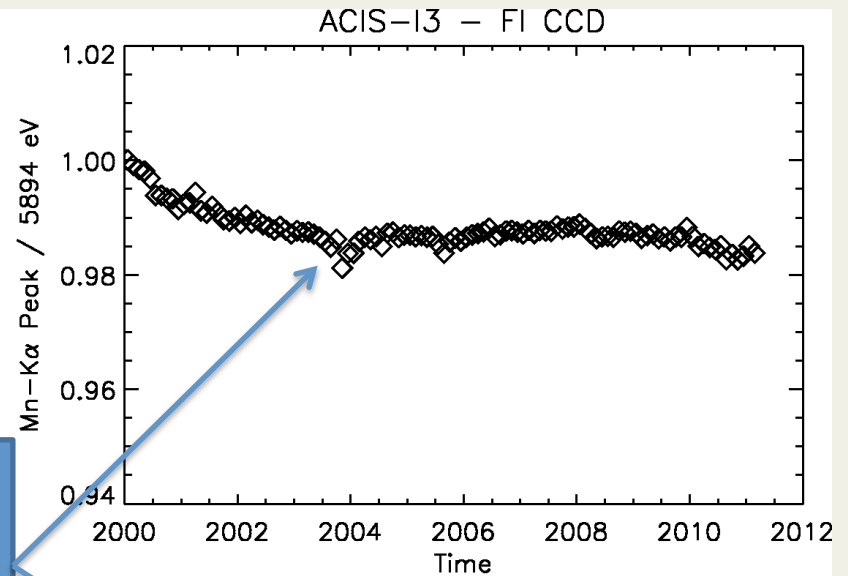
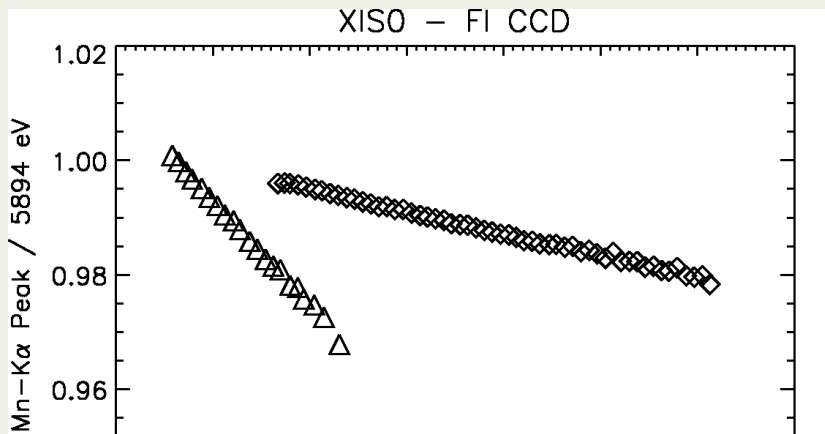
Line Center Evolution



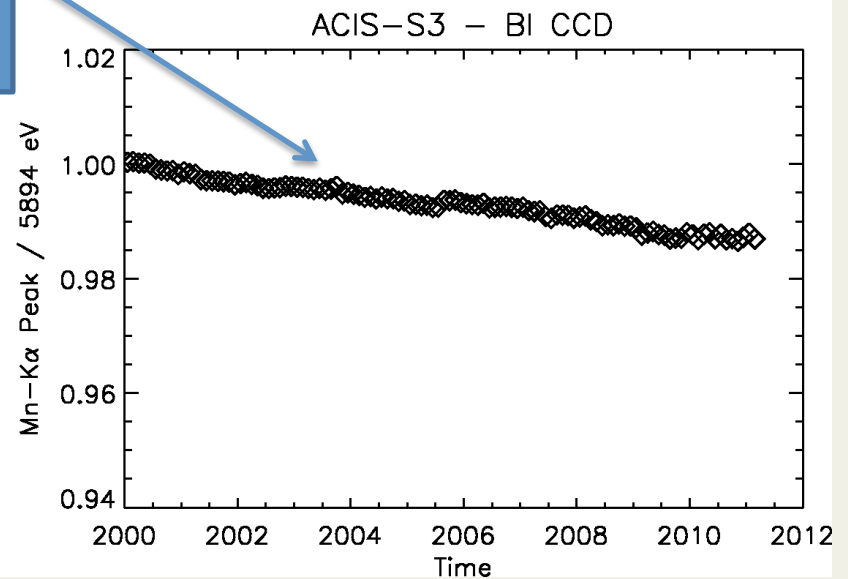
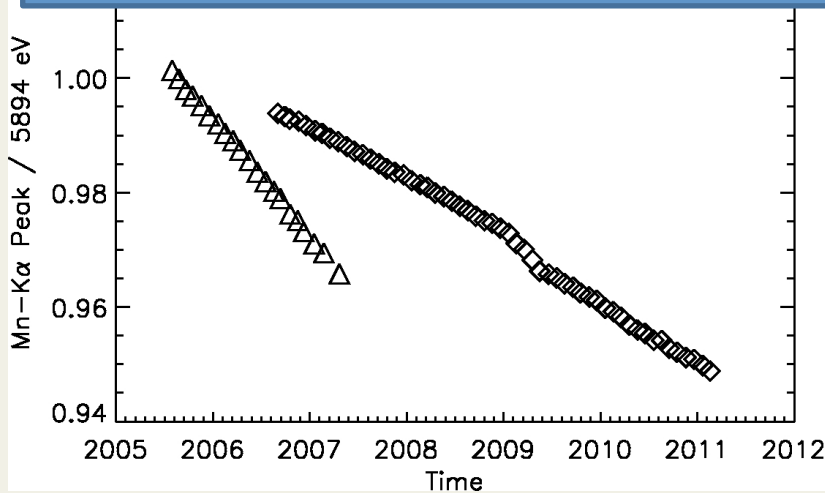
XIS smoothly changing.
Particle background stable on long timescales.
Charge injection improves CTI.
Reduces dCTI/dt.
Also contributes to smoothness?



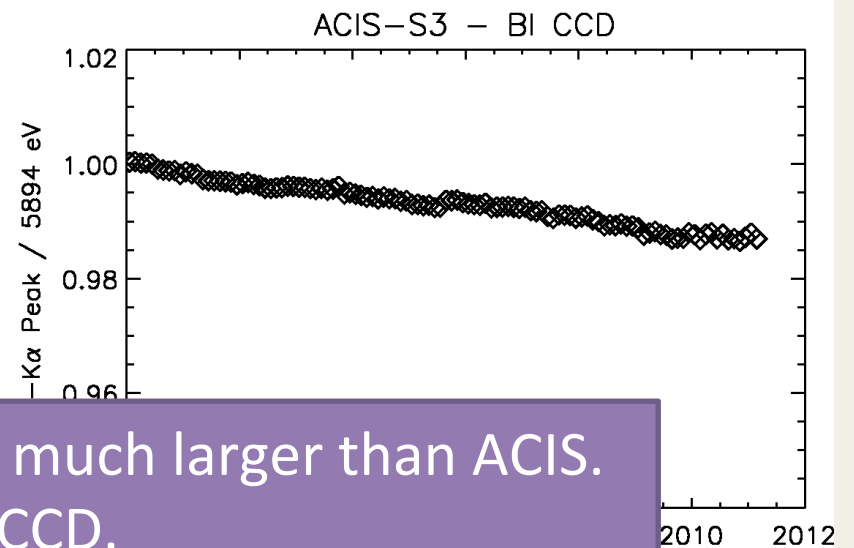
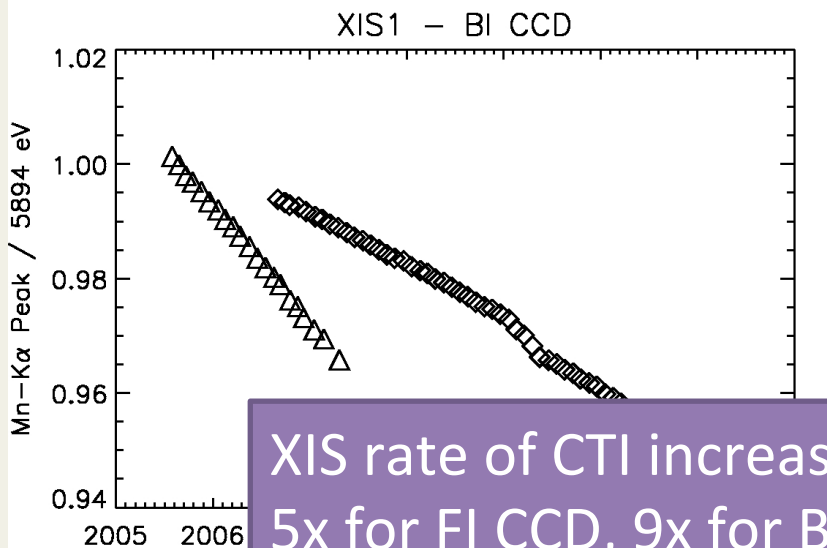
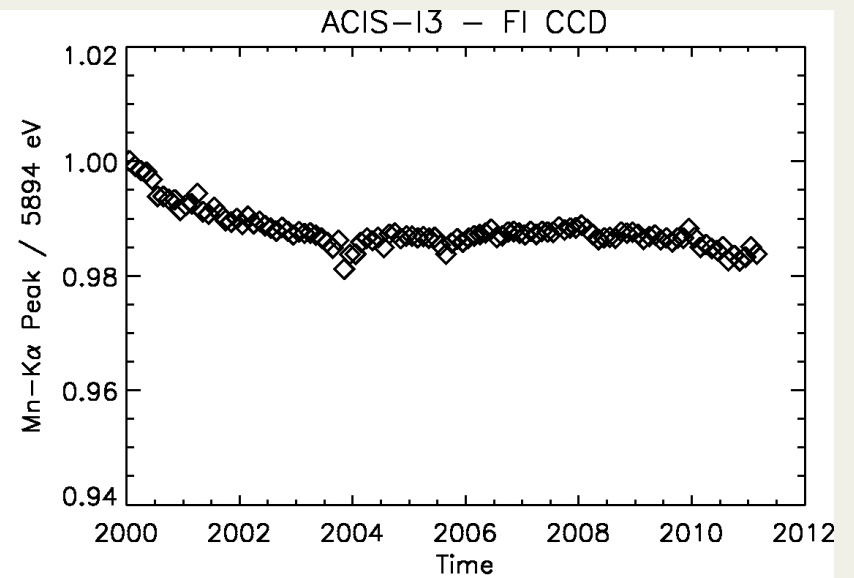
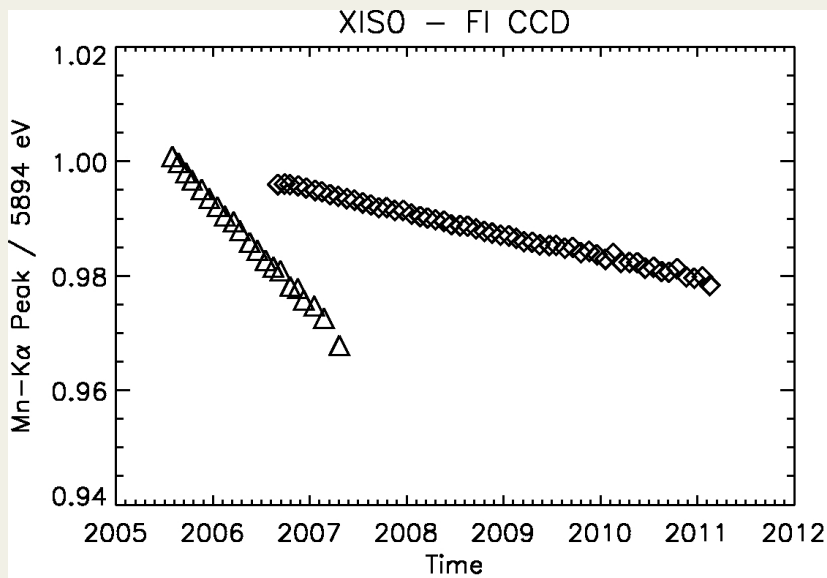
Line Center Evolution



ACIS more irregular.
Particle background dependent
on solar cycle and activity.

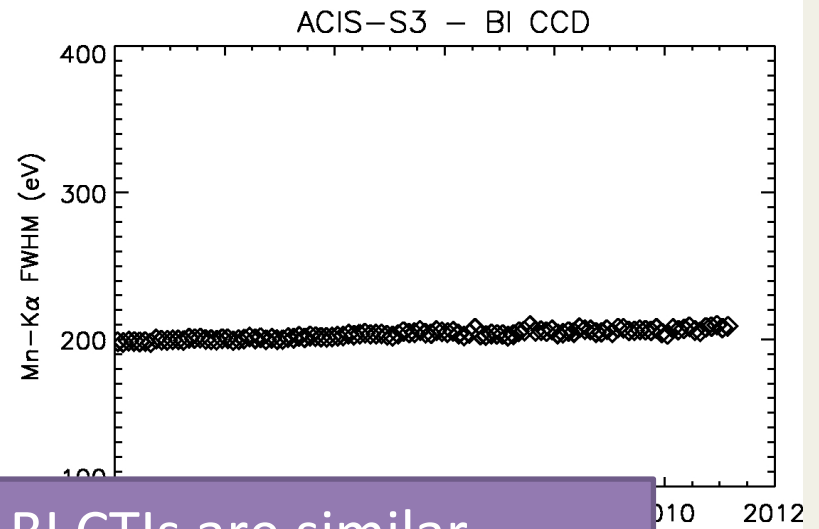
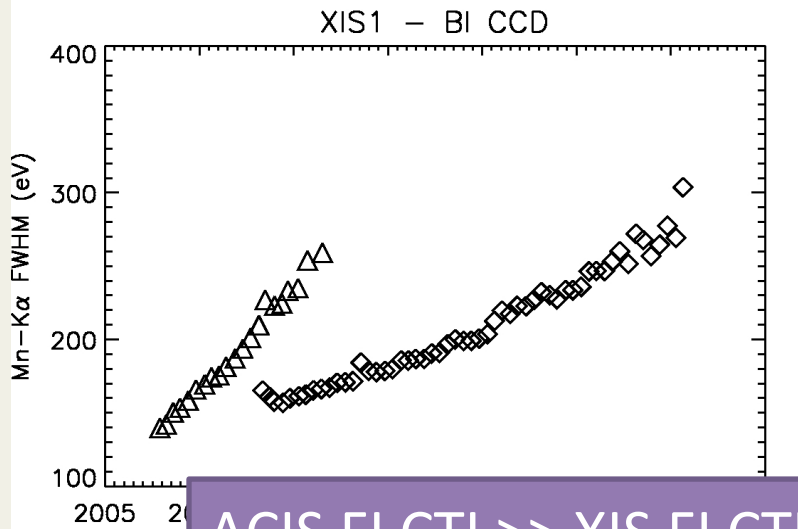
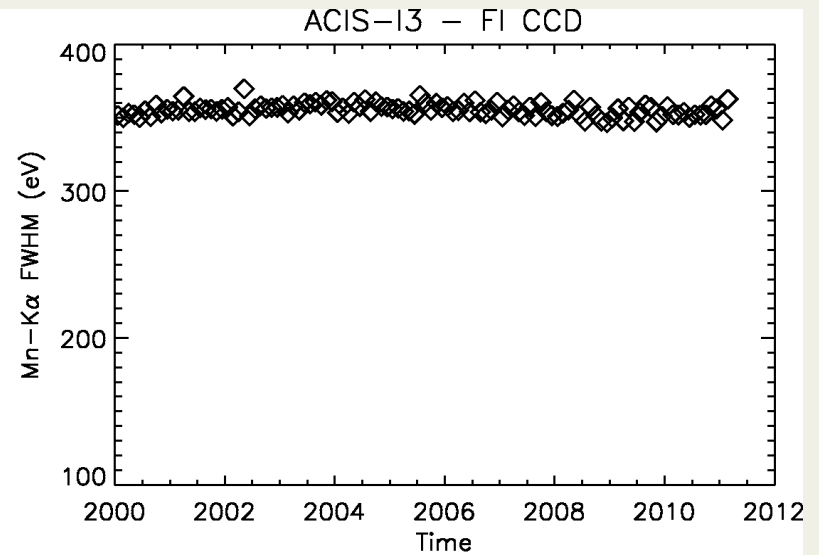
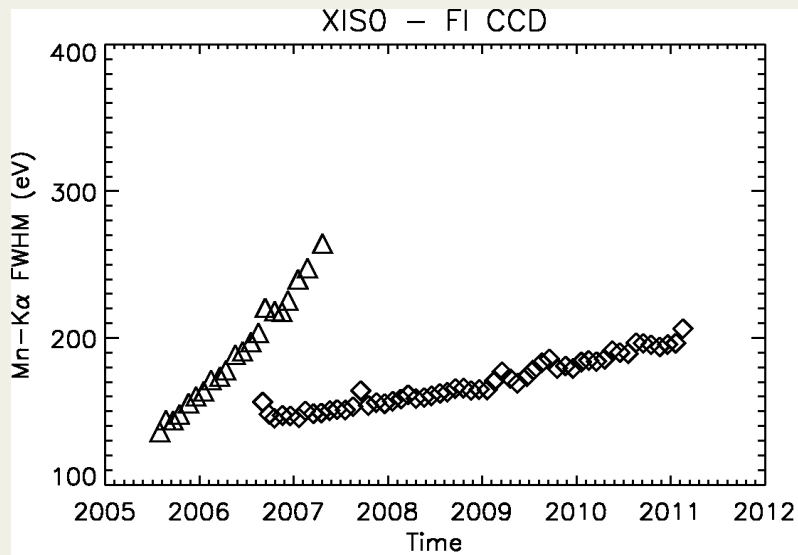


Line Center Evolution



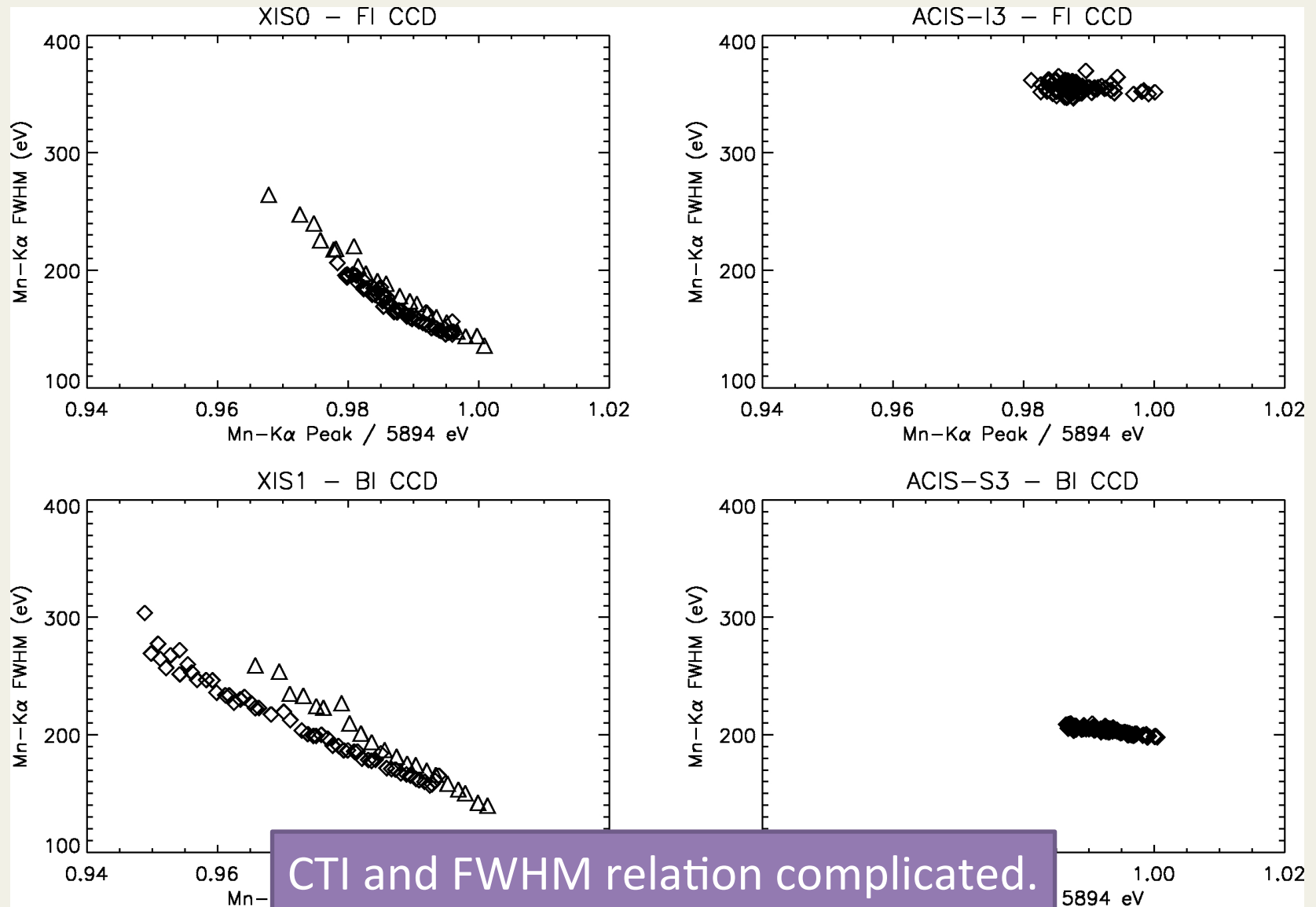
XIS rate of CTI increase much larger than ACIS.
5x for FI CCD, 9x for BI CCD.

Line Width Evolution



ACIS FI CTI >> XIS FI CTI. BI CTIs are similar.
ACIS FWHM mostly flat. XIS FWHM is increasing.

Line Width Evolution



CTI and FWHM relation complicated.
ACIS and XIS behave differently.

Some Initial Observations

- XIS smoothly changing
 - Low-earth orbit plus charge injection
 - Sacrificial charge is stable on month timescales
- $dCTI/dt$, $XIS > ACIS$
 - High-earth orbit has different particle energy distribution, can hide from low-energy particles?
 - Or is this temperature-dependent? Low temperatures \rightarrow Low $dCTI/dt$
- $dCTI/dt$ & $dFWHM/dt$ relation is complicated
- Future work
 - CTI & FWHM dependence on sacrificial charge
 - Cut-off rigidity for XIS, Particle background for ACIS

