

# The *Suzaku*/XIS: Status Report



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for the *Suzaku*/XIS Team

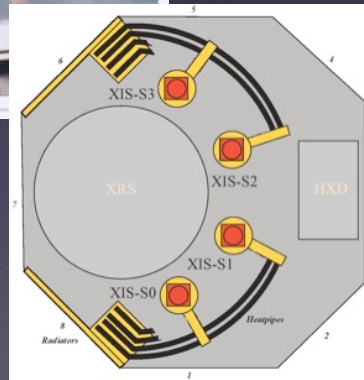


# Outline

- instrument health and status
  - spacecraft and instrument anomalies
  - gain and effective area tracking
  - changes in background
  - changes in charge injection
- calibration status
  - CTI and RMF fine-tuning
  - open issues

# Suzaku/XIS - Overview

- 4 CCDs with independent X-ray telescopes (XRTs)
- 3 front-illuminated (FI) XIS0 XIS2 XIS3  
1 back-illuminated (BI) XIS1



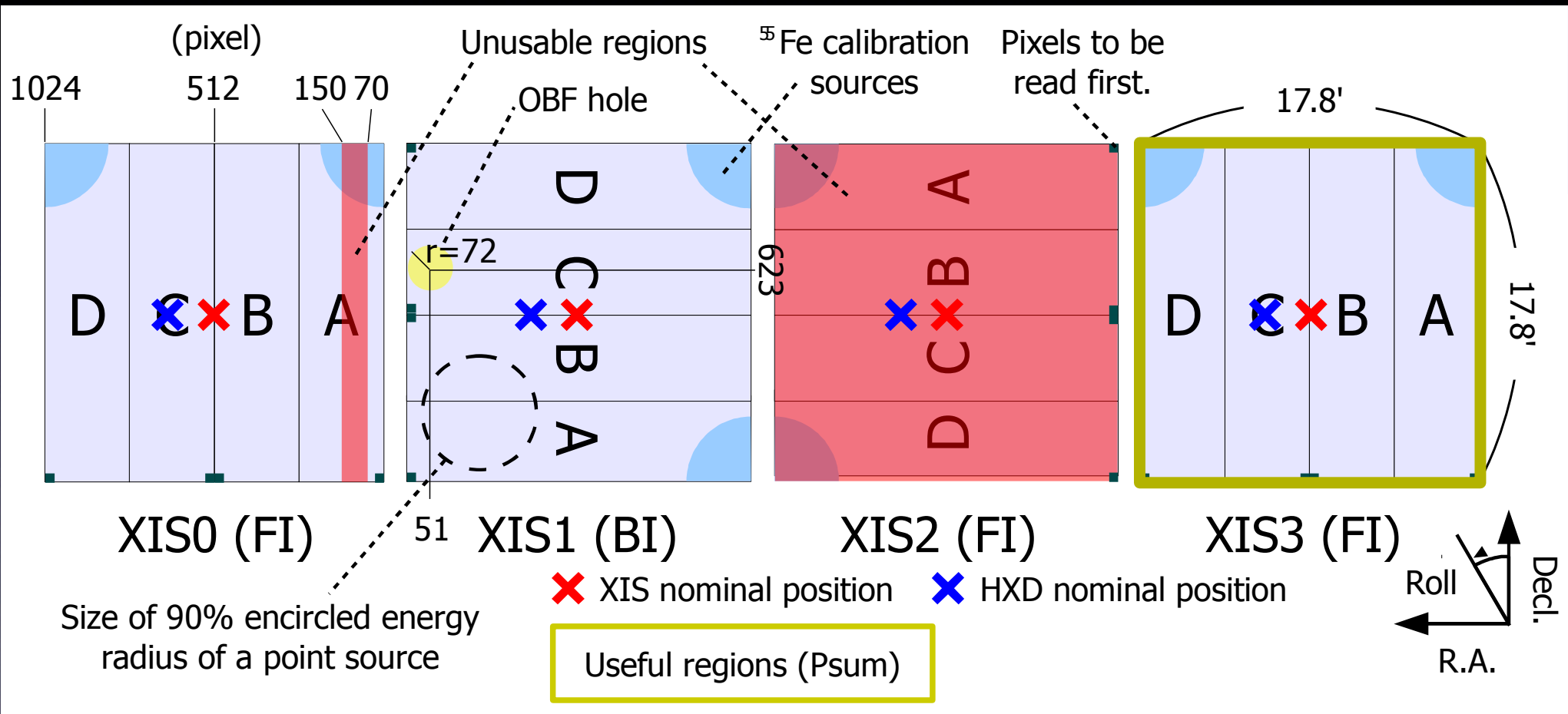
Field of view	17.8' x 17.8'
Energy range	0.2-12 keV
Energy resolution	~180 eV @6keV
Effective area	340 (FI)/390 (BI) cm <sup>2</sup> @1.5keV
Time resolution	8 s (Normal) - 7.8 ms (Psum)

from Tsujimoto's "pocket guide"

# Major XIS Events

July 10, 2005	launch of <i>Suzaku</i>
August 13, 2005	XIS doors open, start of observations
November 9, 2006	anomaly ( $\mu$ -meteorite?) in XIS2; 2/3 of chip affected, <b>XIS2 switched off</b>
January 30, 2008	CPU board malfunction in MPU; switch to redundant board
June 23, 2009	anomaly ( $\mu$ -meteorite?) in XIS0; 1/8 of chip affected, <b>XIS0 safe for normal ops</b>
December 18, 2009	anomaly ( $\mu$ -meteorite?) in XIS1; no CCD damage, <b>likely hole in XIS1 OBF</b>

# XIS Status



from Tsujimoto's "pocket guide"

# Gain and FWHM Tracking

- $^{55}\text{Fe}$  cal sources  $\rightarrow$  Mn  $K\alpha$  at 5.9 keV  
raw data, no CTI correction

- gain change  
with SCI on  
(% per yr)

XIS0  $-0.399 \pm 0.001$

XIS3  $-0.372 \pm 0.001$

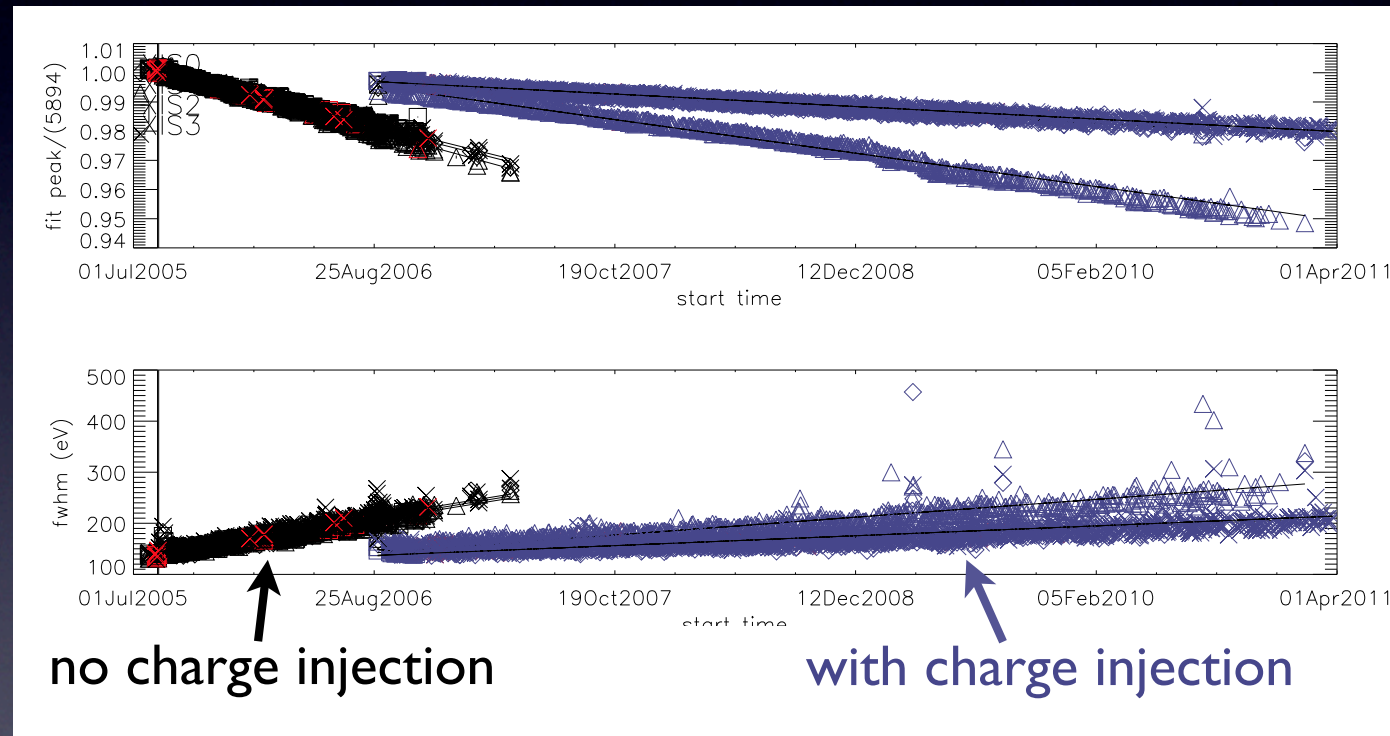
XIS1  $-0.997 \pm 0.001$

- FWHM change  
with SCI on  
(eV per yr)

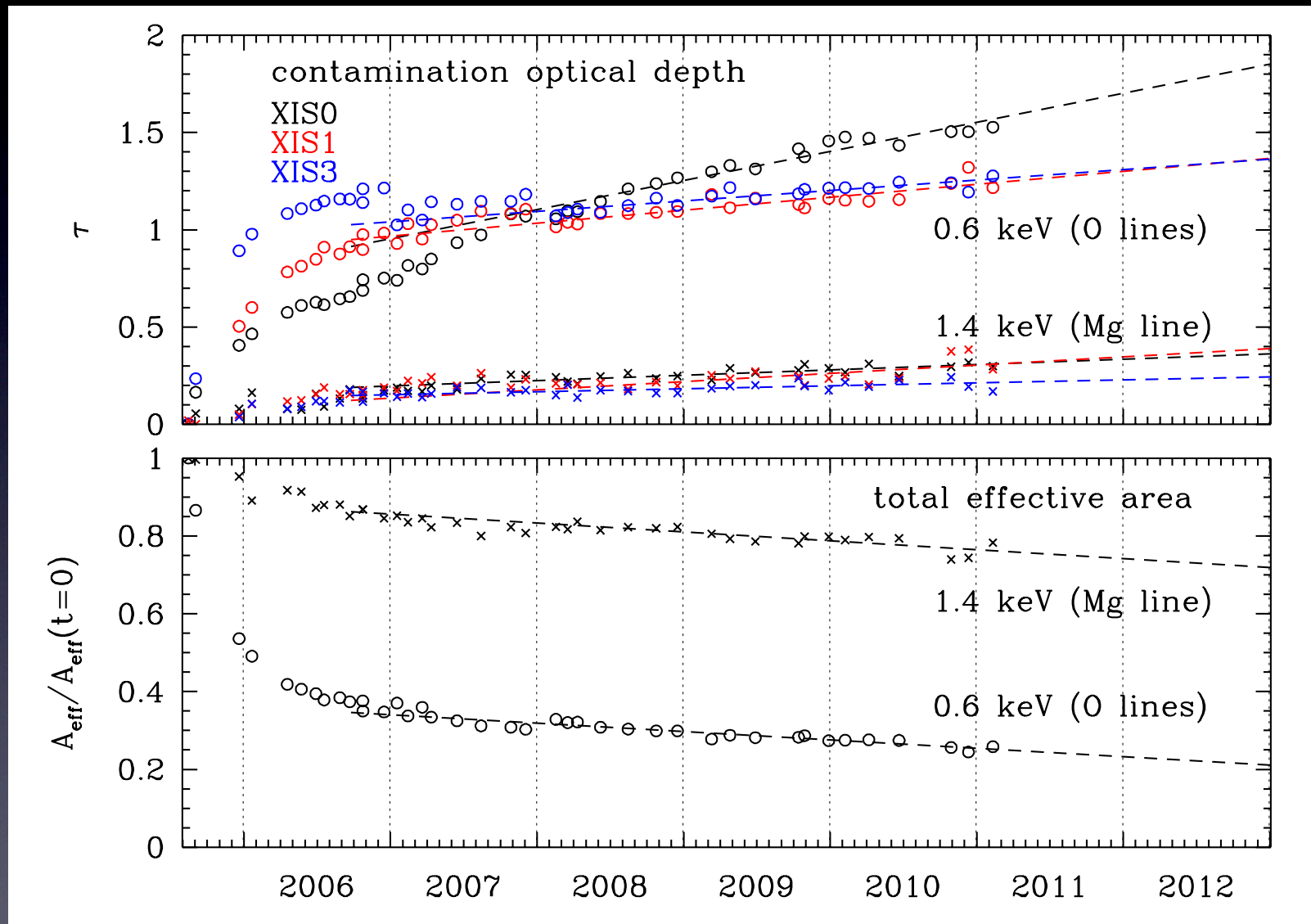
XIS0  $16.1 \pm 0.8$

XIS3  $16.8 \pm 1.4$

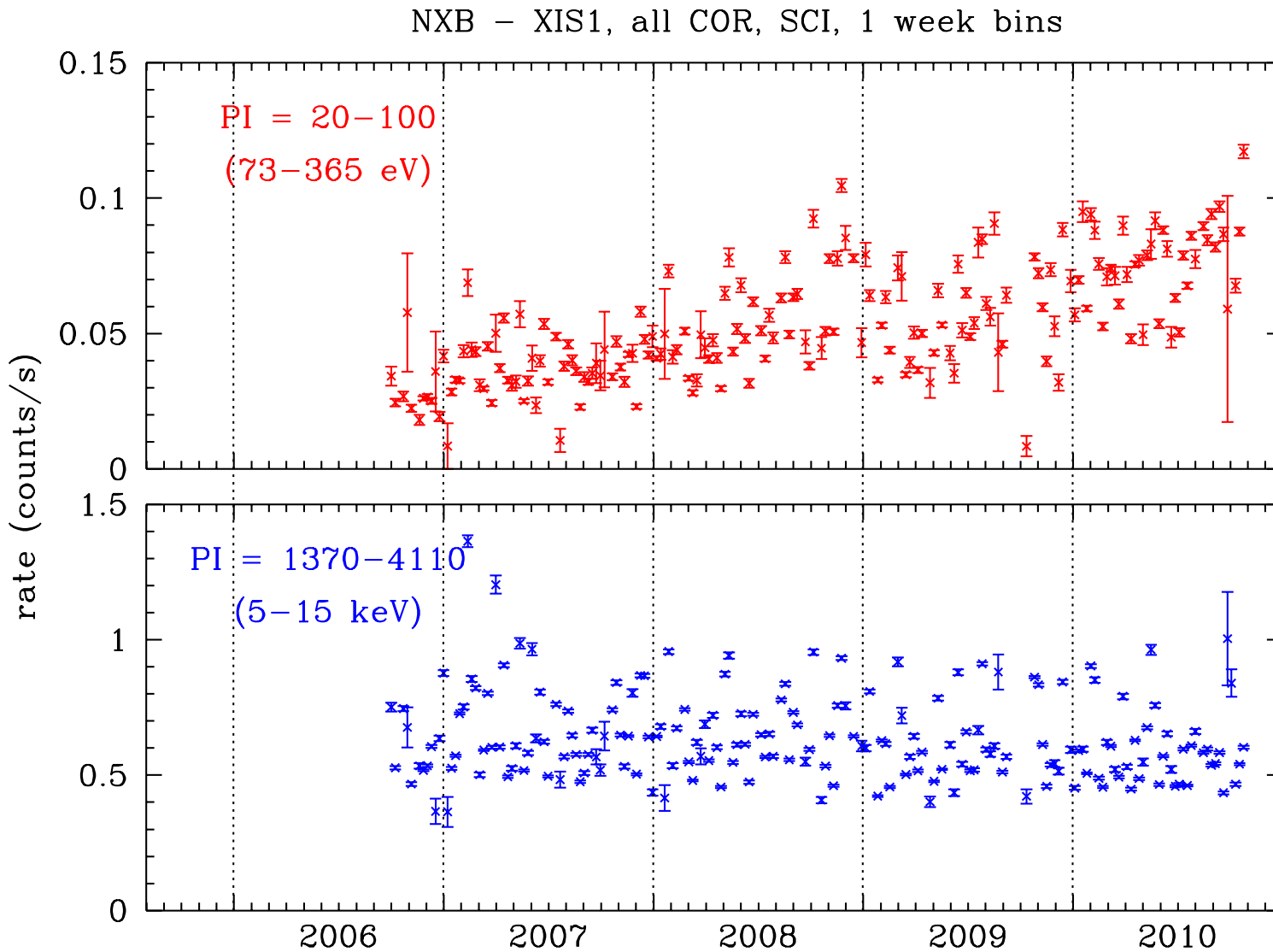
XIS1  $30.4 \pm 1.2$



# Effective Area Tracking

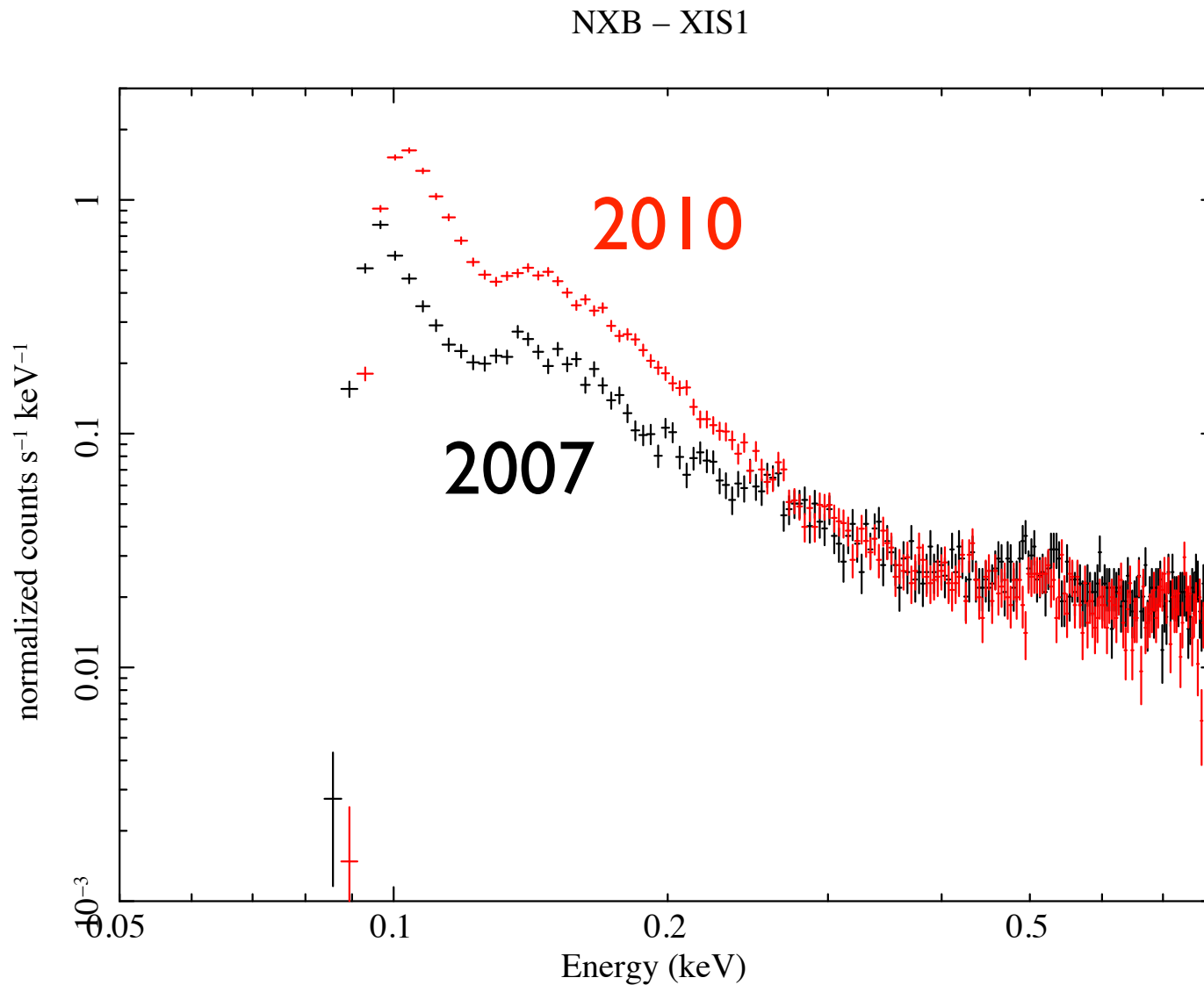


# Background Tracking

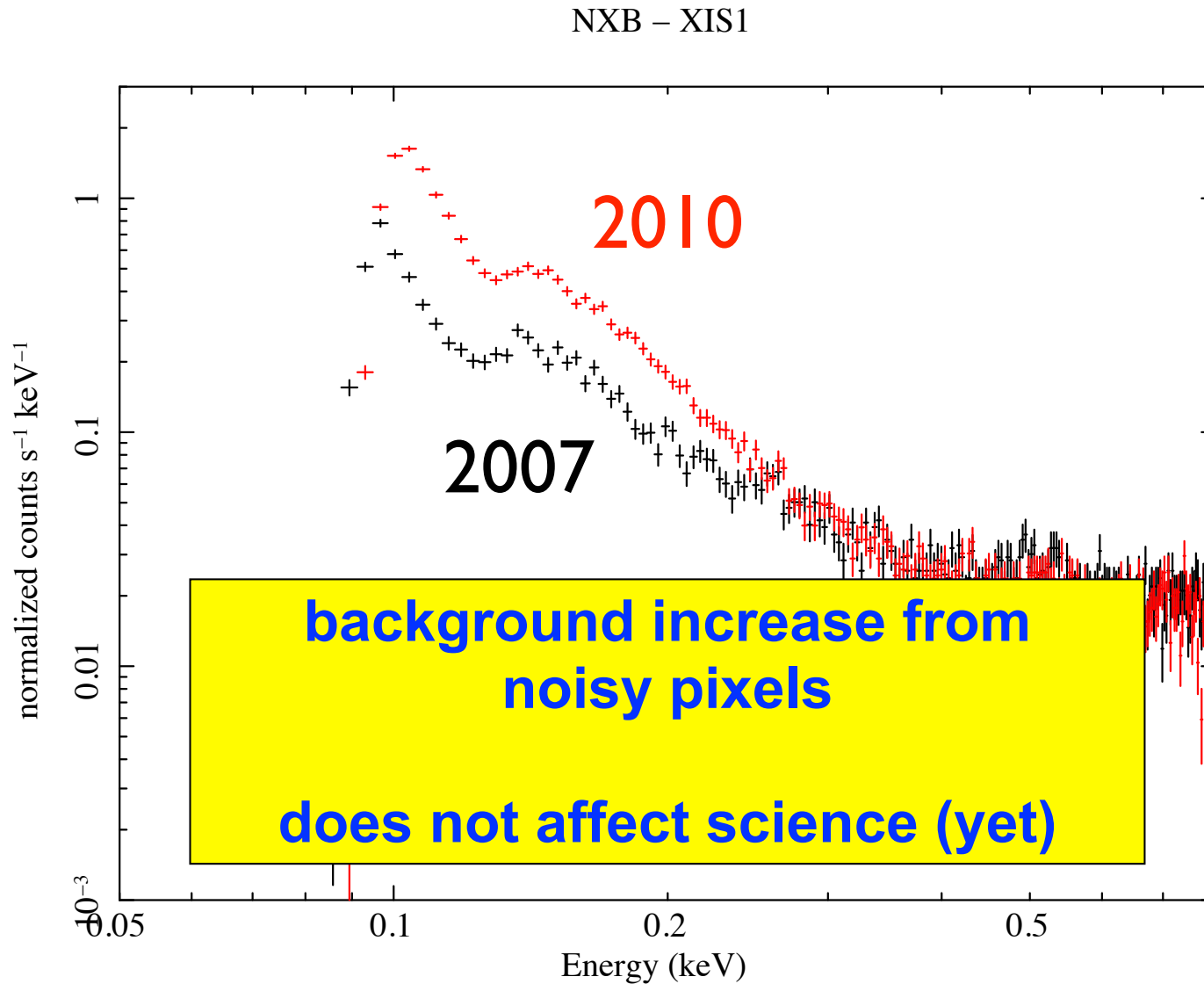




# Background Tracking

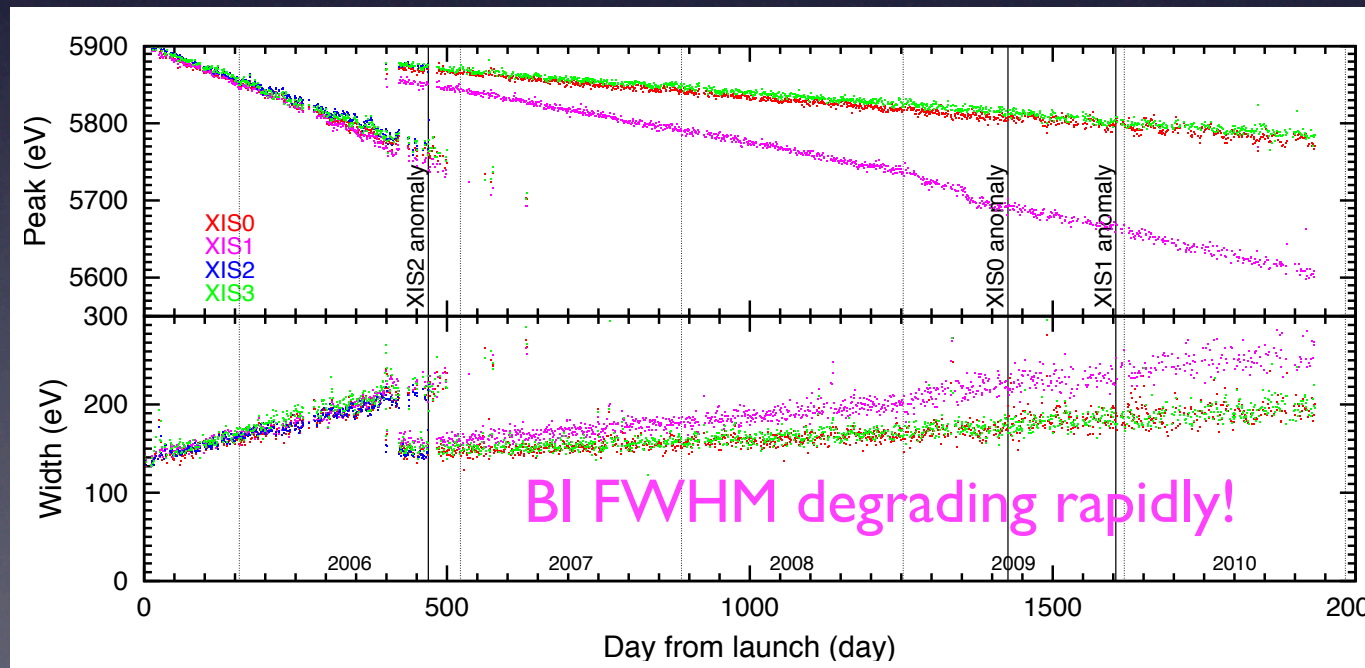
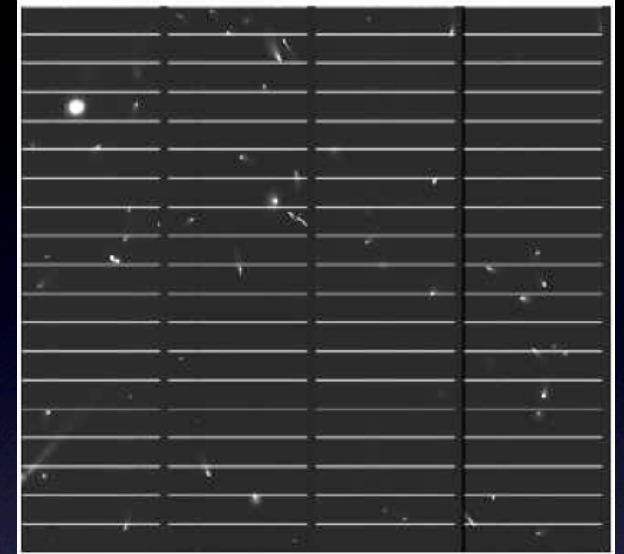


# Background Tracking



# Charge Injection Changes

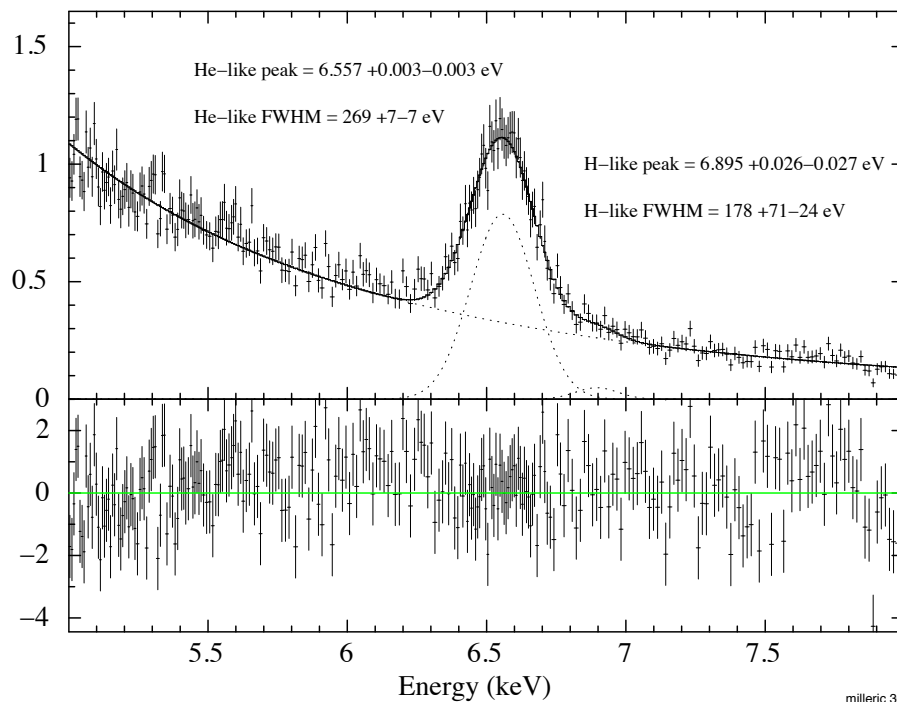
- row of charge injected every 54 rows  
“spaced-row” (SCI)
- fills traps, reduces CTI
- FI: 6 keV  
BI: 2 keV (to reduce noise < 0.4 keV)



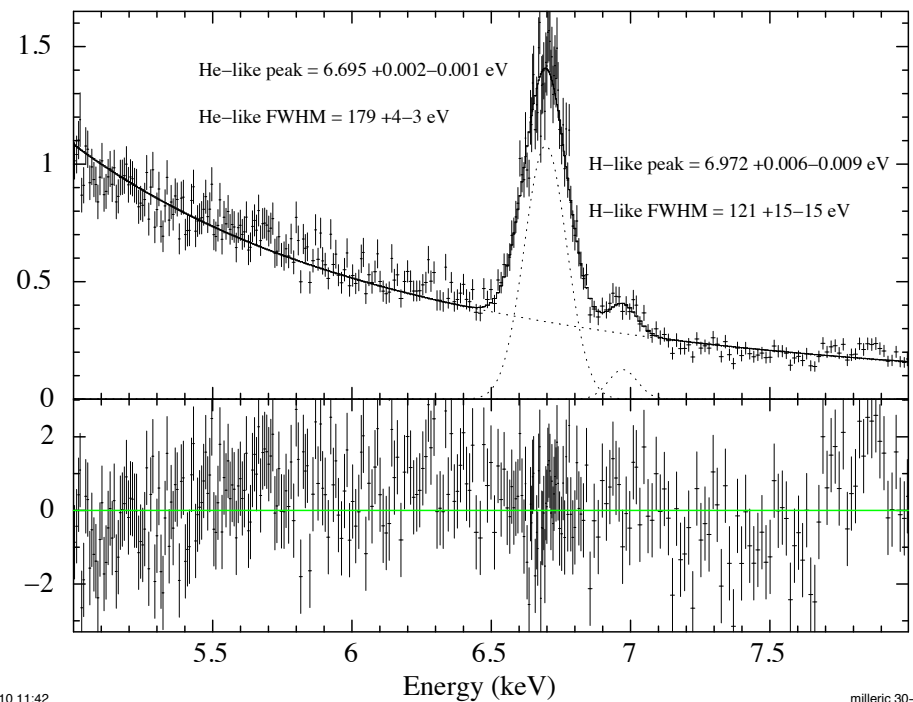
# Charge Injection Changes

- August 2010 start experiment w/ increased BI SCI
- FWHM improves; **180 → 120 km/s at 6.5 keV (Fano limit??)**
- telemetry saturation from trailing row (mask onboard)

Perseus – XIS1, 20100810 (normal SCI)

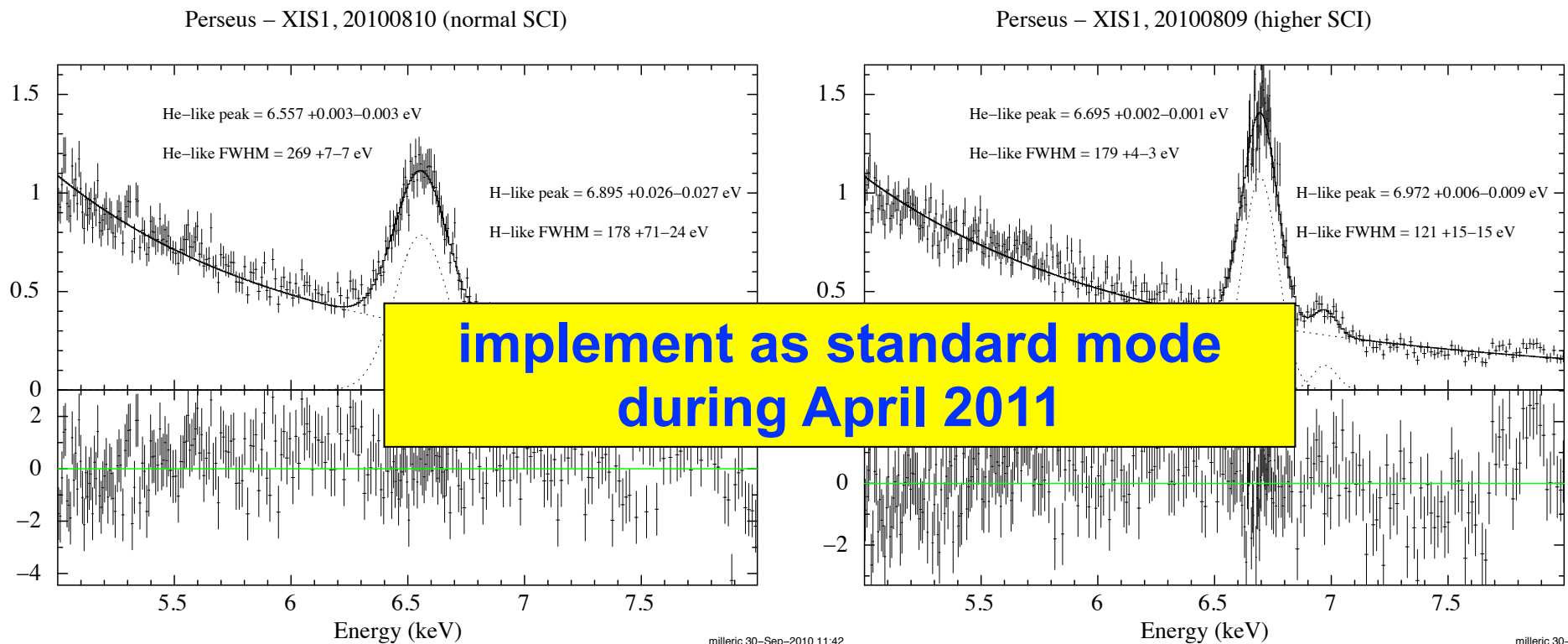


Perseus – XIS1, 20100809 (higher SCI)



# Charge Injection Changes

- August 2010 start experiment w/ increased BI SCI
- FWHM improves; **180 → 120 km/s at 6.5 keV (Fano limit??)**
- telemetry saturation from trailing row (mask onboard)

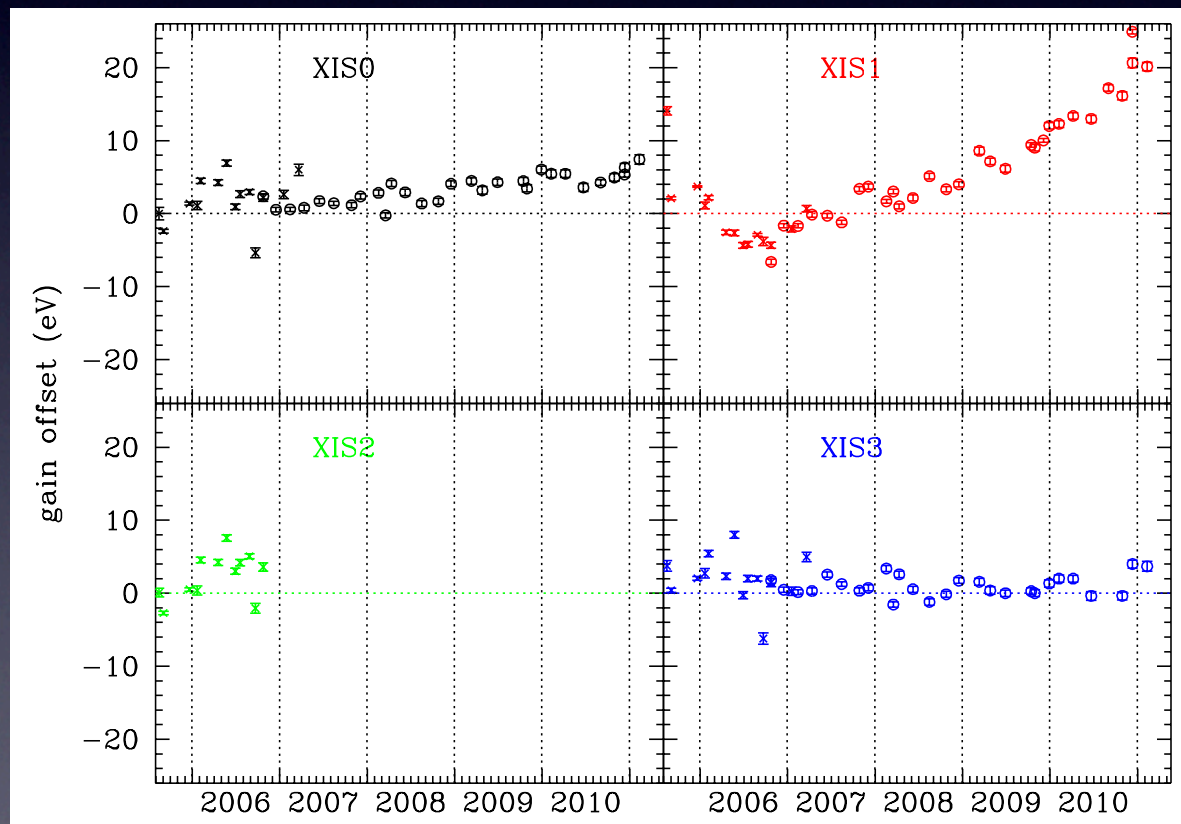


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- calibration status
  - CTI and RMF fine-tuning
  - open issues

# Energy Scale Calibration

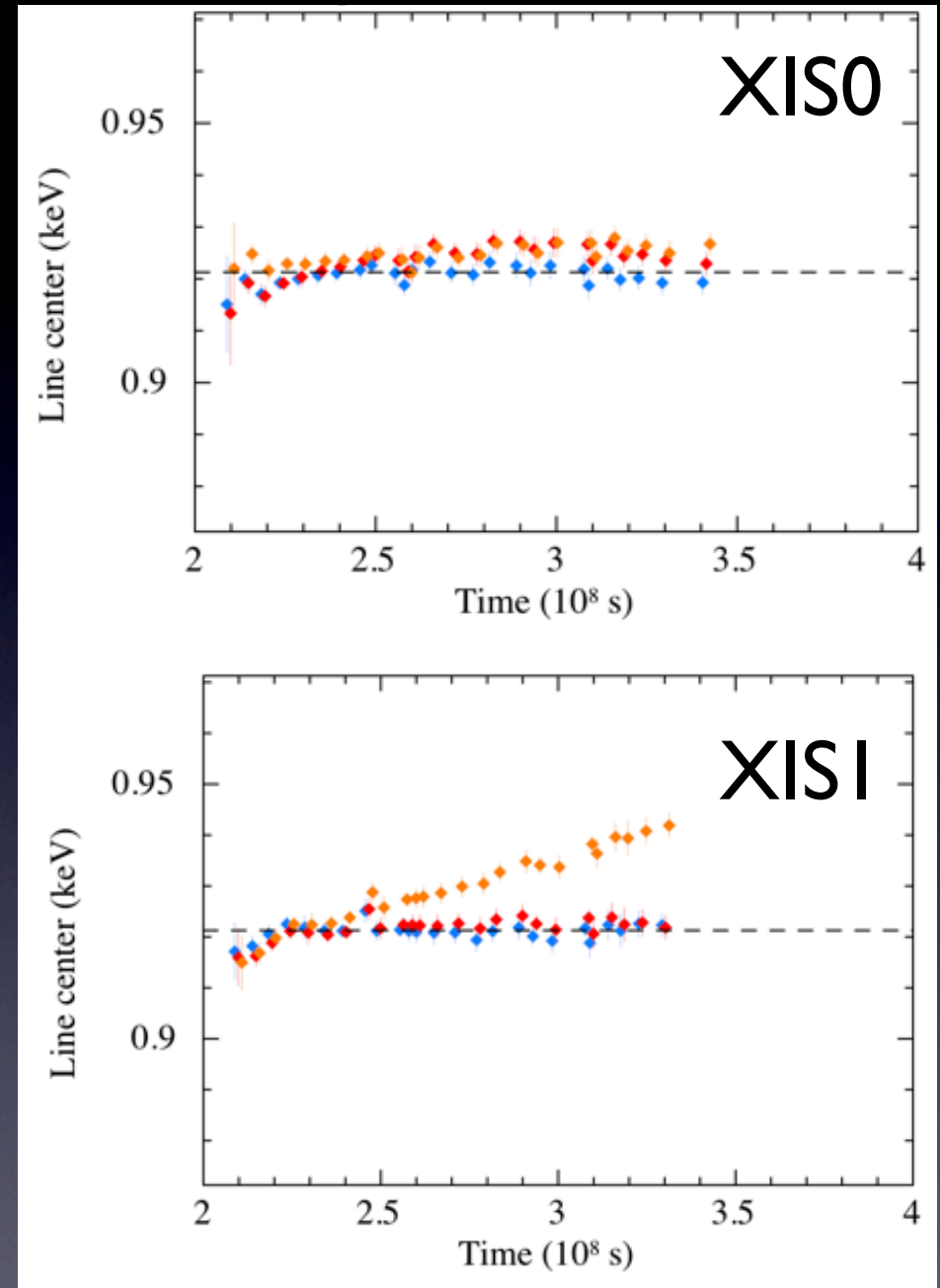
- at 1 keV, energy scale over-corrected at recent times
- fine tune CTI parameters to make low/high energy agree



gain shift  
0.5-1 keV  
from  
E0102  
(data-model)

# Results for Ne He $\alpha$

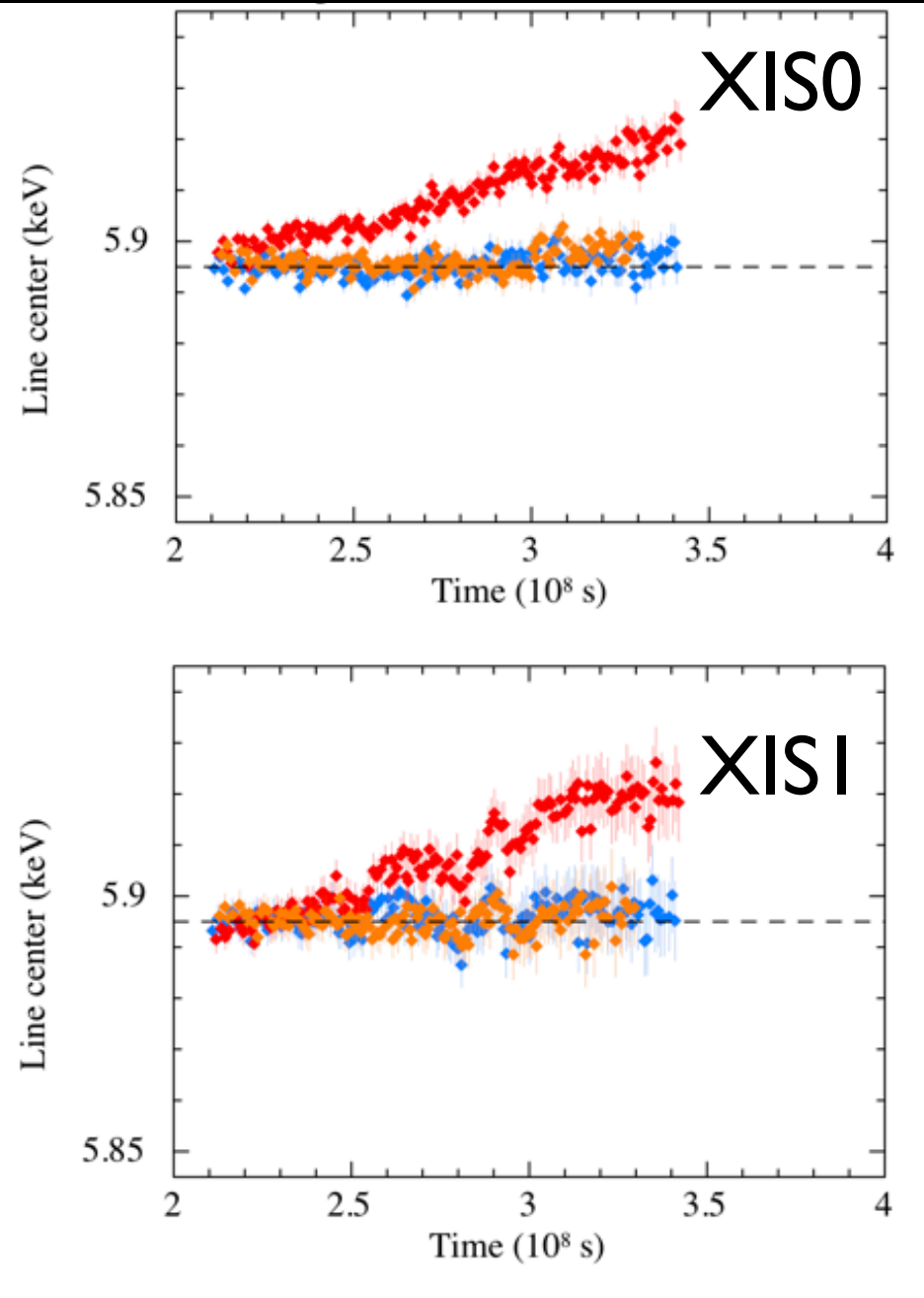
- current release, ver. 14, ID=20100929
- new makepi before fine tuning, ID=20110123
- new makepi after fine tuning, ID=20110219





# Results for Mn $K\alpha$

- current release, ver. 14, ID=20100929
- new makepi before fine tuning, ID=20110123
- new makepi after fine tuning, ID=20110219

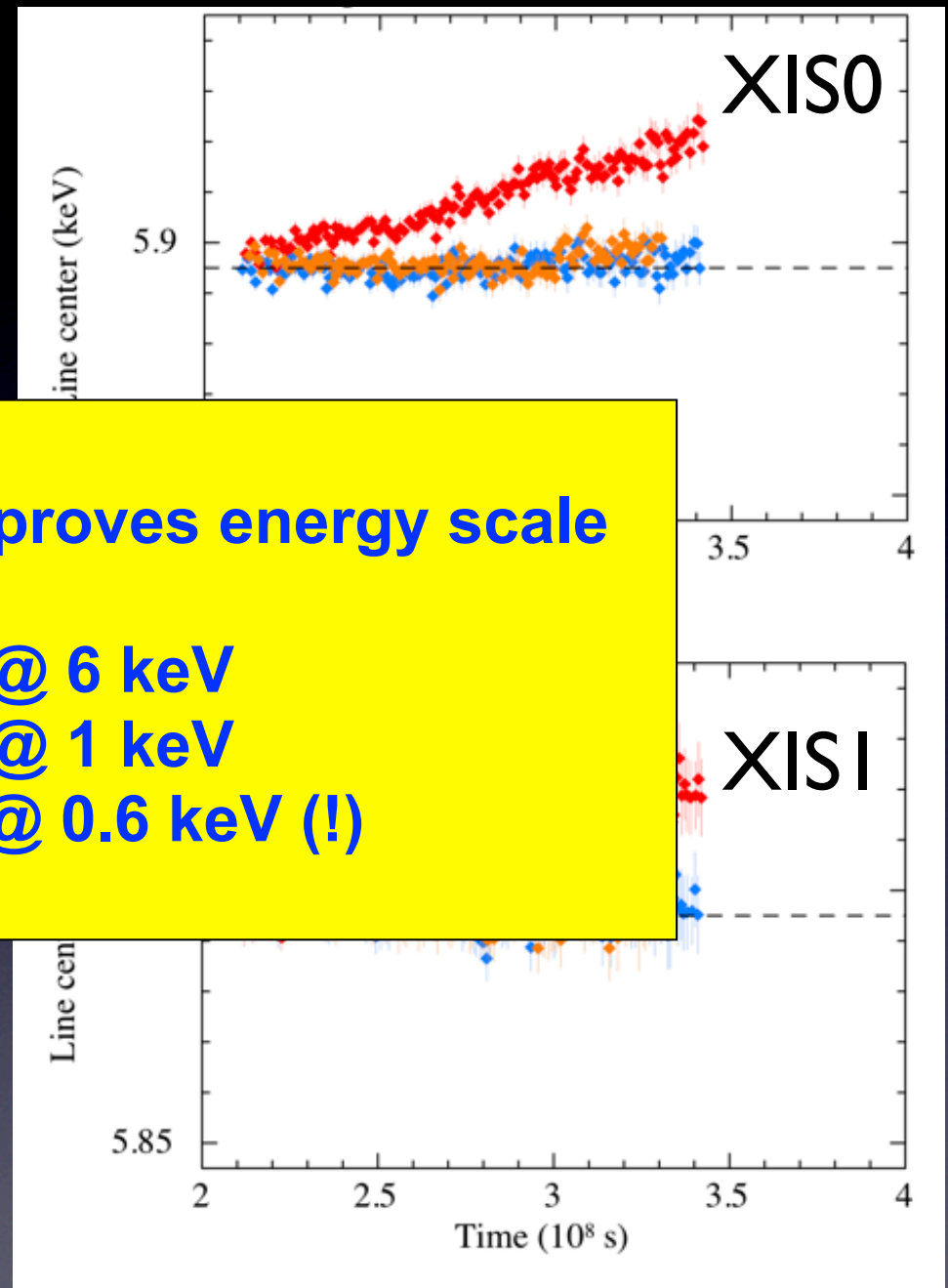


# Results for Mn $K\alpha$

- current release, ver. 14,  
ID=20100929
- new making  
tuning, ID
- new making  
tuning, ID

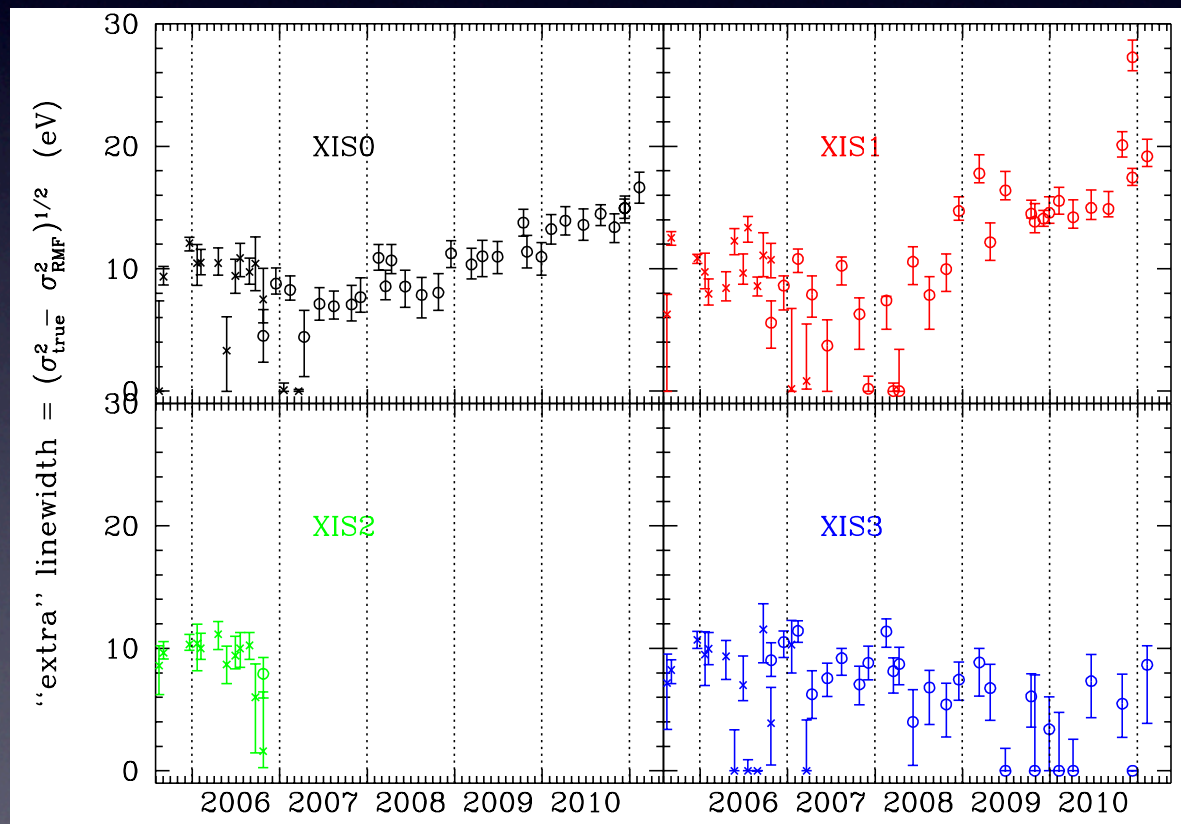
**fine tuning CTI improves energy scale**

**0.1% @ 6 keV  
0.5% @ 1 keV  
1.0% @ 0.6 keV (!)**



# Response Calibration

- low-energy FWHM underestimated for XIS0, XIS1
- discrepancy increasing since 2008

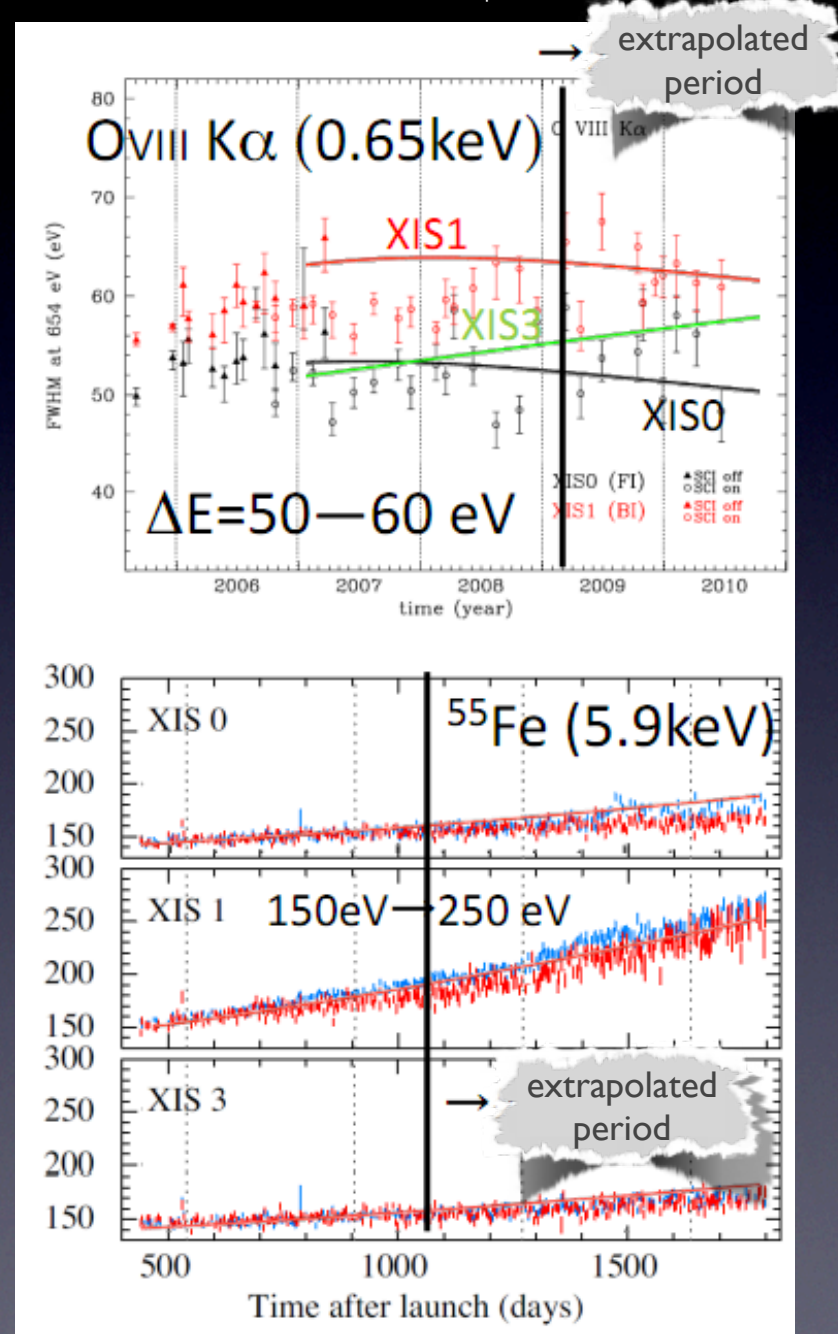


residual  $\sigma$   
0.5-1 keV  
from  
E0102

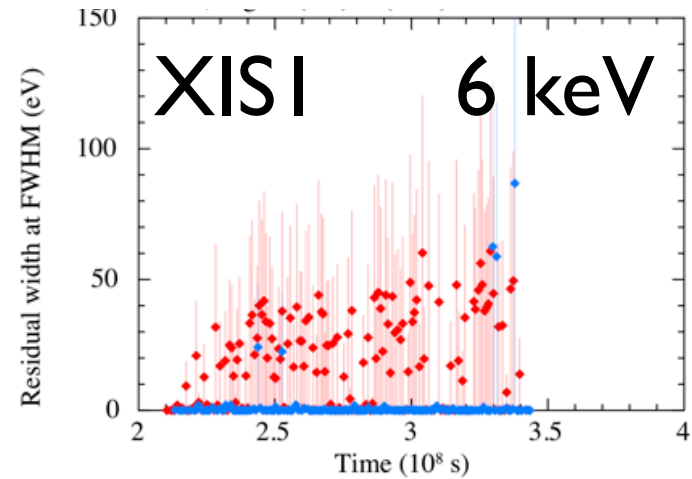
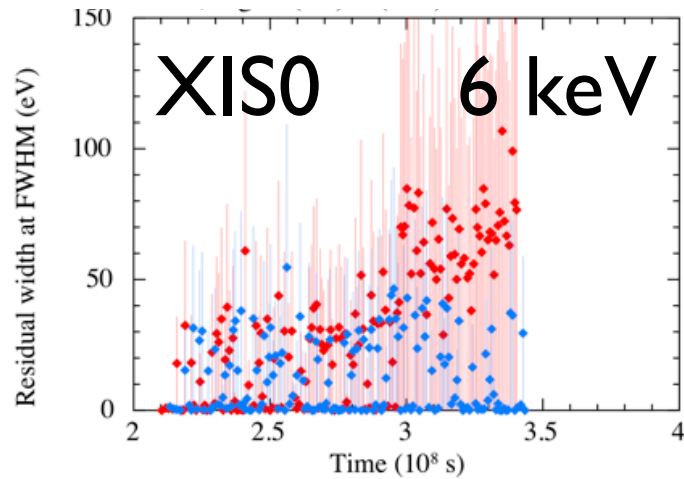
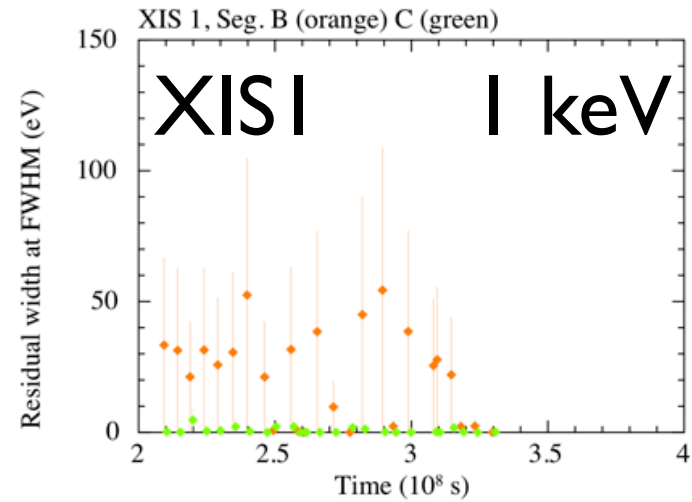
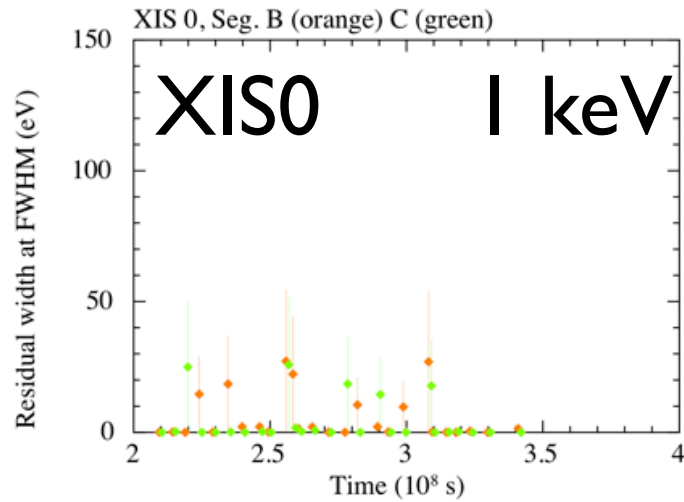
# Problems with Response

taken from Nobukawa report on 20110210

- indirect modeling
- implicit boundary condition:  
FWHM<sub>a</sub>=0 @ E=0  
FWHM slope is **too steep at low E**
- unexpected behavior of the model
- FWHM at OVIII for XIS0 and XIS1 **is decreasing with time!**



# New RMF Params (In Progress)



# Open Calibration Issues

- P-Sum (timing) mode
  - only XIS3; response files soon to appear in CALDB
- OBF contamination
  - new composition/evolution model
  - rolled out in Jan 2011, broke FTOOLS, rolled back in
  - new CALDB and FTOOLS update ASAP
- Si edge
  - still working on it

# XIS Status - Summary

- XIS0 has lost ~ 10% of area but is operating safely
- XIS1,3 are operating normally

## X-RAY IMAGING SPECTROMETER (XIS)

### INSTRUMENT MONITORING

**XIS INFO**

- HOME
- NEWS
- ABOUT
- PEOPLE
- GALLERY
- CALIBRATION
- MONITORING
- TEAM PAGE

**XIS COLLABORATORS**

- ISAS/JAXA
- KYOTO U.
- OSAKA U.

**SUZAKU INFO**

- GO FACILITY
- SUZAKU AT ISAS
- XIS AT GSFC
- HXD AT TOKYO U.
- XRT AT GSFC

**CCD PERFORMANCE MONITORING**

[Cal Source Monitoring](#) Using information from the Fe55 calibration source regions, we track the gain, spectral resolution, hot pixels, and CTI indicators. SCI-off and SCI-on data are monitored separately. These data have not processed by the calibration software.

[Monthly Cal Source Spectra](#) Spectra of integrated monthly Fe55 cal source data, by sensor and SCI setting.

**INSTRUMENT HEALTH MONITORING**


[Instrument HK Monitoring](#) Tracking of the CCD temperature, baseplate temperature, and TEC voltage.

[CCD Temperature Anomalies](#) Summary of anomalous temperature excursions for each detector.

**CONTAMINATION MONITORING**

[Point Source Monitoring](#) Tracking the on-axis OBF contamination with regular observations of soft point sources (primarily E0102).

[Bright Earth Monitoring](#) Tracking the spatial dependence of the OBF contamination with monthly integrated observations of the sun-lit Earth, which emits field-filling O and N emission lines.



## Suzaku X-ray Imaging Spectrometer Quick Reference

(This leaflet is intended to assist users to plan an XIS observation. The Suzaku web page (<http://www.astro.isas.jaxa.jp/suzaku/index.html>) and the "Technical Description" document supplement the information. Consult [xisope@astro.isas.jaxa.jp](mailto:xisope@astro.isas.jaxa.jp) for further details.

**Basics** XIS is equipped with four X-ray CCDs (XIS0-3) for imaging and non-dispersive spectroscopy. The four CCDs are at the focus of four co-aligned telescopes and observe the same field. Three CCDs are front-illuminated (FI) and one is back-illuminated (BI) superior respectively in the hard- and soft-band. XIS is operated simultaneously with HXD.

Field of view	17.8° x 17.8°
Energy range	0.2-12 keV
Energy resolution	~180 eV @9keV
Effective area	340 (FI)/390 (BI) cm <sup>2</sup> @3.5keV
Time resolution	8 s (Normal) - 7.8 ms (Psum)

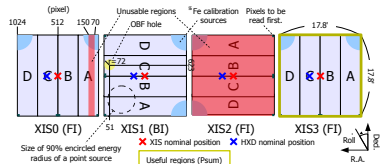
**Aim point** Choose either XIS- or HXD-nominal position, depending on which detector you emphasize. The count rate differs by ~10%. Positions other than these may be useful for mapping observations.

Position		Normalized rate	
XIS nominal	1	XIS	0.9
HXD nominal	0.9	HXD	1

**Clocking** XIS is operated in a combination of clocking and editing modes. Users are responsible to choose the appropriate clocking mode. It is acceptable to use different clocking modes for different sensors. For faint (<12 [s/sensor]) point-like sources, use Normal mode with appropriate window and/or burst options. For high timing accuracy, choose Psum (XIS3) and others (XIS0,1).

Clock mode		Normal								Psum							
Opt	Wts.	no	1/4	1/8	no	no	no	no	1/4	1/4	1/4	1/4	1/8	no	no		
Burst	no	no	no	no	2.0	0.7	0.5	0.1	1.0	0.5	0.3	0.1	0.5	no	no		
Max cr/s to avoid pile-up*	12	48	96	48	10	10	10	10	96	1.9	3.2	7.1	1.9	1.5	10		
Loss rate %	2	7	14	76	91	94	98	54	77	86	94	57	0				
Support	OK	OK	*2	OK	*3	*3	*2	OK	OK	*2	*2	*2	*2	*2	*2		

**View** XIS0-3 has 1024x1024 pixels composed of four segments (A-D) with one readout node for each segment. Due to unavoidable micro-meteorite hits etc, a part of XIS0 and the entire XIS2 (Normal) and all but XIS3 (Psum) are not usable. Two <sup>55</sup>Fe calibration sources (Mn I K $\alpha$  and K $\beta$ ) lines at 5.9 and 6.5 keV are installed. Users can specify the roll angle. Use the Maki tool.



**Counts/s** Estimate the count rate using the PIMMS tool. Approximately, 1 mCrab flux yields 1.6 [s/sensor] (FI) and 1.9 [s/sensor] (BI). For bright variable sources, check MAXI and RXTE/ASM. Rate estimate is crucial for selecting XIS modes. PIs of TOO observations of bright variable sources may update the estimate by a few days prior to the observation.

<http://space.mit.edu/XIS/monitor>

[http://www.astro.isas.jaxa.jp/~tsujimot/pg\\_xis.pdf](http://www.astro.isas.jaxa.jp/~tsujimot/pg_xis.pdf)

