Suzaku Operations & Calibration Status

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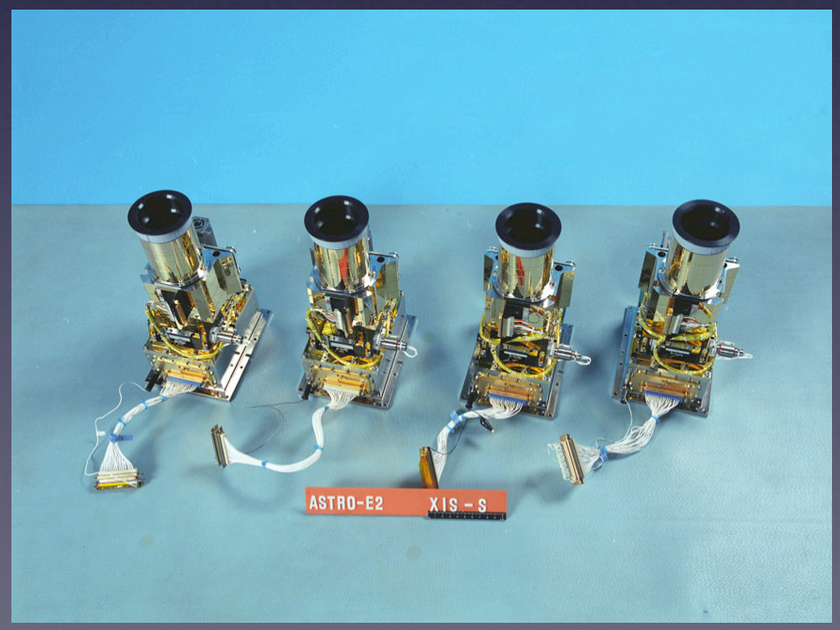
IACHEC 2015 – 北京香山饭店

Suzaku – Overview

X-ray Imaging Spectrometer (XIS)

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



Hard X-ray Detector (HXD)

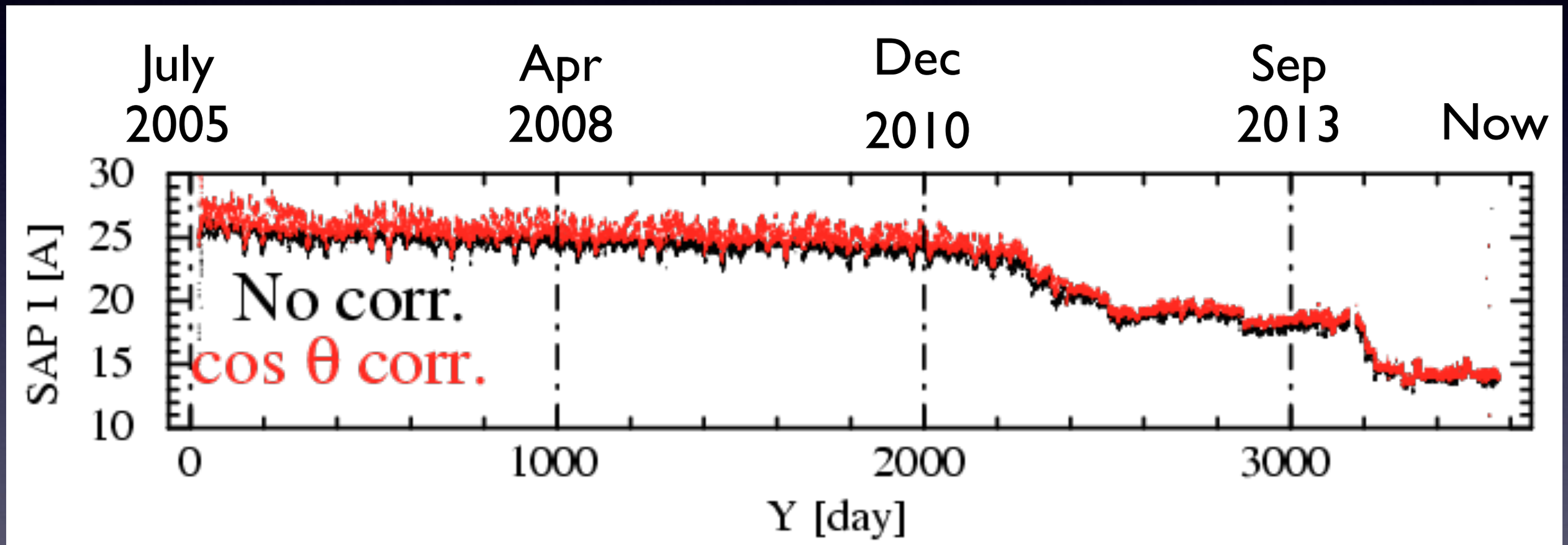
- collimated PIN diode + GSO scintillator detector, 10–600 keV

Operations

The Future of Suzaku

- Power Problems:
  - solar power system has degraded (almost) as expected
  - batteries have degraded in capacity and charging ability
    - two batteries needed, not redundant
  - several prolonged safe-holds, including all of Jan 2015
- It is unclear how long *Suzaku* will continue observing
  - 1.5 years is the goal, to overlap ASTRO-H

Suzaku Power Supply



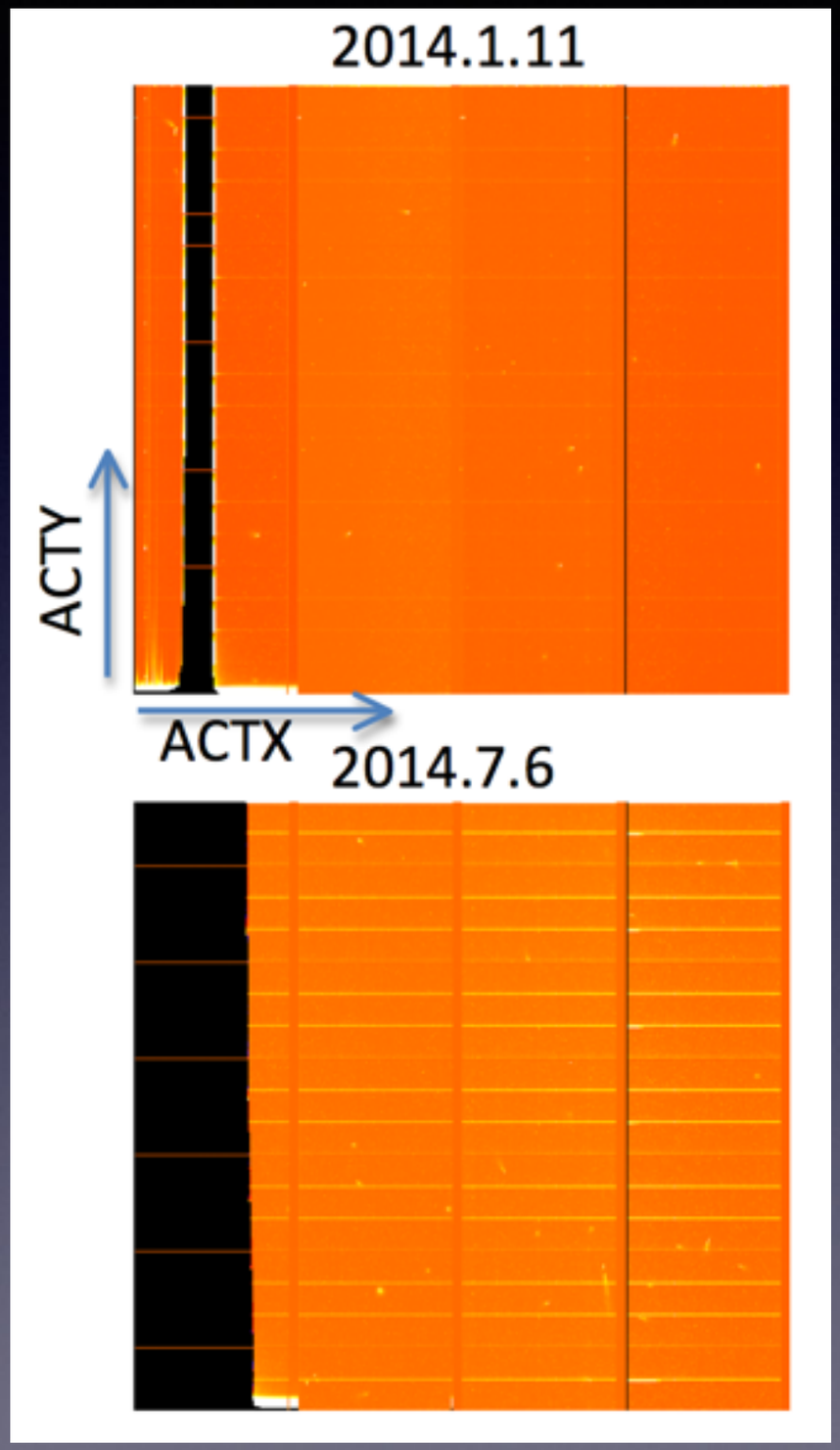
The Future of Suzaku

- Mitigation:
  - Non-critical systems turned off
  - Battery control changes
  - Heaters turned off in shade, on in Sun light
  - Sun angle range 70–110 deg
- AO10 planned to last 6 months, May–October 2015
  - 3 XIS operated as long as power is sufficient/stable
  - HXD turned on during high day-to-night ratio
  - AO10 could be 1.5 years if only 1 XIS is used

XIS

Calibration Updates

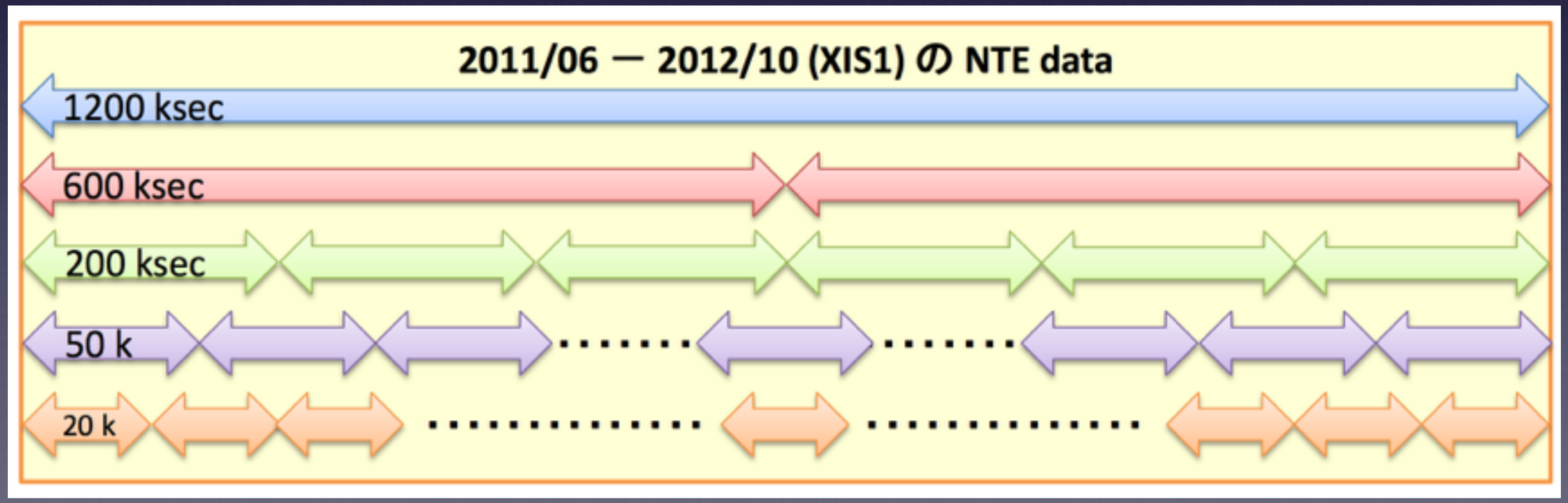
Loss of Area on XIS0



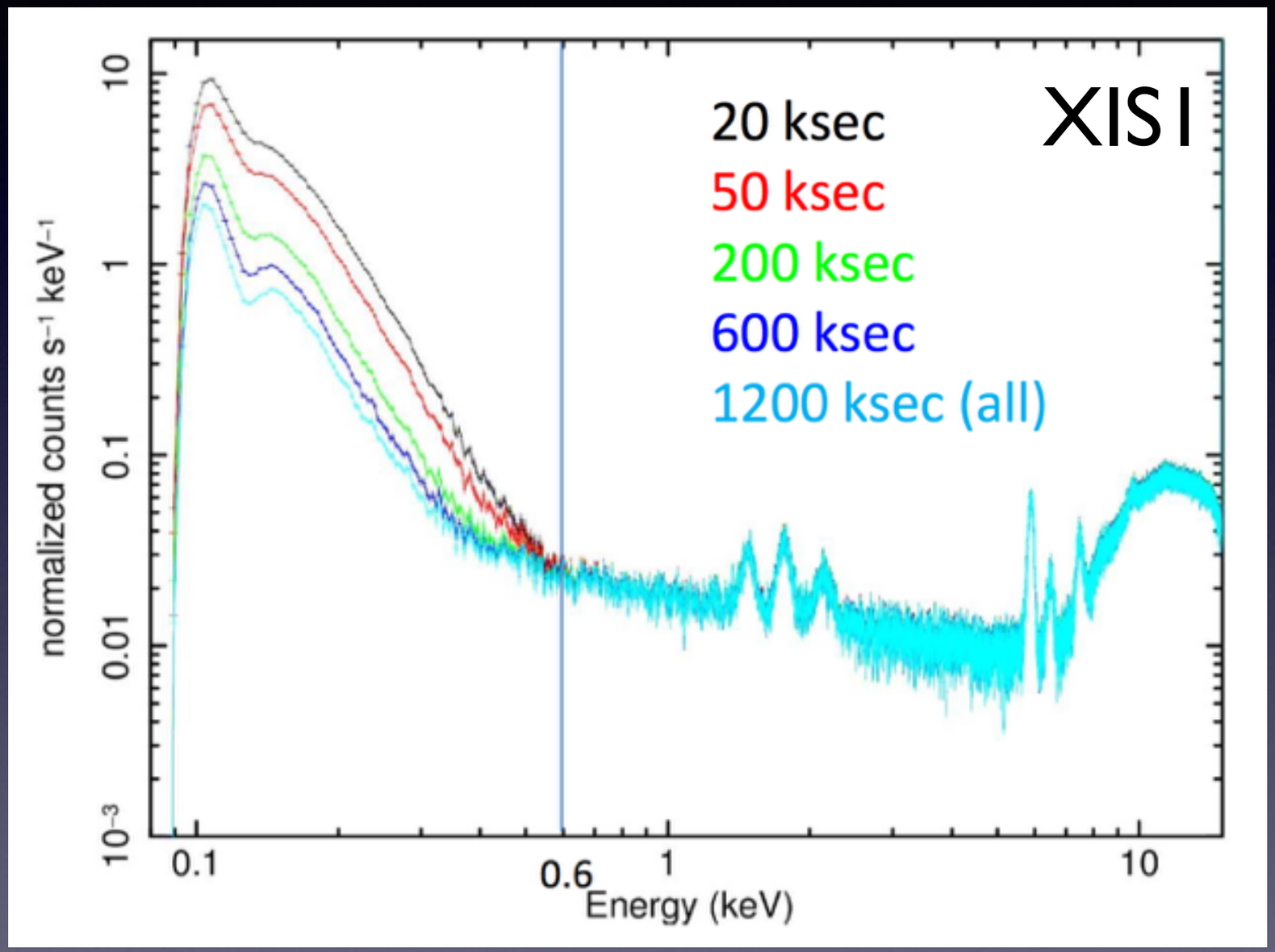
- dead region on XIS0, produced by micrometeoroid impact in 2009, has increased from 1/8 to 1/4 of CCD
- changed occurred while XIS0 was turned off for a UVC in May 2014
- also increase of charge trailing behind charge injection rows
- increase on-board area discrimination
- users must be aware of charge injection trailing rows!

Flickering Pixels in Non X-ray BG

- flickering pixels are identified with *cleansis*, a statistical tool, in science observations
- also run on NXB database, accumulated from night Earth obs.
- far more flickering pixels are identified in typical obs. (~50 ksec) than in NXB database (~ 1 Msec)

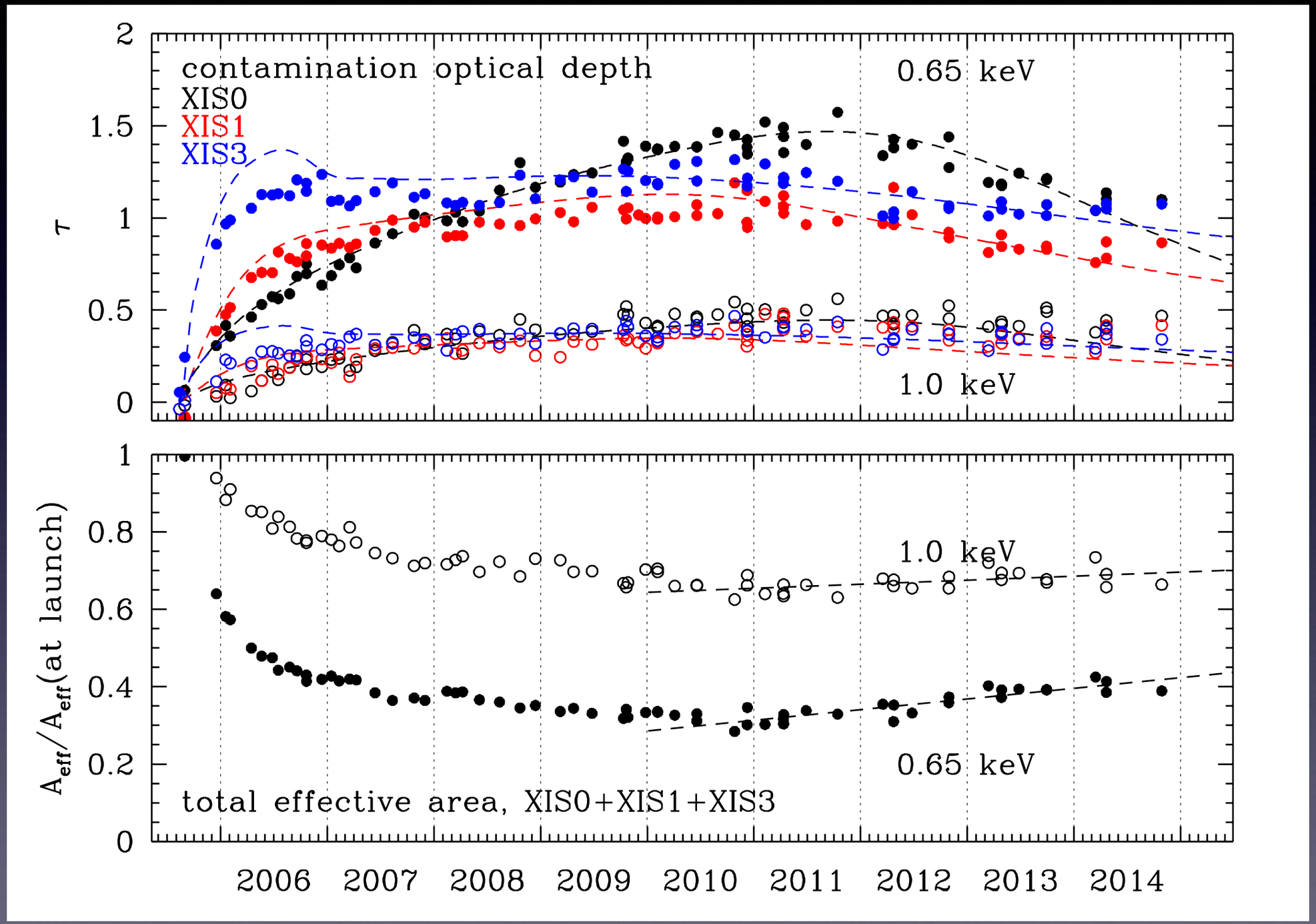


Flickering Pixels in Non X-ray BG



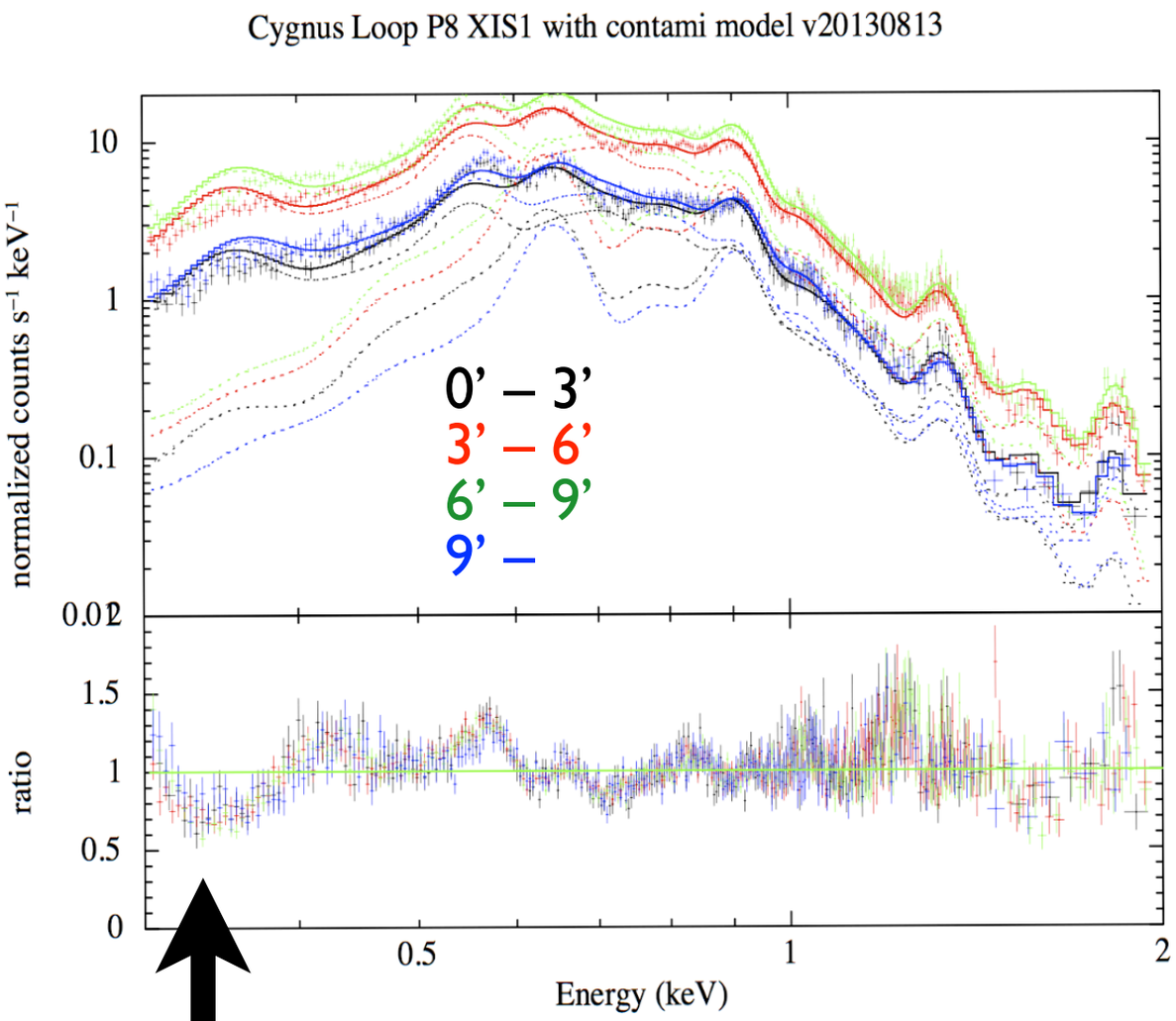
- new CALDB file of all historically flickering pixels, plus recipe
  - useful for low-surface brightness studies
  - removes 6.5% of A_{eff}
- new mission-independent tool *searchflickpix* for ASTRO-H

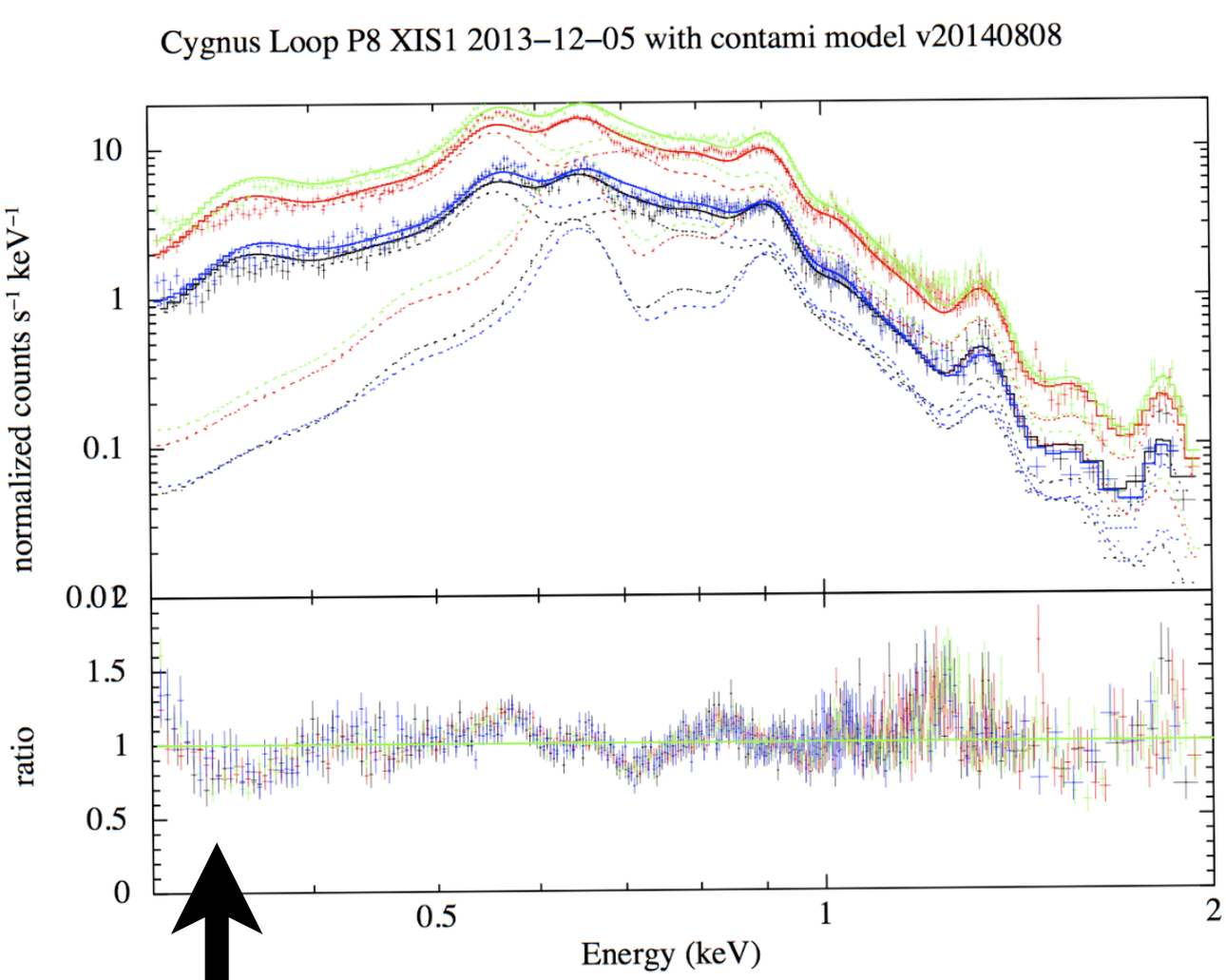
XIS Contamination Trend



on-axis, from E0102

XIS Contamination Model

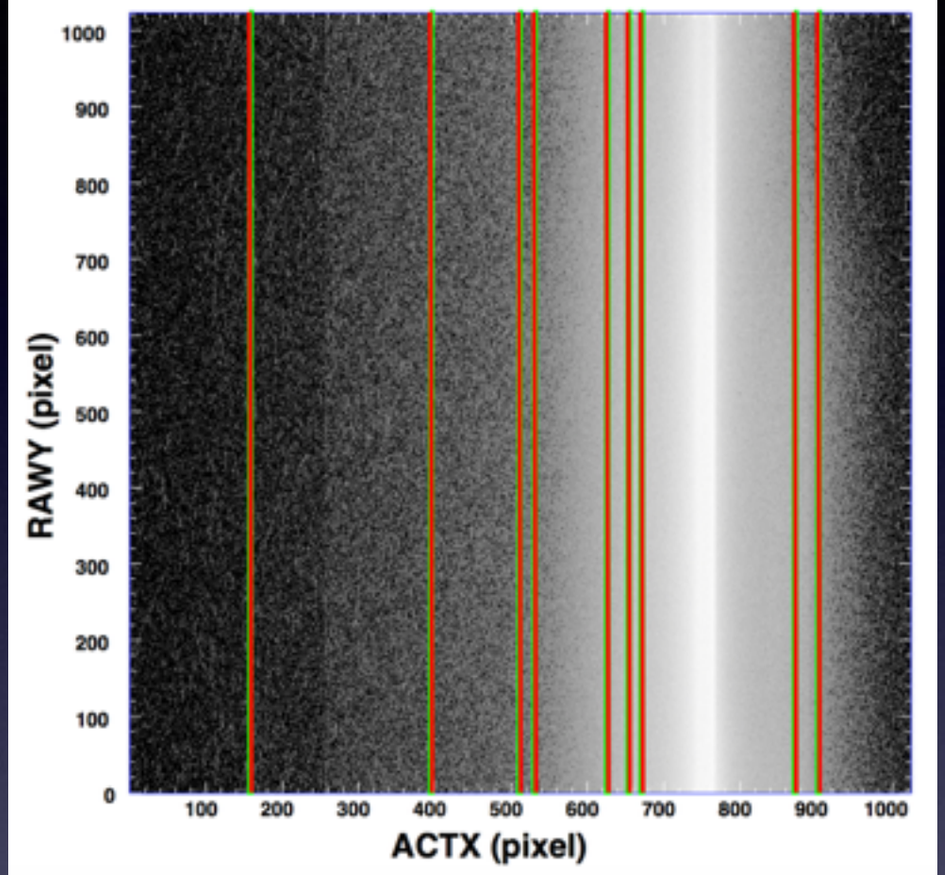




v20130813

v20140808

XIS P-sum Observations

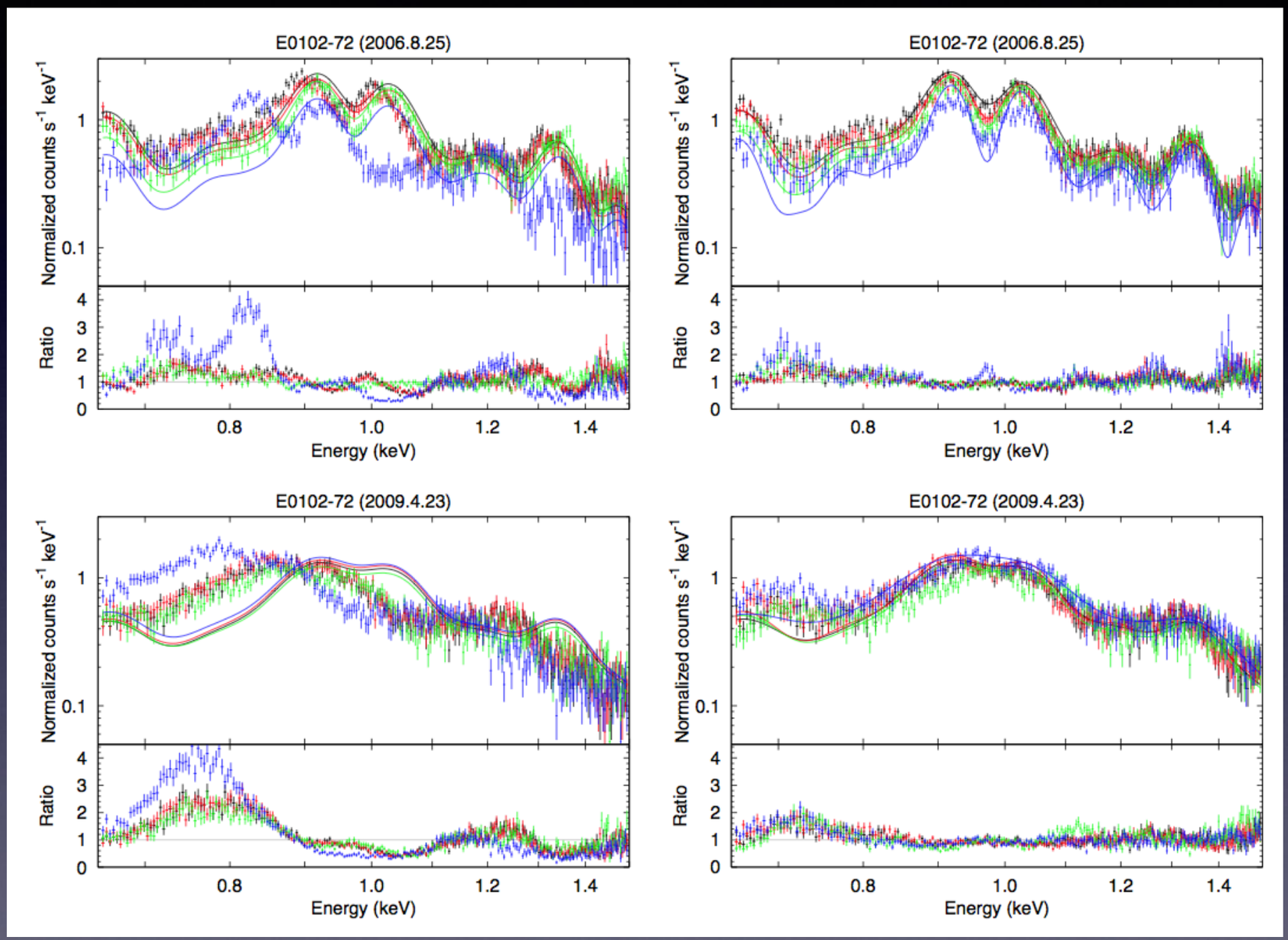


- 128 rows stacked
- 8 ms time resolution
- no charge injection
- node-to-node gain variation

Object	Type	Date
GRS 1915+105	LMXB	2007.05
Cyg X-2	LMXB	2008.07
Her X-1	LMXB	(2006.03), 2010.09
Cyg X-1	HMXB	2008, 09, 11, 13
SMC X-1	HMXB	2011, 2012
PSR 1509-58	PSR	2005.08
1E 1207.4-5209	PSR	2006.07, 2007.02
G 21.5-0.9	PSR	2007.03
1E 1547.8-5408	PSR	2009.01, 2010.08
RXJ 0007.0+7302	PSR	2010.01

…plus ~ 10 E0102 and Perseus observations

XIS P-sum Calibration – Gain



$\Delta E \sim 5$–30 eV

XIS P-sum Calibration – Time

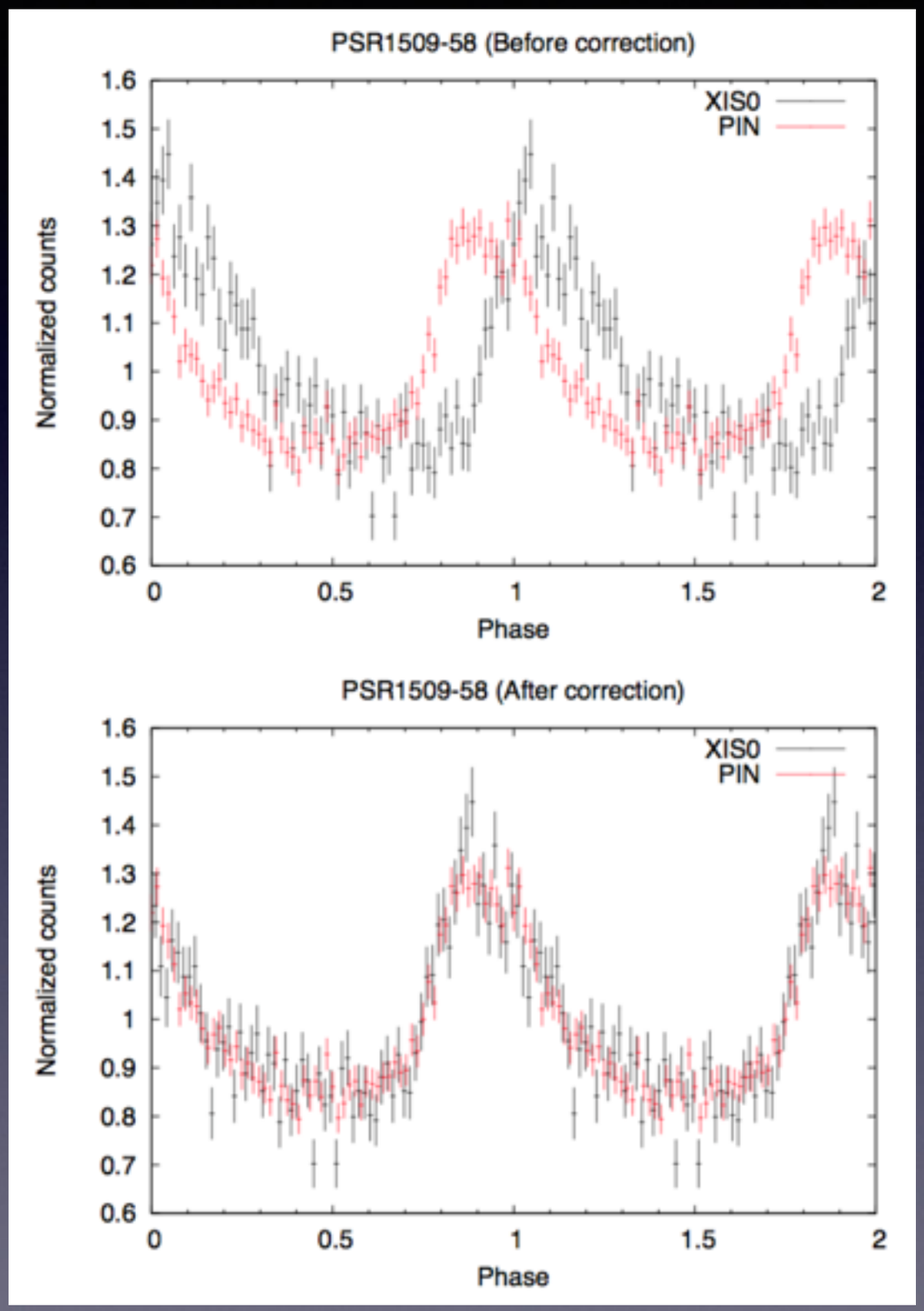


Table 2: Timing Offsets

Object	Period	Timing offset
PSR 1509–58	151.358 ms	24.46 ± 0.11 ms
Crab	33.628 ms	23.19 ± 0.03 ms

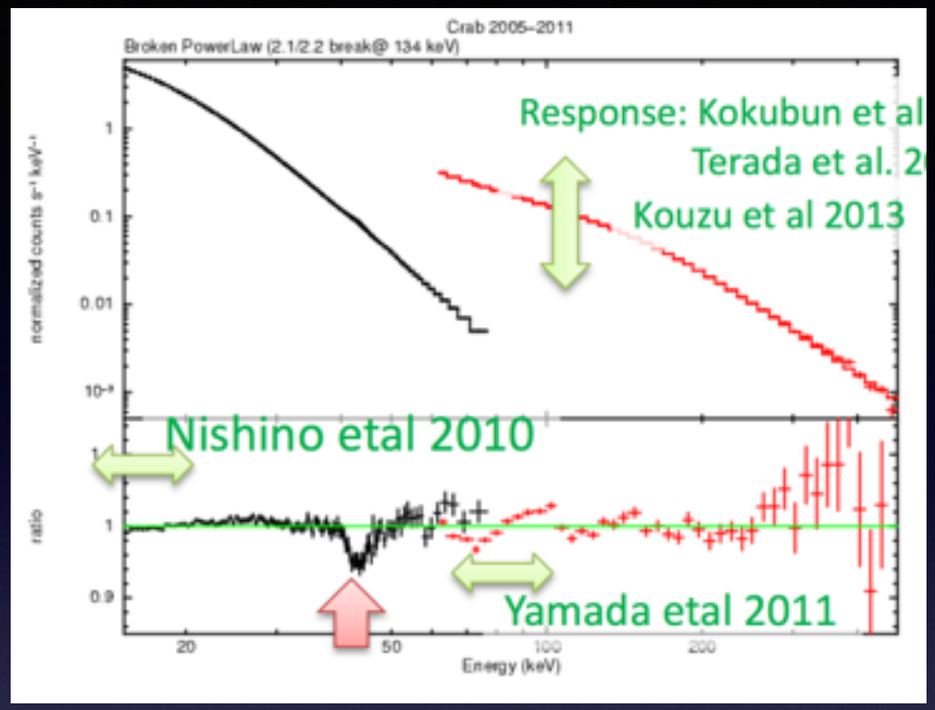
XIS clock is fast;
24 msec must be subtracted
by hand from XIS P-sum times!

HXD

Calibration Updates

HXD Update 1

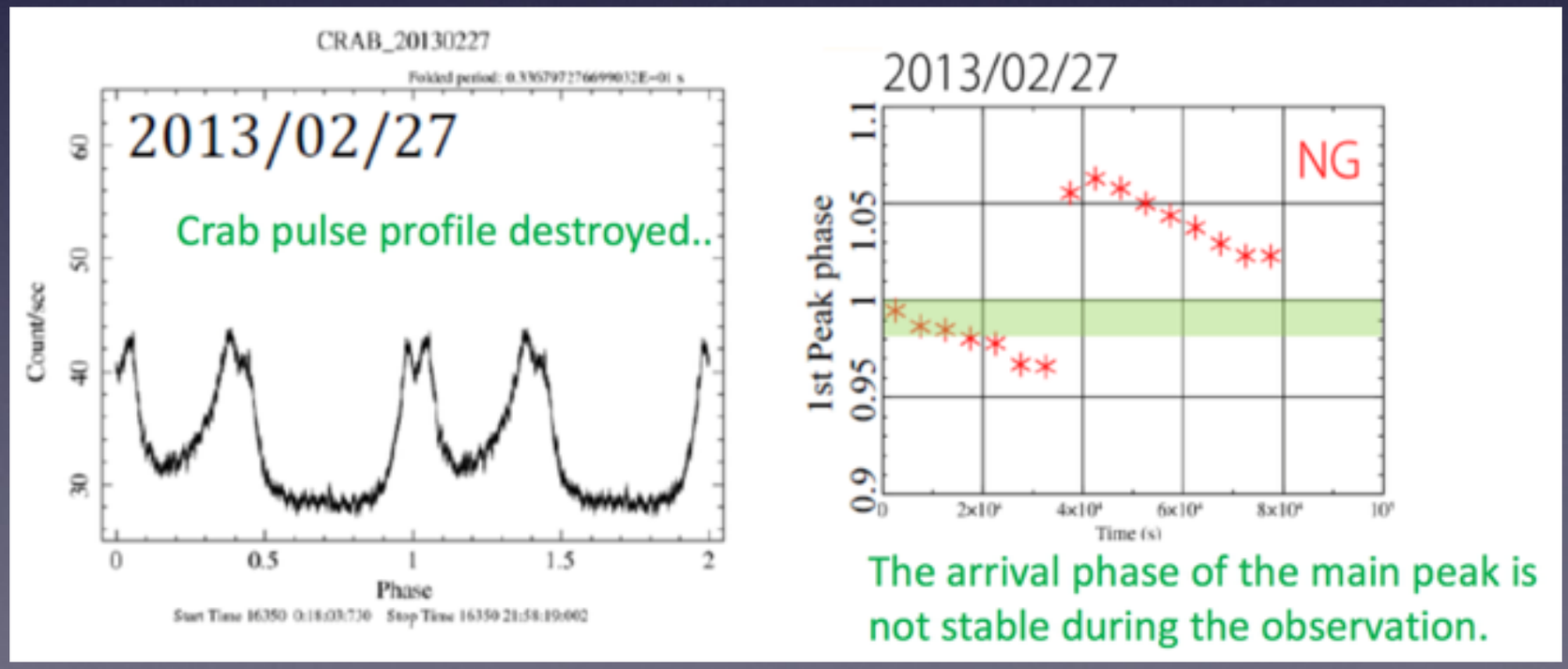
- Energy response
  - No major update
  - Next step: tune Gd Kα structure in PIN response
  - on-going Geant4 simulations of Gd K contribution from GSO to PIN, effect of event selection



- Non X-ray background
  - NXB systematic errors are 3% (PIN) and 1% (GSO) (Fukazawa et al 2008)
  - PIN NXB model v2.2 released, valid after August 2012 NXB after 2014 August is under analysis (HXD ops)

HXD Update 2

- Time assignment
  - Absolute timing accuracy 270–360 μs for observations before 2012
  - Between 2012 and 2014, accuracy is ~3 msec, (cf. IACHEC 2014)
  - In Mar 2014, ground station bug fixed, but another error remains.
  - Timing accuracy after 2014 is not confirmed yet because of lacking HXD calibration obs; Crab calibration as a top priority for HXD.



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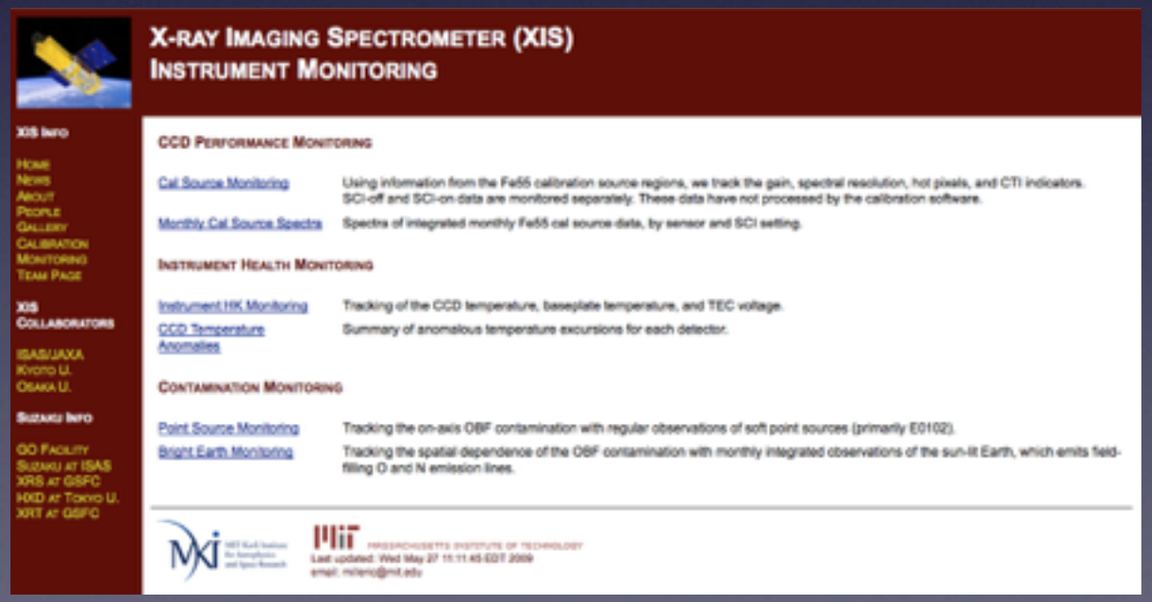
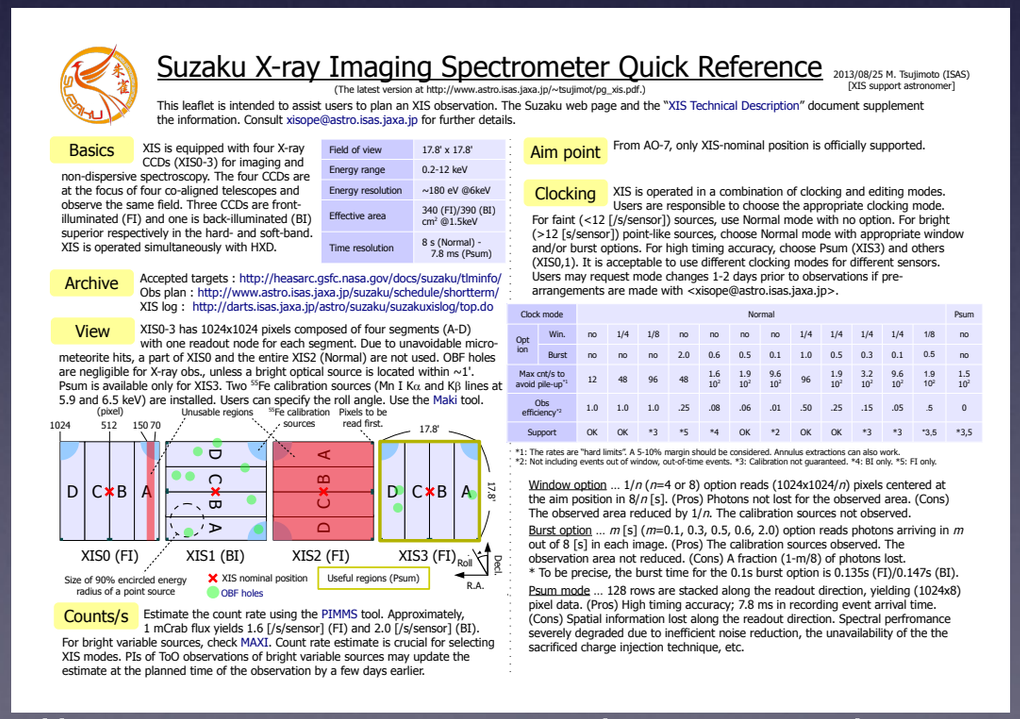
Suzaku Status – Summary

- solar panels and battery continue to degrade
- XIS contamination continues to decrease
- if power becomes a problem, detectors will be turned off, but hope to go another 0.5–1.5 years
- Cycle 10 starts May 1, and is perhaps the last!



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



http://www.astro.isas.jaxa.jp/~tsujimot/pg_xis.pdf