

The *Suzaku* XIS In-Flight Calibration Plan

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*A Disclaimer

- no access to pre-flight calibration plan
- contents assembled from:
 - brief email exchange with Hayashida-san, Tsujimoto-san
 - my recollections
 - data archive of SWG targets and AO calibration targets

as usual, all mistakes are my own

The Pre-Flight Plan – Single Use Targets

- Crab on-axis
 - XRT effective area
 - XIS and HXD aimpoints
 - location of optical axes of 4 XRTs
- Crab off-axis
 - 5–10 arcmin offsets for vignetting (20 x 5 ksec)
 - 20–30 arcmin offsets for stray light (16 x 2 ksec)
- **SS Cyg on-axis**
 - shape of PSF (actually a SWG science target)
- RXJ1856
 - CCD QE below C edge

The Pre-Flight Plan – Recurring Targets

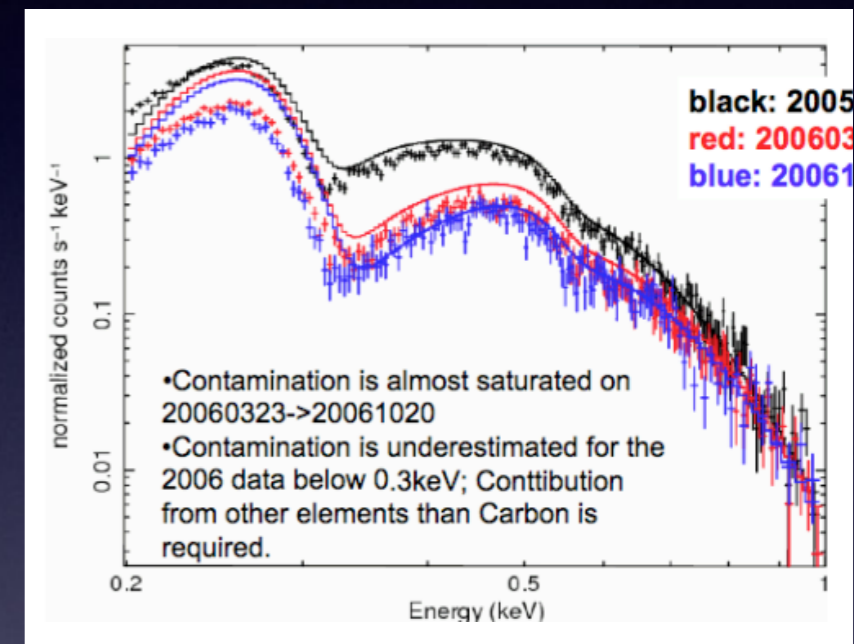
- E0102
 - low energy gain and response
- corner ^{55}Fe calibration sources
 - only 6 keV, not field-filling
 - high energy gain and response
 - instrument performance monitoring
 - CTI correction (not truly)
 - not useful for window or P-sum modes
- other sources XIS would get for free that would be invaluable
 - NI32D
 - Perseus Cluster
 - Cygnus Loop

The Plan Changed – Loss of XRS

- initial science and calibration sources were geared toward XRS (the microcalorimeter)
- after the loss of XRS just after launch, a new SWG and AOI science plan was quickly formulated, focusing on XIS and HXD
- it's not clear (to me) if a new calibration plan was likewise formulated for SWG time, or if it needed to be

The Plan Changed – Contamination

- first discovered in **RXJ1856** observation 3 months after launch (and after two E0102 observations)
- target to confirm CCD QE below C edge
- confirmed with additional RXJ1856 and E0102 observations 6 months after launch
- a new AOI calibration plan was formulated based on:
 - loss of XRS and new importance of XIS
 - need to understand and monitor contamination
 - initial results from some calibration and science targets
 - first rumblings (?) of IACHEC



The New Plan – Year 2

- E0102 (2 x 30 ksec)
 - low energy gain and response
 - contamination monitoring and modeling (on-axis)
- RXJ1856 (1 x 40 ksec)
 - contamination monitoring and modeling (on-axis), especially below C edge
- PKS2155 (1 x 30 ksec)
 - effective area cross-calibration with *Chandra*, *XMM*
- Galactic Center (1 x 50 ksec)
 - high energy gain and response
- Cygnus Loop (4 x 10 ksec)
 - CTI, low energy gain and response
 - contamination monitoring and modeling (off-axis)
- day Earth (continual)
 - contamination monitoring and modeling (off-axis)

The Newer Plan – Year 3

- window, burst, P-sum mode calibration began in earnest
 - calibration sources not available in window, P-sum
 - Perseus used for window gain, response (2 x 20 ksec)
 - E0102 used for burst, eventually for low-energy gain, response of window (2 x 20 ksec)
- charge injection turned on in 2006, but non-charge injection calibration observations still in rotation to extrapolate calibration
- **Galactic Center (1 x 50 ksec) dropped in Year 3 (2008)**
 - high energy gain and response
 - Perseus used instead

The Newer Plan – Years 4+

- NI 32D added in year 5 (2010) (1 x 30 ksec)
 - mid energy gain and response
 - mission cross-calibration
- XIS1 charge injection raised in 2010, but previous observations at previous level still in rotation to extrapolate calibration
- Crab 1.0-1.5 degree offsets in 2010 for *really* stray light
 - for Perseus key project (15 pointing x 10-20 ksec)

AO10 Calibration Targets (Proposed)

May 2015 – Oct 2015

Target	Prime	Reason	ksec
CRAB	HXD,XIS	timing, cross-cal	40
E0102-72	XIS	soft gain & response, on-axis contamination	30
E0102-72	XIS		30
E0102-72_I_4_WIN	XIS	window soft gain & response	30
CYGNUS_LOOP_P8	XIS	off-axis contamination	10
PERSEUS	XIS	hard gain & response	40
PERSEUS_I_4_WIN	XIS	window hard gain & response	20
RXJ1856.5-3754	XIS	on-axis contamination	40
NI32D	XIS	medium gain & response	25
3C273	IACHEC	cross-calibration	60
PSK2155-304	XIS	on-axis contamination	20

Summary

- loss of XRS completely changed calibration plan
- discovery of contamination changed calibration plan
- opening door while looking at source of known flux (E0102) allowed us to accurately model contamination build-up
- for many operational changes, need extension of calibration observations for continuous calibration
- XIS relies entirely on celestial sources for in-flight calibration