Swift XRT calibration status

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on behalf of the Swift XRT team
Swift XRT status

- XRT boresight
- Ground software updates
- CTI
  - column-by-column CTI required
- RMFs/ARFs – updated release
- BAT/XRT cross calibration
- Future Prospects
XRT boresight

Prior to Oct 2005

New boresight calibration, Dec 2005

Position angle residual offset dependence

Typical GRB position accuracy 3.5” (in 1ks).

(Moretti et al 2006)
XRT boresight

Time dependent boresight shift discovered

Residual after applying a time dependent boresight correction.
Software updates (ASDC)

- **xrttdrss2**
  - Processes prompt PC mode Single Pixel Event data sent via TDRSS. Significantly improves no. of prompt XRT positions.

- **xrtexpomap**
  - creates exposure maps for both WT & PC modes to account for bad-columns. (Used in ARF and light curve generation.)

- **xrtwtcorr/xrtpccorr**
  - corrects for bias variations in WT/PC mode through an orbit
Software updates - *xrtwtcorr*

Adjusts bias row subtraction using last 20 pixel data telemetered with every frame.

Corrects for temperature dependent bias offsets.
Software updates - xrtpccorr

Estimate residual bias for PC mode data from mean of corner pixels of grade 0 events.

Drop caused by grade migration as a result of optical contamination.
Software updates - *xrtpccorr*

**No bias correction**

- **black** – first 700s
- **red** – last 500s

**With bias correction**

- **black** – first 700s
- **red** – last 500s
New RMF/ARF release - WT

- WT mode calibration no longer performed on Crab because of pile-up and its extended source nature
- Used two observations of Mkn421
  - one deep (3e6 photons) to smooth residuals around O, Al, Si, Au-edges
  - one simultaneous with XMM (Dec 06) to verify parameters
- Further observations of 3c273 (Jan 07 - simultaneous with XMM), and RXJ1856 used to verify effective area - reduction by 15% at low E required compared with theoretical ARFs.
New RMF/ARF release – PC

- PC mode primarily calibrated on PSR0549-69
- Observations of 3c273 and RXJ1856 used to verify effective area
  - reduction of 15% required at low E.

- Latest RMF significantly improves the redistribution tail of high energy photons for observations of heavily absorbed sources
Fe-55 (corner source) CTI measurement
CTI effect on E0102

SNR0102 – PC grade 0

black: 2005 May; red: 2007 Feb

normalized counts/sec/keV

channel energy (keV)

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Column dependent CTI – PC mode

94 ks total exposure (non uniform)
Column dependent CTI – WT mode

34ks exposure

Si-K line not well defined

WT column

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• Crab isn't a favourable cross-calibration source from an XRT point-of-view – piled-up (in WT) and extended (no extended source ARF available).
• Require a source bright in the BAT, and favourably placed (so as not to be contaminated by other sources), and not too piled-up in XRT WT mode.

Cyg X-1
XRT: 550-850 cps
(excluded 15 pixels from core)

• Const factor 0.98 for simple vphabs (diskbb + powerlaw + diskline) fit
• Const factor 0.85 for vphabs (diskbb + bknpow + diskline) fit.
Future Prospects

- CTI corrected on a column-by-column basis
  - requires 50-75ks exposure on Cas A or Pup A to map central CCD
- CCD substrate voltage will be raised to 6V in order to reduce dark current and noise at our relatively high operating temperatures (-50 to -70 C)
  - New “calibration" mode created to enable easy selection of WT or PC mode.

Special thanks to XMM calibration team for notifying us of cross-calibration opportunities. So far 3c273, Mkn421, PKS2155, NGC7172...