**SWIFT-XRT-CALDB-04**
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Pages Changed: all

# SWIFT XRT CALDB REV 2.0 RELEASE NOTE

## SWIFT-XRT-CALDB-04: Gain

## 1. Component Files:

| FILENAME | VALID DATE | RELEASE DATE | CAL VERSION |
|---|---|---|---|
| swxpcgain20010101v003.fits | 01 January 2001 | 15 October 2004 | 003 |
| swxpdgain20010101v003.fits | 01 January 2001 | 15 October 2004 | 003 |
| swxwtgain20010101v003.fits | 01 January 2001 | 15 October 2004 | 003 |

## 2. Scope of Document:

This document contains a description of the gain calibration analysis performed at Penn State to produce the gain calibration products for the XRT calibration database.

## 3. Changes:

This is the first released version of the Gain Calibration document.

## 4. Scientific Impact of this Update:

This is the first released version of the Gain Calibration document.

## 5. Caveat Emptor:

It is noted that significant charge traps exist in certain columns (as indicated within the document text) of the XRT CCD which may cause the local effective gain to be markedly different from that described by the global gain/CTI coefficients contained in the released gain calibration files. The form of the Calibration Database does not currently allow for precise correction for such traps in the XRT standard processing tools (*xrtpipeline*).

## 6. Expected Updates:

It is expected that radiation damage during the orbital lifetime of Swift will degrade the XRT CCD charge transfer efficiency through the production of more charge traps. Periodic updates to the gain files will be made to account for these changes.
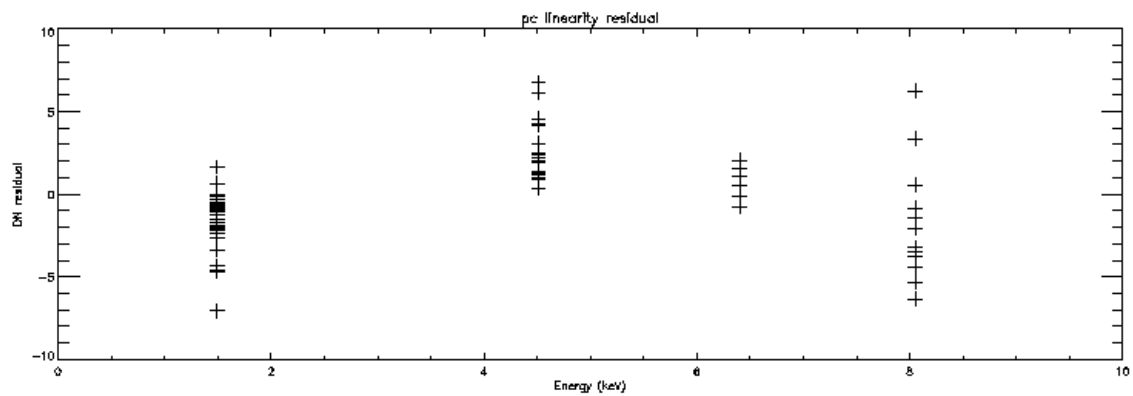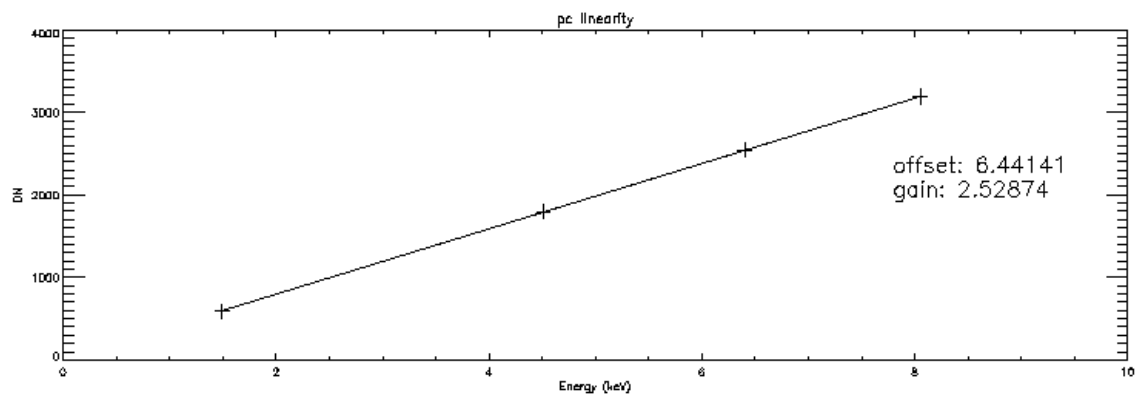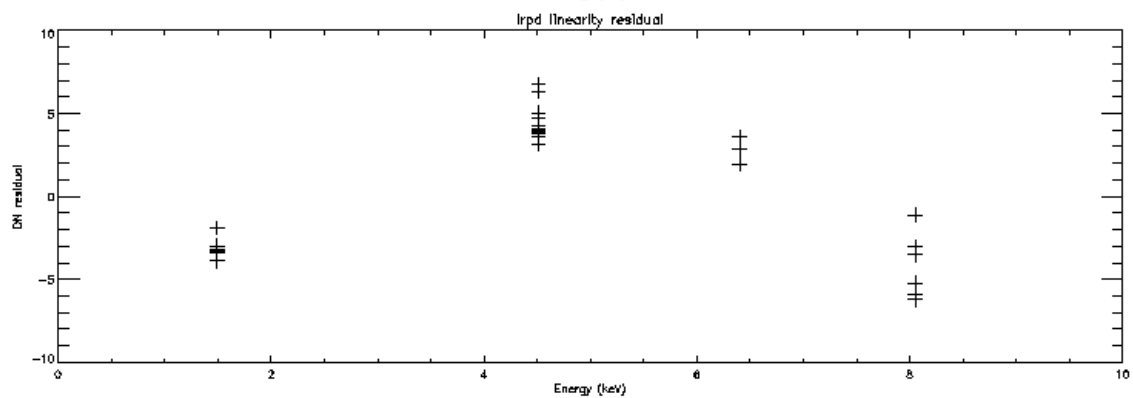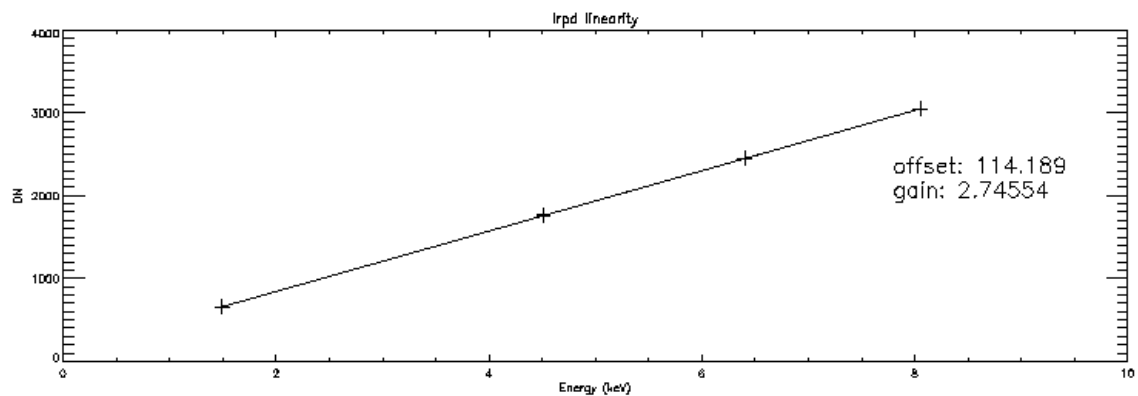
## 7. Panter Gain calibration:

The original gain calibration for the XRT in all modes was determined from data collected at the Panter X-ray calibration facility during Sept-Oct 2002 (with CCD temperature of –100 C).  The nominal gain factor in each mode has been determined by performing a linear fit of digital number (DN) to eV of discrete line data collected at energies of 1.49 keV (Al K_) 4.51keV (Ti K_), 6.4 keV (Fe K_) and 8.05 keV (Cu K_). Data at 0.28 keV (C K_) were found to be contaminated by background and hence were not used in the calibration. Plots of the gain linearity (in DN vs energy for each mode) are displayed below together with the associated residual of the linear fit to the gain in each mode.
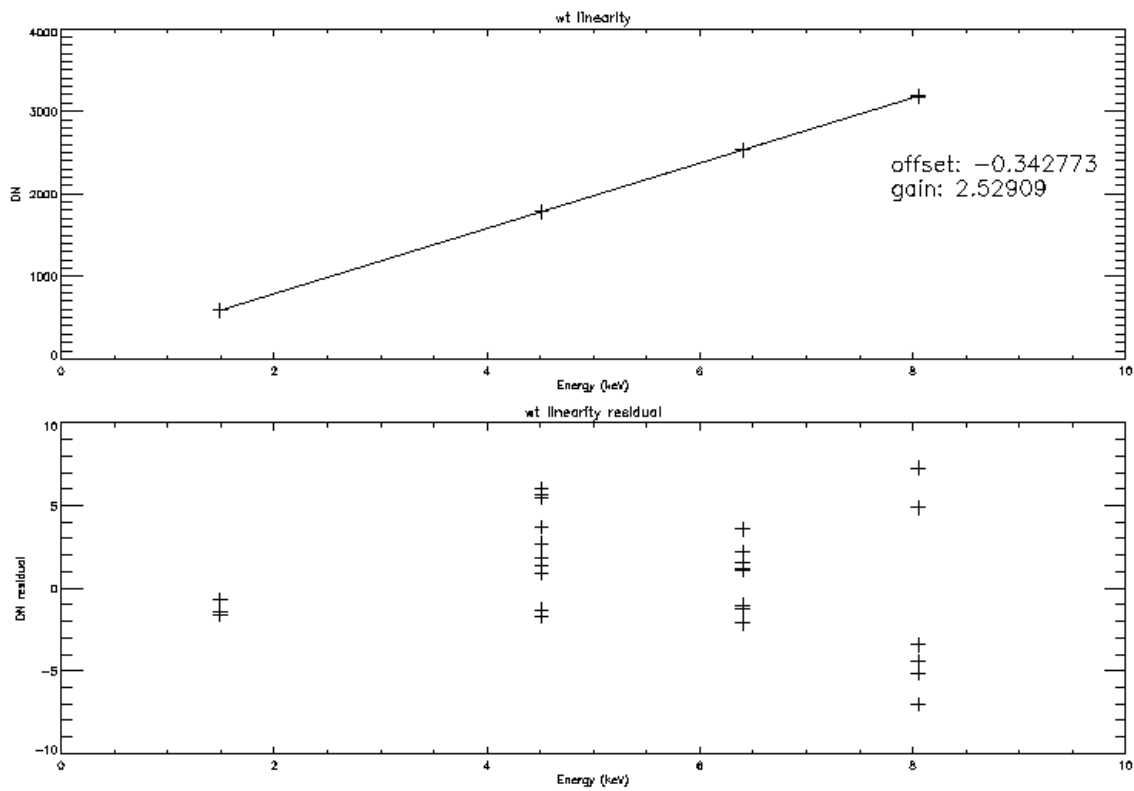
As the current format of the gain calibration database file does not support a polynomial description of the gain function, we have chosen to perform the gain calibration using the higher energy values, leaving the slight discrepancy at lower energies to be corrected in later versions of the ground/in-flight calibration. The nominal gain values determined as described above for each mode for the Panter calibration data are:

low rate photodiode: 2.75 eV/DN
photon counting: 2.529 eV/DN
windowed timing: 2.529 eV/DN

lrpd linearity

DN

offset: 114.189
gain: 2.74554

Energy (keV)

lrpd linearity residual

DN residual

Energy (keV)

pc linearity

DN

offset: 6.44141
gain: 2.52874

Energy (keV)

pc linearity residual

DN residual

Energy (keV)

## 8. Thermal Vacuum Gain Calibration (LRPD):

One amendment to the above strategy has become necessary because the low-rate photodiode mode (lrpd) waveform was altered after the completion of the Panter calibration period, changing the value of the nominal gain for this mode. To recalibrate the lrpd mode gain, we have performed a linear fit to the Mn K_ (5.993 keV doublet) and Mn K_ (6.490 keV) lines collected in thermal vacuum testing during June 2004 (after the waveform change, with CCD temperature of –100 C). The nominal gain values determined as described above for each mode are:

low rate photodiode: 2.55 eV/DN
photon counting: 2.529 eV/DN
windowed timing: 2.529 eV/DN