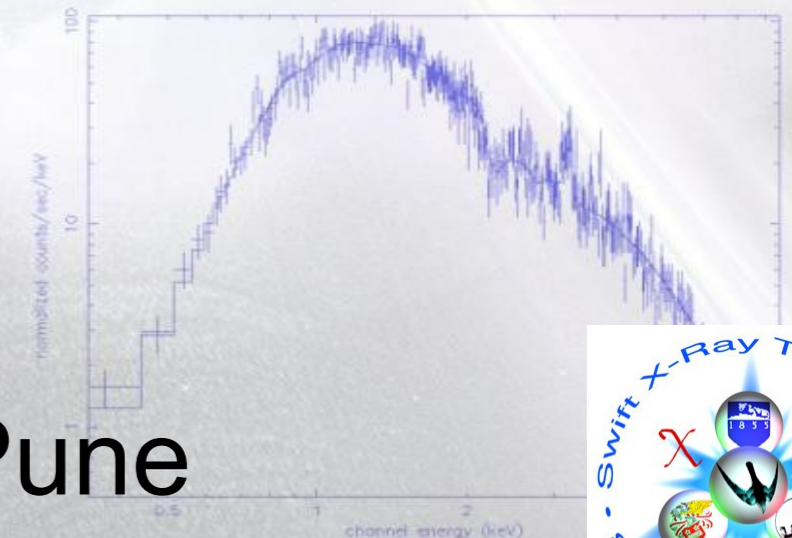
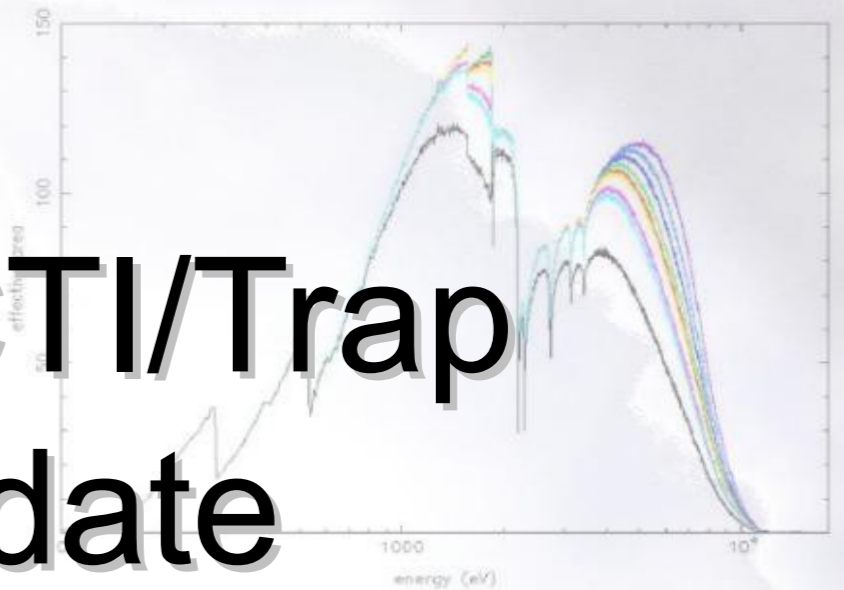


Swift-XRT Gain/CTI/Trap Calibration update

Claudio Pagani
Beatriz Mingo
Andy Beardmore



IACHEC - 2016, Pune



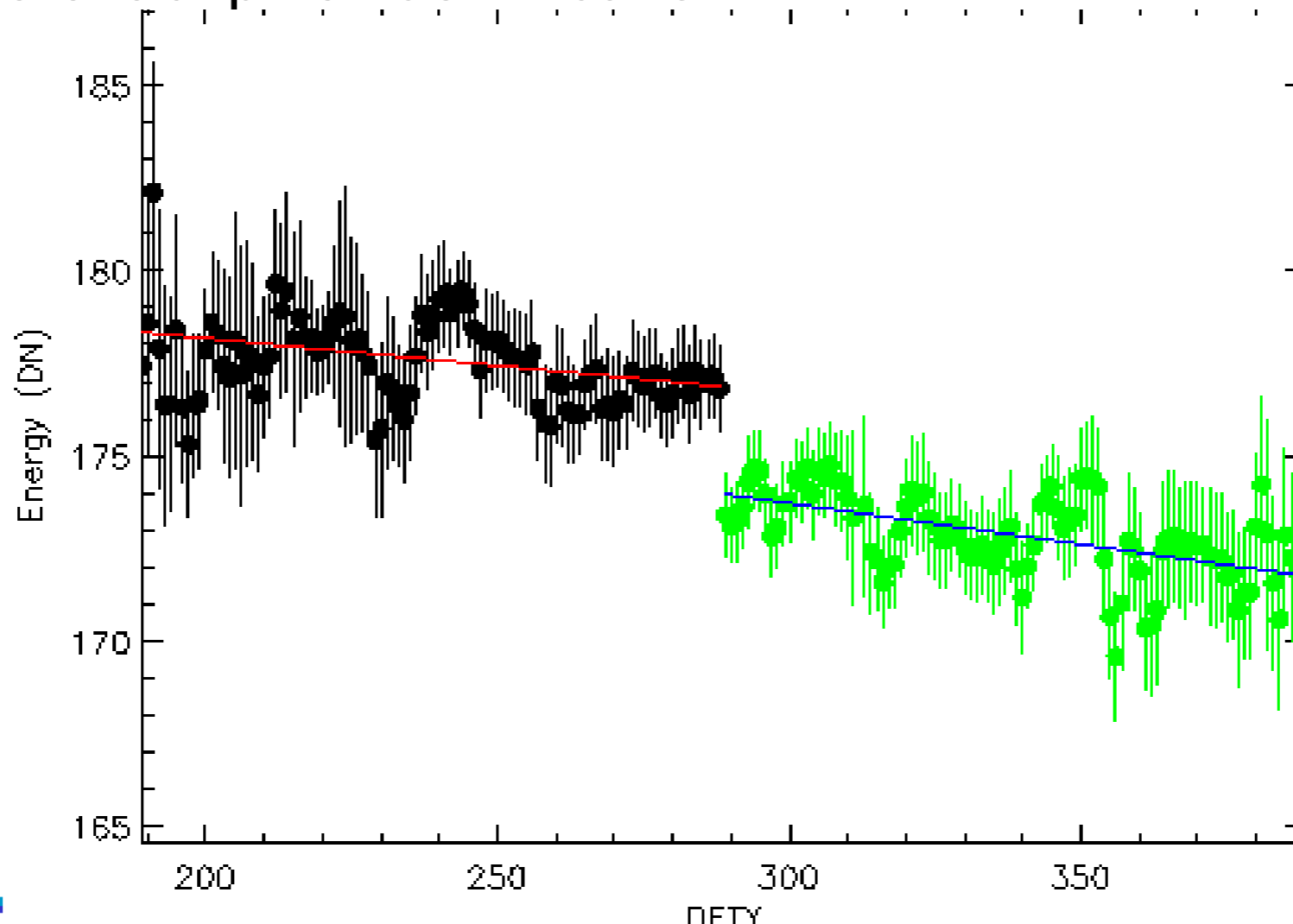
- Latest CALDB gain file release occurred on **Aug 3rd 2015**
 - Gain files include trap measurements from trap mapping epochs of **September 2014, February 2015 + June 2015** (WT mode only)
- Spring 2016 gain calibration observations underway

New “features”:

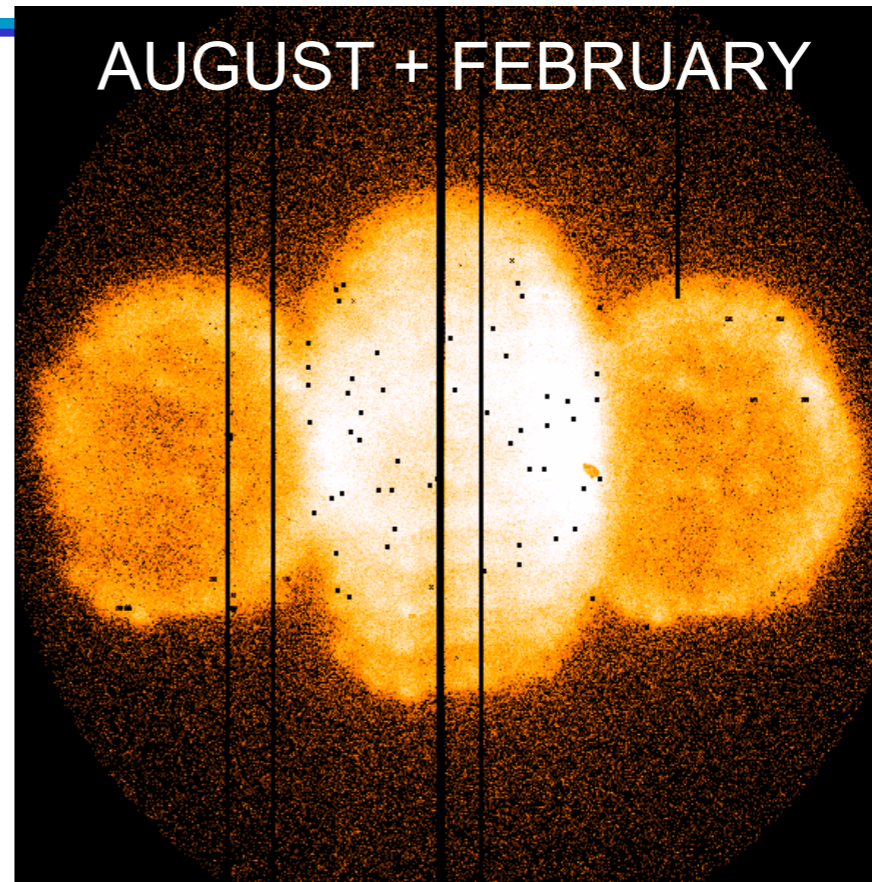
- Improved trap localisation thanks to multi-epochs merger
- New mapping strategy in PC mode, still using Tycho but now covering all the CCD
- New offset strategy in WT mode, using Cas A (smaller angular size, allows derivation of offsets over shorter column segments)



- Multiple epochs (e.g. 2012-2014) merged to localise trap positions more accurately (PC mode)
 - Traps are now identified to the exact pixel location in the *central 200 columns* of the detector.
 - At the *left+right sides* we still need to accumulate more statistics to achieve the exact pixel identification.

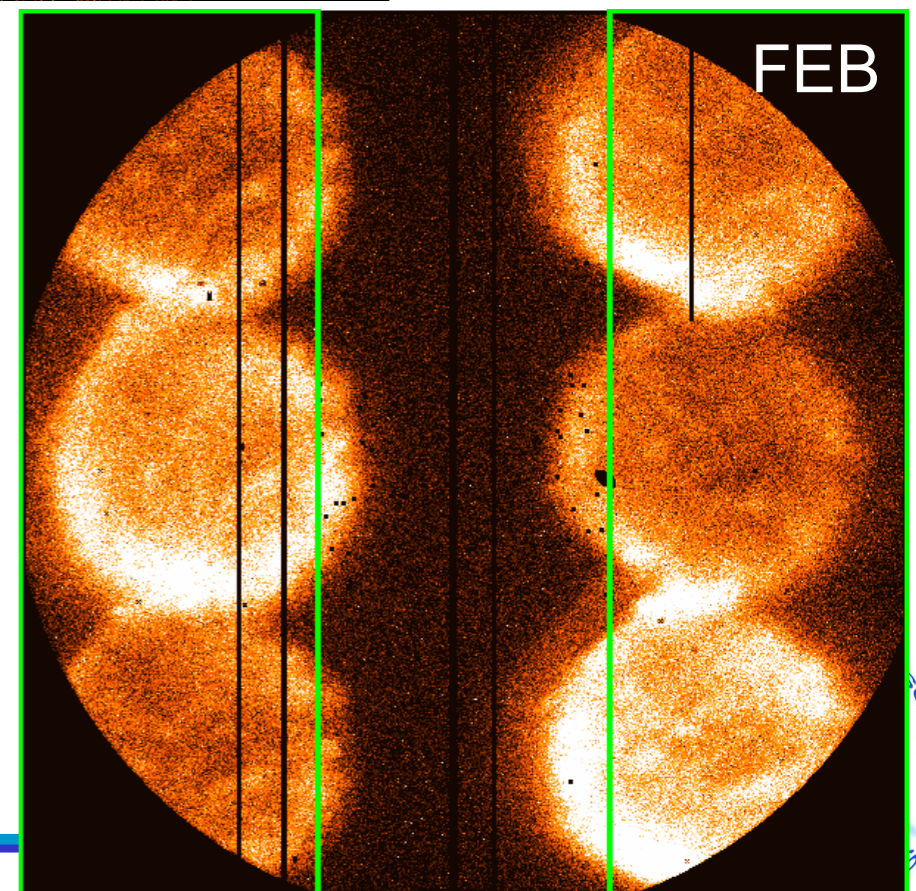
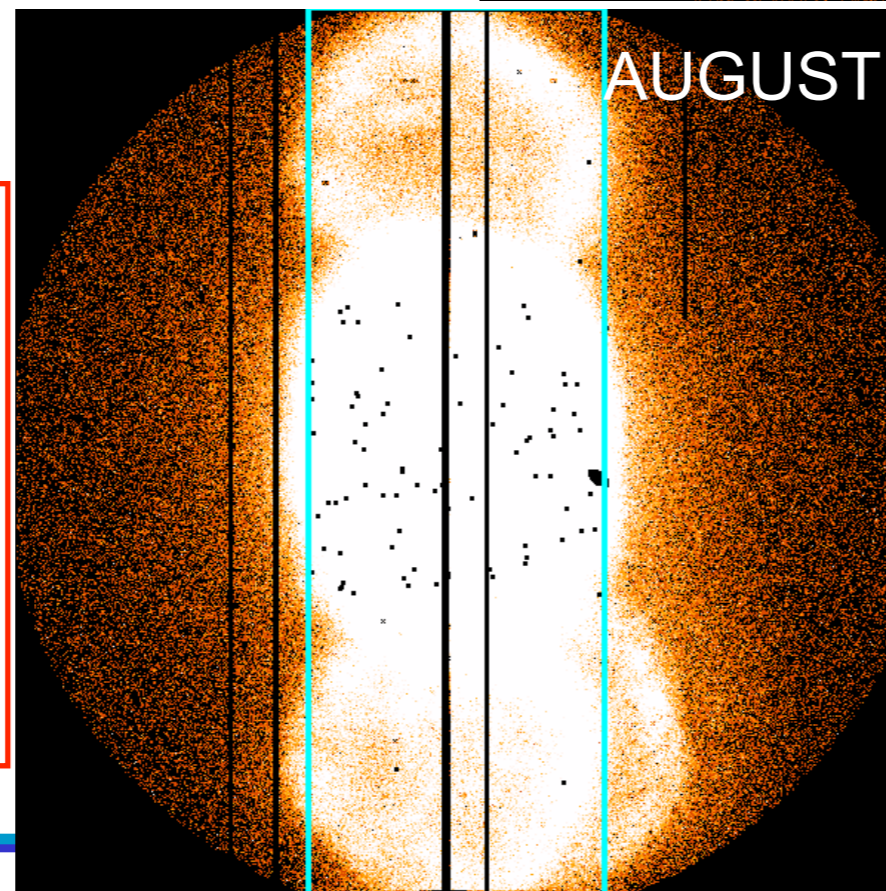


OLD STRATEGY

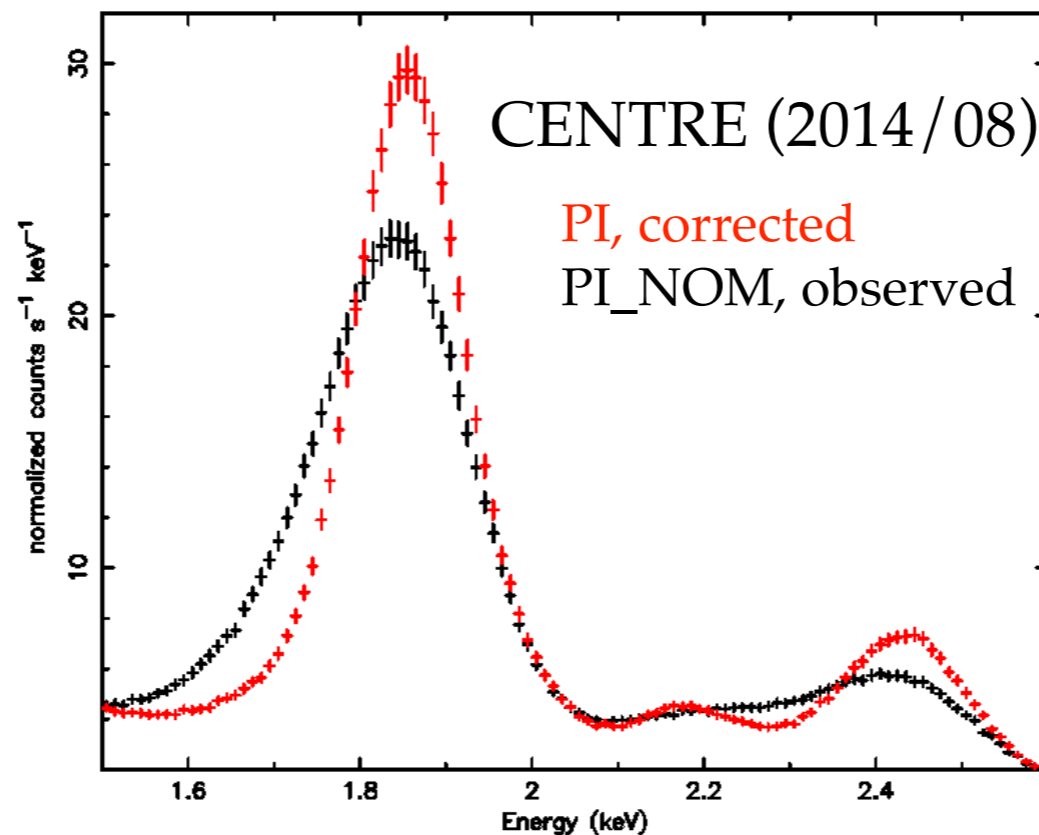


NEW STRATEGY

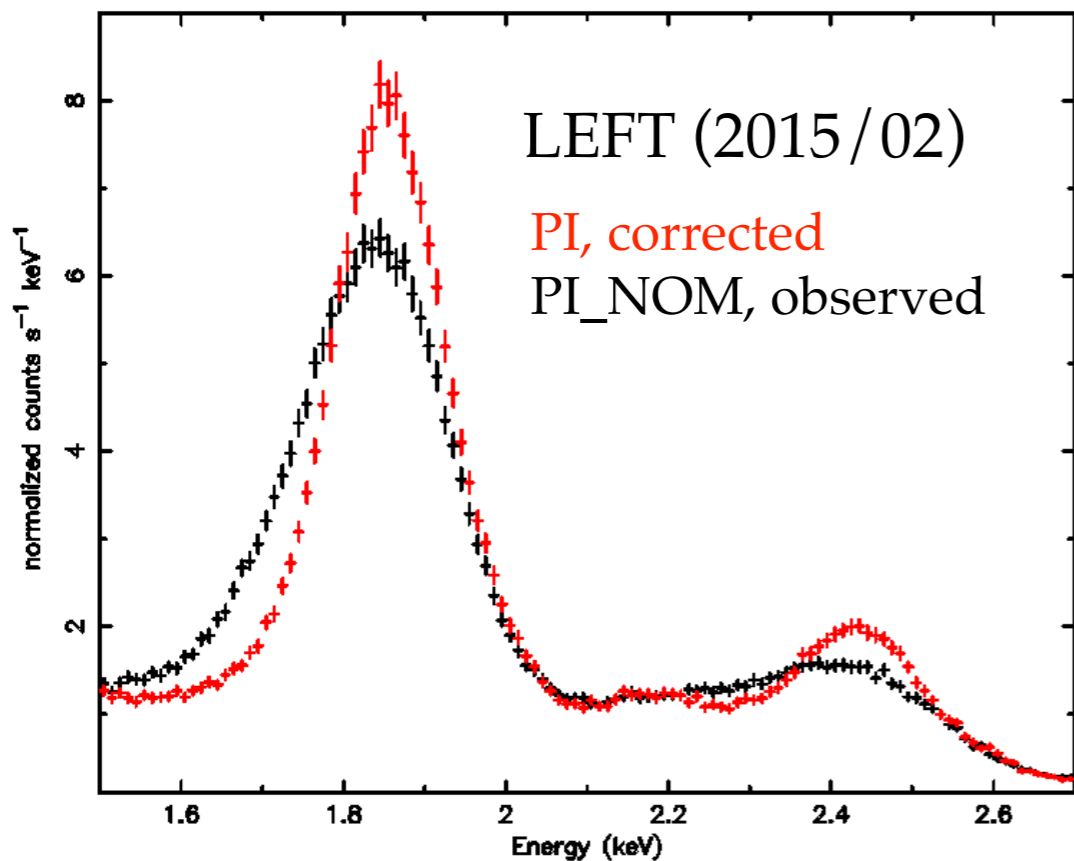
Gives more uniform response over entire CCD - justified by slow increase in traps number (~10 year) and slow evolution of the PC spectral resolution



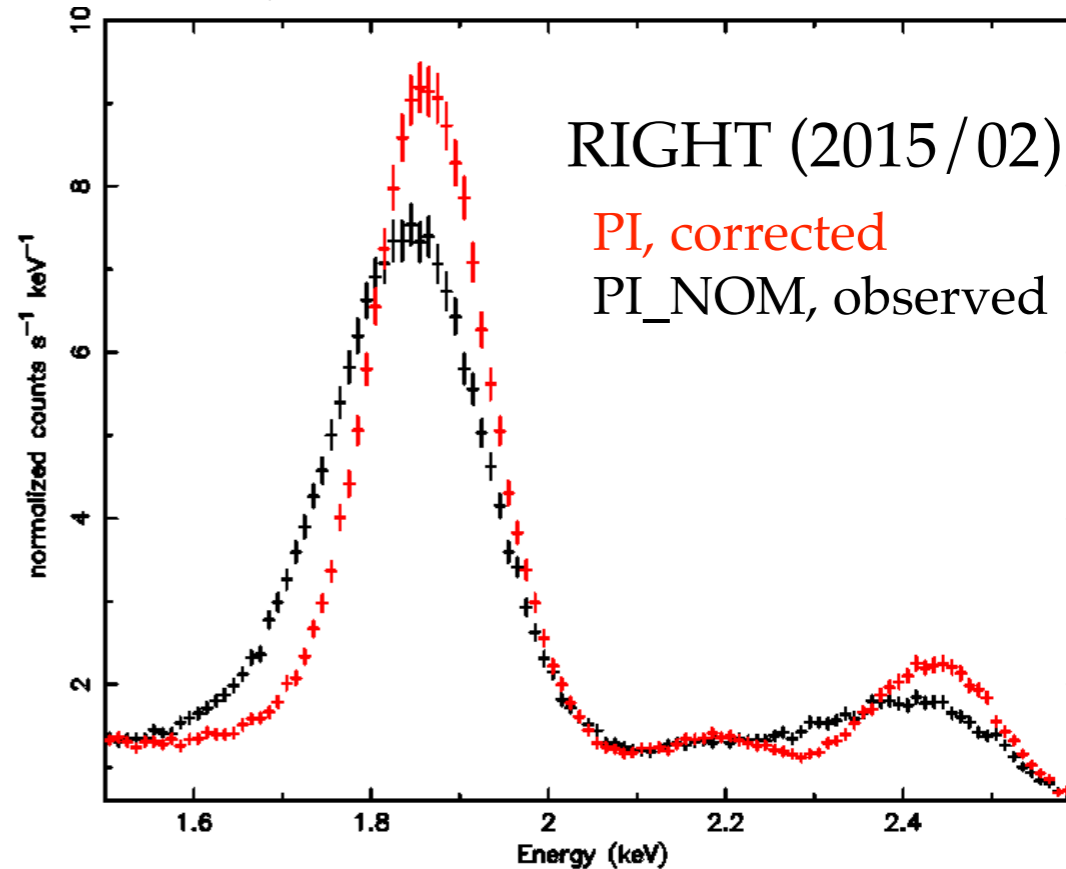
Tycho 2014/08 – PC mode – PI vs PLNOM



Tycho 2015-02 – PC left



15-02 – PC right, obs vs corr

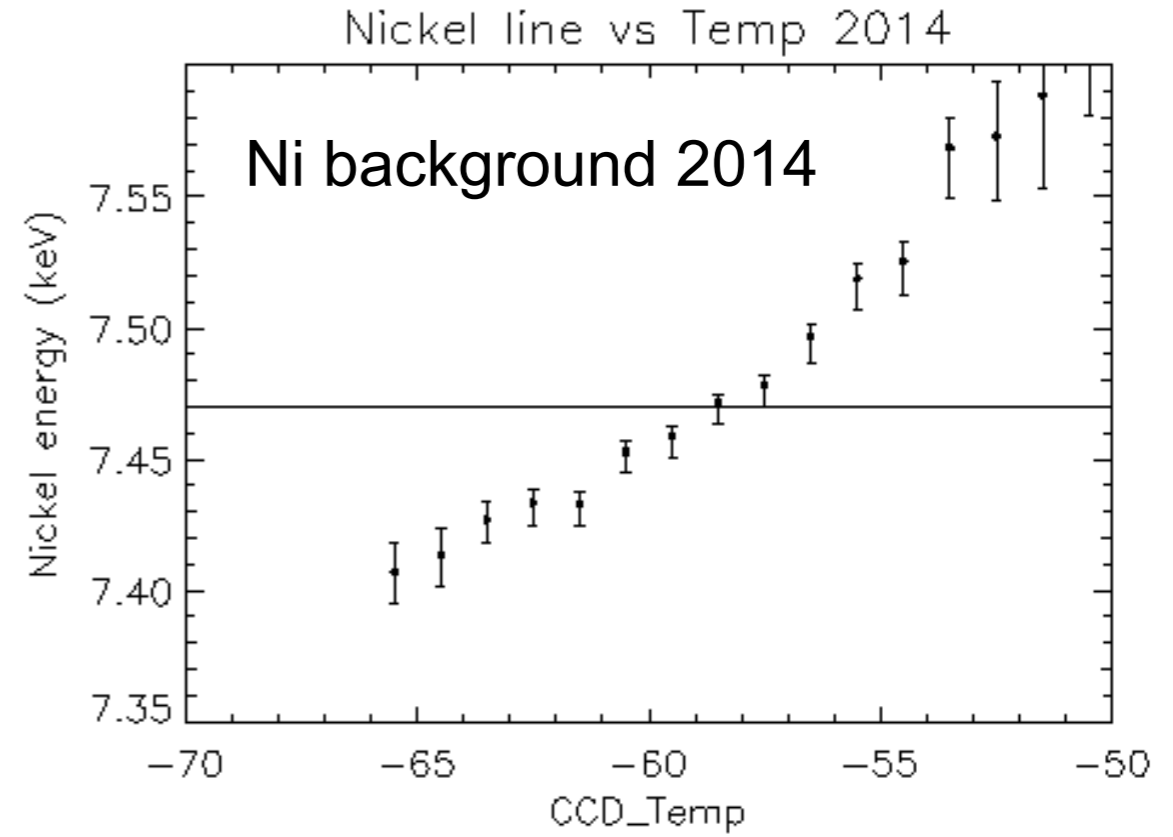
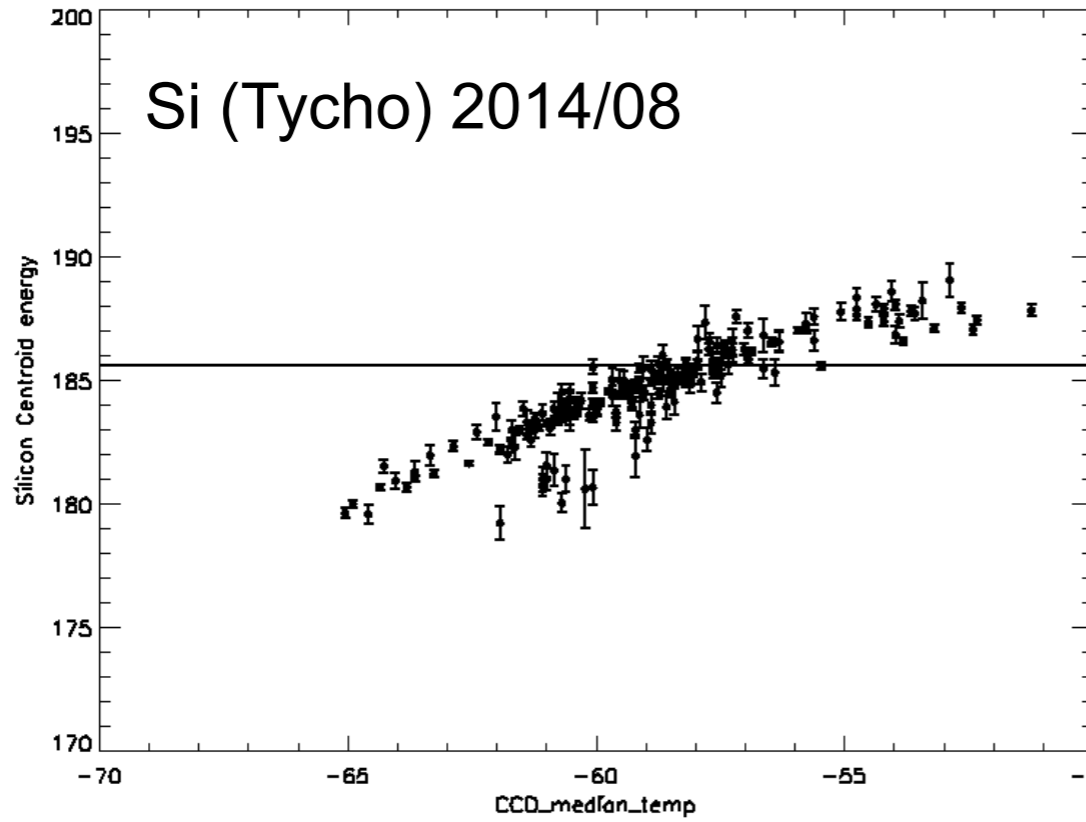




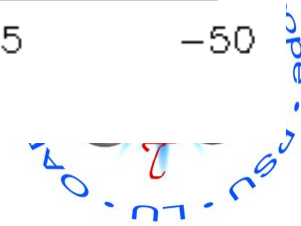
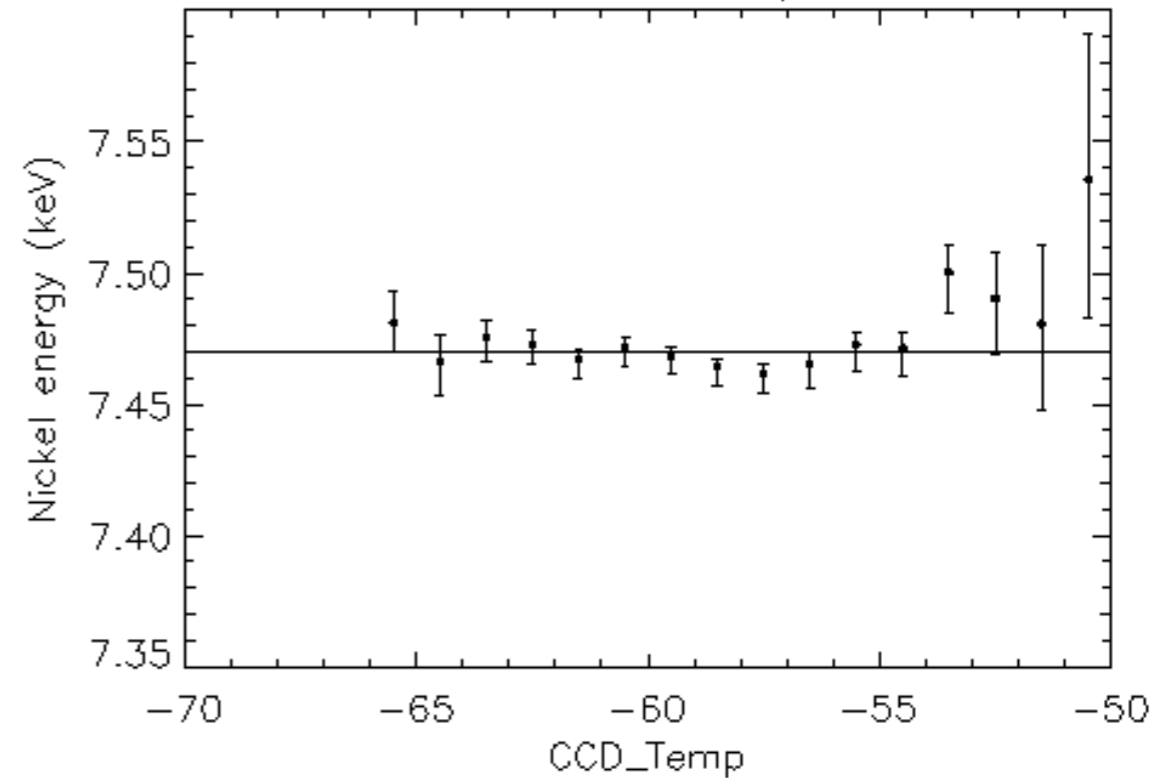
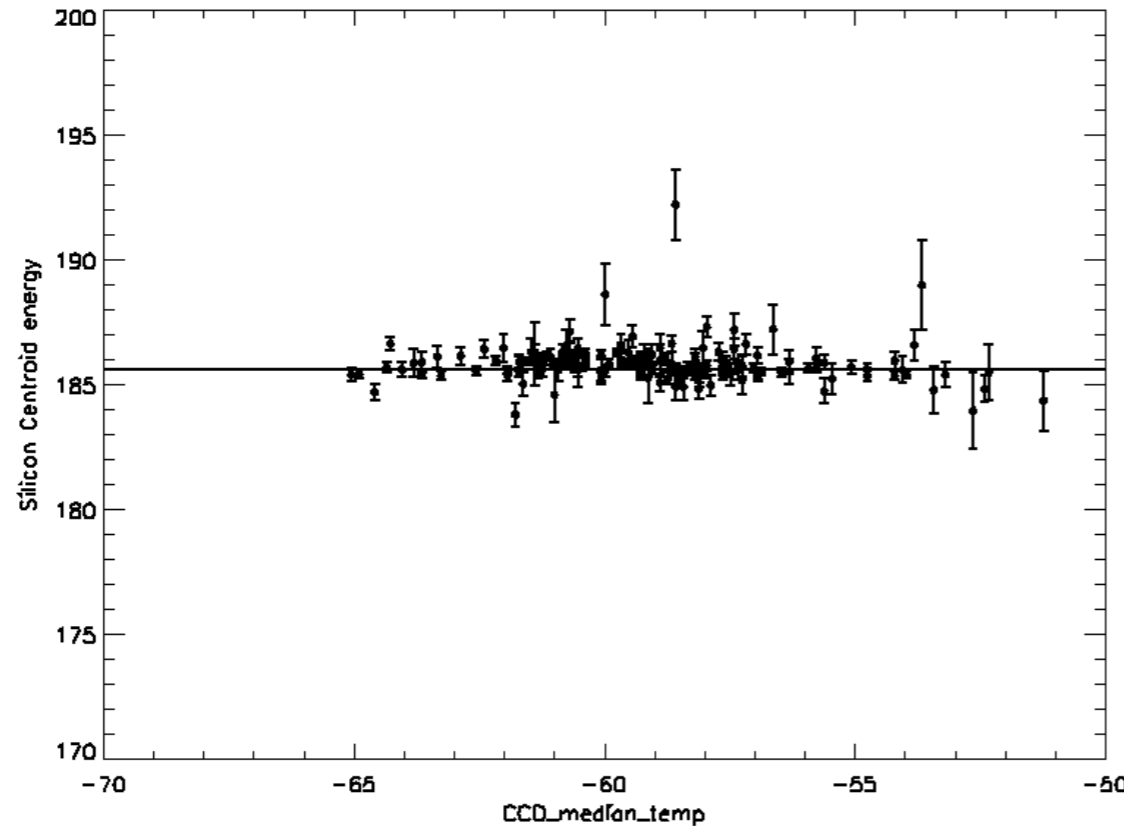
Gain file temperature dependence



Temperature independent
trap corrections



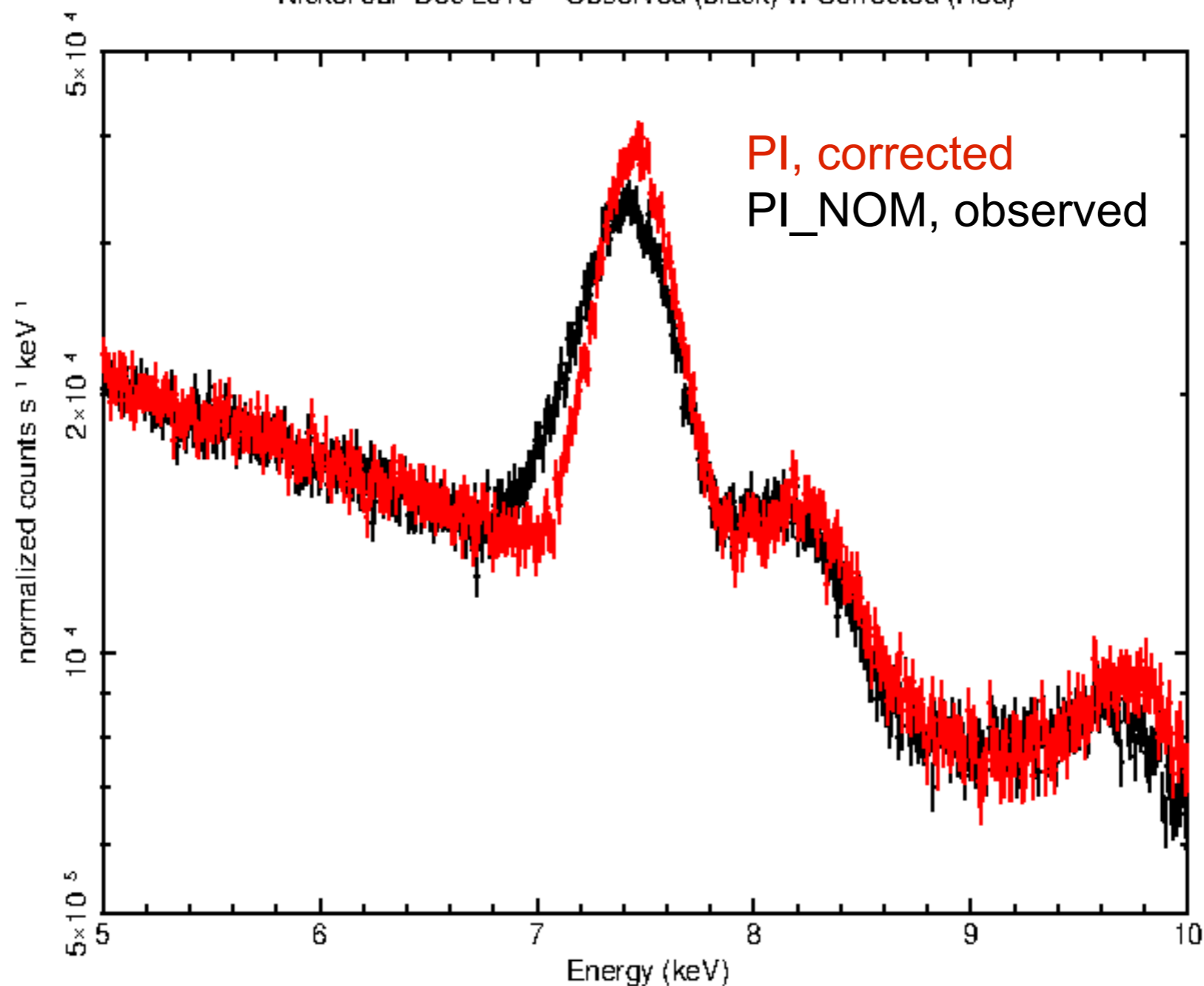
Temperature dependent
trap corrections



Ni instrumental background line 2015

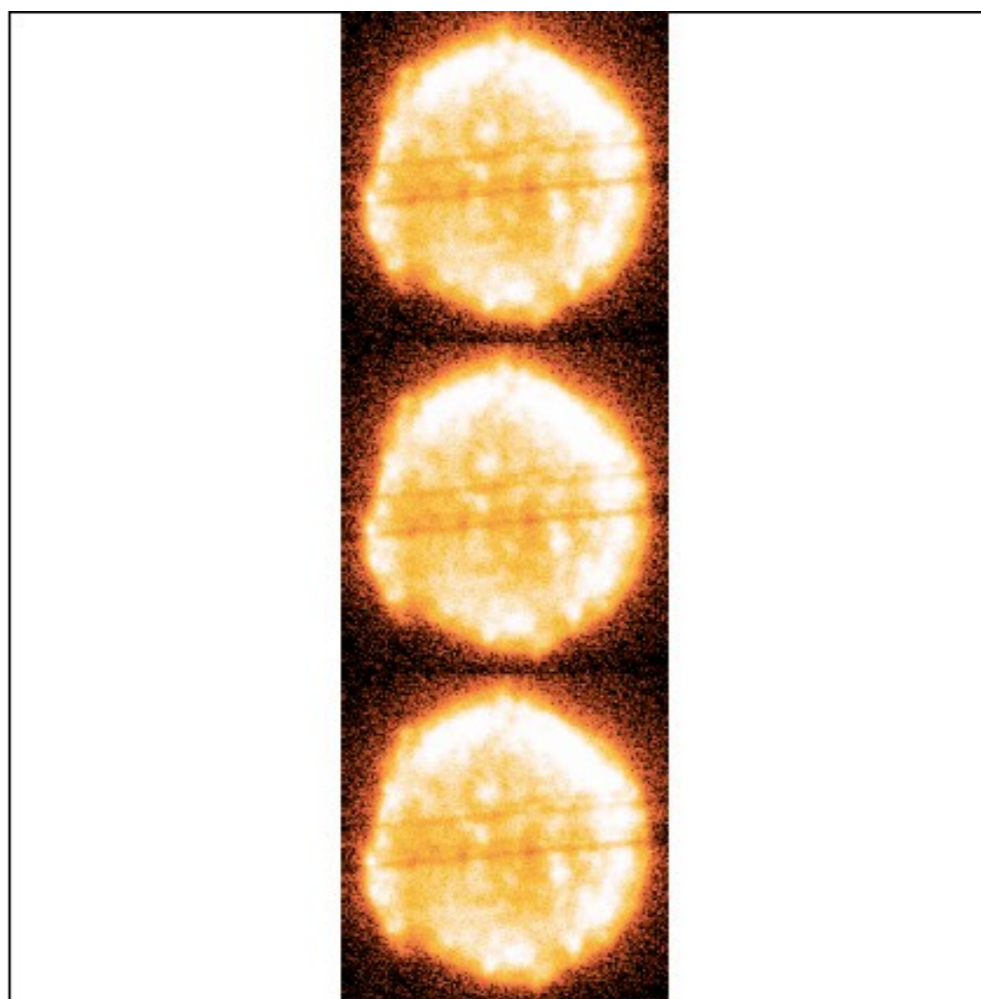
- observed & corrected spectrum

Nickel Jul-Dec 2015 - Observed (black) v. Corrected (Red)



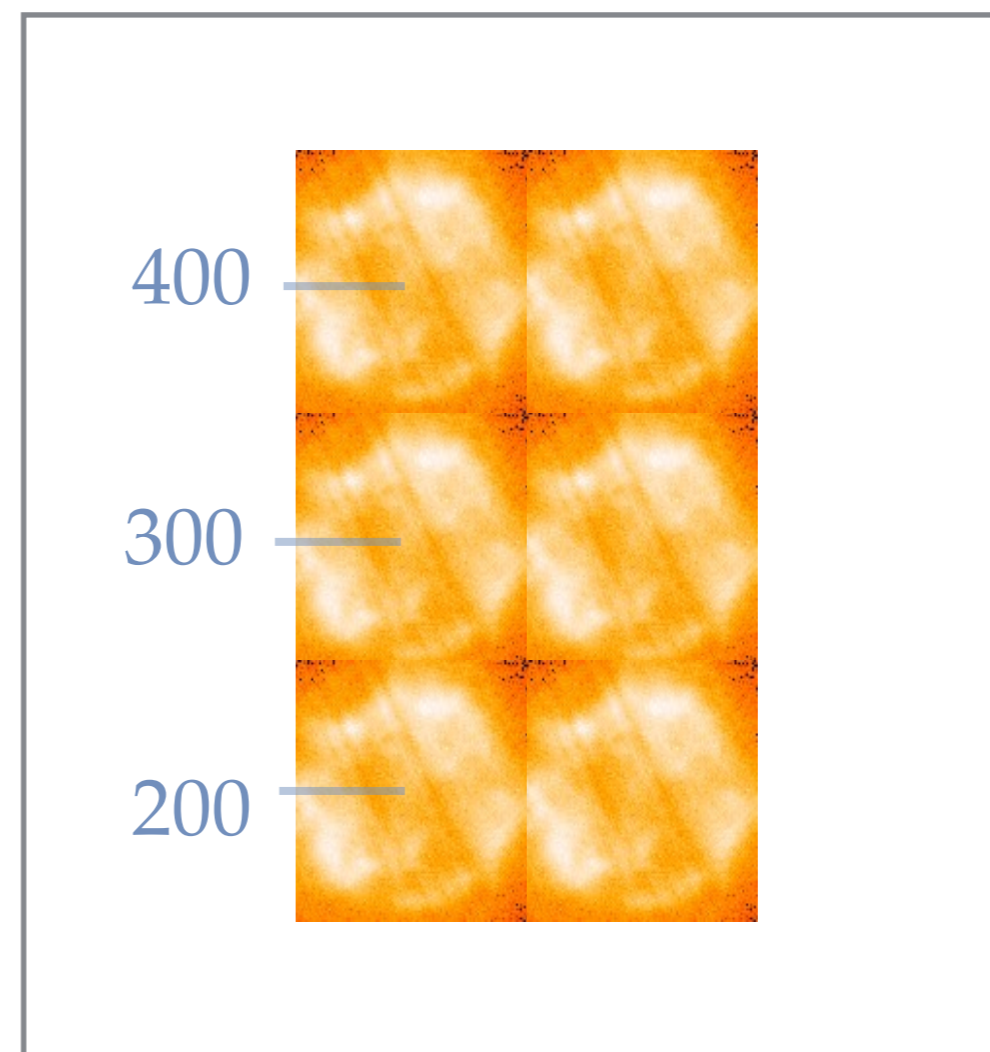
Old offsets:

3x15ks Tycho pointings



New offsets:

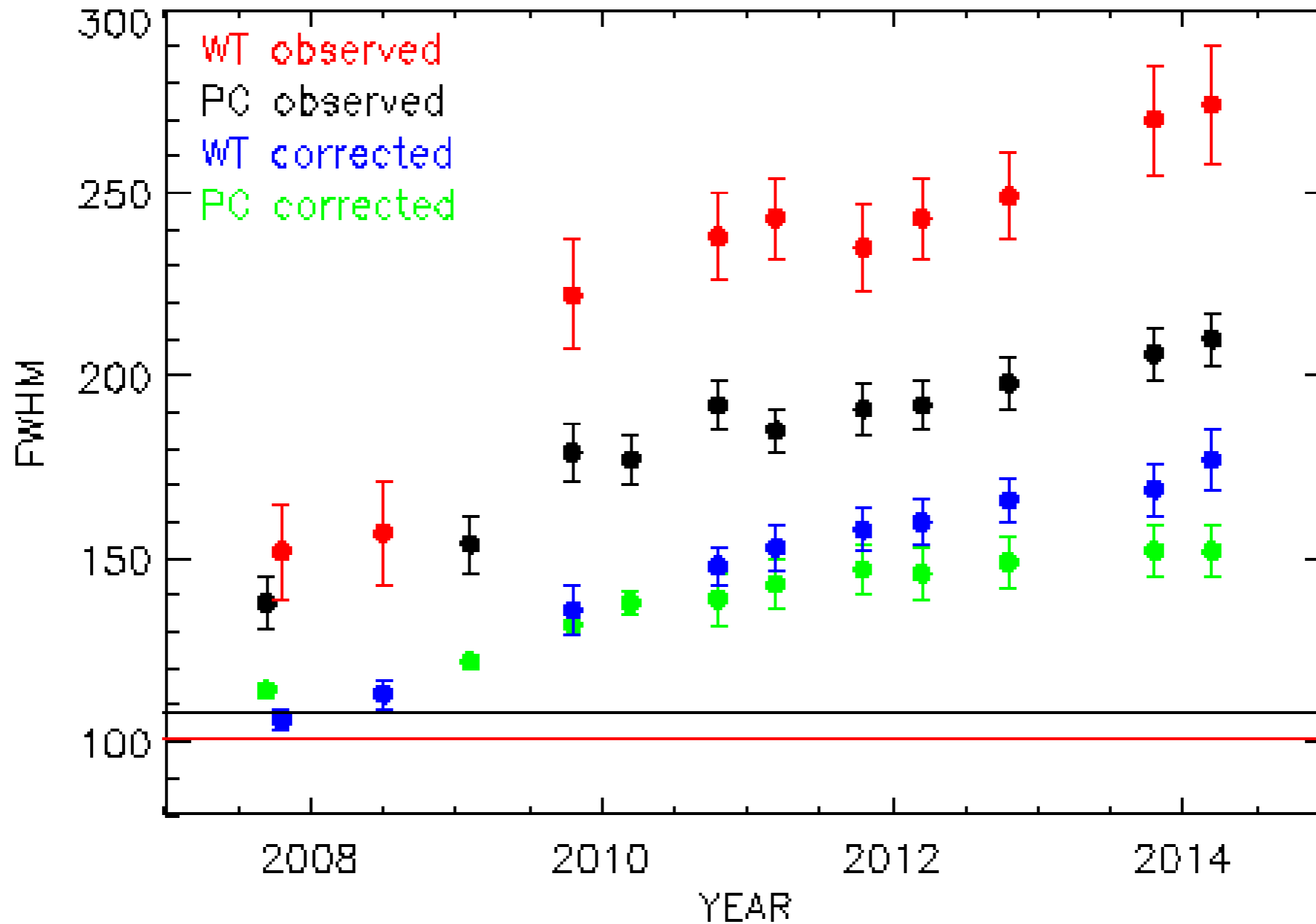
6x10ks Cas A pointings



- Tycho is big – 200 pixels (7.8') across – trap offsets calculated and applied over large column segment lengths
- Switched to Cas A – 100 pixels across – improves corrections due to shorter segments in vertical direction

FWHM evolution

Si line FWHM of Cas A and Tycho observations

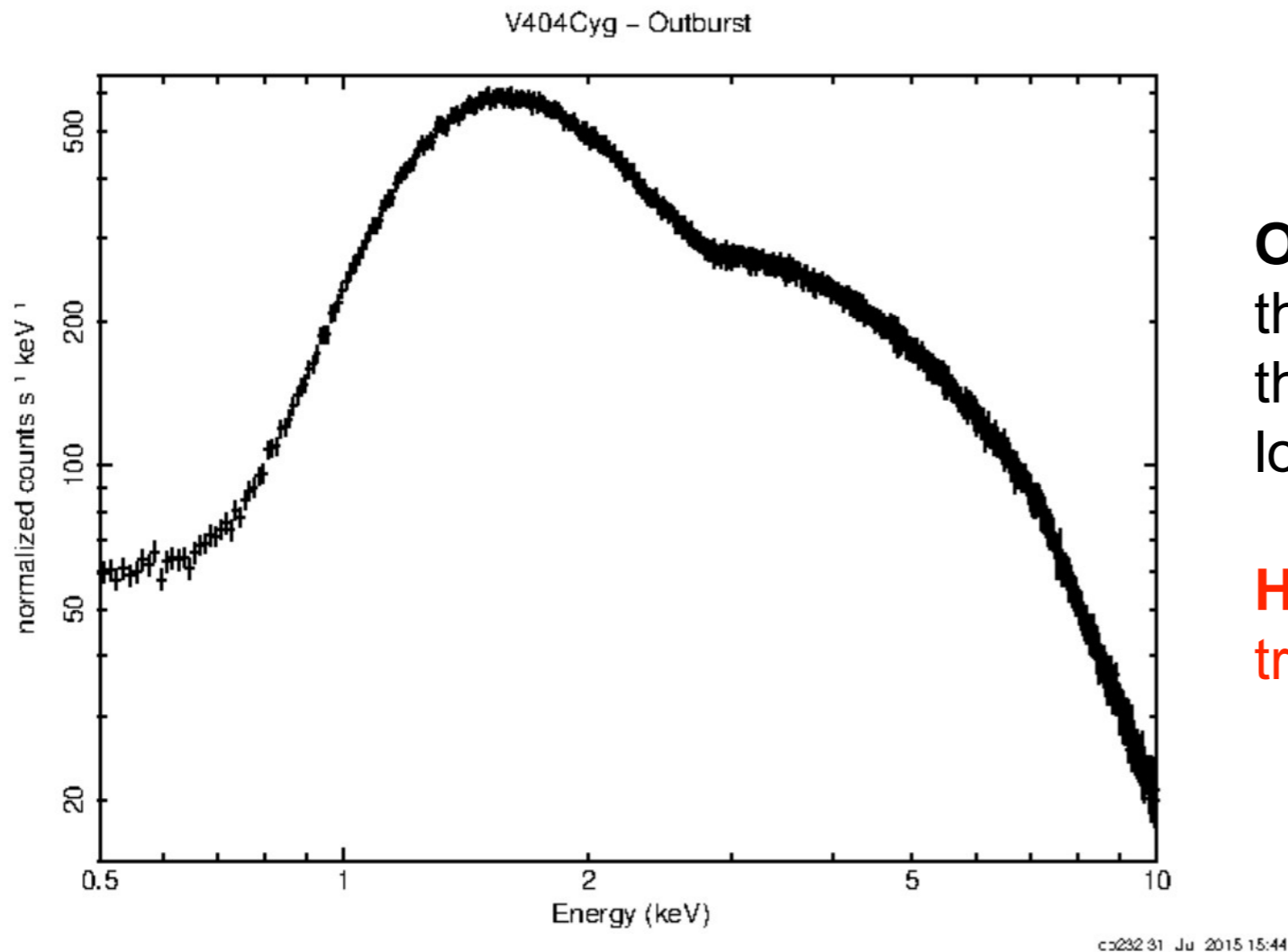


Gain files summary

- New gain files out (release August 3rd, 2015)
 - Next release will occur after Spring calibration season
- Merging multiple-epochs improves trap localisation (PC mode)
- Updated trap mapping strategy :
 - PC mode: Central 200 columns mapped in September, Left+Right sides mapped in February
 - WT mode: New Cas A pointings once a year (in September)
- Trap corrected energy resolution is stable (and has been for ~2-3 years), so no new RMF releases planned at this time



- BH binary V404 Cyg in outburst in June 2015,
- Source was very bright at times (~ 20 Crab below 10 keV) and absorbed, with very good XRT coverage.

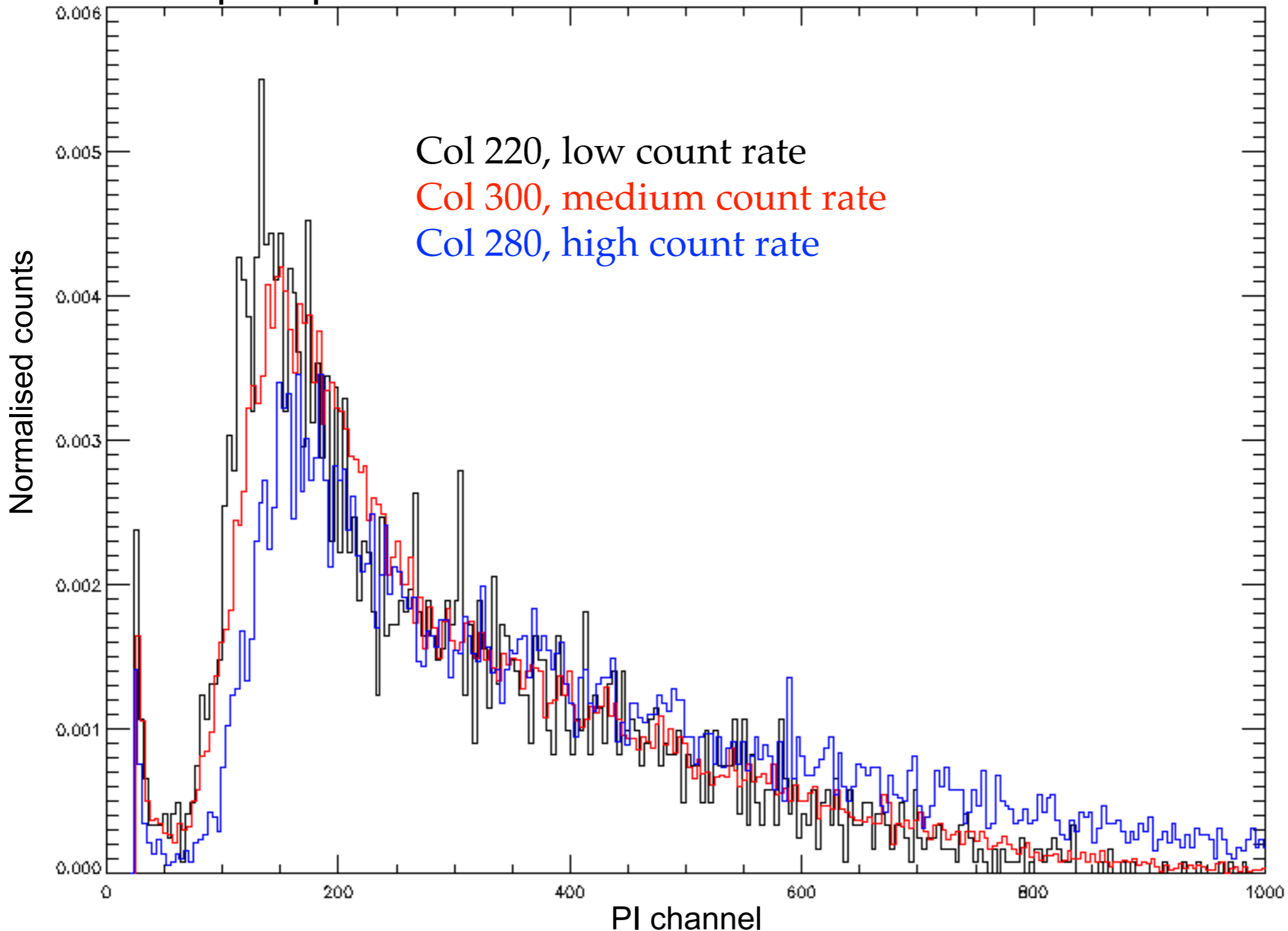


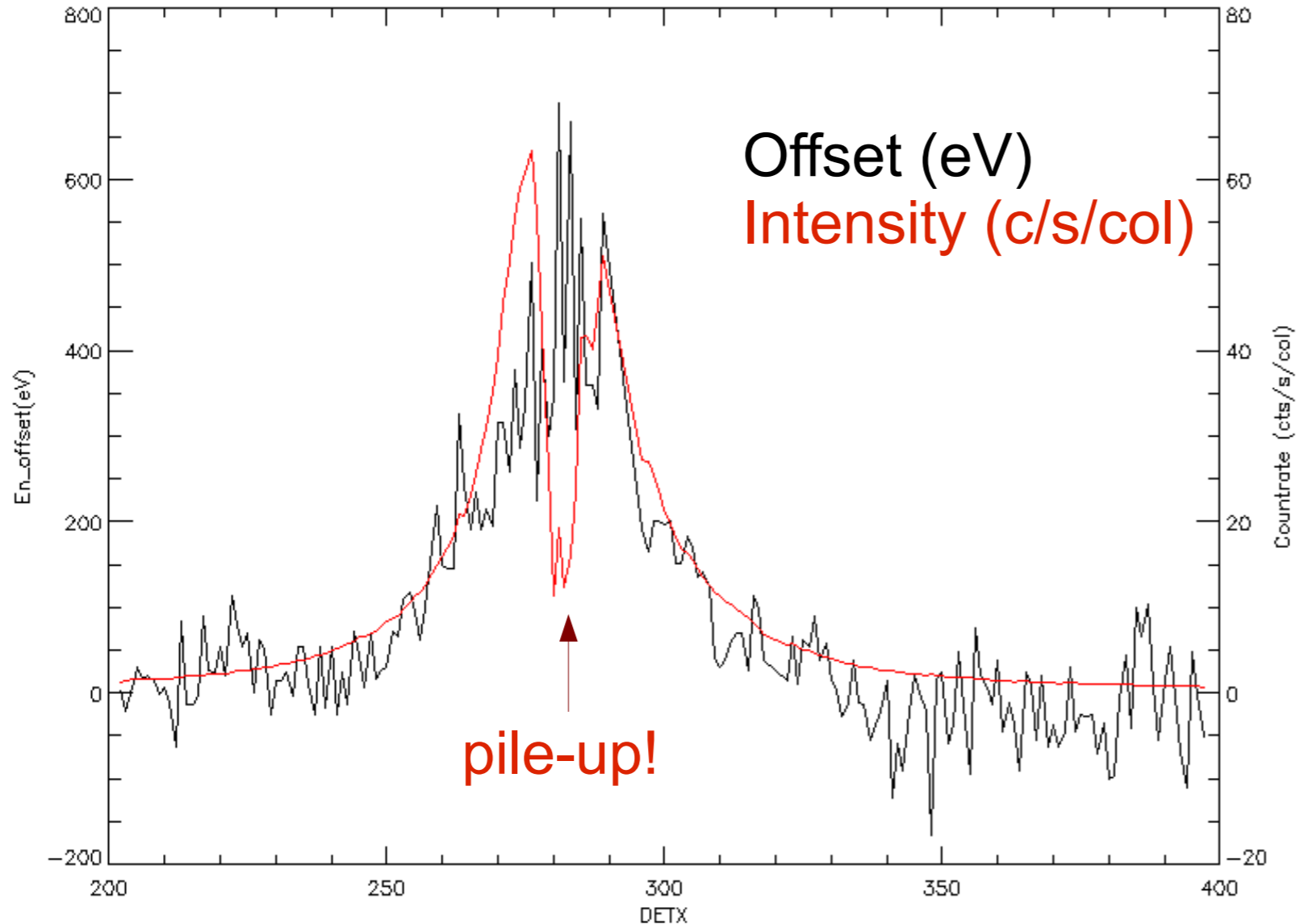
Original plan - try to use the shape of the spectrum around 1 keV to model the energy dependence of the traps at low energy for each column

However – noticed rate dependent trap offsets for the first time



Example spectra as a function of detector column :





Energy dependent offset clearly seen

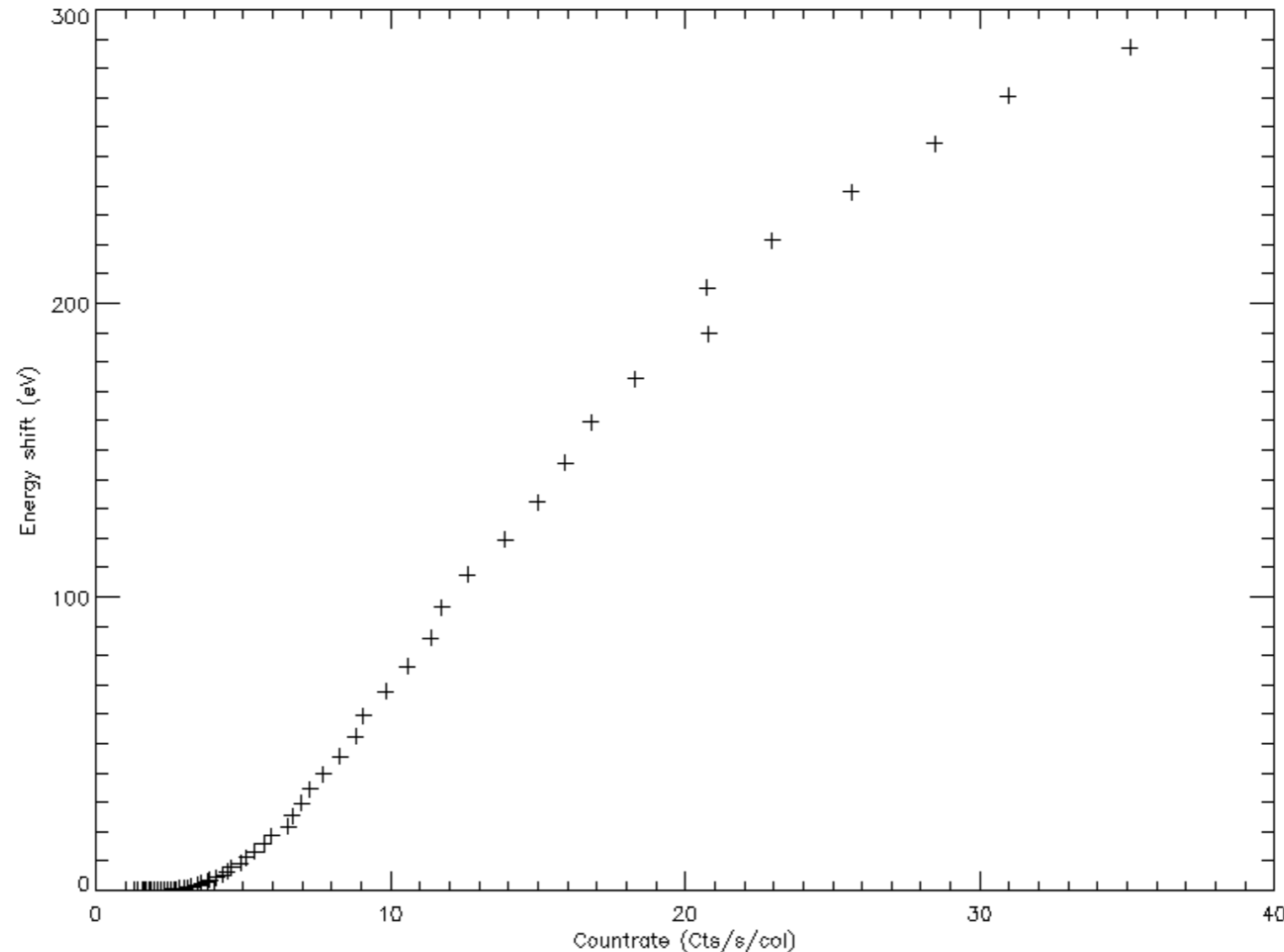
“Sacrificial charge” effect:

when 2 or more charge packets are transferred over the same trap during readout, the charge from the first packet fills the trap, and the following packets are transferred unaffected

→ trap losses are a function of the source flux

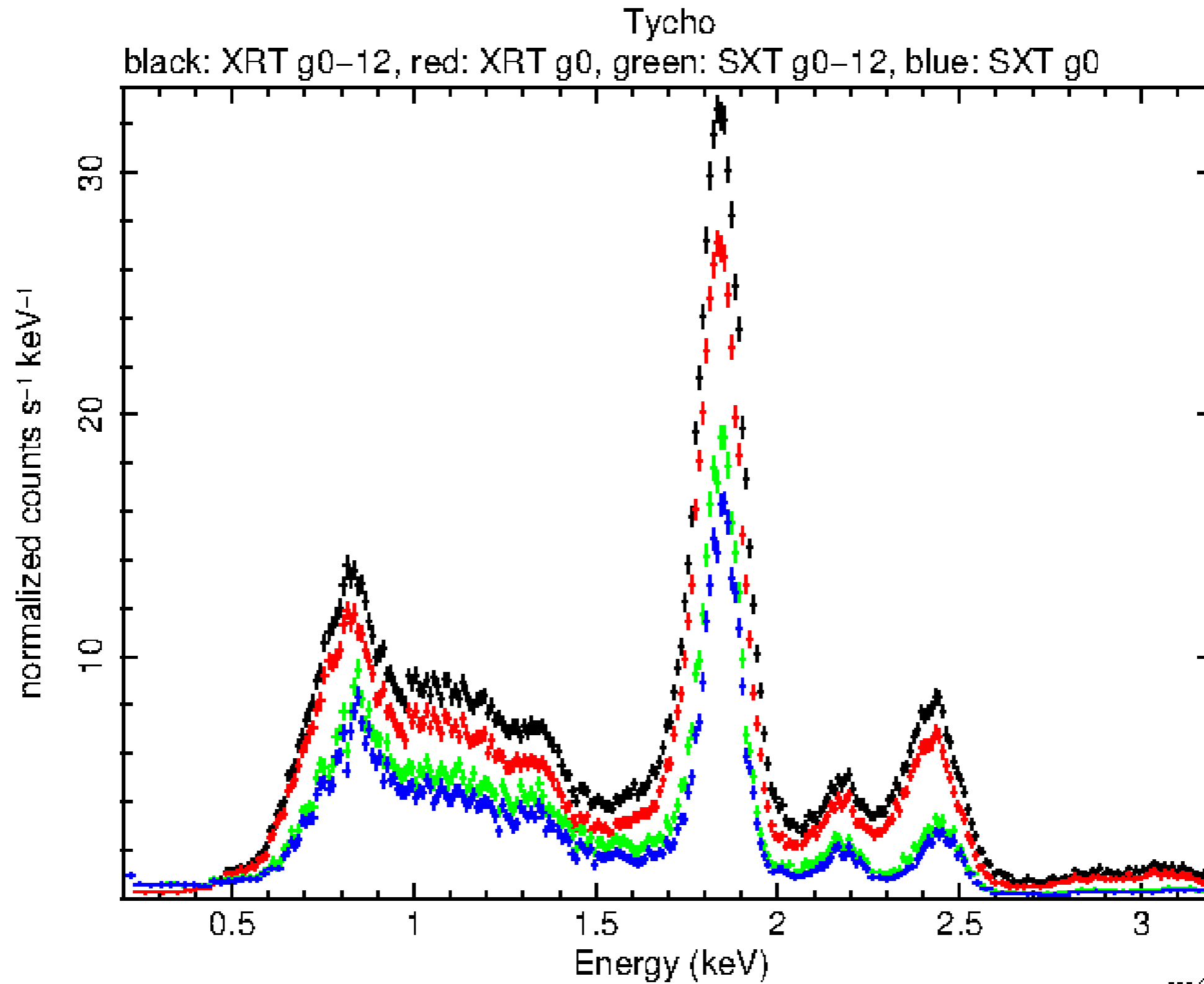


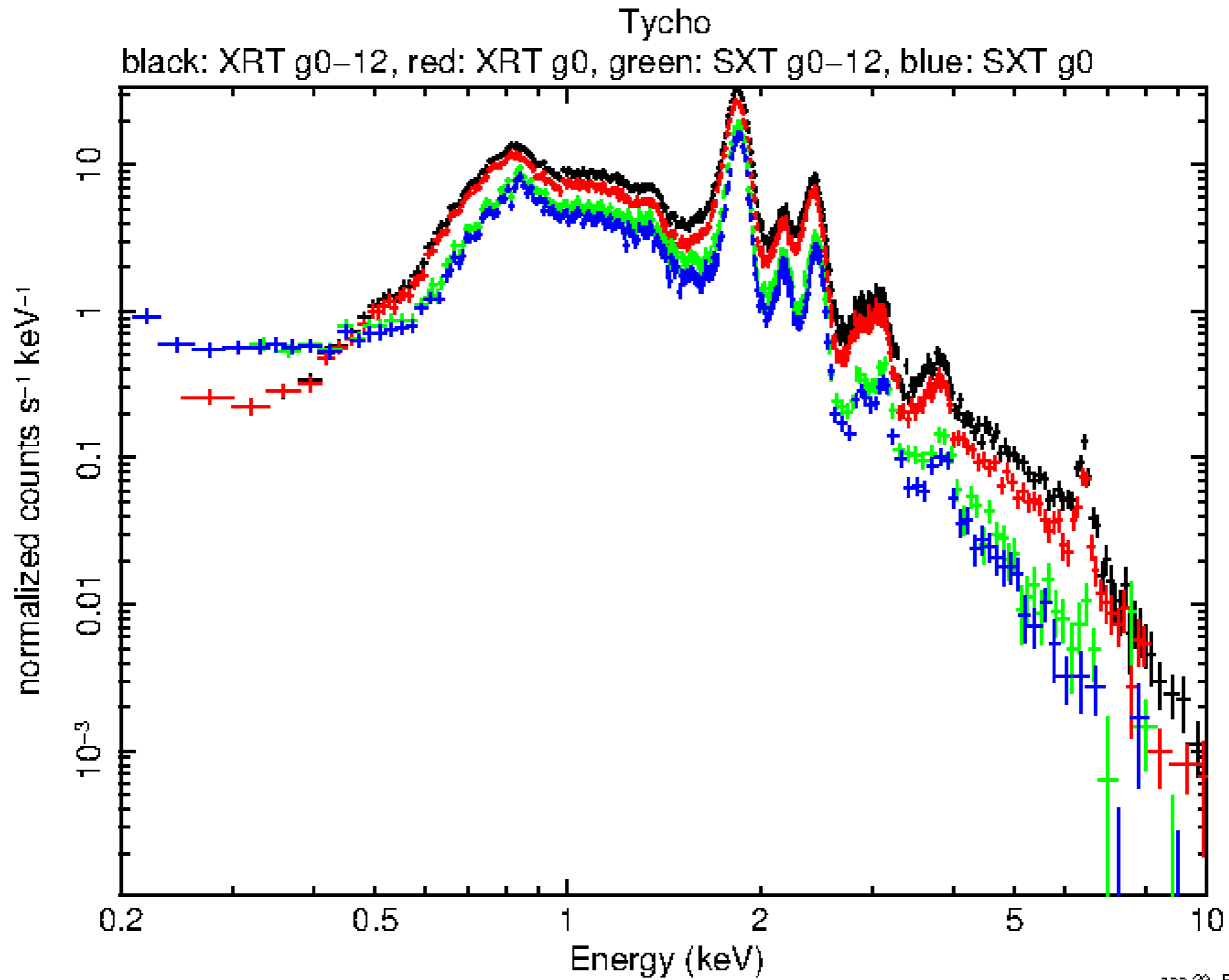
Energy shift v source count rate



- In WT mode, when the **count rate in a column goes above 5 count/s** the sacrificial charge effect becomes noticeable.
- Investigating whether we can correct for such effects – **however, sources are actually piled-up at such rates and affected columns are removed (to exclude the piled up core)**







2016 Feb 29 17:47

