The in-orbit instrumental background and ARF calibration of EP/FXT

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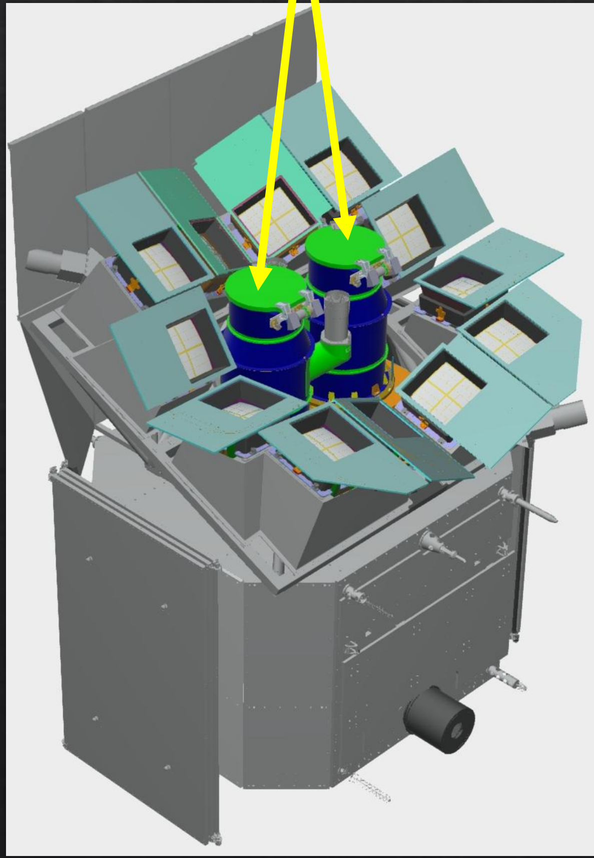
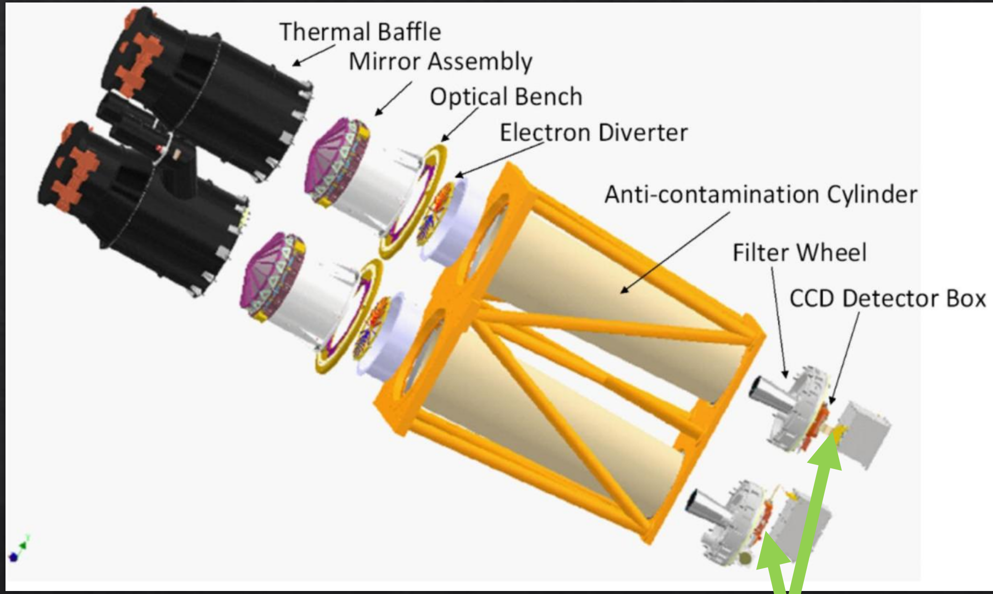
Outline

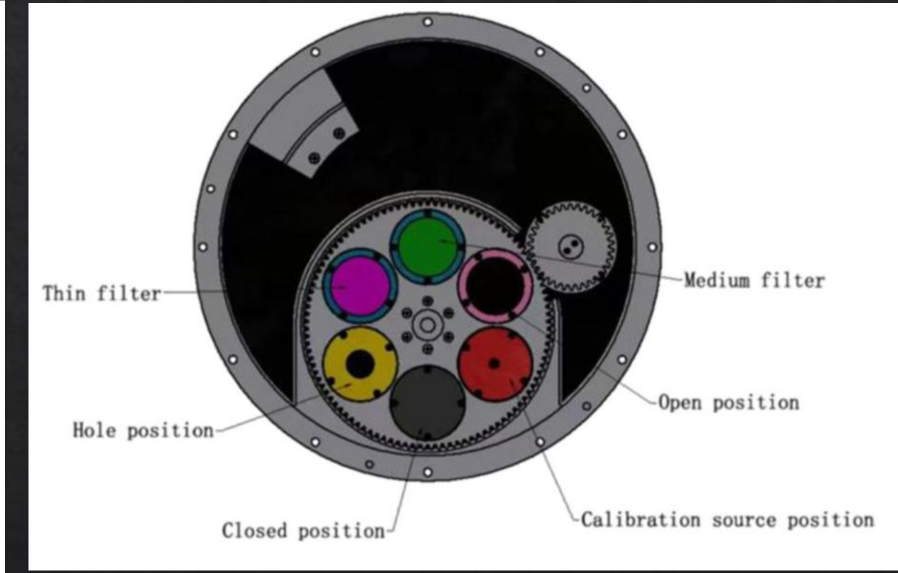
- EP/FXT
- Instrumental Background
  - Estimate modelling
- ARF Calibration
- Summary and Discussion

EP/FXT

Sunshade cover







The readout orientations of the two pnCCDs are orthogonal to each other.

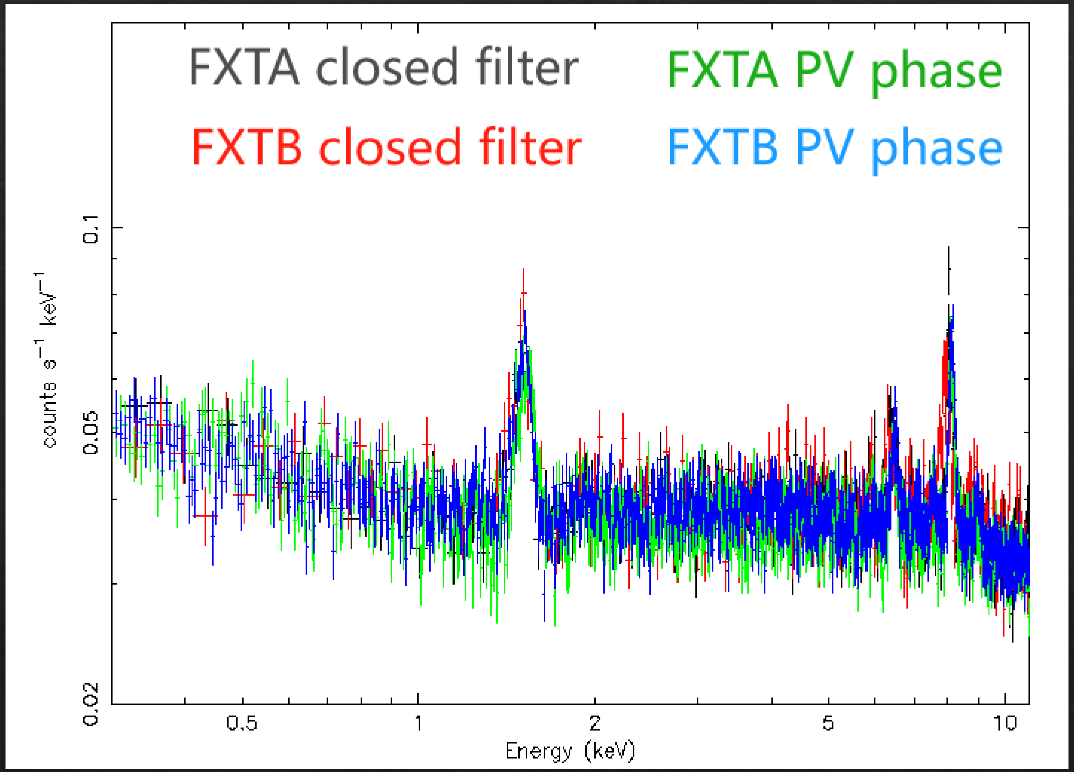
FXT in-orbit observations for the instrumental background:

① PV phase, sunshade cover closed data (SCD)

② General observations, filter wheel was placed to the closed position (FWC)

FXT instrumental background

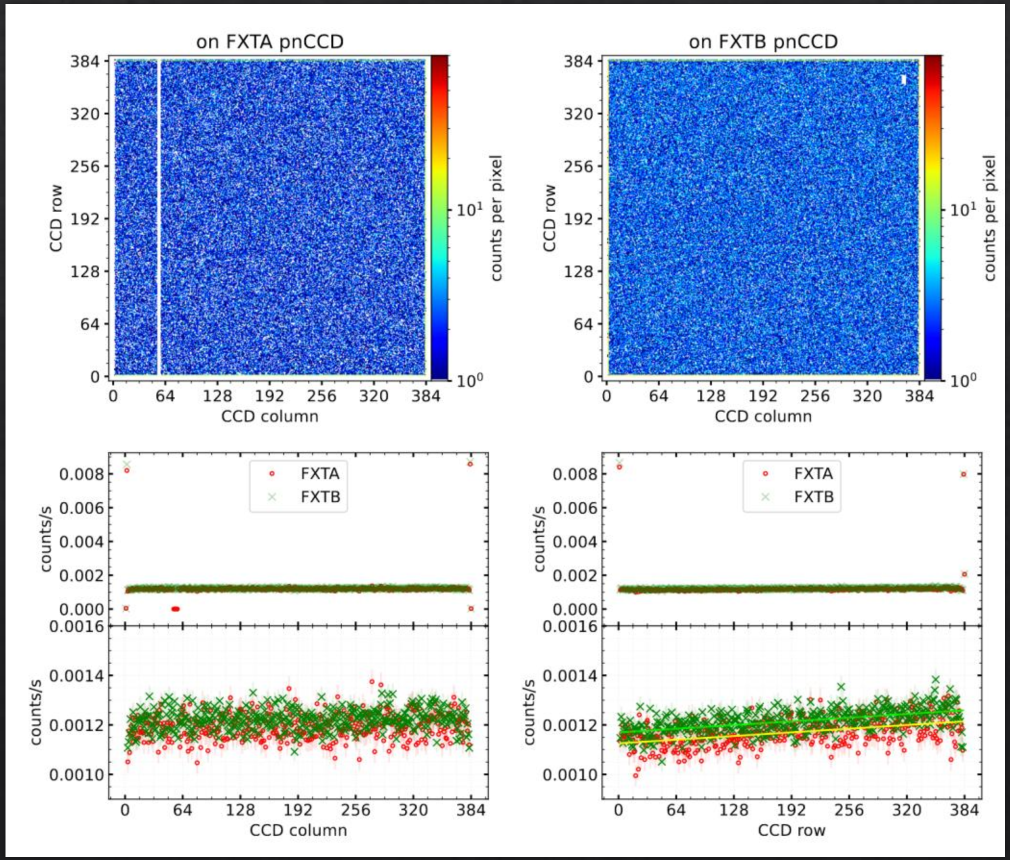
Background spectra and rates



Intrumental background rate:

- FXT × 5 ~ eRosita
- FXT obs ~ 1.2 × FXT pre-launch sim

Distribution on pnCCD pixels

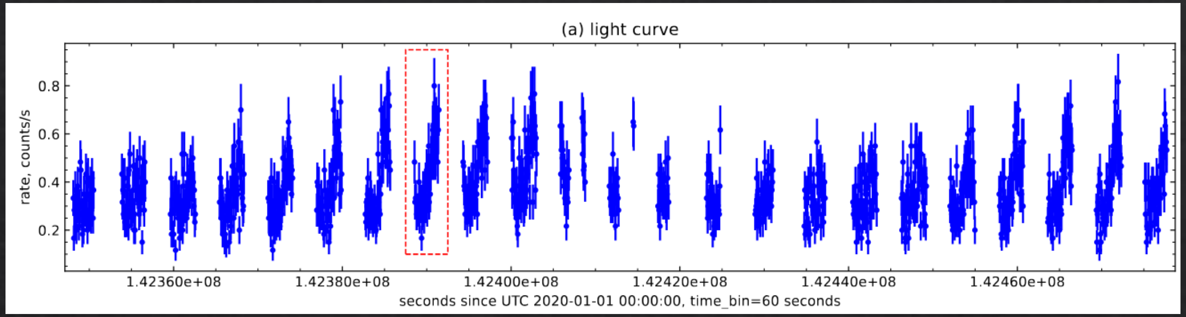


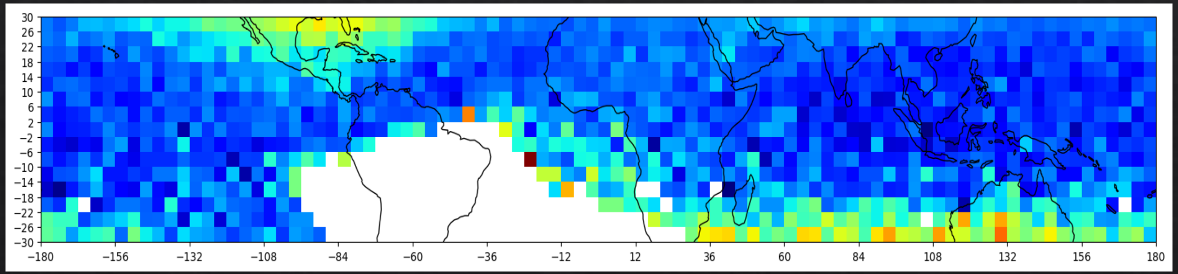
Distribution on pnCCD:

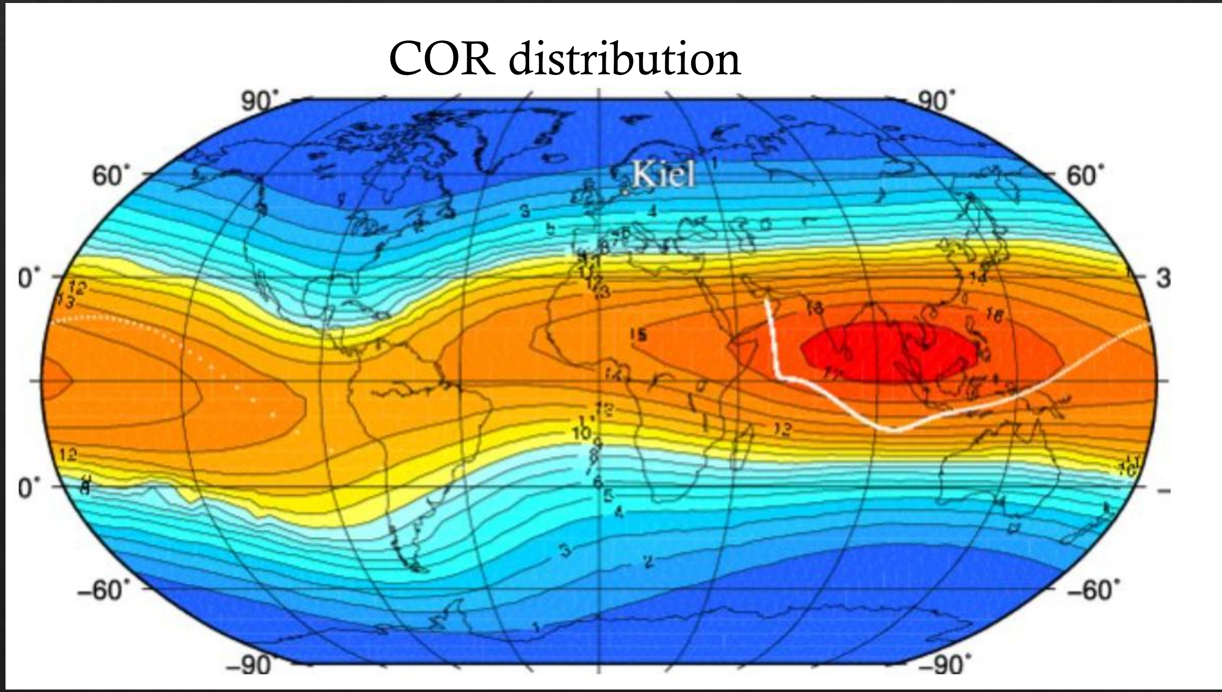
Y = a *(1+ slope *x), slope ~ 2e-4

FXT instrumental background

Instrumental background rate distributions on orbit

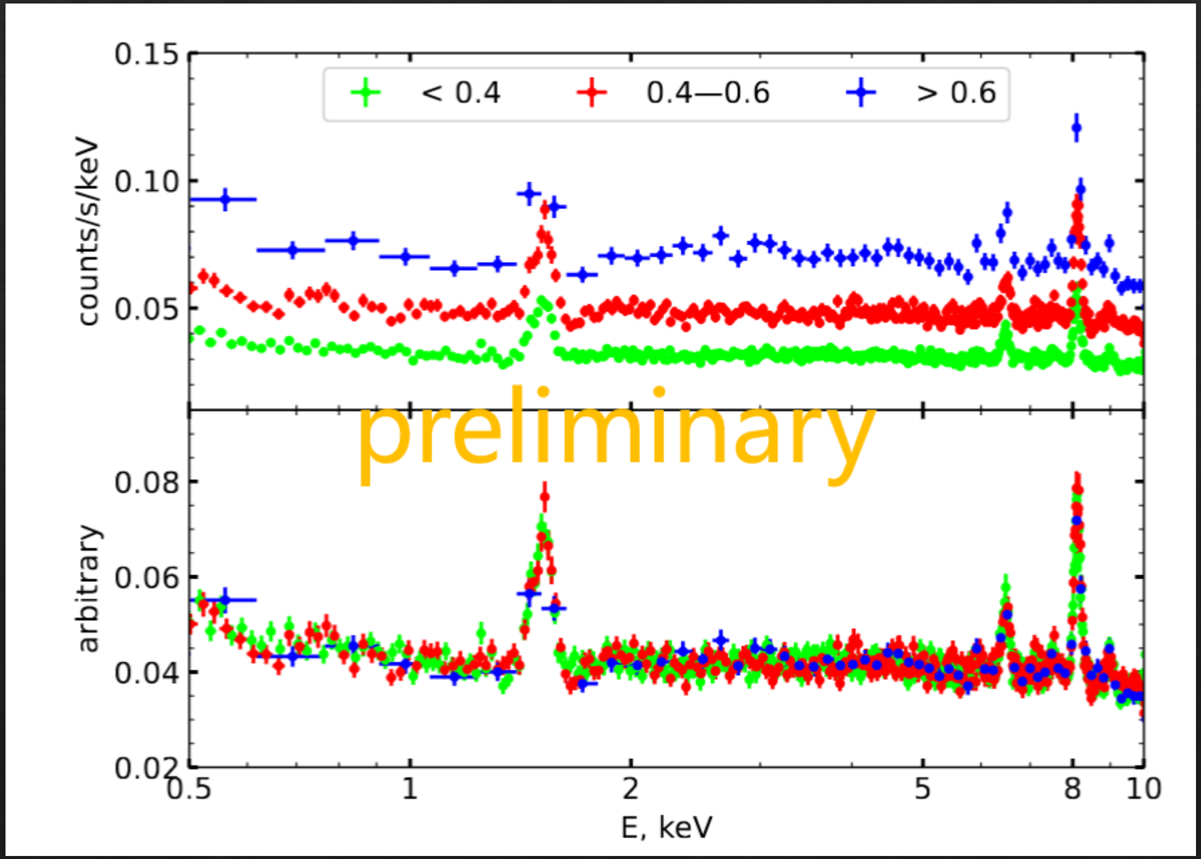






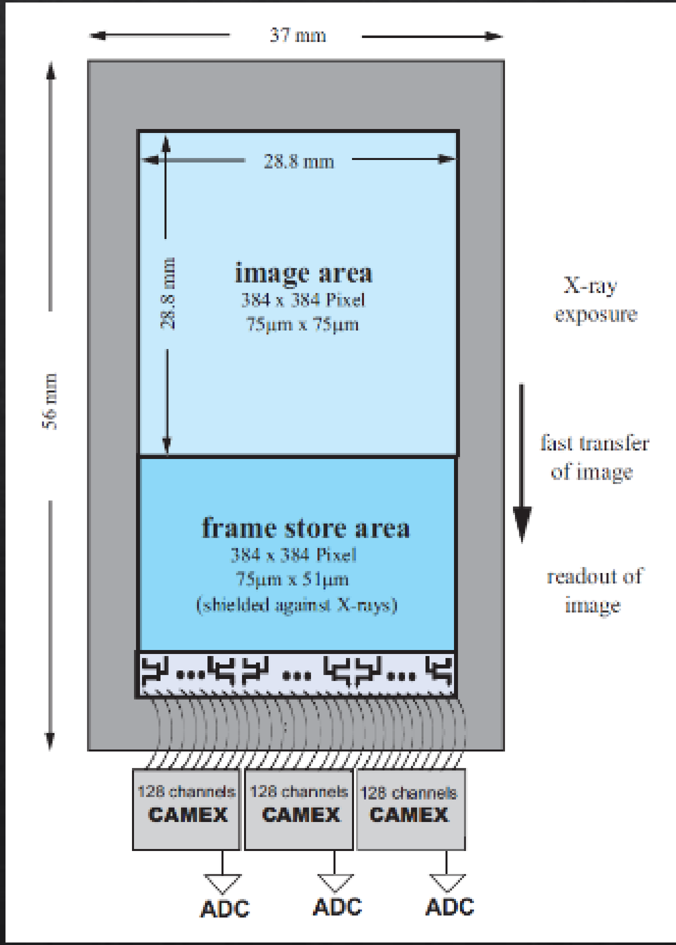
The instrumental background varies with the geomagnetic field.

FXT instrumental background

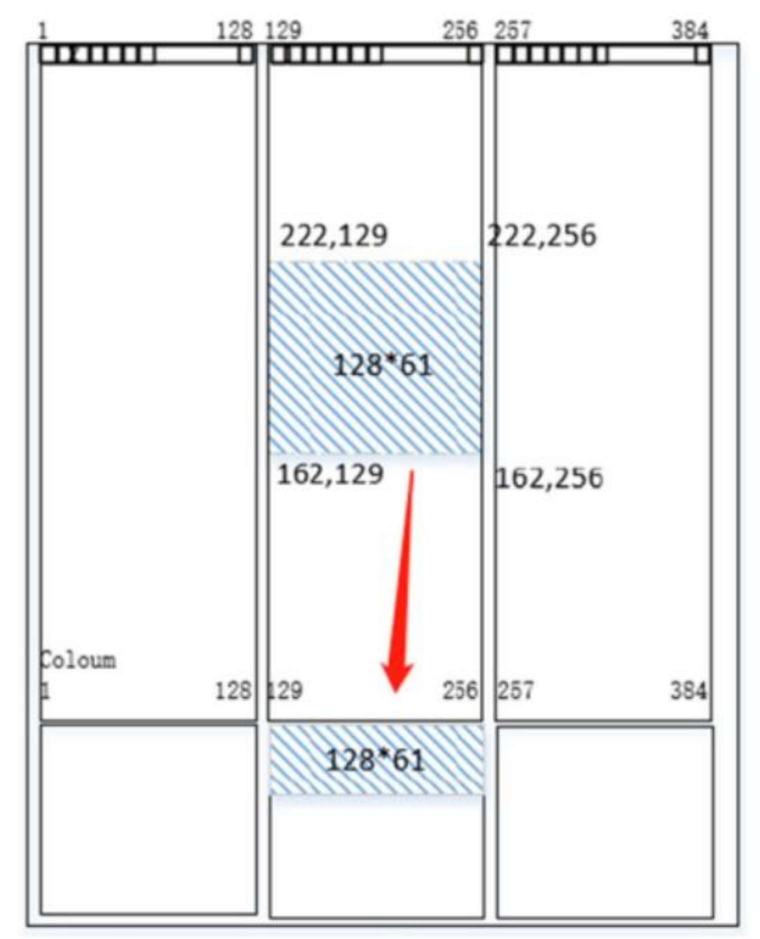


The spectral shape keeps consistent in different rate ranges

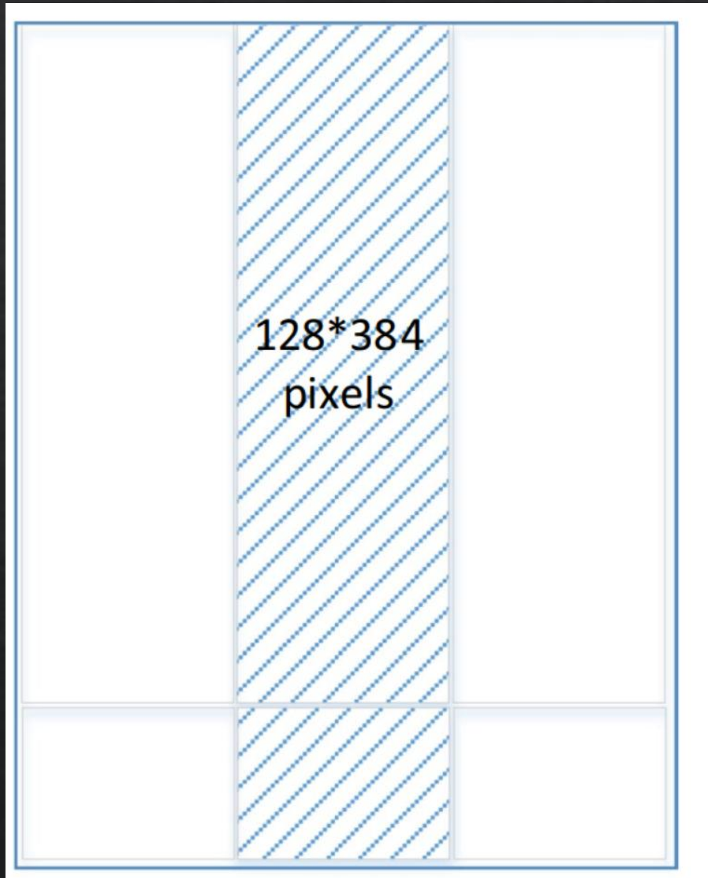
Instrumental background modelling



FF readout mode

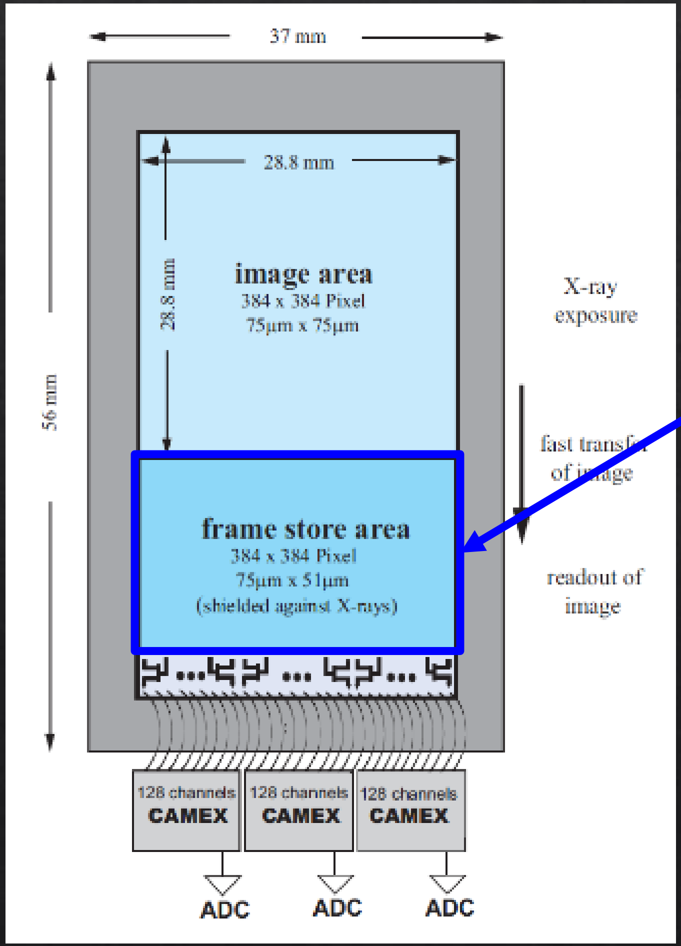


PW



TM

Instrumental background modelling

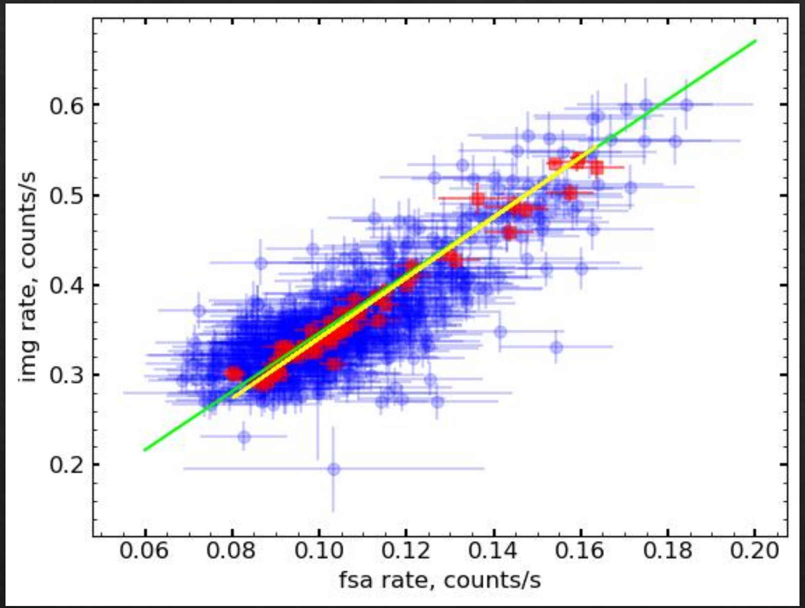


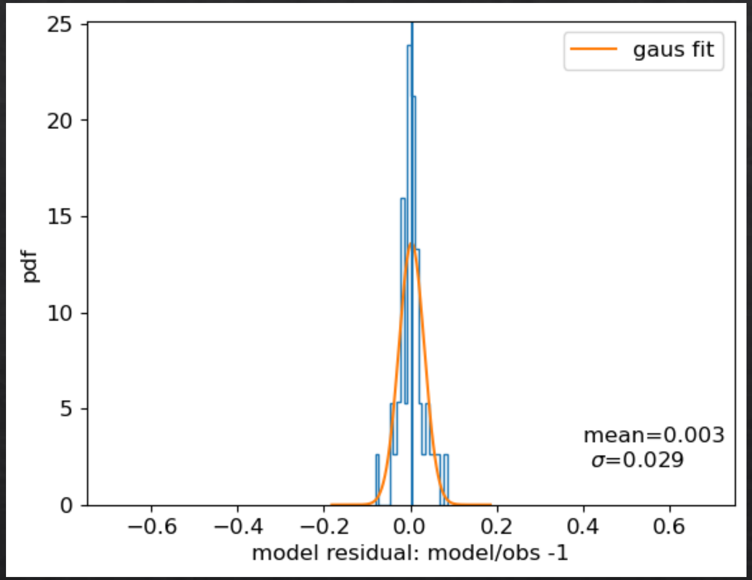
FF readout mode

FXT has an innovative design of FF: the FSA is also integrated for a time of 25 ms and read out during the IMG integration time.

Instrumental background modelling

Correlation with FSA events



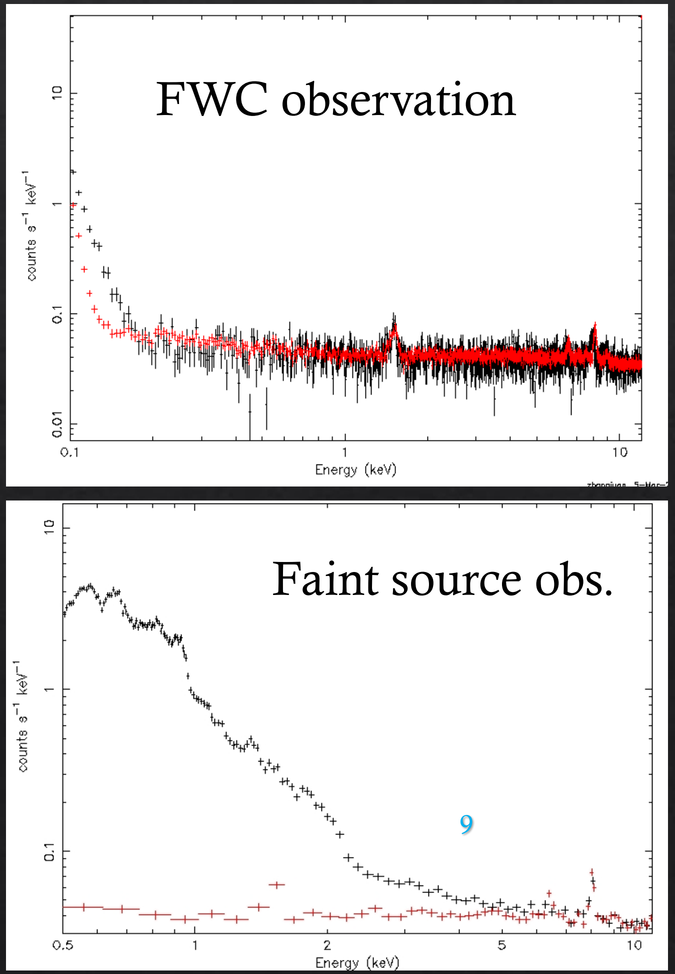


-> estimate the instrumental background modelling

$$Y = (3.2833 \pm 0.0706)X + (0.0126 \pm 0.0075)$$

Error~3%

Validation

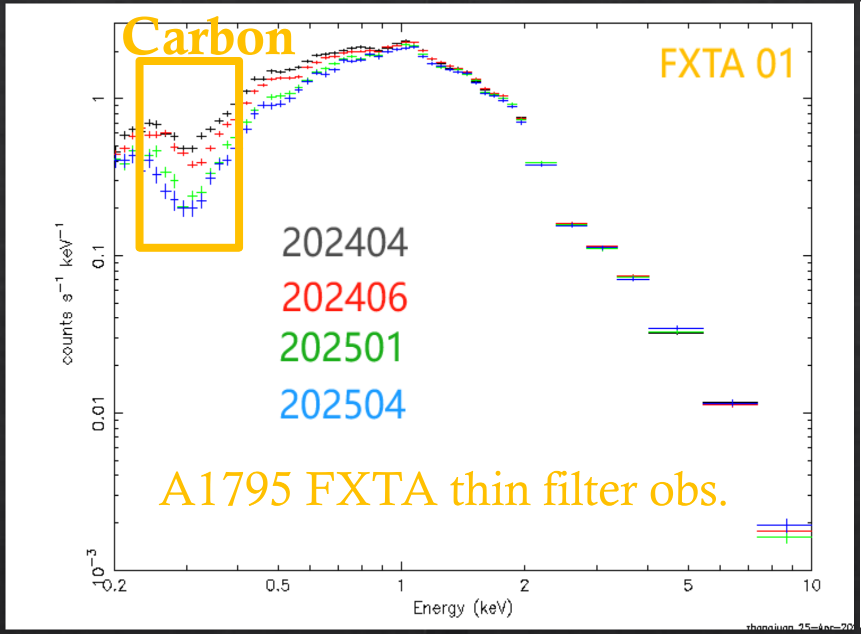


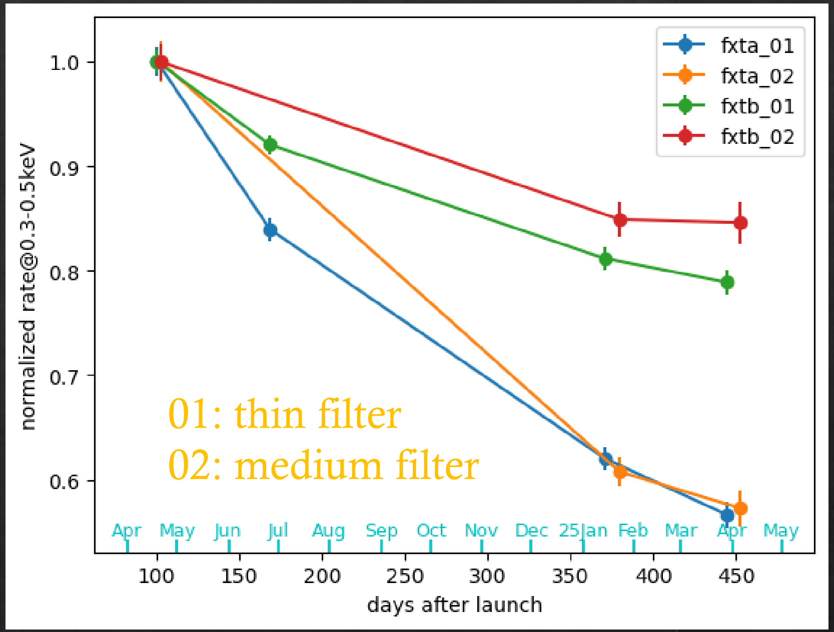
ARF calibration

In-orbit obs. Include:

- A1795
- RX J1856
- G21.5
- 3C 273
- etc.

Contamination in ARF !





Temporal decline in FXTA and FXTB follows separate trends,
thin and medium filters exhibit similar behaviors within each module

⇒ is unlikely to be dominantly located on the filters themselves

⇒ More likely on a shared component? Detector??

ARF calibration

Calibration methods:

ARF recalibration performed as the final step in CALDB update, after bore-sight correction, vignetting adjustments, and E-C refinement, etc.

①

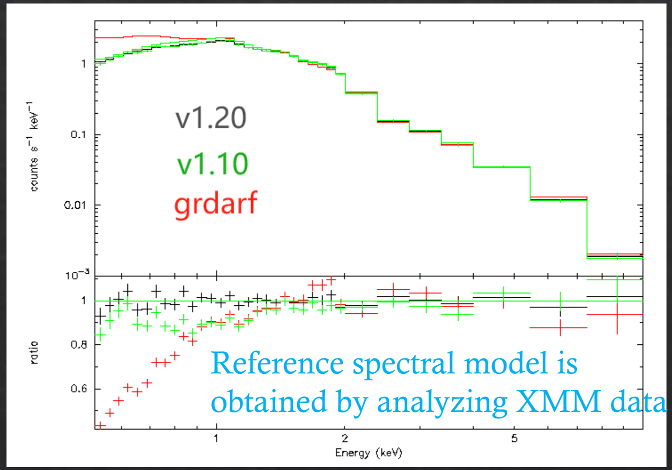
$$N(PI) = \int \boldsymbol{S(E)} * \boldsymbol{f(E)} * ARF(E) * RMF(E, PI)dE$$

$$ARF_{update}(E) = \boldsymbol{f(E)} * \boldsymbol{ARF(E)}.$$

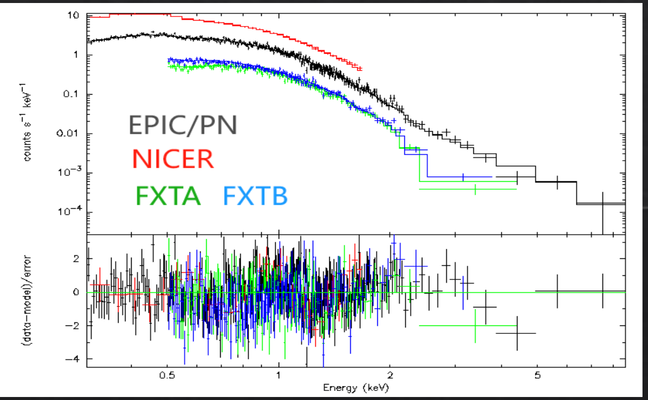
②

Unfolded ratio iteration

- Adjusted ARF based on A1795 obs., which covers FXT energy range

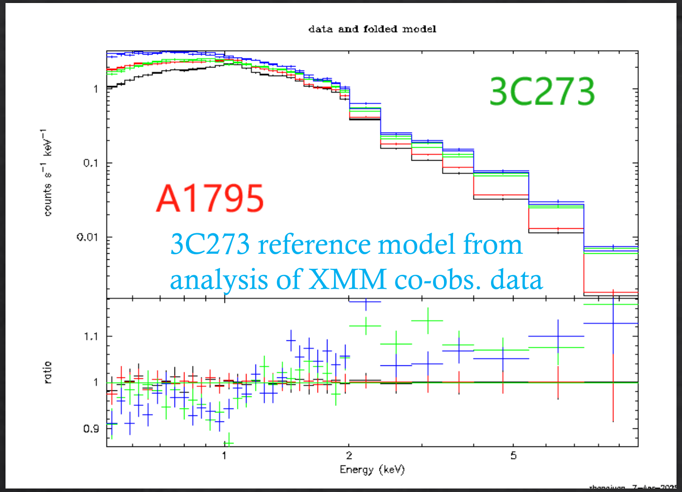


- Updated ARF works well, e.g. for EP240222a

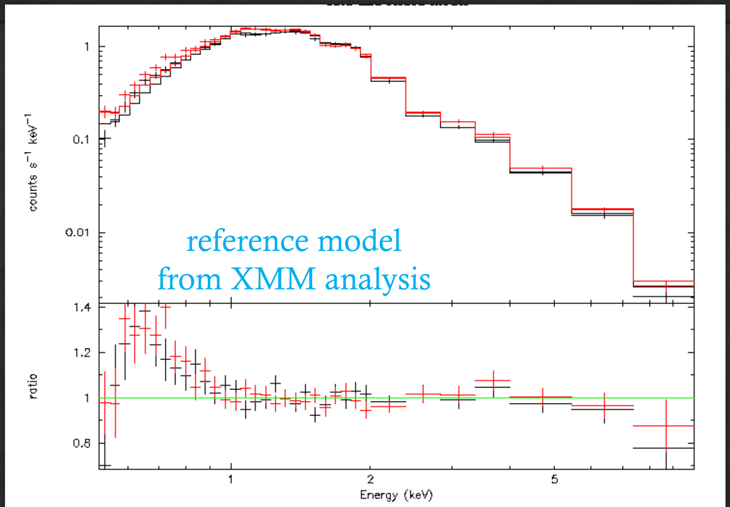


ARF calibration issues

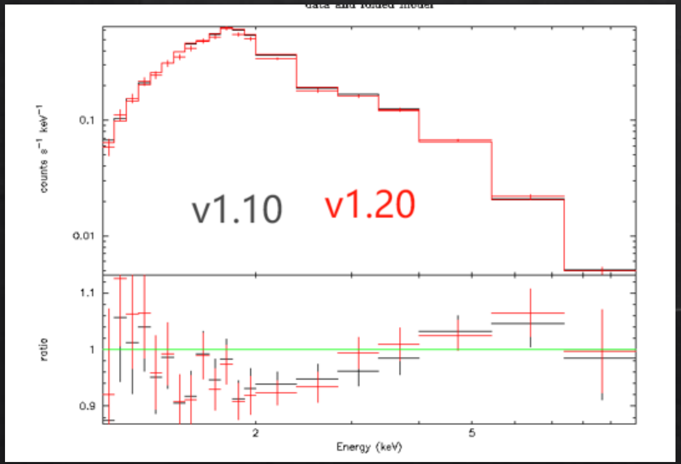
in 3C 273



in A478

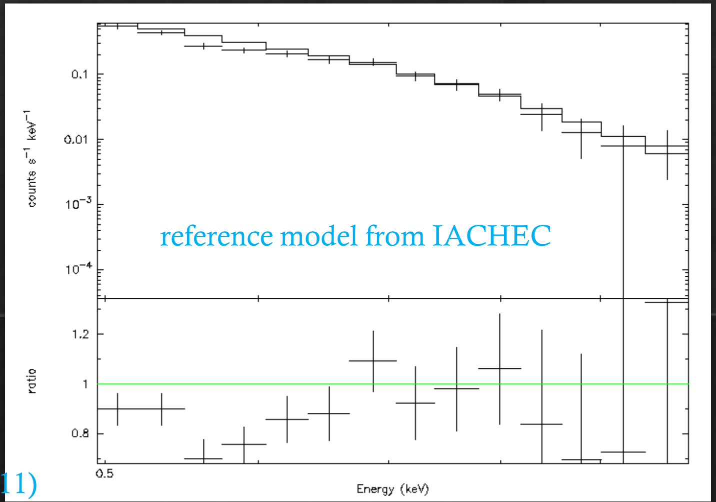


in G21.5



reference model from Tsujimoto et al., A&A525, A25(2011)

in RXJ1856



- ☐ Residuals:

<1 keV :

- 3C 273 & 1856: model < Observation
- A478: model> Observations

>2 keV:

- 3C 273 & G21.5: nearly opposite residual trends

- ☐ Cause of Discrepancies:

The origin of these residuals remains undetermined but may arise from:

- Reference spectral model for extended srcs like A1795 and A478??
- Limitations in the generated arf accuracy considering the psf and vignetting calibration??
- Rmf??

Summary and Discussion

- Measured Instrumental Background
  - Provide a model to estimate the instrumental background
- ARF
  - Calibrated based on A1795 obs.
  - Different residual structures exist for certain sources:
    - What causes these residuals?
    - Are they due to the reference model or analysis procedure?
    - Do other factors affect observation-model agreement in different way for different sources?

Thanks for your attention!

Comments and suggestions are welcome