O. Limousin et al.

CEA Astrophysics Division

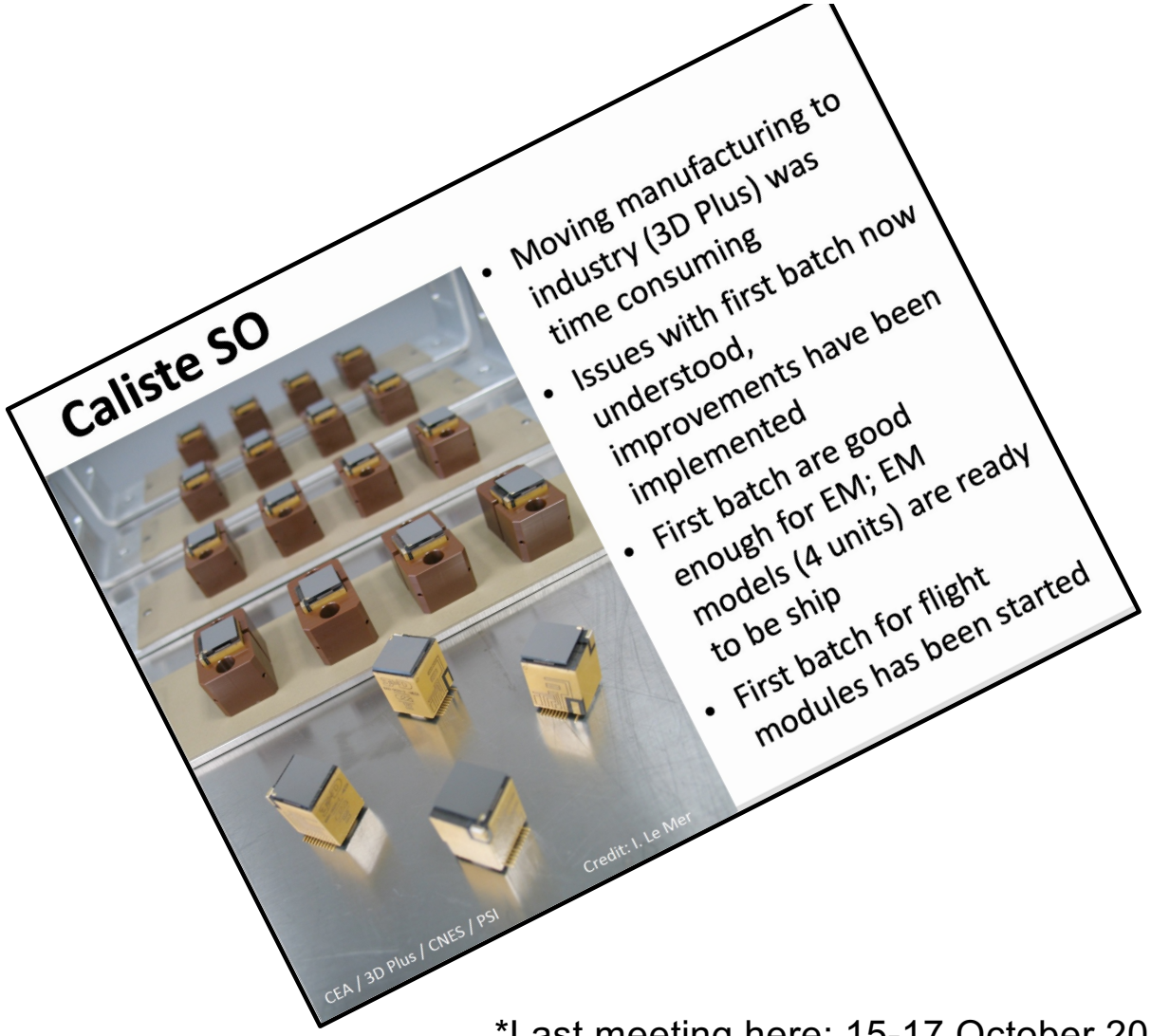
STIX Team Meeting,

Wroclaw, November 07 2023

Detector update

SUMMARY

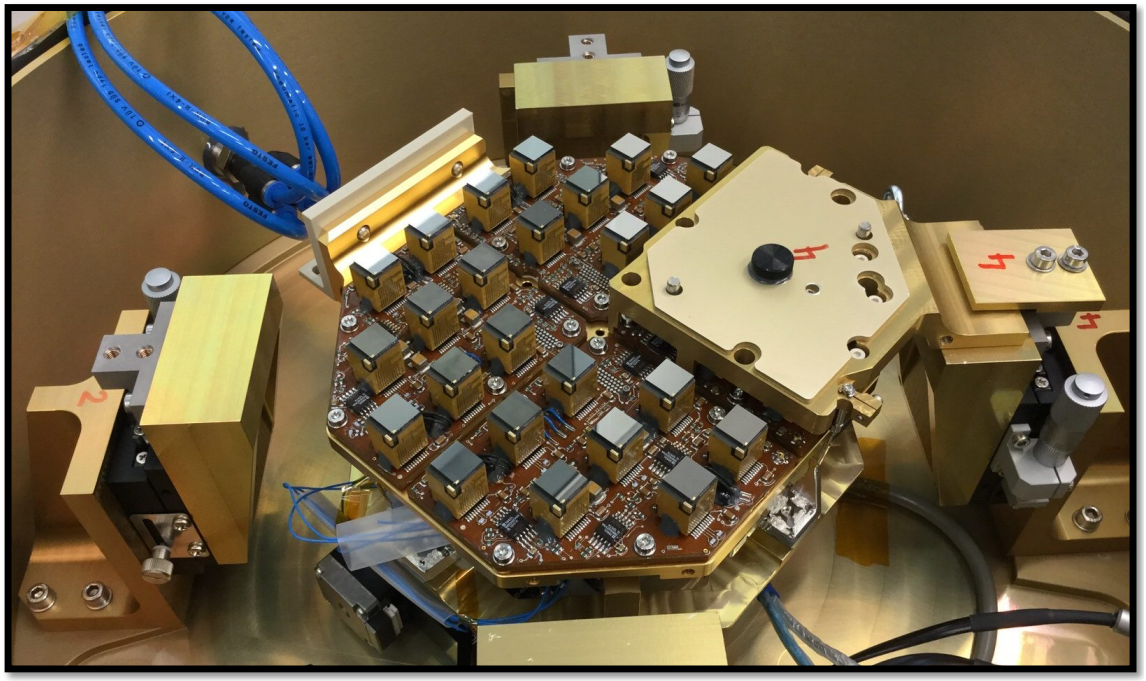
- Detector status and performances
- Dead Time / Zombie Time
- Take home message



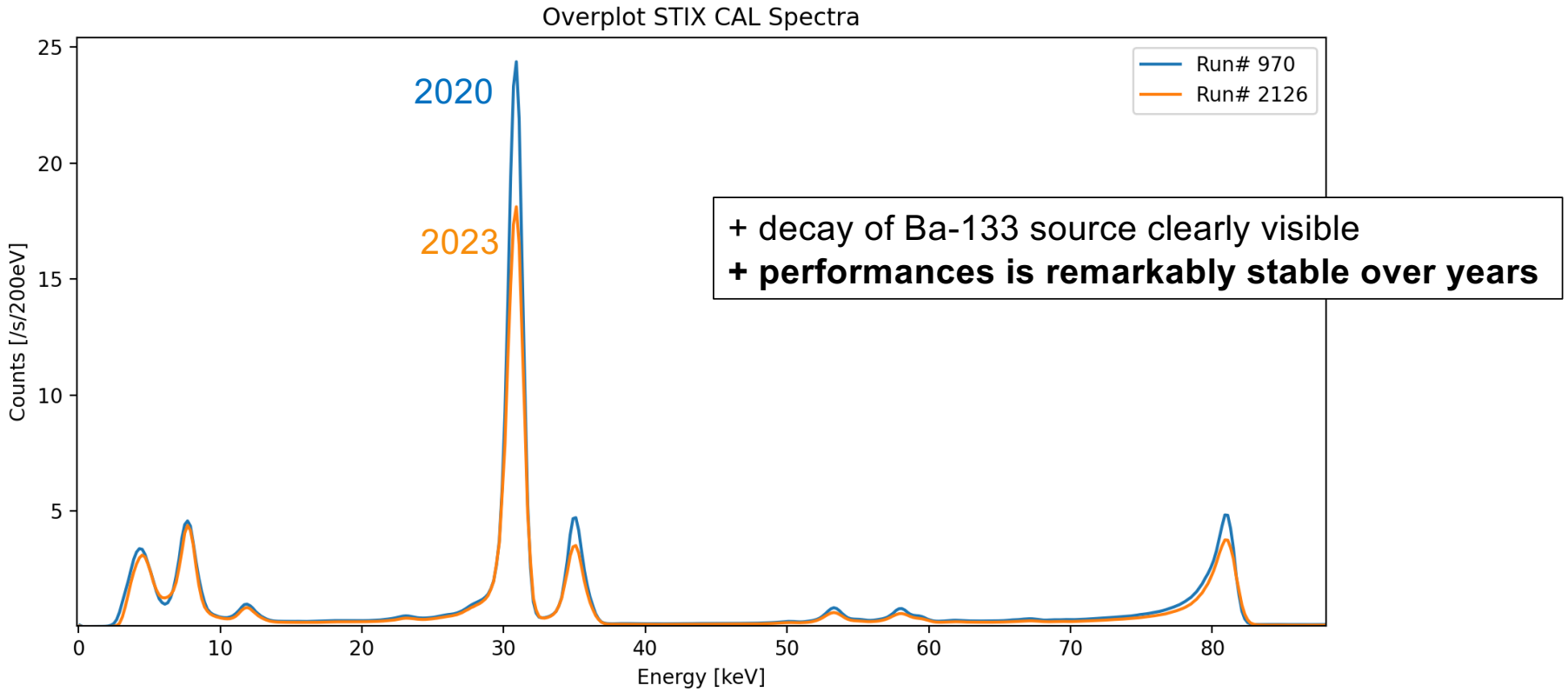
*Last meeting here: 15-17 October 2013
From Säm's status report

FACT SHEET

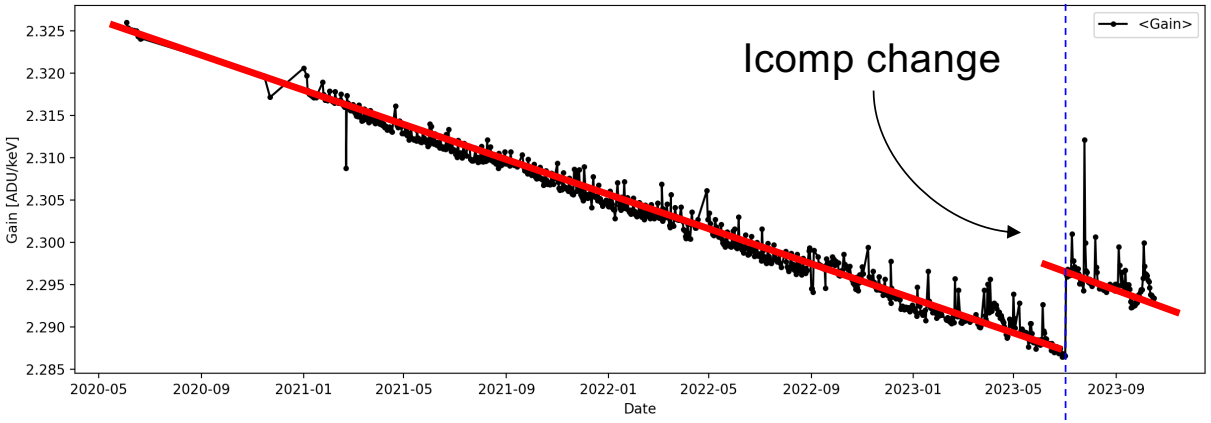
- 100% pixels good
- Low threshold 3.2 keV for all channels
- No change in HV settings
- Recent change in Icomp
- Detector stable in time
- Progressive aging of the detectors
- Ba-133 decay, lower background

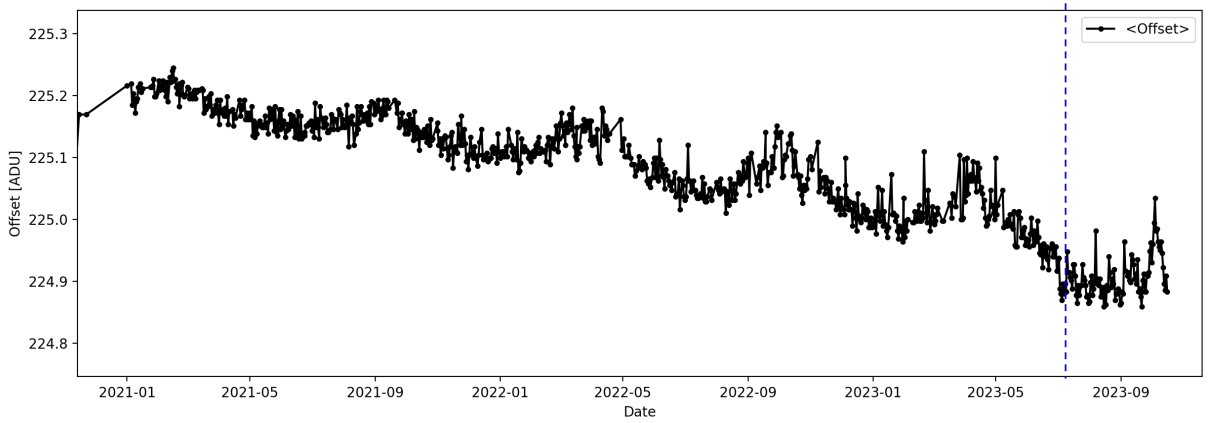


Detector performances in flight at t0+3yrs



Gain and Offset shift over time

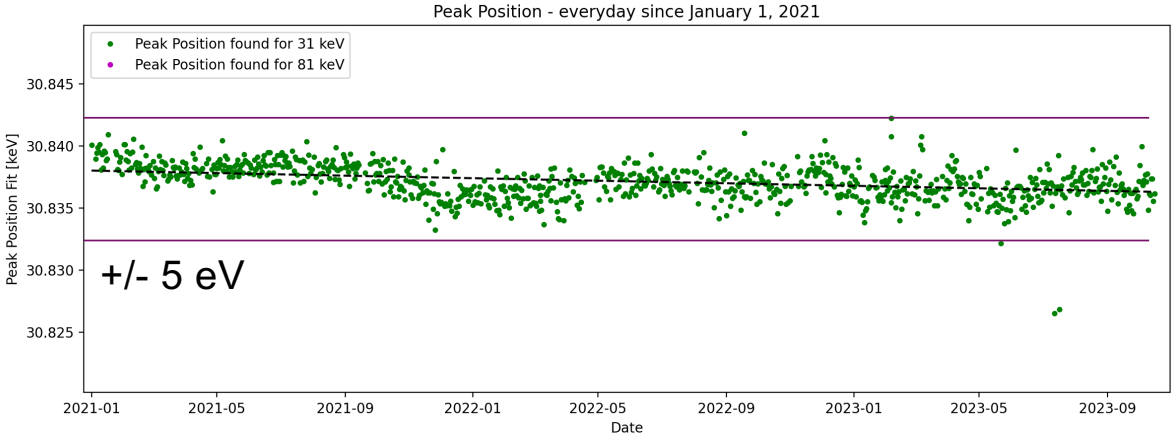


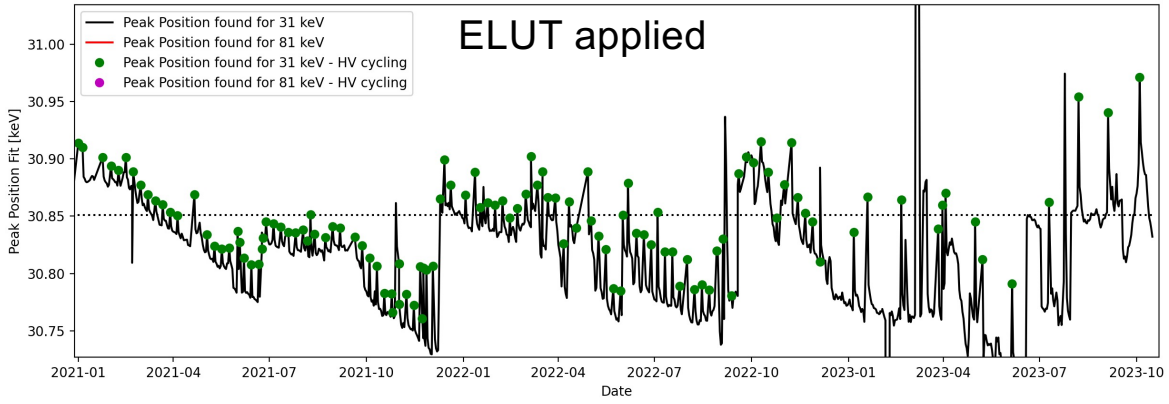


- Gain shifts with 2 components
  - **~0.6 % per year**
  - Radiation damage (CdTe)
  - Longer HV reset does not seem to change this rate

- Offset remarkable stable
  - **0.2 ADU peak-to-peak**
  - ~0.06% variation
  - Baseline holder
  - Anti-correlate with Sun-SC distance

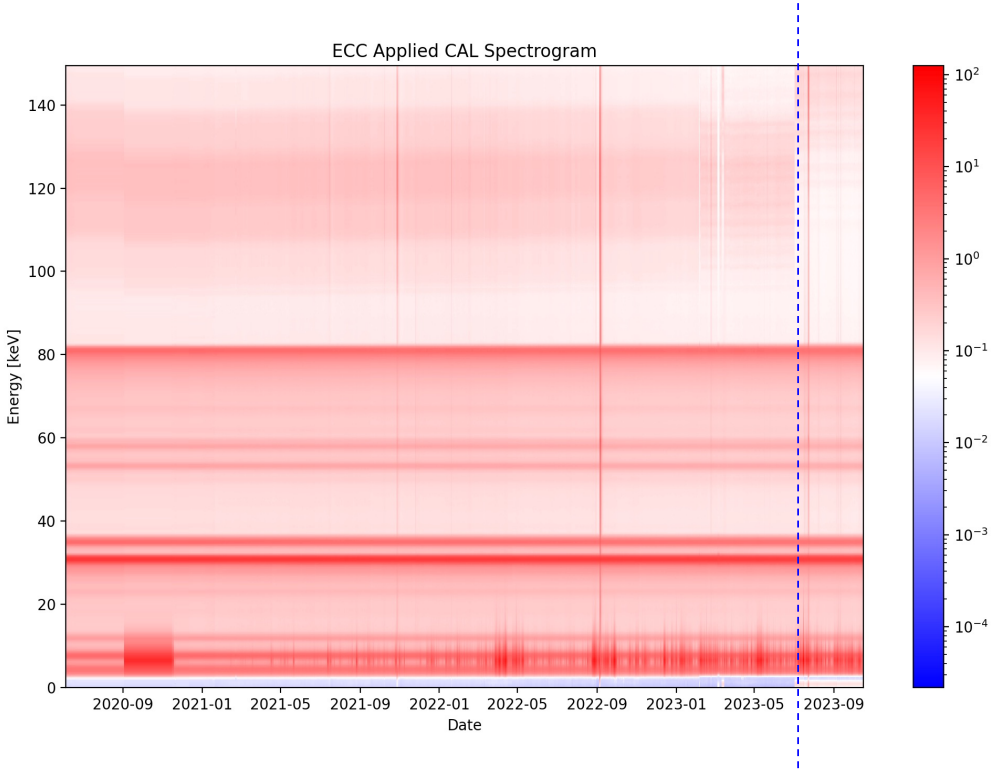
ELUT

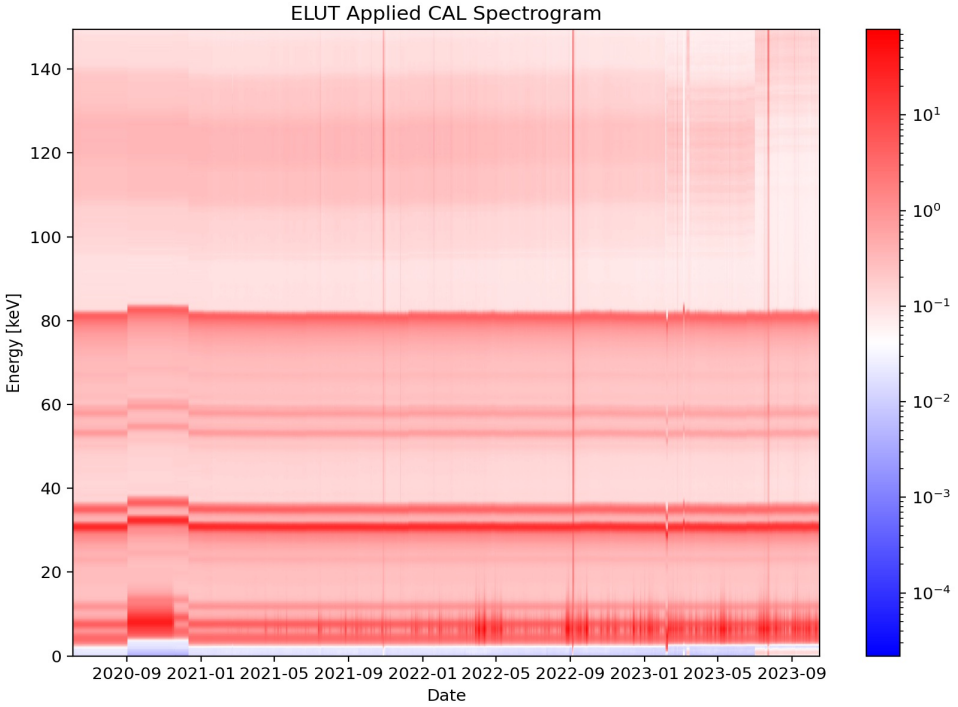




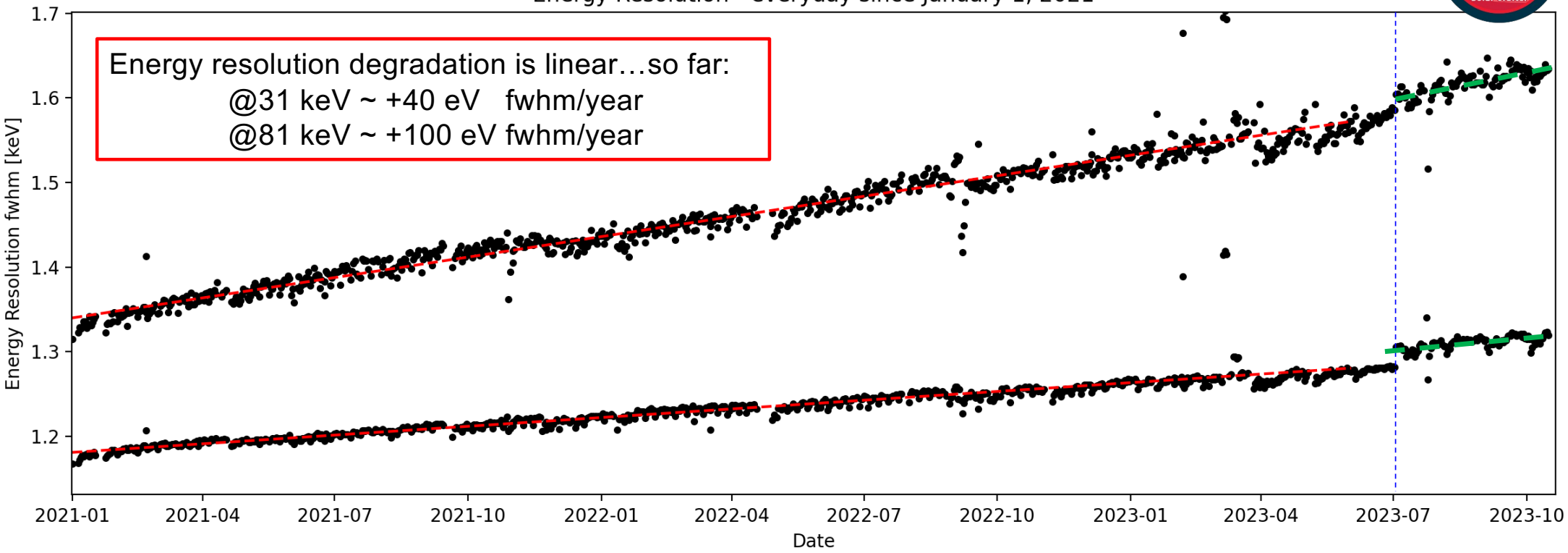
- Calibration spectra daily from each pixel
- ECC-AMR method
- A new ELUT is generated ~6 months
- Could be ~3 months. More change recently with fine binning and Icomp change
- **We are currently at ELUT#11**

Detector Calibration accuracy over time





Energy resolution



Energy resolution degradation is linear…since icomp is set to 2:
@31 keV ~ +64 eV fwhm/year
@81 keV ~ +110 eV fwhm/year

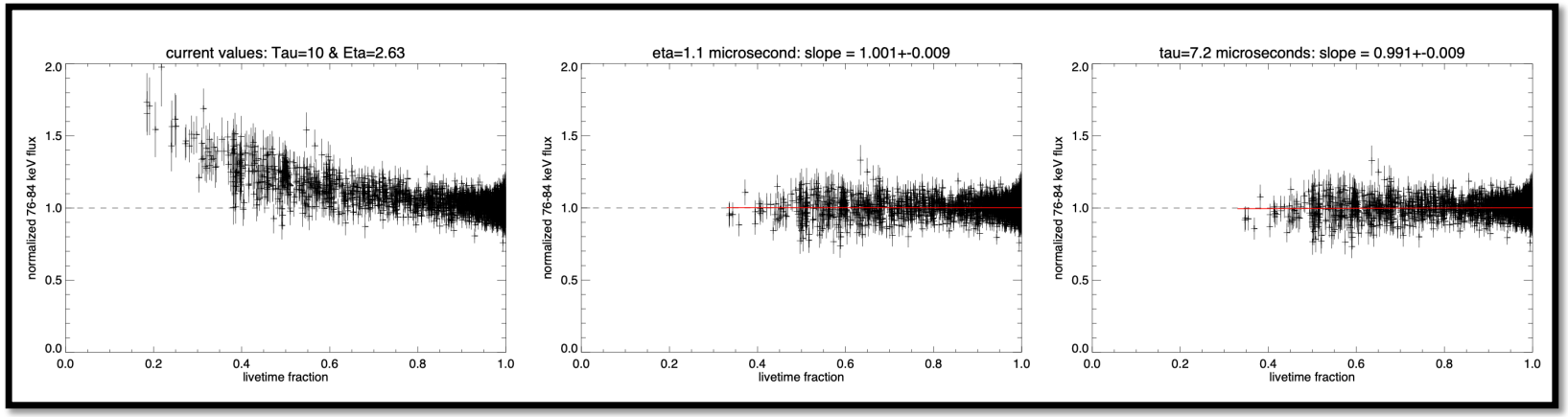
LOW THRESHOLD VALUE

- Earlier in the mission
  - **Energy resolution corresponds to ~100 e^- rms of noise**
  - Low threshold set to 3.2 keV ➔ 7 sigma of the noise [3200/(4.42*100)]
  - The noise at low energy rises by ~4 e^- rms

- Now with icomp 2
  - **Energy resolution corresponds to ~125 e^- rms of noise** (at low energy)
  - Low threshold set to 3.2 keV ➔ 5.8 sigma of the noise [3200/(4.42*125)]
  - The noise at low energy rises by ~6.2 e^- rms

We might have to increase the threshold when the noise at 31 keV will be ~150 e^- rms, this will be in about 2 to 4 years … will see, not scary.

DEAD TIME RECONSTRUCTION



- Live-time correction on STIX science data reveals that deadtime is shorter than expected, in case of high count rates.
- This is calculated correcting lifetime on different dataset and making sure the Ba-133 lines remain stable in flux after correction

DEAD TIME RECONSTRUCTION

- What's new:
  - From a design and electronics point of view, everything is precisely as expected - Extensively checked and re-measured on ground
  - From a phenomenological point of view: we know why the effective dead time is actually shorter than expected
  - We have a simulation running

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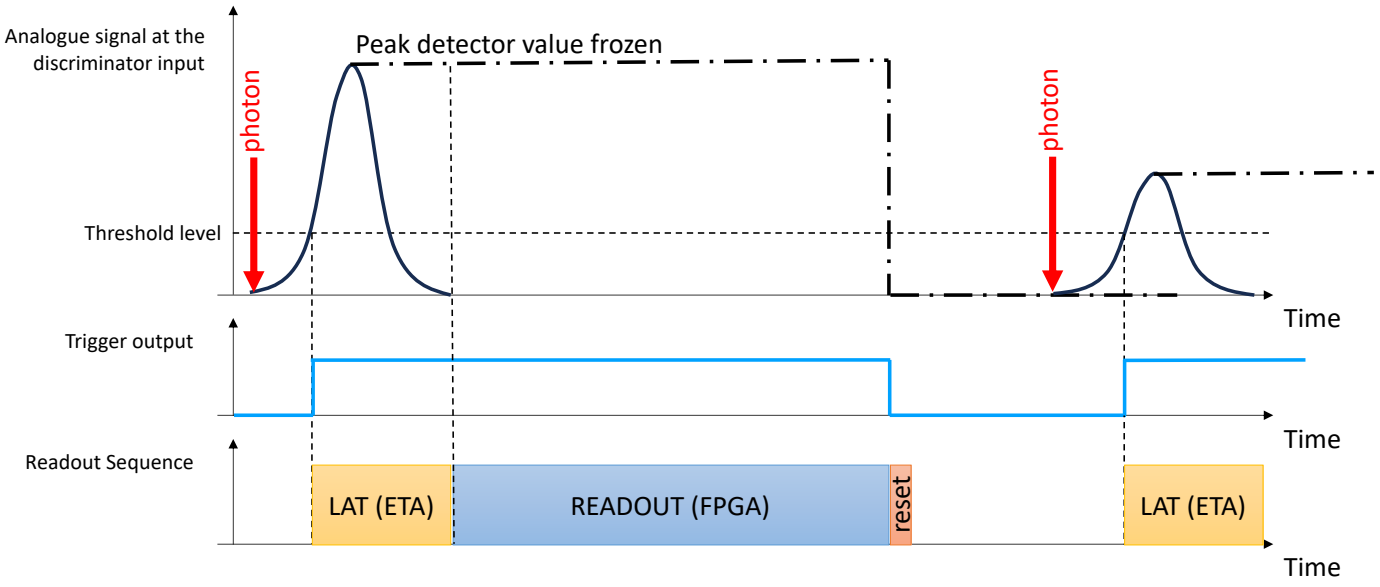

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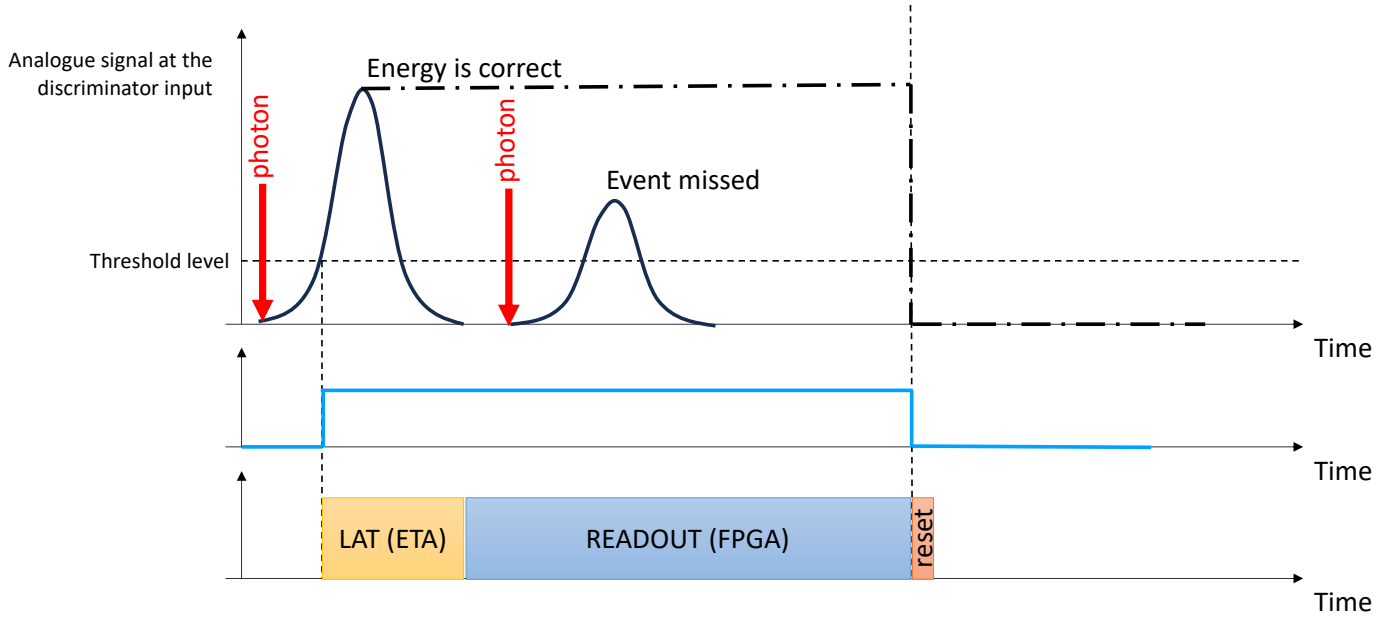

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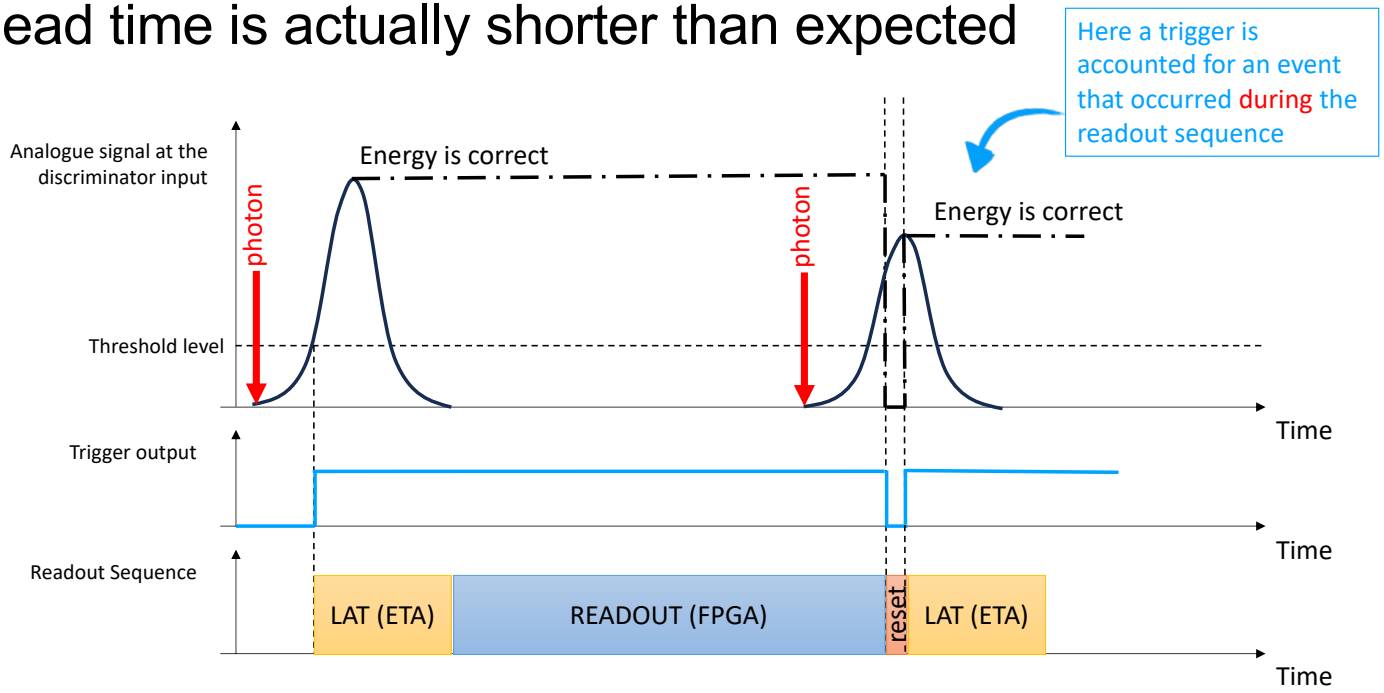

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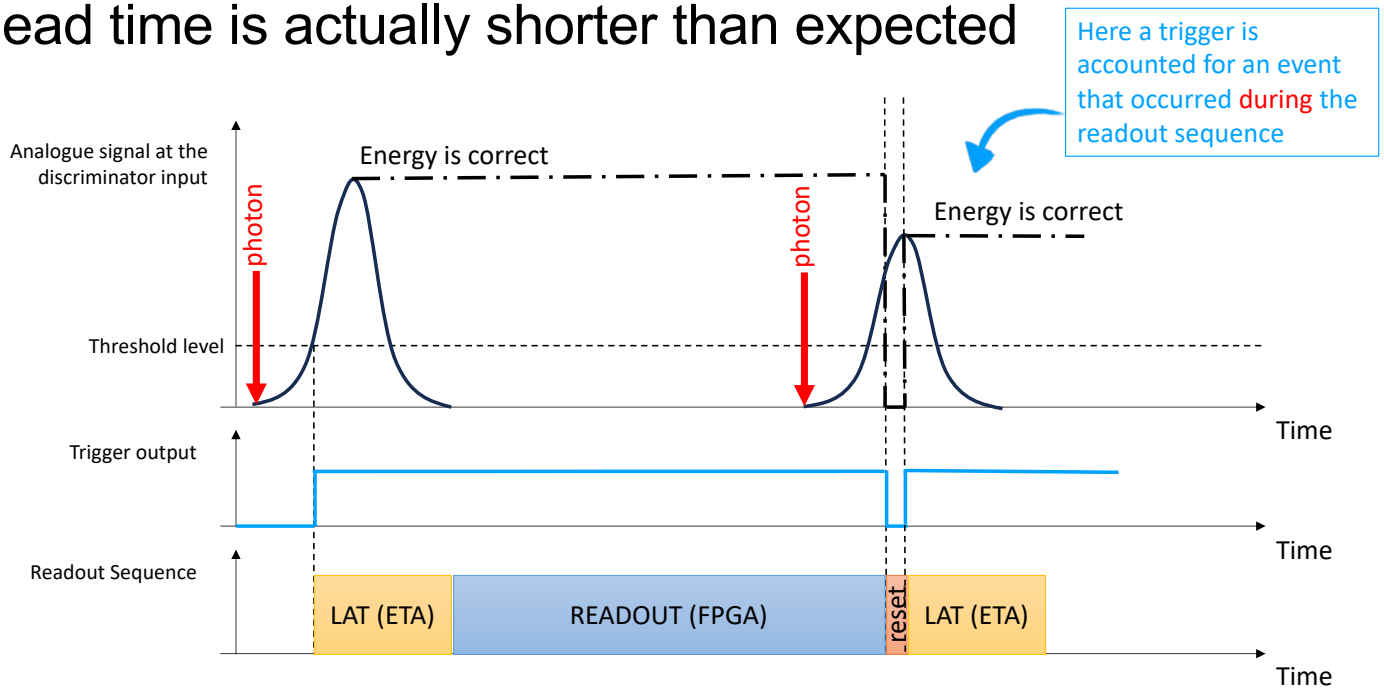
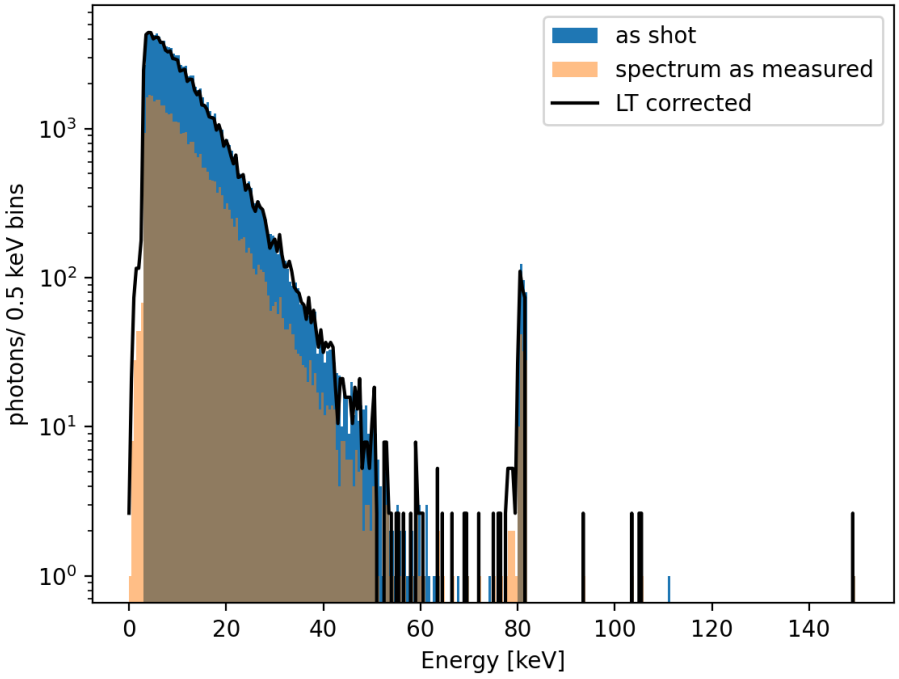


DEAD TIME RECONSTRUCTION

- What do we learn from the simulations in short:
  - The effective deadtime nicely allows to correct for deadtime (TBC)
  - The effective dead time is rate and energy dependent
  - I think from the spectral distribution and the group trigger rates, the dead time can be assessed
    - **Having a single set of parameters ETA/TAU is probably not enough to fix the dead time correction accurately for ever.**

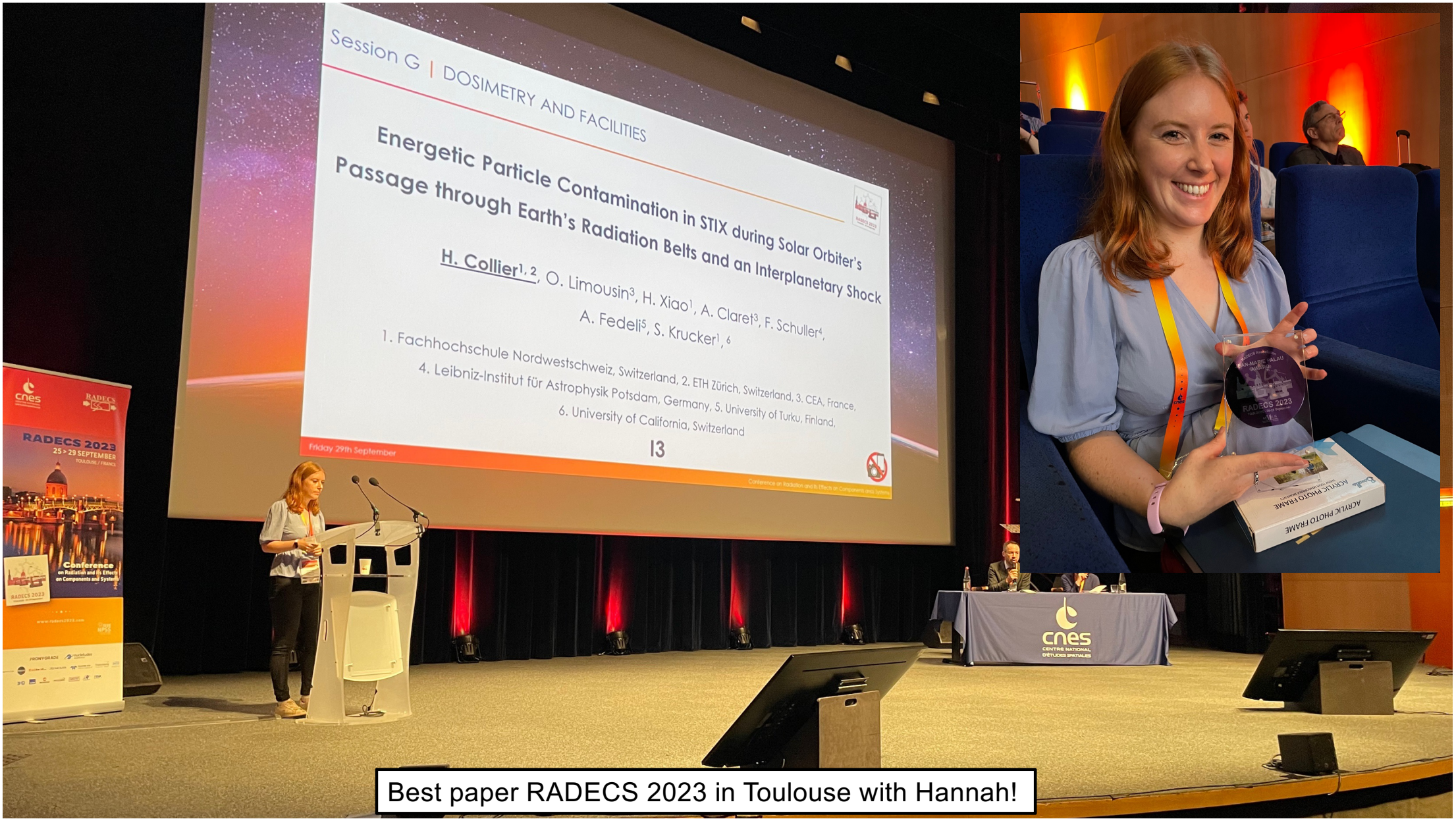
Example for 1E5 cts/s/group



TAKE HOME MESSAGE

- **Caliste-SO is working very well in STIX**
  - Change in depolarization period looks good (1 month / 20 minutes instead of 1 week / 5 minutes)
  - ICOMP 2 (more current in the preamplifier) is successful to push the bump out of STIX range
  - Naturally, the noise is a bit higher as expected
  - The threshold should be kept as low as 3.2 keV for another 2 to 4 years of operations
  - ELUT has to be continuously monitored and updated, ~3 months

- **Know issues, still some work to do for the detector group …**
  - Bump is now understood
  - Temperature oscillation related corrections still to be worked out
  - Dead time corrections still in progress with Zombie effect
  - SEP X-ray corrections to be tested and implemented



Best paper RADECS 2023 in Toulouse with Hannah!