



IBIS

F. Lebrun, CEA-Saclay, SAp



IBIS overall status

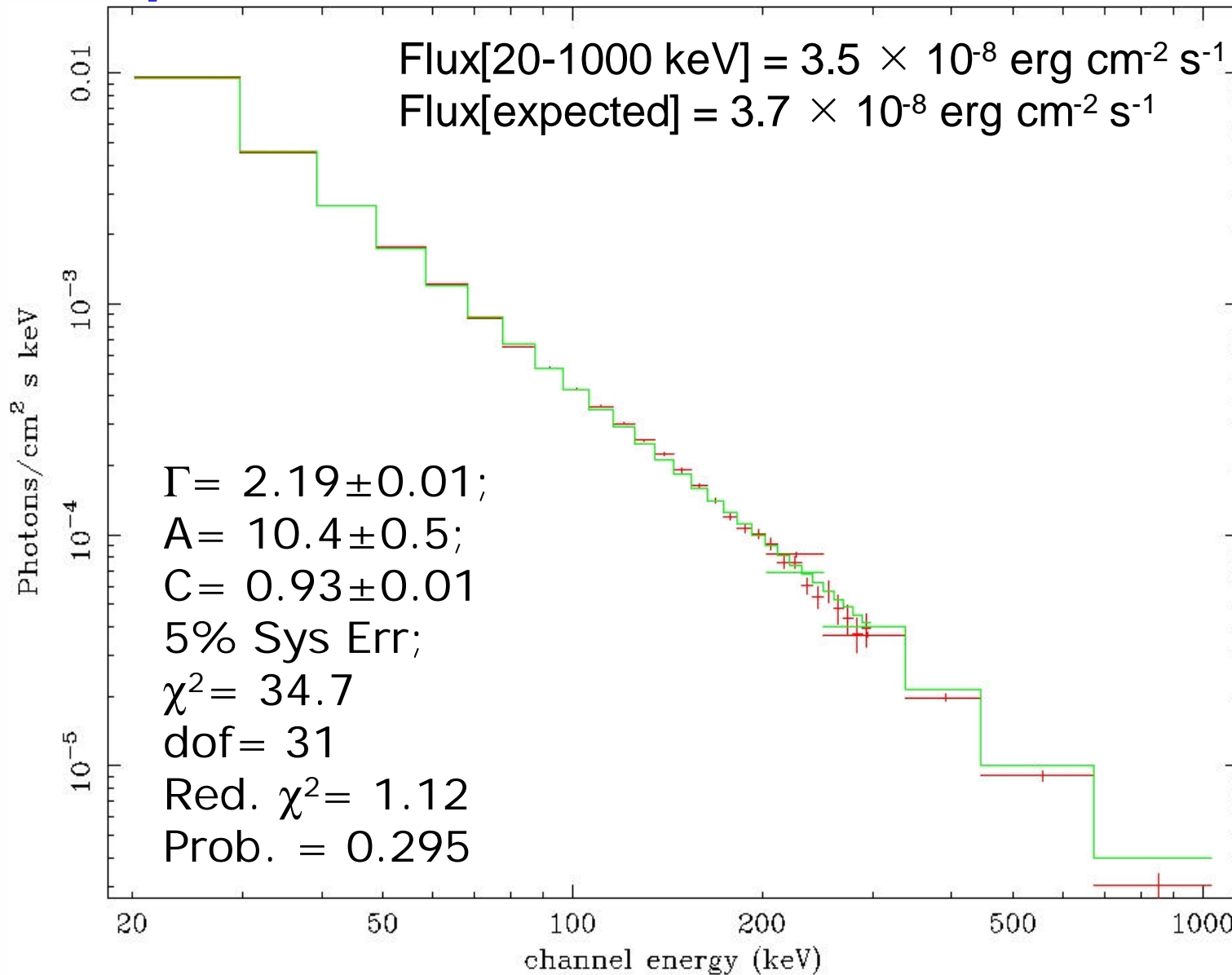
- The hardware is fine: no significant failure no significant evolution
- Background is increasing (decreasing solar activity) but has an overall limited effect on telemetry requirements:
 - No need to increase PICsIT TM allocation (histograms)
 - ISGRI TM need increases as ~ 0.5 background increase (celestial BKG \sim internal BKG)
- The PICsIT software and calibration have been strongly improved (see L. Foschini talk)
 - ARF
 - RMF
 - Mosaics
 - Multiple interactions
- Heavy work on the ISGRI calibration and software:
 - Background structures
 - LUT2
 - Pixel low thresholds
 - ARF (low energy sensitivity)
 - Spectral calibration
 - Dead time
 - Uniformity
 - Lower rise-time threshold



Release of OSA 4.2 (Dec 2004):

- First release of RMF/ARF;
- Full IBIS (ISGRI+PICsIT) spectra;
- Improvements in mosaic, to perform long integration (tested up to ~ 500 ScW);
- Addition of different sky projections: TAN, ARC, STG;
- First detections of the Crab with multiple events, up to ~ 3.6 MeV.





- **Galactic Black Holes:**

- Cygnus X-1 (see talk by M. Cadolle-Bel)
- XTE J1550-564 (see talk by M. Revnivtsev)

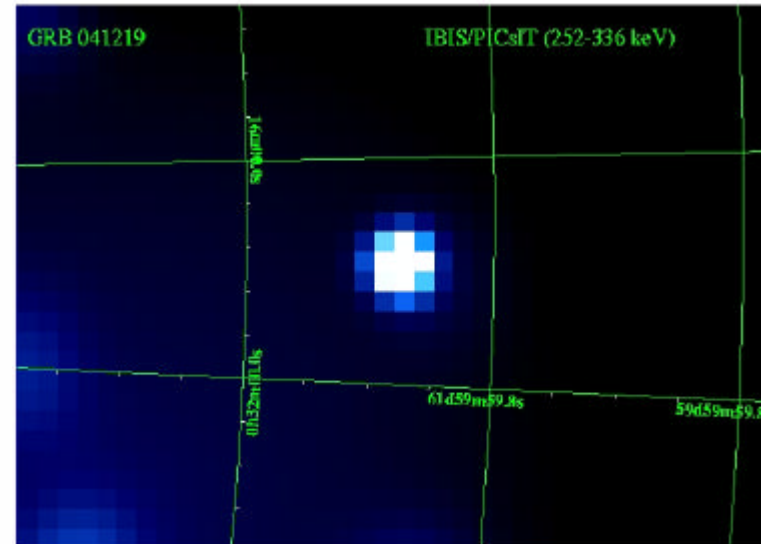
- **Pulsars and PWN:**

- Crab

- **Gamma-ray Bursts:**

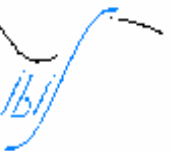
- GRB021125
- GRB030320
- GRB041219

NEW



In flight calibration: ISGRI background structure

- The main source of systematic errors in the ISGRI data is the inaccuracy of background structure corrections
- The need (pressure) for systematic error reduction is increasing because
 - General observers with long observing time do not reach the expected sensitivity
 - The release of archive data implies that more and more people will pile up data and will be also limited by the systematics
- The improvement in observing strategies will only help observations after August 2004
- We have started in Saclay a deep study of the ISGRI background structures taking into account that the structures strongly depend on
 - The energy (e.g. W fluorescence lines)
 - The epoch (a change was suggested after the November 2003 solar flare)
- A posteriori corrections (using deconvolved structures after source removal) are also under study (see R. Walter talk)



ISGRI background maps elaboration



- As a first step, we (Matthieu Renaud, PhD student) have searched the Saclay INTEGRAL data base for observations without obvious source contribution either
 - With a high latitude pointing (all observation modes)
 - using a 5x5 dither pattern (excluding regions with strong source contribution)
- We ended up with nearly 2 Ms
- We have defined 256 energy intervals narrow enough (1.5 keV at 60 keV) to sample the ISGRI spectral resolution
- Shadowgrams in these energy intervals have been produced for each SCW
- We have piled up the shadowgrams in each energy intervals over the SCWs
 - Before the November 2003 solar flare
 - After the flare

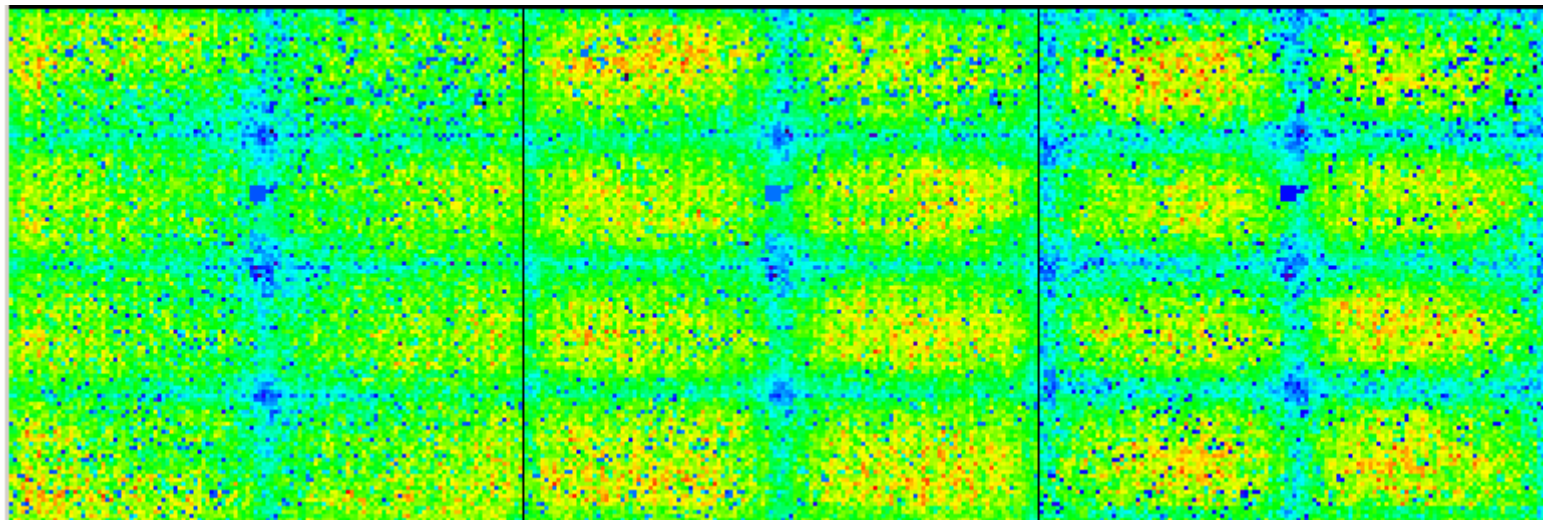
ISGRI background structures (all data)

56 keV

57.5 keV

59 keV

60.5 keV



cea

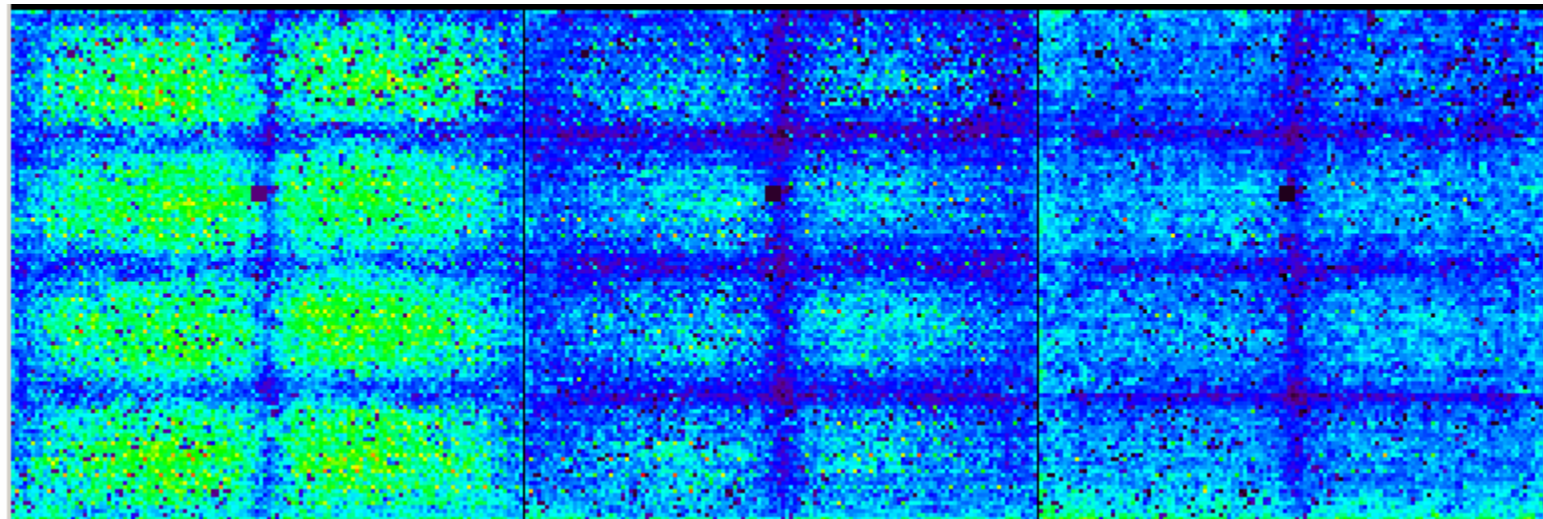


60.5 keV

62 keV

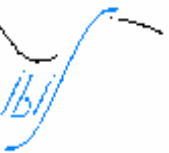
63.5 keV

65.5 keV



ISGRI background structures: future work

- Enlarge the data base (and the statistics) retrieving all relevant data from ISDC
- Study the time evolution of the background structures to define the variability timescale and appropriate time intervals
- Produce correction maps for these time intervals et deliver them to ISDC
- Study the relationships between the background structures and the VETO and IREM count rates



- LUT2 is unsatisfactory because
 - A “Snake” appears in the reconstructed source spectra. Presently this feature is corrected in the ARF to produce a reasonable Crab spectrum but this is not satisfactory for spectra very different from the Crab spectrum
 - 511 keV line is over corrected
- An alternative LUT2 (A. Segreto) have been produced which aims at
 - Reproducing a power law spectra for Crab
 - Giving reasonable lines at 60 and 511 keV
- There is no fully satisfactory solution to this, but improvements are possible. Tests of various LUT2 are on-going using the ground calibration data (key region: 100 keV)



ISGRI ARF: origin of the low sensitivity below 20 keV

- Possible origin

- Low-energy mask transparency underestimated ?
- Pixel low-thresholds ?
- Noisy pixels ?
- Ag (glue) absorption ?
- Fitting methods

- First Investigations

- Mask transparency confirmed
- Low threshold around 15 keV does play a role but cannot account for the whole effect
- The low energy sensitivity is not affected if noisy pixels are properly corrected
- Ag (glue) absorption does play a role but cannot account for the whole effect
- Fitting methods apparently have an effect but relatively small

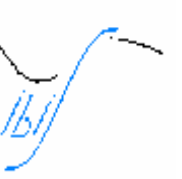
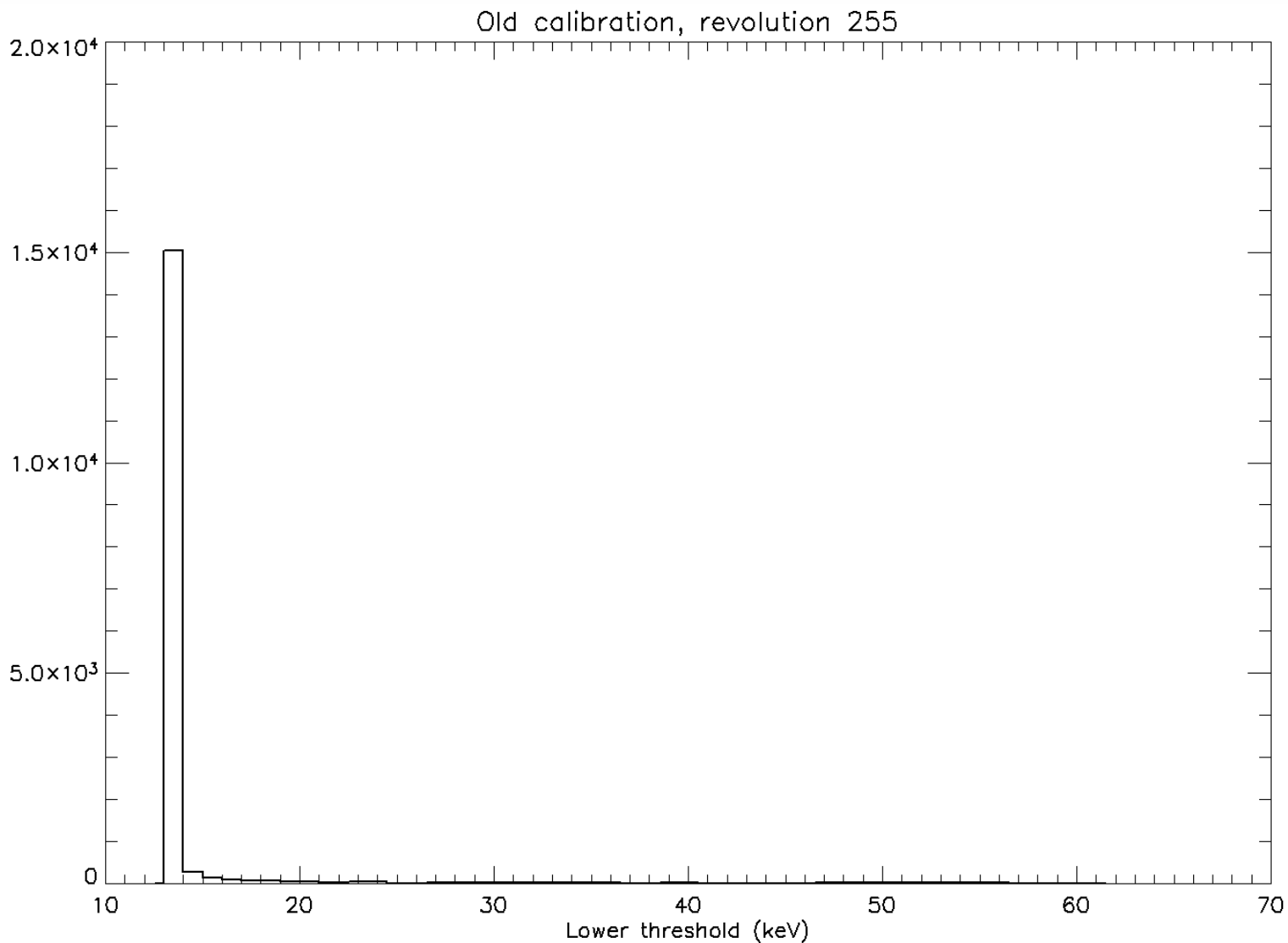


ISGRI low threshold

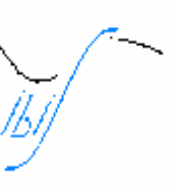
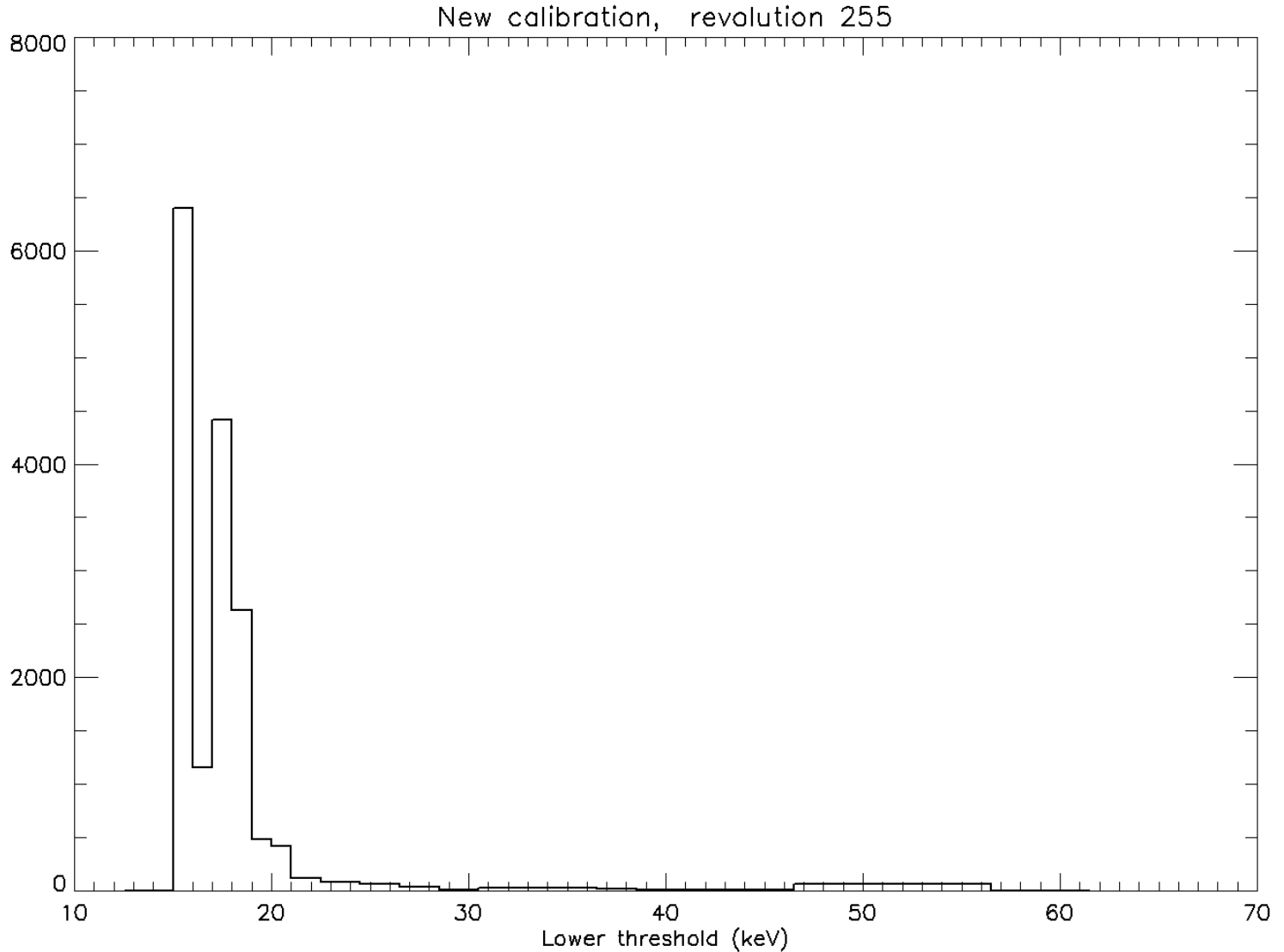
- The low threshold calibration has been re-investigated
 - The pixel low threshold does not depend on the ASIC output gain but it does depend on the pixel (input) gain
 - At the same low threshold step, there is a significant dispersion in the low thresholds
 - The average low threshold is higher than anticipated:
15 keV → 17 keV!
- This impacts on the data processing (spectral extraction)



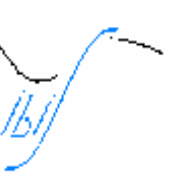
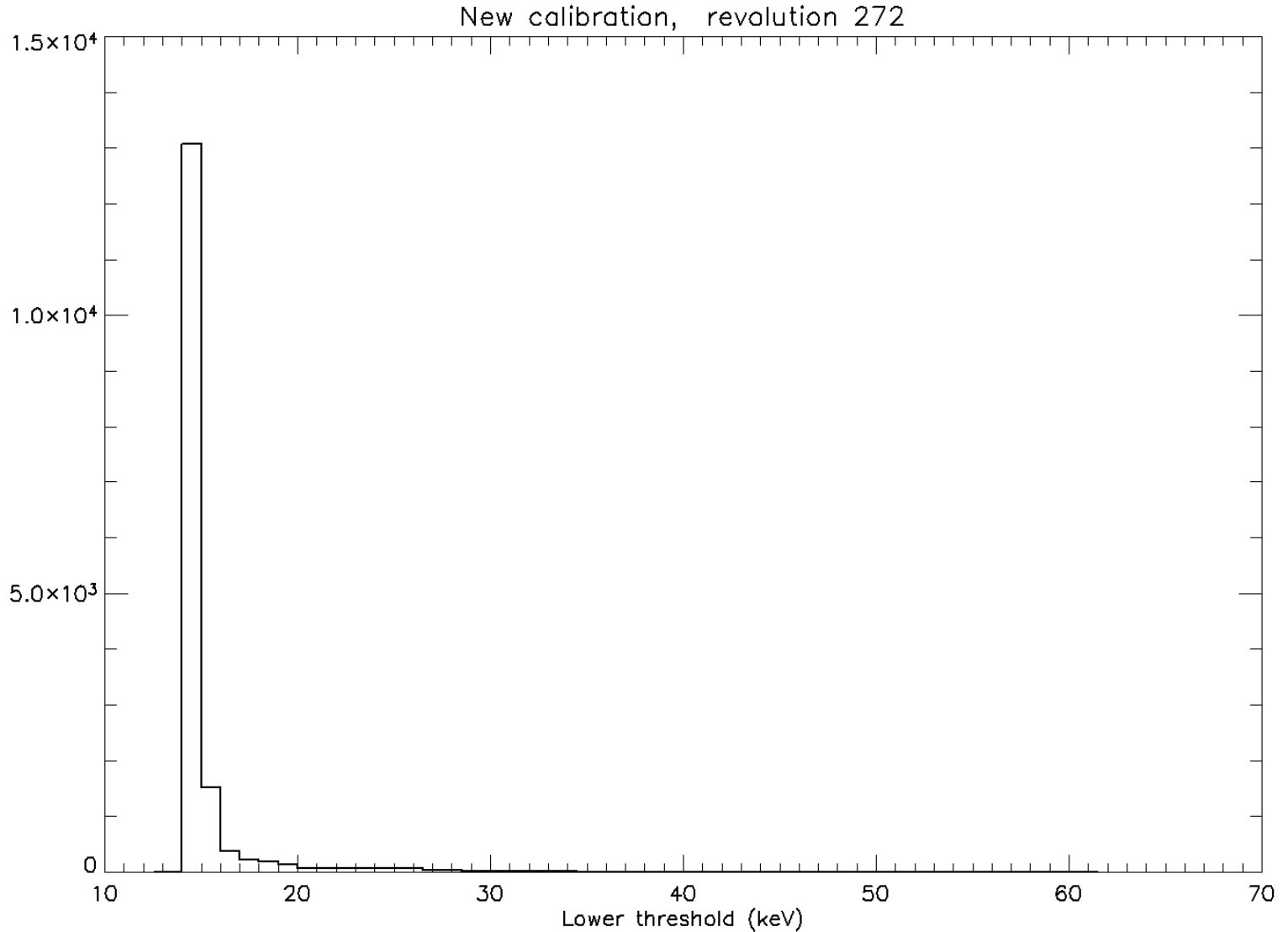
ISGRI low thresholds according to the old calibration



ISGRI low thresholds according to the new calibration

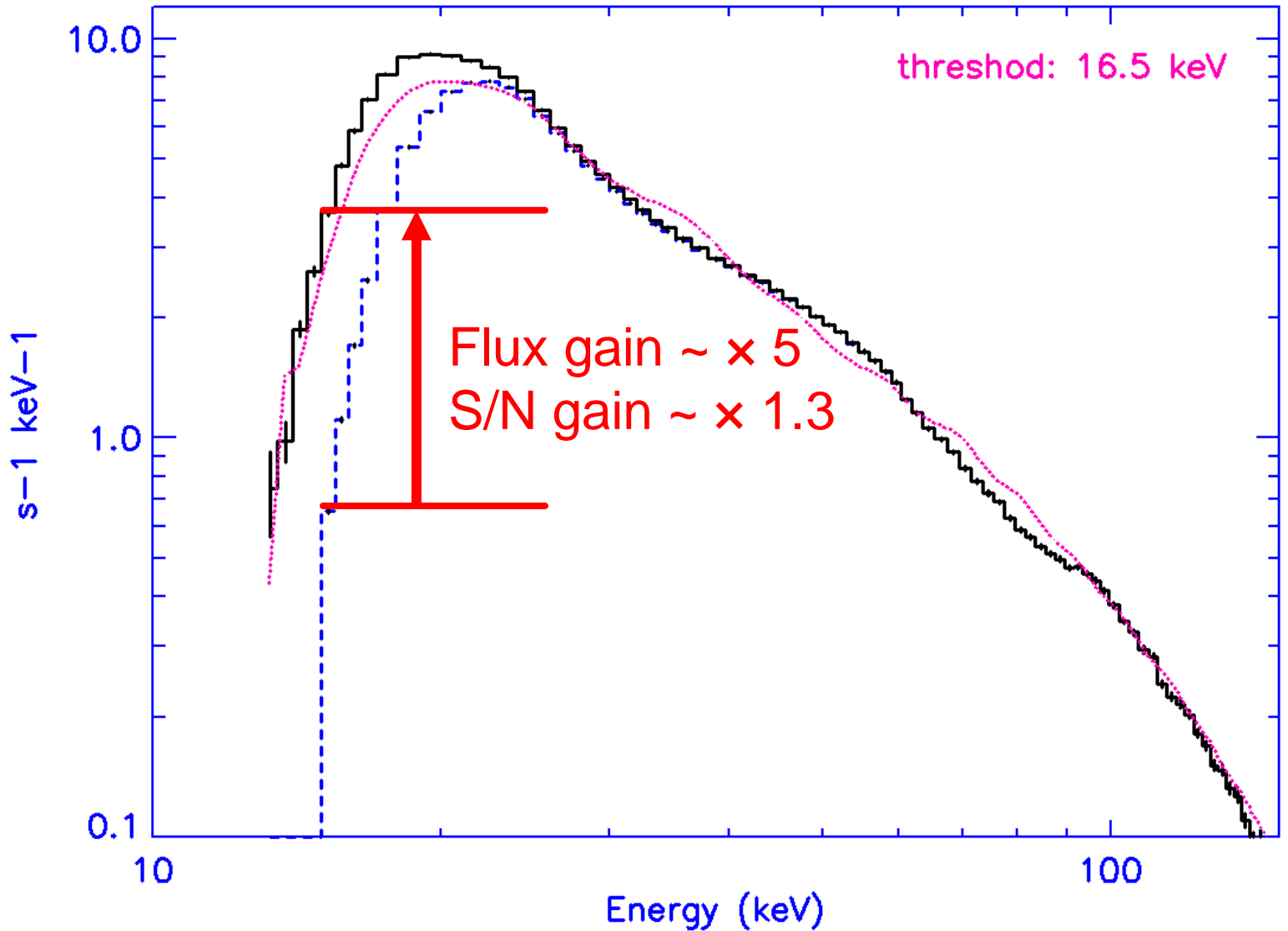


ISGRI low thresholds (new cal.) after tuning



ISGRI: effect of old and new calibration on spectral extraction

Crab rev 39



ISGRI lower rise-time threshold

- The lower rise-time threshold may be too high and could induce a loss of sensitivity by a few percent at low energy
- During the recently executed Crab calibration the ISGRI rise-time selection was disabled for a few ks
- This calibration will allow us to set more precisely this lower threshold
- A side effect may be an increase of the telemetry by a few percent
- Precise evaluation is on-going. The new RT threshold will be between 4 and 6



ISGRI uniformity

- $I=(S+B)*U$
- In principle OSA includes uniformity corrections but the uniformity map is filled with 1.0
- We have preliminary indications that this is not satisfactory
- Heavy work is on going to extract the uniformity (ground and in-flight calibration) as a function of energy (detector and ASIC response may affect it)

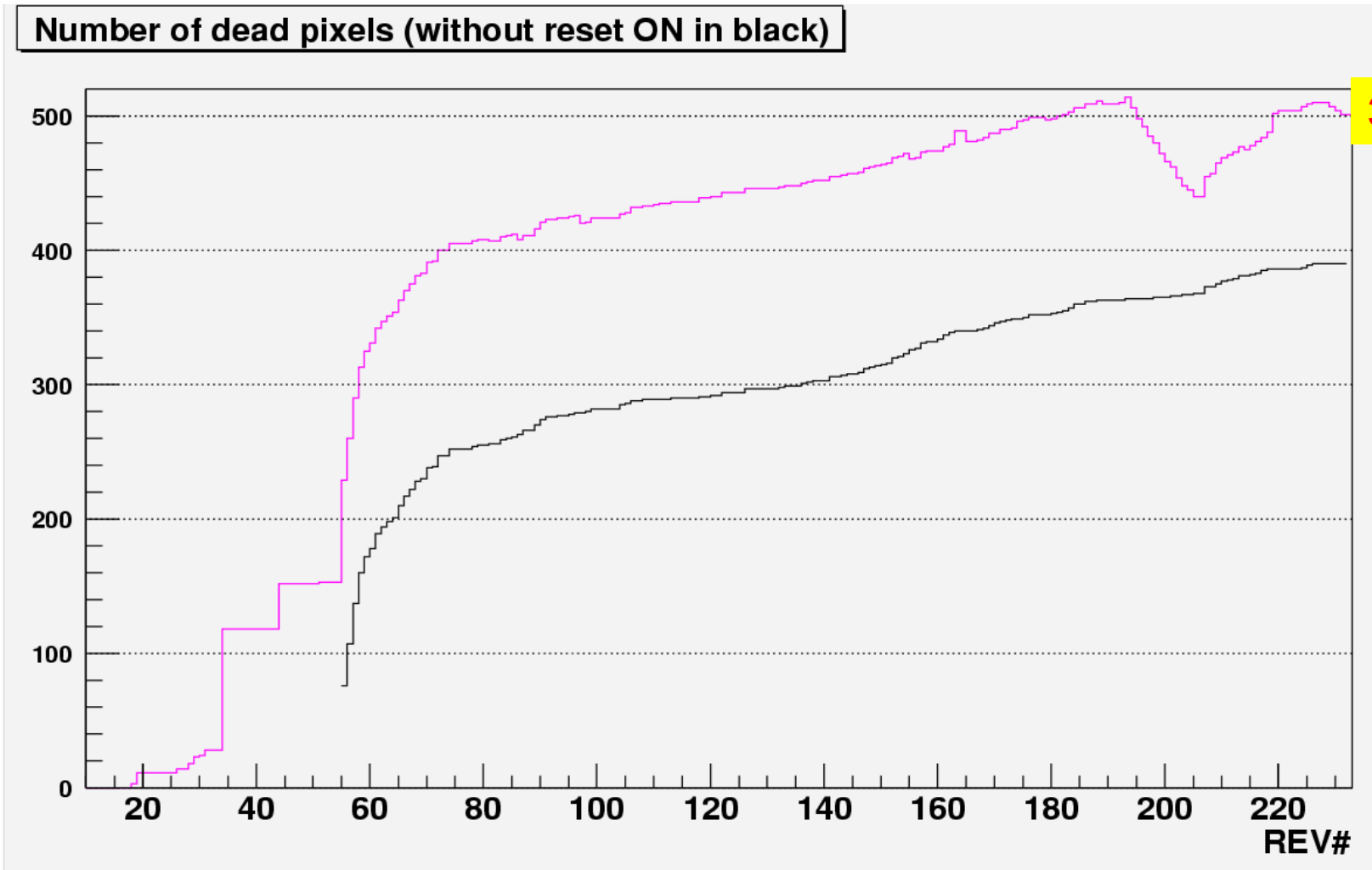


ISGRI spectral calibration

- Present spectral calibration is unsatisfactory
 - Variations by a few percent are observed in the background line positions
 - Position of the 511 keV line depends on the position on the orbit (V. Longeou)
- New calibration is under elaboration (C. Couvreur) where gain and offset are functions of:
 - Date (long term effect of irradiation on detectors)
 - Temperature
 - Time after detector bias-on
 - Strong solar flare dates



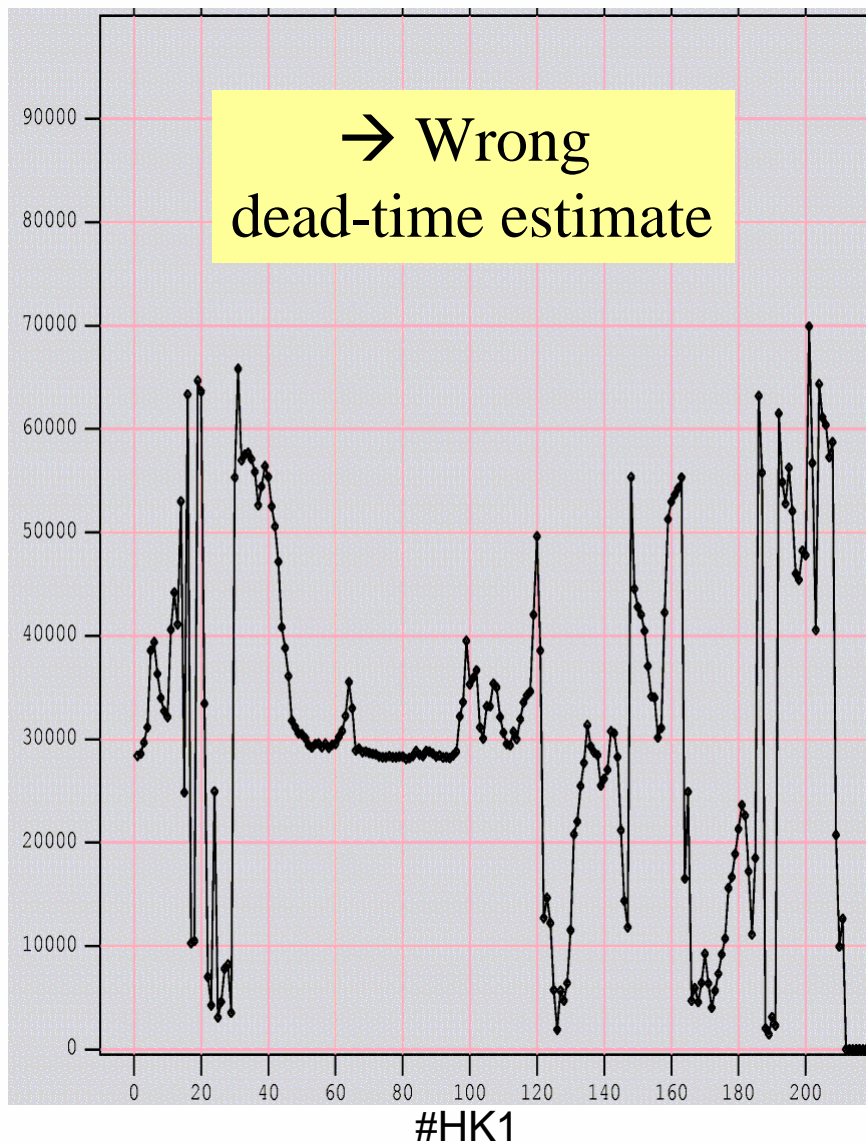
ISGRI disabled pixels (~ 100 / year)



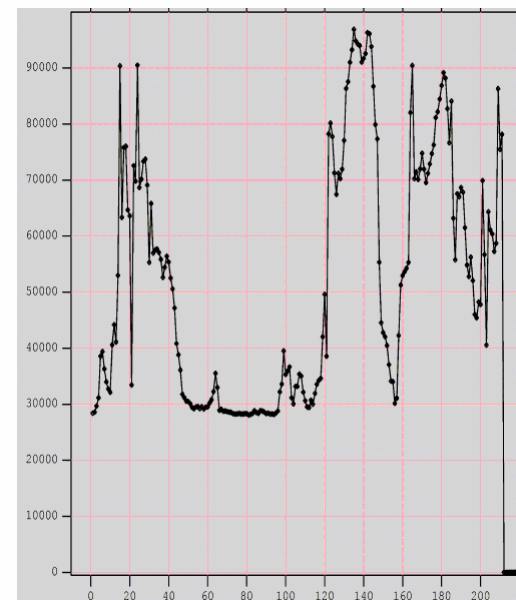
Aymeric Sauvageon

IBIS VETO count rate S/W correction

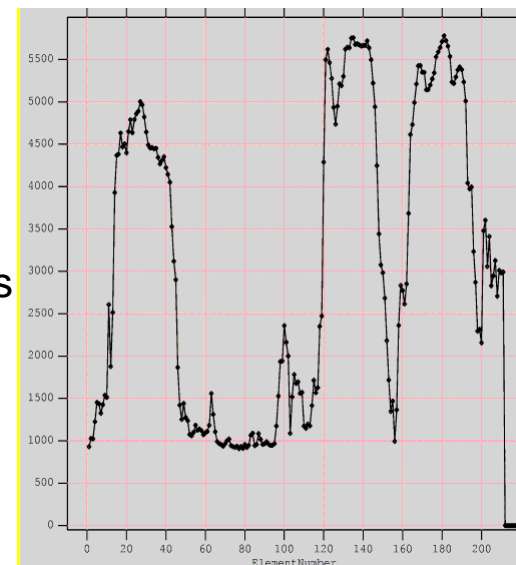
Raw VETO count rate at belt entry



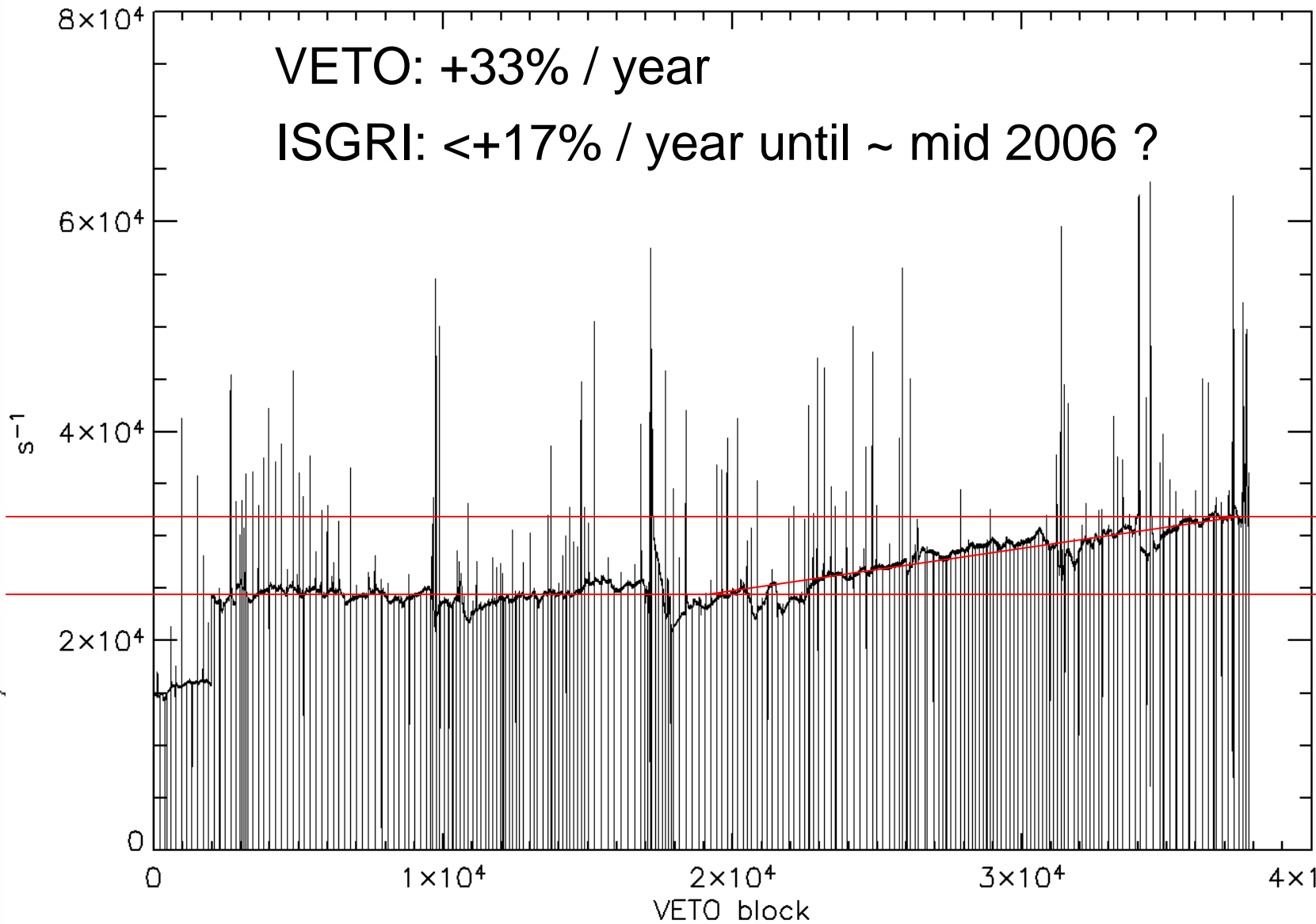
Correction



ISGRI Triggers (HK1)



IBIS VETO count-rate evolution



V0332+53

