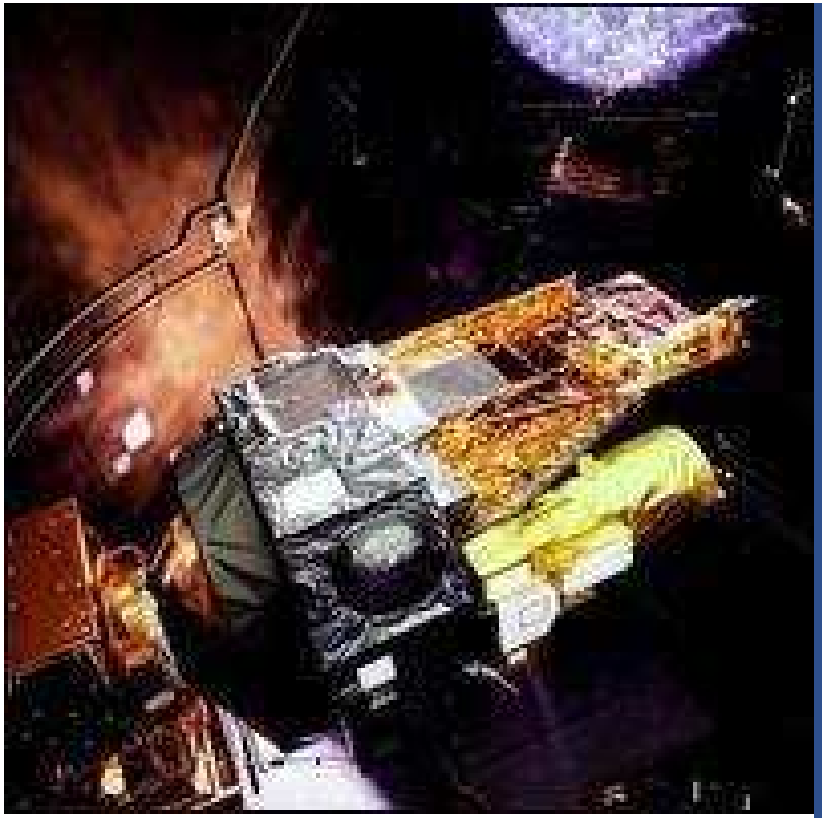
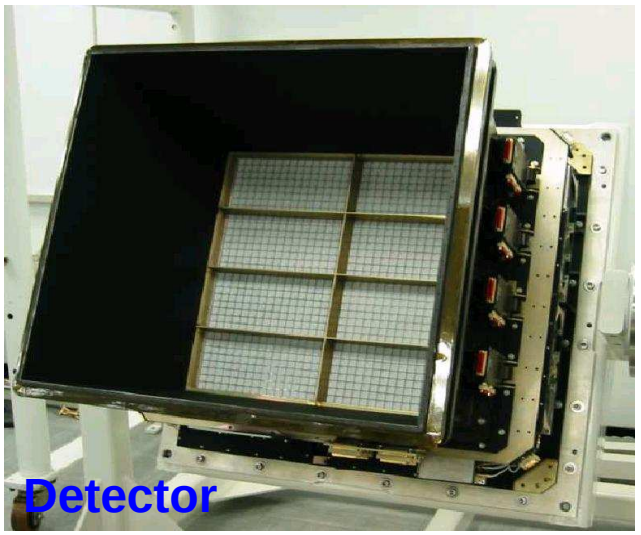
Status & Updates for INTEGRAL/IBIS

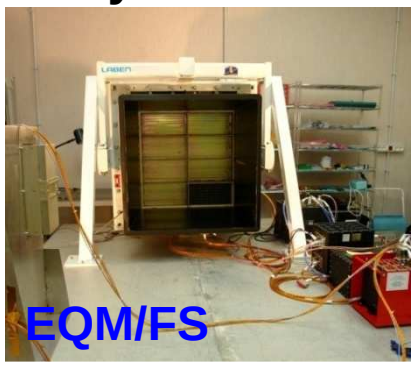


Lorenzo Natalucci on behalf of the IBIS Team

IBIS status & performance summary

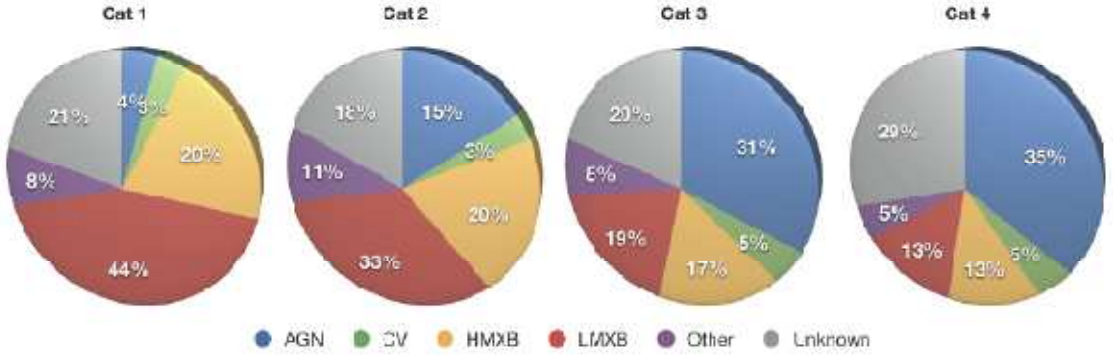
- In orbit since Oct 2002 (7.5 years)
- All subsystems (detectors, VETO, Modular Units and Electronics, DPE, On board Software, Cal Unit etc) are nominal
- No equipments have been lost, no usage of redundant parts
- No single failure or critical degradation
- Detector temperatures always within safe range
- Good supporting level from the Team, covering operations, S/W and calibration
- IBIS EQM model fully maintained/operated @ IASF-Roma

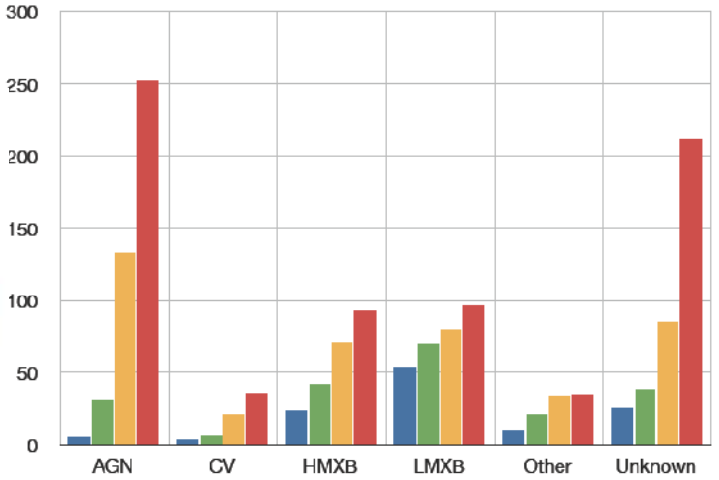




IBIS Catalog Sources (CAT4)

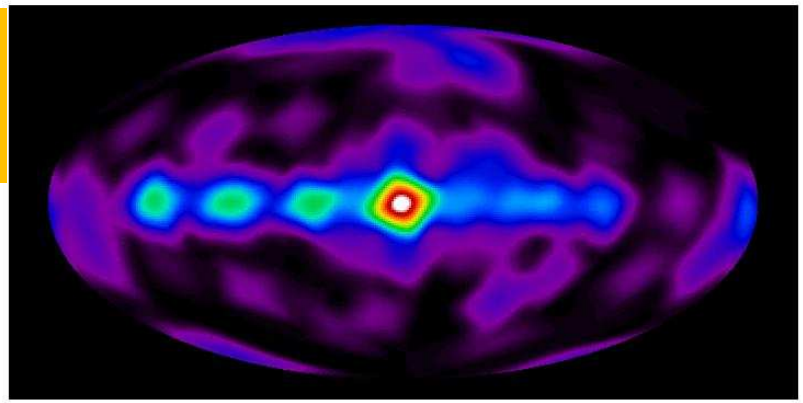
Evolution CAT1 to CAT4





723 sources detected > 4.5σ
~30% unidentified

- The population of unidentified sources is steadily growing
- Great effort in follow-up programs especially in the optical & IR



IBIS exposure map for CAT4 (Bird et al. 2010)

Calibration of the Point Source Location Accuracy (PSLA)

- **PSLA is a critical parameter for the success of counterpart identifications. For a large FOV coded mask instrument it depends on: (1) SNR; (2) Position of the source within the FOV**

- **A previous determination of PSLA was reported by Gros et al. (2003) based on analysis of SCWs from Crab and other few bright sources, and early analysis software (OSA3)**

- **Gros et al results are given globally for sources within 14 of the on-axis direction. The PSLA is fitted by the function**

$$y = ax^c + b$$

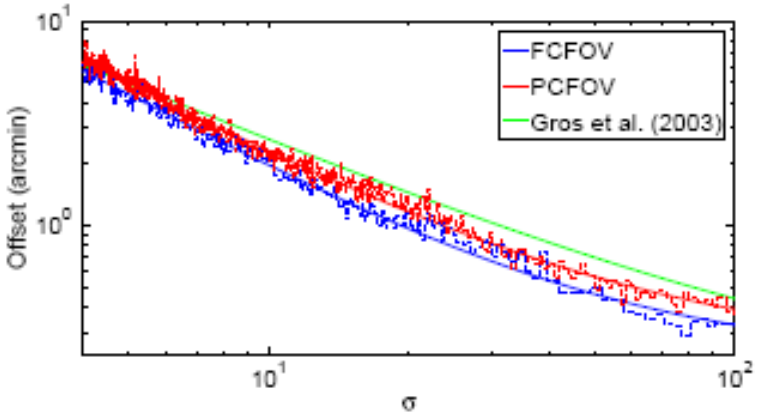
x=SNR, y=90% confidence error radius

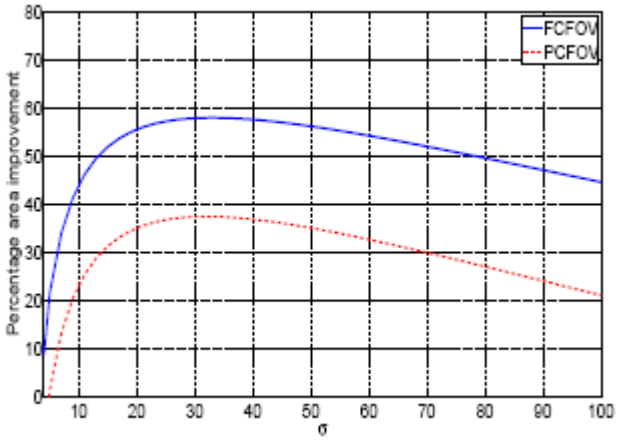
- **Given the high number of sources available now, the PSLA of IBIS can be checked against a large amount of data obtained from sources with best known positions**

Calibration of the Point Source Location Accuracy

Method: record and analyze the measured offset distribution respect to true positions in both FCFOV and PCFOV, against SNR for individual pointings

- Select catalog sources with best known positions: error radius < 30" results in 332 sources and a total of ~100,000 offset measurements from individual pointings (of which, 25% in FCFOV)





Scaringi et al, A&A 2010

Summary of main results concerning PSLA

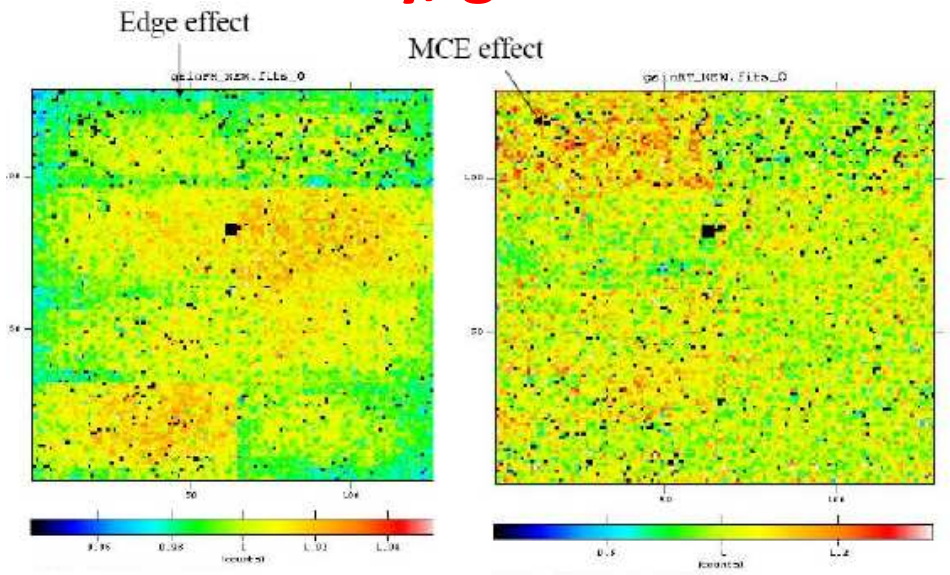
- The PSLA is found to be improved significantly by the new analysis

- Values of the PSLA function for FCFOV and PCFOV, at different confidence levels are given in the Scaringi et al. paper

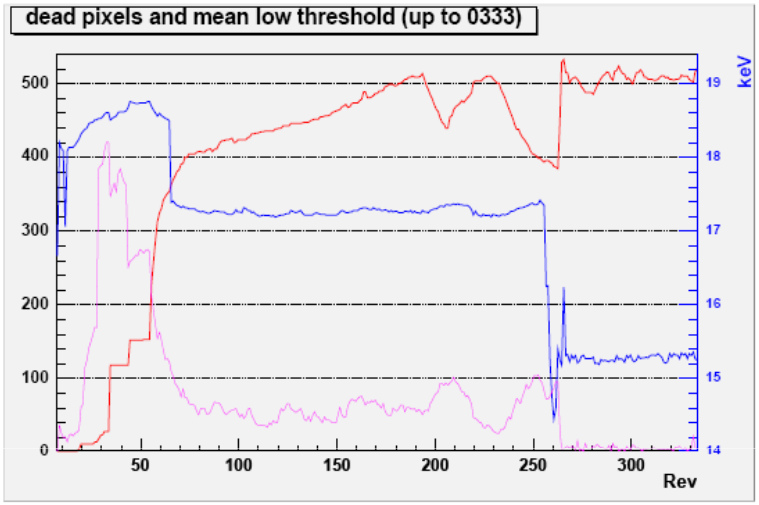
- The biggest improvement occurs at ~20-40σ source detections, allowing better identification even for short duration transients (~10^3s)

- Faint sources, like unidentified AGNs, are normally detected from the sum of many pointings in both the FCFOV and PCFOV. If we assume the conservative approach of choosing the values of PCFOV for these sources, we still retain a great benefit

Stability, gain variations and energy correction



pixel-to-pixel gain variations



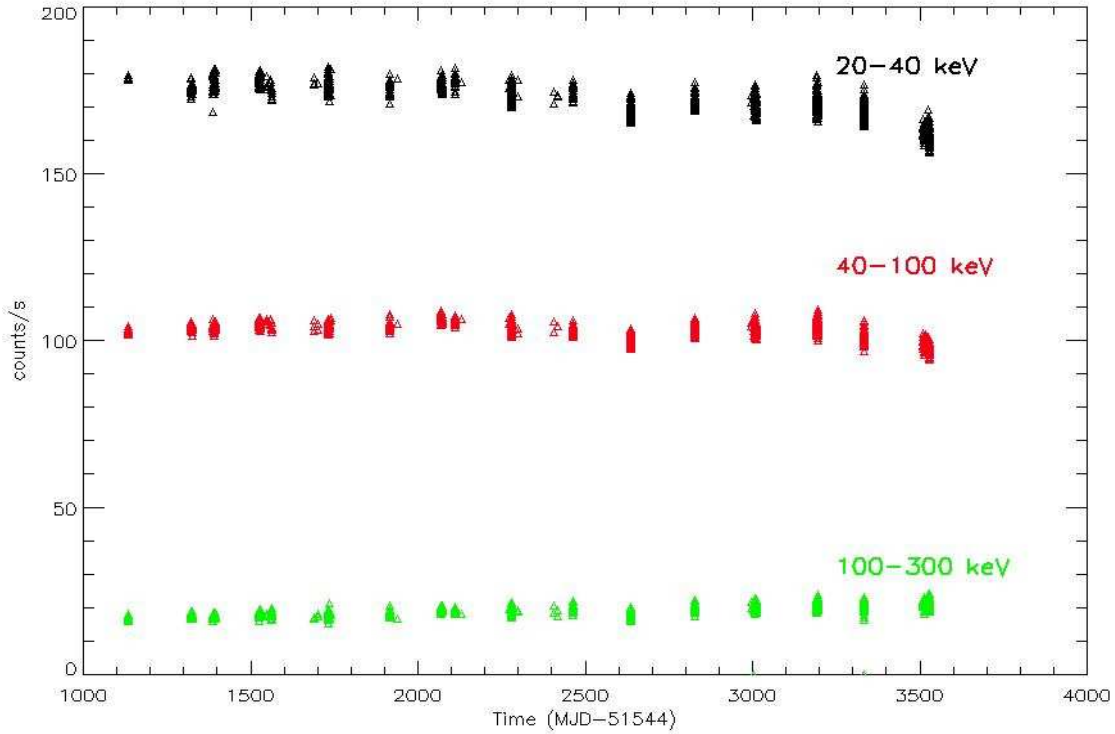
A Noisy Pixel Handling System (NPHS) allows to monitor the spectral performance of single pixels and switch off the noisy ones temporarily or permanently. Many triggers are caused by particle events and can be excluded by tuning the low threshold.

Pixels gains are corrected vs time, temperature and radiation dose.

The reconstructed energy is computed by a two step procedure:

1. **correction of offset & gain for pulse height and rise time (LUT1)**
2. **correction for the charge loss (LUT2)**

Long term Crab light curves



"Raw" count rates from imaging data obtained with OSA-8. Systematic deviation are appearing that are corrected post-facto in the response.

- **Need periodic re-calibration once/year (time dependent responses to account for systematic deviations)**
- **Corrected data are accurate to a level of 1-2%**

Post-facto Response Correction

Obtained by using Crab observations: performed regularly (2 times/year)

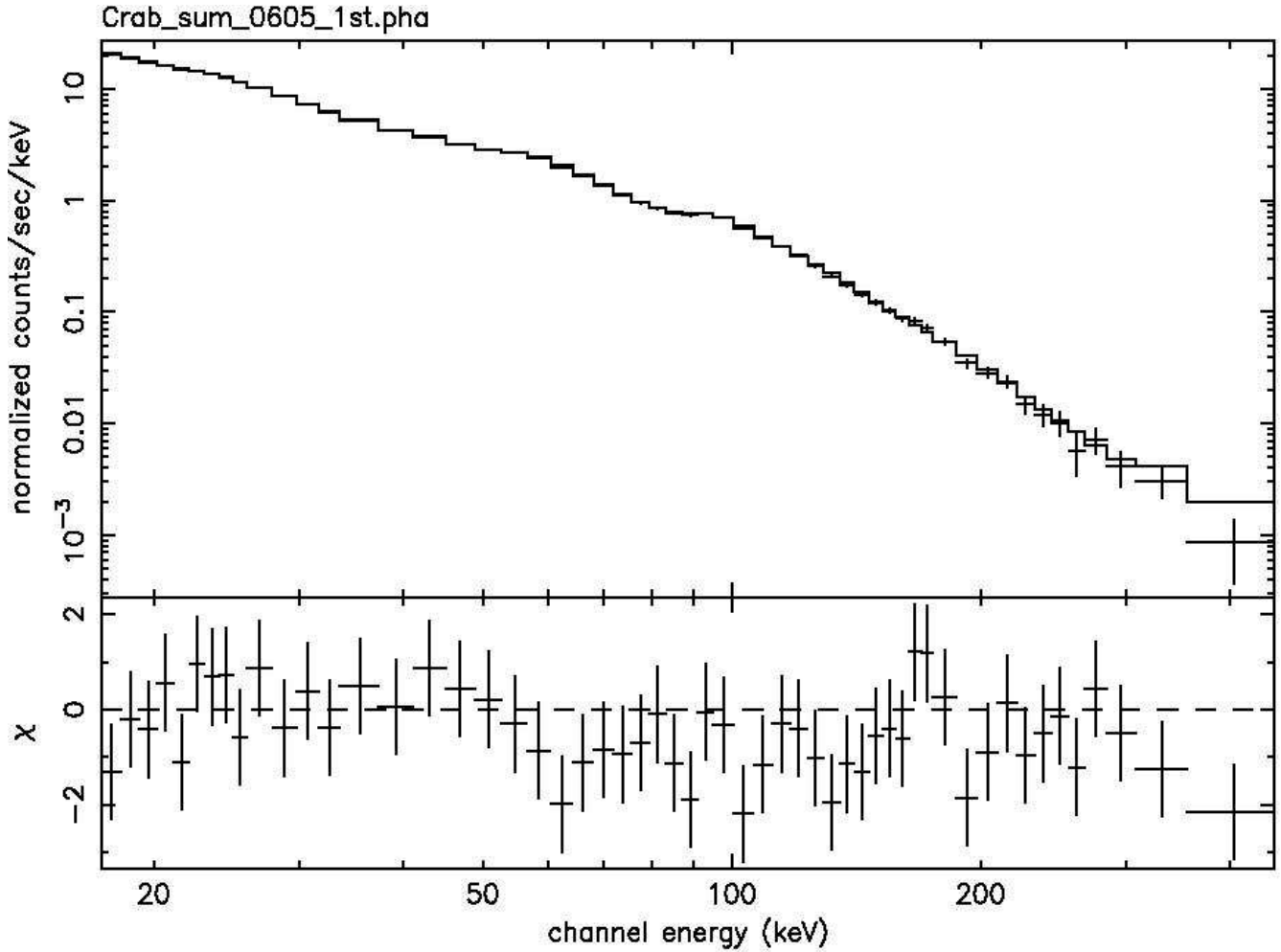
Currently Response matrices are *time* dependent and also *software* dependent: e.g. for improved version of energy correction package

Latest responses delivered for OSA 8 in March

OSA-9 software is expected to contain improvements especially for imaging, calibration files updating and off-axis correction

For the post-facto correction, we use the same Crab model as the one described in Jourdain et al 2009 (Proc. 7th INTEGRAL Workshop): broken power law with break @100 keV

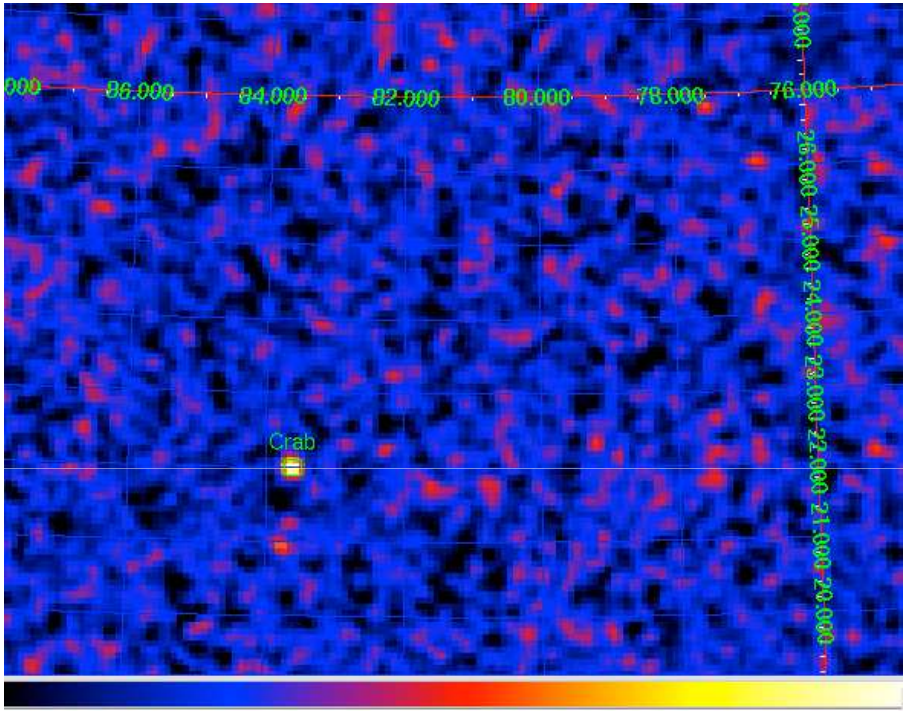
Crab Rev. 605 (5x5 pattern) fitted by ARF of Rev. 666



Errors with 2% syst, χ^2_r=0.98

No change in spectral parameters and normalization

ISGRI High Energy Detection of the Crab emission



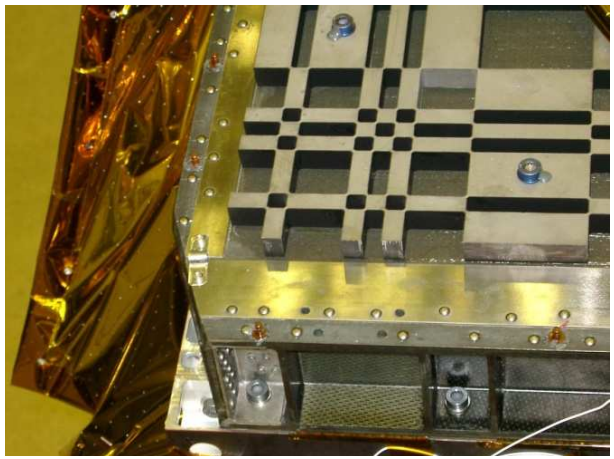
431-471 keV Exposure: 3 Ms
Significance ~ 10σ

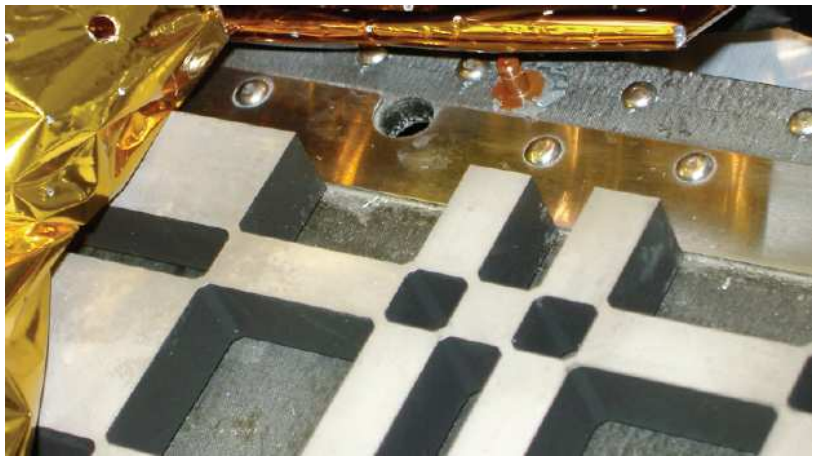
- **Crab is also "barely" detected in the 470-530 keV range (~4σ)**
- **Work in progress: try to ameliorate SNR up to energies > 500 keV to extend the high energy end of the in-flight calibration**

Improve the imaging sensitivity [1/2]

- **The projections of the edge parts of the mask on the detector by bright sources cause unwanted *ghosts* in the images due to the presence of glue, holes, bolts not taken into account**

- **In order to correct for them, we build a *mask radiography* in flight to achieve much better images (expected in OSA-9)**

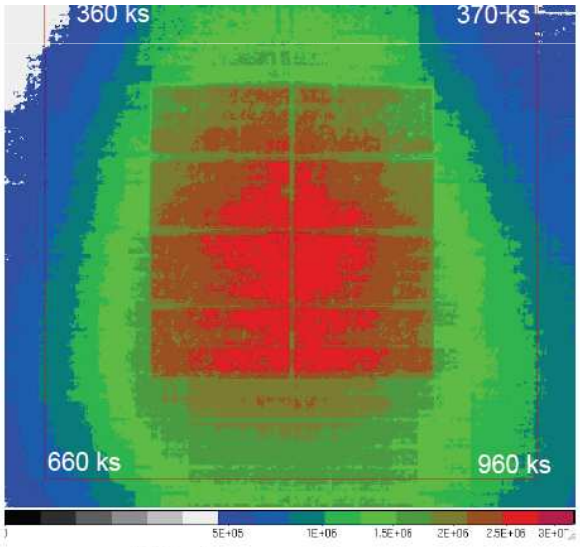




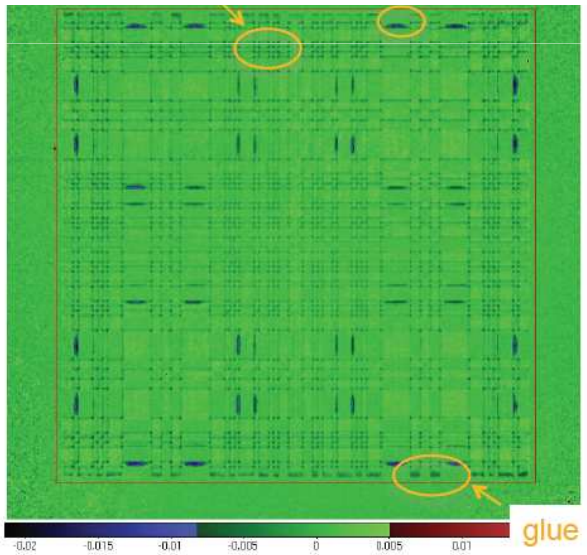
Improve the imaging sensitivity [2/2]

- **The mask fine structures can be recognised and measured by exposing the mask parts to a high source flux (data of strong sources).**

- **An undergoing measurement campaign is ongoing, based on available observations of bright sources and accumulation of further data from the Crab (~400 ks twice a year)**



Effective mask exposure time in ks



Mask defects radiography

S. Soldi (CEA/SAp Saclay) & G. Belanger (ESAC)

OSA8 /OSA9 imaging for bright sources & around bright sources