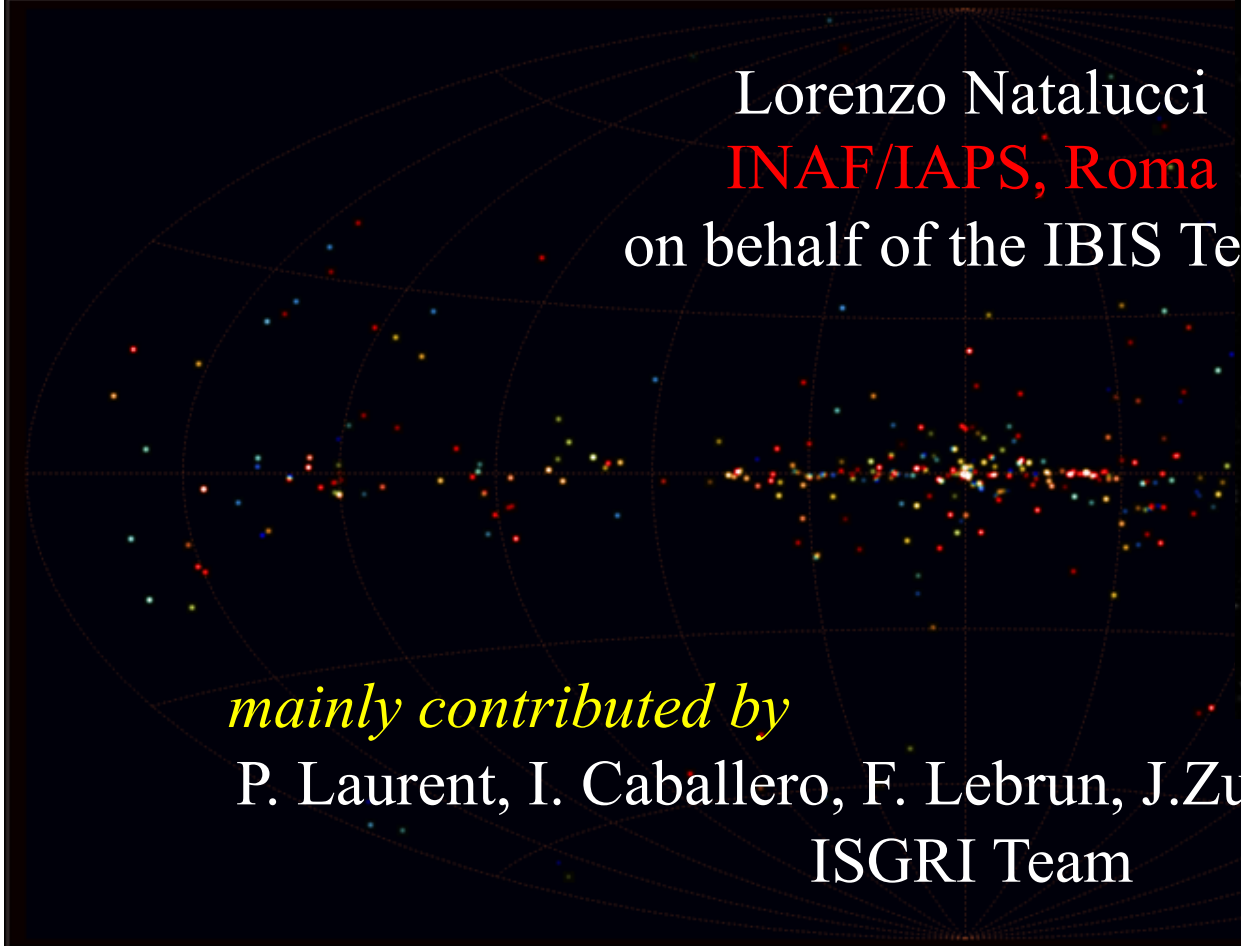
# IBIS calibration update



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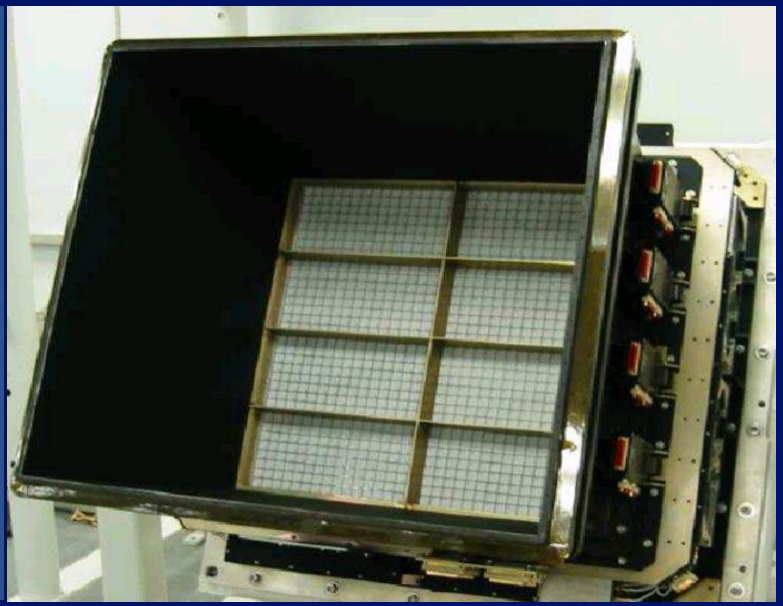
on behalf of the IBIS Team

*mainly contributed by*

P. Laurent, I. Caballero, F. Lebrun, J.Zurita Heras and the ISGRI Team

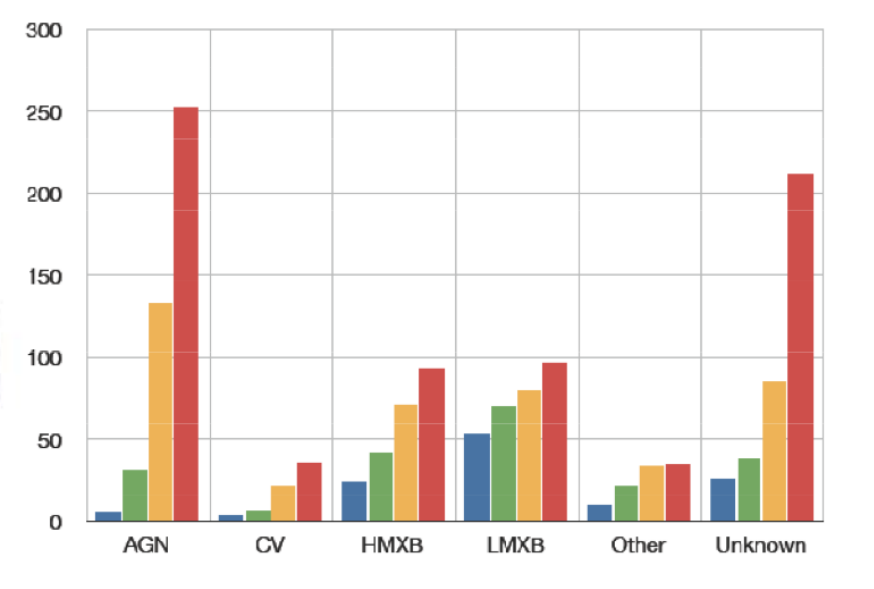
# The IBIS instrument



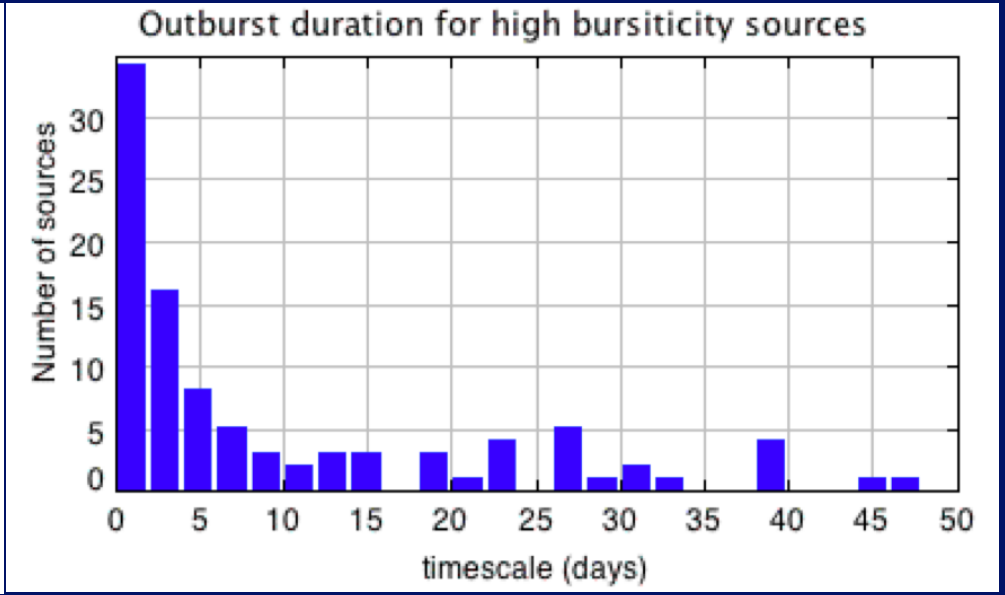
- In orbit since Oct 2002 (~9.5 years). Nominal operations, no significant degradation of sensitivity
- ISGRI Energy range 18-1000 keV; CdTe detector, 8 modules 16384 pixels. ~95% healthy pixels after 9.5 years
- Coded mask @3m provides FOV ~19 deg (>50% coding)
- 723 sources in CAT4 (Bird et al. 2010), many others being discovered in survey programs

# Many new X-ray transients

- Sources with a high level of variability comprise ~15% of the IBIS census (Bird et al., 2010)
- About 130 new IGRs sources have been found with the previous Galactic Plane Scans;



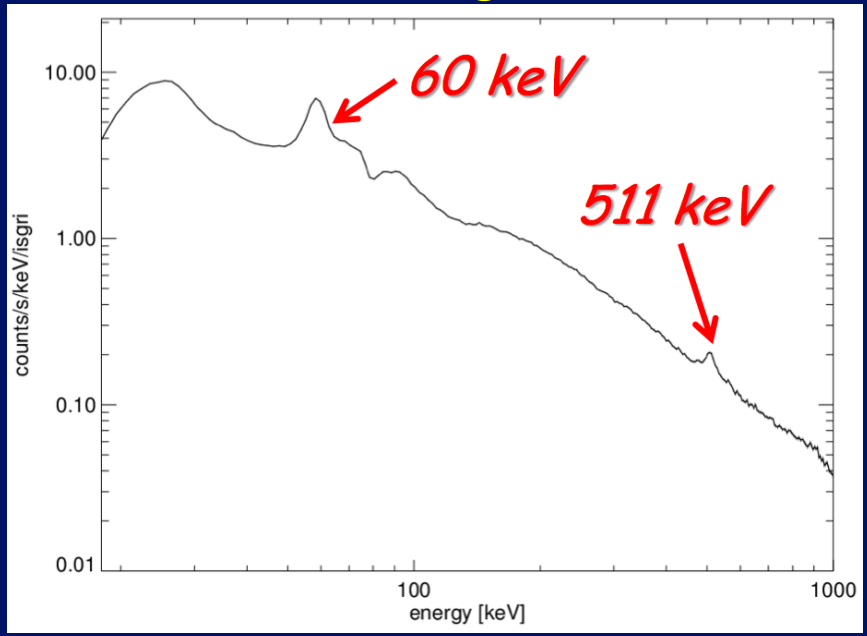

CAT1 to CAT4 evolution




outburst durations for sources flagged as extreme transients in the 4th IBIS catalogue

# Monitoring of Instrument Parameters

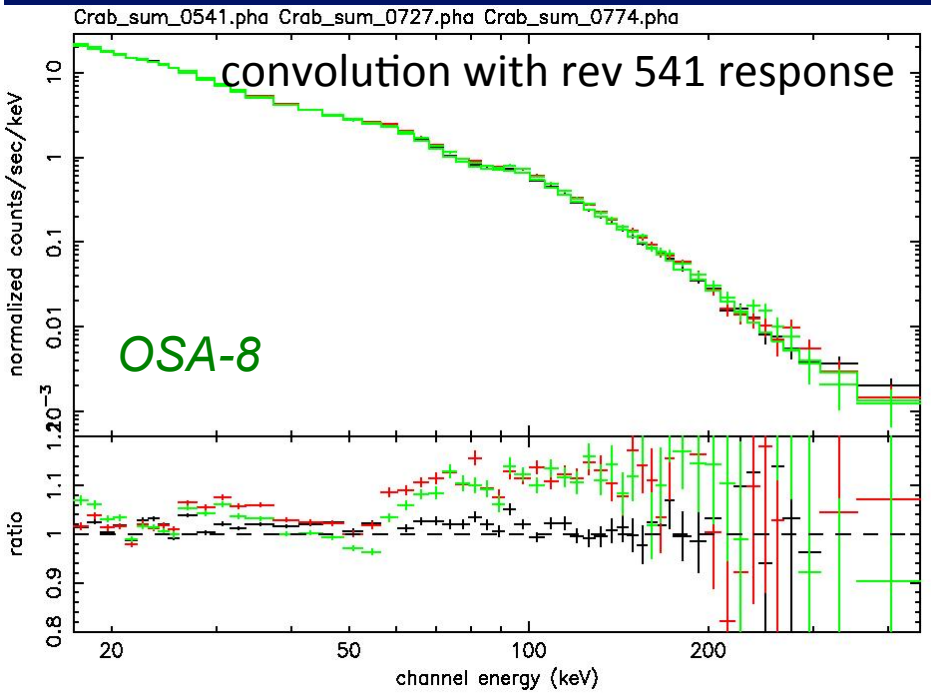
- Using gamma-ray lines in the background spectra and temperature monitors to model gain/offset variations and energy resolution



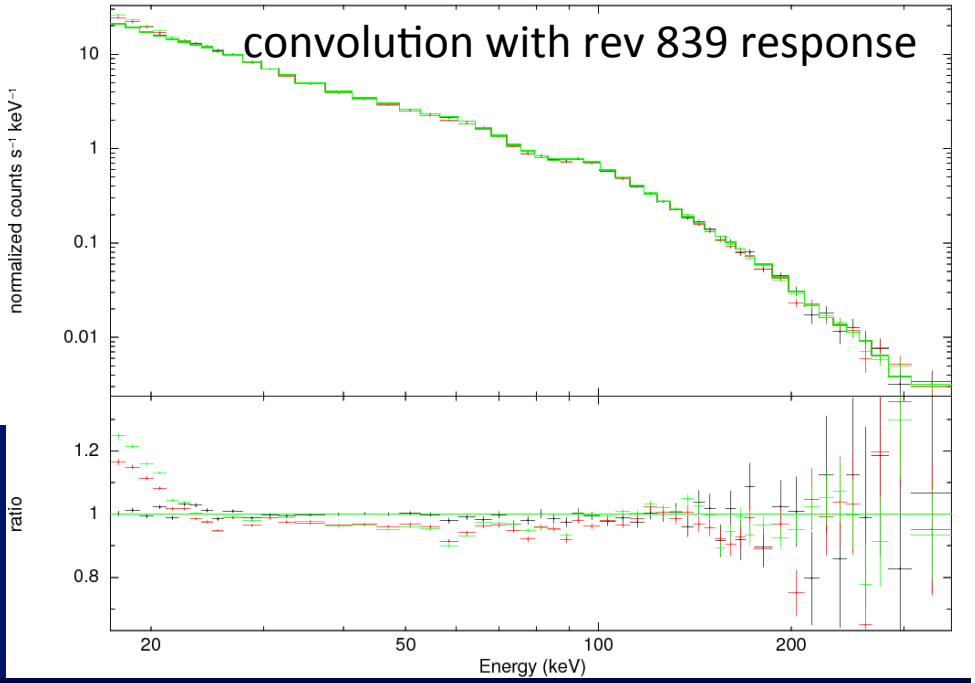

- Monitoring of low thresholds at pixel level
- Monitoring response by periodic observations of the Crab, currently performed twice a year during Spring & Fall

# Spectral Response

- Response matrices are time dependent (but not observation dependent): delivered approx. once/year



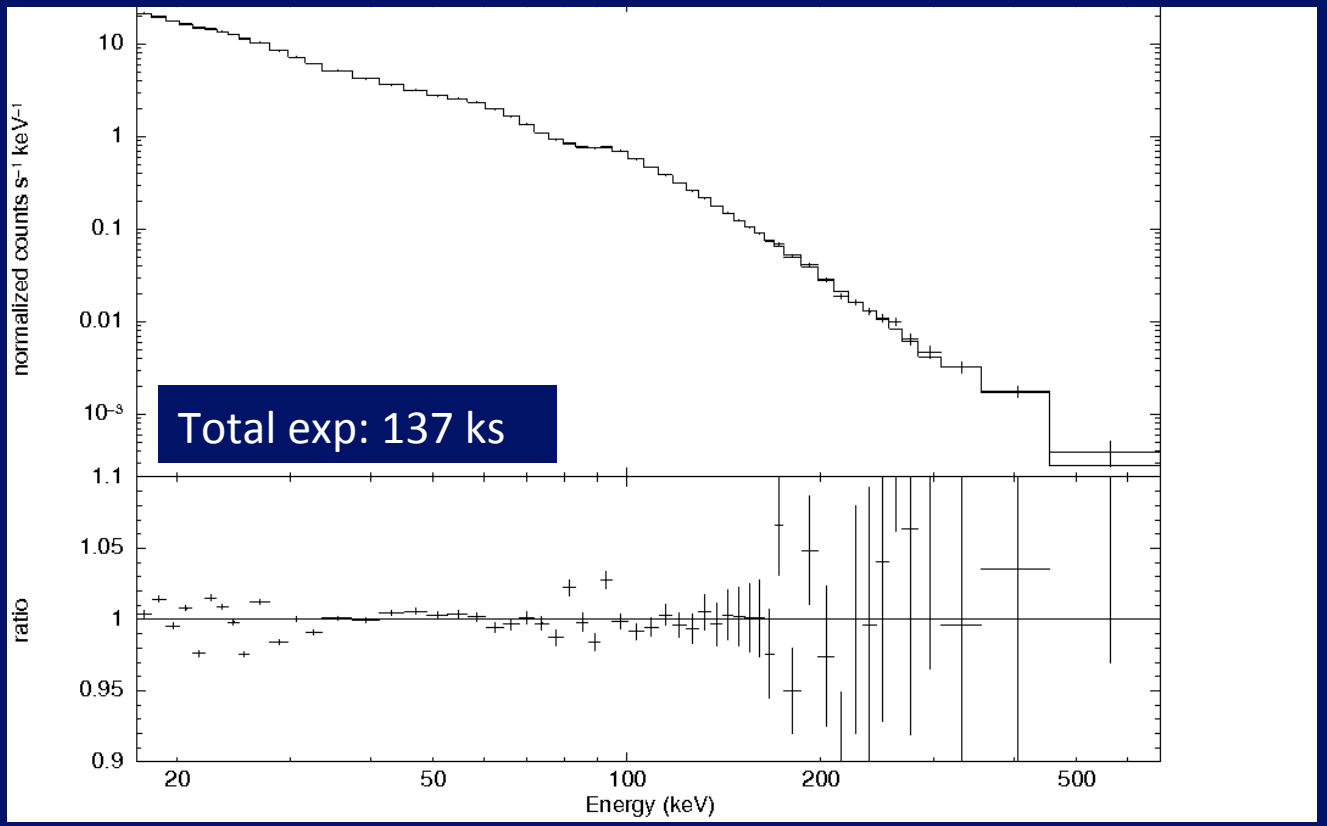

Rev. 541
Rev. 666
Rev. 774




Rev. 839
Rev. 902
Rev. 967

# Long-term accuracy of the time dependent correction

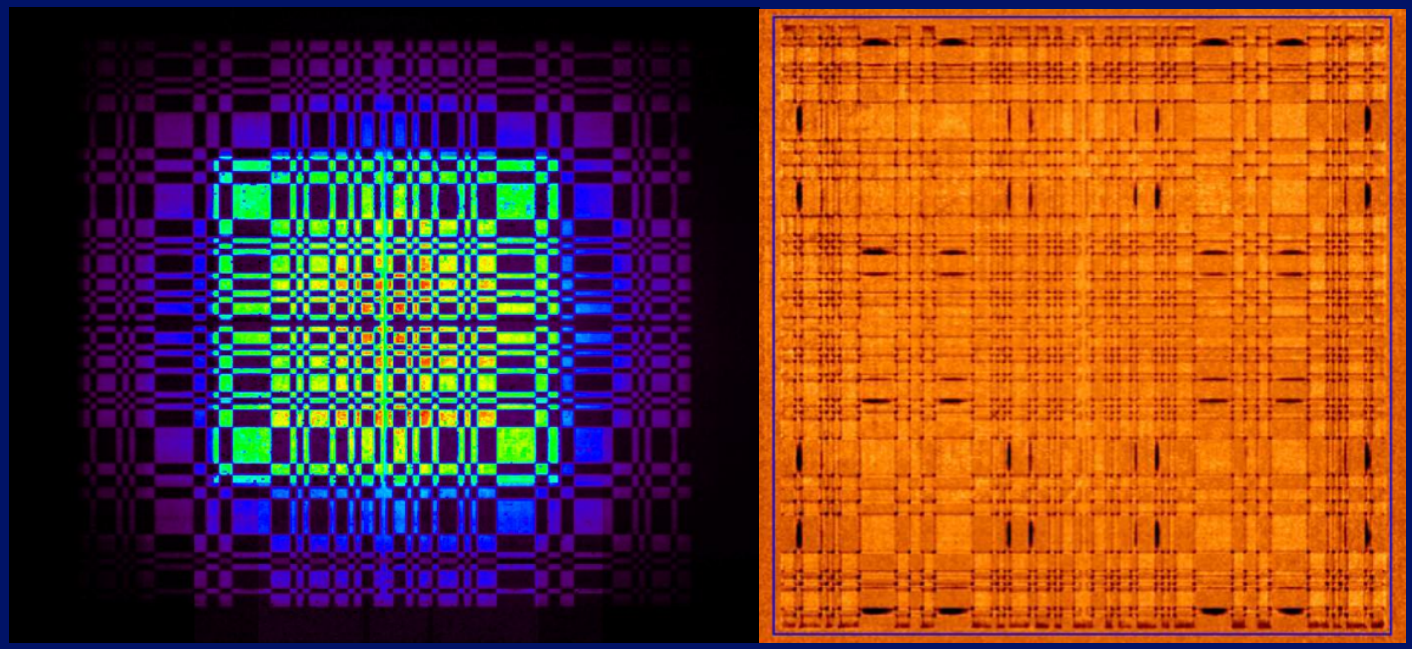
Average spectrum on-axis, OSA 9.0, Revs. 541 to 839, elapsed ~2.5 years




The *ratio* values are at the level of a few % in the single channels

# Improving the Images

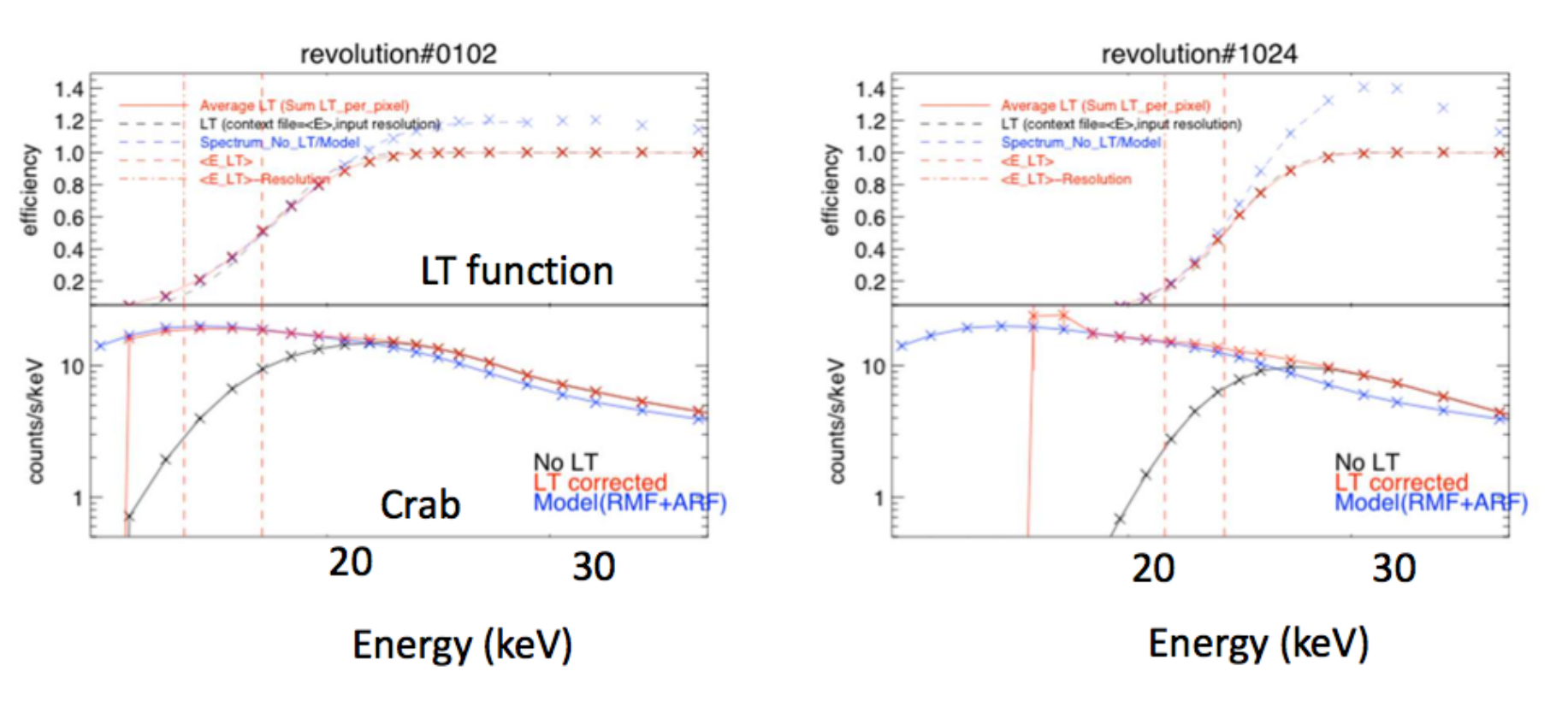
- Ghost removal: more detailed mask radiography with longer exposure time from bright sources



- Using exposures on bright sources (Crab, Cyg X-1) plus dedicated calibration observations
- Total effective exposure ~13 Ms

# Improving the Spectra: LT evolution

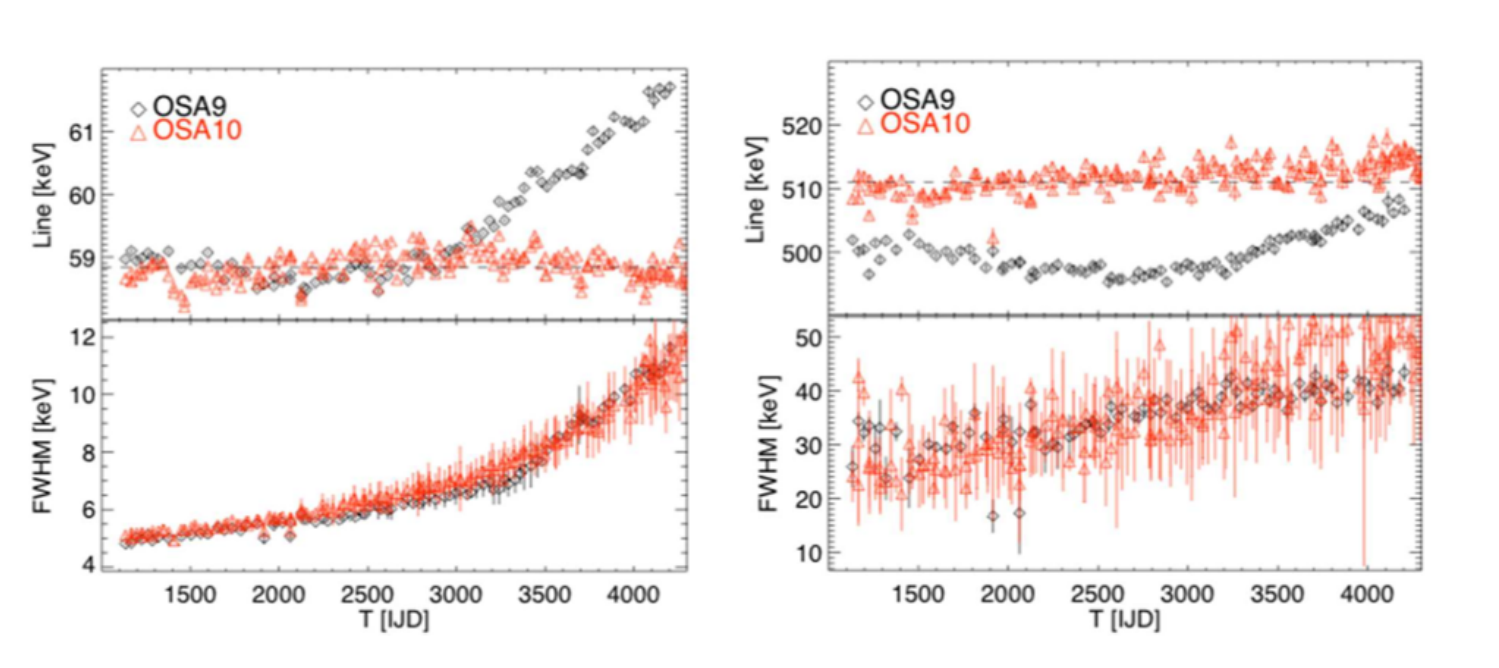
- The average low threshold efficiency has a long-term evolution
- Effect not fully modeled in OSA v9; resolution supposed constant



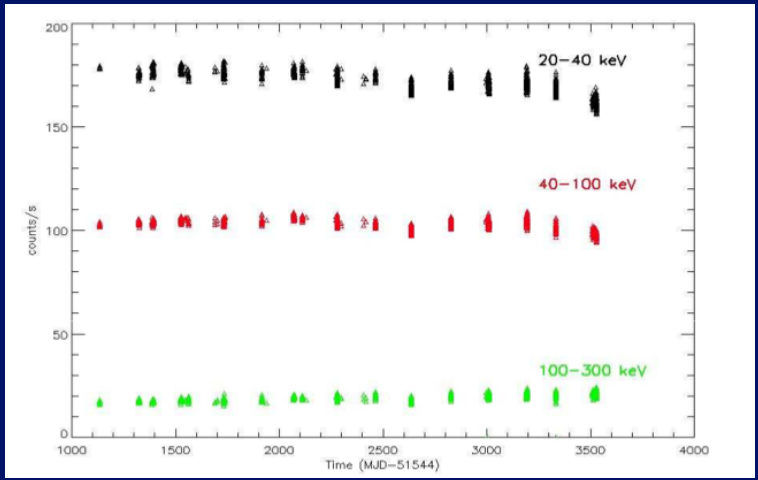

F. Lebrun, IUG meeting Jan 2012

# Improving the Spectra: energy correction

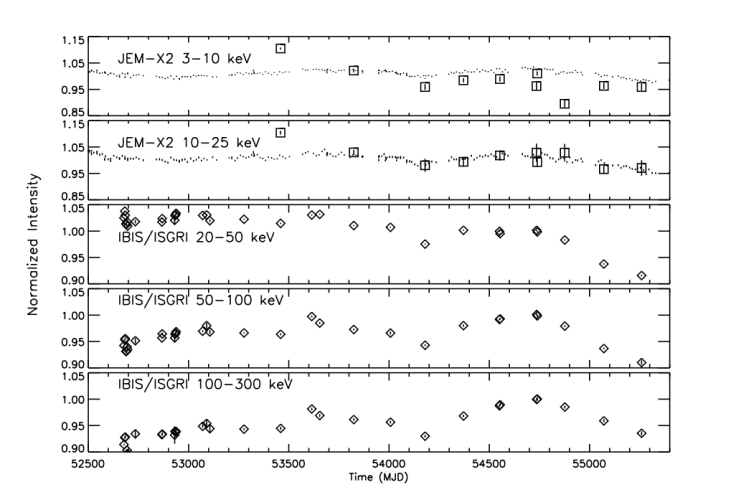
- New correction for temperature dependency
- Improved offset evolution description (depart from linear trend is evident in latest period)
- Improved gain correction: model based on the ~25 keV bump (Cd 22.95 keV, Te 27.18 keV) and the ~60 keV W line

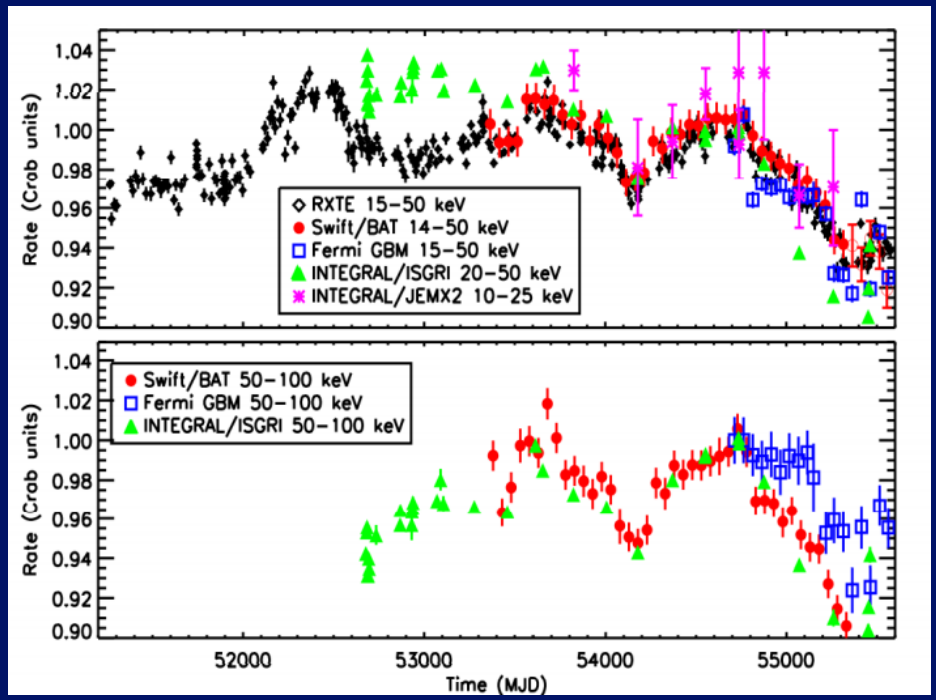


# The Crab variability issue




IACHEC 2010




Wilson-Hodge et al., ApJ 727, L40 (2011)

# Conclusions

- New significant improvements in calibration: better gain, offset and better energy correction, better determination of low threshold efficiency
- Spectral response still needs correction using Crab spectra.
- Ghost removal software improved with better data selection
- OSA10 delay, expected delivery within a few weeks