Technical University of Denmark

JEM-X Calibration

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JEM-X calibration issues

Time dependent questions

- Gain evolution
  - Efficiency must be monitored by regular Crab staring as gain is increasing
  - Evolution of spatial gain map can be checked by 30 keV Xenon fluorescent line present in the detector background
- Increased temperature sensitivity of gain is tracked by calibration sources, but ground SW has needed update to track the gain better
- Anode loss affects the effective area
  - Challenge: understanding the effect of lost anodes on the rest of the detector

Time independent questions

- Off-axis response of the collimator is measured with Crab observations
- Electronic efficiency and selection criteria are measured by spectral ratio of observing with different gains using Crab staring

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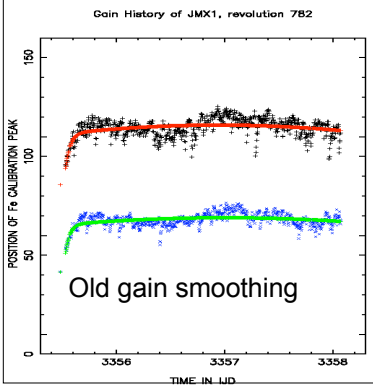
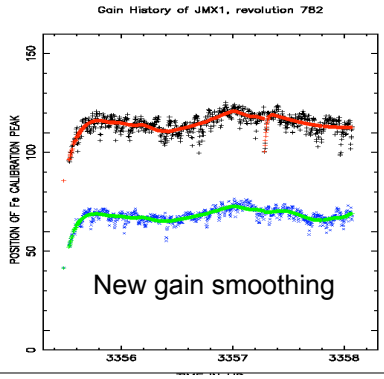
Gain variations due to temperature and gain fitting

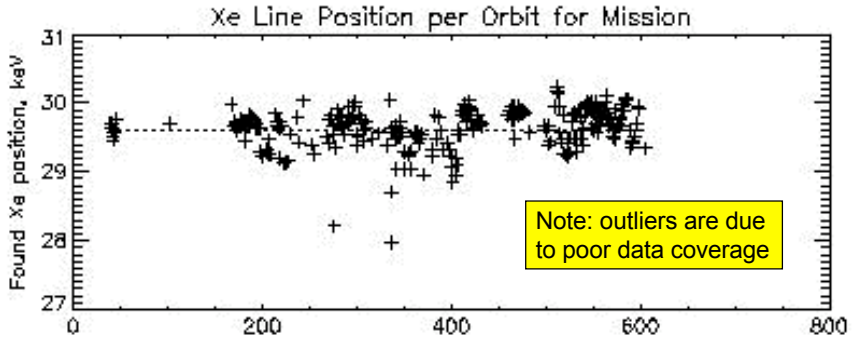
- Gain change due to temperature has increase from 1% to 4% per degree
- New less “stiff” gain smoothing has been introduced





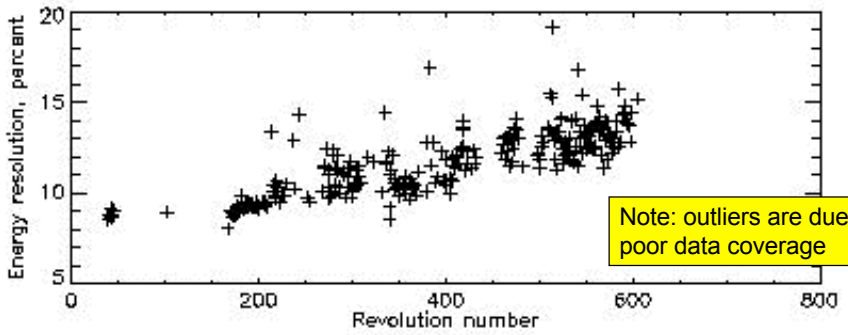
JEM-X gain correction

- Verification of gain correction by using Xe line at 29.6 keV present all over the detector



JEM-X energy resolution

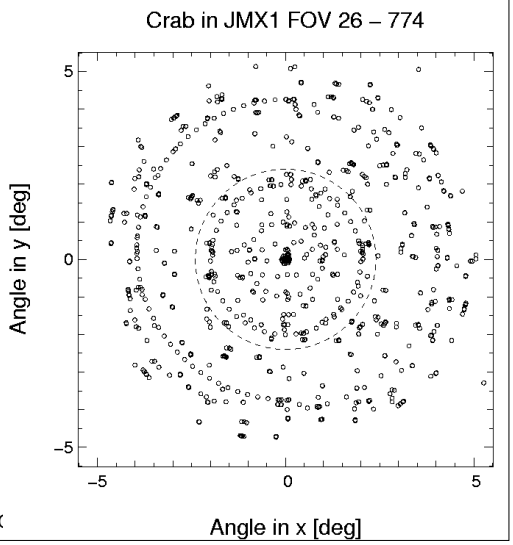
- average detector resolution 29.6 keV Xe line
- General increase may partly be recovered by improved spatial gain map



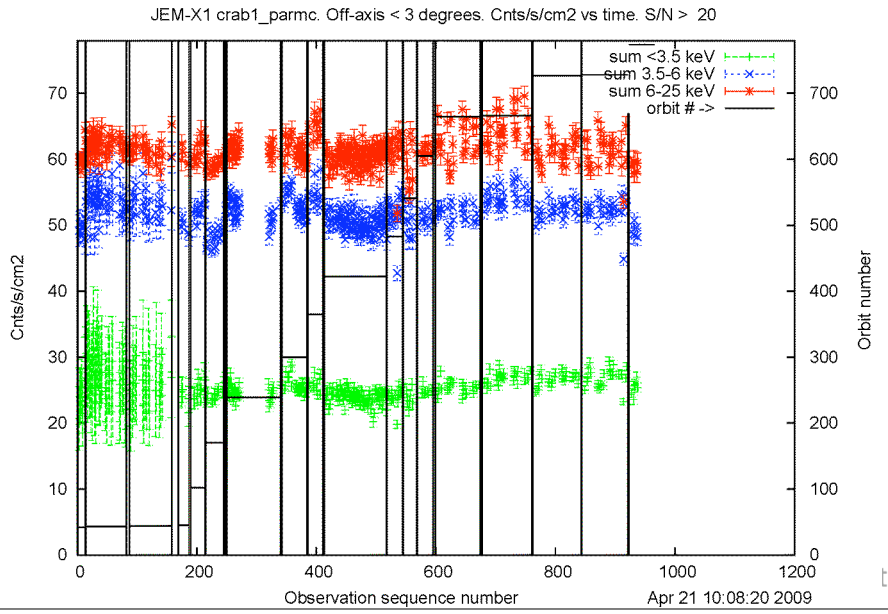
Note: outliers are due to poor data coverage

Crab in JEM-X FOV for measuring collimator response

- The JEM-X FoV is well sampled so far
- However, to investigate the collimator, samples at the same epoch are easier to compare
- Half-circles in 239 and 774 are good examples

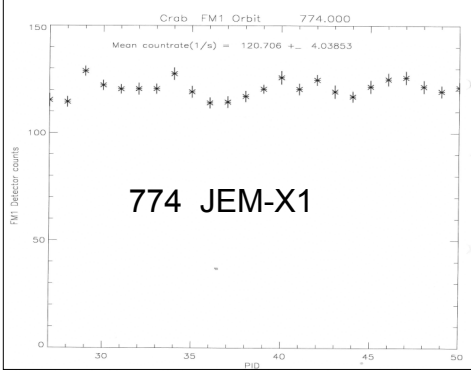


JEM-X1 Crab fits with OSA 8

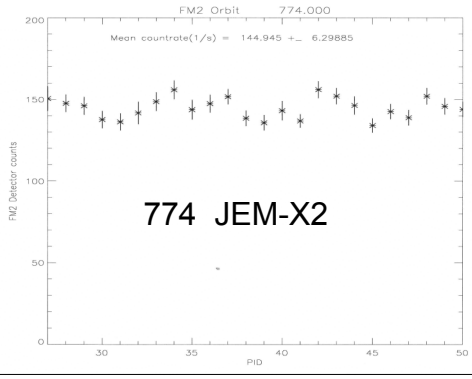


Results from orbit 774 4º semi-circle

- At 4º off-axis, in partly coded FoV, only part of the detector is illuminated
- Stand-alone SW by Carl Budtz-Jørgensen used
- ~4% systematics possibly caused by:
  - Collimator,
  - spatial gain variations,
  - detector effective area variations possibly not accounted for by dead anode map



774 JEM-X1



774 JEM-X2

JEM-X calibration – objectives and means

- Maintain stable flux and spectral determination of sources in the fully coded FoV
  - Regular calibrations with Crab on-axis and off-axis to follow time evolution of the detector (typically 10 ks dedicated + SPI 5x5 dither)
- Understand off-axis response (collimator)
  - Crab at various positions (circle, line, or other), best comparable when taken at the same time (complete the 4º started in 239 and 774, considering program in fully coded FoV)
- Updating spatial gain map and monitoring spectral resolution
  - Co-adding Xe line spectra on pixel scale for all data from hundreds of orbits, no dedicated observations

Conclusions

- JEM-X performance is time dependent, requiring regular monitoring calibrations and occasional “engineering” type sessions with special configuration
- On axis Crab: 2 x 10 ks per year
- Other calibration exercises: 10-20 ks per year
- Much data already exist to (in principle) improve calibration by adjusting the parameters in the imaging software
  - Man-power limited