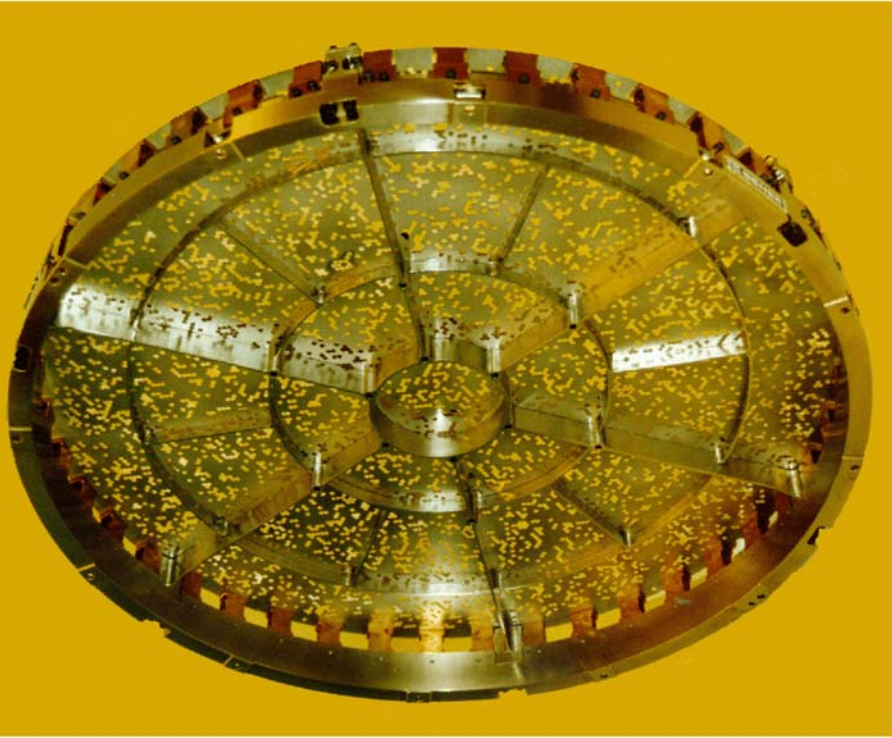


Crab spectrum from JEM-X onboard INTEGRAL

Niels J. Westergaard
C. Budtz-Jørgensen

Instrument properties
Selection of detector area
Gain effects
All detector spectra and background
Results from fitting

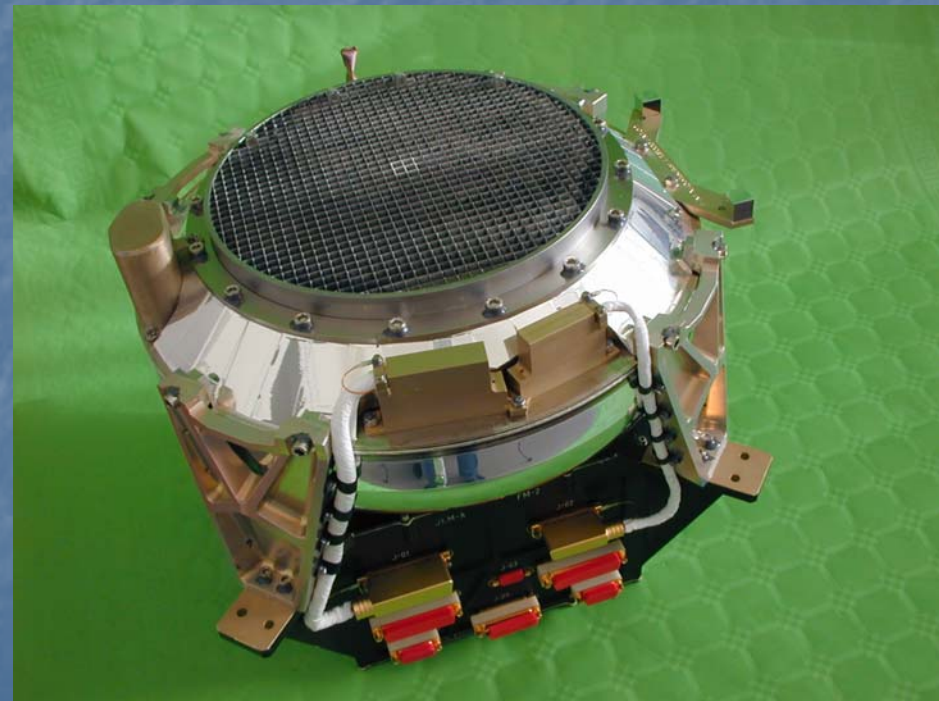
JEM-X HARDWARE



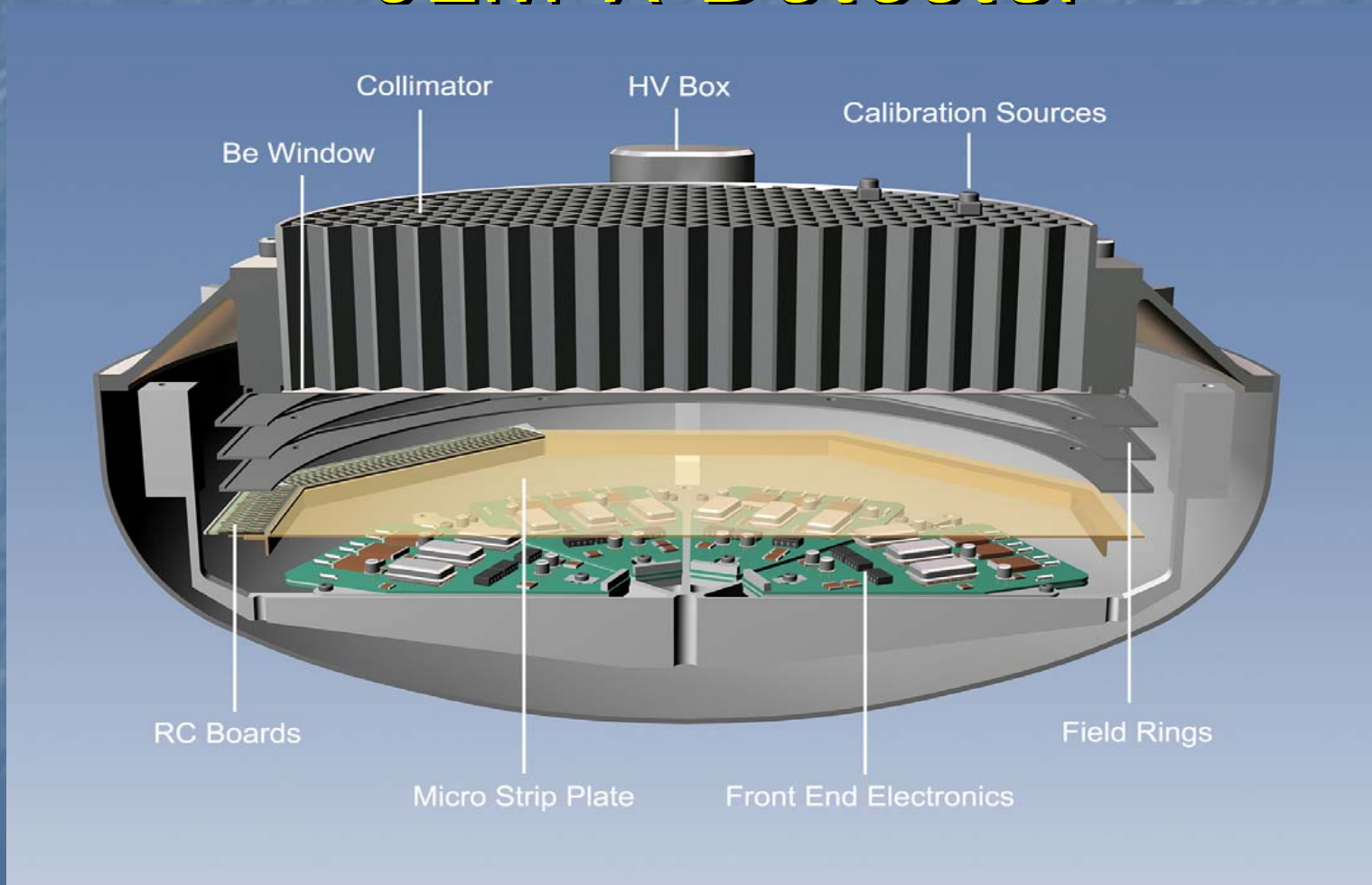
Mask : 535 mm
Mask hex holes: 3 mm
Detector diam : 250 mm
Mask-Detector: 3401 mm

19. May 2008

3rd IACHEC Schloss Ringberg



JEM-X Detector



However, soon it was discovered that we lost anodes ...

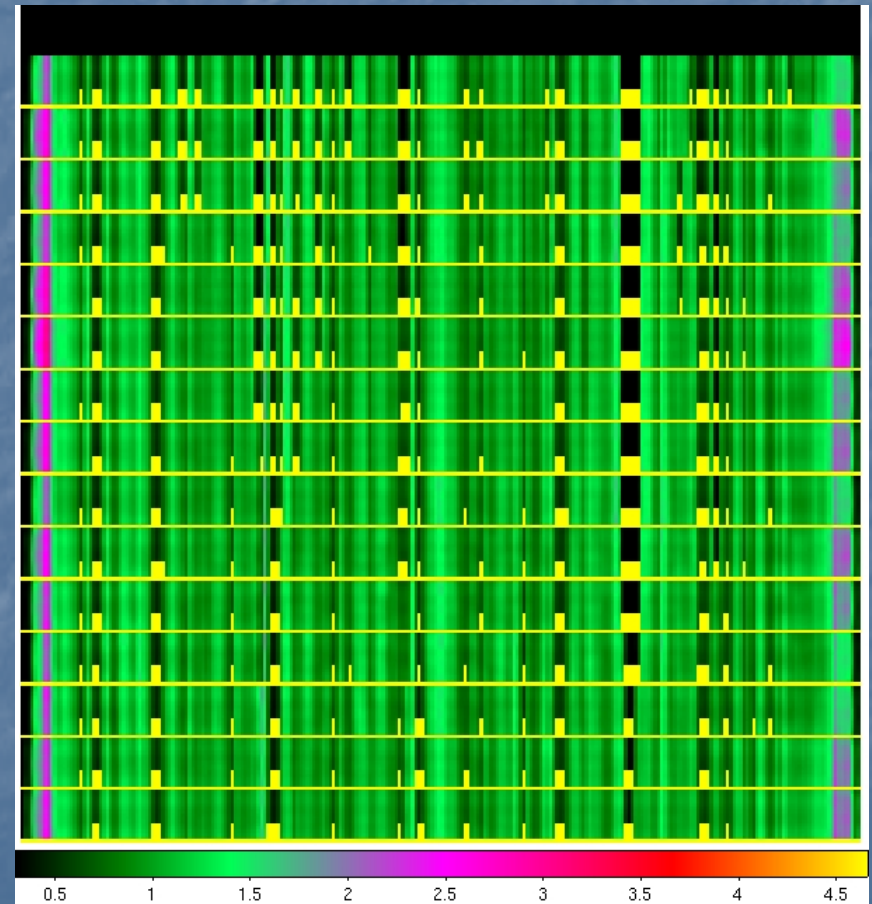
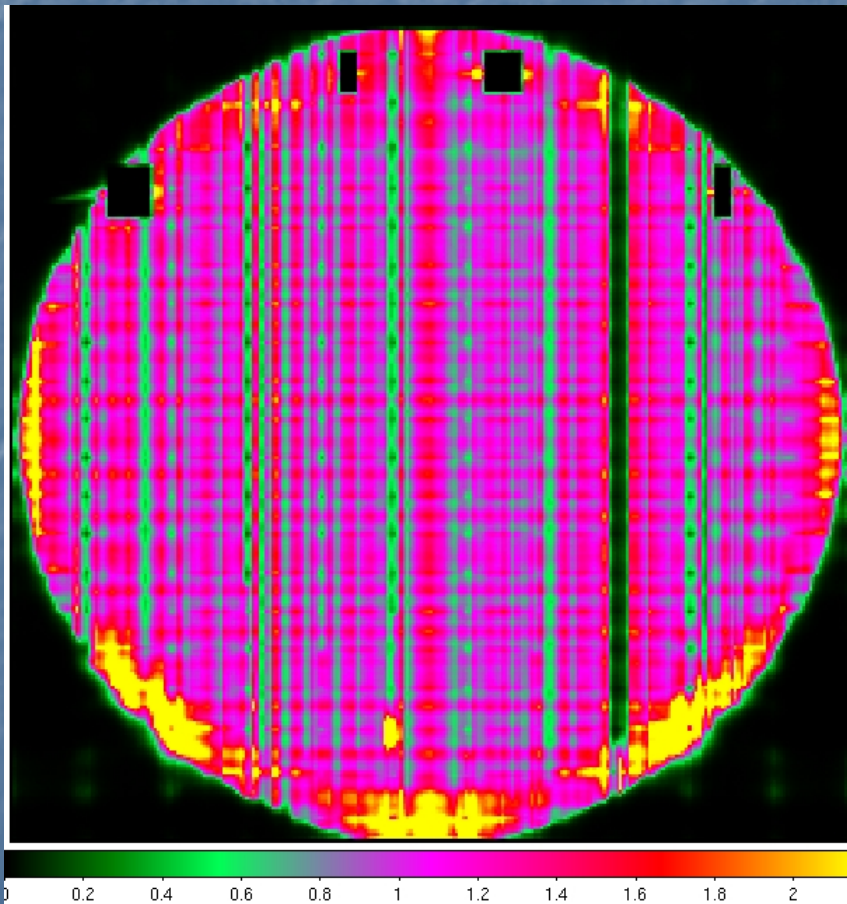
Consequences:

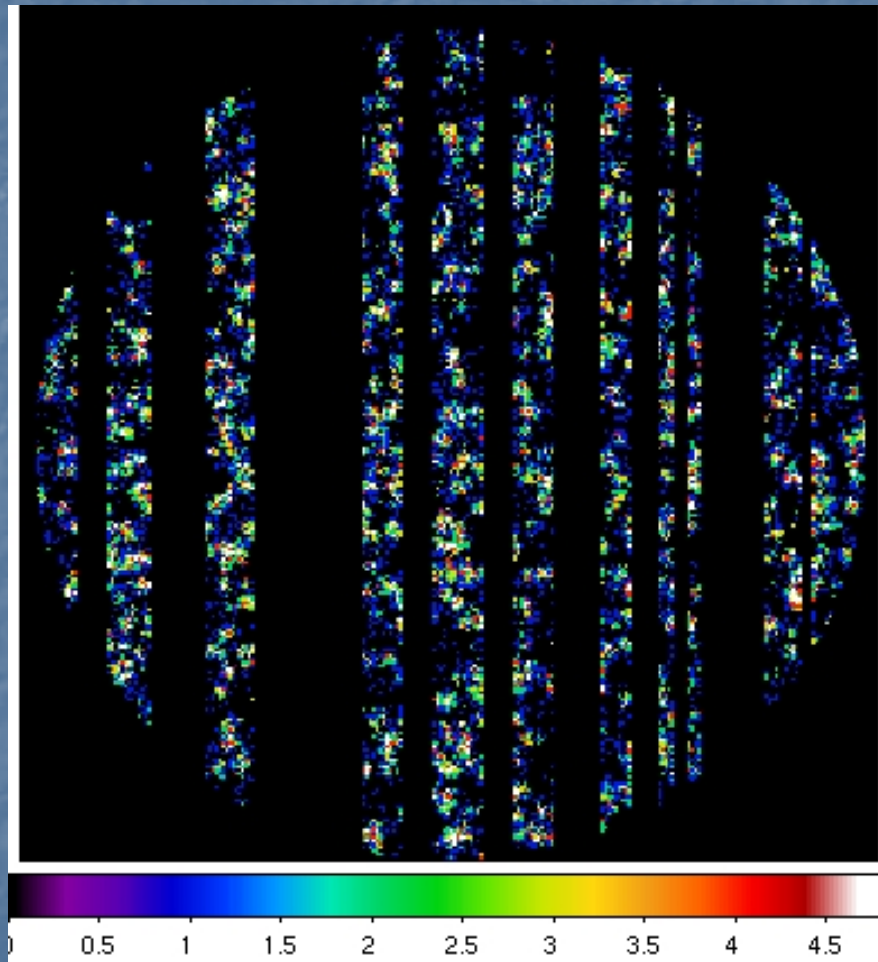
- The high voltage was lowered → lower gain
- Only one instrument is used at a time

- The Crab was used 'actively' for the calibration

JMX1 shadowgram revolutions
311 – 497, 12 – 25 keV

Progression of anode deterioration





The selected detector part to minimize the effect of anode problems.

Two phenomena appeared:

- 1) Due to the lower high voltage the electronic threshold cuts in at energies below 10 keV
- 2) The gain increases slowly in the course of time with high voltage on
This is counteracted by lowering the voltage from time to time

The electronic efficiency (threshold and bkg rejection) is a function of PHA.
The ARF depends on the energy of the photon.

The absorption in the thermal foil, the Beryllium window and the detector gas (Xe) is known.

The calibration of the electronic efficiency is done by comparing the Crab spectrum with nominal and low high voltage.

JEM-X Electronic Efficiency

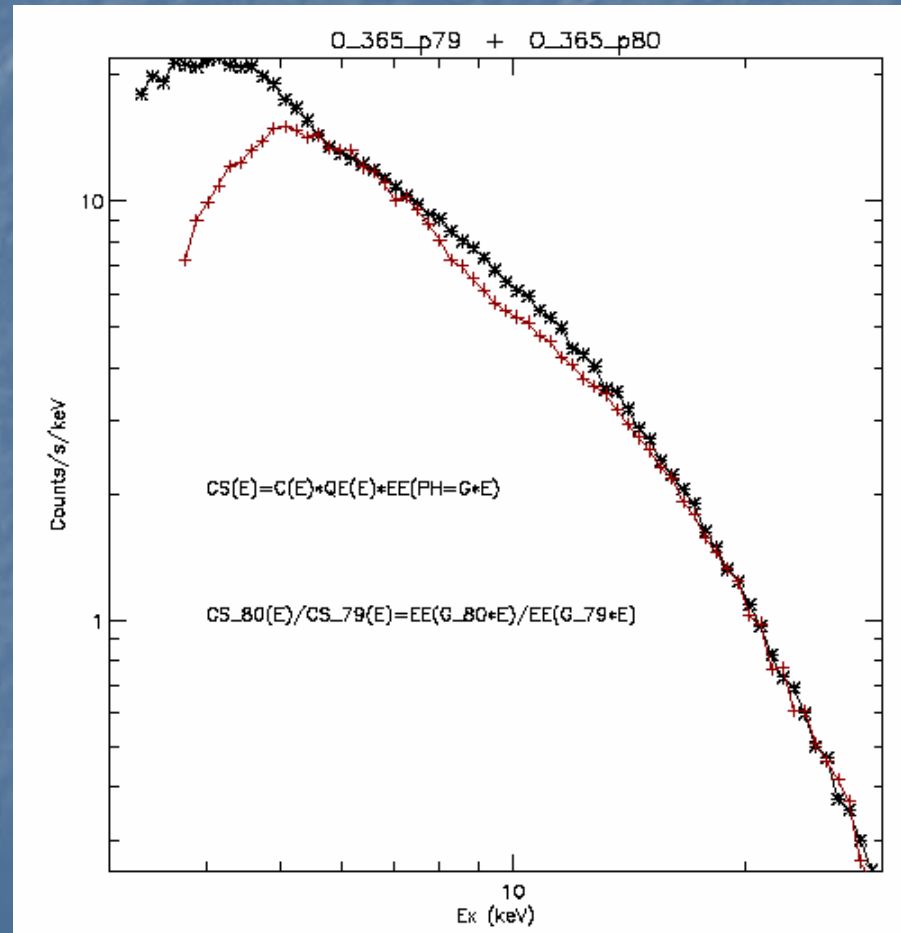
In the approximation where the energy resolution is disregarded:

- $N(E) = \text{Flux}(E) * \text{ARF}(E) * \text{EE}(\text{PH}=\text{Gain} * E)$
- $\text{EE}(\text{PH}=\text{G2} * E) = \text{EE}(\text{PH}=\text{G1} * E) * N2(E) / N1(E)$

Solved by assuming $\text{EE} = 1$ for high PH; with $\text{G2} < \text{G1}$ one gets EE for a lower PH. With $\text{E}_{\text{next}} = \text{G2} * E / \text{G1}$ the next lower value is obtained – and so on ...

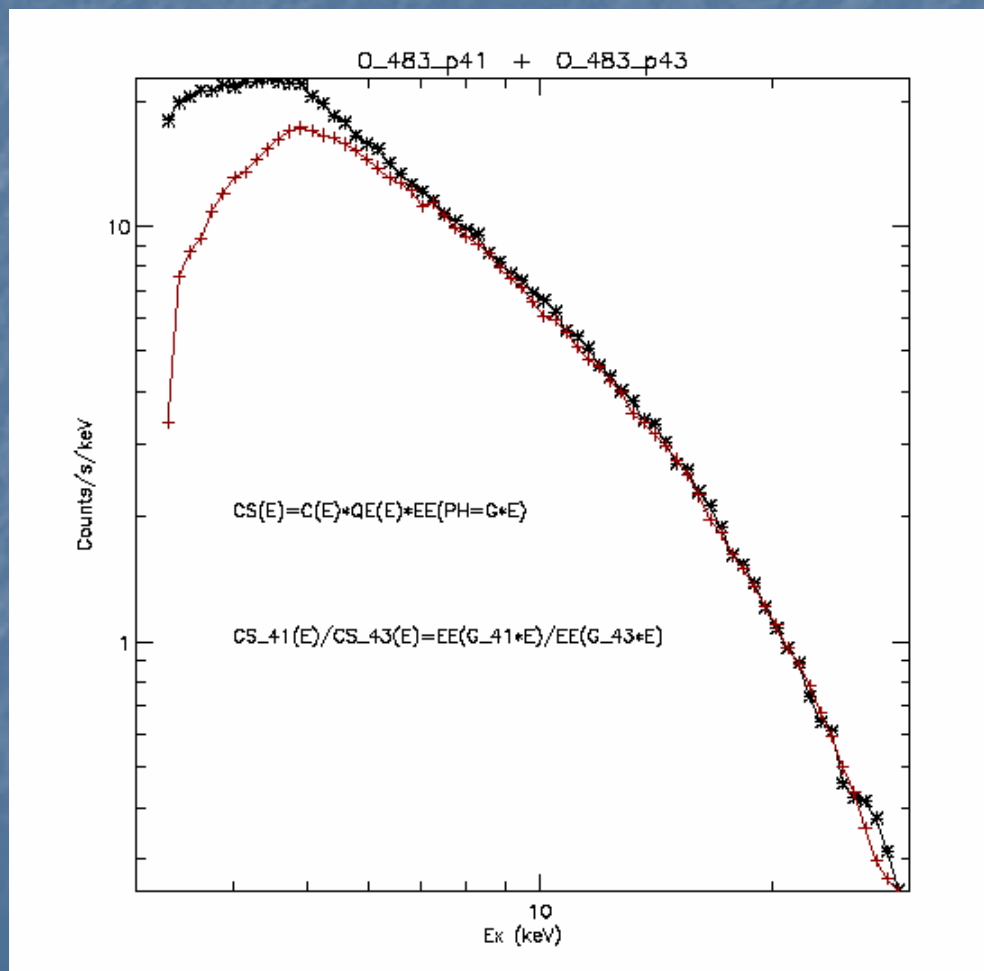
JMX1 Spectra

JMX1 spectra
with event
rejection that
depends on
pulseheight. It
is open
between
threshold and a
certain value.

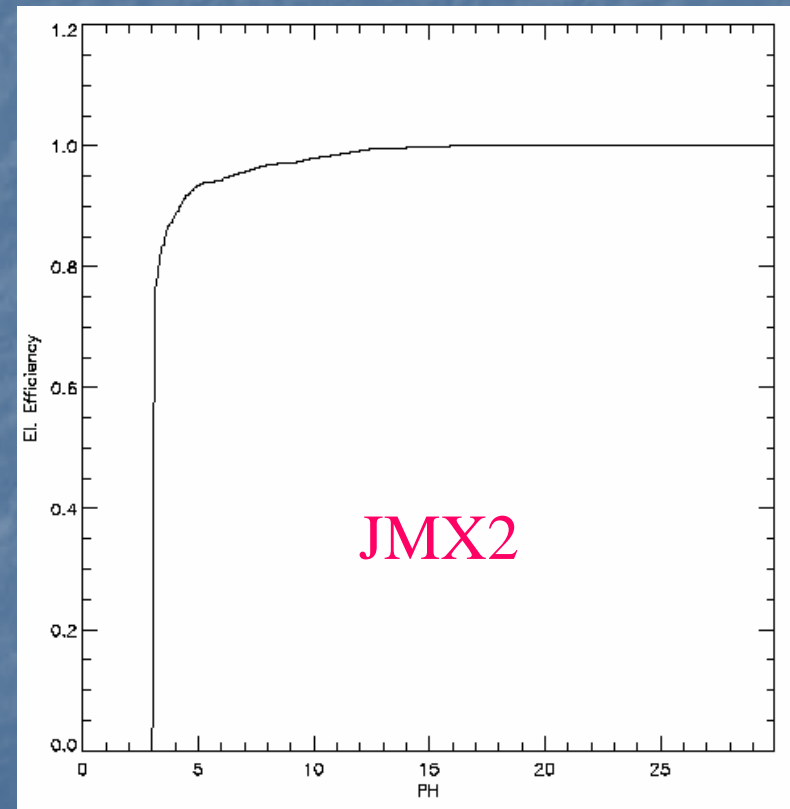
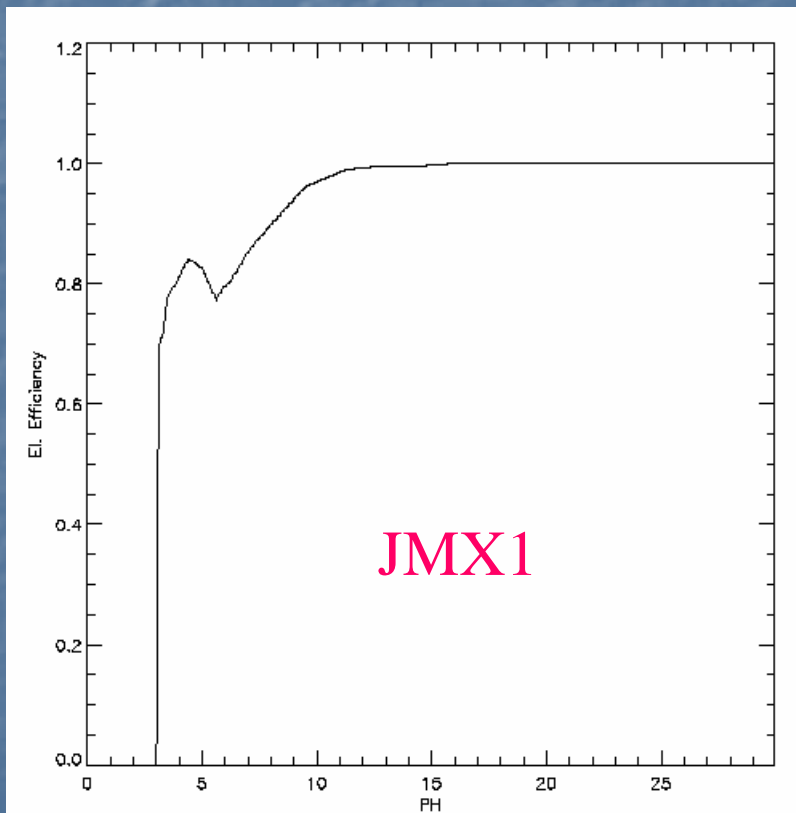


JMX2 Spectra

Spectra derived by fits to JMX2 Crab images generated (cross-correlation method) for 70 energy bins



Electronic Efficiency



Including the gain dependence in the spectral fitting

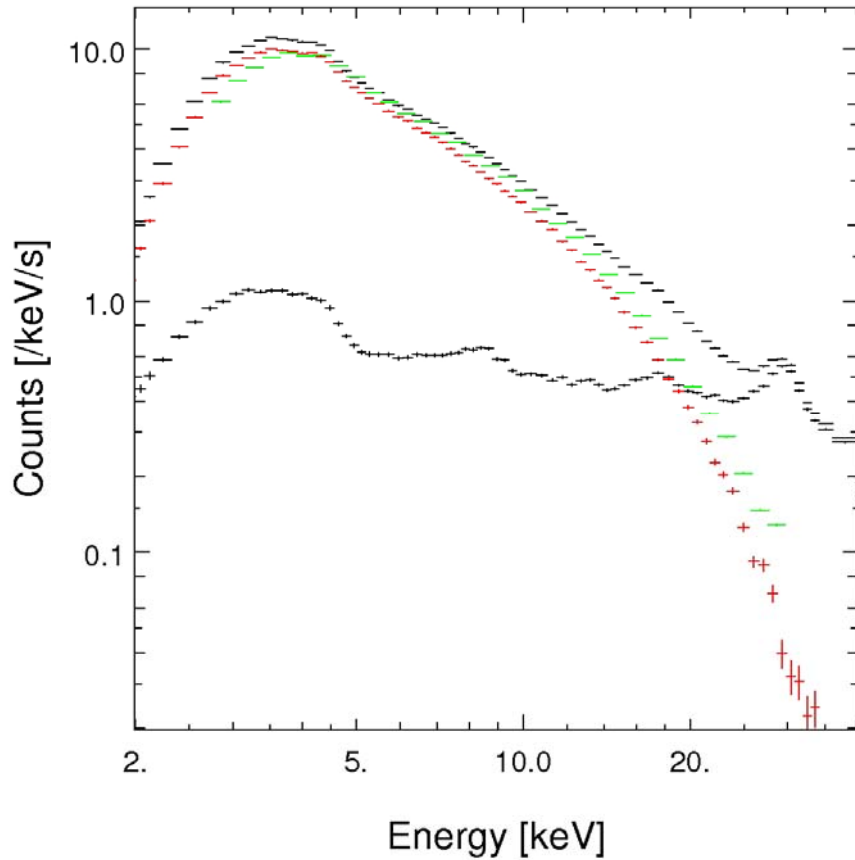
Usually we have

$$\text{Cts} = (\text{RDM} * \text{ARF} * \text{flux})$$

but the electronic effects the number of counts after redistribution
hence:

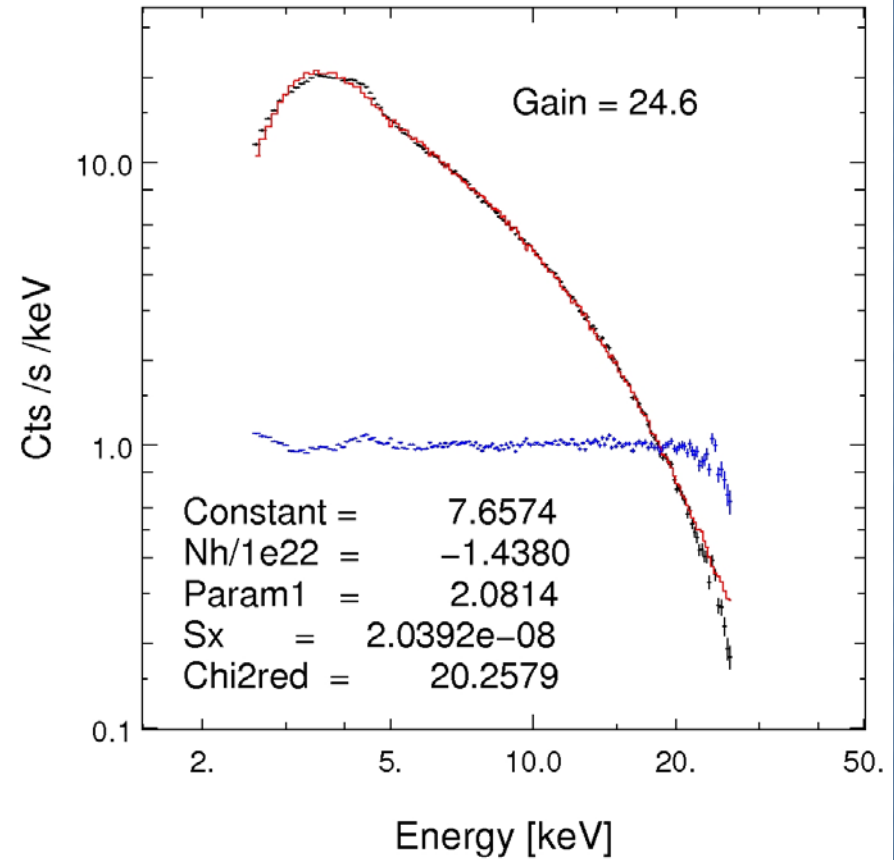
$$\text{Cts} = \text{Eeff} * (\text{RDM} * \text{ARF} * \text{flux})$$

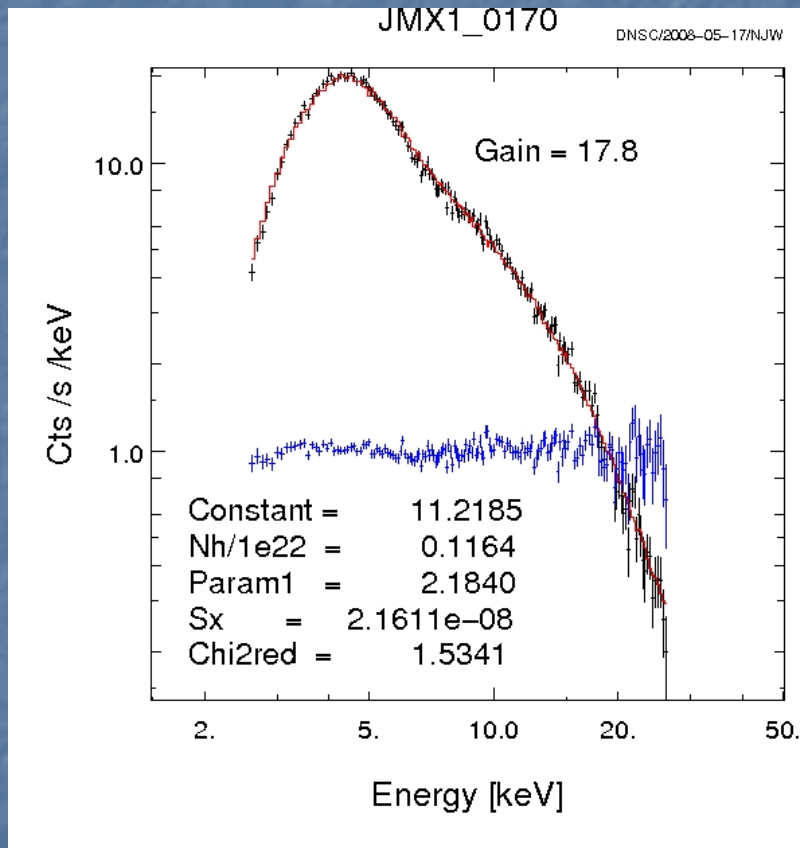
JMX1 80 ks, Rev 0605



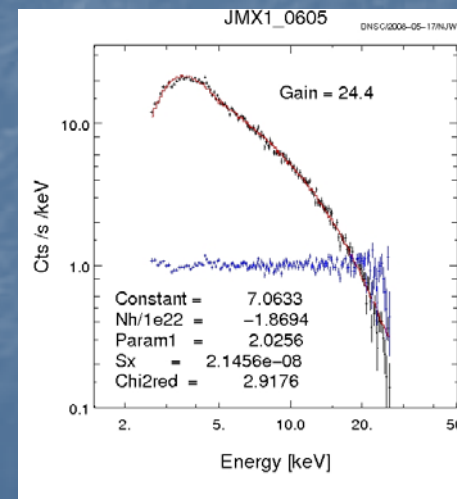
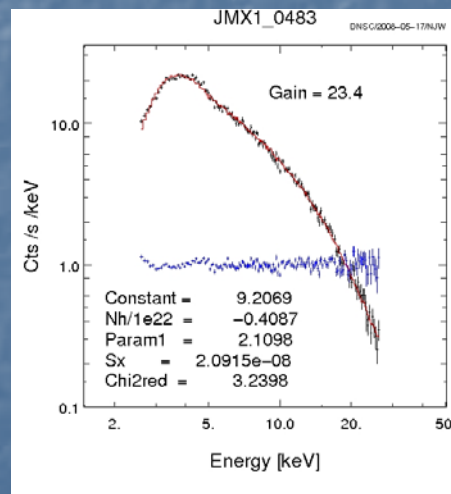
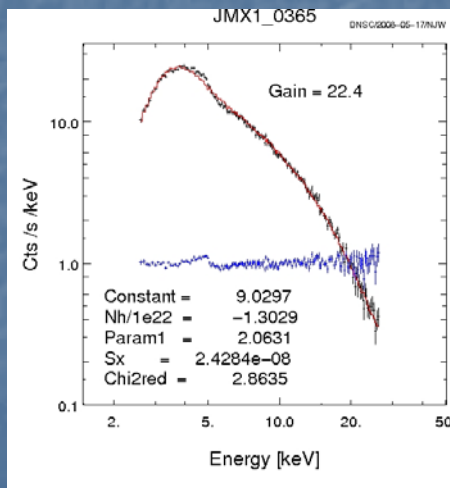
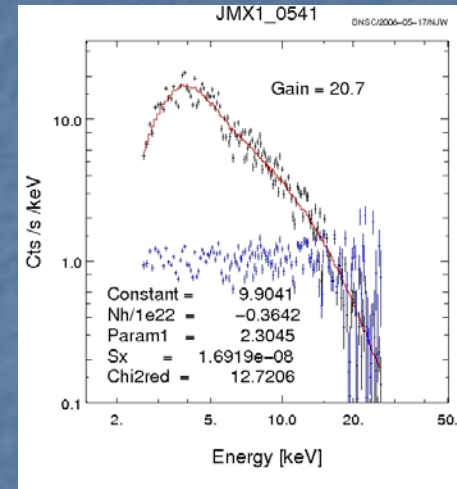
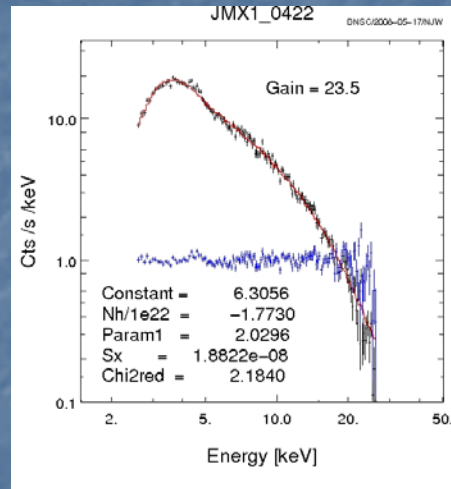
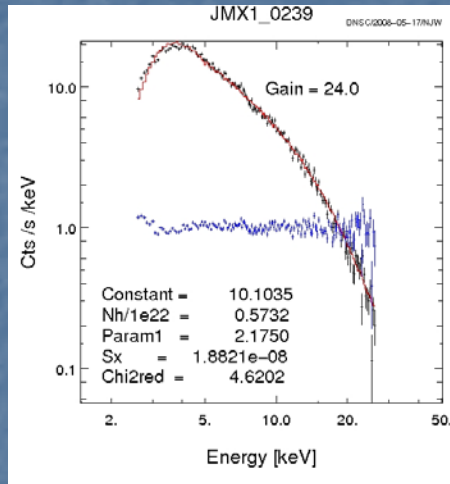
JMX1_80ks_0605

DNSC/2008-05-19/NJW

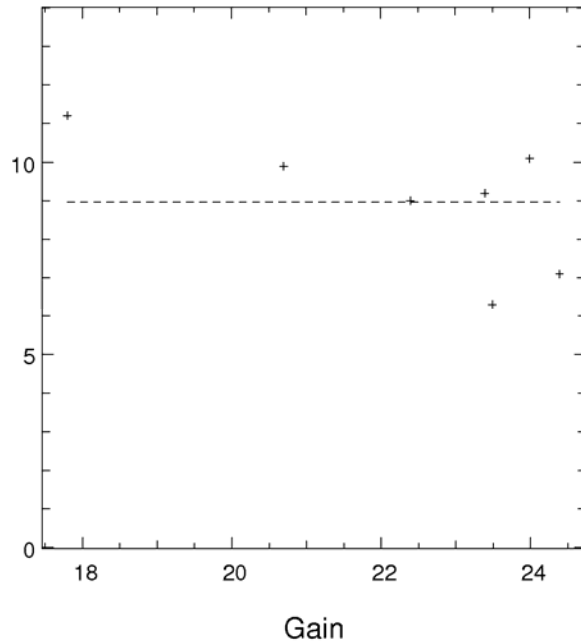




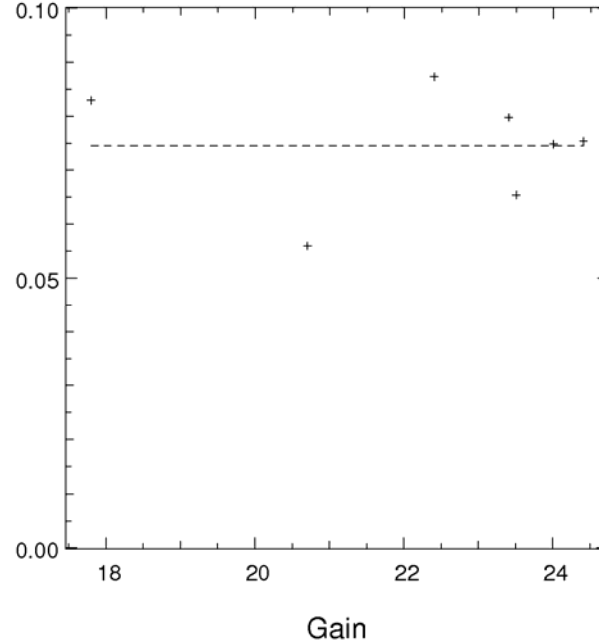
The result of fitting a powerlaw spectrum to the detector count spectrum



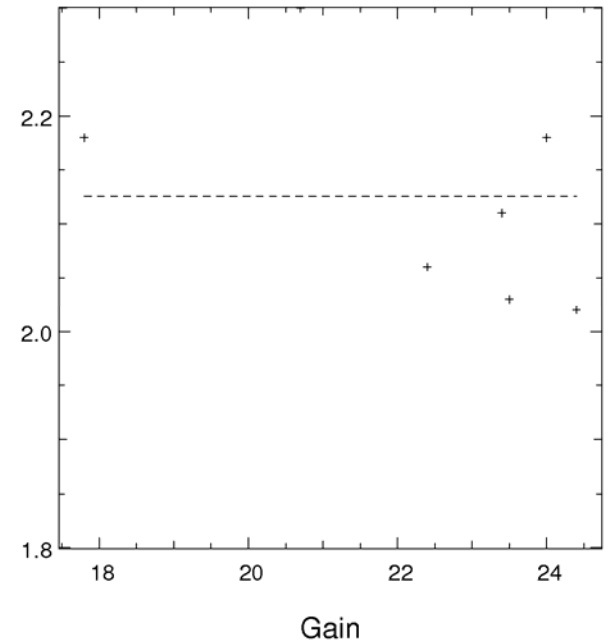
Normalization (1 keV)



Normalization (9.5 keV)



Photon Index



Concluding remarks

The absolute calibration must be improved

A powerlaw for the Crab is supported with an index
between 2.08 and 2.10 in the 3 – 30 keV range

The electronic efficiency must be better determined e.g.
in the next Crab calibration campaign

The ARF is now fixed but spectra taken with different
gain cannot be added. A new strategy must
be defined