SPI CALIBRATION WITH CRAB OBSERVATION

Request for a long 5x5 Crab calibration

- A request has been sent to the IUG
- The request has been accepted by the PS
- The last Crab observation lasted 2 Rev.

(~ 400 ks duration)

SPECTRUM FOR THE 5X5 DITHERING PATTERN

~ 81 ks

FIT RESULTS:

BROKEN POWER LAW

Without systematics

α_1 = 2.08 +/- 0.02

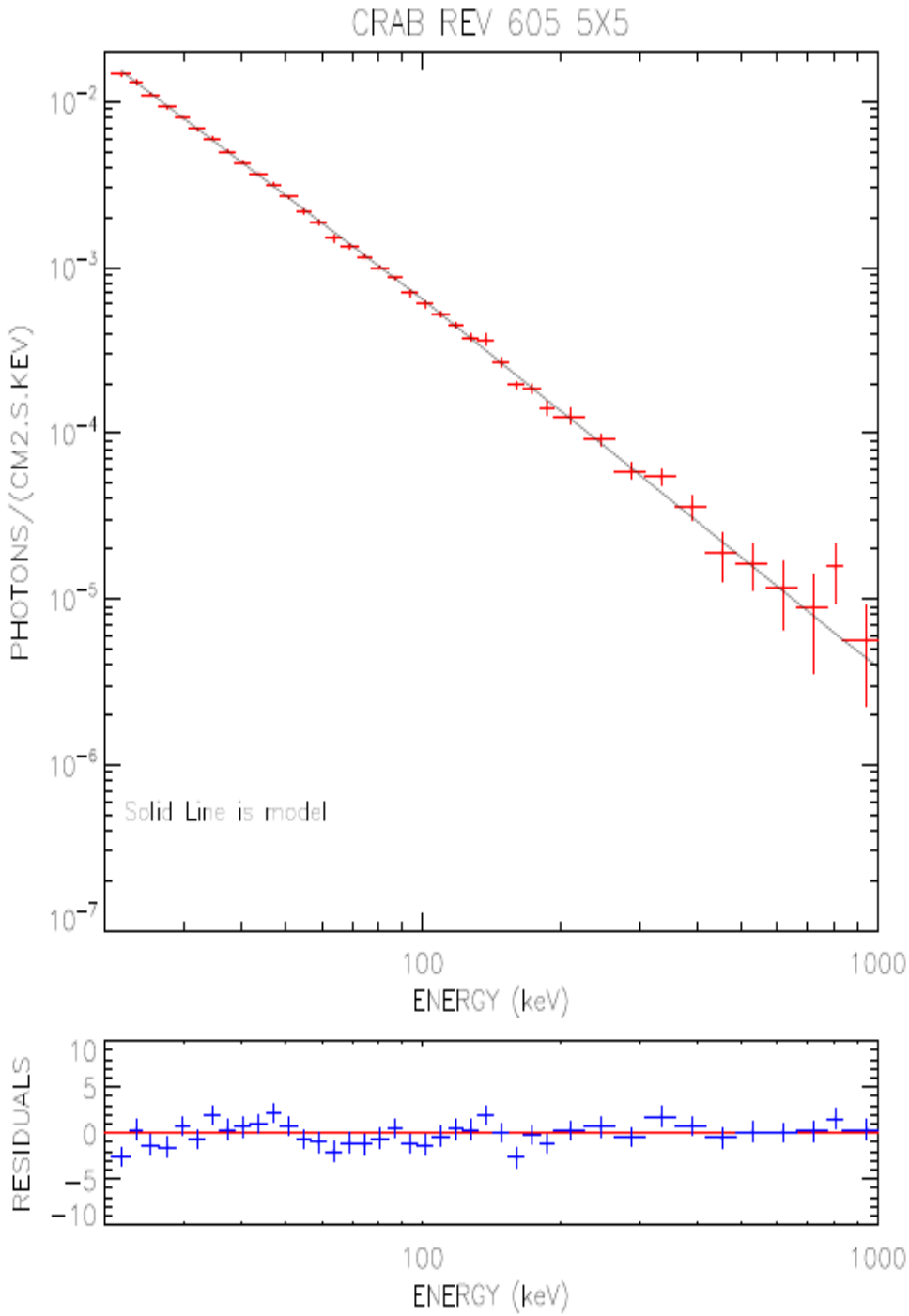
Eb fixed to 100 keV

α_2 = 2.23 +/- 0.05

FLUX @ 100 keV :

6.23 10-4 ph/ cm2 s

COMPATIBLE WITH PREVIOUS SPI RESULTS



Next Crab calibration

- For the next Crab calibration we request the same amount of time
  - 2 revolutions in 5x5 dither pattern
- Then the aim of 1Ms (as expressed during the last IUG) will be fullfilled.

INTEGRAL Cross-calibration Status between 3 keV and 1 MeV

Answer to IUG action 05-4 by Instrument teams

JEM –X

Orbit 300 data
(ARF derived from earlier observations):

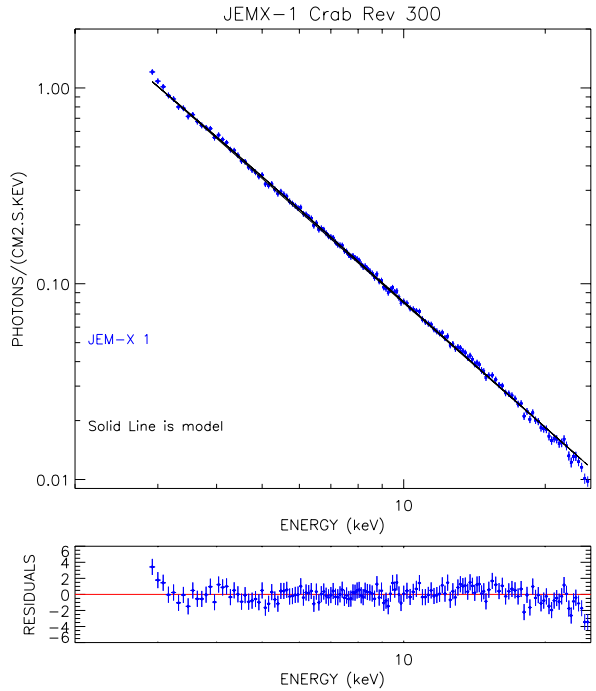
- JMX1
  Photon Index = 2.15±0.05

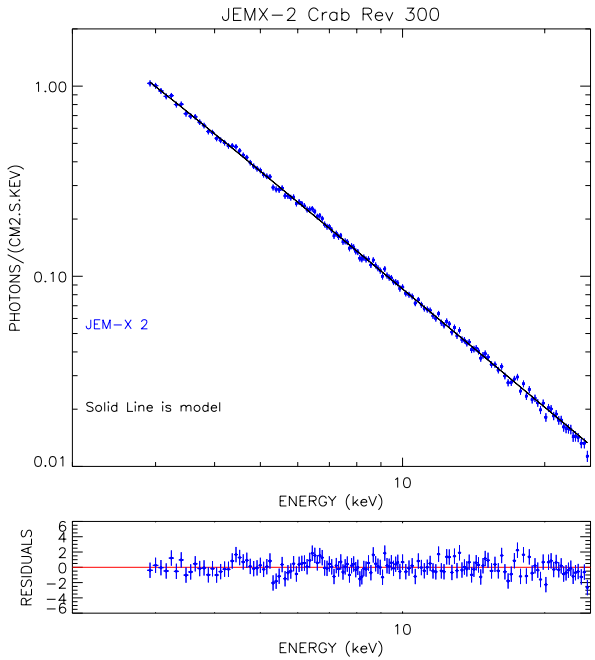
Flux @ 1 keV = 11.3±0.1 ph cm^{-2} s^{-1} keV^{-1}
  NH = 0.265×10^{22} cm-2 (frozen)

- JMX2
  Photon Index = 2.07±0.05

Flux @ 1 keV = 10.2±0.1 ph cm^{-2} s^{-1} keV^{-1},
  NH = 0.265×10^{22} cm-2 (frozen)

For both instruments the energy flux from
2 – 10 keV is 2.28×10^{-8} erg cm^{-2} s^{-1}





ISGRI

From “absolute” matrix

- Orbit 300 data:

  Photon Index = 2.12±0.03
  Flux @ 100 keV = 6.5 × 10-4 photons cm-2 s-1

- Orbit 605 data :

  Photon Index = 2.13±0.03
  Flux @ 100 keV = 6.2 × 10-4 photons cm-2 s-1

- values very similar and compatible at ~ 2 σ level with SPI.
- This proves that below 100 keV ISGRI can give an independent and stable estimate of the Crab spectrum

BUT

some more work is needed to assess the response at high energies and to get rid of the residual systematics (visible with narrow bands) below 100 keV.

That is why the ISGRI response matrices (in particular the ancillary response function, ARF) derived by means of Montecarlo simulations, and based on the current knowledge of the instruments, are corrected “a posteriori” in order to match the SPI Crab spectrum, which is taken as an independent absolute measure.

SPI

Total = all revolutions with 17 detectors
5X5 patterns

325 ks of useful duration, distributed over 7 revolutions

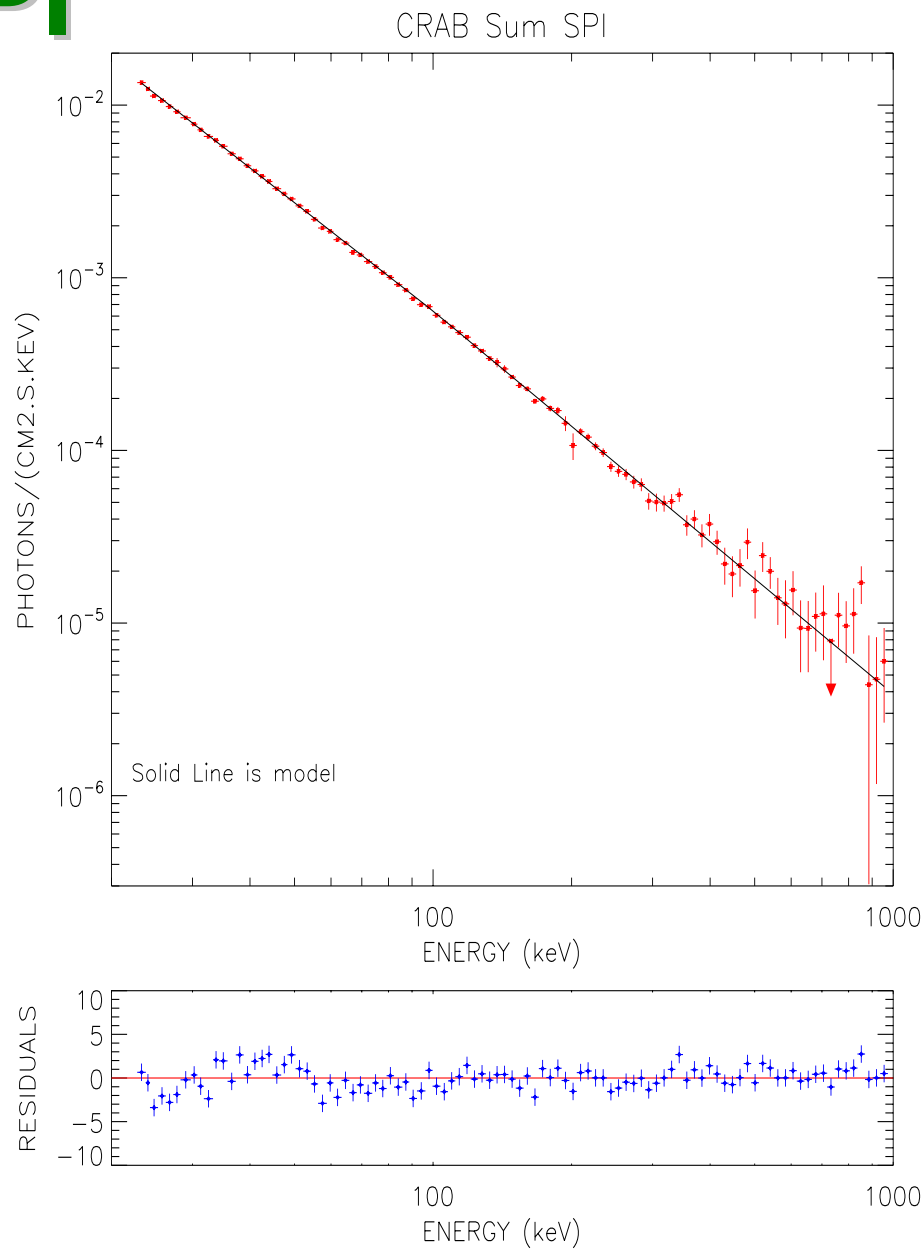
From 23. keV to 1 MeV, 0% systematic:

- **Model :**

a broken power law
with Ebreak fixed to 100 keV

Photon Index 1 : 2.08 +/- 0.01
Break Energy (fr) : 100.000 keV
Photon Index 2 : 2.22 +/- 0.03

Flux @ 100 keV: 6.3 10^{-4} ph. cm^{-2} s^{-1}
Extrapol. flux@1 keV : 9.33 ph. cm^{-2} s^{-1}



INTEGRAL CRAB SPECTRUM

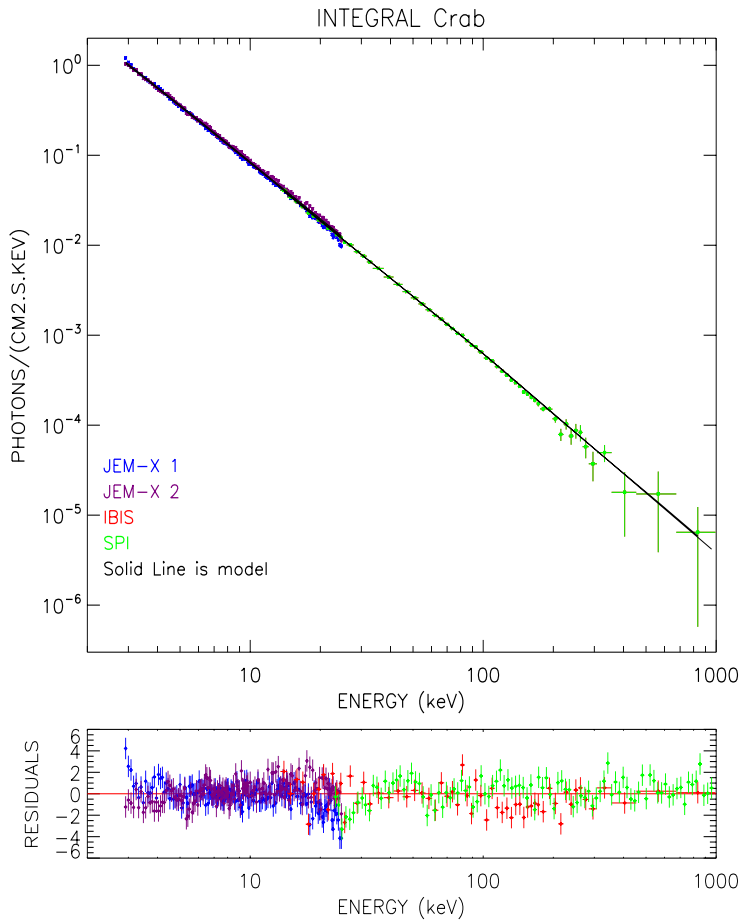
- JEM-X 1 and 2 data 3 to 25 keV (15 ks in revolution 300).
- ISGRI data have been used from 14 keV to 1 MeV (revolution 300), as in Section II but with OSA-7 (“corrected”) matrix.
- SPI : As presented above
- Systematics have been added at a level of 3% for JEM X-1 & 2; 1% for ISGRI and SPI

Model : a broken power law
with Ebreak fixed to 100 keV
plus an absorption with Nh fixed to 0.265 10^{22} cm^{-2}

Photon Index 1 : 2.105 +/- 0.3 10^{-2}
Break Energy : 100.000 keV frozen
Photon Index 2 : 2.22 +/- 0.2 10^{-1}

Flux @ 100 keV: 6.18 10^{-4} photons cm^{-2} s^{-1}

factor SPI fixed to 1.0
factor ISGRI : 0.99 +/- 0.2 10^{-2}
factor JEM X-1 : 1.022 +/- 0.3 10^{-2}
factor JEM X-2 : 1.06 +/- 0.3 10^{-2}



Conclusion

- The INTEGRAL instruments give consistent results on the Crab Nebula spectrum,
  with a global shape in agreement with observations from previous experiments.

- In particular, the cross-normalisation factors between instruments are within reasonable values.

This demonstrates that INTEGRAL can provide reliable spectra over its wide energy range.