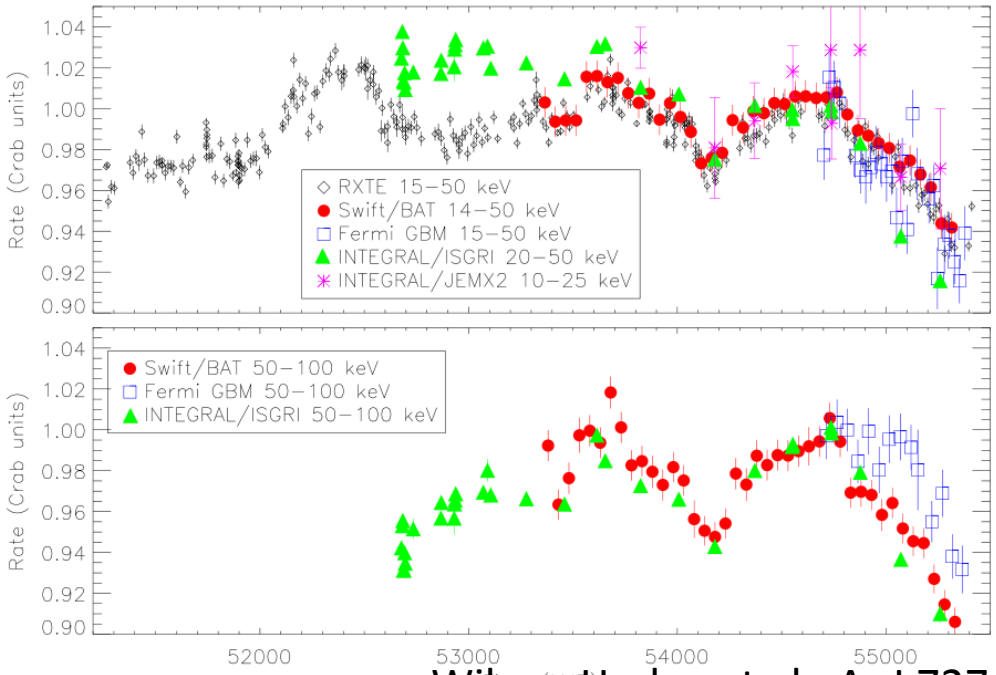
IBIS update on Crab calibrations

L. Natalucci, A. Bazzano, M.T. Fiocchi and P. Ubertini (INAF/IASF-Roma)

Flux variability of the Crab Nebula



A decade of observations from various instruments

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

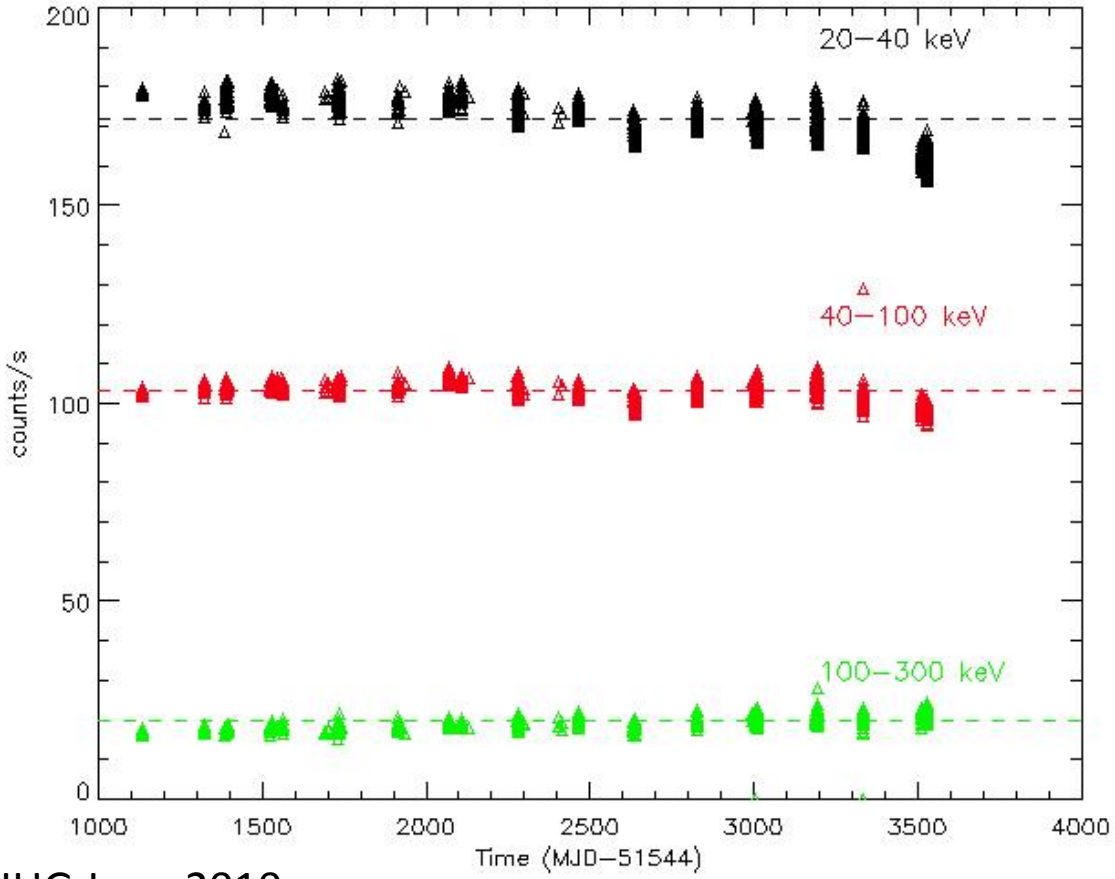
Fermi-GBM detects ~7% variability in the hard X-rays (12-500 keV) in ~2 years since mid 2008

Modular variations on a 3 years timescale are observed by Swift/BAT, RXTE/PCA and INTEGRAL/IBIS

Conversely, the pulsed flux decrease is constant and consistent with spin down rate, showing that **the origin is nebular**

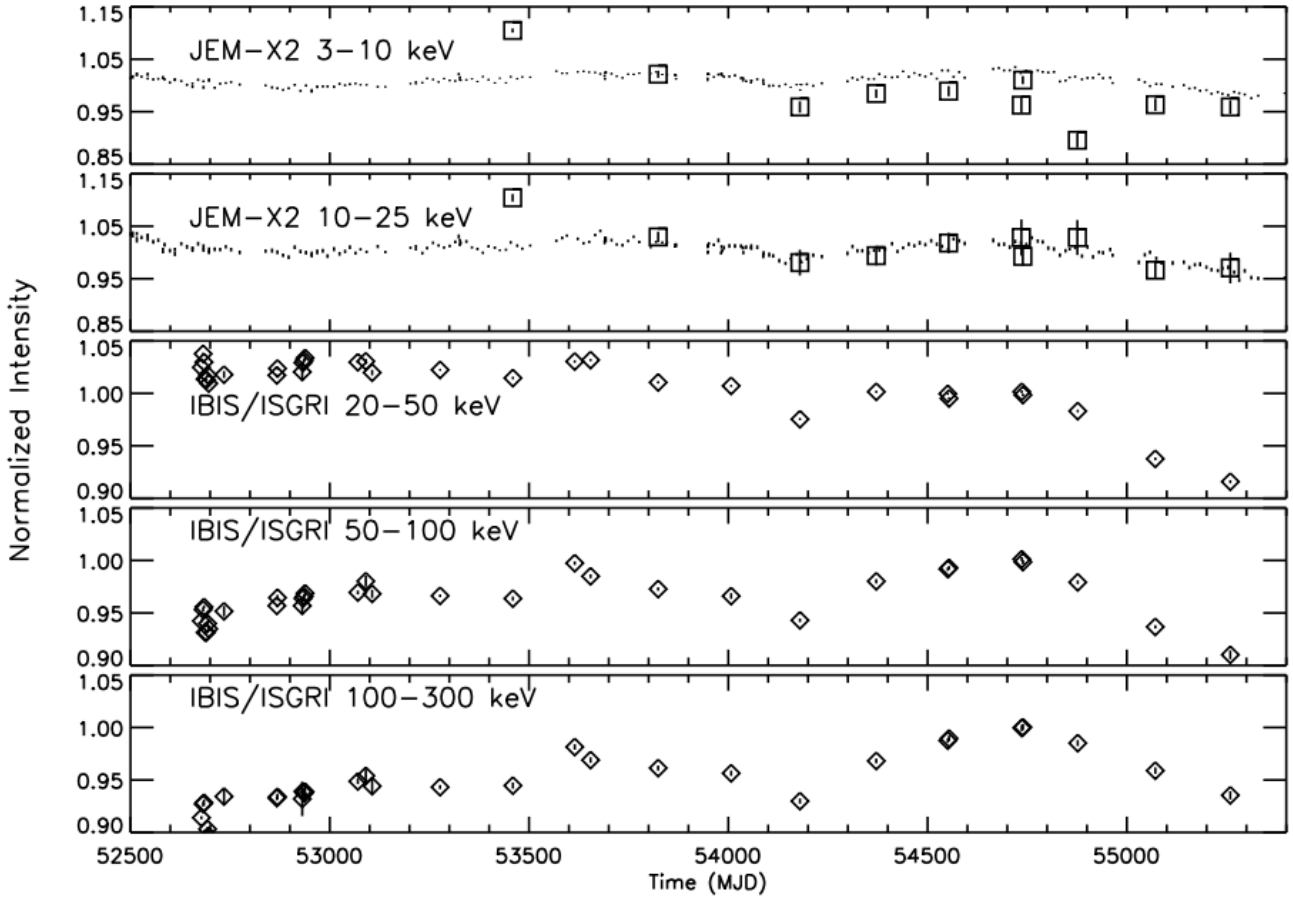
"Old" IBIS Light curves

Previously shown IBIS LC are consistent with the modular variations, and were wrongly ascribed to changes in the instrument effective area



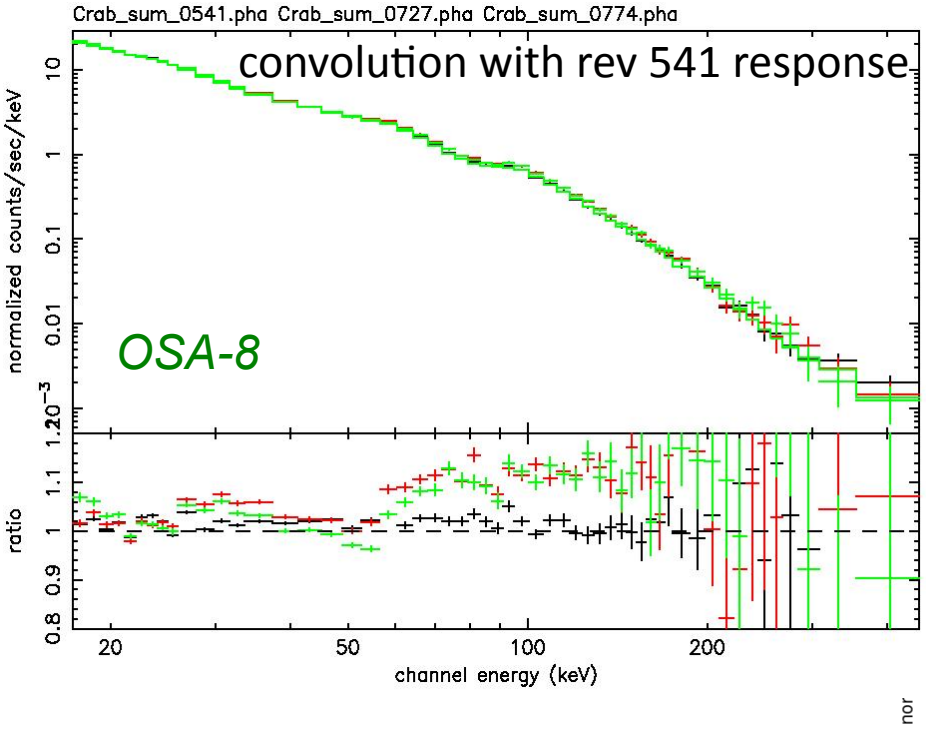
P. Ubertini, IUG June 2010

Correlated variability IBIS & Jem-X



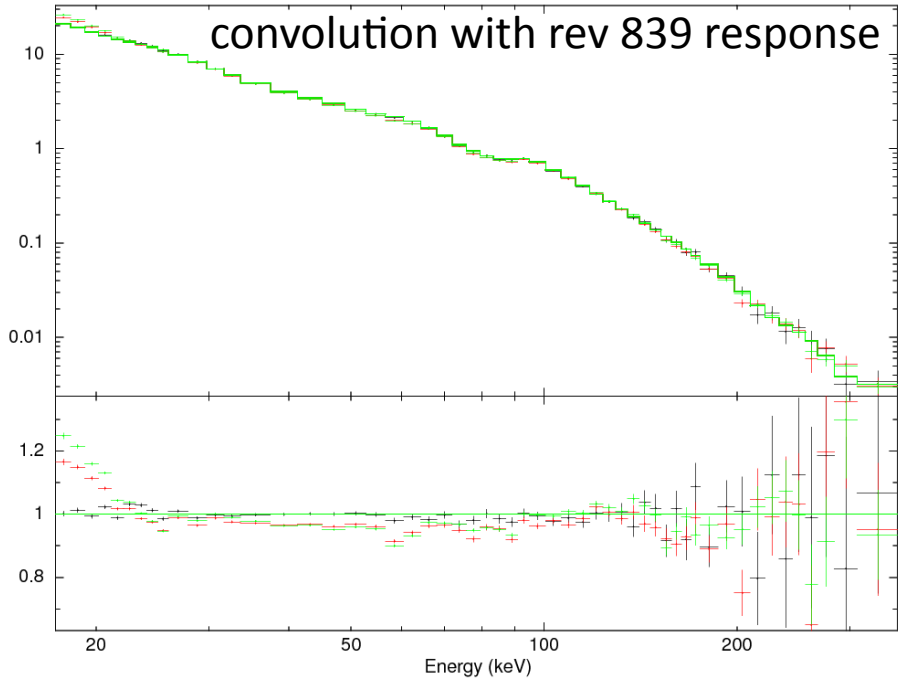
Wilson-Hodge et al., ApJ 727, L40 (2011)

Changes in count rate spectra



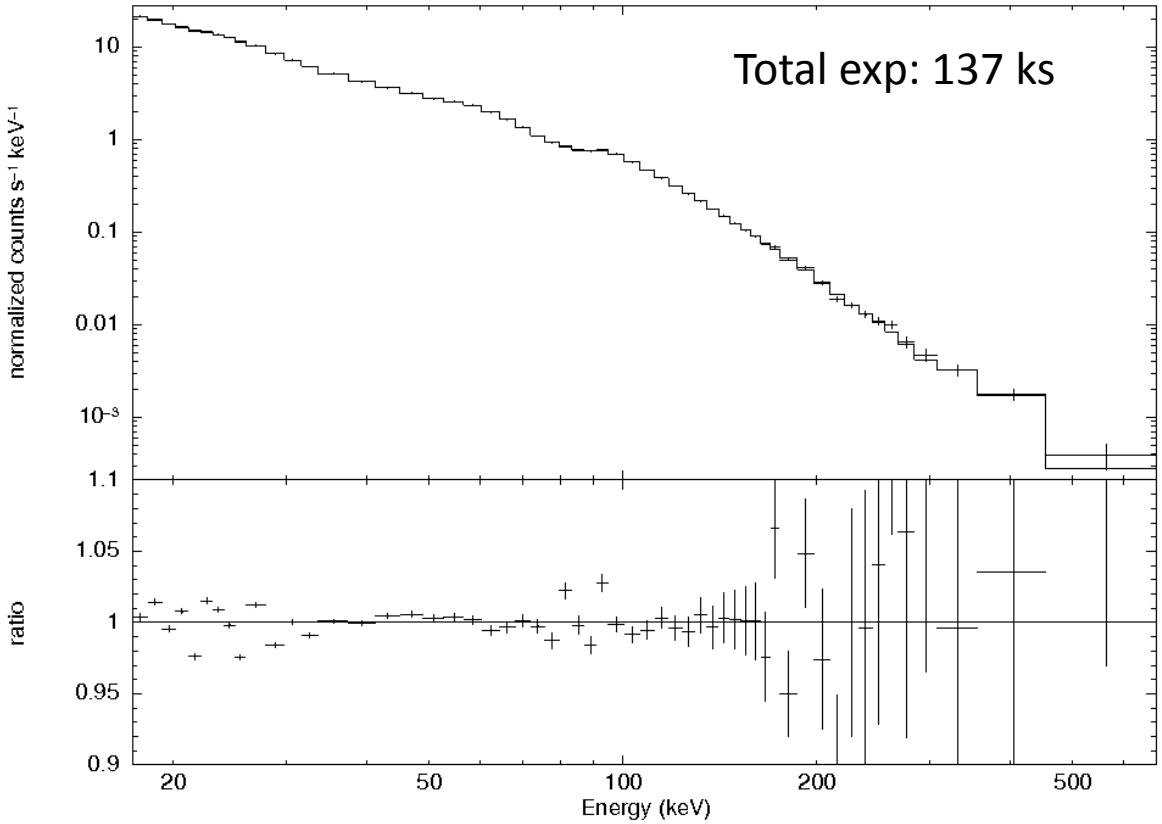
Rev. 541
Rev. 666
Rev. 774

Rev. 839
Rev. 902
Rev. 967



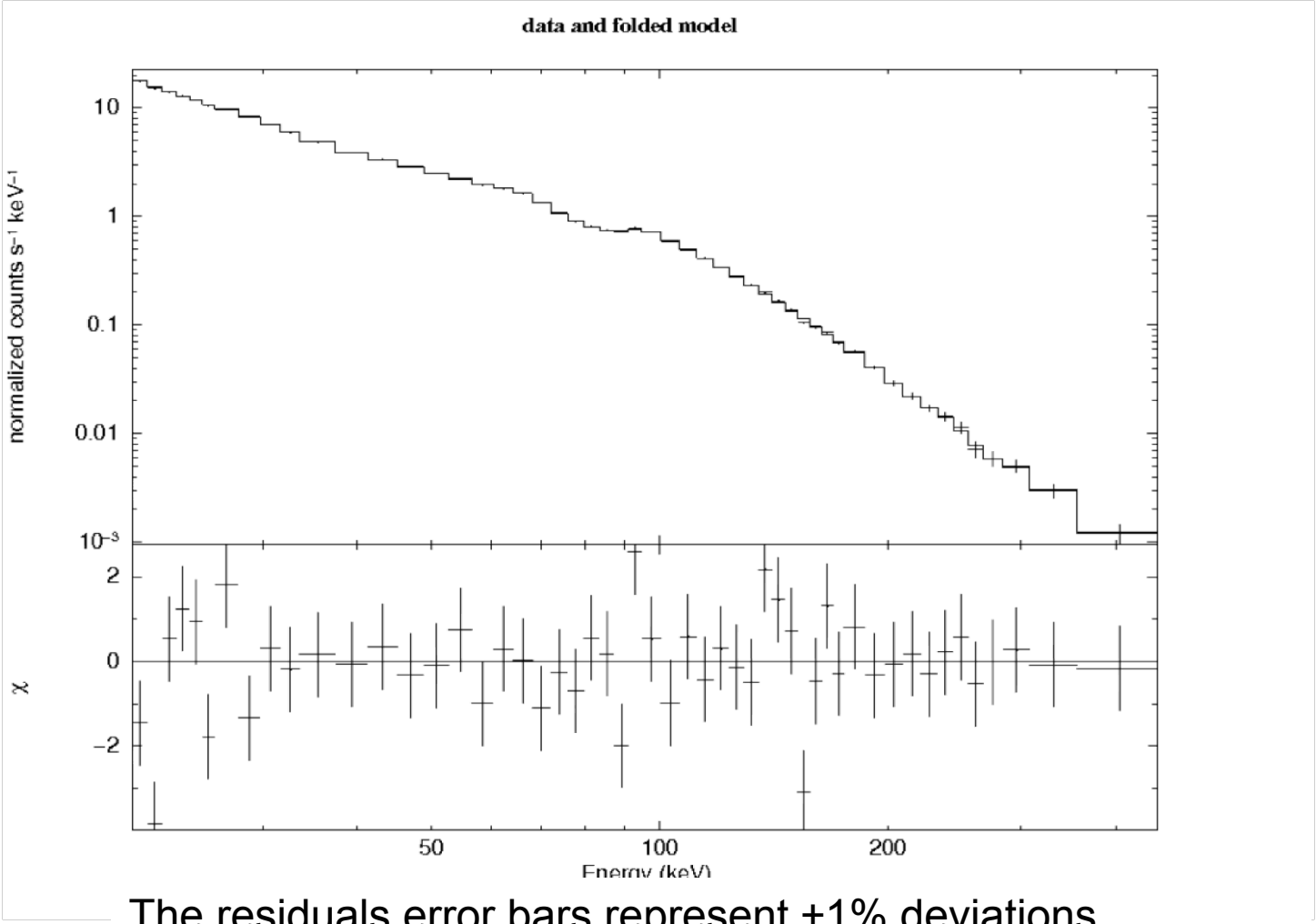
Long-term accuracy of the time dependent correction

Average spectrum on-axis, OSA 9.0, Revs. 541 to 839



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

ARF based on rev 967, computed at IASF-Roma



The residuals error bars represent ±1% deviations

On-going & Future Activities

ARF delivery is now stopped at rev 839

Several new “drawbacks” for calibration including the impact of **Crab variability** and inaccuracy of **gain correction** increasing with time

First issue to be (*or not to be?*) discussed broadly in the high energy community

Second issue can produce systematic biases in the spectral analysis. To solve this, we need 3 steps:
(a) new version of isgri_energy, (b) build and test of a set of new ARFs, (c) issue of a new OSA version by ISDC

A possible solution is to implement the rev 967 ARF immediately for use with the current OSA.

IACHEC

International Astronomical Consortium for High Energy Calibration

HOME WORKING GROUPS MEETINGS WIKI NEWS

Welcome to the IACHEC page

The IACHEC aims to provide standards for high energy calibration and supervise cross calibration between different missions. This goal is reached through working groups, where IACHEC members cooperate to define calibration standards and procedures. The scope of these groups is primarily a practical one: a set of data and results (eventually published on refereed journals) will be the outcome of a coordinated and standardized analysis of references sources ("high-energy standard candles"). Past, present and future high-energy mission can use these results as a calibration reference.

News:
The 6th IACHEC meeting will take place from **April 10** to **April 14 2011** at Villa Grazioli (Frascati, Roma).

Working Groups

- Legacy
- Methodology
  - Background
  - CCD issues
  - Contamination
  - Effective areas
  - High Resolution
- Standard Candles
  - Clusters
  - Isolated Neutron Stars
  - Non-Thermal SNR
  - Thermal SNR
  - White Dwarfs

Meetings (with talks)

2006 Nesbud, Iceland
2007 Lake Arrowhead, California
2008 Ringberg Castle, Bavaria
2009 Shonan Village Center, Japan
2010 Woods Hole, Massachusetts
2011 Villa Grazioli, Italy

Active Observatories involved

Chandra
Integral
MAXI
RXTE
Suzaku
Swift
XMM-Newton

Useful Links

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IACHEC collaboration papers

Paper	Missing	Submission
1E0102-7219	pn redistribution, RGS1/RGS2	mid-June 2010
Blazar sample	HRC/QE, SASv1.0	Summer 2010
Capella		IACHEC 2011
CCD	First step: SPIE papers	Long-term
Cluster	Figure editing, definition of standard candle, Fe-line diagnostics systematics	June 2010
Crab		IACHEC 2011
G153	O.K. … data have just arrived	IACHEC2011
G21.5-0.9	Several (but non fundamental) analysis details – action items plan	August 2010
PKS2155-304	Suzaku/Chandra effective area	?

(from M. Guainazzi, IACHEC summary 2010)

Cross-calibration of the X-ray Instruments onboard the Chandra, INTEGRAL, RXTE, Suzaku, Swift, and XMM-Newton Observatories using G21.5–0.9⋆

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[5] INAF, Istituto di Astrofisica Spaziale e Fisica Cosmica, Via del Fosso del Cavaliere, 100 00133 Roma, Italy
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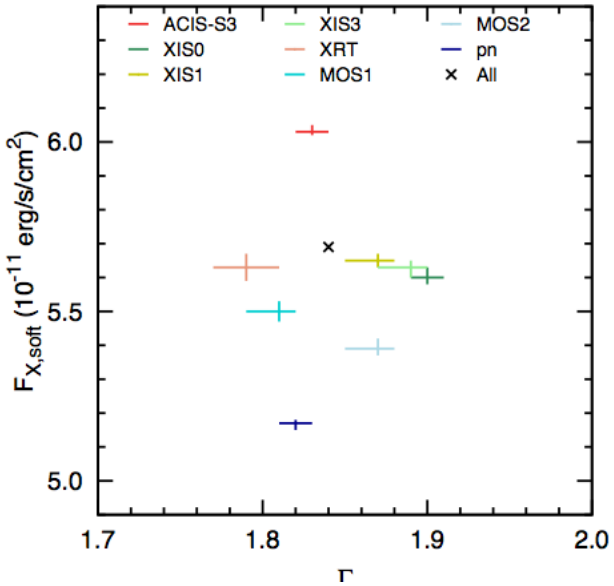
Received / Accepted

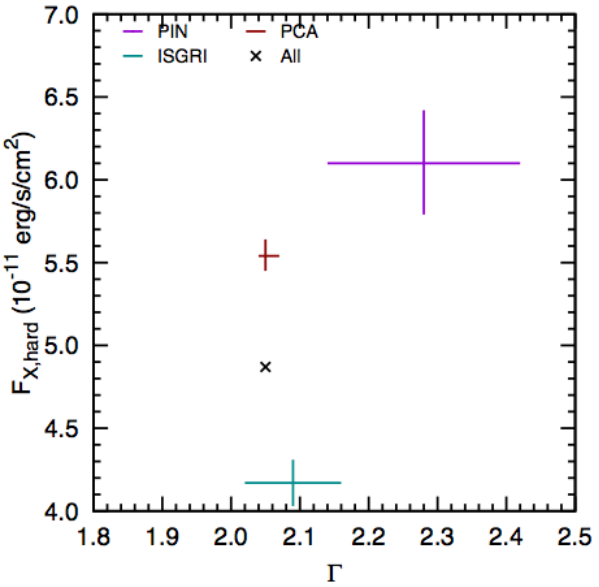
ABSTRACT

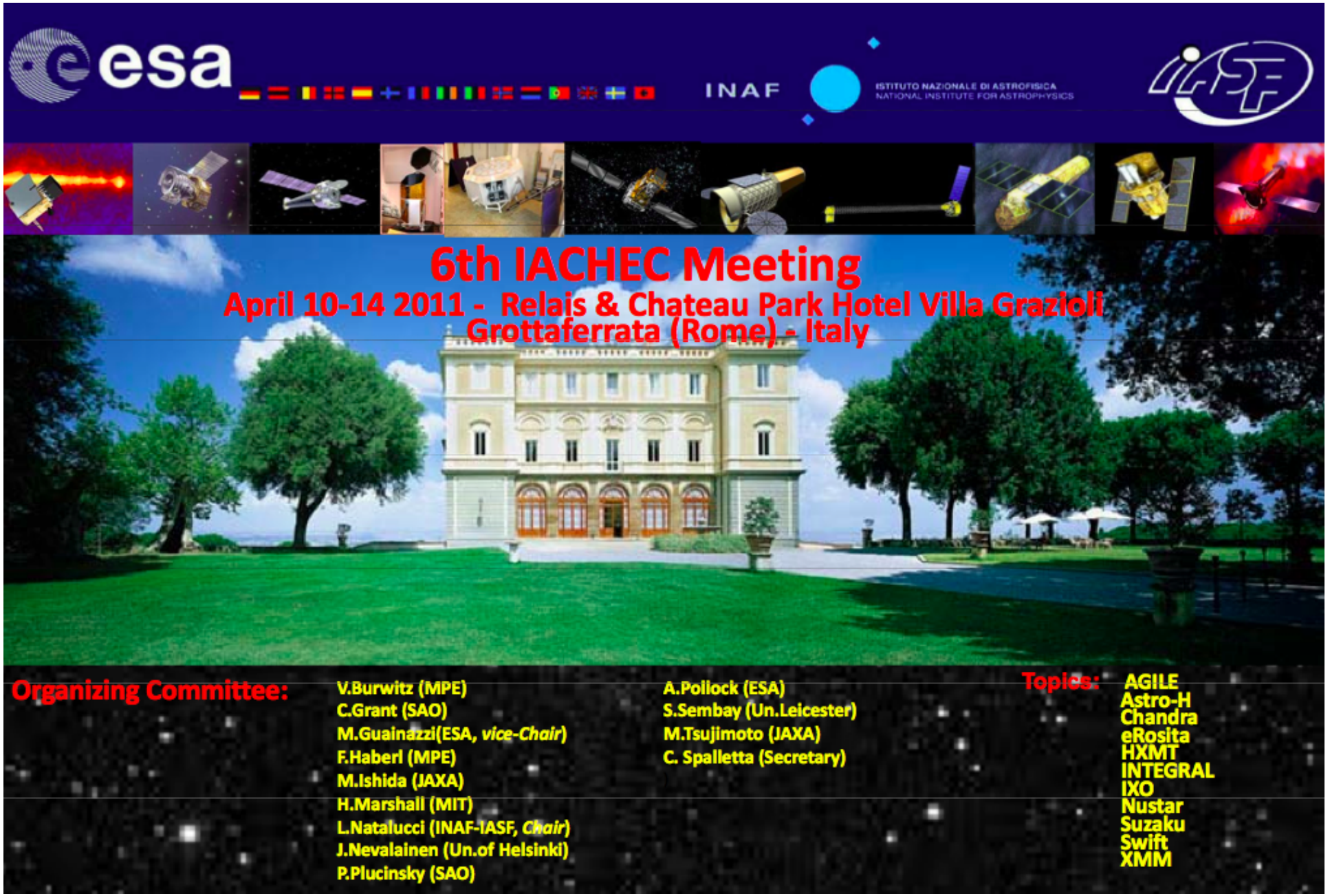
Context. For many years, X-ray astronomy missions have used the Crab nebula as a celestial calibration source for the X-ray flux and spectral shape. However, the object is often too bright for current and future missions equipped with instruments with improved sensitivity.
Aims. We use G21.5–0.9, a pulsar-wind nebula with a time-constant power-law spectrum and a flux of a few milli-Crab in the X-ray band, as a viable, fainter substitute to the Crab. Using this source, we conduct a cross-calibration study of the instruments onboard currently active observatories: Chandra ACIS, Suzaku XIS, Swift XRT, and XMM-Newton EPIC (MOS and pn) for the soft-band, and INTEGRAL IBIS-ISGRI, RXTE PCA, and Suzaku HXD-PIN for the hard band.
Methods. We extract spectra from all instruments and fit under the same astrophysical assumptions. We compare the spectral parameters of the G21.5–0.9 model: power-law photon index, H-equivalent column density of the interstellar photoelectric absorption, and flux in the soft (2–8 keV) or hard (15–50 keV) energy band.
Results. We identify systematic differences in the best-fit parameter values unattributable to statistical scatter of the data alone. We interpret these differences as due to residual cross-calibration problems. The differences can be as large as 20% and 9% for the soft-band flux and power-law index, respectively, and 46% for the hard-band flux. The results are plotted and tabulated as a useful reference for future calibration and scientific studies using multiple missions.

Key words. instrumentation: detectors — X-rays: individual (G21.5–0.9)

(published A&A 2010)



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April 10-14 2011 - Relais & Chateau Park Hotel Villa Grazioli
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S.Sembay (Un.Leicester)
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Nustar
Suzaku
Swift
XMM

IACHEC 2011 Program [1/2]

Monday, 11 April 2011
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Morning session: calibration status of operational missions

Chair: H.Marshall

09:00-09:05: L.Natalucci, "Welcome"
09:05-09:10: M.Guainazzi, Actions from the previous meeting
09:10-09:35: A.Chen, "Calibration of the AGILE Gamma Ray Imaging Detector"
09:35-10:00: P.Laurent, "Status of INTEGRAL/IBIS calibration activities"
10:00-10:25: E.Miller, "Calibration Status of the Suzaku XIS"
10:25-10:50: A.Beardmore, "XRT calibration activities"

10:50-11:20: break

11:20-11:45: L.David, "The internal-cross calibration status of Chandra"
11:45-12:10: M.Guainazzi, "Status of XMM-Newton X-ray payload calibration"
12:10-12:35: M.Smith, "XMM-Newton/Chandra Blazar Flux Comparison"
12:35-13:00: N.J.Verstergaard, "Using the Crab Nebula for JEM-X calibration"

13:00-14:00: lunch break

Afternoon session: review of the Working Groups status

Chair: M.Ishida

14:00-14:15: J.Nevalainen, "Cluster WG report"
14:15-14:30: K.Kekkula, "Cross calibration of XMM-Newton EPIC and Suzaku XIS instruments with clusters of galaxies"
14:30-14:45: H.Marshall, "Progress on several cross-calibration projects"
14:45-15:00: P.Plucinsky, "Using E0102 and N132D as calibration standards"
15:00-15:35: D.Patnaude, "Variations in Galactic Supernova Remnants used as X-ray Calibration Sources"
15:35-15:50: L.Natalucci, "Non-thermal SNR WG report"

15:50-16:25: break

16:25-17:00: M.Tavani, "Crazy Crab"
17:00-17:25: G.Case: "When a Standard Candle Flickers: The Dimming of the Crab Nebula"
17:25-17:40: A.Pollock, "Review of high-resolution WG activities"
17:40-17:55: V.Burwitz, "Update on the White Dwarfs Working Group"
17:55-18:30: T.Rauch, "White Dwarfs atmosphere models"

IACHEC 2011 Program [2/2]

Tuesday, 12 April 2011
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Morning session: Working Groups

08:45-09:00: E.Miller: "The Wiki on the IACHEC web pages"
09:00-13:00: Working Groups meet

13:00-14:00: lunch break

Afternoon session: Future missions

Chair: L.Natalucci

14:00-14:20: N.J.Vestergaard, "Calibration status of NUStar"
14:20-14:40: V.Burwitz, "Status of the eROSITA Mission"
14:40-15:00: K.Dennerl, "Impact of the low energy threshold on the spatial resolution and spectral properties of X-ray CCDs"
15:00-15:20: Y.Terada, "Challenges on ASTRO-H Data Analysis & Software from Suzaku lessons"
15:20-15:50: K.Ishibashi, R.Petre, J.den Herder: "Calibration plans for Astro-H"
15:50-16:20: Y.Chen, C.Cao, C.Liu: "Calibration status of the HXMT payload"

16:20-16:50 break

16:50-17:20: M.Weisskopf: "Calibration of X-Ray Observatories"

17:20-18:30: Round table (Chairs: M.Guainazzi, S.Sembay)

Wednesday, 13 April 2011
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Morning session: Working groups

09:00-13:00: Working groups meet

13:00-14:00: lunch break

Afternoon session: Systematic errors and statistical biases in calibration
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Chair: M.Weisskopf

14:00-14:35: V.Kashyap, "Calibration, Systematic Errors, and Astrostatistics"
14:35-15:00: A.Pollock, "Calibration and model consequences of competing statistical methods"
15:00-15:25: H.Marshall, "Theory and Practice of Handling Systematic Errors"
15:25-15:50: G.Belanger, "Basic notions in time series analysis: from arrival times to resampling"

15:50-16:20: break

16:20-16:45: A.Foster, "Updated Atomic Data for X-ray Astronomy"
16:45-18:30: Round table (Chairs: A.Pollock, H.Marshall, J.Nevelainen)

Thursday, 14 April 2011
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Chair: S.Sembay

09:00-11:00: reports by the Working Groups

11:00-11:30: break

11:30-12:00: M.Guainazzi, "Meeting summary"
12:00-13:00: Discussion and next meeting.