

INTEGRAL Contract
ASI-INAF
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IUG 4-5 February
2015
ESAC

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IBIS/ISGRI calibration update

*IBIS/ISGRI: Energy Response
Monitoring,
Cross-calibration*

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INAF-IAPS, Rome

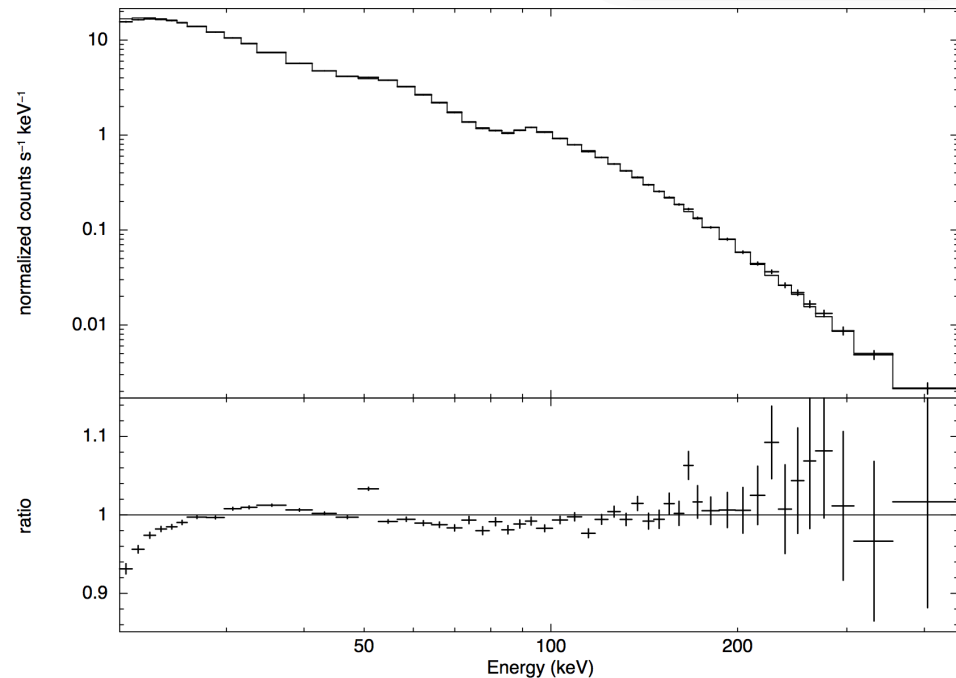
Recent Crab observations available for calibration

Revolution	Date	Remarks
1221	13-15 Oct 2012	100ks custom pointings, 10ks staring, 100ks 5x5wide isgr_arf_rsp_0043.fits in OSA10.1
1268-1269	2-7 March 2013	200 ks/orbit, 5x5wide, includes 10ks staring isgr_arf_rsp_0044.fits in OSA10.1
1278	1-2 Apr 2013	50ks 5x5seq, 50ks custom
1327-1328	25-31 Aug 2013	200ks/orbit, 5x5seq, includes 10ks staring isgr_arf_rsp_0045.fits in OSA10.1
1342	9-10 Oct 2013	50ks custom
1387	21-22 Feb 2014	200 ks 5x5seq, include 10ks staring
1444, 1447, 1452, 1456	Aug-Sept 2014	45ks/orbit, 5x5seq
1461	30 Sep—3 Oct 2014	50ks custom, 35ks staring, 123ks 5x5 seq
1462	3-6 Oct 2014	200ks 5x5seq
1466,1468	17-22 Oct 2014	45ks/orbit, 5x5seq

Updating the ARF dataset (2014-2015)

- ✓ Changes in ISGRI spectral response occurring on monthly time scale (most prominent are the low energy drain and ~ 50 keV feature)
- ✓ In OSA10, time dependent ARFs cover efficiently the period **2002-2013**
- ✓ Two more ARFs needed to cope with **2014 evolution** (*ongoing*)

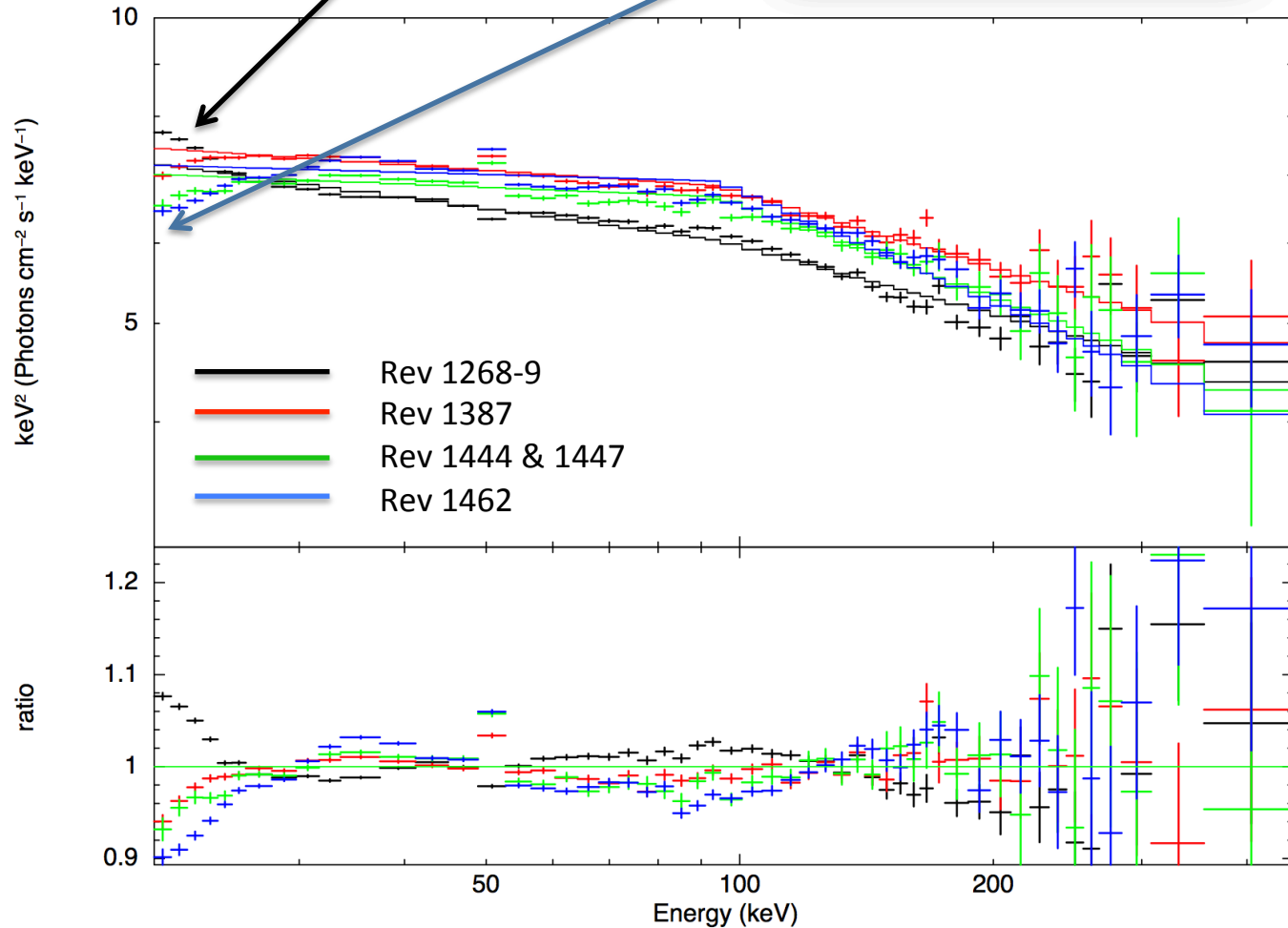
Crab 5x5 seq, rev. 1387, 200ks



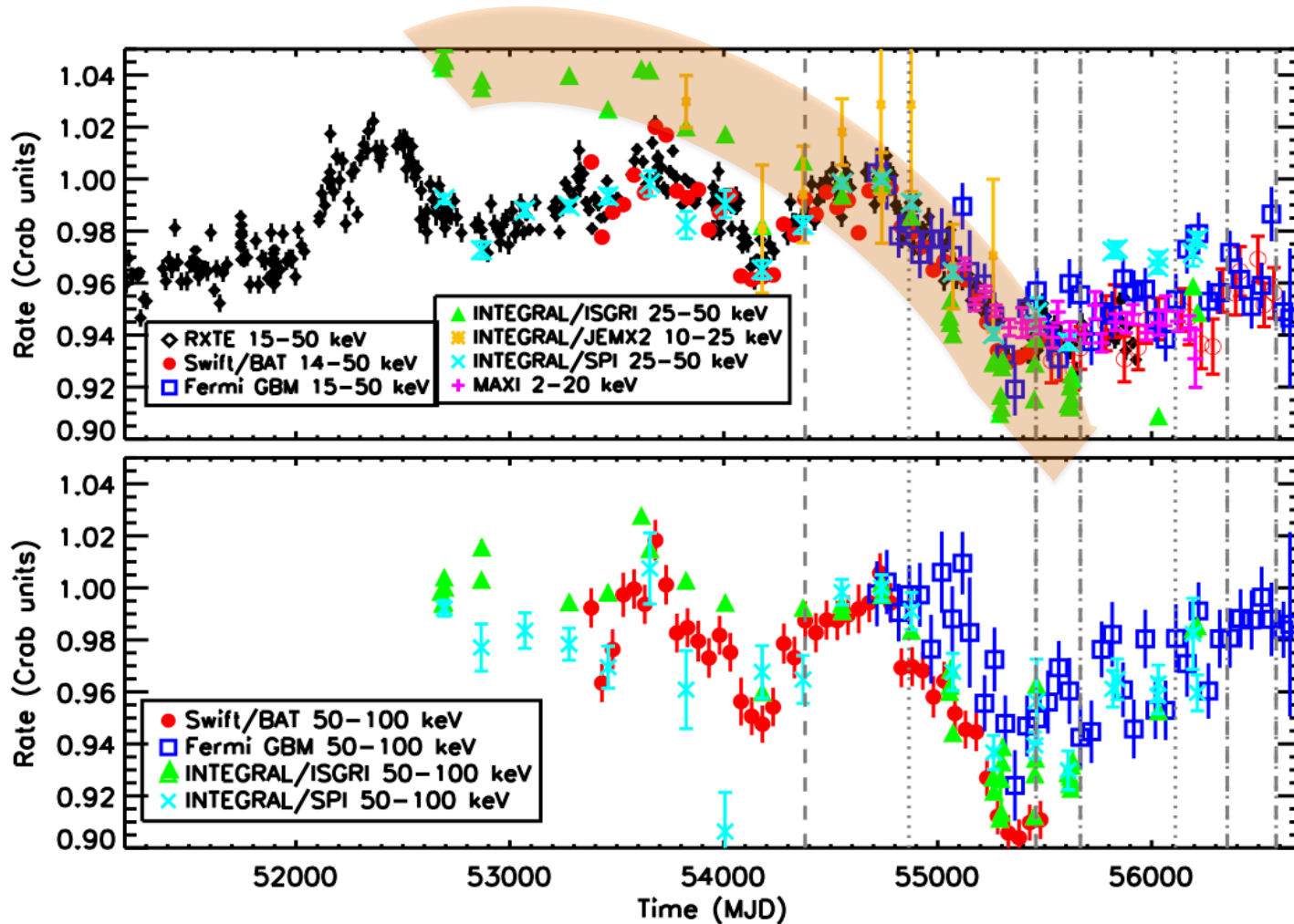
Crab spectrum taken on February 2014, fitted with 'isgr_arf_rsp_0045.fits' (Aug 2013)

Crab spectra for recent observations

- ✓ Period: March 2013- October 2014
- ✓ Residuals to [isgr_arf_rsp_0045.fits](#) (Aug 2013)



Effects of low energy drain in the long term



LC presented by G. Case (IACHEC Conf., 2014)

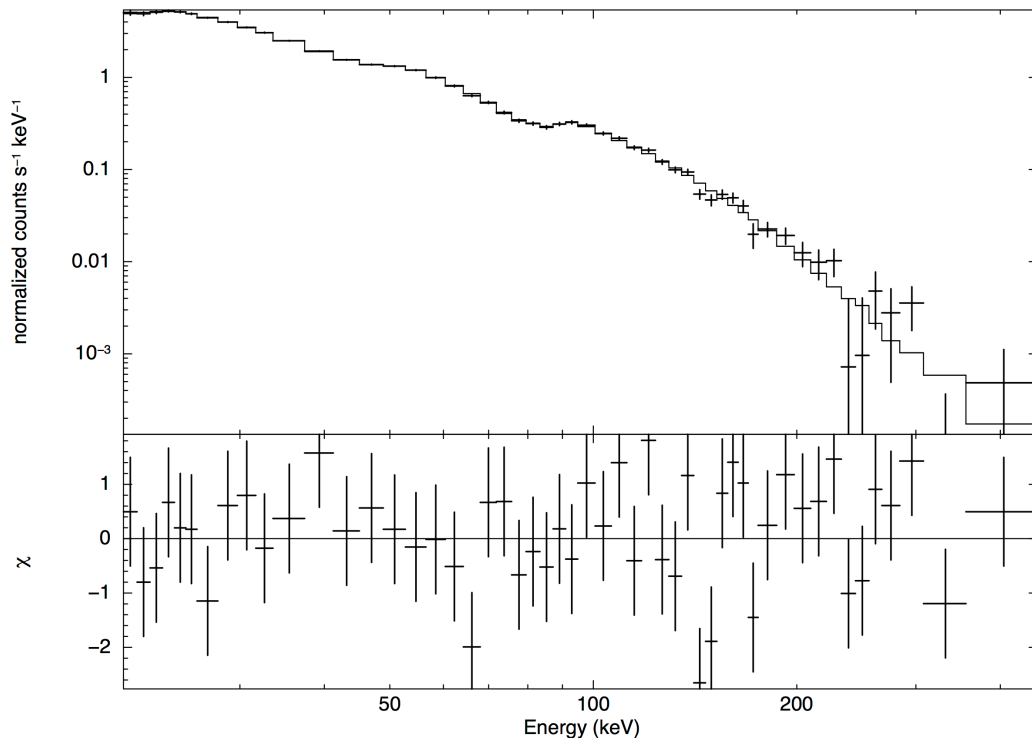
Model	Model	Component	Parameter	Unit	Source No.:	Active/On	Value
par	comp				1		
Data group: 1							
1	1	wabs	nH	10 ²²			0.300000 frozen
2	2	bknpower	PhoIndx1				2.11917 +/- 7.03716E-03
3	2	bknpower	BreakE	keV			94.0000 frozen
4	2	bknpower	PhoIndx2				2.25418 +/- 1.49219E-02
5	2	bknpower	norm				10.4605 +/- 0.288577
Data group: 2							
6	1	wabs	nH	10 ²²			0.300000 = 1
7	2	bknpower	PhoIndx1				2.05347 +/- 7.44948E-03
8	2	bknpower	BreakE	keV			94.0000 = 3
9	2	bknpower	PhoIndx2				2.21994 +/- 1.65025E-02
10	2	bknpower	norm				8.65005 +/- 0.252300
Data group: 3							
11	1	wabs	nH	10 ²²			0.300000 = 1
12	2	bknpower	PhoIndx1				2.03227 +/- 7.82859E-03
13	2	bknpower	BreakE	keV			94.0000 = 3
14	2	bknpower	PhoIndx2				2.26263 +/- 1.97196E-02
15	2	bknpower	norm				7.62596 +/- 0.233098
Data group: 4							
16	1	wabs	nH	10 ²²			0.300000 = 1
17	2	bknpower	PhoIndx1				2.01605 +/- 7.61800E-03
18	2	bknpower	BreakE	keV			94.0000 = 3
19	2	bknpower	PhoIndx2				2.30791 +/- 1.64371E-02
20	2	bknpower	norm				7.30965 +/- 0.218399

Chi-Squared = 225.51 using 208 PHA bins.
 Reduced chi-squared = 1.1506 for 196 degrees of freedom
 Null hypothesis probability = 7.286164e-02

Testing October 2014 ARF with recent GPS data

- ✓ New ARF produced using Crab calibration in rev. **1462**
- ✓ Under testing

Cygnus X-1, revs. 1488 to 1490 (26.5ks); cutoffpl



$$\Gamma = 1.927 \pm 0.050$$

$$E_{\text{cut}} = 184 (-26, +35) \text{ keV}$$

$$\chi^2 = 48.20/49$$

(syst=0, no systematic error added)

Average flux (20-100 keV):

$$7.4 \times 10^{-9} \text{ erg cm}^{-2} \text{ s}^{-1}$$

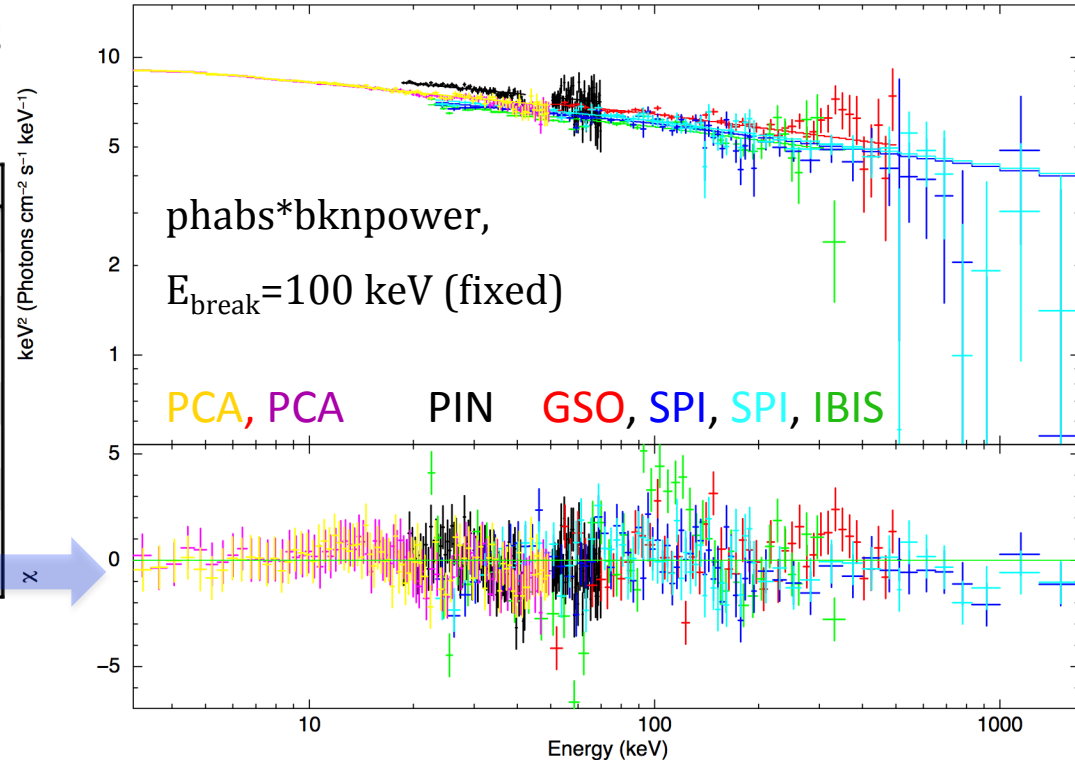
ARF - Future work

- ✓ Produce and test two additional ARFs, for 2014 and early 2015
- ✓ Include a more accurate high energy response ($E > 250$ keV)
- ✓ Ingest the new IC files in OSA
- ✓ Agreement with Saclay to test new energy correction using Crab

Update on cross-calibration

- ✓ Crab nearly simultaneous observations <2011

Epoch	Date	Instruments
A	Sept-Oct 2005	PCA,HXD,IBIS,SPI
B	Sept 2006	PCA,HXD,IBIS,SPI
C	March 2007	XIS,PCA,HXD,SPI
D	Sept 2007	PCA,IBIS,SPI
E	August-Sept 2008	PCA,HXD,IBIS,SPI
F	August 2009	PCA,SPI
G	March-April 2010	PCA,IBIS,SPI,HXD
H	Sept 2010?	PCA,SPI
I	Feb-Mar 2011	PCA,IBIS,SPI,HXD



- ✓ Upgrading with more recent observations with XMM and NuSTAR
(strictly simultaneous dataset during Fall 2014)
- ✓ Ongoing work within IACHEC collaboration