

# Non-thermal SNR WG Meeting 2017

## -Violet Room, March 29-

### **Attendees:**

K. Madsen, L. Natalucci, E. Cucchetti, B. Grefenstette, V. Savchenko, C. Markwardt, T. Sato, Y. Terada, H. Takahashi, S. Koyama, K. Oshimizu, M. Tsujimoto, G. Case

- **Crab:**

Updated light curve by Gary Case (GBM team)

Cross-cal project update

New cross-cal dataset in 2016 including Hitomi

- **G21.5.0.9:**

Hitomi results on G21.5-0.9

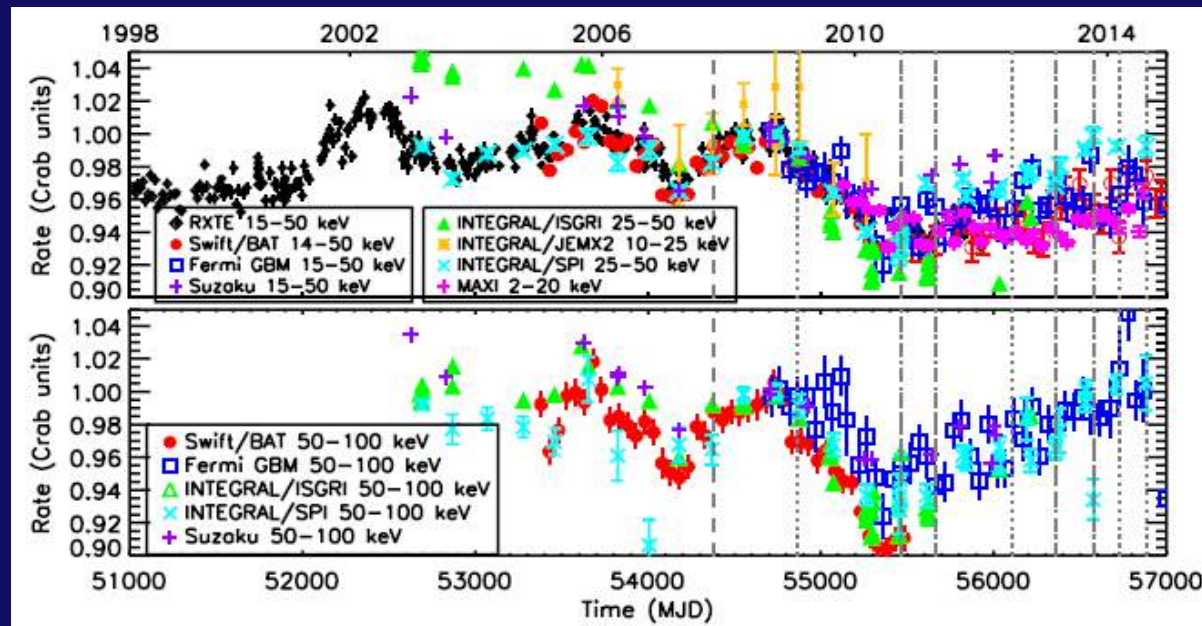
G21.5-0.9 (status after Masahiro's paper)

Planning future paper

# The Declining Crab

Presented by G. Case

- Light curves for each instrument are normalized to its average rate from MJD 54690-54790.

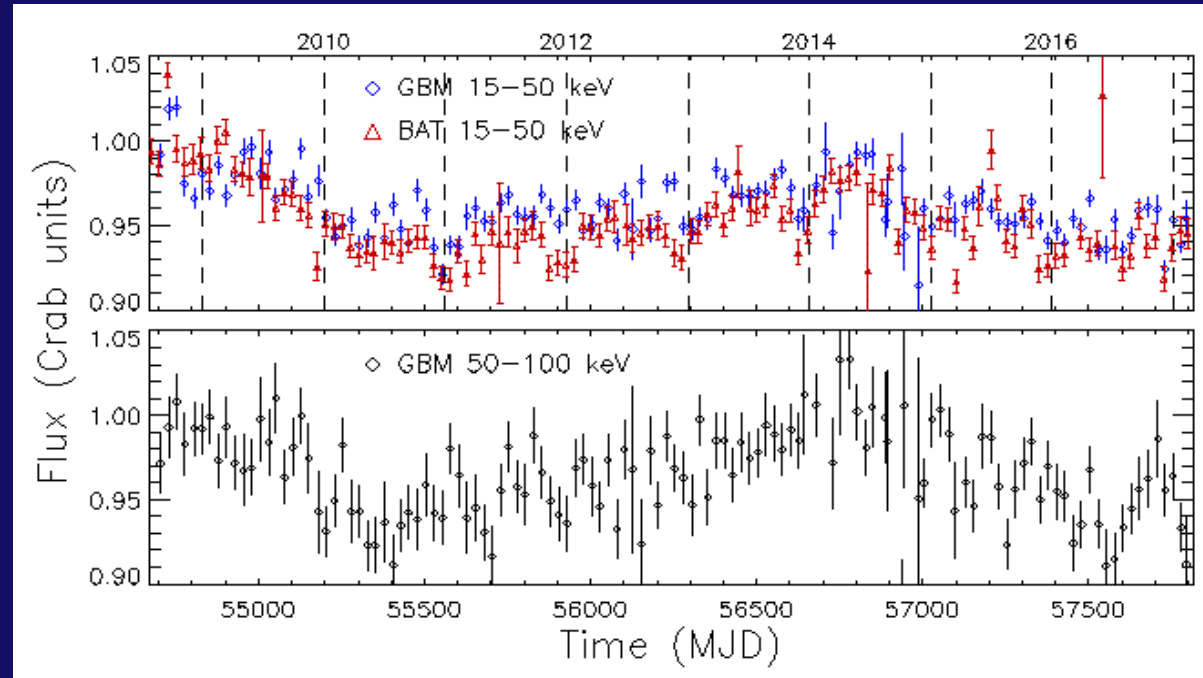


(Thanks to Colleen Wilson-Hodge [NASA/MSFC])

- Instruments on four separate spacecraft show  $\sim 7\%$  decline in Crab flux from August 2008-July 2010!
- From mid-2010 to end of 2015, Crab mostly recovered

# What the Crab has Been Up to Lately...

Presented by G. Case



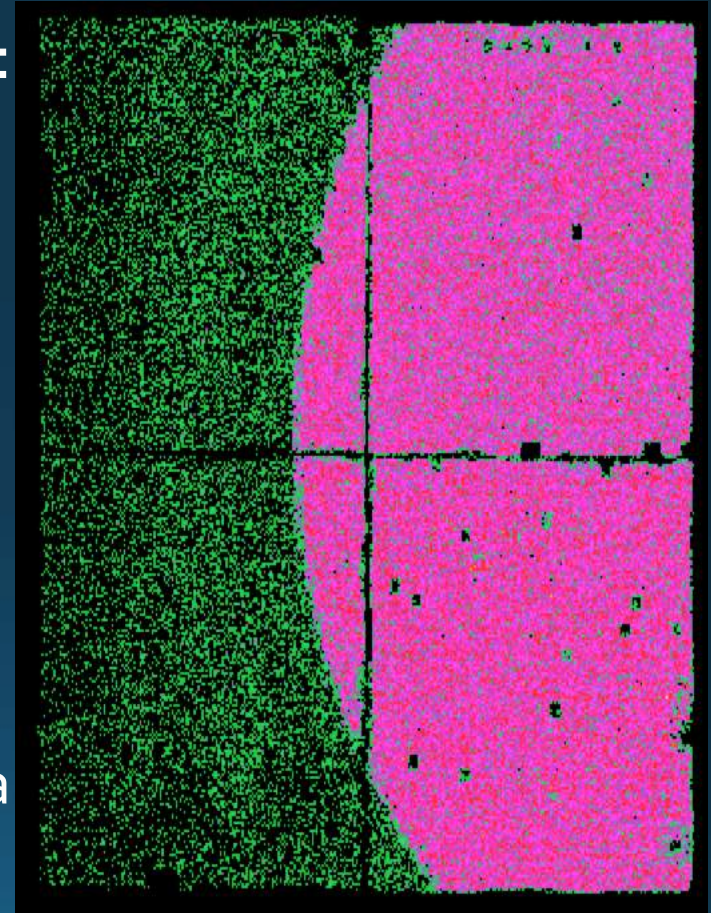
- Crab has been going down since mid-2014
- Reached about the same level as the minimum in 2011
- Bottomed out now?

# Crab monitoring programs

1. Results of Crab light curve from GBM team available on the web
2. NuSTAR monitoring program proposal. Frequency: monthly
3. INTEGRAL has an active monitoring program in the Crab visibility periods (~bi-monthly observations)

# Proposal for monthly campaign

- One observation a month for:
  - 20 ks SL observation (science, calibration)
  - 10-20 ks background observation
  - 10 ks focused observation (calibration)
- Aim is to get:
  - Measure 2% flux variations
  - Get accurate snap shot spectra



Presented by K. Madsen

# Summary & update on Crab project

- Results exclusively based on the analysis of nearly simultaneous periods, rather than using averaged spectra.
- Emphasis on the hard band ( $>10$  keV)
- Instruments on board: XIS, PIN, GSO, PCA, IBIS/ISGRI, SPI, NuSTAR, EPIC-pn, GBM, BAT
- Total of 14 epochs (2005-2014).
- Broken power law model, with  $E_{br}$  fixed at 100 keV
- Swift/BAT data now obtained for 8 epochs! (during this meeting)
- Impressive wealth of data!

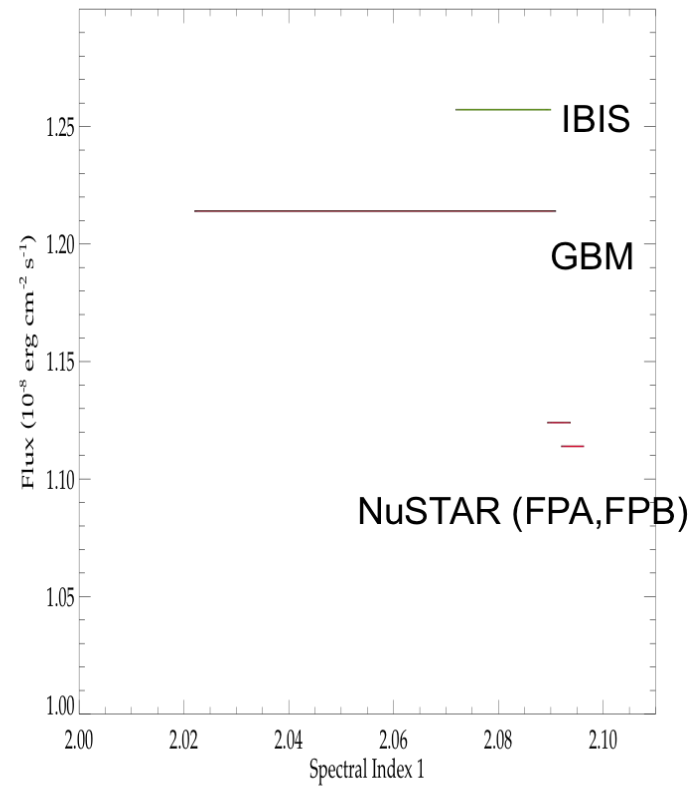
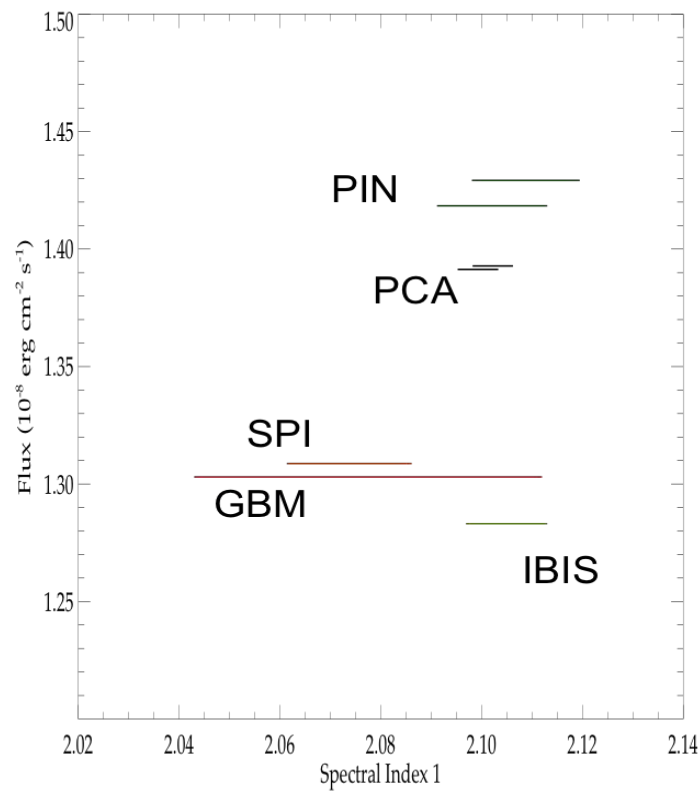
**Not yet published; significant updates from this WG meeting**

# Results from two representative epochs

Sept 2008

Sept 2012

$\Gamma$ 1 vs 25-80 keV flux



# Epoch in 2016?

**Nearly simultaneous dataset: NuSTAR, INTEGRAL, Hitomi, XRT (GBM, BAT?)**

- Nustar, 2016-04-01, 6.5h on axis (elapsed)
- INTEGRAL: 2016-03-28 to 2016-03-30 (rev. 1661)
- Hitomi pointing on 2016-03-25

**AstroSAT? (2016-03-31)**

**WG decision: add this new epoch in the Crab project list**



# Crab project – contact points

Instrument	Contact Person	Remarks
XIS	M. Tsujimoto	
HXD/PIN	Y. Terada	
HXD/GSO	“	
PCA	C. Markwardt	
IBIS/ISGRI	L. Natalucci	OSA-11 delivery in 6 months
SPI	E. Jourdain	
NuSTAR	K. Madsen	Recalibration on SL pointings?
epic-PN	M. Smith	Burst mode
BAT	C. Markwardt	New analysis using PCACORR?
GBM	G. Case	
SXS	M. Tsujimoto	New data to be provided
HXI & SGD	H. Takahashi	“
SXI	K. Mori	“

## Energy bands and epochs

**TO BE UPDATED FOR NEW EPOCH IN 2016  
AND NEW DATASET FROM BAT**

Instr.	Energy Bands (keV)
XIS	3-10
PIN	10-25, 25-80
GSO	25-80 <sup>^</sup> 100-300
PCA	3-10, 10-25, 25-80
IBIS	25-80, 100-300
SPI	25-80, 100-300
NuSTAR	3-10, 10-25, 25-80
EPIC	3-10
GBM	(25-80), 100-300

<sup>^</sup>for GSO, E >40 keV

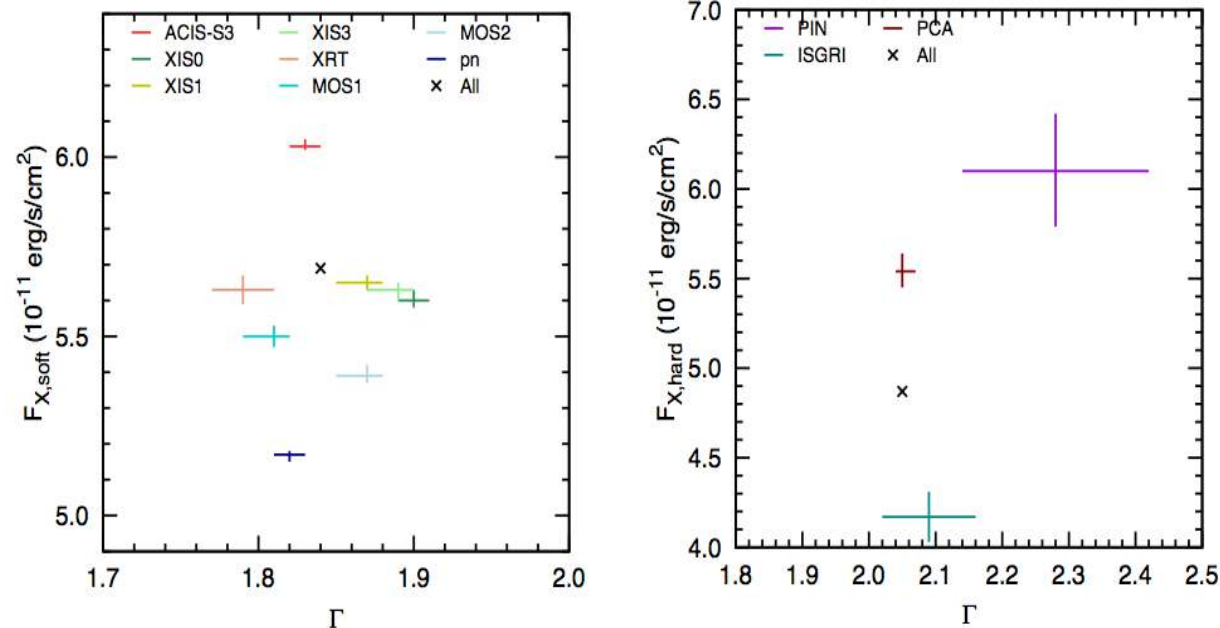
Epochs	Instruments	Period	<1 week(*)
A	PCA, PIN, GSO, IBIS, SPI	2005-09-15 to 2005-10-11	
B	PCA, PIN, GSO, IBIS, SPI	2006-09-05 to 2006-09-29	
C	XIS, PCA, PIN, GSO, IBIS, SPI	2007-03-11 to 2007-03-22	
D	PCA, IBIS, SPI	2007-09-22 to 2007-09-27	Y
E	PCA, PIN, GSO, IBIS, SPI, GBM	2008-08-27 to 2008-09-26	
F	PCA, IBIS, SPI, GBM	2009-08-14 to 2009-08-26	
G	PCA, IBIS, SPI	2010-02-23 to 2010-03-04	
H	PCA, PIN, GSO, GBM	2010-04-03 to 2010-04-17	
I	PCA, SPI, GBM	2010-09-22 to 2010-09-25	Y
J	PCA, IBIS, SPI, GBM	2011-02-12 to 2011-02-19	Y
K	PCA, PIN, GSO, GBM	2011-03-17 to 2011-03-27	
L	NUSTAR, (PIN, GSO), IBIS, SPI, GBM	2012-09-21 to 2012-09-26	Y
M	EPIC, NUSTAR, IBIS, SPI, GBM	2014-10-01 to 2014-10-02	Y

(\*) except for GBM (obs. elapsed time ~40days)

# G21.5

In the soft X-ray band, results are broadly consistent with other measurements (e.g. 3C273).

Different situation for the hard band: for example, PIN/ISGRI flux ratio=1.3 but for the Crab we find  $\sim 10-12\%$



Scatter plot of PL fit parameters for *soft-band* and *hard-band* instruments. (Tsujiimoto et al., A&A 2010)

# G21.5

- We had one paper on this (Tsujimoto+11)
- Motivations for a new paper.
  - New data accumulated: NuSTAR, Hitomi, INTEGRAL, etc.
  - New calibration results. e.g., Hard-band response (8-12 keV) improved for XIS0,3.
  - New model (Energy break)
- We can prepare a new paper with a focus on  $>\sim 5$  keV range.

# G21.5 new dataset?

(to be completed by Tsujimoto-san)

Instrument	Contact Person	Remarks
Chandra (ACIS-S3)	J. Drake	(No new data)
XRT		
XIS		
HXD/PIN		
IBIS/ISGRI	V. Savchenko	Baseline: OSA-11
PCA	C. Markwardt	
NuSTAR	K. Madsen	Recalibration on SL pointings?
epic-PN		
MOS		
Hitomi?		instruments?
BAT	C. Markwardt	

# Main decisions

- **Crab project:**
  - include the new 2016 epoch with NuSTAR, INTEGRAL and Hitomi, also BAT? (ask about Astrosat, MAXI)
  - Improve dataset (PCA, Maxi?)
  - Fit together INTEGRAL and Suzaku/HXD data to look for the HE break
  - Periodic telecons with 3 months cadence to follow on progress
- **G21.5:** start a new cross-cal paper, using new dataset including NuSTAR, Hitomi and BAT (lead: Tsujimoto-san)
- **Crab phase resolved spectroscopy:** common study Chandra/NuSTAR

# Actions

- Gary: distribute the link to the GBM LC public web page
- Lorenzo: distribute the latest information on the calibration description for each instrument
- Lorenzo: update table of epochs including the 2016 data
- Lorenzo: talk to Dipankar about Astrosat data for the 2016 dataset
- Crab monitoring: try to coordinate Nustar and Integral coverage? (Kristin/Lorenzo)
- PCA data: talk to Javier Garcia for new dataset of PCA spectra using PCACORR
- Yuki: contact Mihara-san for MAXI Crab spectra
- Masahiro: ask the G21.5 project contact points to provide new datasets
- Masahiro: ask special permission to use Hitomi data for Crab and G21.5
- Lorenzo: setup a doodle poll for telecon in 3 months