



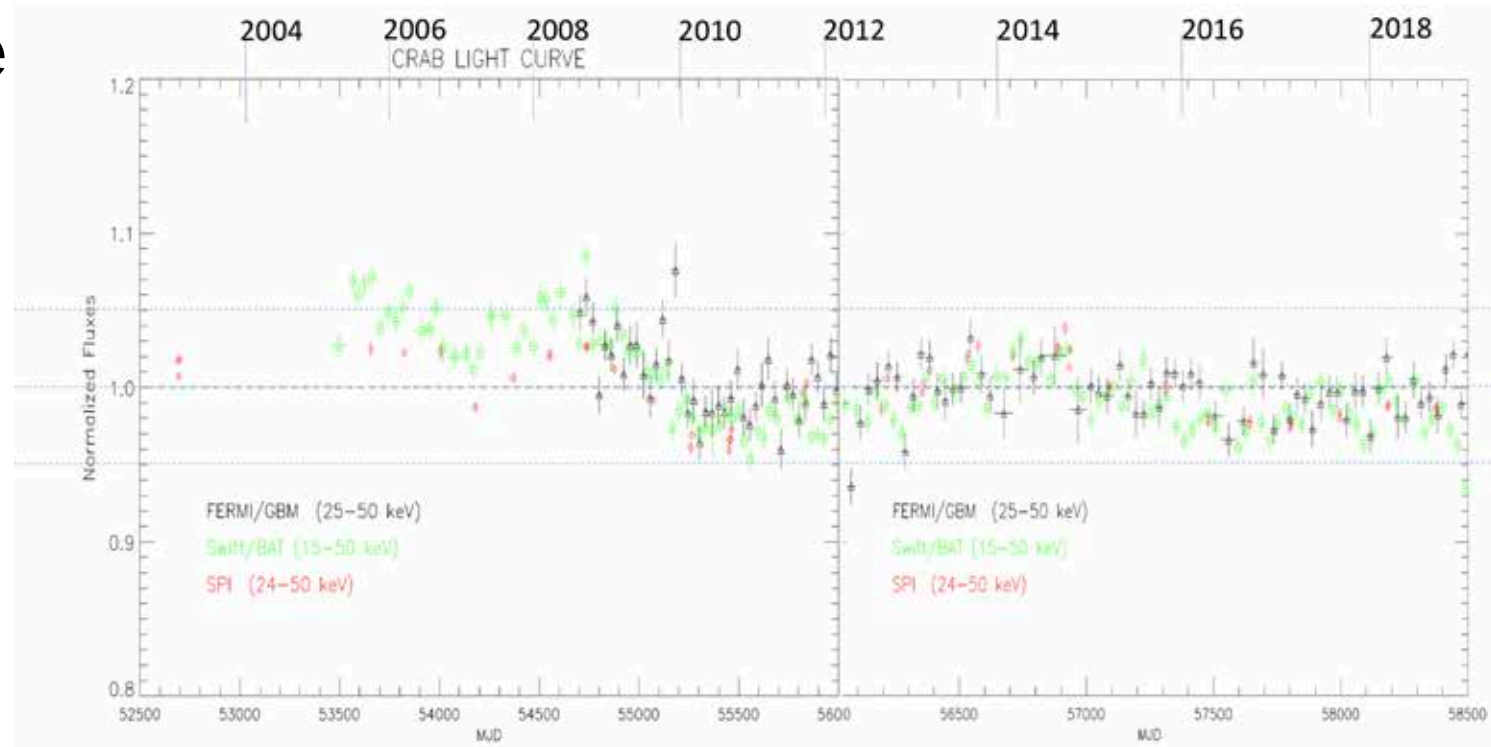
Non-thermal WG summary

Kristin Madsen on behalf of Lorenzo Natalucci



Integral - The Crab

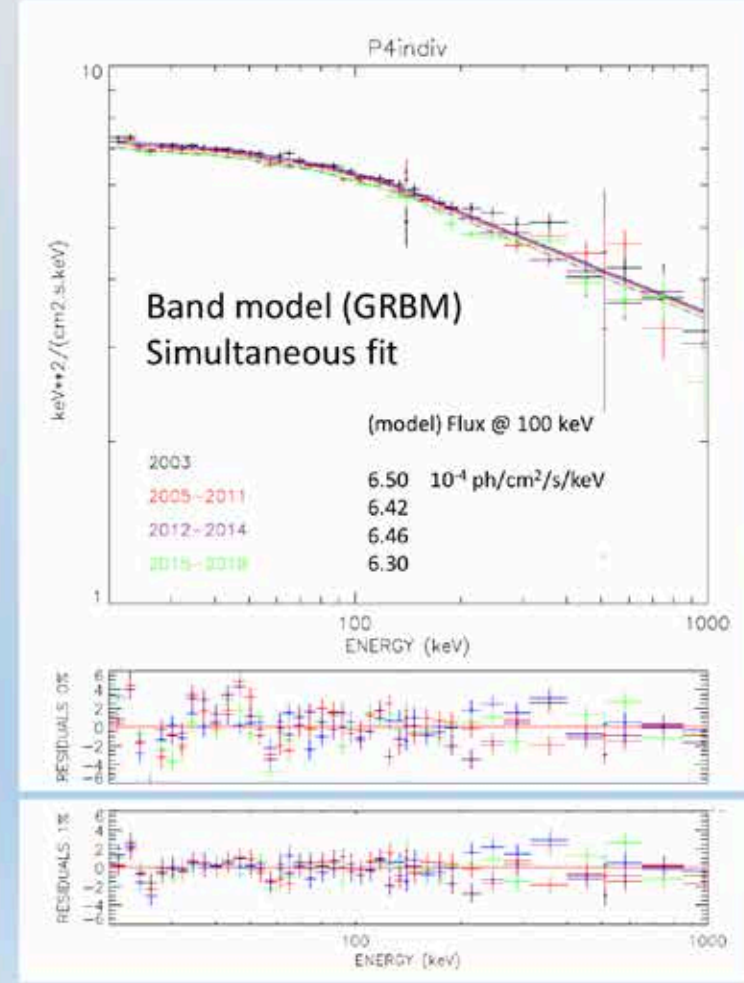
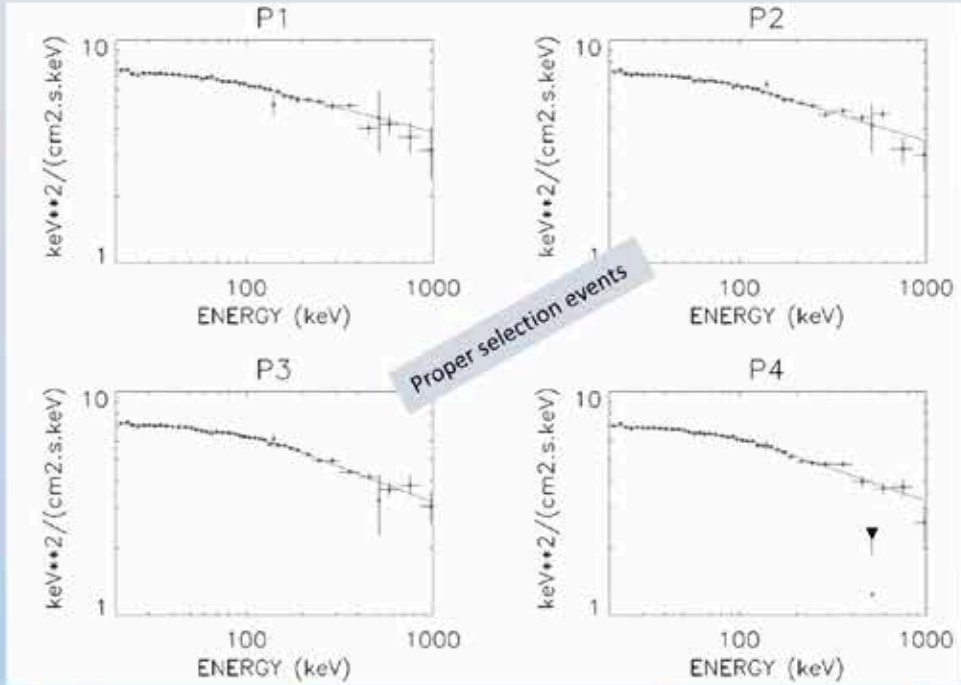
- Integral/SPI is tracking the same source variations as the other observatories
- GRBM Band model is preferred by SPI over broken powerlaw
- The curvature could go all the way down to 20 keV





GRBM, Band model

$$A(E) = \begin{cases} A(E) = K(E/100)^{\alpha_1} \exp(-E/E_c) & \text{if } E < E_c(\alpha_1 - \alpha_2) \\ A(E) = K[(\alpha_1 - \alpha_2)E_c/100]^{(\alpha_1 - \alpha_2)} (E/100)^{\alpha_2} \exp(-(\alpha_1 - \alpha_2)) & \text{if } E > E_c(\alpha_1 - \alpha_2) \end{cases}$$



GRBM, Band model

0.5 % syst.

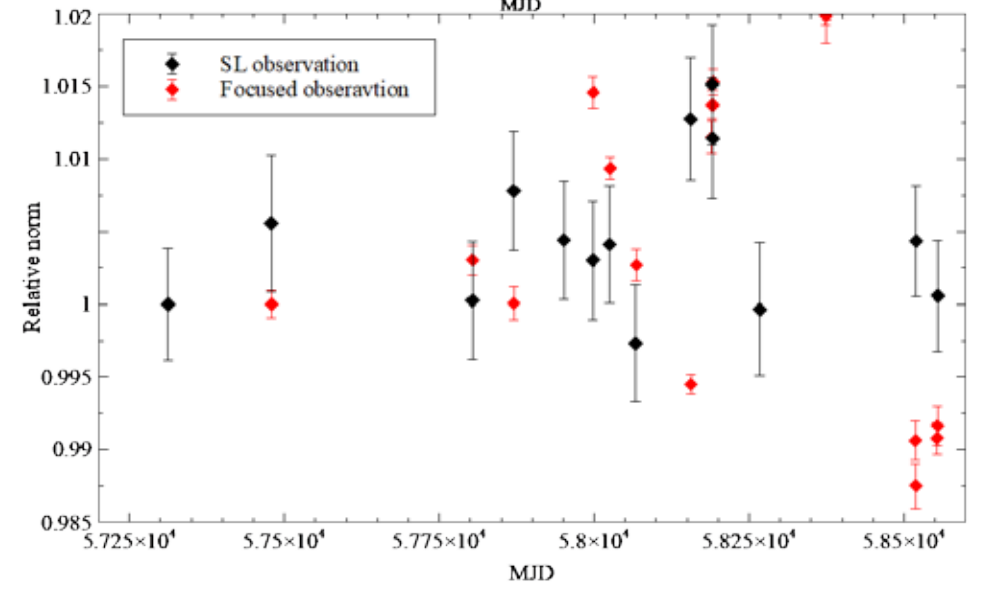
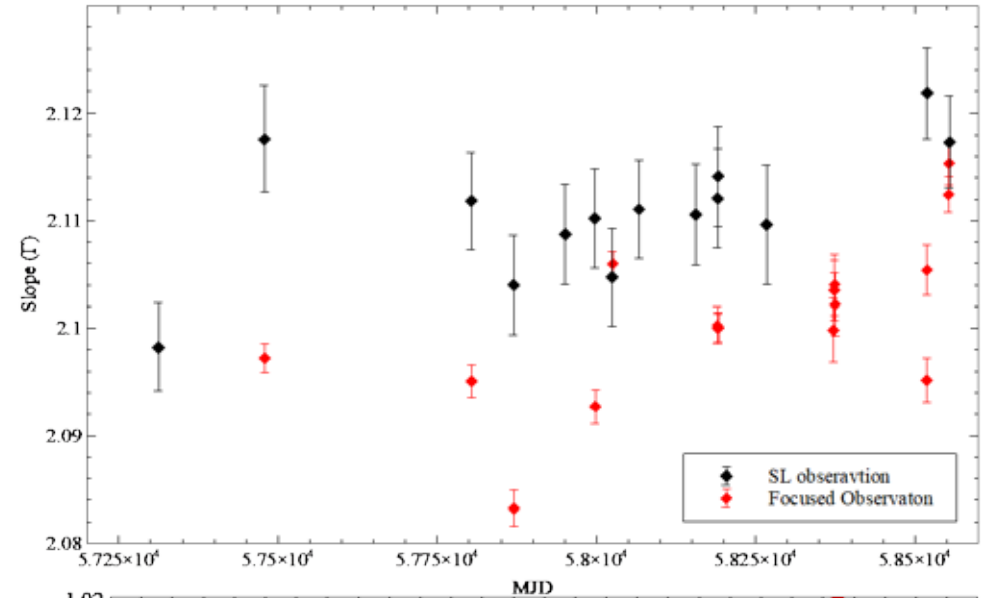
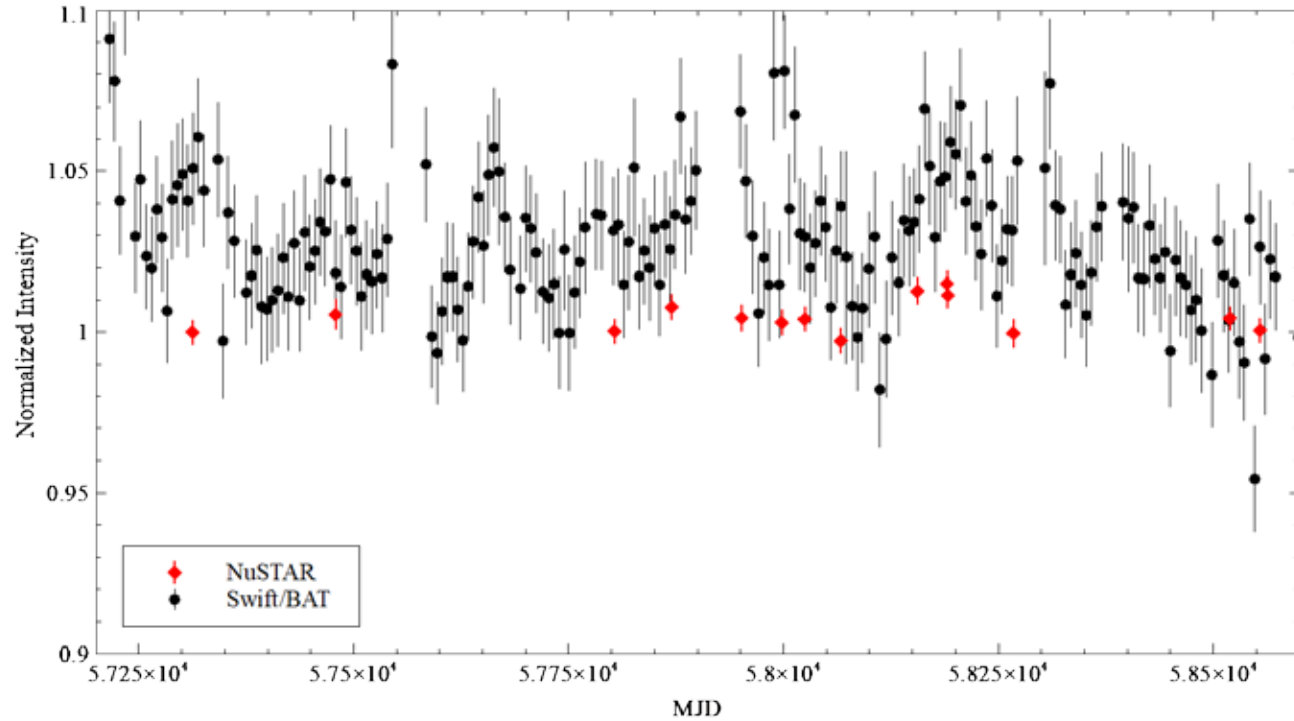
Period Number	α_1	E_c keV	α_2	χ^2
P1 446 ks	2.00	601	2.22	77.01 (39)
P2 1.94 Ms	2.01	620	2.25	82.4 (39)
P3 1.82 Ms	2.0	602	2.32	71.9 (39)
P4 2.2 Ms	1.99	505	2.28	85.9 (39)
Tot	2.0	572.3	2.27	351.2 (165)

Broken PL model

Period Number	α_1	E_b keV	α_2	χ^2
P1 446 ks	2.06	66.0	2.19	83.7 (39)
P2 1.94 Ms	2.08	61.2	2.23	92.9 (39)
P3 1.82 Ms	2.08	93.0	2.27	107.6 (39)
P4 2.2 Ms	2.07	82.8	2.26	104.8 (39)
Tot	2.08	86.0	2.25	426.08 (165)



NuSTAR - Crab





Crab paper – Lorenzo Natalucci

Crab “multi-year” data analysis project

- Results exclusively based on the analysis of nearly simultaneous periods
- 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 nearly simultaneous epochs (2005-2016).
- Broken power law model, with $E_{br} \sim 100$ keV
- Broad bands spectral fitting



Action Items - Crab

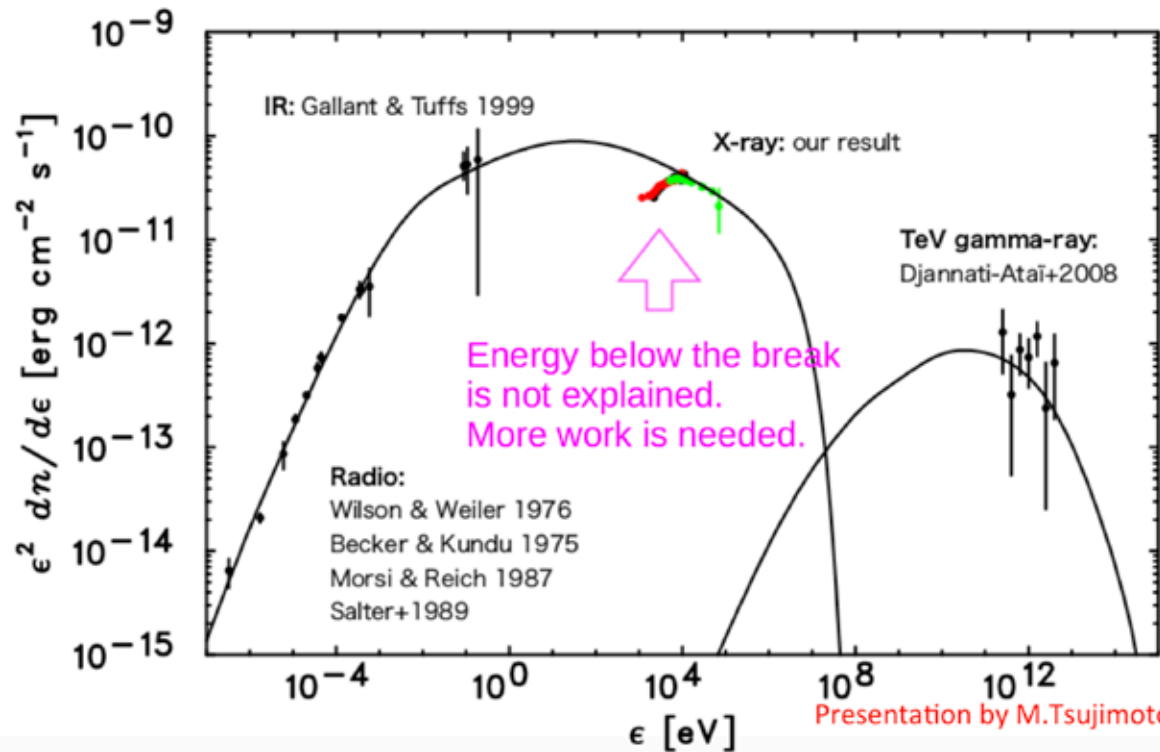
- Apply the GBRM model to NuSTAR SL data and determine if NuSTAR can measure the curvature seen in SPI
 - Goal to determine the degree of curvature in the NuSTAR band to evaluate if a curved description of the data is necessary for the calibration below 80 keV.
- Finish up the paper on the "multi-year" Crab
 - Goal: circulate draft



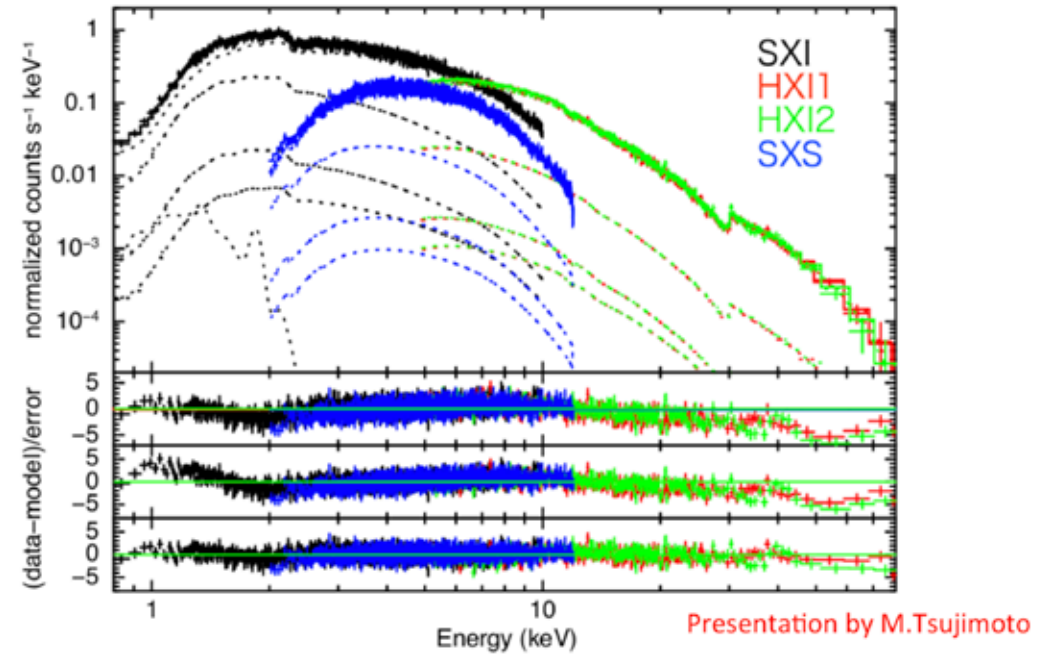
G21.5-0.9 – IACHEC 2018



(2) G21.5 : Application to Hitomi



(2) G21.5 : Hitomi data



2017/C $E_{\text{break}} = 7.1 \pm 0.3 \text{ keV}$, $\Gamma_{\text{soft}} = 1.74 \pm 0.02$, $\Gamma_{\text{hard}} = 2.14 \pm 0.01$



Action Items – G21.5-0.9

- XRISM (Athena and eRosita) will be using this as an effective area calibration source, but spectrum is not a simple power-law
- Contact below will send data to Masahiro, who will do joint fit
- Goal: Define the curved spectrum as an IACHEC standard
- Cont(r)acts

Chandra = Nick

XMM = Felix

NuSTAR = Kristin

Hitomi = Masahiro

Integral = Volodymyr

Swift = Jamie/Andy



Summary

1. NuSTAR applies the GRBM model to SL data and evaluates the significance of curvature in the 3-50ish keV spectrum
2. G21.5-0.9 data will be prepared by instrument groups and provided to Masahiro for joint fit to quantify the curved spectrum of G21.5-0.9 at the next meeting.
3. Lorenzo to circulate a draft of the Crab paper