Lessons learned from Extras/ AREMBES on the EPIC background

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Approach

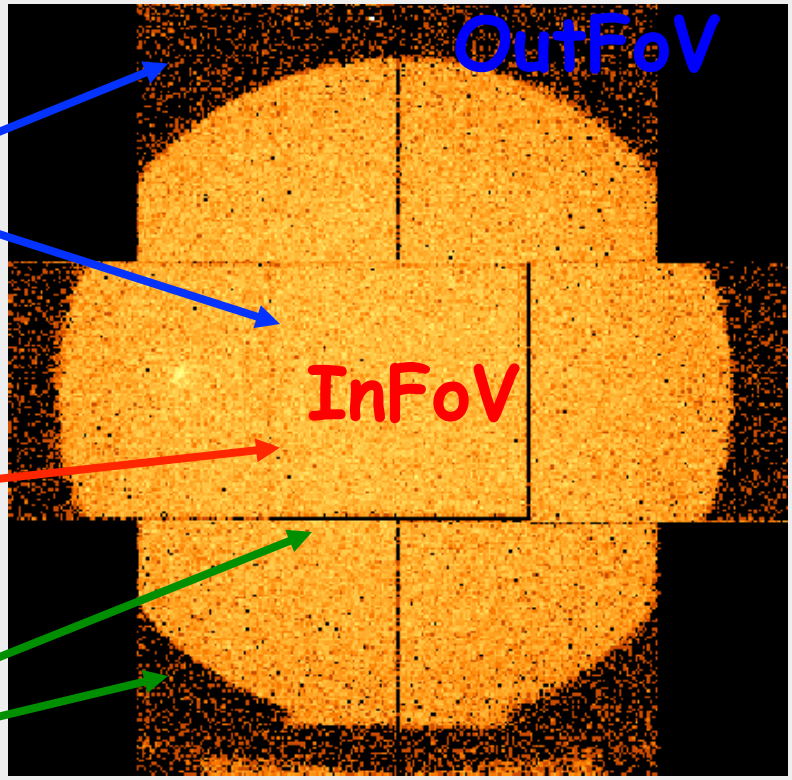
Goal: provide multi-dimensional spectro-imaging model of the bkg components (energy, time, position in the dectector)

The components of the EPIC bkg are

1) GCR bkg (i.e. GCR induced particle bkg, secondaries caused by protons in 0.3-1 GeV
2) SP (those should be ideally filtered out (is there any SP quiescent component ?)
3) Compton bkg (induced by hard photons of the CXB)
4) Sky components (Galactic foregrounds + CXB)
5) Solar Wind Charge eXchange (SWCX)

Instrumental bkg

- Secondaries generated by high energy particle (E>100 MeV) mostly Cosmic Rays p+
- Low energy ions (E<100 KeV) concentrated by mirrors
- Compton component



InFoV_excess = InFoV - OutFoV

GCR BKG

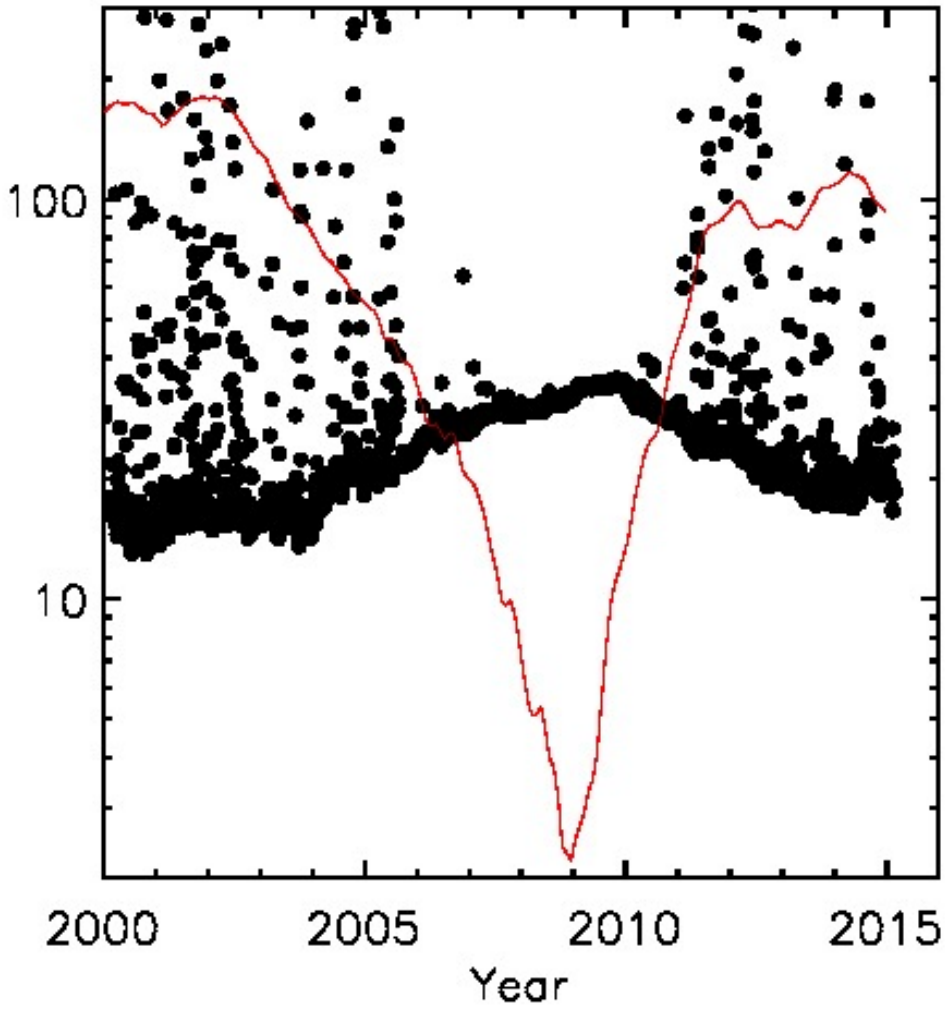
- PRIMARY DATASETS: M2 CLOSED DATA, M2 OUT FIELD OF VIEW DATA, RADIATION MONITOR DATA

- WORKING HYPOTESIS: M2 DATA ARE MOSTLY SENSITIVE TO HIGH ENERGY (> 100 MeV) COSMIC RAY PROTONS, RADMON DATA (20 MeV) ARE SENSITIVE TO DIFFERENT COMPONENTS: COSMIC RAYS (MOST OF THE TIME), SEPS, RADIATION BELTS

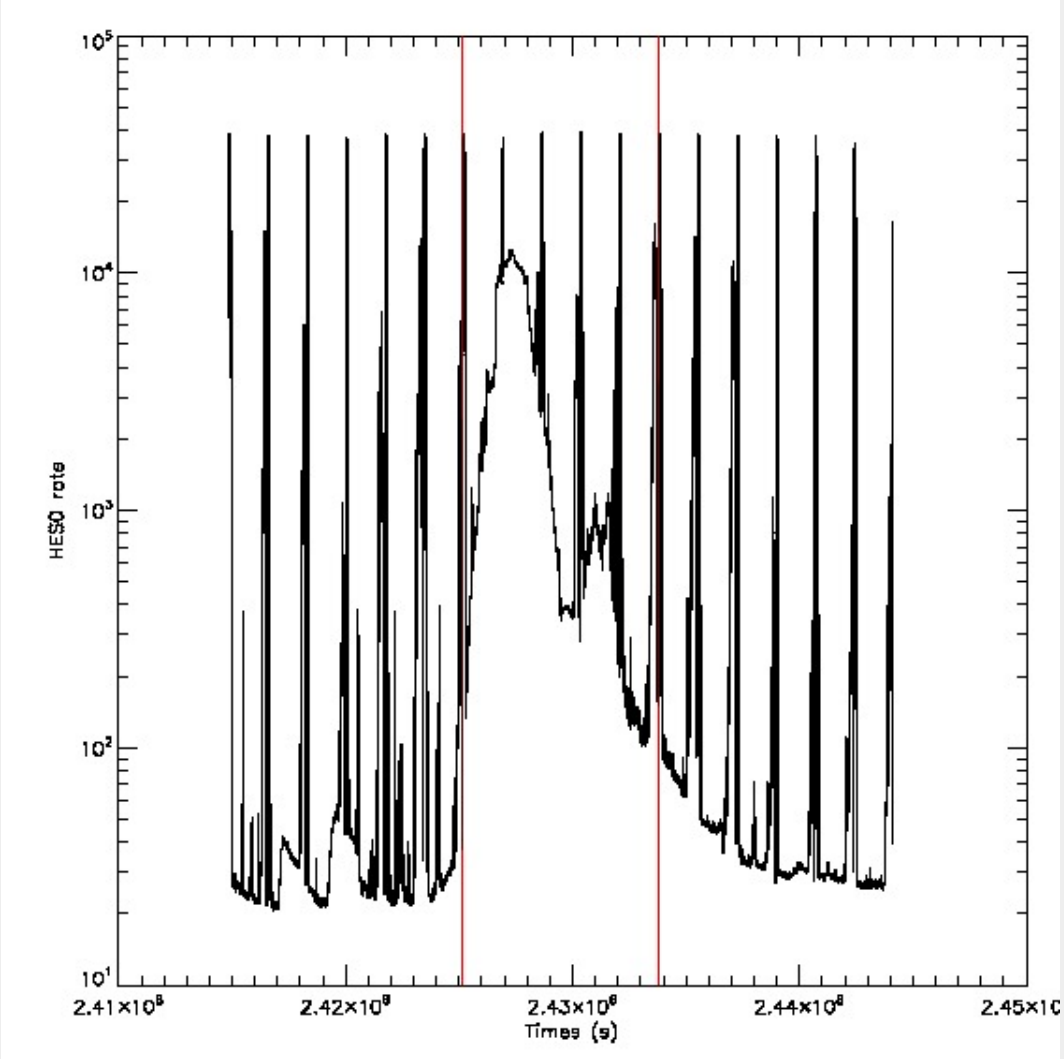
- SCREEN RADIATION MONITOR LIGHT CURVES TO EXCLUDE “FLARING PERIODS” (SEPS FROM SEPEM REFERENCE LIST

  http://dev.sepem.oma.be/help/event_ref.html)

RM AND SOLAR CYCLE

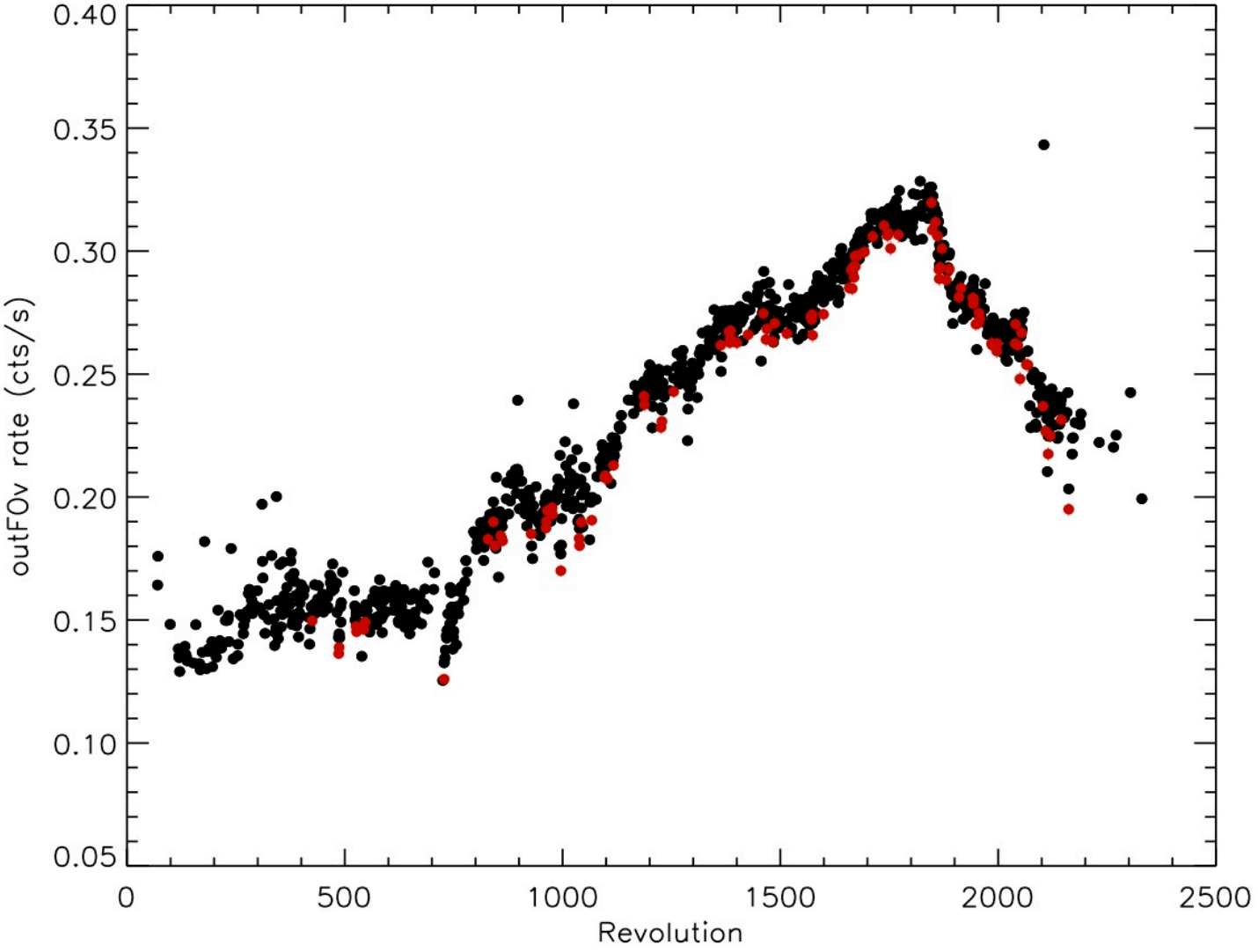


RM AND SEP

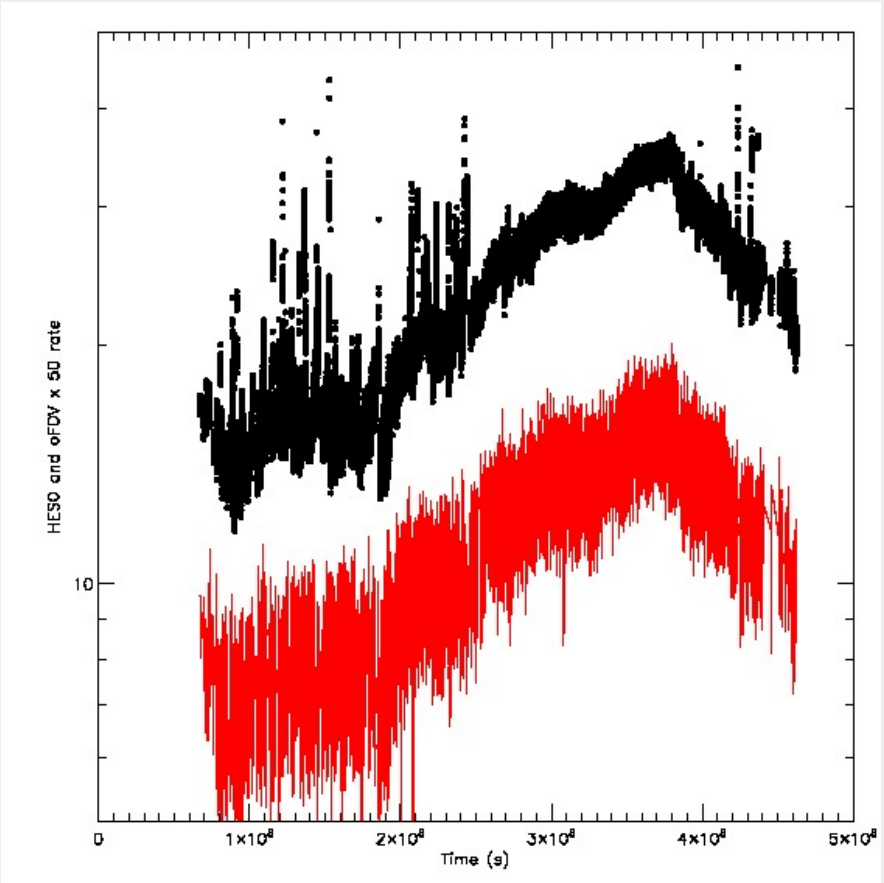


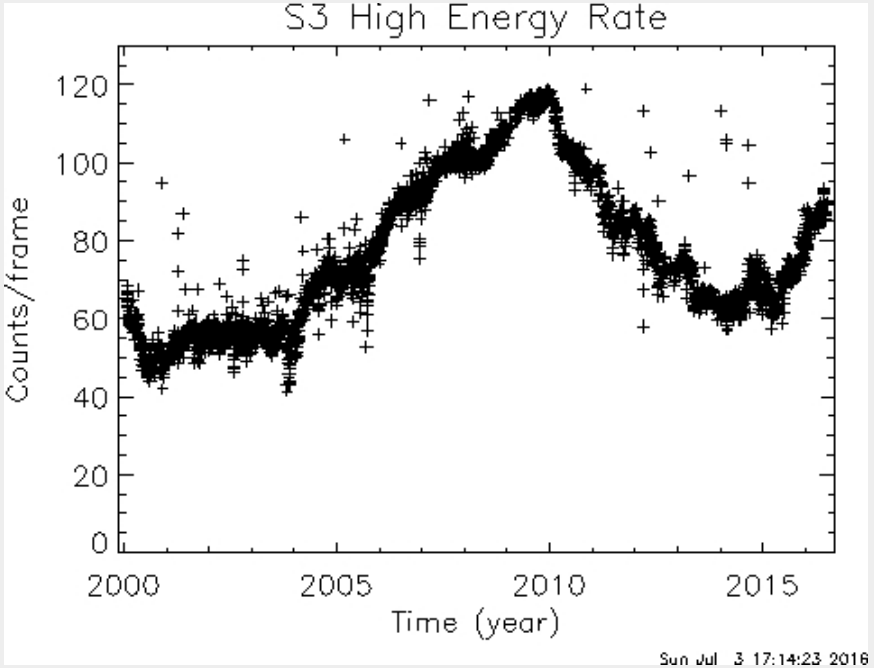
Exclude SEP intervals (rarely not conservative)

LONG TERM VARIATION



RM AND OUTFOV DATA

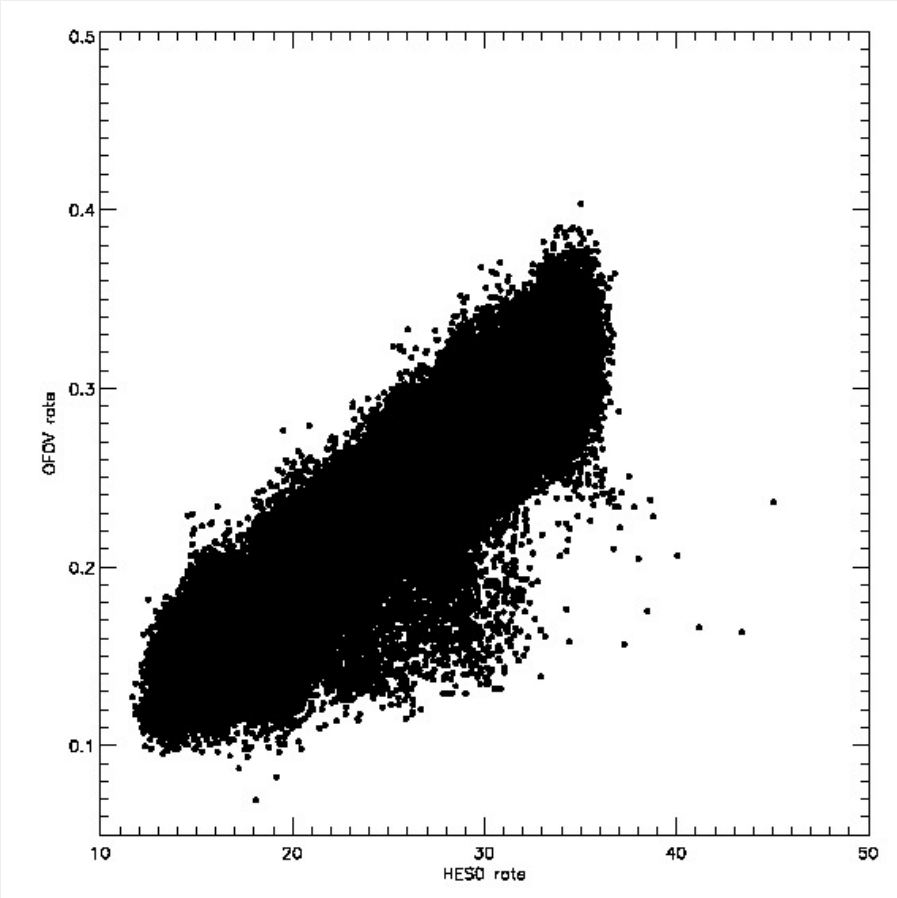




Chandra acis-s3 "threshold" rate (taken from C. Grant website)

STRONGLY SUPPORT HYPOTHESIS OF HIGH ENERGY COSMIC RAY PROTONS AS ULTIMATE SOURCE OF THIS BKG COMPONENT

RM AND OUTFOV DATA



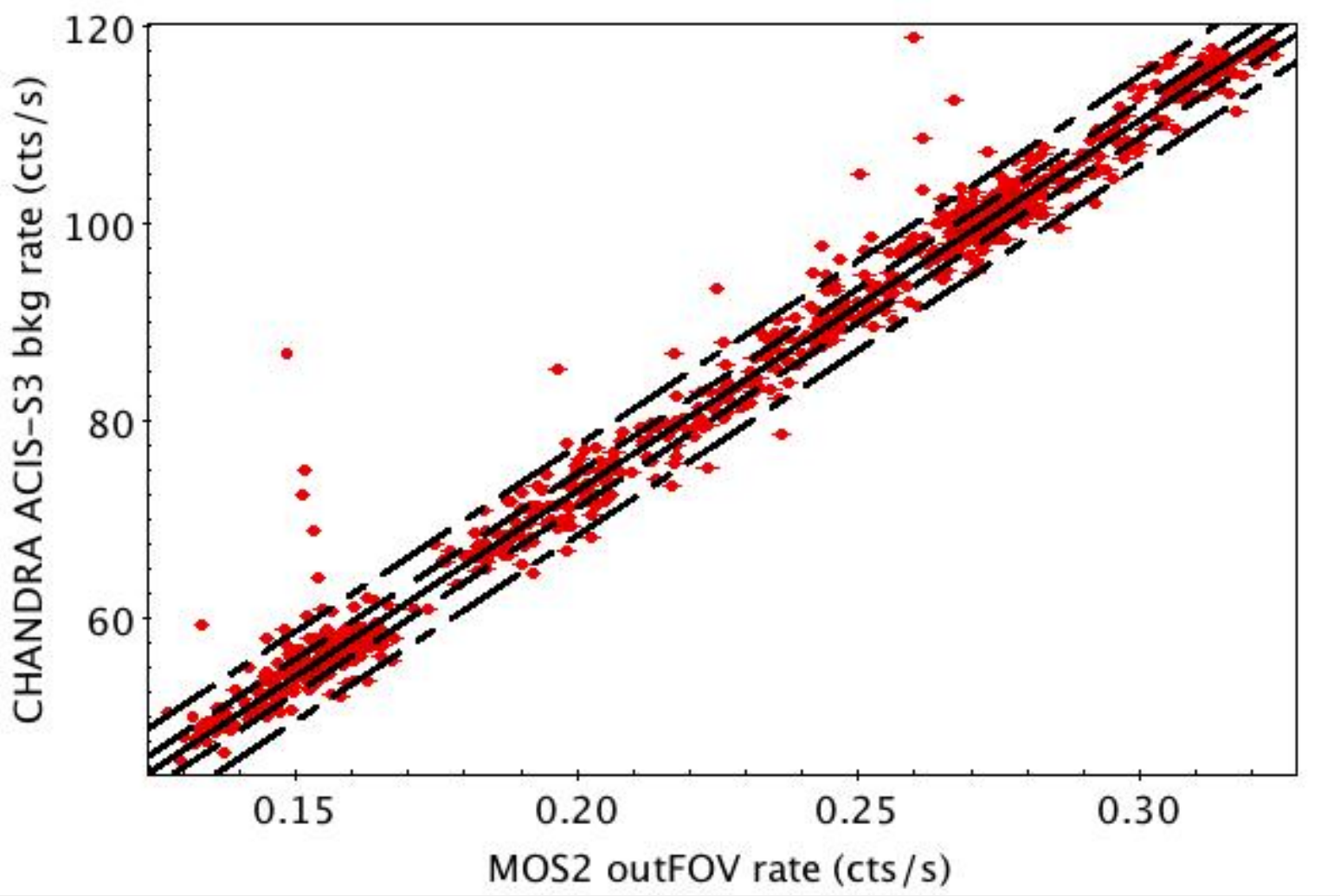
OUTFOV data correlates with Radiation Monitor data

Both modulated by solar cycle

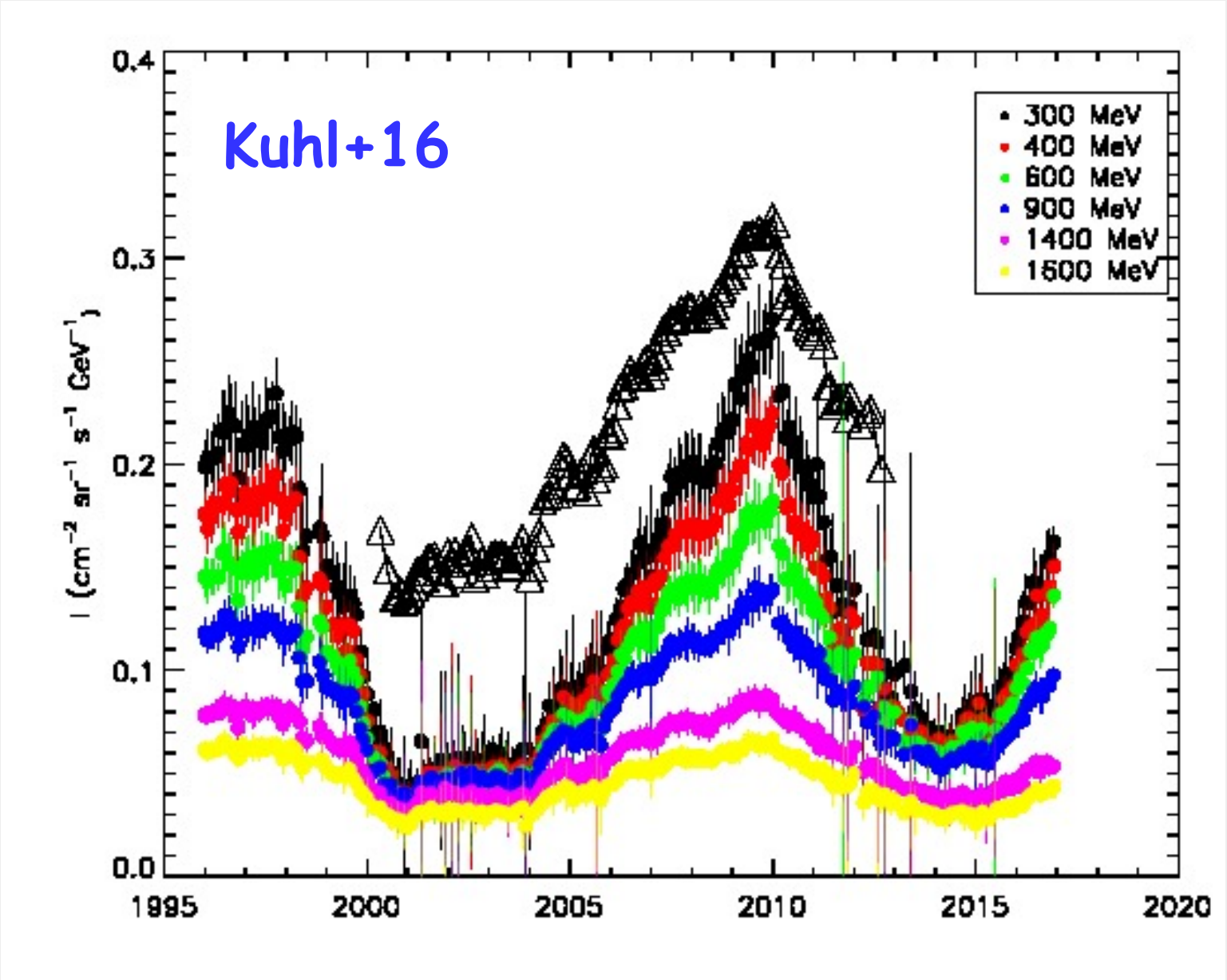
STRONGLY SUPPORT HYPOTHESIS OF HIGH ENERGY COSMIC RAY PROTONS AS ULTIMATE SOURCE OF THIS BKG COMPONENT

XMM vs CHANDRA

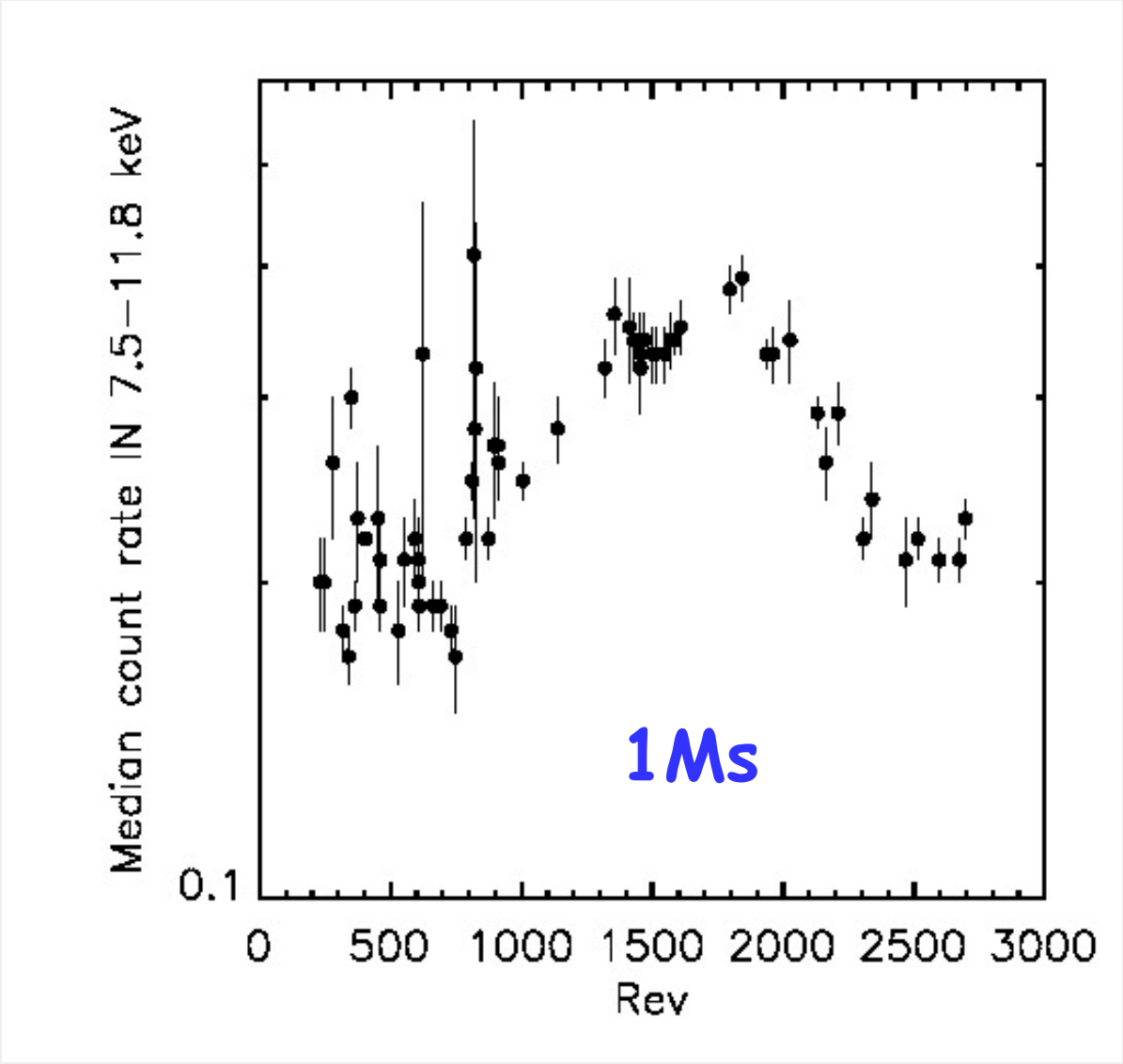
Best fit robust linear regression
y=85.852(+/-0.065)+375.9(+/-1.1)*(x-0.2342) with rms scatter of 1.75 (2%). Show lines at 1 sigma (68%) and 2.6 sigma (99%)



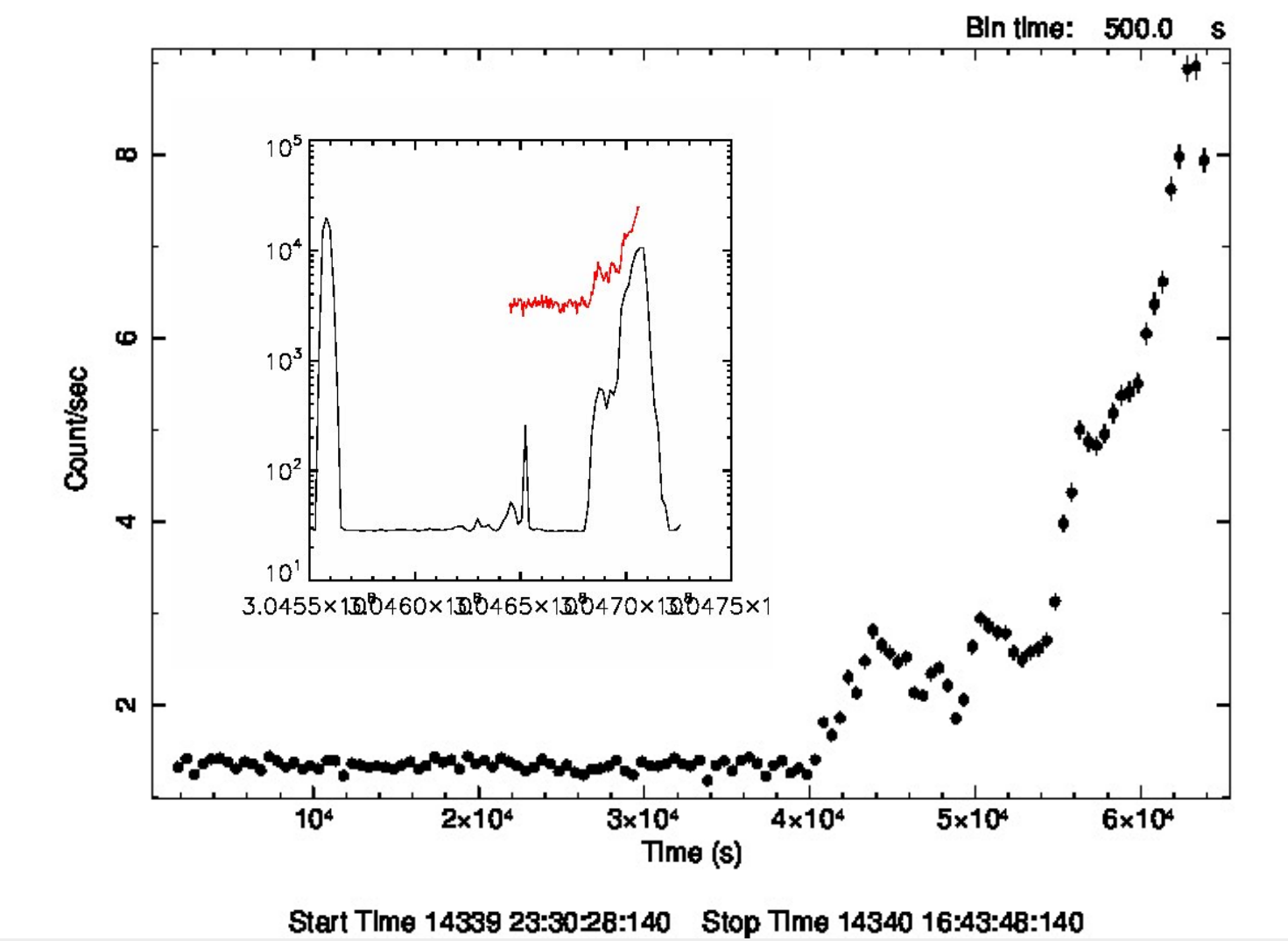
VARIABILITY LONGER SCALE



CLOSED DATA


Median count rate IN 7.5–11.8 keV
0.1
0
500
1000
1500
2000
2500
3000
Rev
1Ms

CLOSED DATA (HANDLE WITH CARE)



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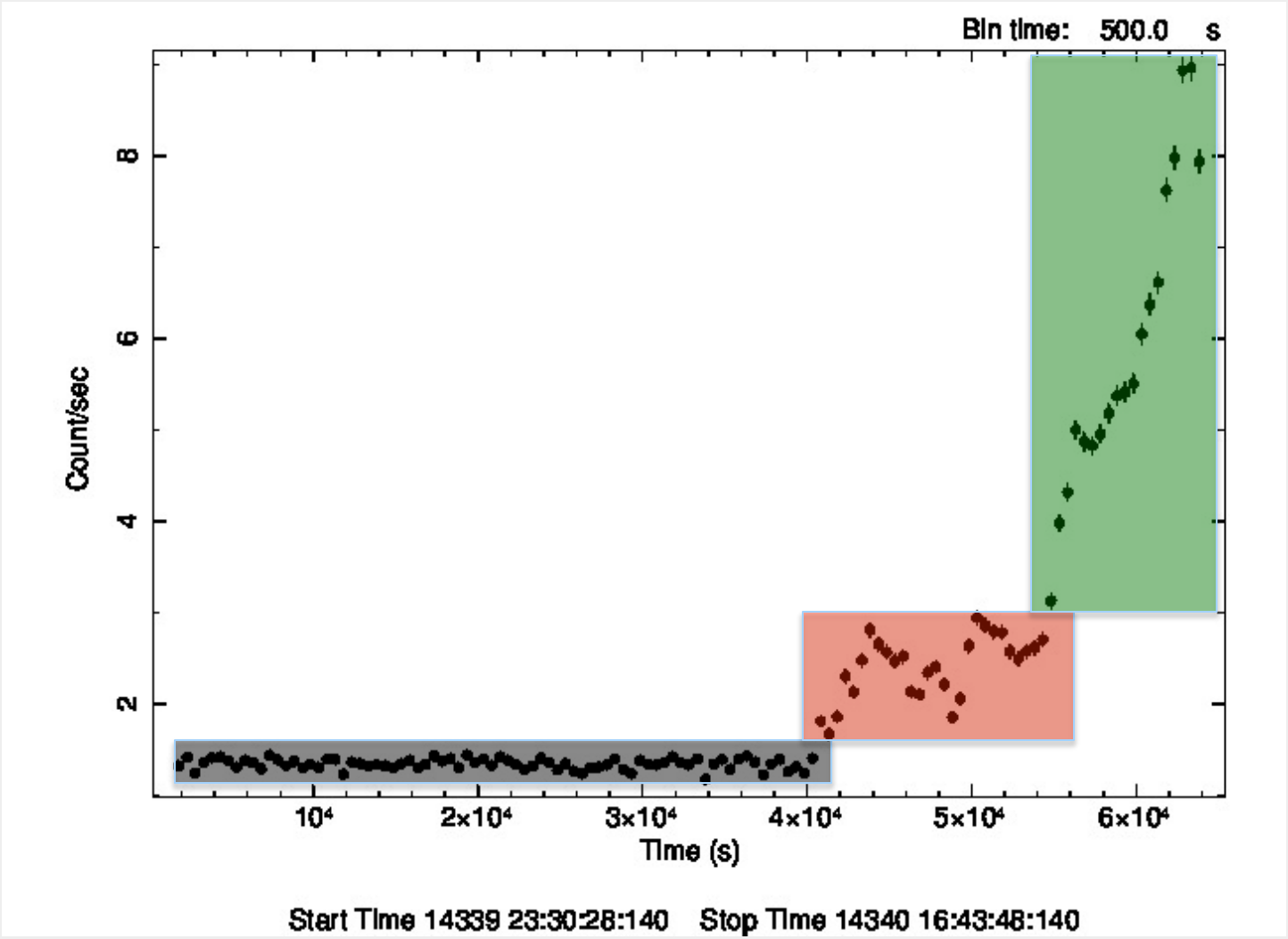

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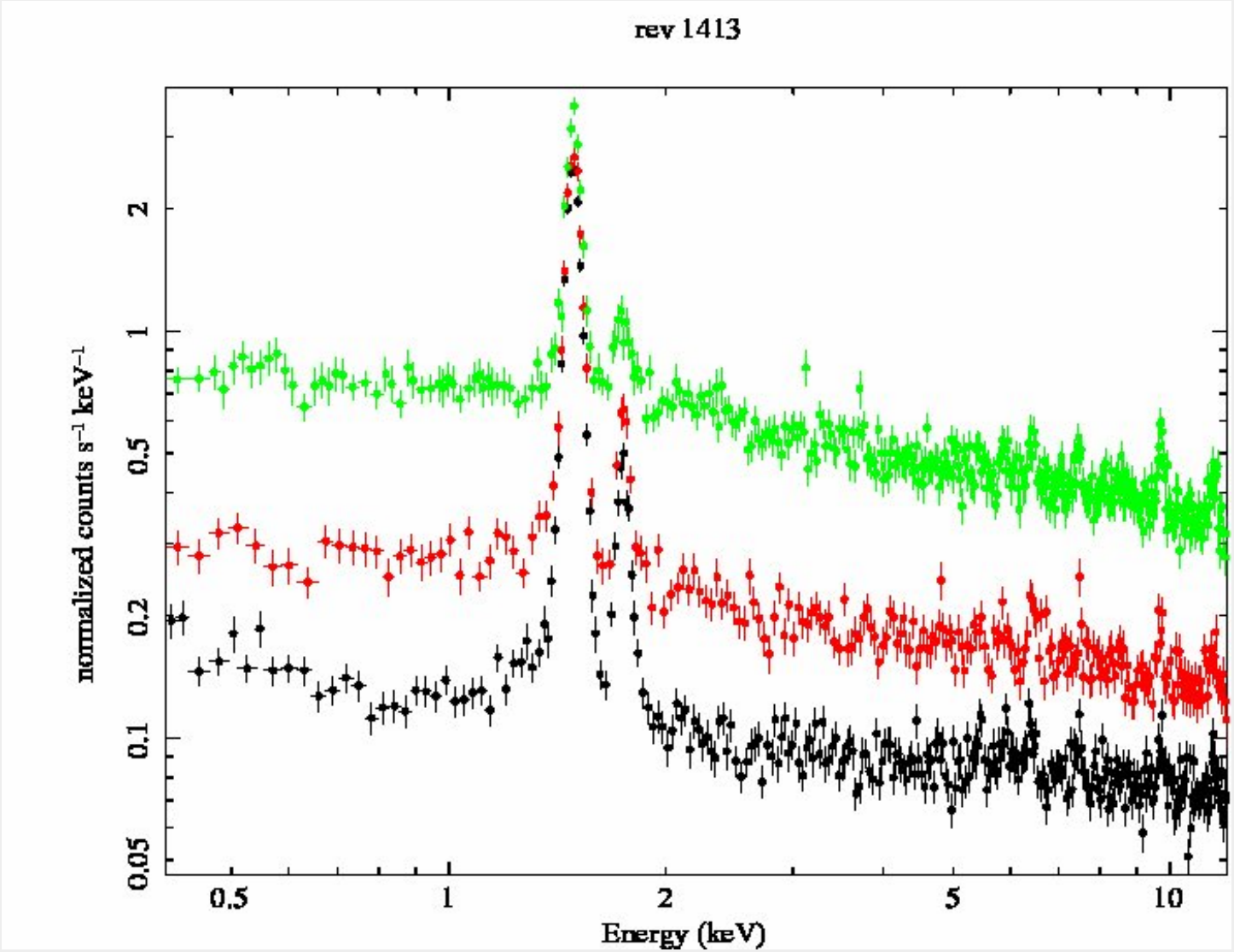
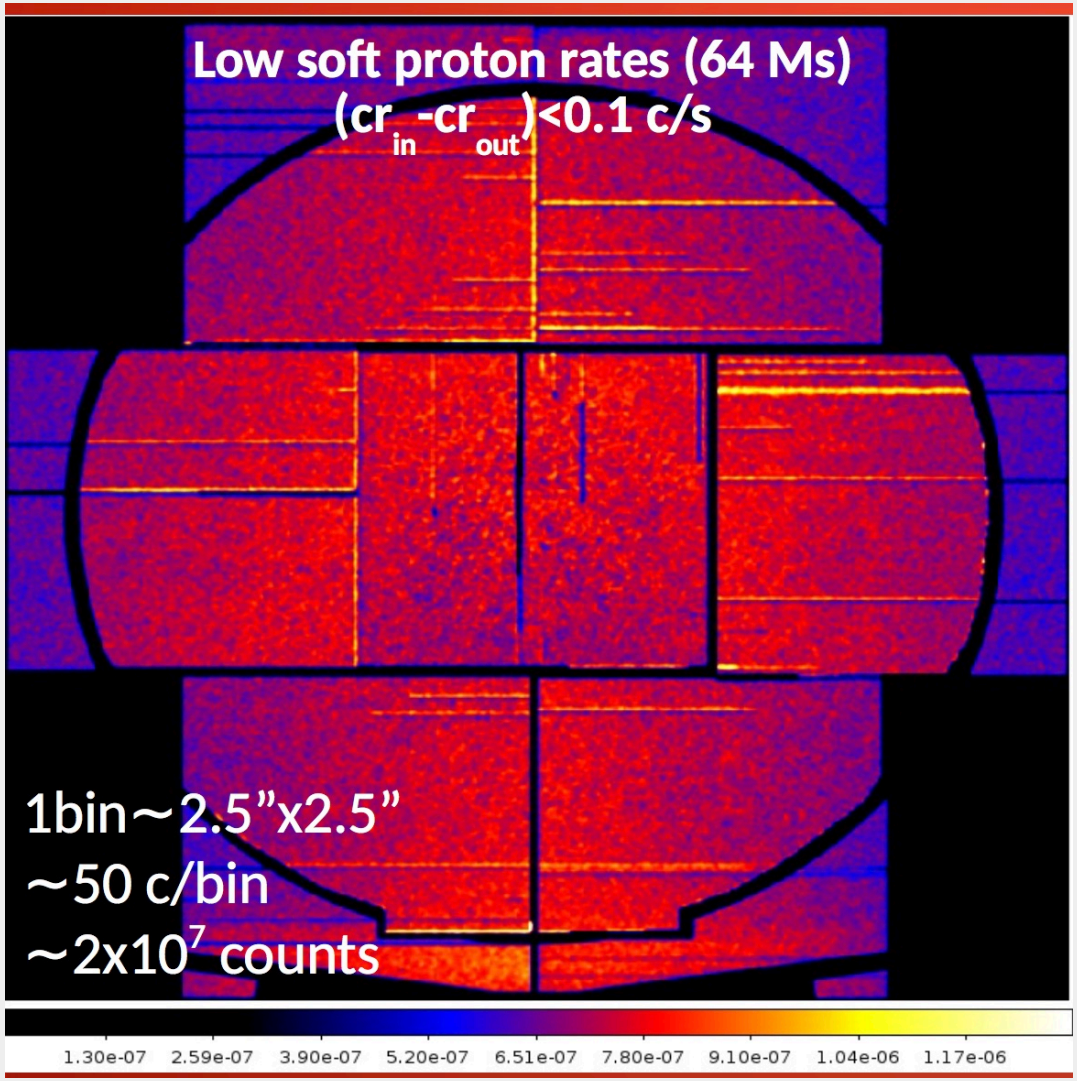


SPATIAL DISTRIBUTION ON THE DETECTOR



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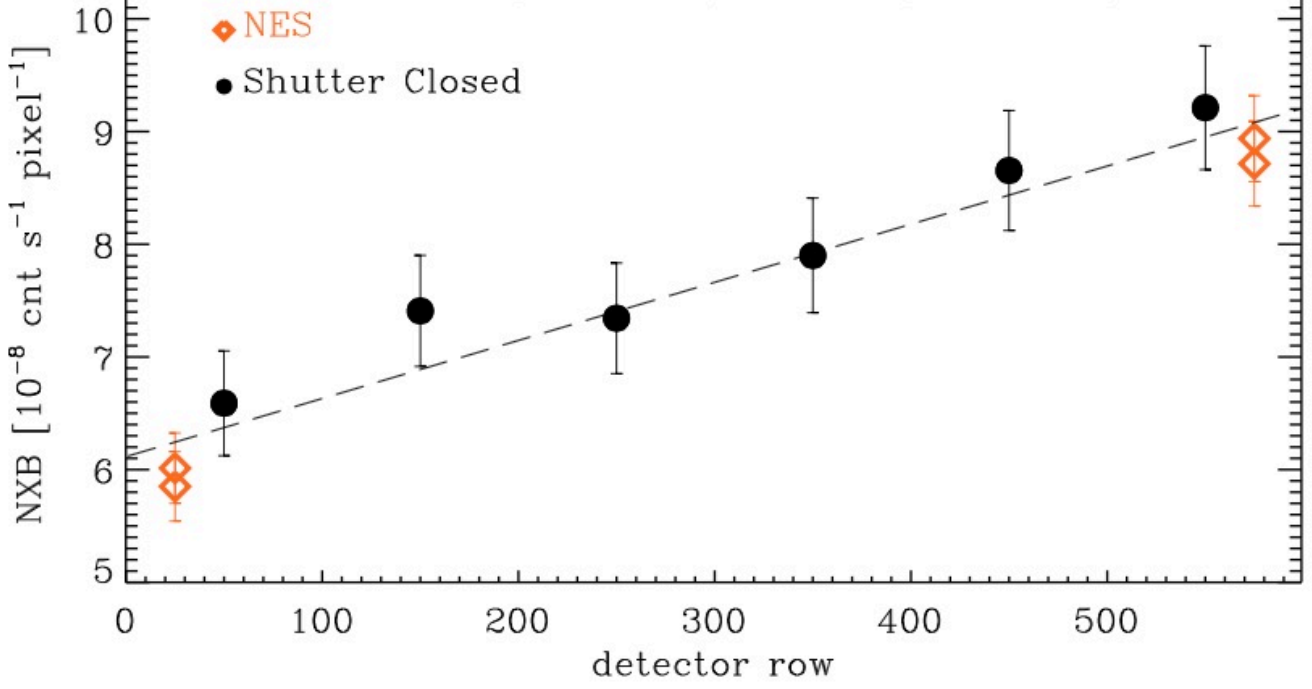
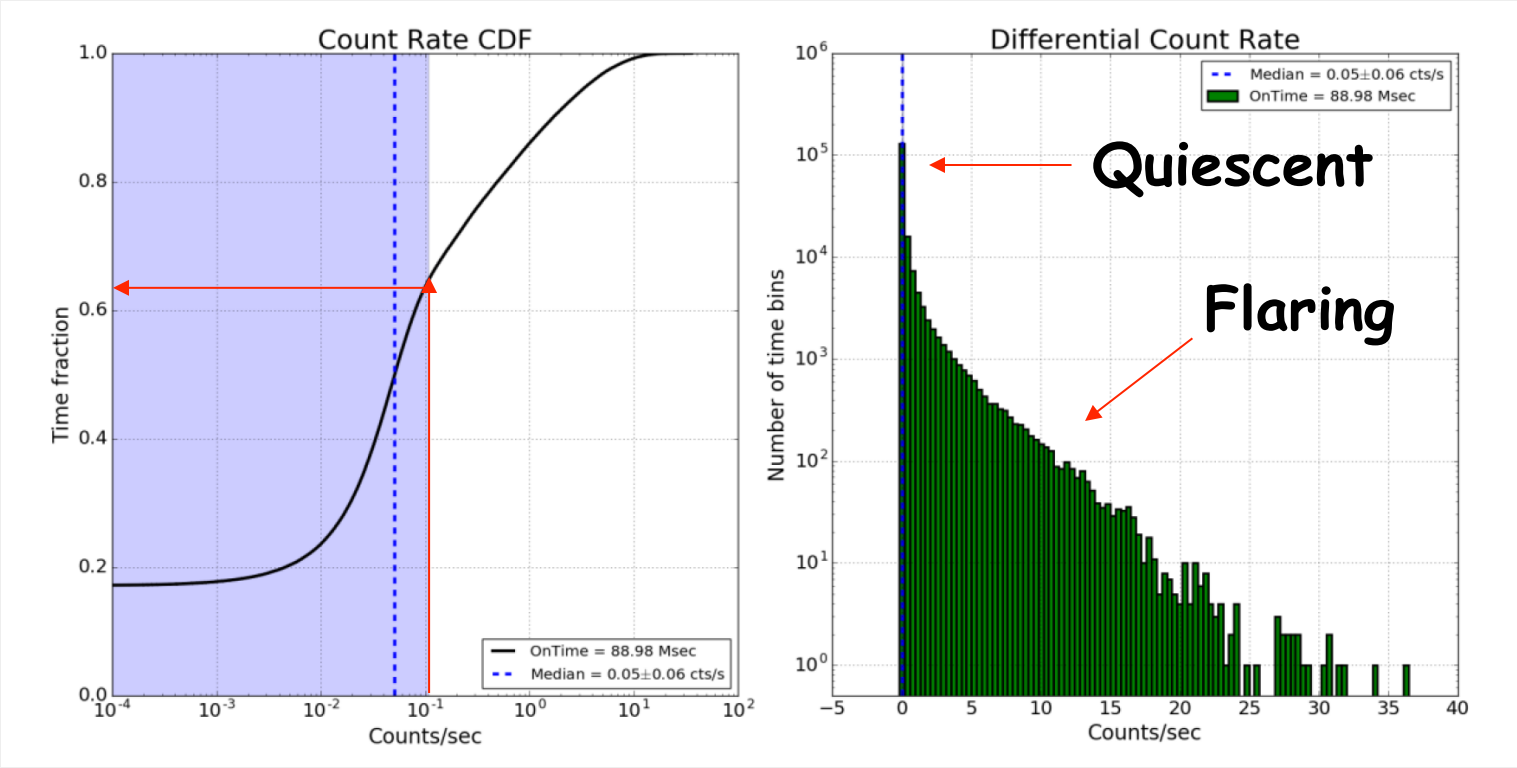


Fig. 3. NXB count rate (per pixel) in the 1.5–7 keV energy band as measured by SC and NES datasets. The linear gradient in the CCD vertical direction is evident.

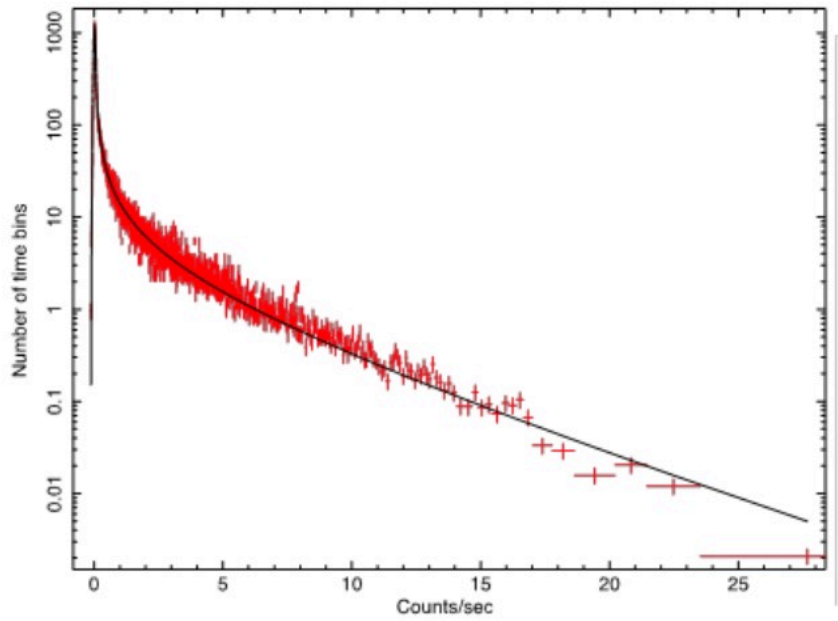
Non uniform distribution on the detector, i.e. gradient in each CCD in the direction of the readout nodes. Already seen in Swift MOS (Moretti+09). Systematic over the FOV of 4% based on analysis of the closed.

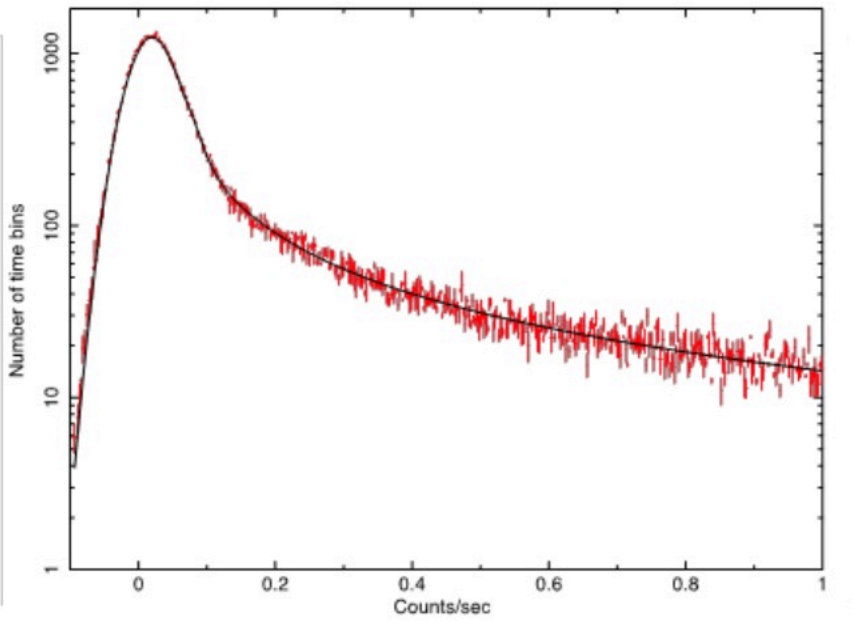
Soft Proton BKG



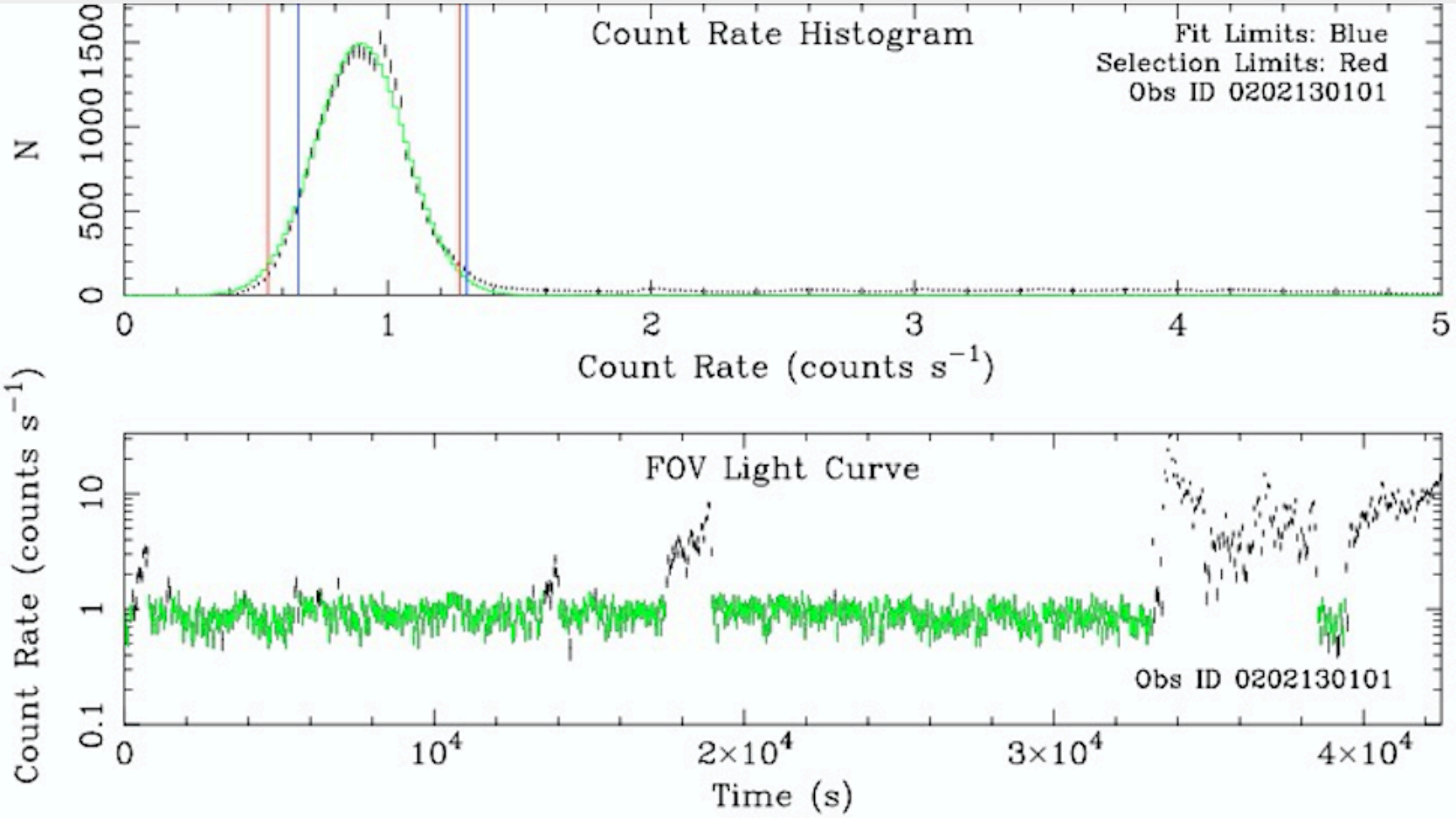
~ 40% of data dominated by flaring component

Soft Proton BKG





FLARE CLEANING



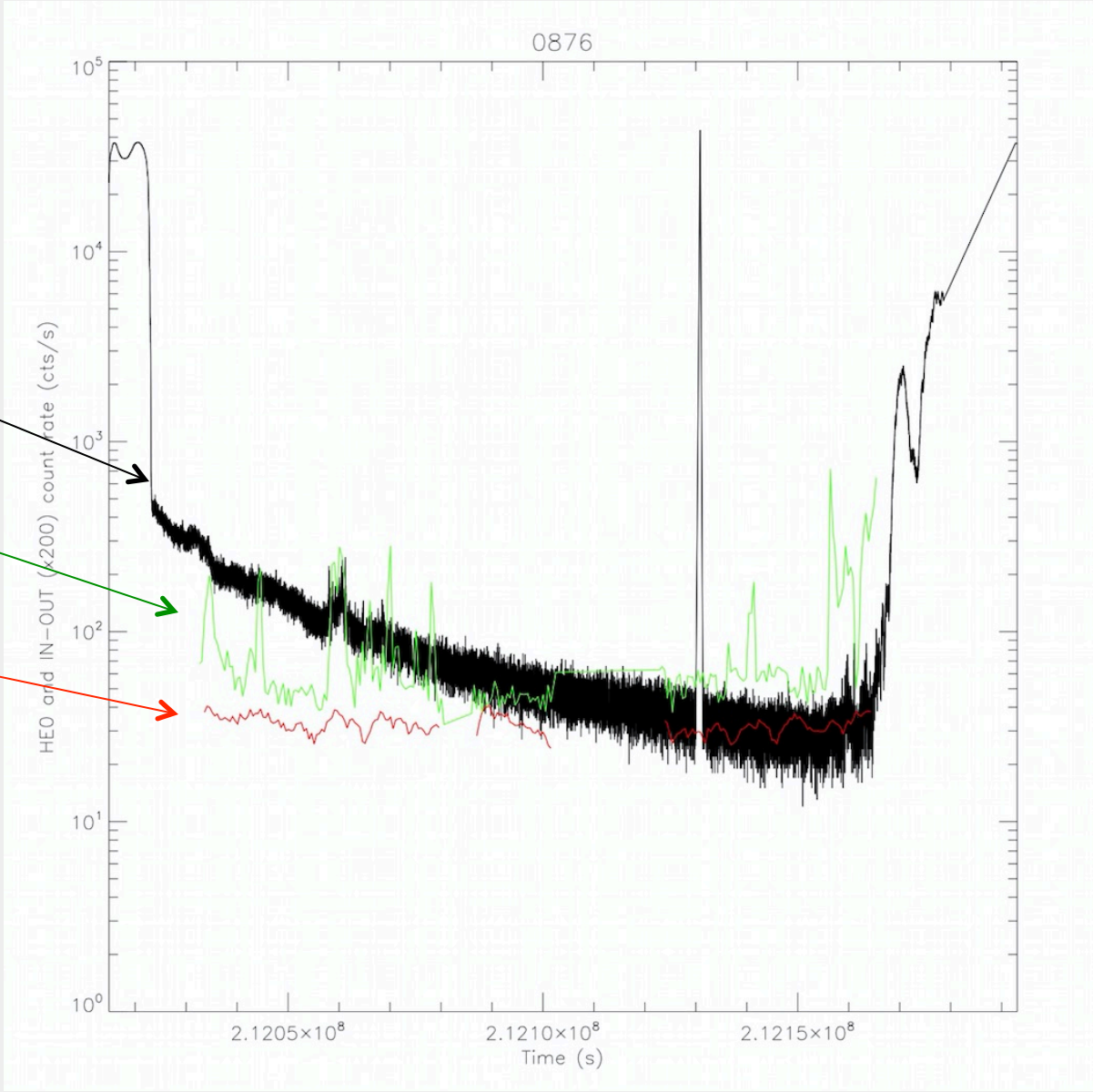
Snowden+08

FLARE CLEANING

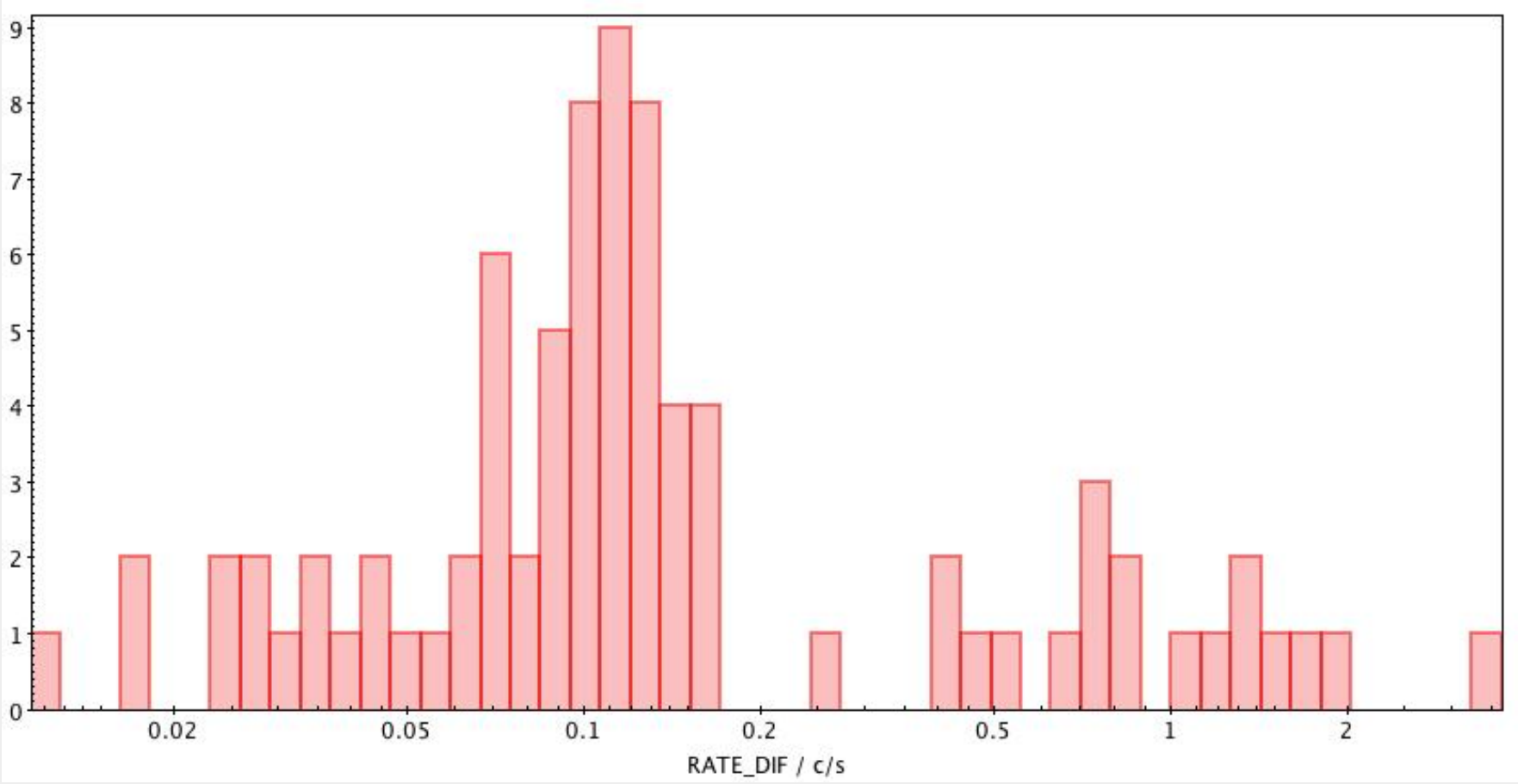
RM

inFOV

outFOV

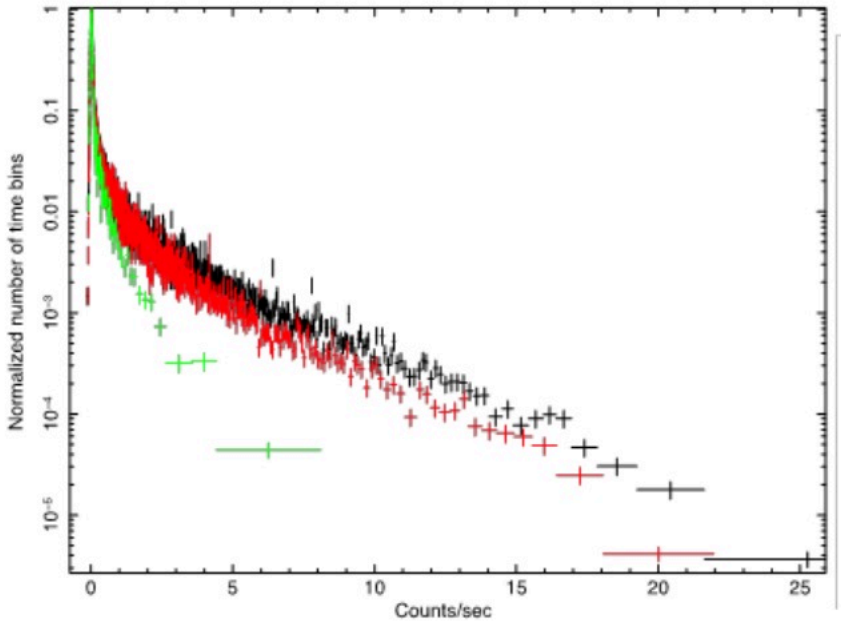


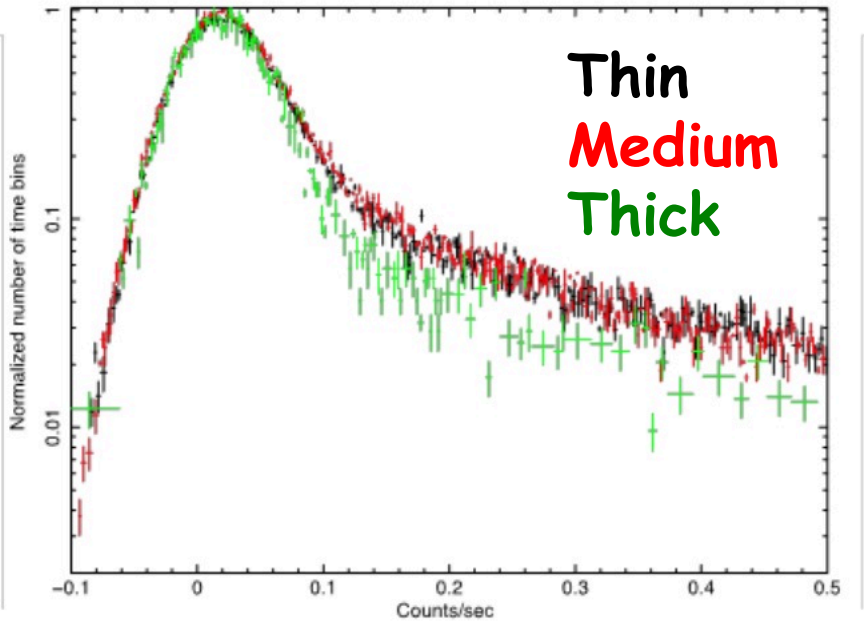
FLARE CLEANING



Clearly IN-OUT is the best suited quantity (rather than, e.g., IN/OUT) to really gauge the level of SP contamination

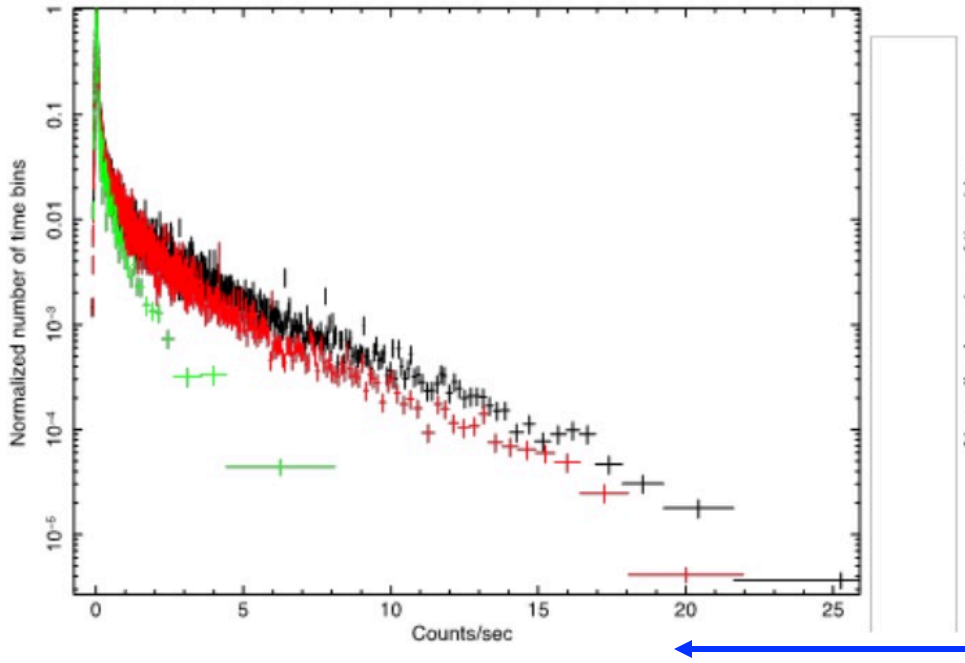
Soft Protons vs Filters

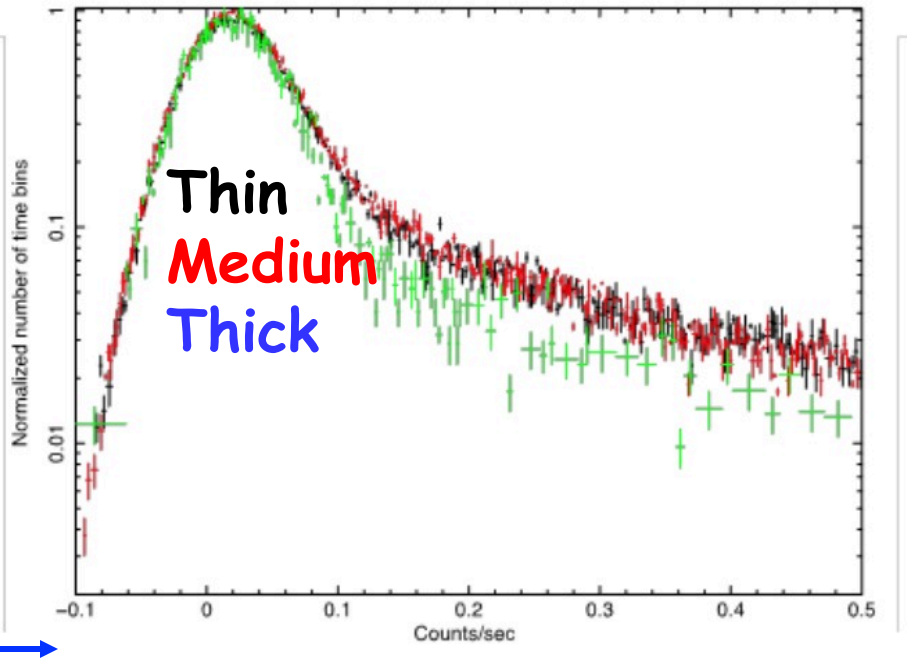




- Diff in flare comp
- No diff in peak pos

Soft Protons vs Filters





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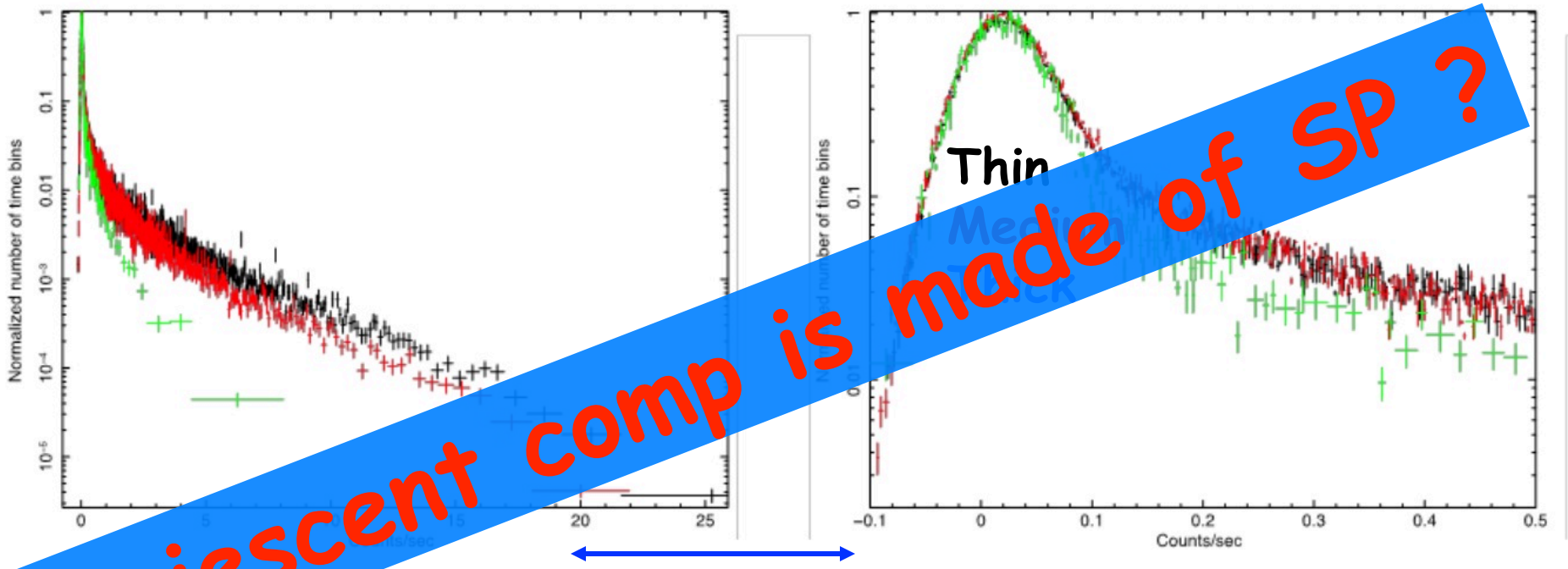
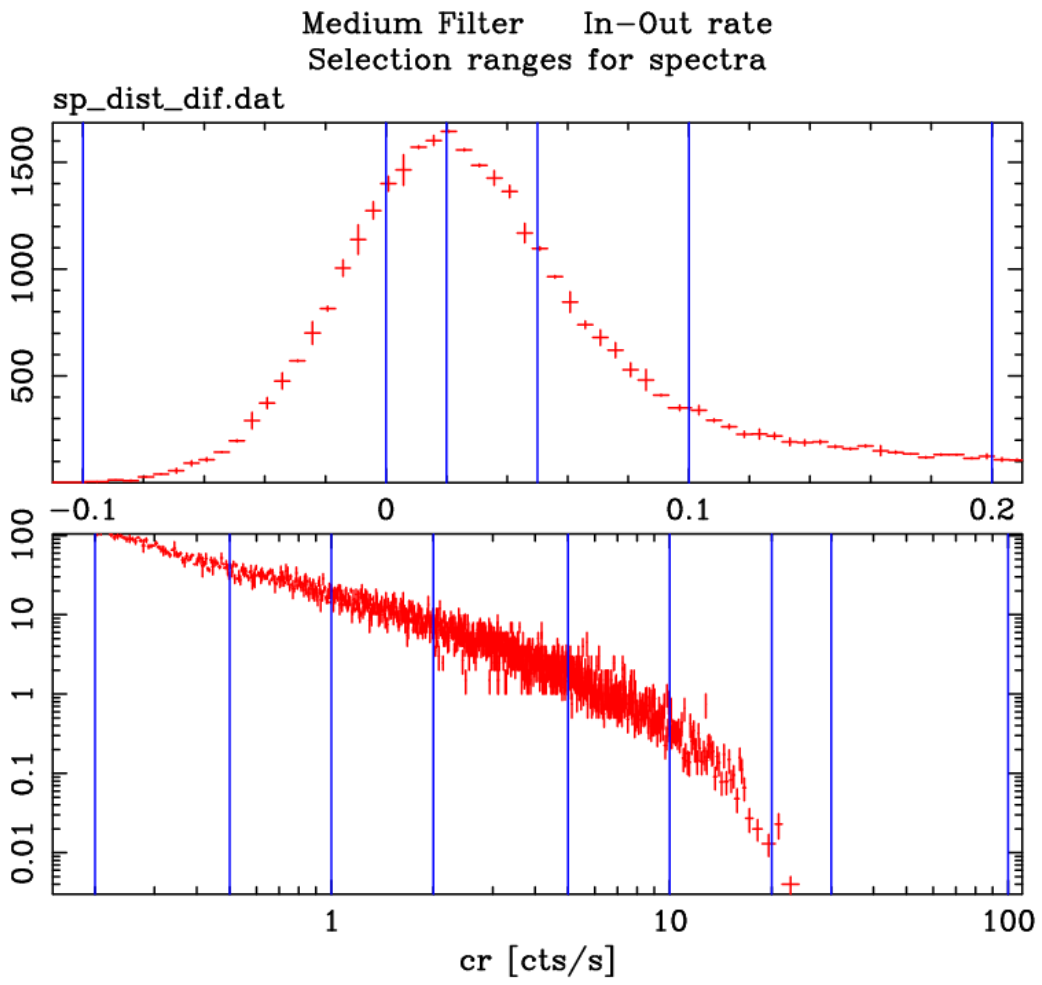


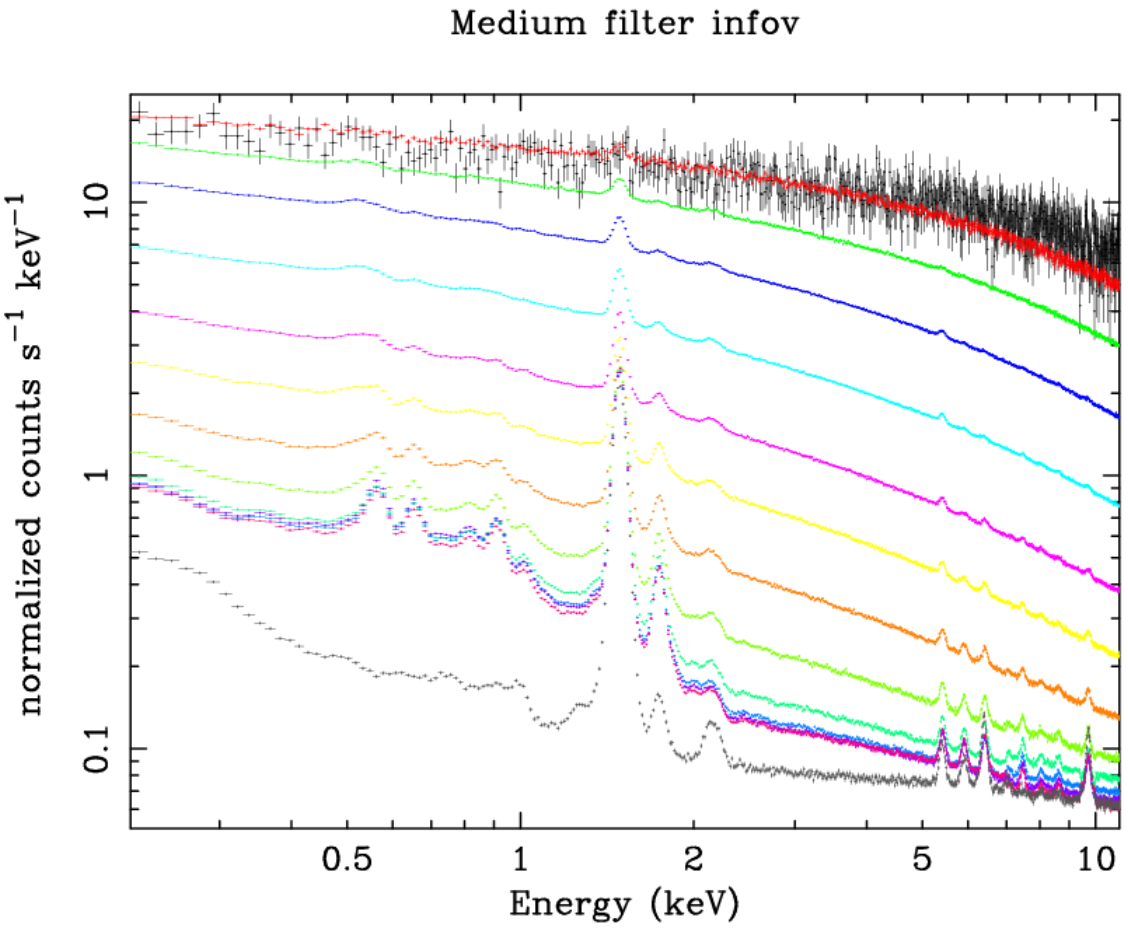
Quiescent comp is made of SP ?

Selection wrt in-out distribution



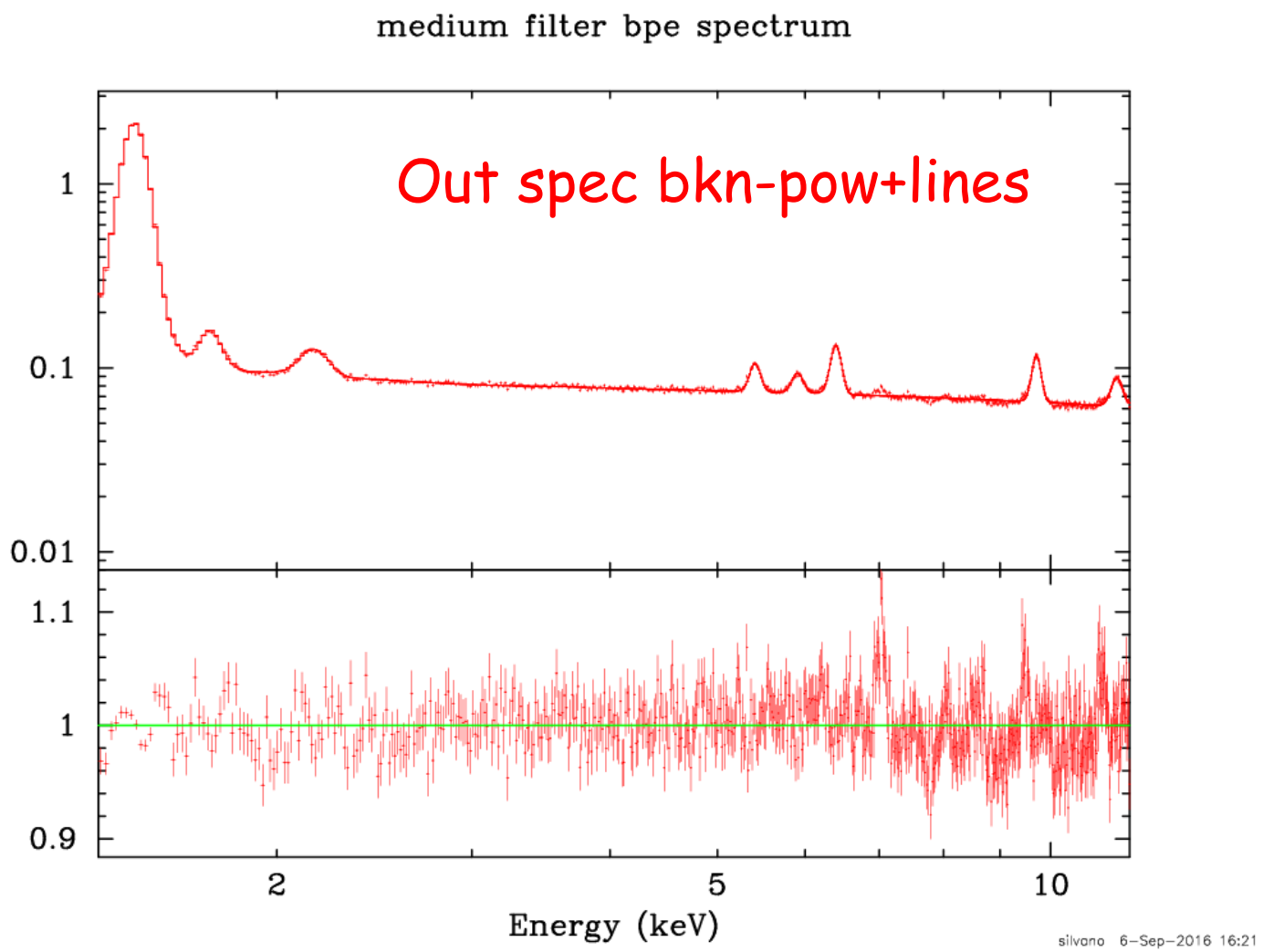
13 spectra for thin & medium filter (fewer for thick)

Selection wrt in-out distribution



Spectral modeling

As an example, let's take the spectrum extracted from blue wing region near peak (bpe)



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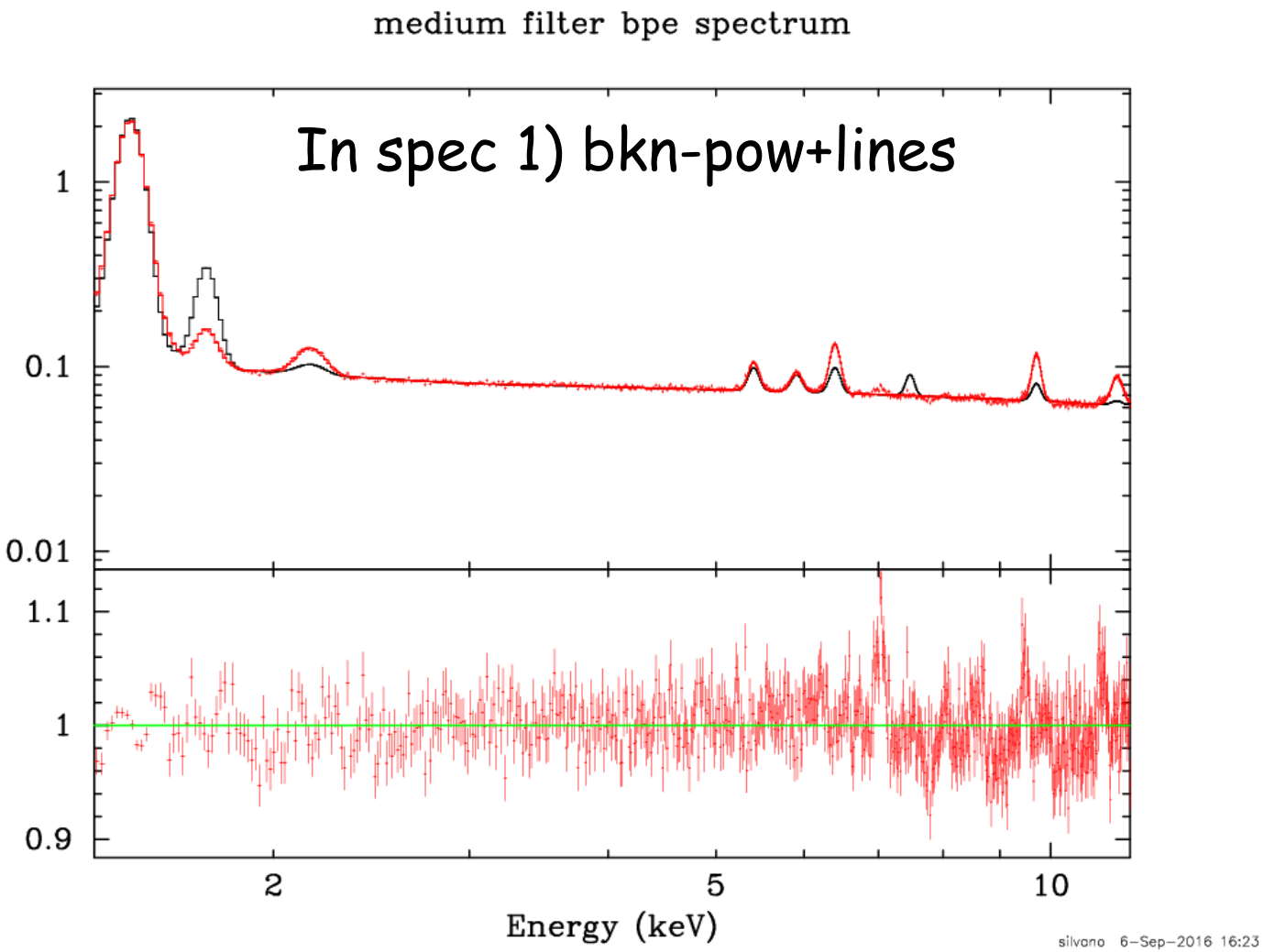

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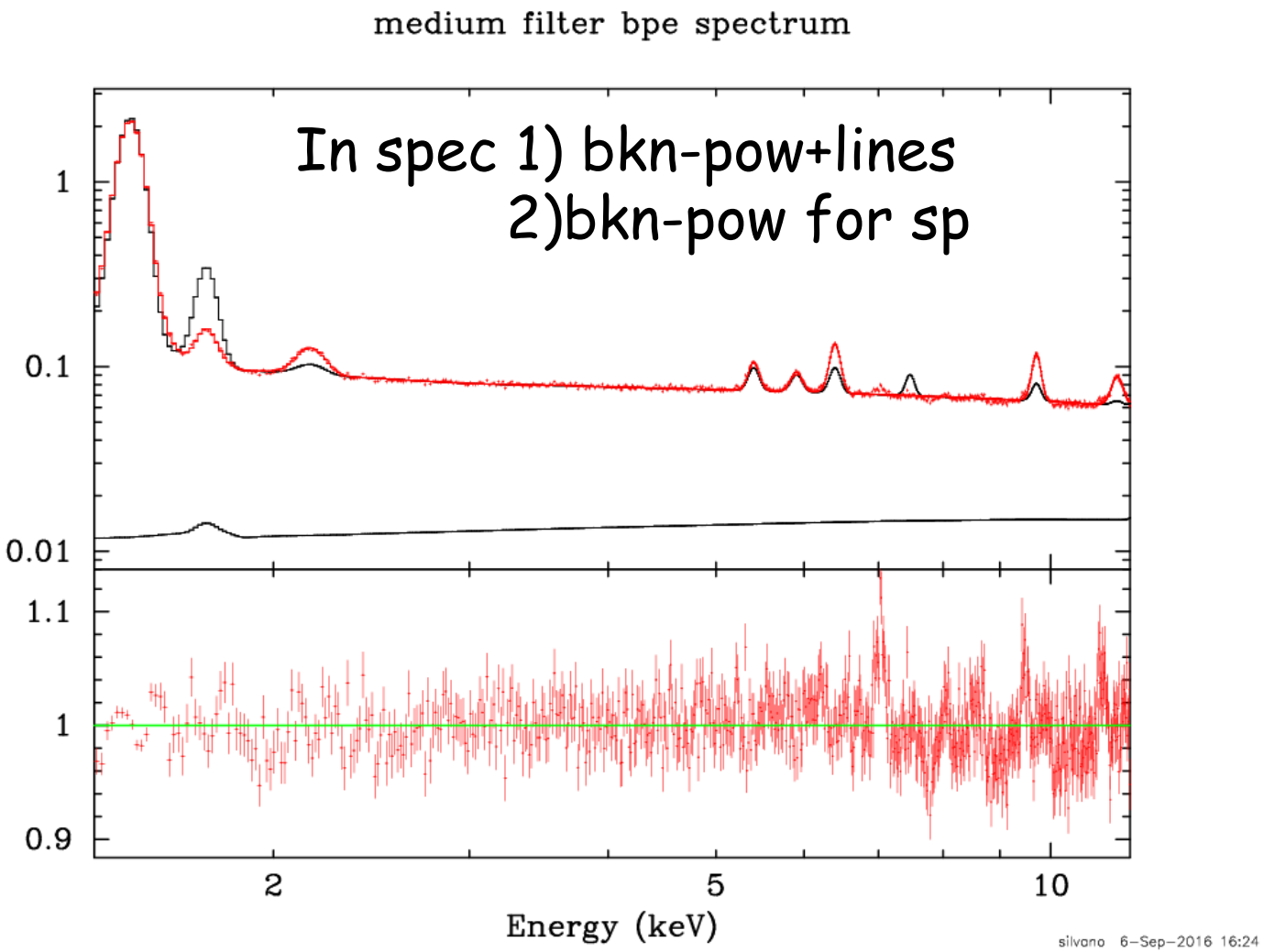

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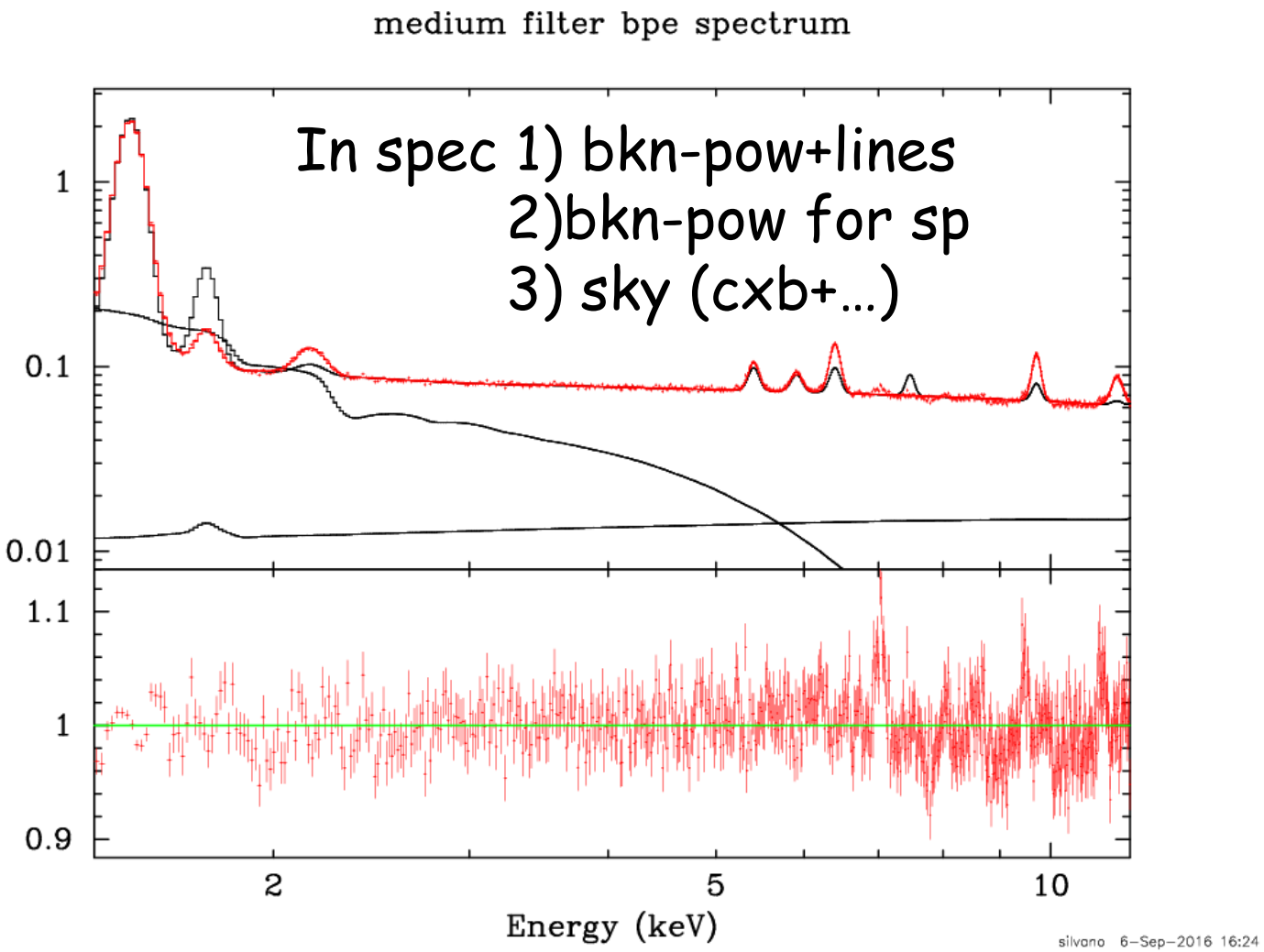

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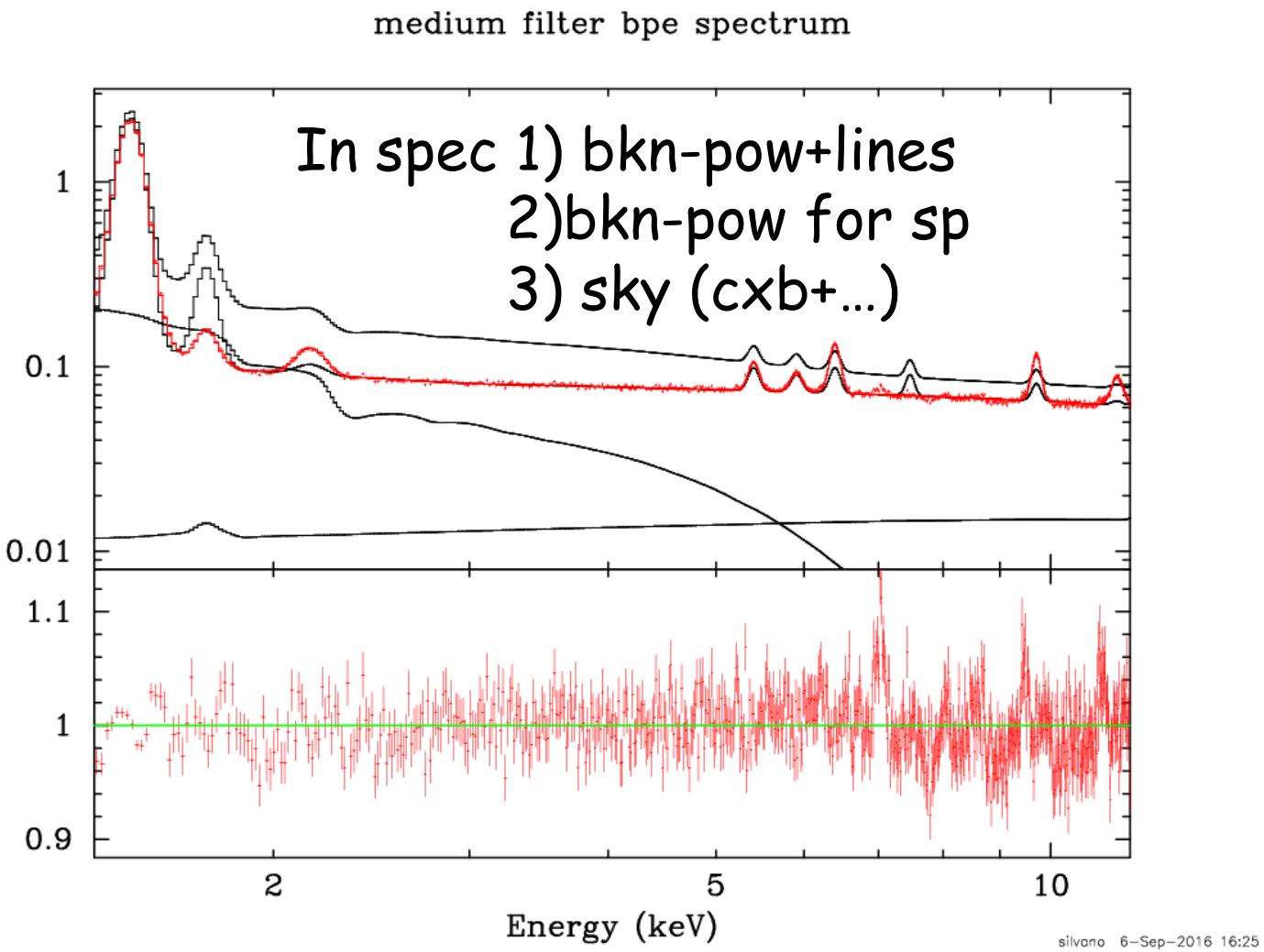

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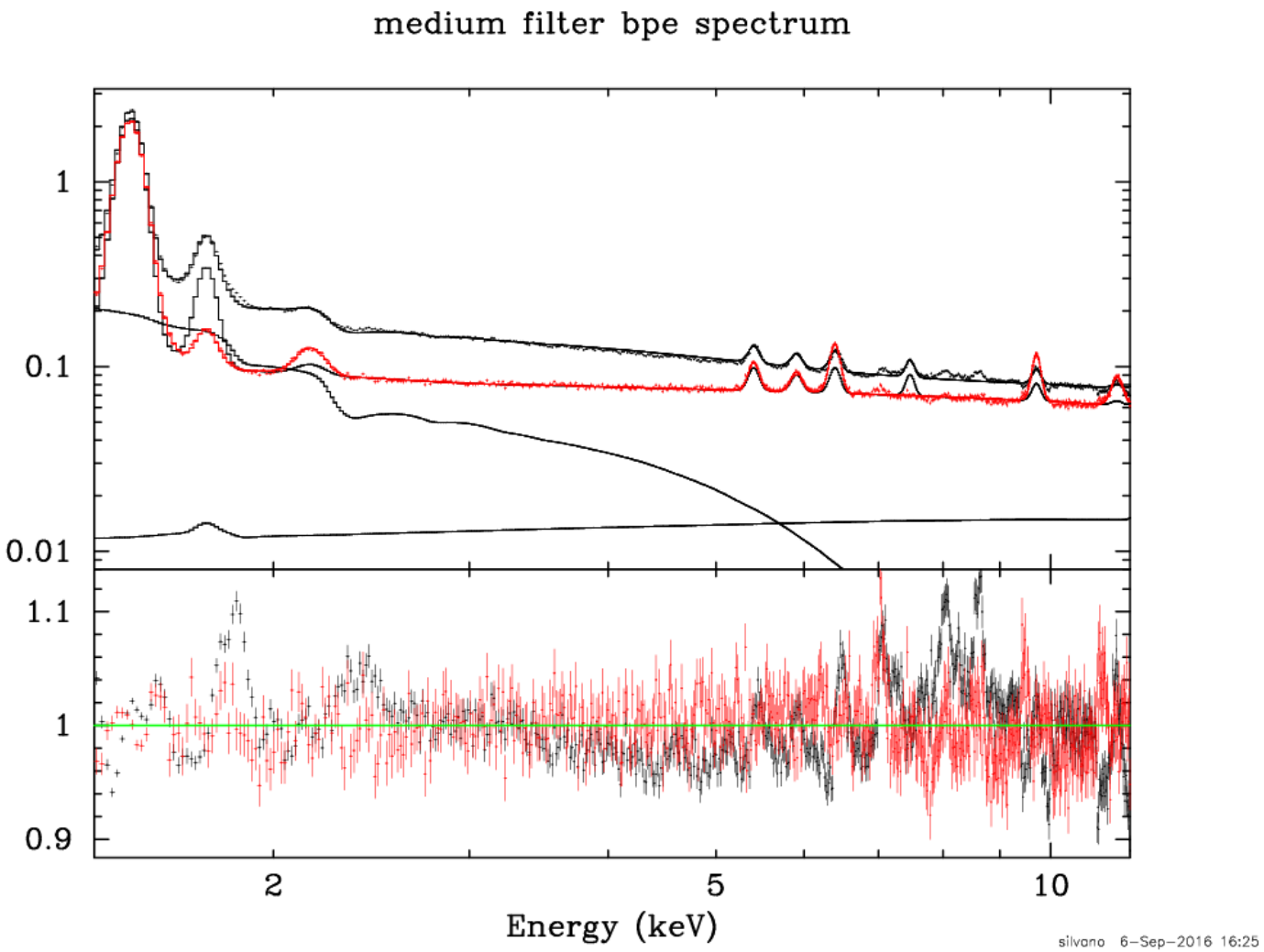
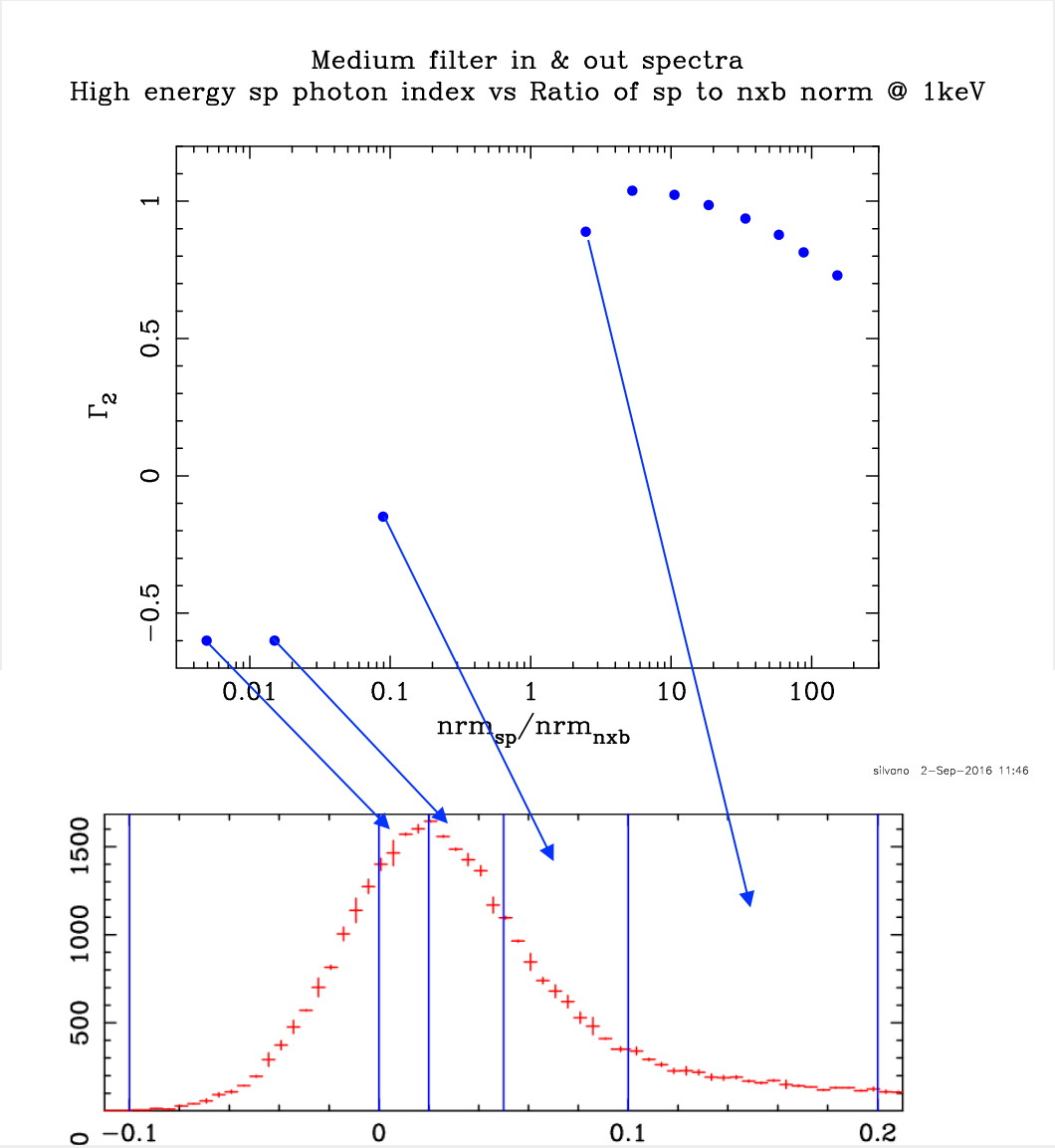


Spectral Analysis

High energy slope of bkn-pow modeling INFoV Excess



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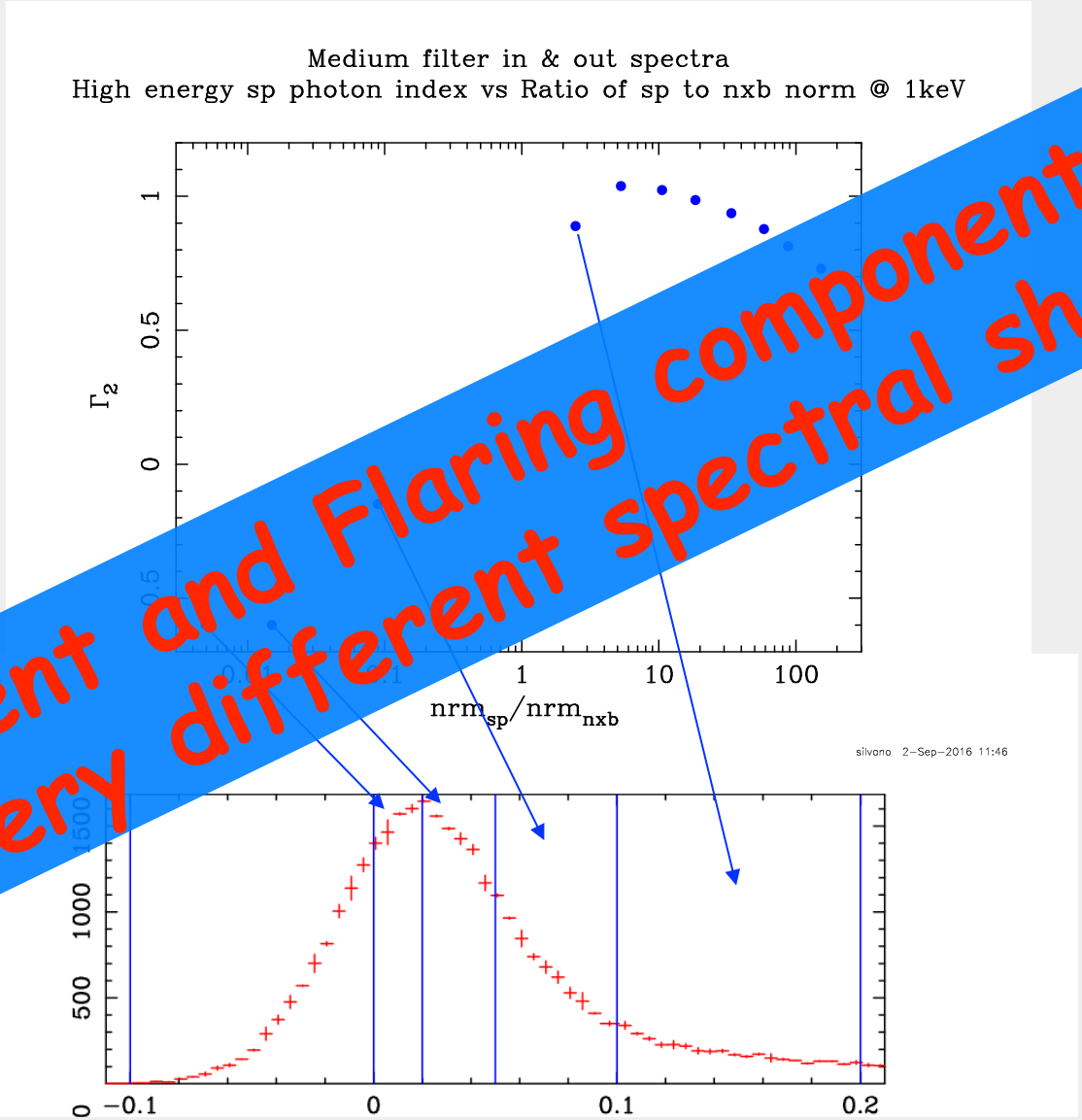


Quiescent and Flaring component have very different spectral shapes

Not only particles

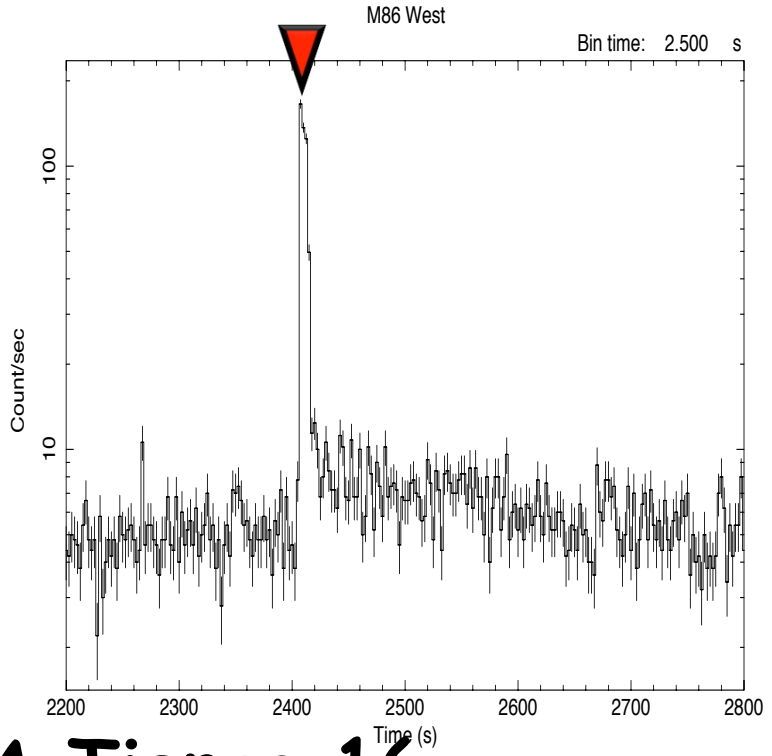
Cosmic X-rays as "instrumental" bkg

Photons with energies 100-200 keV penetrate all the way to detectors

MOS Lightcurve from entire FoV

SGR 1806-20

Direct evidence from SGR 1806-20 Giant Flare on 2004 Dec 27, while XMM was observing a target at 90°!



A.Tiengo 16

SUMMARY

	ENERGY	TIME	DETECTOR
GCR BKG	OK	OK	TBD
SP BKG	OK ?	OK	TBD
COMPTON BKG	FLAT ? CONST ? UNIF in FOV ?		