

Cross calibration of Suzaku/XMM/ Chandra with PKS2155-304

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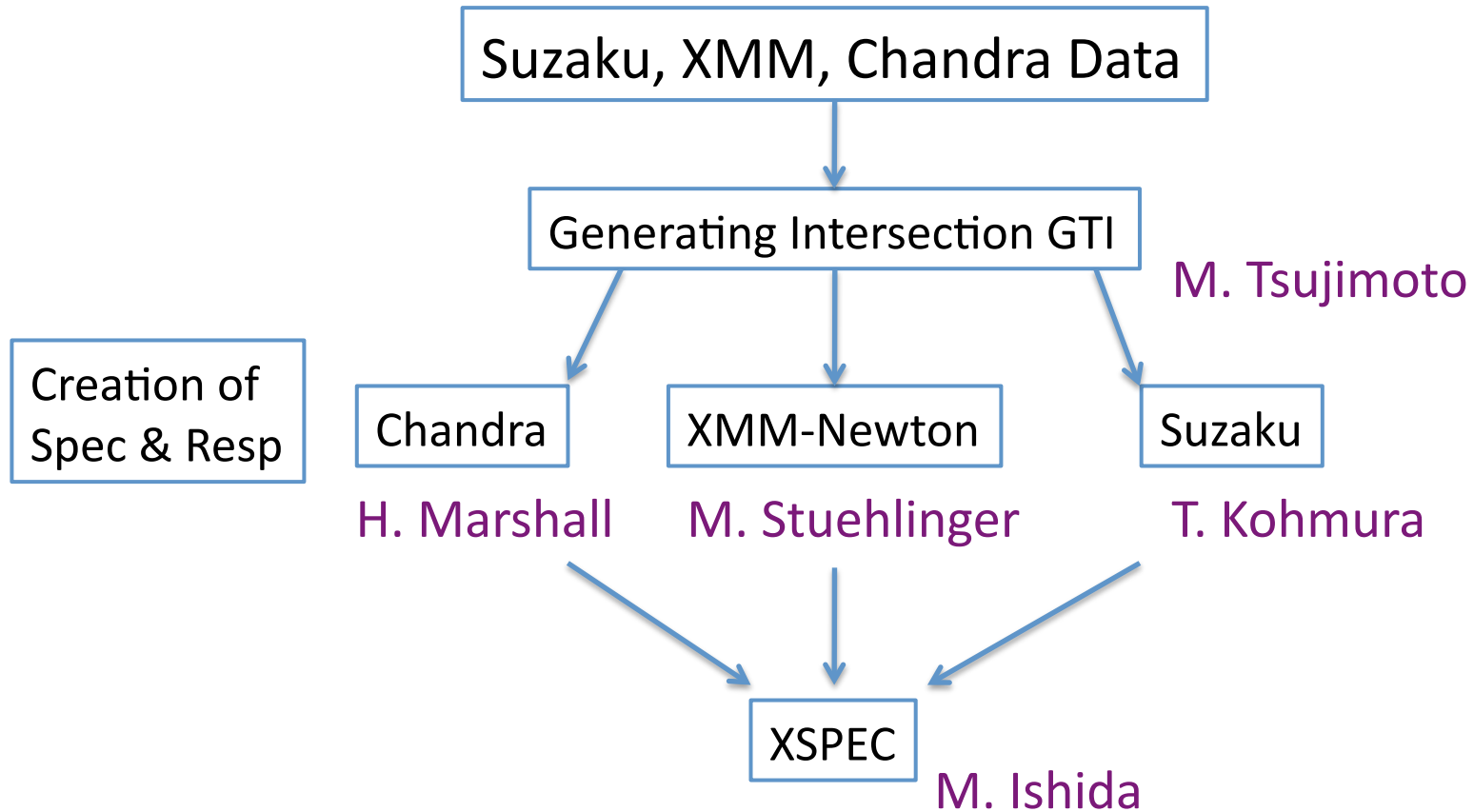
PKS2155-304

- One of the brightest BL Lac objects.
 - Showing simple power-law (possibly broken power-law) spectrum.
 - Point source.
 - Needless to care about telescope vignetting (unlike diffuse sources like non-thermal SNRs).
 - Free from contamination (unlike a rotation-powered pulsar in SNRs).
 - Variable: need simultaneous observation among alive missions.
- ⇒ We planned coordinated observation among Suzaku, XMM-Newton and Chandra for calibration purpose since 2005.

Status of the PKS2155-304 project

- Continued since the first Iceland meeting
- We are finalizing the results
 - Started preparing publication
 - Web page

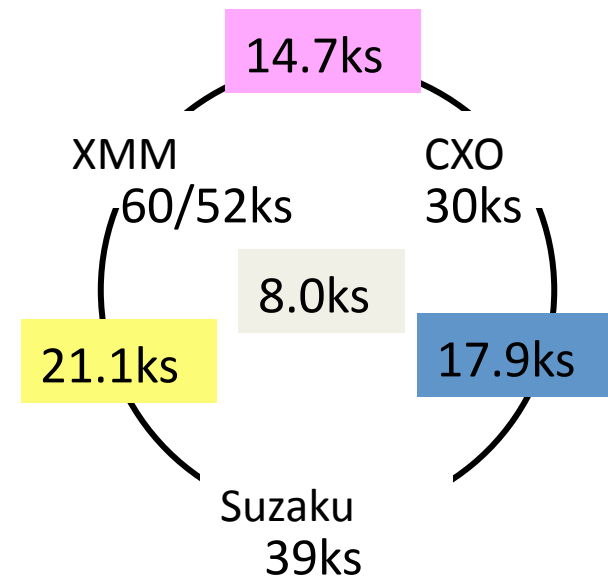
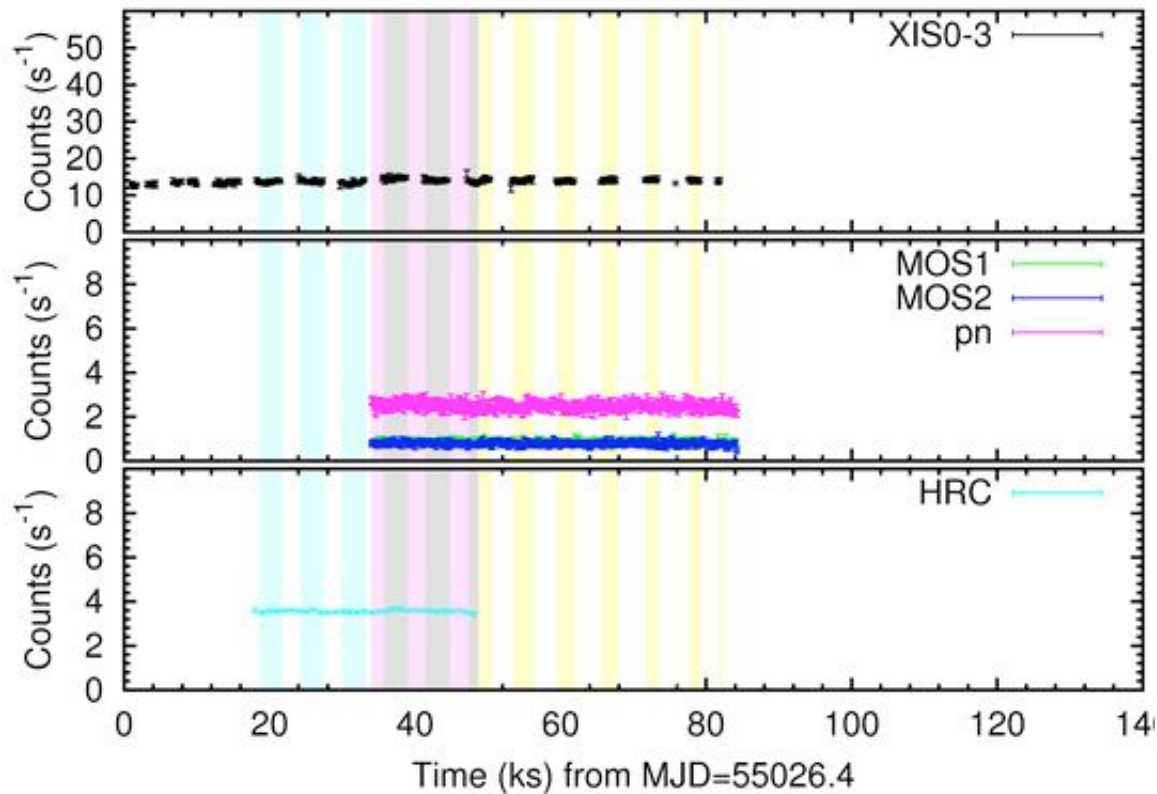
Our team



Observations

- 2005 Nov 30-Dec 2
 - XIS-FI/BI, EPIC-MOS/pn
- 2006 May 1-2
 - XIS-FI/BI, EPIC-MOS/pn, HRC-LETG
- 2007 Apr 22
 - XIS-FI/BI, EPIC-MOS/pn, HRC-LETG
- 2008 May 12-13
 - XIS-FI/BI, EPIC-MOS/pn, ACIS

Intersection GTI (2006)

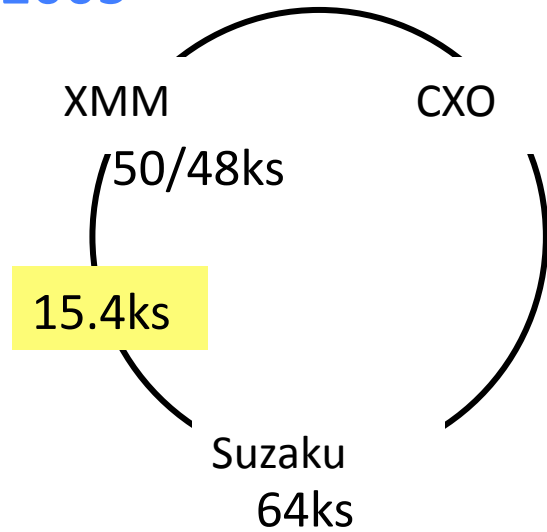


- The source was faintest among the three observations.
- Simultaneous coverage of any pair is moderate.
- Overlap of all instruments is limited.

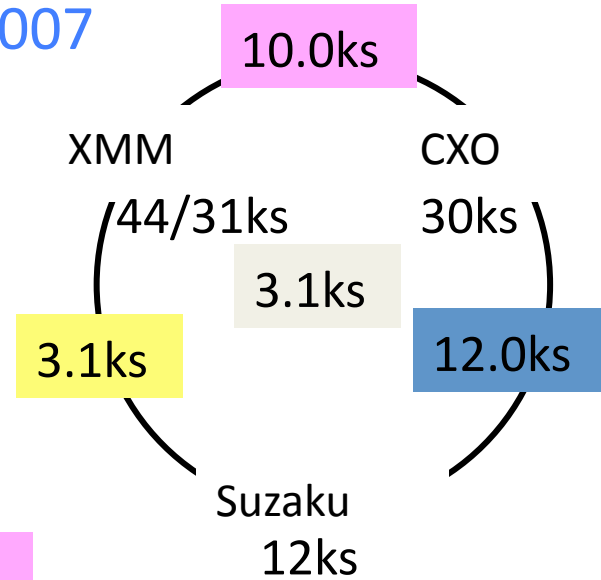
By Tsujimoto-san

Intersection GTI Summary

2005

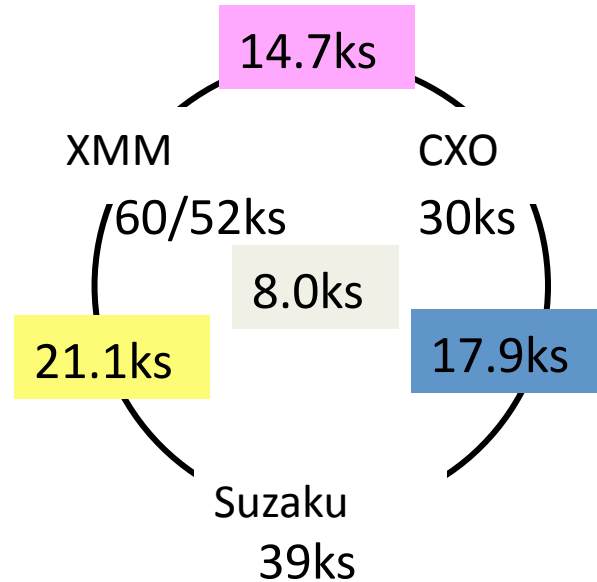


2007

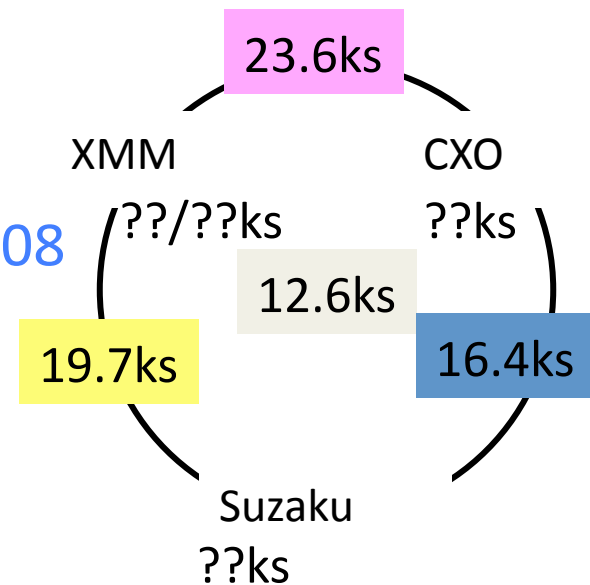


By Tsujimoto-san

2006



2008



Note: as of today, Suzaku and XMM-Newton data are ready.

Data screening: Suzaku

- CALDB XIS20090402, XRT20080709
- Heasoft 6.6.2
- grade0+2+3+4+6
- BAD columnexcluded
- SAA SAA_HXD=0 && T_SAA_HXD > 436
- ELV > 5° / DYE_ELV >20°
- ANG_DIST ...<1.5'
- Sourcer<4.33' / BGD R=4.33'–6'

By Kohmura-san

Data screening: XMM-Newton

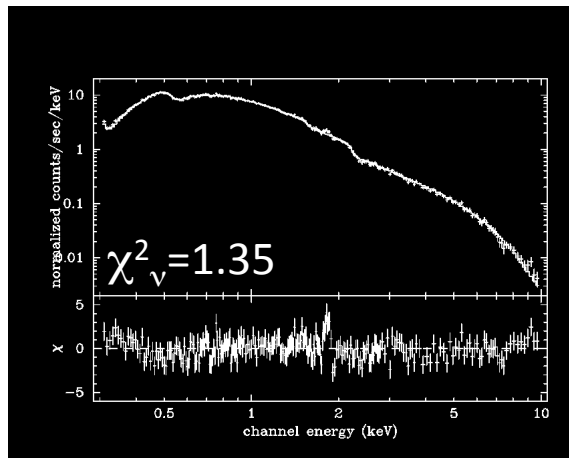
- Calibration Files
 - CCF status as of 01.01.2009
- Photon extraction
 - emproc / epproc referencepointing=object
- pixel patterns and flags used
 - pn: PATTERN 0-4 with FLAG=0
 - MOS: PATTERN 0-12 with FLAG=#XMMEA_EM
- Integration regions
 - Rout = 1200pixels / Rin = 100-200pixels to avoid photon pile up.

By Martin-san

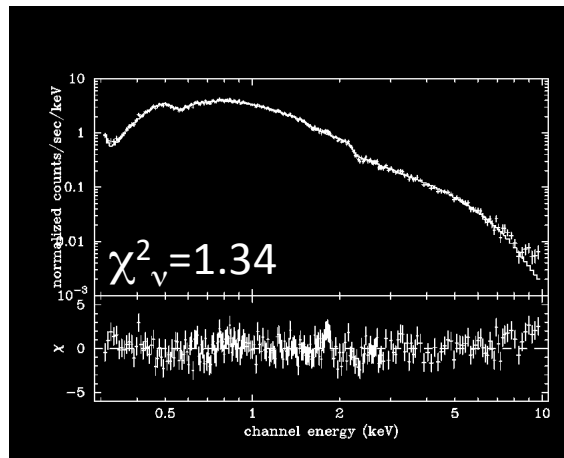
Suzaku XIS: 2005, 2006, 2008

2005

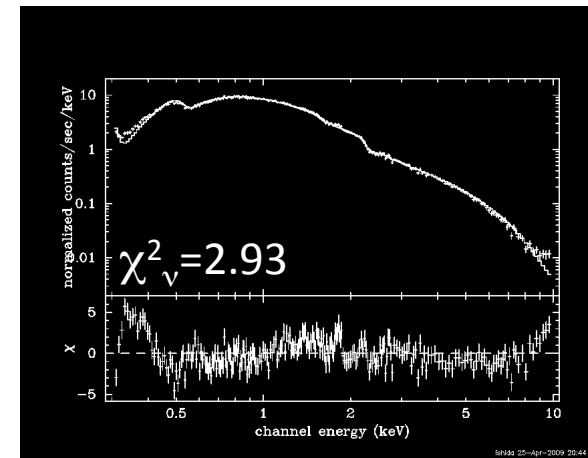
XIS-BI



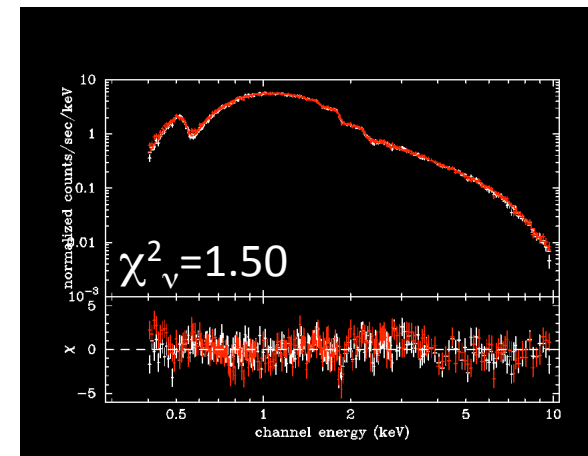
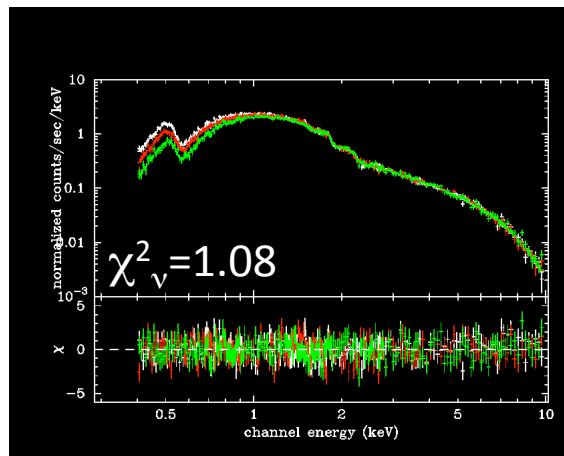
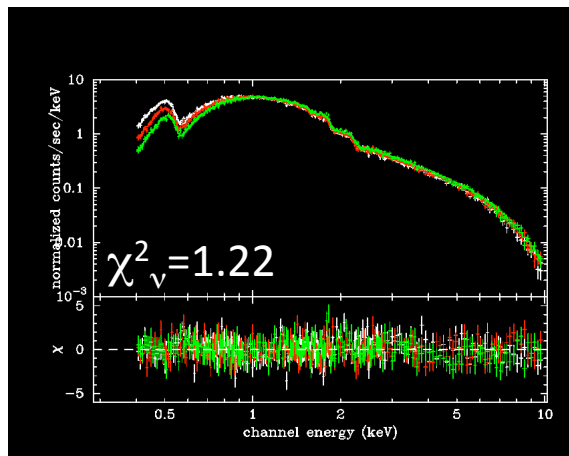
2006



2008



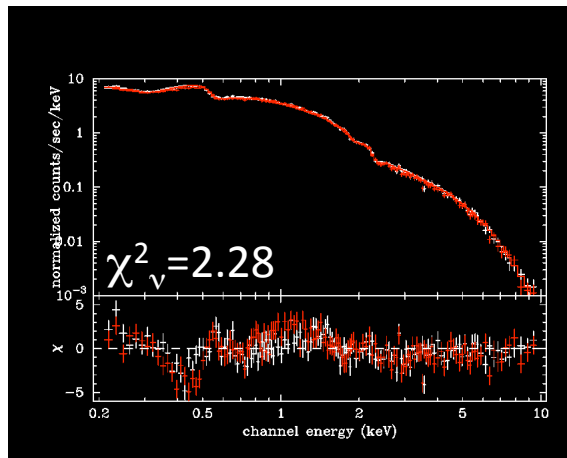
XIS-FI



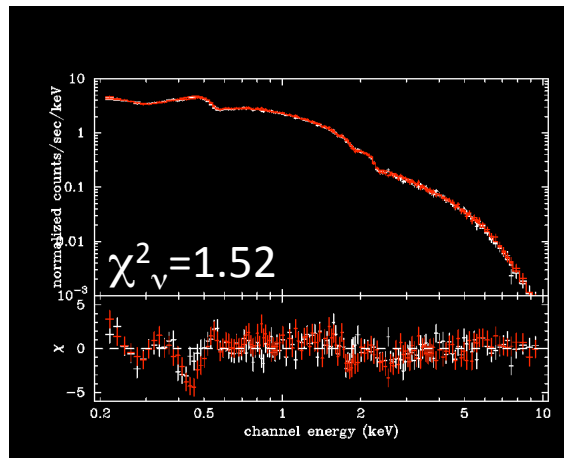
EPIC Spectra: 2005, 2006, 2008

2005

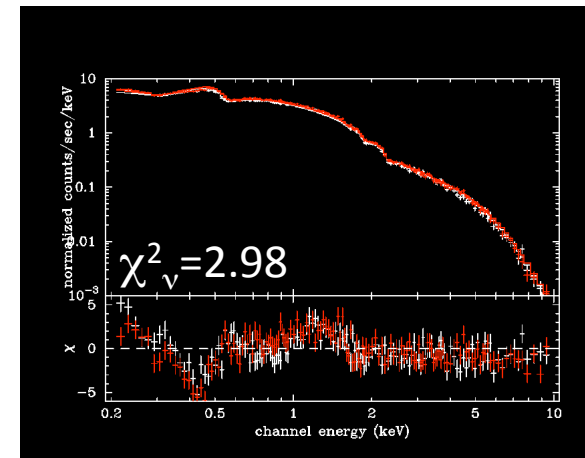
EPIC-MOS



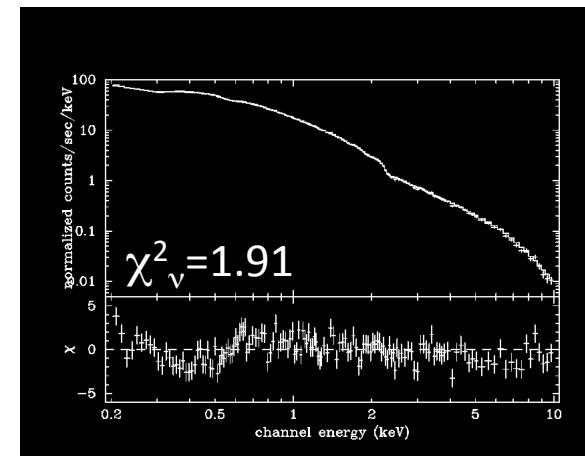
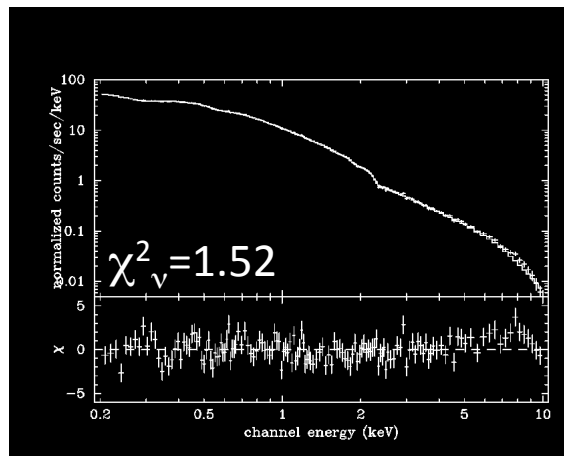
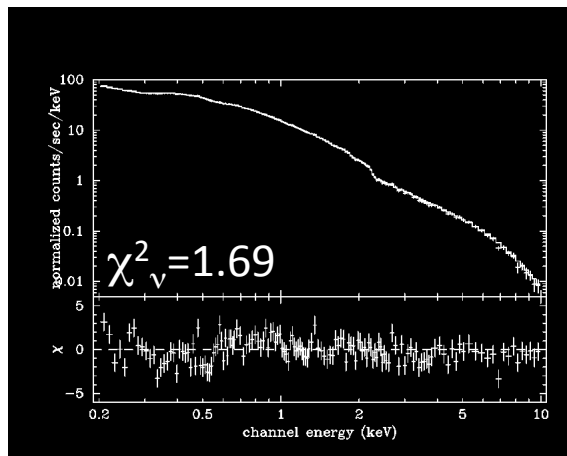
2006



2008



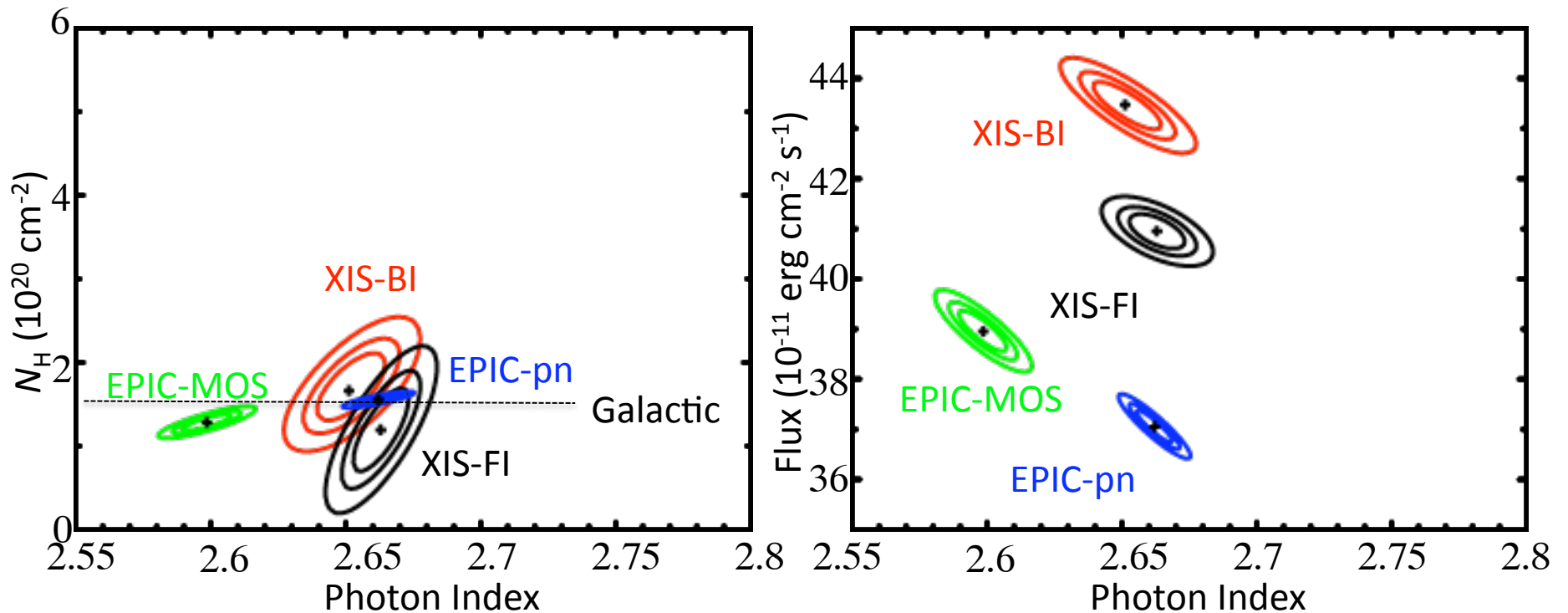
EPIC-pn



2005 XIS/EPIC parameters

XIS-FI: 0.4-10.0 keV, EPIC-MOS: 0.2-10.0 keV

XIS-BI: 0.3-10.0 keV, EPIC-pn: 0.2-10 keV



Photon index: 2.60-2.66

N_H : consistent with the Galactic value

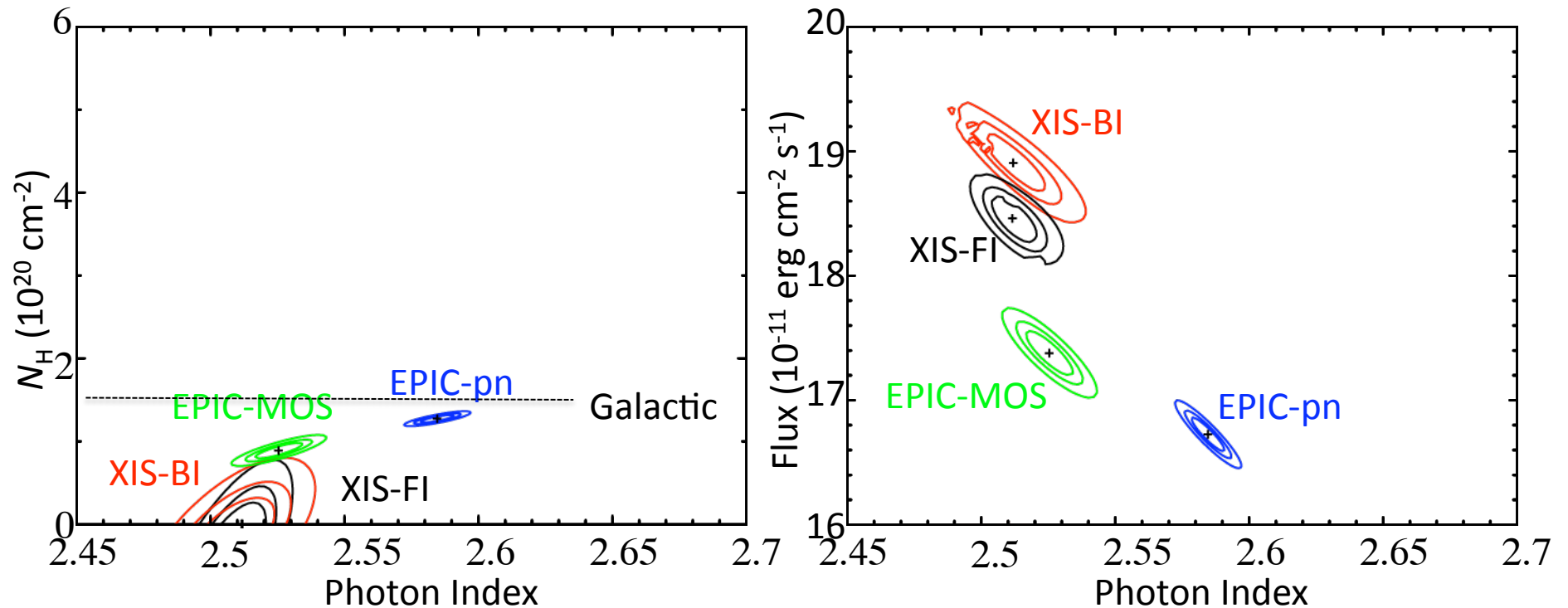
Flux: within $\pm 10\%$

(Those of EPIC seem smaller)

2006 XIS/EPIC parameters

XIS-FI: 0.4-10.0 keV, EPIC-MOS: 0.2-10.0 keV

XIS-BI: 0.3-10.0 keV, EPIC-pn: 0.2-10 keV



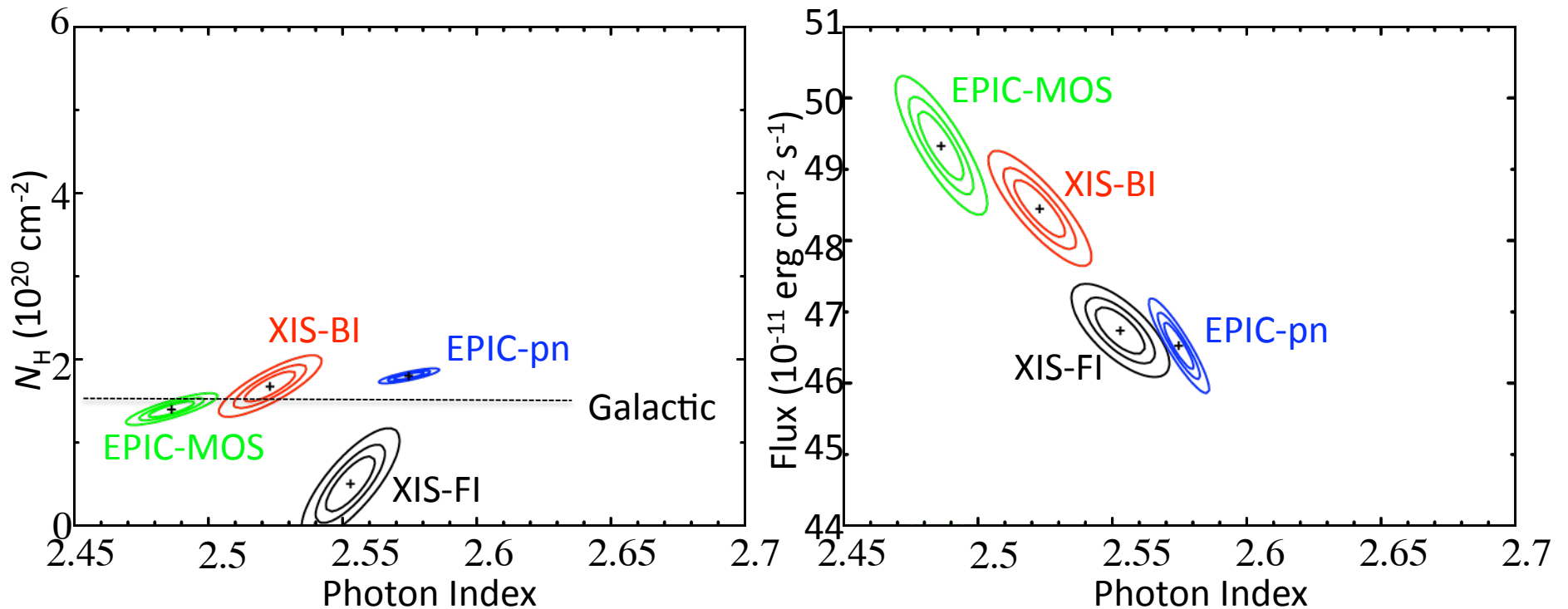
Photon index: 2.51-2.57
NH: smaller than the Galactic value

Flux: within $\pm 10\%$
(Those of EPIC seem smaller)

2008 XIS/EPIC parameters

XIS-FI: 0.4-10.0 keV, EPIC-MOS: 0.2-10.0 keV

XIS-BI: 0.3-10.0 keV, EPIC-pn: 0.2-10 keV



Photon index: 2.48-2.57

NH: scatter around the Galactic value

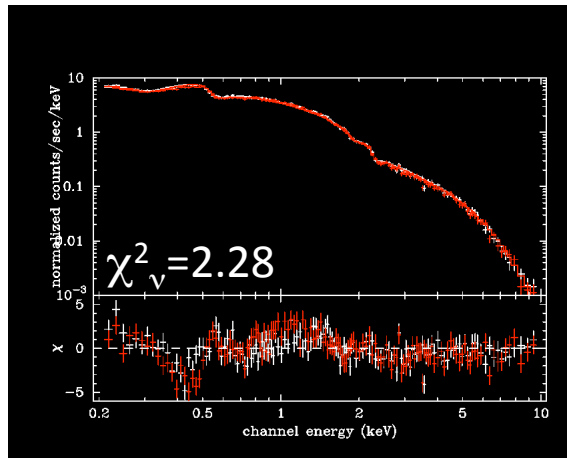
Flux: within $\pm 3\%$

(EPIC and XIS seem consistent)

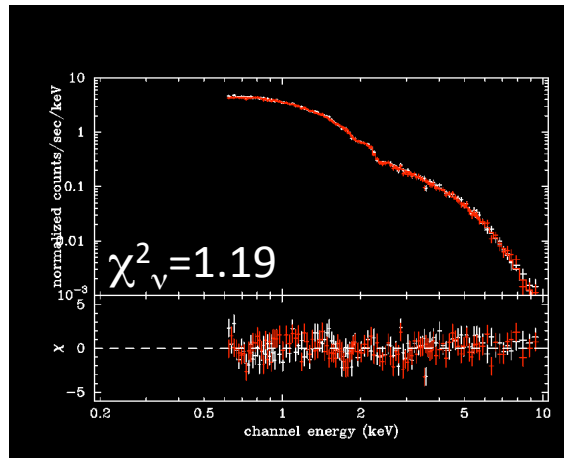
2005 EPIC: different energy band

0.2-10keV

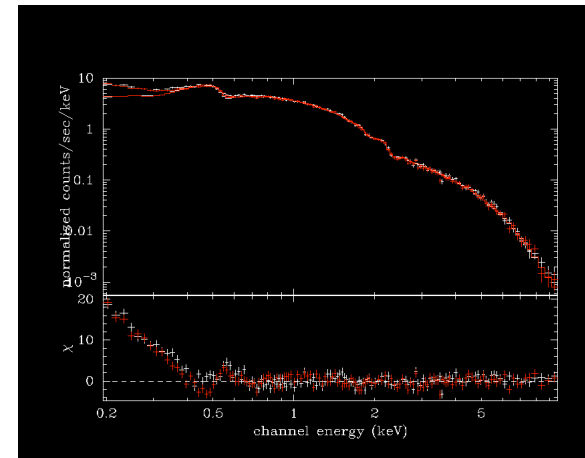
MOS



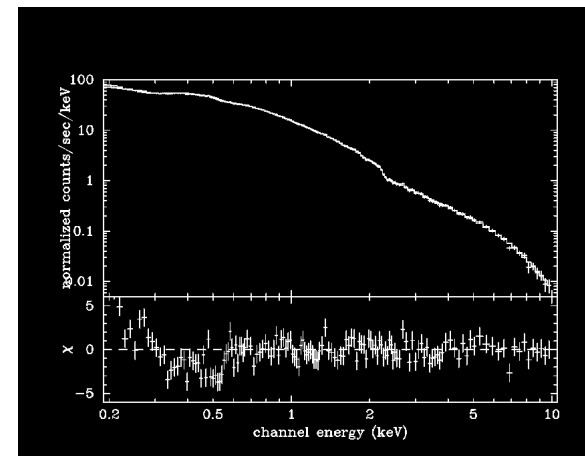
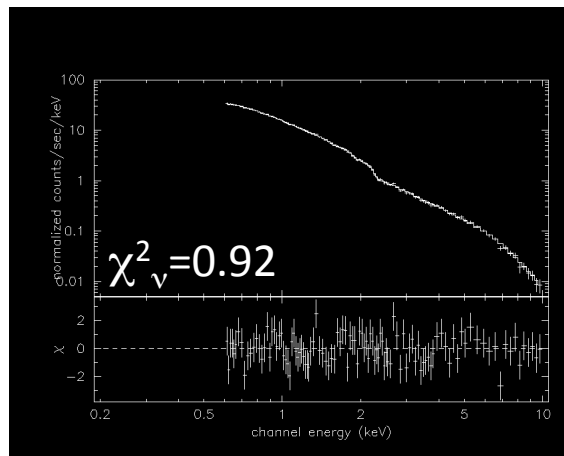
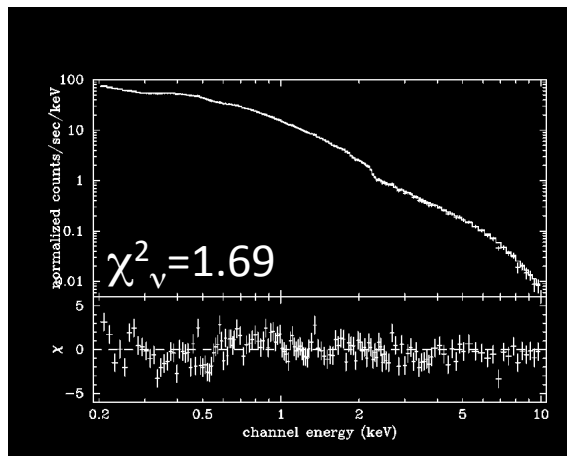
0.6-10keV



0.6-10keV (retrieve to 0.2keV)



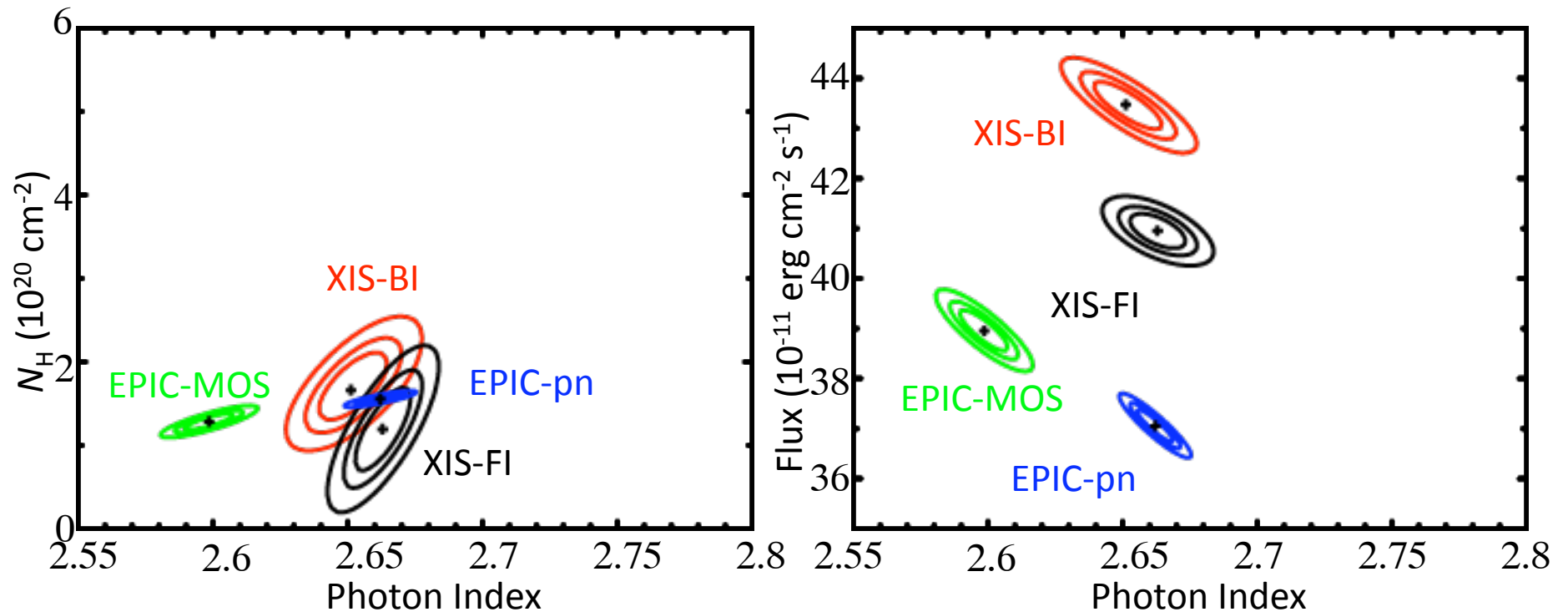
pn



2005 XIS/EPIC parameters (1)

XIS-FI: 0.4-10.0 keV, EPIC-MOS: 0.2-10.0 keV

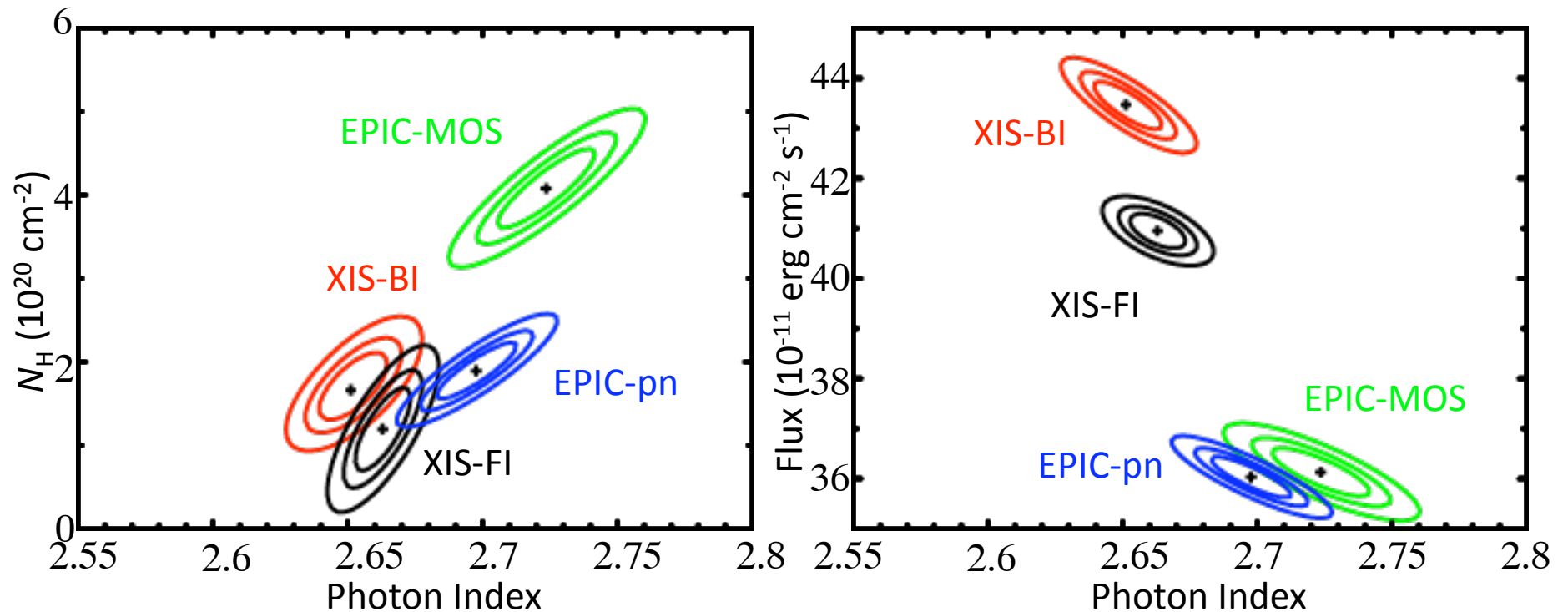
XIS-BI: 0.3-10.0 keV, EPIC-pn: 0.2-10 keV



2005 XIS/EPIC parameters (2)

XIS-FI: 0.4-10.0 keV, EPIC-MOS: 0.6-10.0 keV

XIS-BI: 0.3-10.0 keV, EPIC-pn: 0.6-10 keV



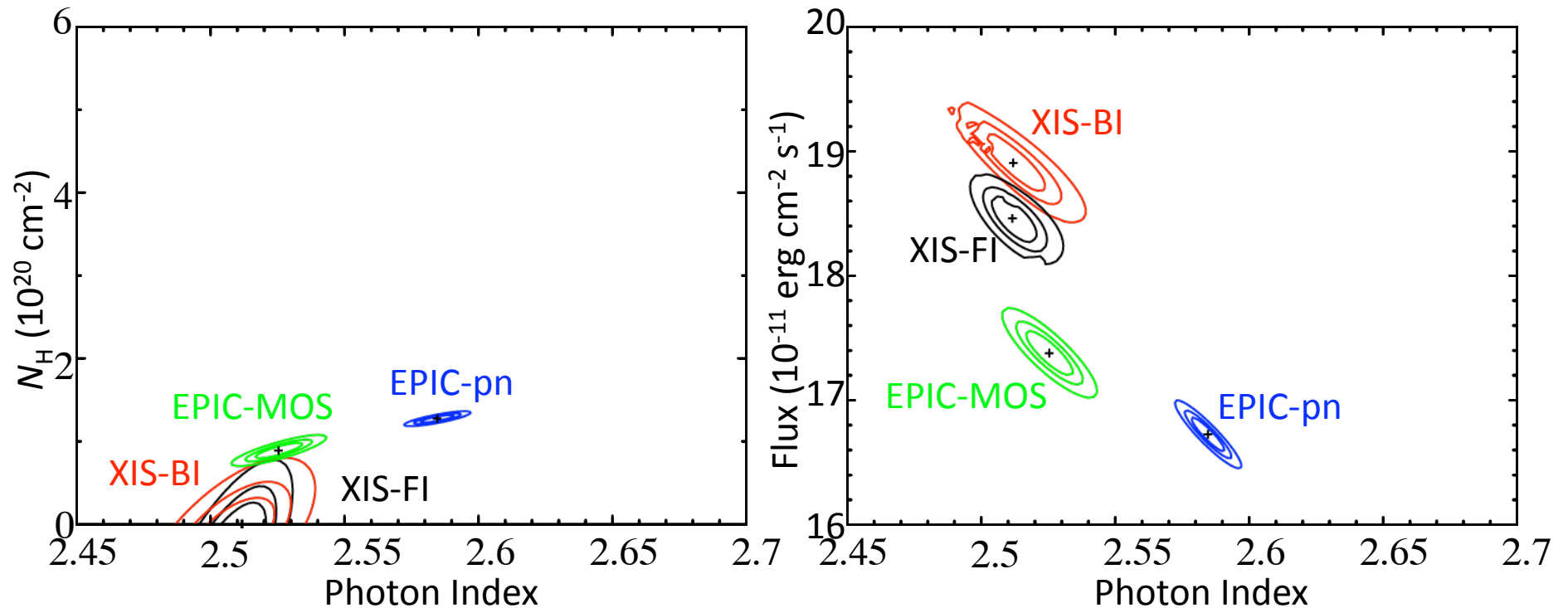
Photon index of MOS: 2.60 \rightarrow 2.72

Flux drop of MOS: 39 \rightarrow 36

2006 XIS/EPIC parameters (1)

XIS-FI: 0.4-10.0 keV, EPIC-MOS: 0.2-10.0 keV

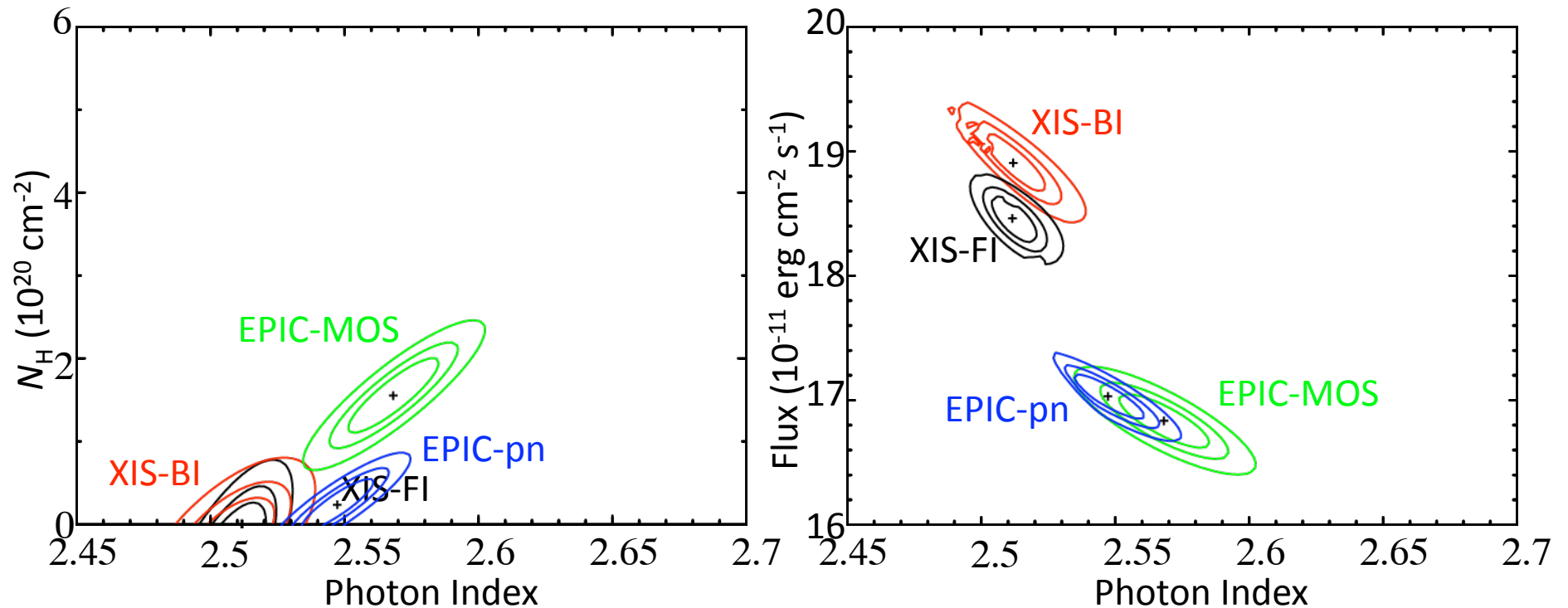
XIS-BI: 0.3-10.0 keV, EPIC-pn: 0.2-10 keV



2006 XIS/EPIC parameters (2)

XIS-FI: 0.4-10.0 keV, EPIC-MOS: 0.6-10.0 keV

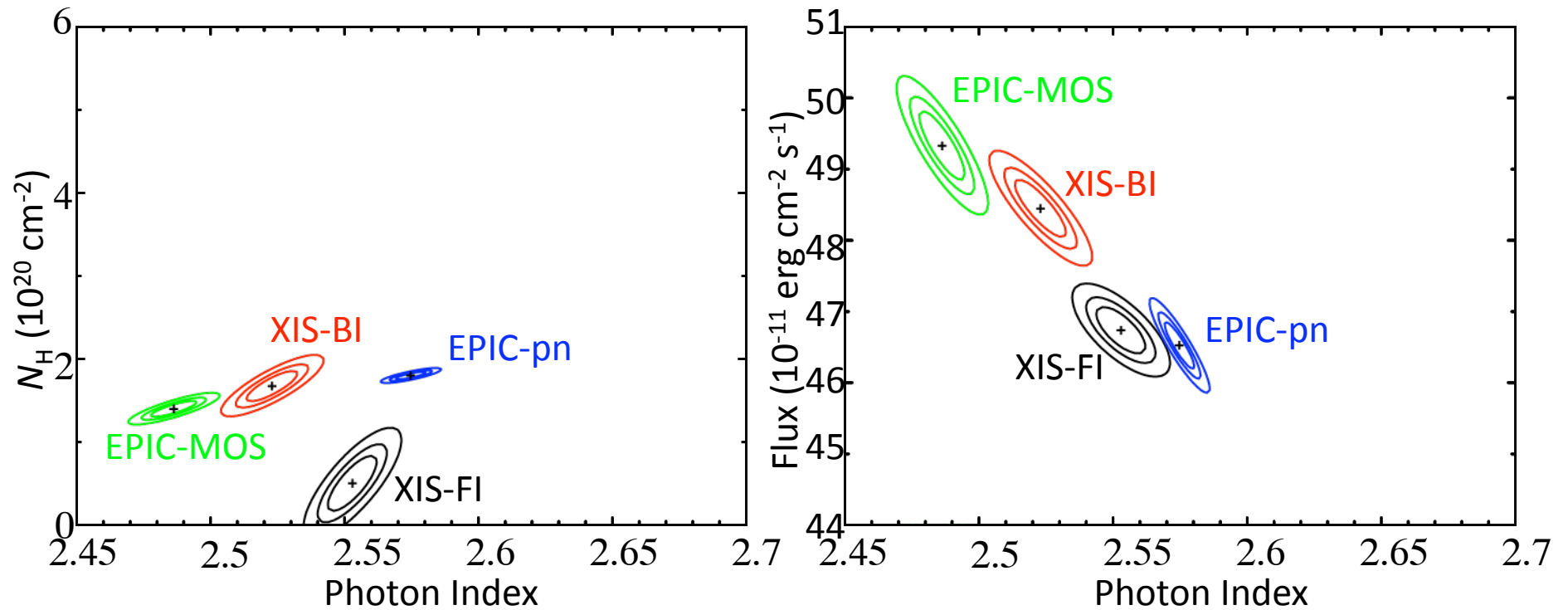
XIS-BI: 0.3-10.0 keV, EPIC-pn: 0.6-10 keV



2008 XIS/EPIC parameters (1)

XIS-FI: 0.4-10.0 keV, EPIC-MOS: 0.2-10.0 keV

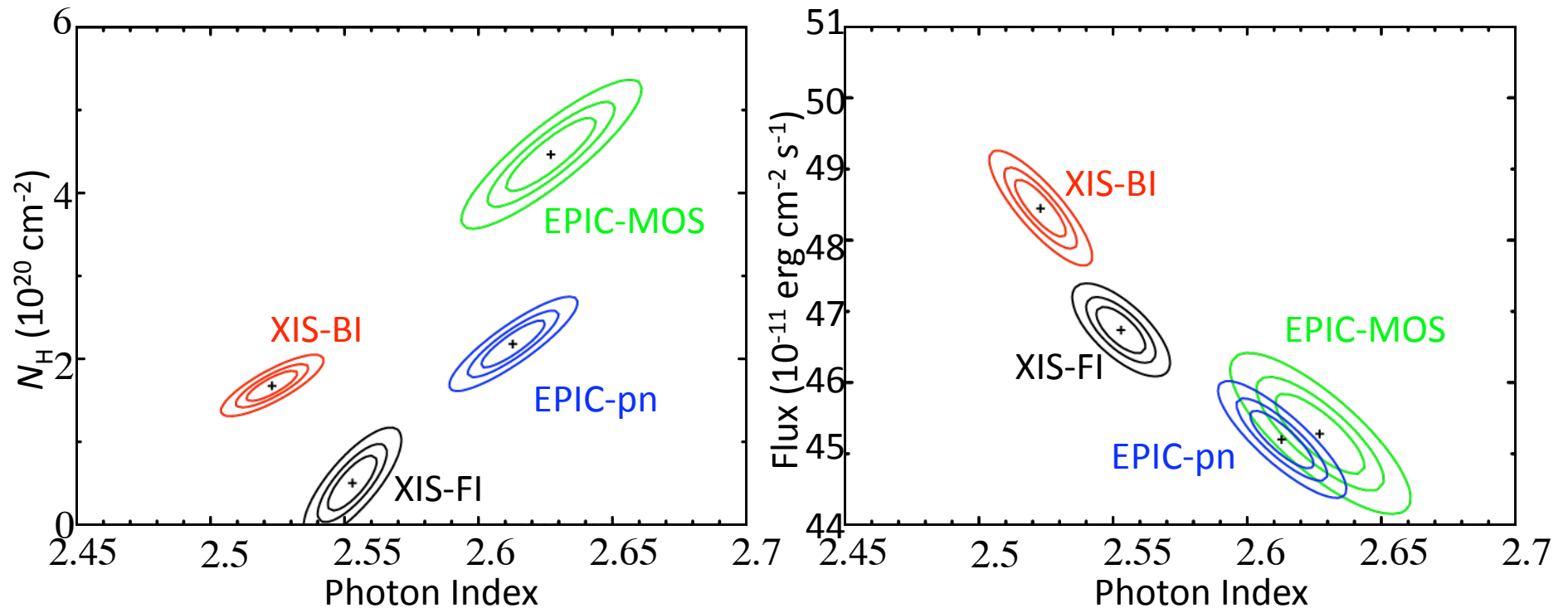
XIS-BI: 0.3-10.0 keV, EPIC-pn: 0.2-10 keV



2008 XIS/EPIC parameters (2)

XIS-FI: 0.4-10.0 keV, EPIC-MOS: 0.6-10.0 keV

XIS-BI: 0.3-10.0 keV, EPIC-pn: 0.6-10 keV



Photon index of MOS: 2.47 -> 2.66

Flux drop of MOS: 49 -> 45

Summary

- Photon Index is consistent between XIS and EPIC within ~ 0.05 .
- XIS flux seems larger than EPIC flux by at most 20%.
- Calibration of 2008 data is poor for both XIS and EPIC.
- Need more calibration of energy dependence of the effective area (probably for both).