X-ray Mission Cross Calibration

Comparison of XMM-Newton EPIC, Chandra ACIS-S3, ASCA SIS and GIS, and ROSAT PSPC results for G21.5-0.9, 1ES0102-72.3, and MS1054.4-0321

A “Man on the street” view of the current status of the cross calibration.

→ Publicly available software (SAS 5.2, mostly CIAO 2.1) and current calibration data bases (well almost)

→ Will not address “Truth” but “Beauty” is a relative concept

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Paul Plucinsky, Dick Edgar – CXC

Dave Lumb – ESTEC

Richard Saxton, Steve Sembay – U. Leicester

Richard Mushotzky – GSFC

Ian George, Kip Kuntz – UMBC

Caveats

Calibration and software as current in the last month or two

→ The calibration and software are moving quantities which are improving with time, i.e., in the last 8 months these results have changed for the better.

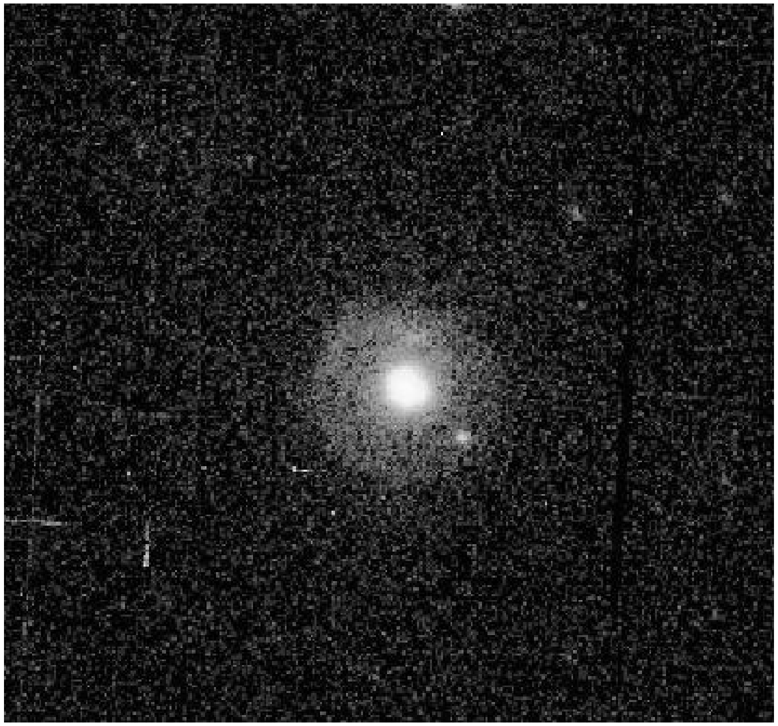
Fudge for the ACIS-S3 fits: a carbon Kalpha edge of optical depth 1.0 has been added which improves the fits

There are sensitivities to the energy range, background selection, spectral model, which data are being fit, what parameters are being fit simultaneously, etc.

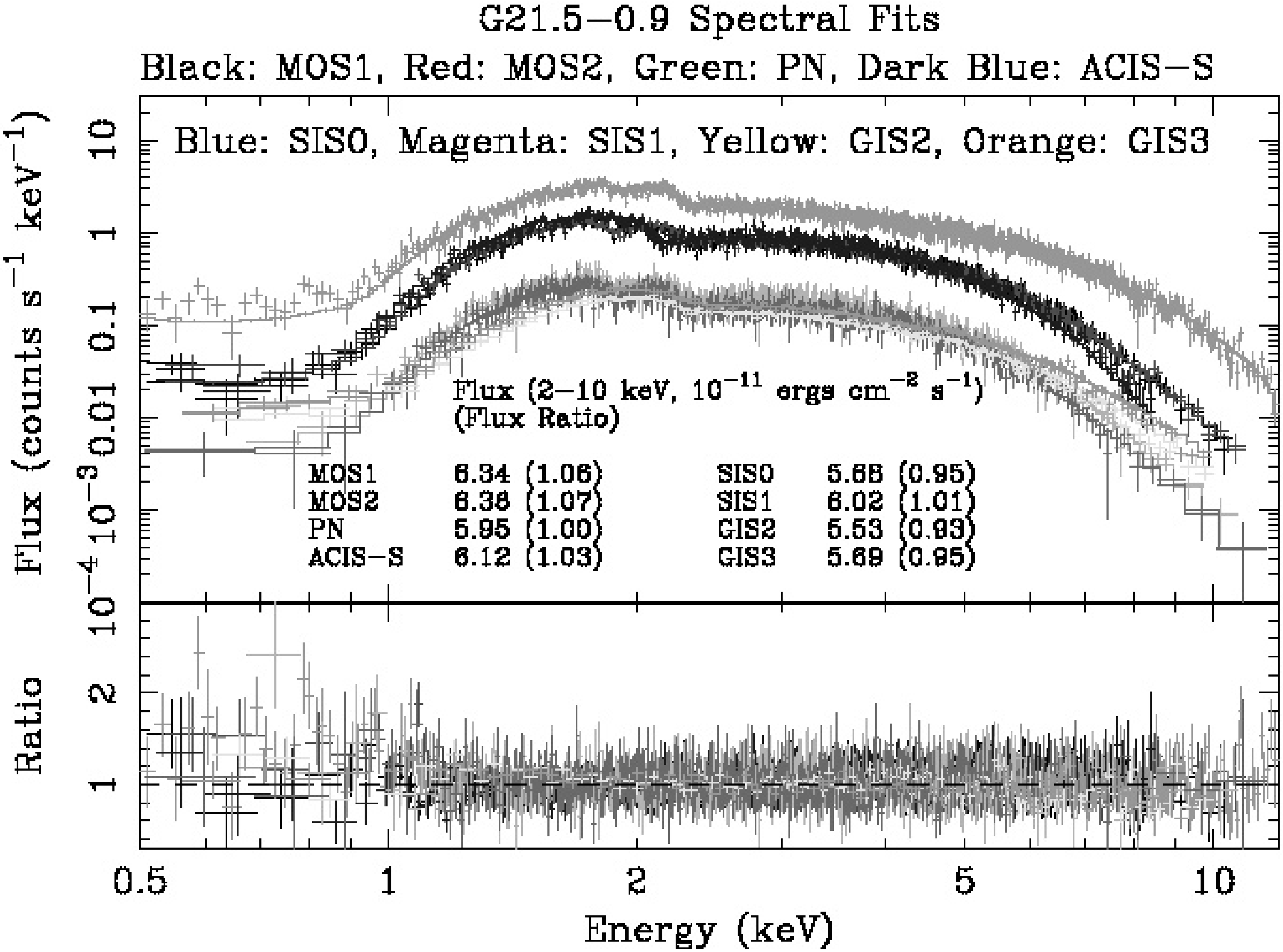
ACIS results are for the S3 CCD only.

G21.5-0.9

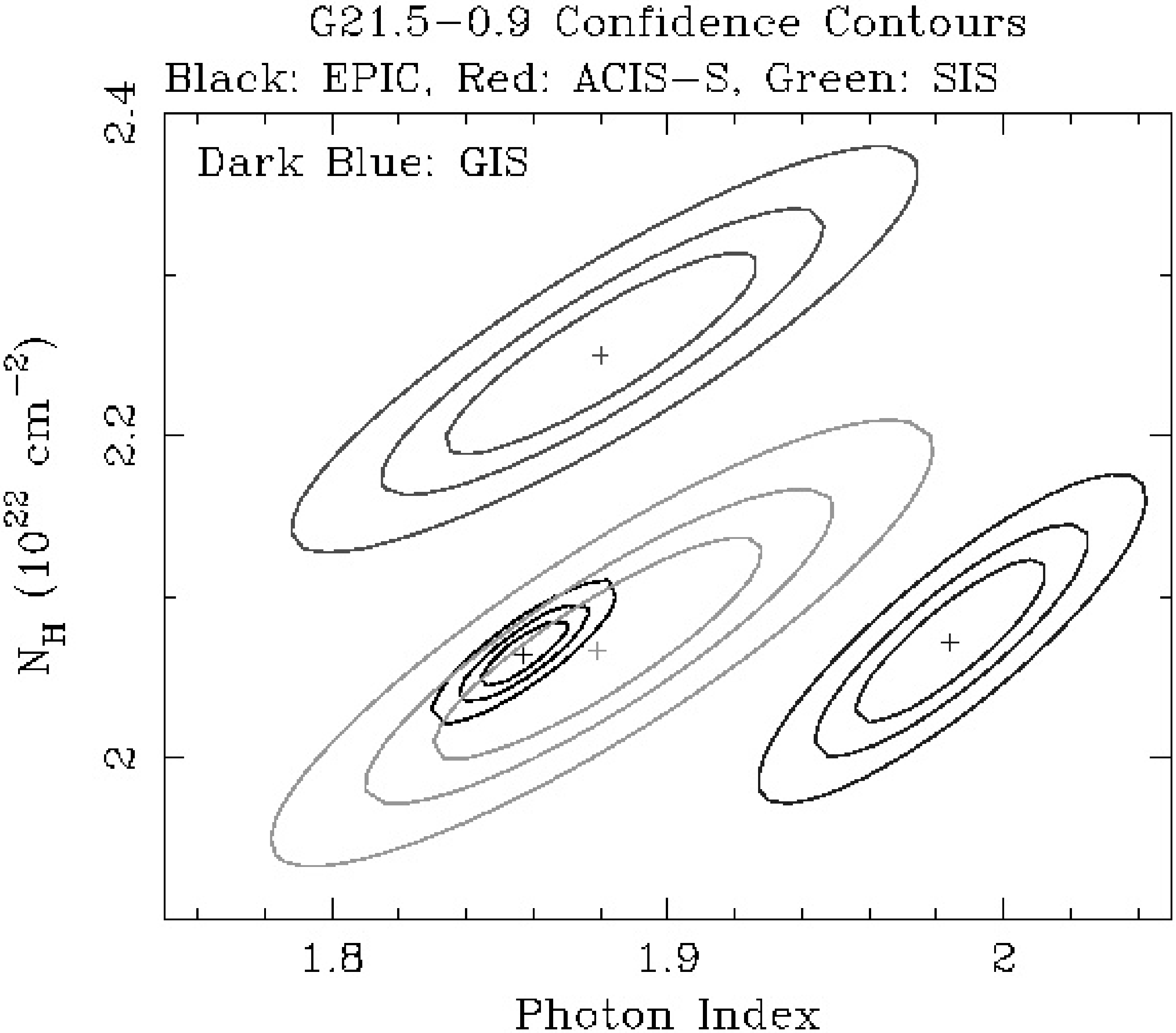
- Crab-like SNR with an extended X-ray halo
- In order to compare XMM and Chandra results with those from ASCA, full remnant extracted (XMM/Chandra 165” radius, ASCA 240” radius)
- Power-law spectrum dominates
- PN, MOS1, MOS2, ACIS-S3, SIS0, SIS1, GIS2, GIS3



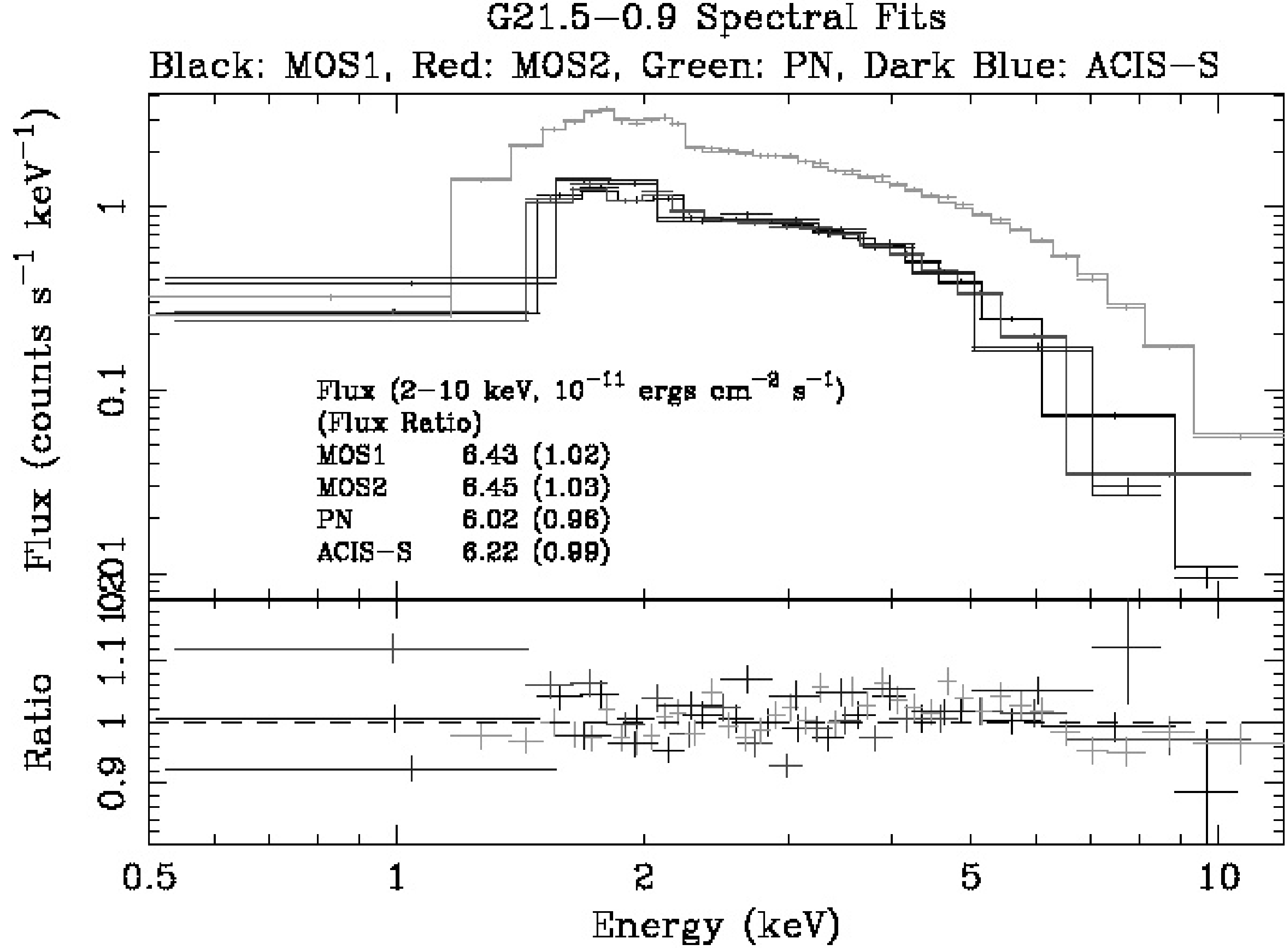
G21.5-0.9 Spectra - All



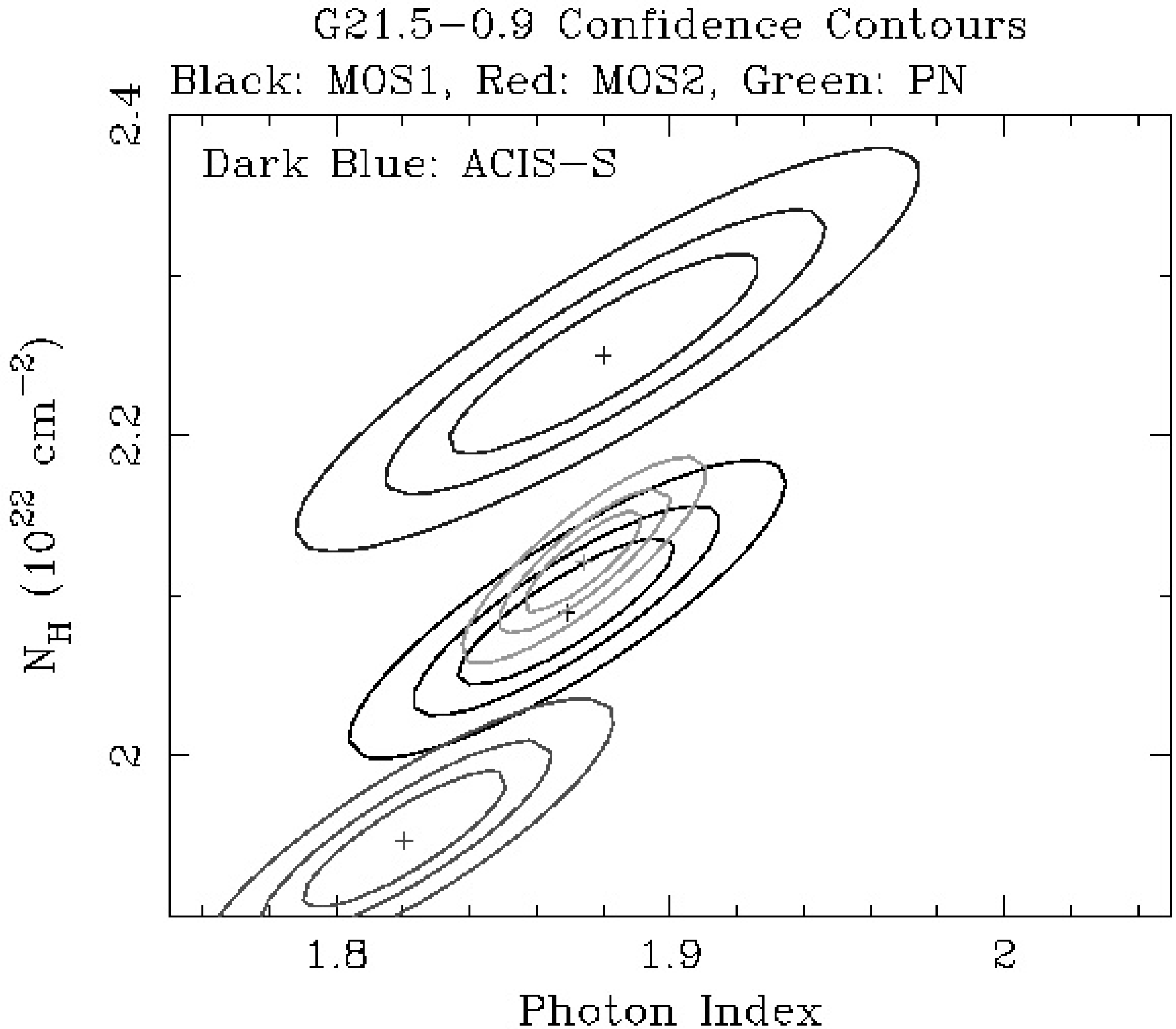
G21.5-0.9 Confidence Contours - All



G21.5-0.9 Spectra – EPIC/ACIS



G21.5-0.9 Confidence Contours – EPIC/ACIS



1ES0102-72.3

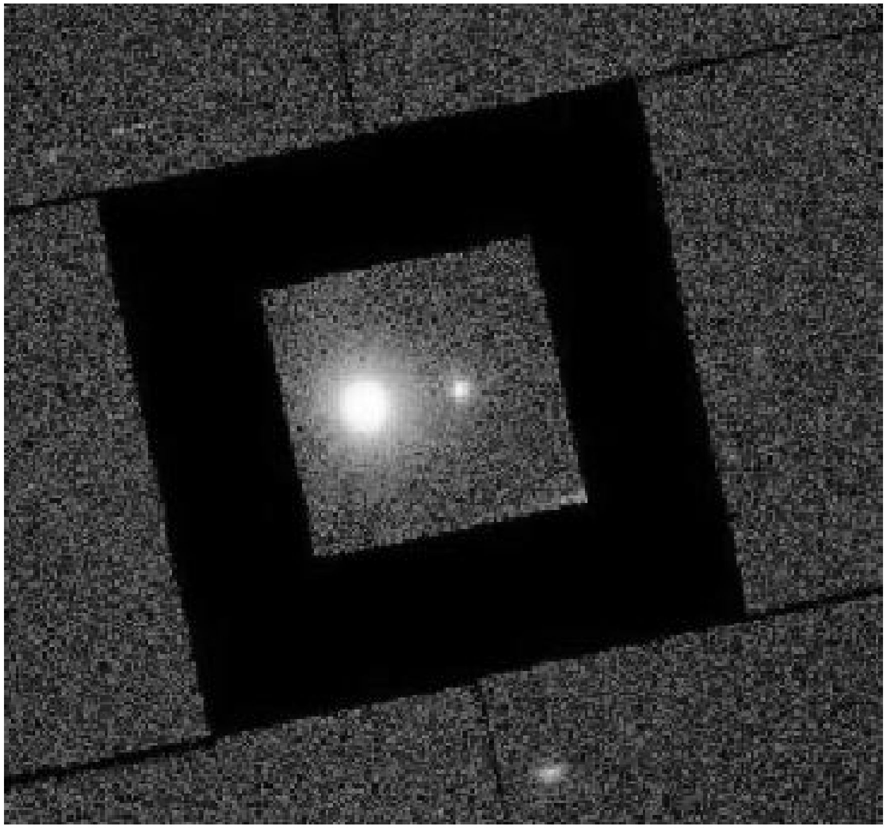
SMC SNR

Very line rich

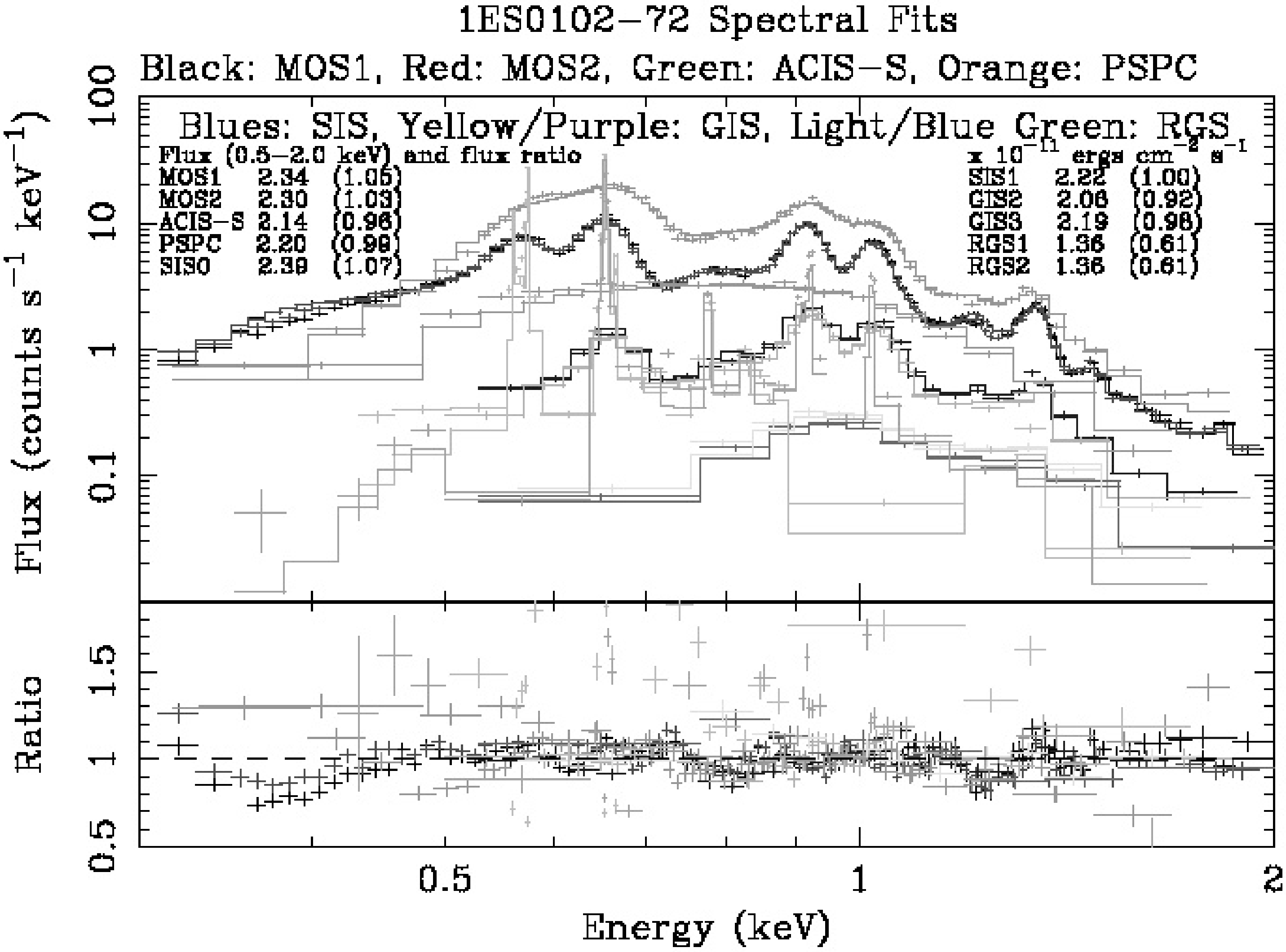
MOS1, MOS2, ACIS-S3, SIS0, SIS1, GIS2, GIS3, PSPC, RGS1, RGS2

Spectrum: 2 absorbed APEC thermal spectra with variable abundances

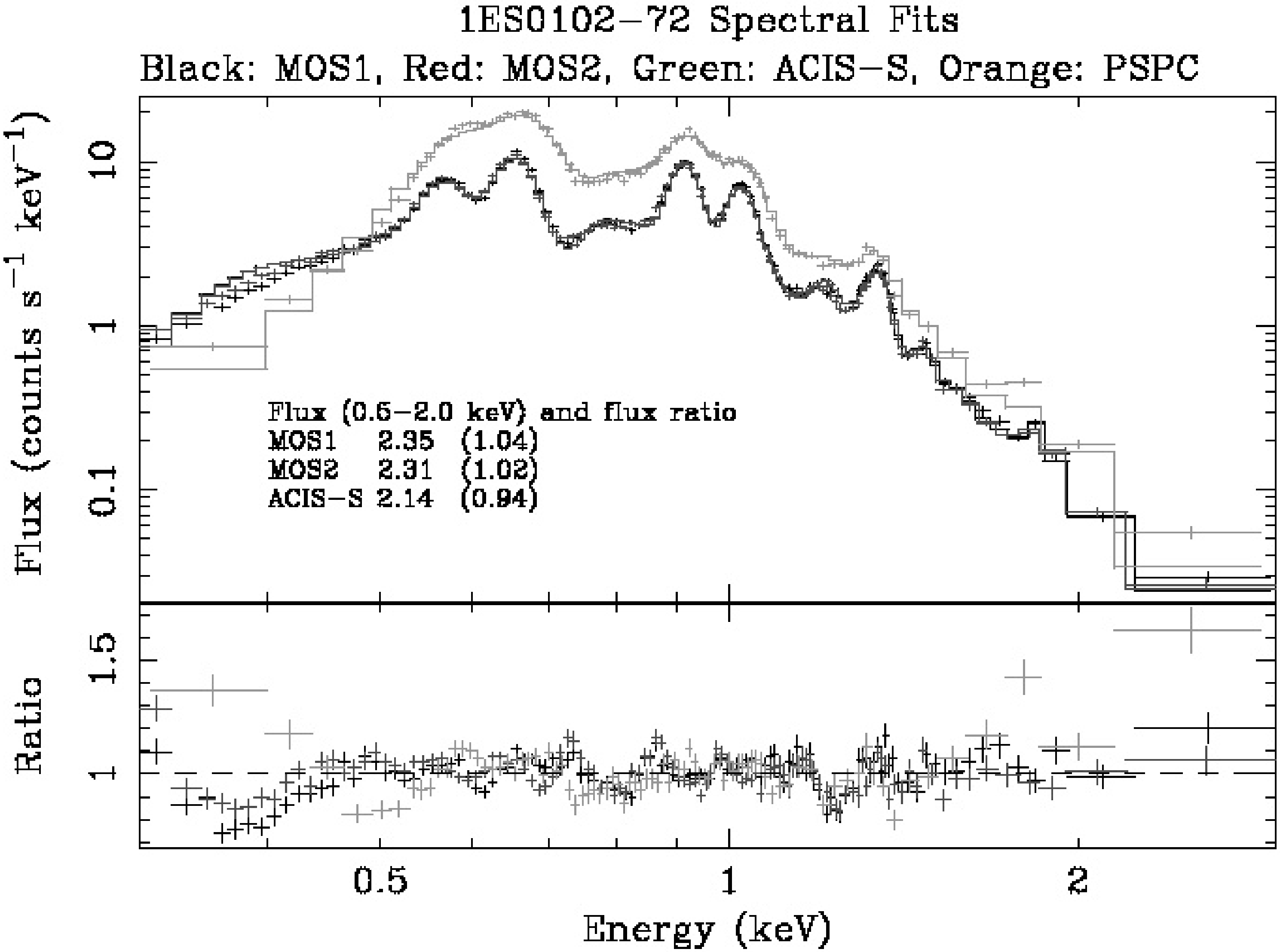
Terrible fit in terms of χ^2_ν but good enough for fitted flux comparison



1ES0102-72.3 Spectra - All

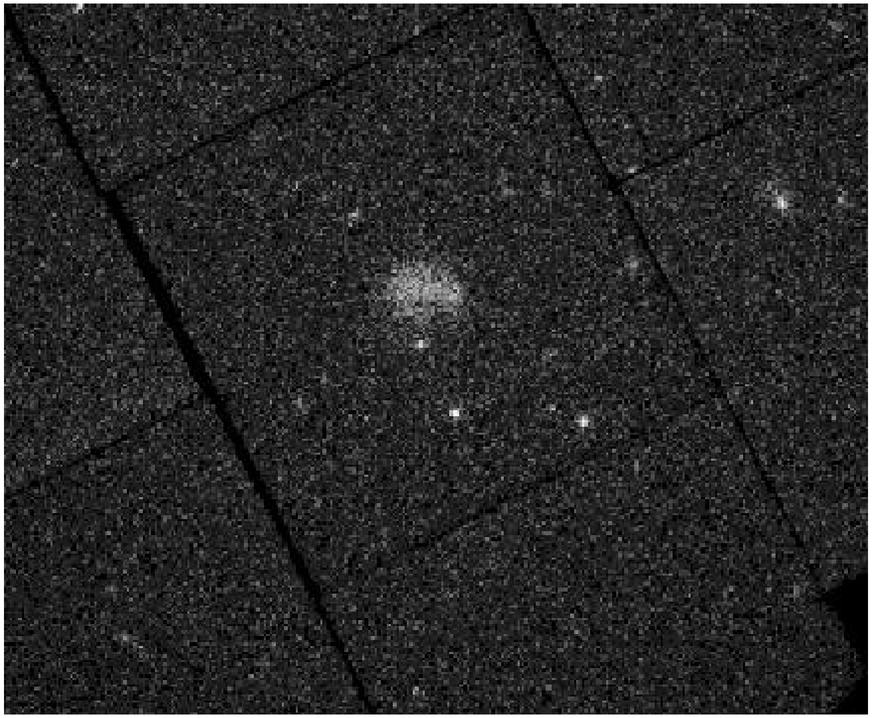


1ES0102-72.3 Spectra – MOS/ACIS

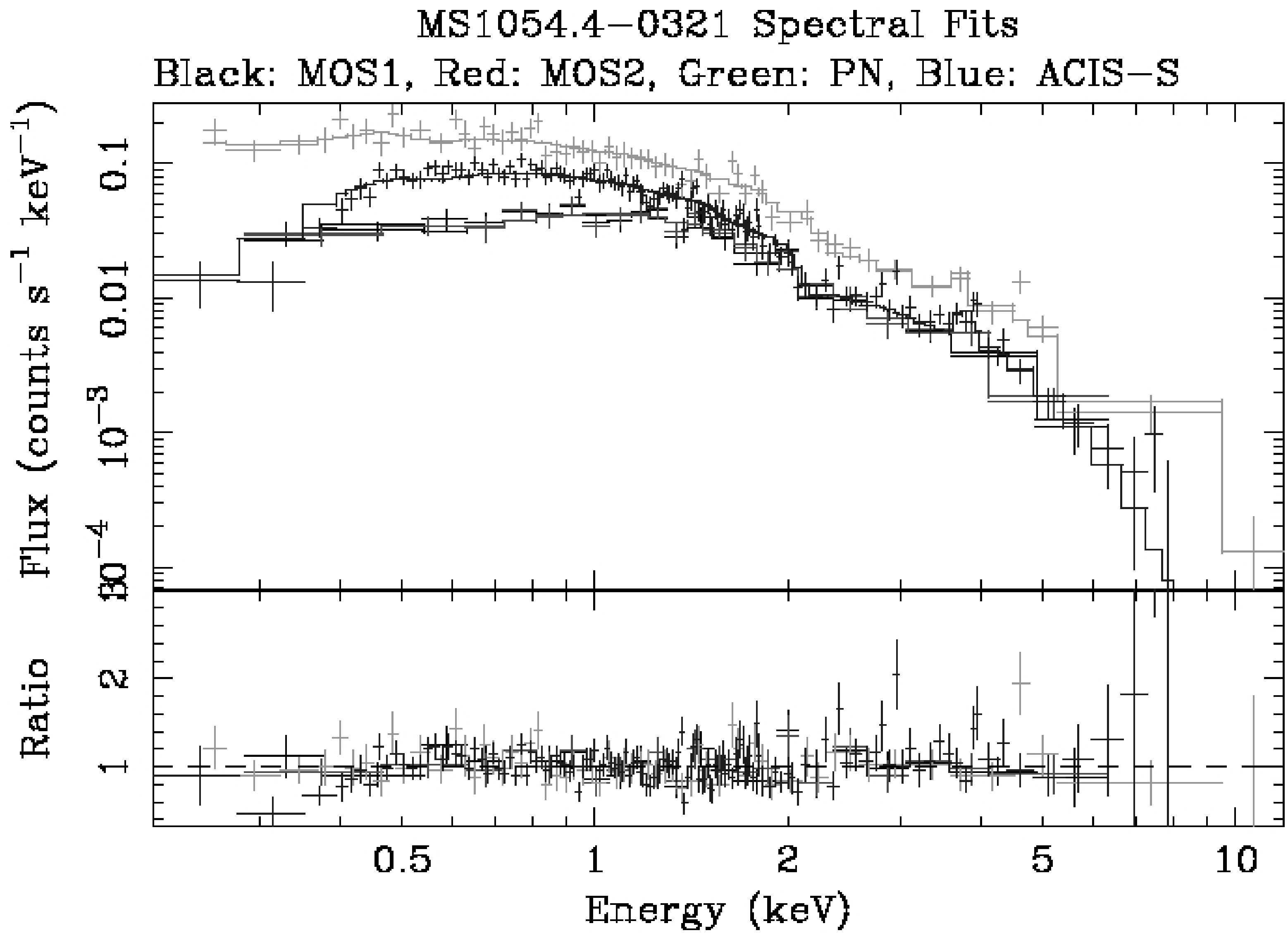


MS1054.4-0321

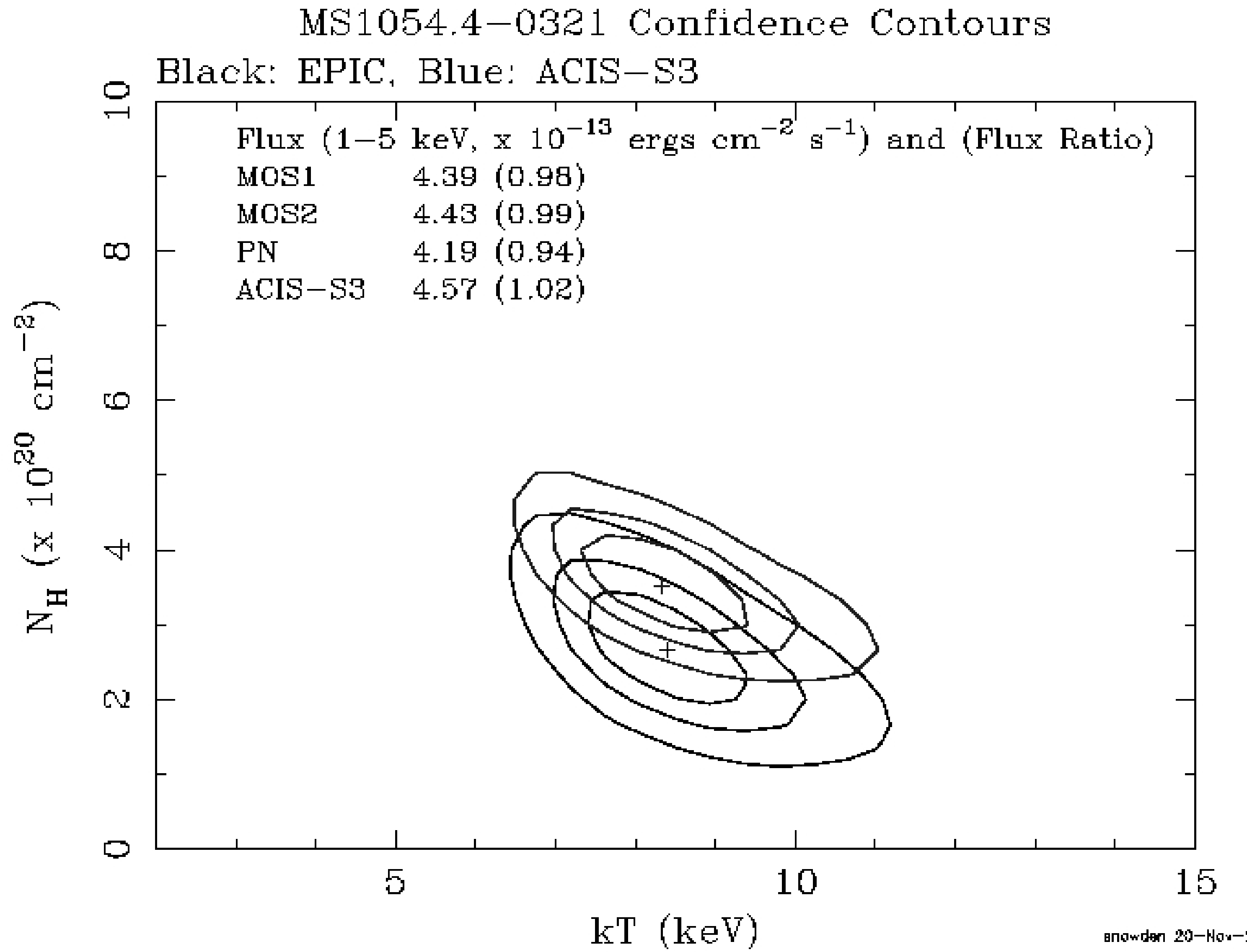
- High redshift cluster
- Low absorption
- MOS1, MOS2, ACIS-S3
- One absorbed high-temperature spectrum
- Relatively poor statistics
- XMM proprietary data courtesy of Mike Watson



MS1054.4-0321 Spectra



MS1054.4-0321 Confidence Contours



Relative Flux Summary

Simultaneous Fits, normalized to the MOS1, MOS2, ACIS-S3 average

	G21.5-0.9 2 – 10 keV	1ES0102-72.3 0.5 - 2.0 keV	MS1054.4-0321 1 – 5 keV
PN	0.95	----	0.94
MOS1	1.01	1.04	0.98
MOS2	1.01	1.02	0.99
ACIS-S3	0.98	0.95	1.02
SIS0	0.91	1.06	----
SIS1	0.96	0.99	----
GIS2	0.88	0.91	----
GIS3	0.91	0.97	----
PSPC	0.85*	0.97	----

* Flux compared over the 0.5-2.5 keV band

Conclusions

Pretty good, but work left to do.

- → EPIC/ACIS flux calibration good to +/- 5%
- → Power law indices good to < 0.1
- → EPIC MOS/PN inconsistency must be resolved
- → ACIS-S3 low energy response must be fixed

- → And, of course, more comparisons need to be done
  - Different spectra
  - EPIC vs ACIS-I