

IACHEC Multi-Mission Study

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★ Comparison of cluster spectra measured with XMM-Newton/EPIC, Chandra/ACIS, Swift/XRT, Suzaku/XIS, ROSAT/PSPC
i.e. 5 missions, 10 instruments

★ Residual ratios to evaluate the effective area cross-calibration:

- We use EPIC-pn as a reference. (Try also ACIS, **TBD**)
- For instrument *i* we calculate the mean of the ratio

$$R_{i/pn} = \frac{data_i}{model_{pn} \otimes resp_i} \times \frac{model_{pn} \otimes resp_{pn}}{data_{pn}}$$

★ The latter term corrects for deviations btw. pn model and pn data which cannot be produced by the model (no point in comparing reference instrument with another using a model which does not fit the reference instrument data)

Cluster selection criteria

★ Hot enough so that we

- have enough counts at the highest energies
- minimise the 1 keV line emission (we are studying the effective area, not PSF or energy scale calibration)

➔ $kT > 6 \text{ keV}$

★ Statistical uncertainties at 1% level within sufficiently small energy bins ➔

- Not too distant so that the cluster not too faint i.e. $z < X$ (TBD)
- Observed with XMM-Newton, Chandra, Suzaku, Swift and ROSAT with exposure time $> Y \text{ ks}$ (TBD)



Sample

★ Currently the sample consists of

A1795, A2029, Coma and PKS 0745-19

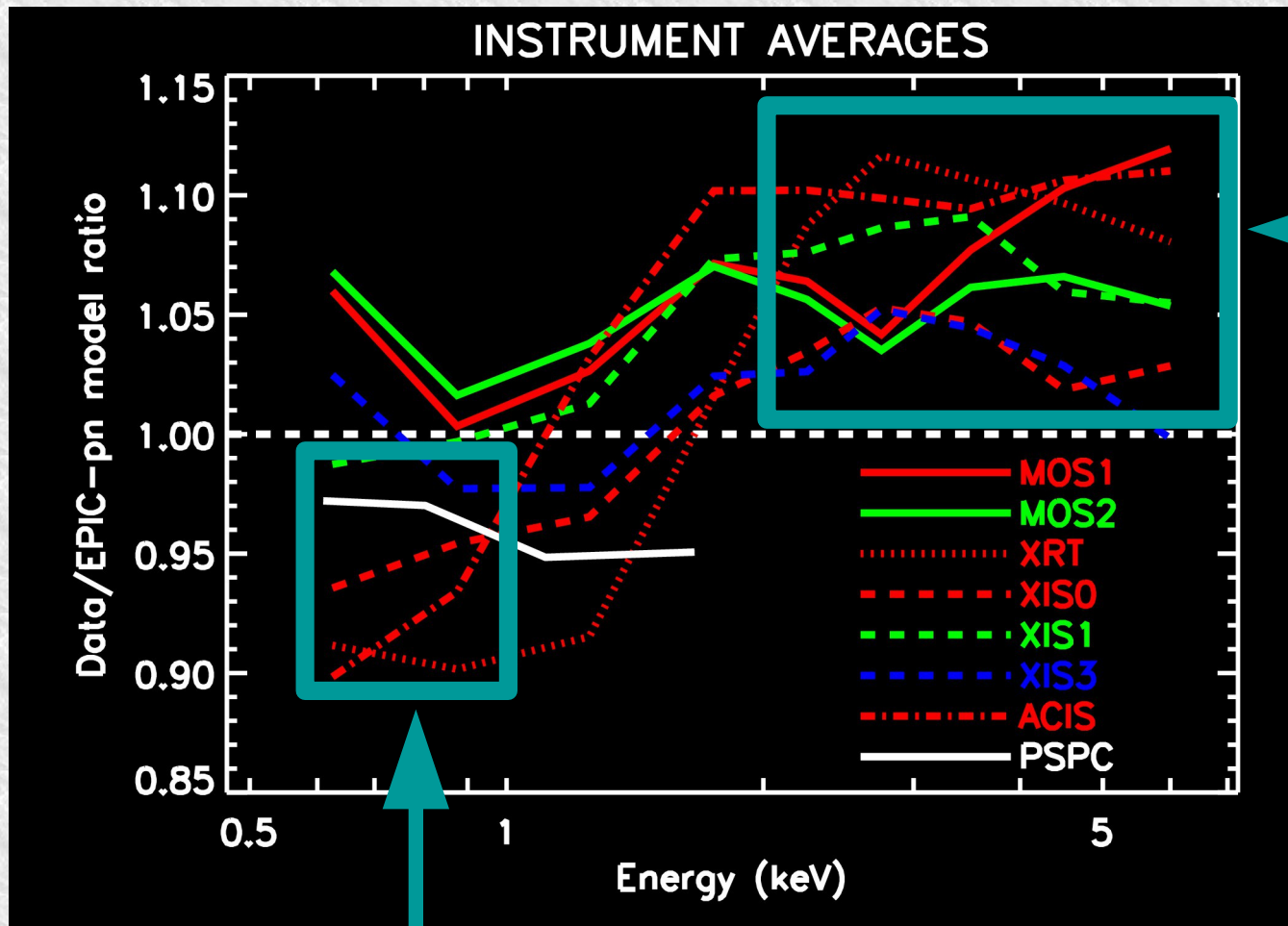
Calibration versions studied

Satellite/instrument	Date of processing	Software/CALDB
XMM-Newton/EPIC	April 2014	xmmsas_20131209_1901-13.5.0
Chandra/ACIS	May 2014	ciao-4.6
Swift/XRT	April 2014	
Suzaku/XIS	May 2014	xissimarfgen 2010-11-05 ae_xi0_contami_20130813.fits
ROSAT/PSPC-B	May 2013	

At the moment the results apply to calibration status on May 2014

Residuals ratios

The average instr/pn residual ratio of each pair



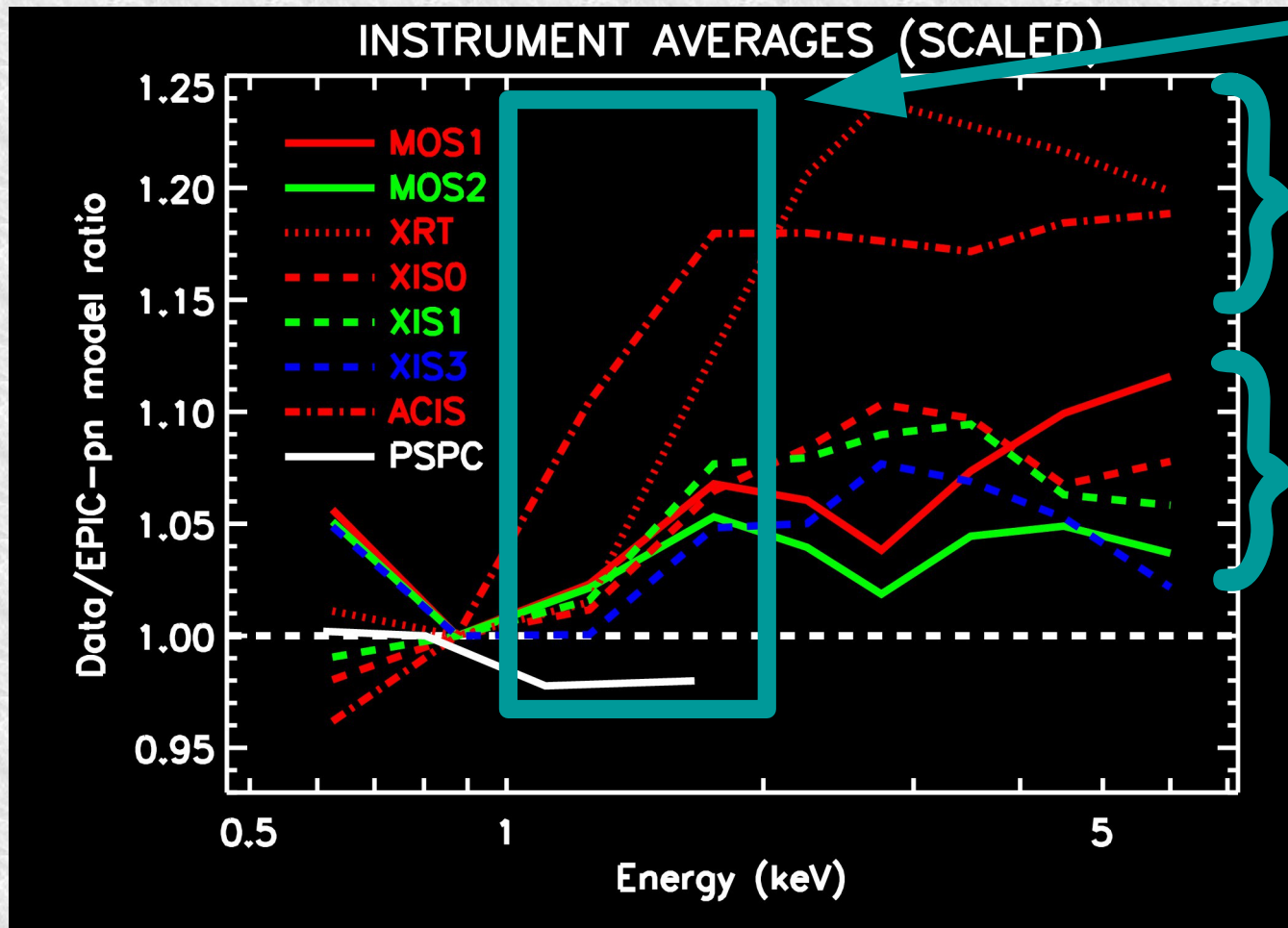
All instruments show higher flux than pn at > 2 keV, but with a varying degree (0-15%)

Request 1 to IACHEC community: Are the evidence convincing enough to make conclusions about EPIC-pn calibration?

Most instruments show lower flux than pn at < 1 keV, but with a varying degree (0-10%)

Scaled residuals ratios

The average instr/pn residual ratio of each pair, scaled to unity at 0.75-1.0 keV



The 1-2 keV gradient:

1) Swift/XRT and Chandra/ACIS similar: 20% increase

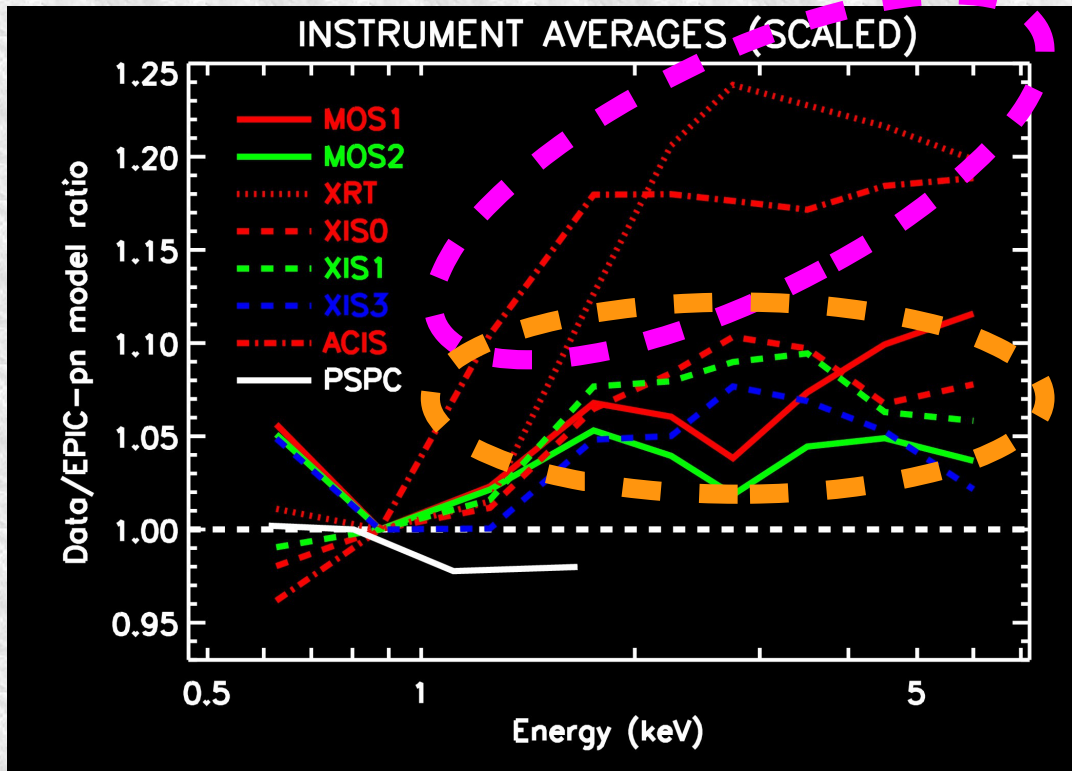
2) XMM/MOS and Suzaku/XIS similar: 5% increase

→ Not a single instrument is guilty



Scaled residuals ratios

Request 2 to IACHEC community: explain why there are the two groups



A) Chandra/ACIS & Swift/XRT

B) EPIC/MOS & Suzaku/XIS

I.e. is (are) there some element(s) of the effective area instrumentation or calibration that is (are) common within a given group, but different btw. the two groups?

The average instr/pn residual ratio of each pair, scaled to unity at 0.75-1.0 keV