Galaxy Clusters WG action items

IACHEC meeting, Napa, 2012

1) Data in the IACHEC WIKI page

2) Suzaku extension

3) Swift extension

4) Chandra/XMM soft band problems

5) Chandra/XMM flux problems

6) Deeper observations of the hottest clusters for better statistics of the FeXXV/XXVI line ratio measurement

7) MOS gain and redistribution calibration using cluster FeXXV Kα line

8) Extend the XMM/Chandra comparison to contain all useful HIFLUGCS clusters and pointings available

9) Clusters v.s. blazars

10) NuStar

1) Data in the IACHEC Wiki page

Improve the page

- Add:
  - XMM processing scripts
  - Background info
  - Patterns, flags
  - Images
  - Coordinates
- Do MOS1 and MOS2 separately
- Provide two sets of data:
  - 1) the one extracted with smaller regions for XMM-Newton/Chandra comparison (DONE) and
  - 2) the one extracted with larger regions for pn/MOS comparison only

2) Suzaku extension

(K. Kettula et al., in prep.)

- Spectroscopic analysis of clusters using two stages of calibration: CALDB 20080709 and CALDB 20110608
- Sample contains 11 ~ relaxed clusters observed with both Suzaku and XMM: A1060, A1795, A262, A3112, A496, AWM7, Centaurus, Coma, Ophiuchus, Triangulum
- Fit with 1-T MEKAL model in 0.5-2.0 and 2.0-7.0 keV bands
- Extraction regions 3-6 arcmin in order to
  - Minimise PSF scatter to and from the extraction region (area wider than PSF). **The accuracy is being tested**
  - Minimise PSF scatter from the cool core. **The accuracy is being tested**
  - Not too large region to minimize background effects (bkg a few % of cluster emission)
- Cluster center/FOV center offsets < 1', except A2199 4'

TBD

- XIS1 contaminate best measured, so use XIS1 as a reference instrument
- Check details of analysis:
  - The wobble effect on the Suzaku extraction region coordinates
  - XIS1 gain
  - XIS1 bad regions
  - NXB normalisation with the > 10 keV count rate
  - PSF scatter from the central cool region
- Check how Ishida et al. (2011) compares with clusters
- Larry will provide ACIS data for some of the clusters
- Circulate a new draft in May
- Submit in June

3) Swift extension

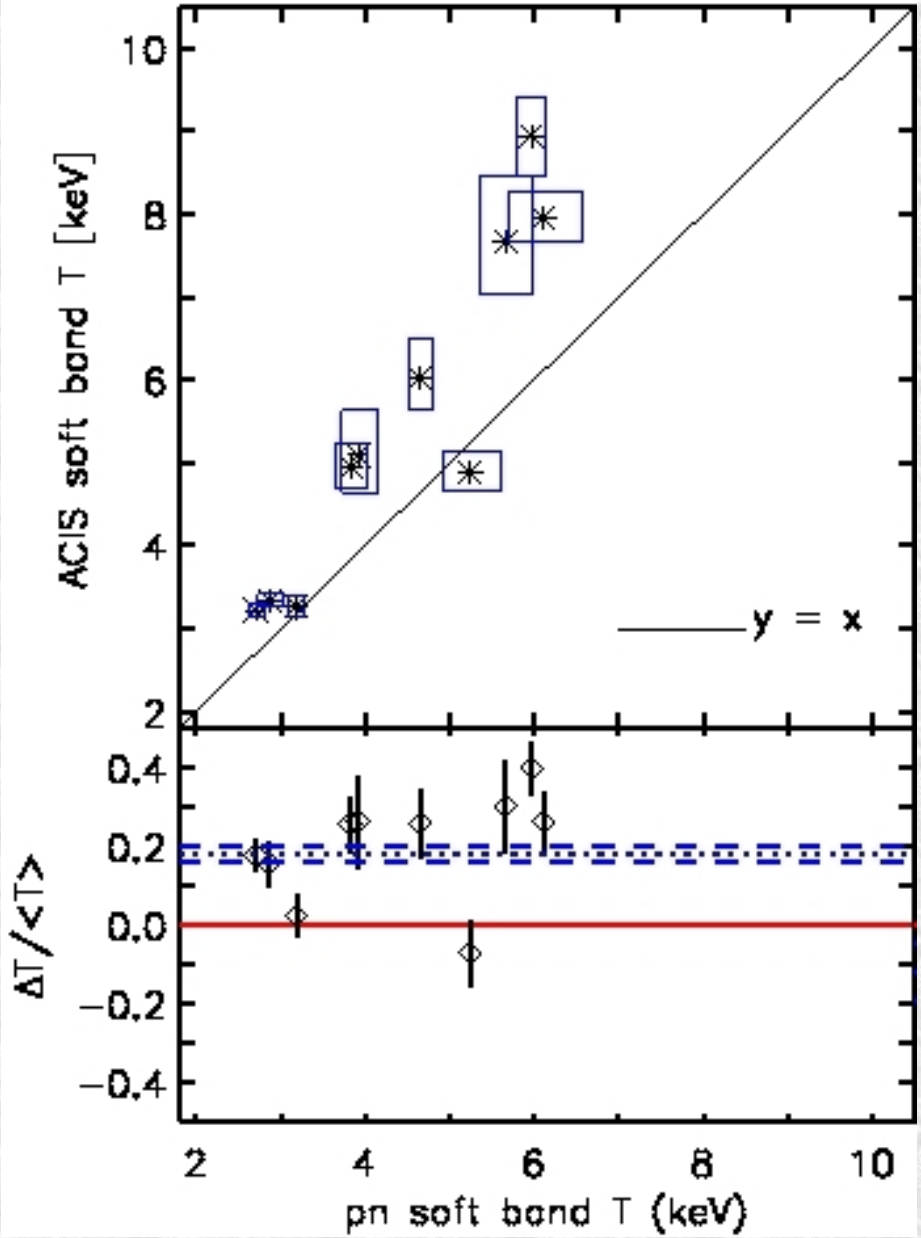
Swift

- Swift/XRT can be used for the comparison of temperatures and fluxes btw. XMM-Newton/EPIC and Swift/XRT
- A.Breadmore and J. Nevalainen have been incontact with Moretti
- Moretti busy due to family reasons, feasible in near future

4) Chandra/XMM soft band temperature problems

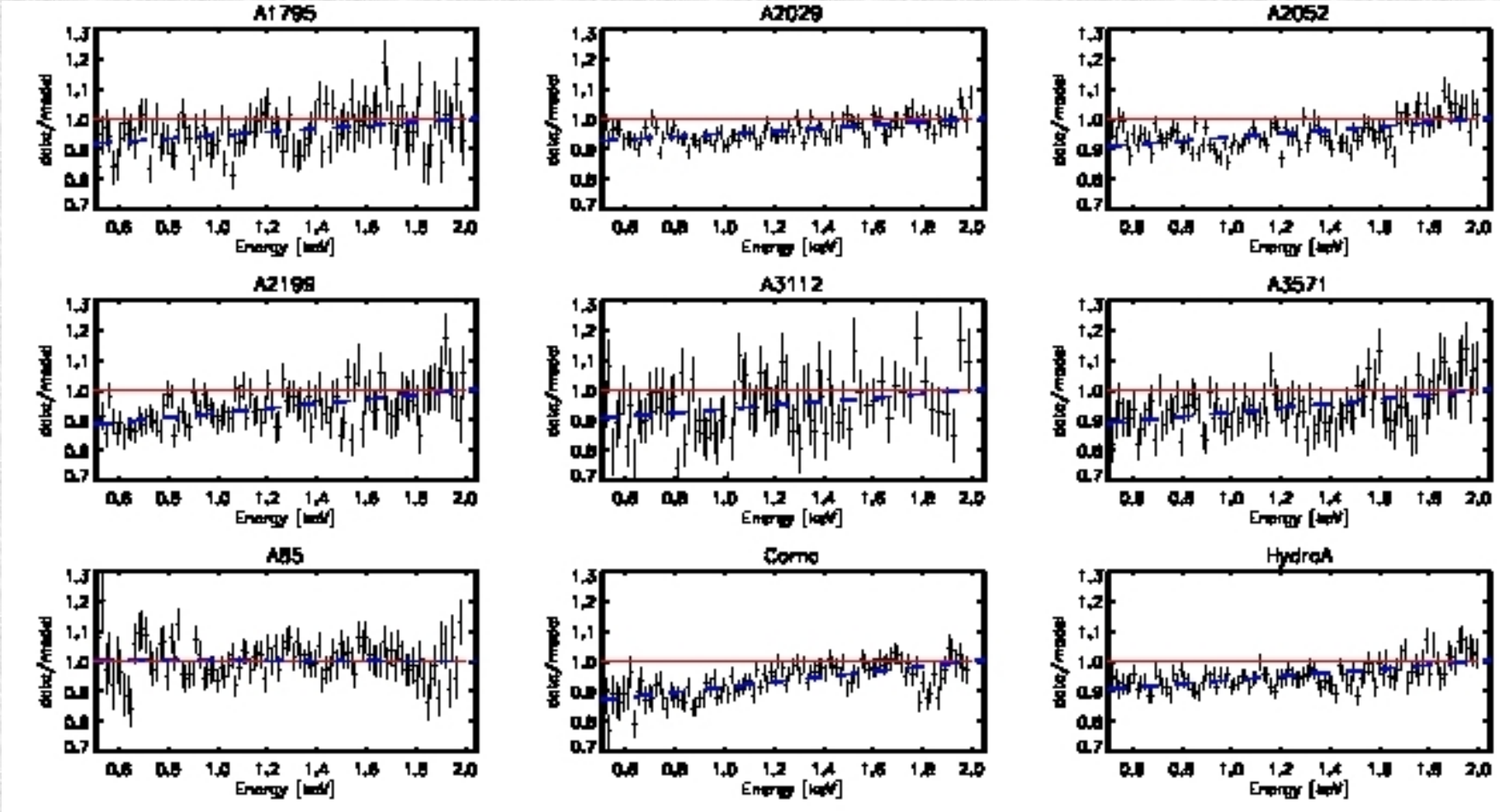
ACIS v.s. pn

- ACIS yields ~20% (9α) higher soft band temperatures than pn
- Most of the photons are in the soft band ➔ full band temperatures biased by 10%



ACIS data / pn model

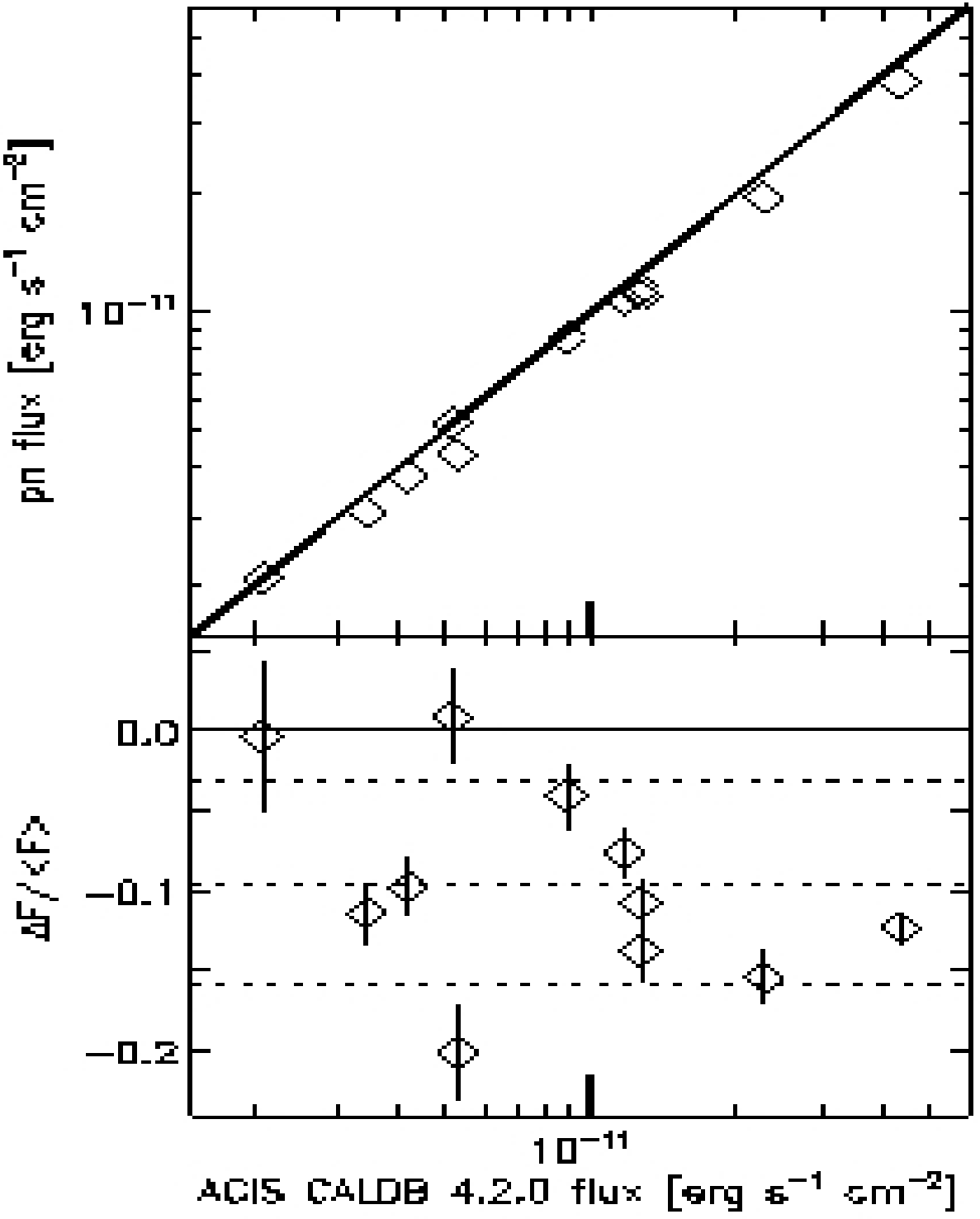
- ACIS data / pn model exhibit a linear trend with energy
- In pn effarea is correct, ACIS effarea too high by ~10% at 0.5 keV



- Confirm the systematic effects with different objects? SNR? Read better Ishida et al 2011 paper.
- See if Suzaku or Swift soft band temperatures agree with XMM-Newton or Chandra.
- Neither XMM-Newton nor Chandra team has a reason to change their calibration. Nor is there much room when compared to ground calibration data.

5) Chandra/XMM flux problems

- ACIS flux exceeds that of pn by ~10% (ACIS/MOS ~5%) → relative effective area normalisation uncertain by this amount



- J. Nevalainen and L. David will examine in more detail some of the most problematic cases
- ROSAT PSPC? S. Snowden is working on a T-profile comparison btw. several instruments. Will provide ROSAT spectra for XMM/Chandra flux comparison.
- Chandra/XMM point source cross correlation ...L. David

6) Deeper observations of the hottest clusters for better statistics for the FeXXV/XXVI line ratio

FeXXV/XXVI line ratio

- Motivation: line ratio measurement adds an nearly continuum-independent temperature estimate, not affected much by the shape of the effective area
- Need to use all useful XMM data and make a physics paper on bremsstrahlung/ionisation temperature comparison, then evaluate if more time needed
- Need more photons to do this with Chandra. Calibration time is too limited. Need a physics proposal, but the physics can be done with XMM

7) MOS gain and redistribution calibration using cluster FeXXV Kα line

- To do cluster physics with Fe XXV line need to know the gain, energy resolution and redistribution very accurately
- J. Nevalainen, M.Stuhlinger and S. Sembay will further investigate

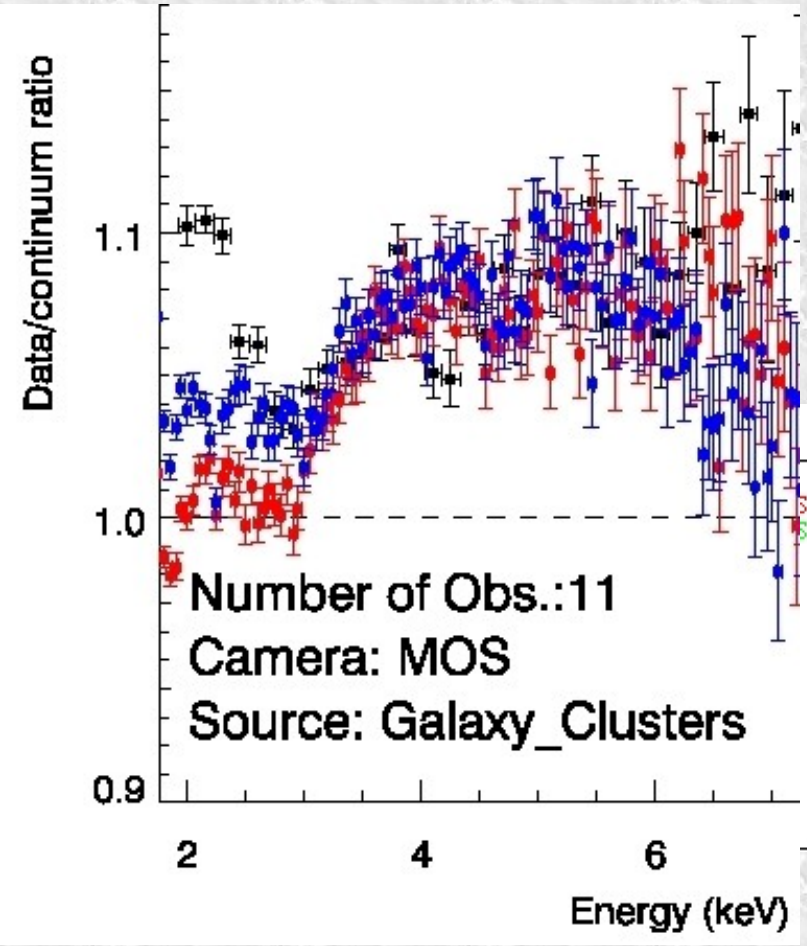
8) Extend the XMM/Chandra comparison to contain all useful HIFLUGCS clusters and pointings available in 2011

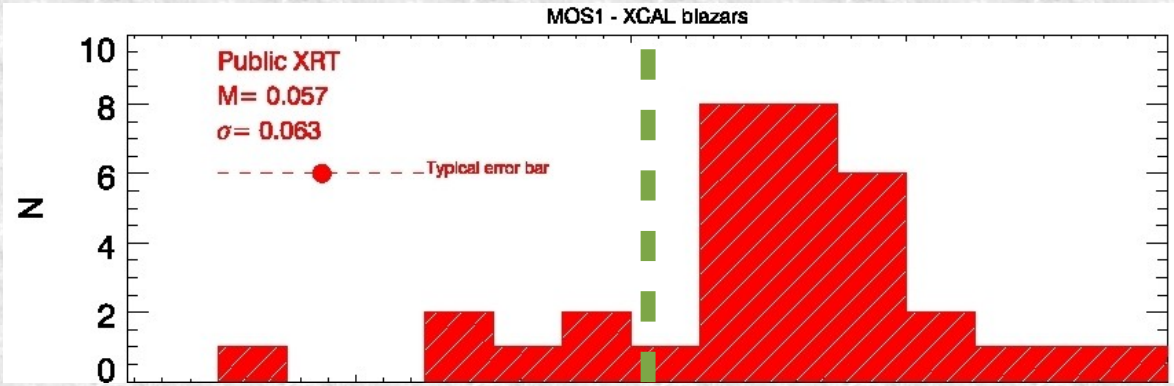
HIFLUGCS extension

- More data points, better statistics, results more reliable, can make distributions of parameters of interest
- Extend the energy band lower than 0.5 keV, up to 10 keV
- Different patterns
- MOS1 and MOS2 separately
- Could study cross-calibration accuracy as a function of time

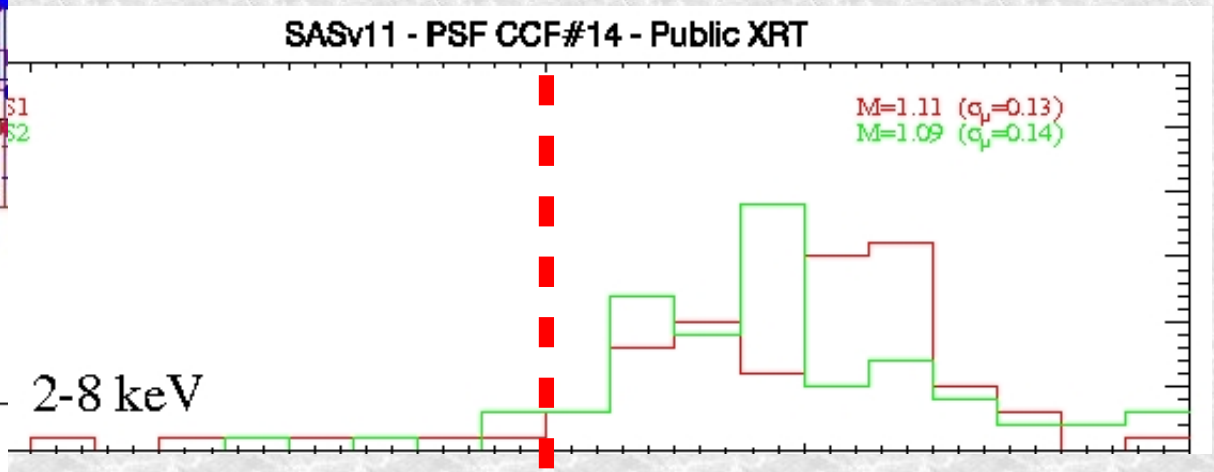
9) Clusters v.s. blazars

- Blazars yield too high MOS fluxes and too hard power-law slopes, compared to pn (from Matteo)
- Need to increase MOS effective area and make it harder in 2-8 keV band



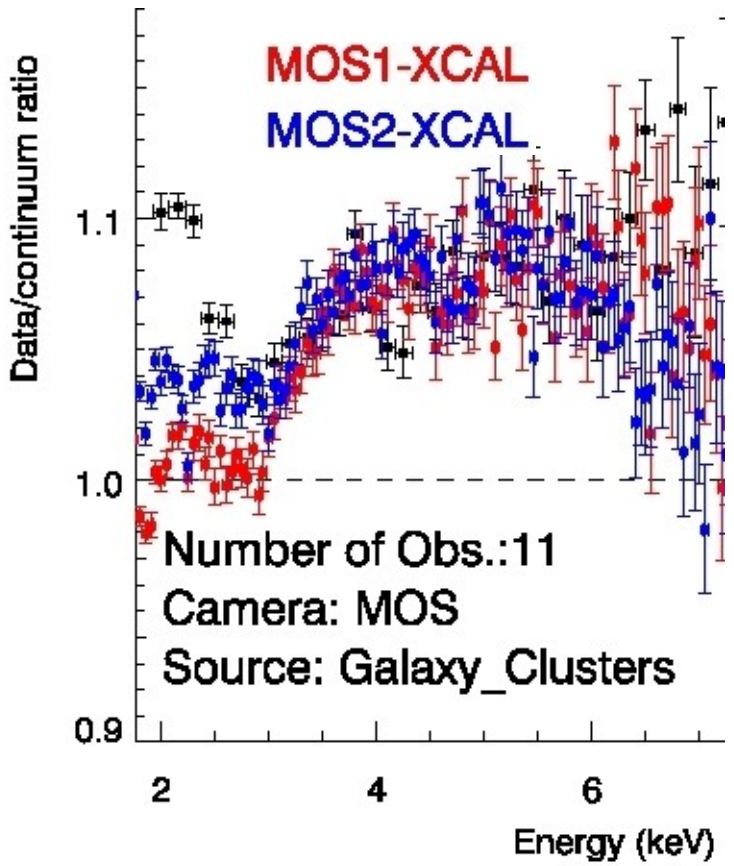


pn-MOS1 gamma

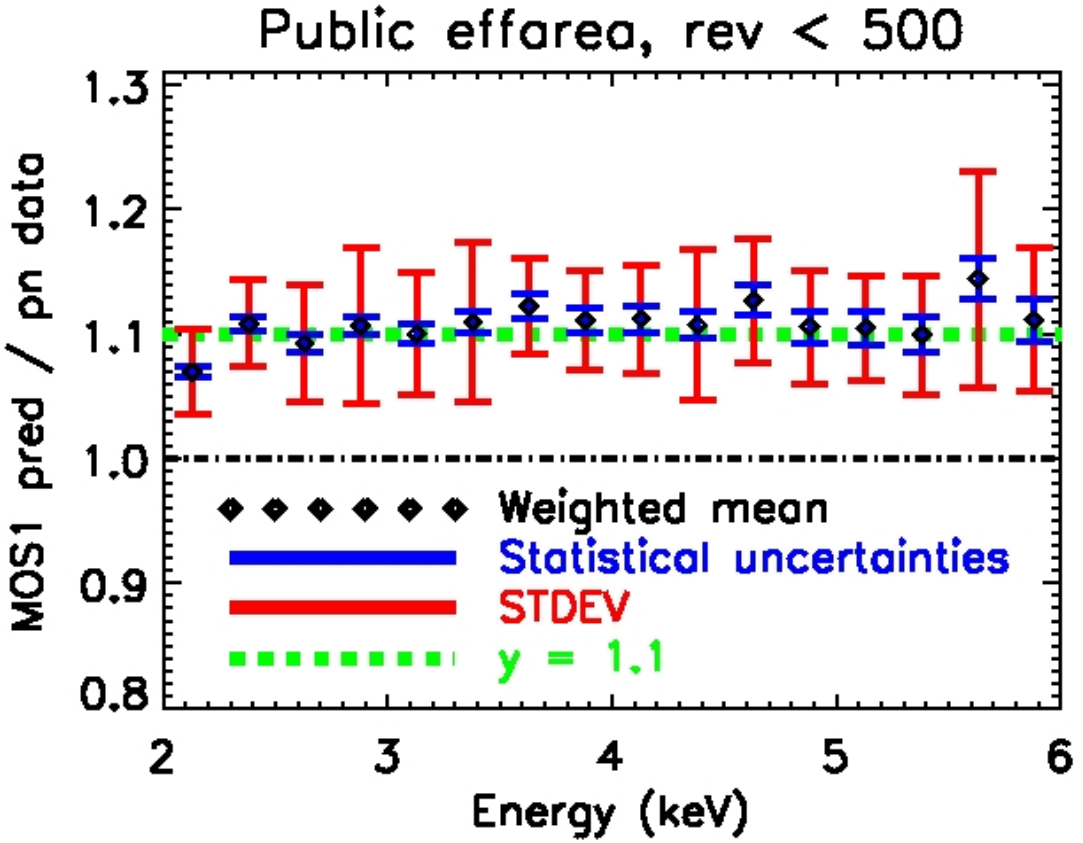


MOS1/pn flux

CLUSTERS + BLAZARS



CLUSTERS



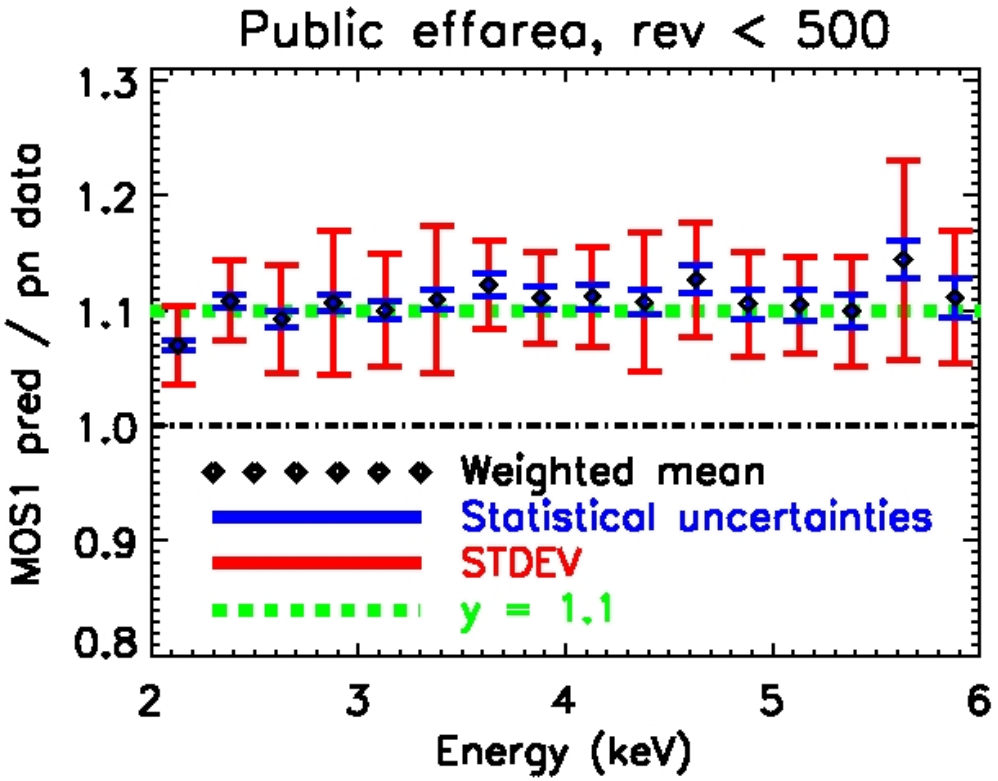
- Clusters do not show the steep rise of residuals at 3.0-4.0 keV as blazars do ➔ trouble

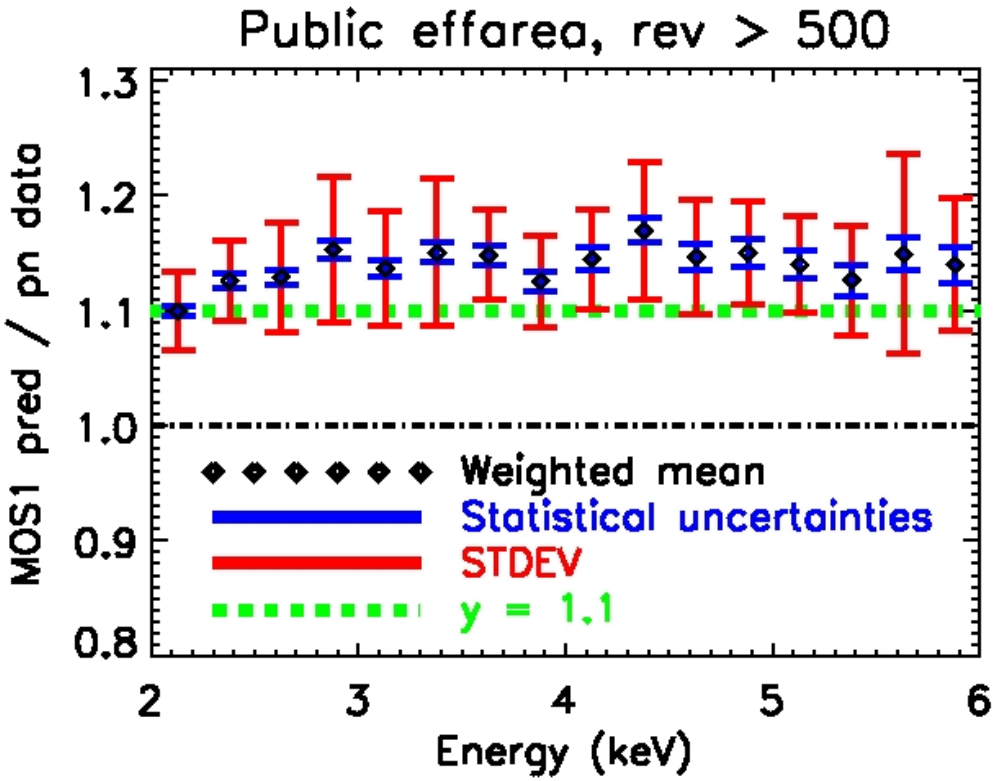
Pre/post cooling

- Cluster sample obtained before revolution 500, blazars after revolution 500
- Perhaps MOS cooling has additional effarea effect at rev > 500?
- New cluster sample: the available post rev 500 pointings for the same clusters as in the sample used in Nevalainen et al. (2010). Could use other clusters as well **(TBD)**

Public effarea,pre/post rev 500

- Clusters show no steep rise at 3-4 keV, i.e. clusters and blazars behave differently with the public effarea at rev > 500. **WHY?**
- Cluster MOS1/pn flux ratio 5% higher at rev > 500 than in rev < 500. **WHY?** A similar trend possibly seen with blazars (M. Smith).





- Jukka and Matteo will investigate blazar/cluster difference in detail in May or June 2012
- M. Smith will help in the analysis
- Check fluxes for each cluster as a function of time. Does the MOS flux increase and pn remain constant as suggested by blazars?
- Look at blazar residuals object-by-object to see is one peculiar object is driving the fit
- Look at blazard residuals as a function of time
- Cluster temperatures tell about the effective area shape around the cut-off energies, while blazar power-law describes the full band continuum shape. Investigate.
- Hot SN?

10) NuStar

- Discussion with NuStar people (Kerstin, Karl, Fiona) about adding some clusters into calibration program
- Agreement that Coma, A1795 and A2029 will be observed
- These are the hottest clusters in the IACHEC sample, relaxed in the inner regions and well observed with many different X-ray missions.
- The brightest central regions covered within a few arcmin to minimise vignetting
- Fe XXV/XXVI EPIC measurement will help in the calibration