EPIC Chandra Cross Calibration with the Perseus Cluster

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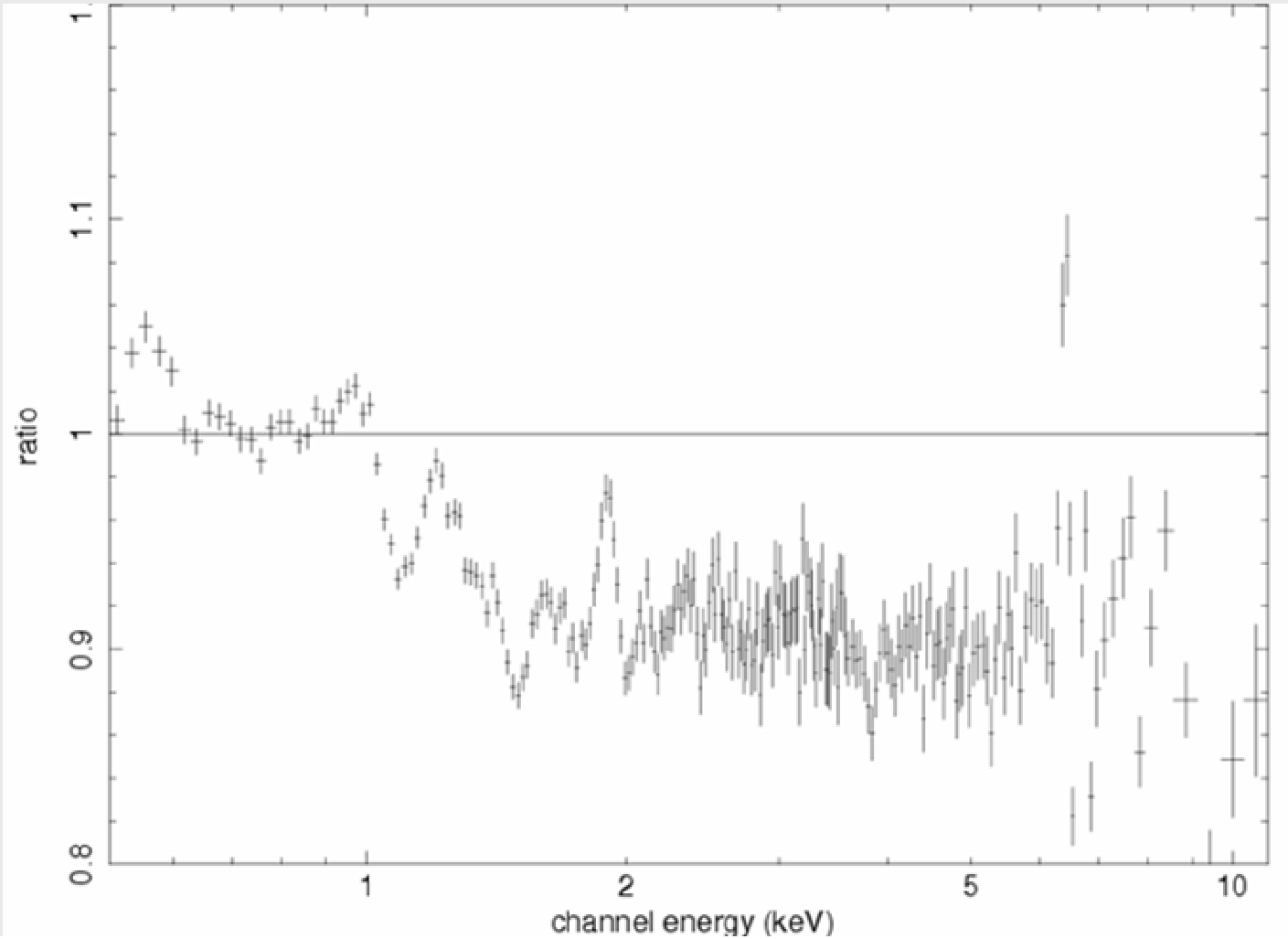
Cross Cal with Clusters

- Has enjoyed some success
- Perseus is the brightest cluster in the X-ray sky
- Lots of photons and no pile-up!
- In the past used to check pn/MOS cross calibration

Example of old vs new pn/mos

Residuals in the form of ratio data/model for PN data on MOS best fitting model



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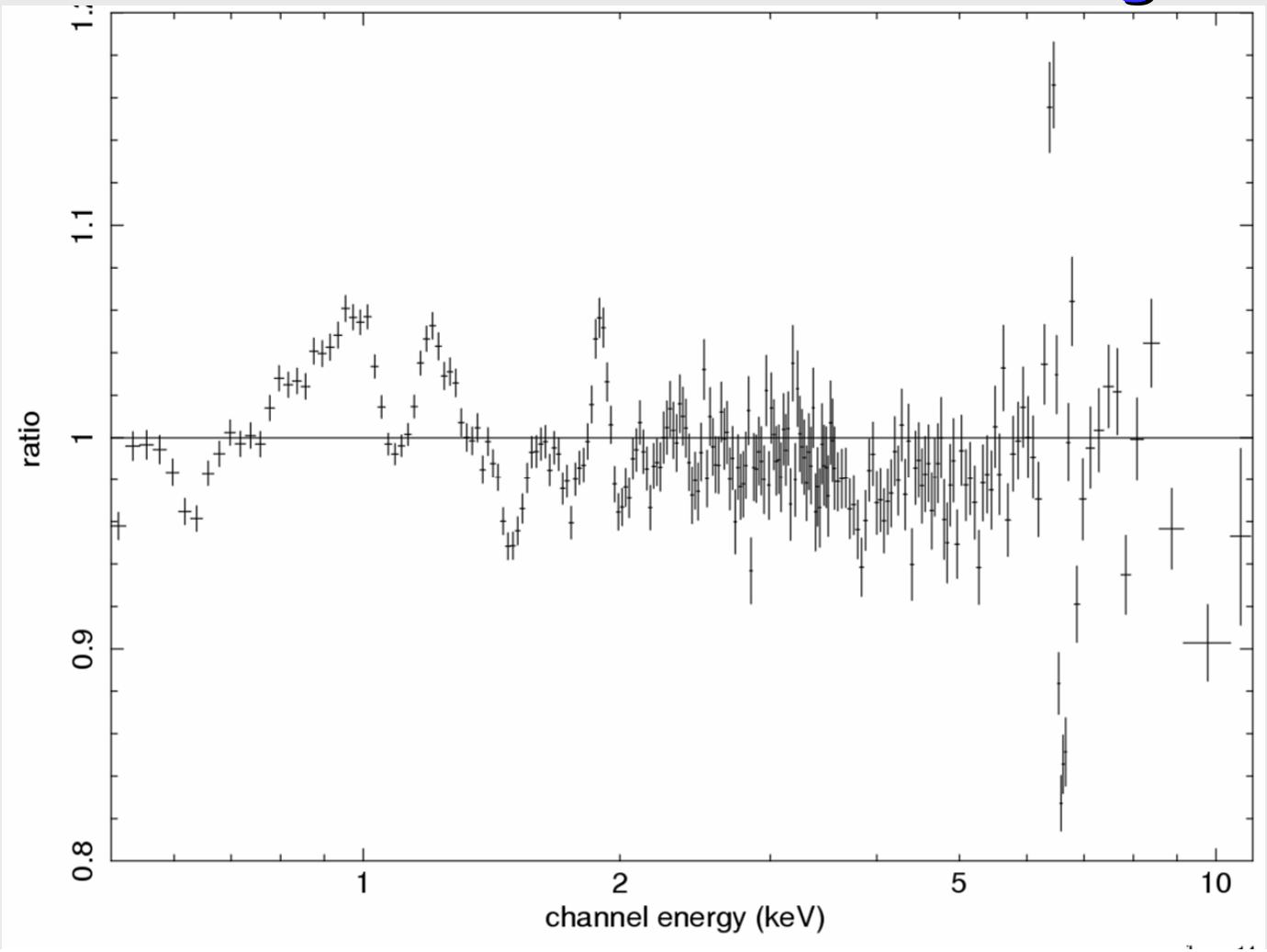


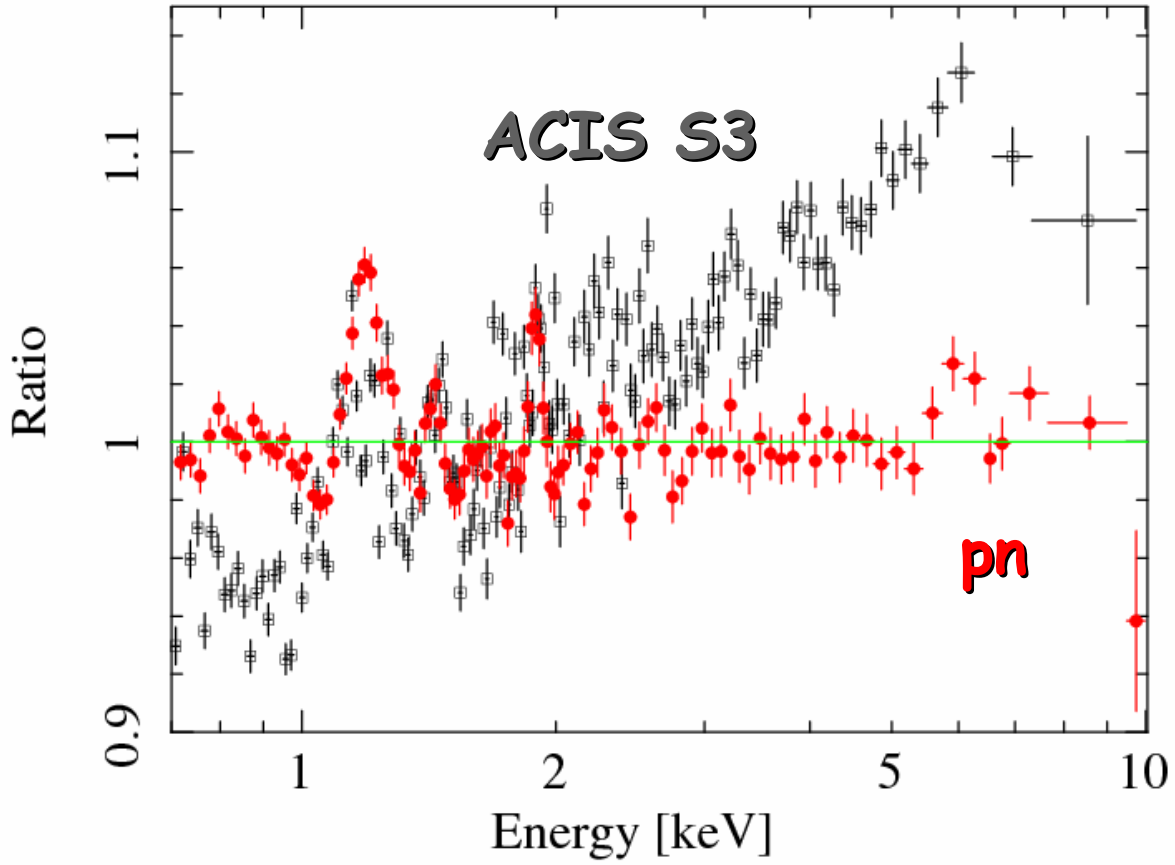
ACIS S3 vs EPIC pn

- Same thing, only now we compare Chandra ACIS S3 with EPIC pn
- About 3×10^6 events for each spectrum
  extracted from annulus with bounding radii of 1' and 2 '
- Used old and new Chandra calibrations
  (CALDB 4.1.1 with hrmaD1996-12-20axeffaN0008.fits)
- Multi T spectral model (Molendi & Gastaldello 09)

ACIS S3 vs EPIC pn

Residuals in the form of ratio data/model for pn and ACIS data on pn best fitting model.

Renorm applied to match spectra at 1.5 keV



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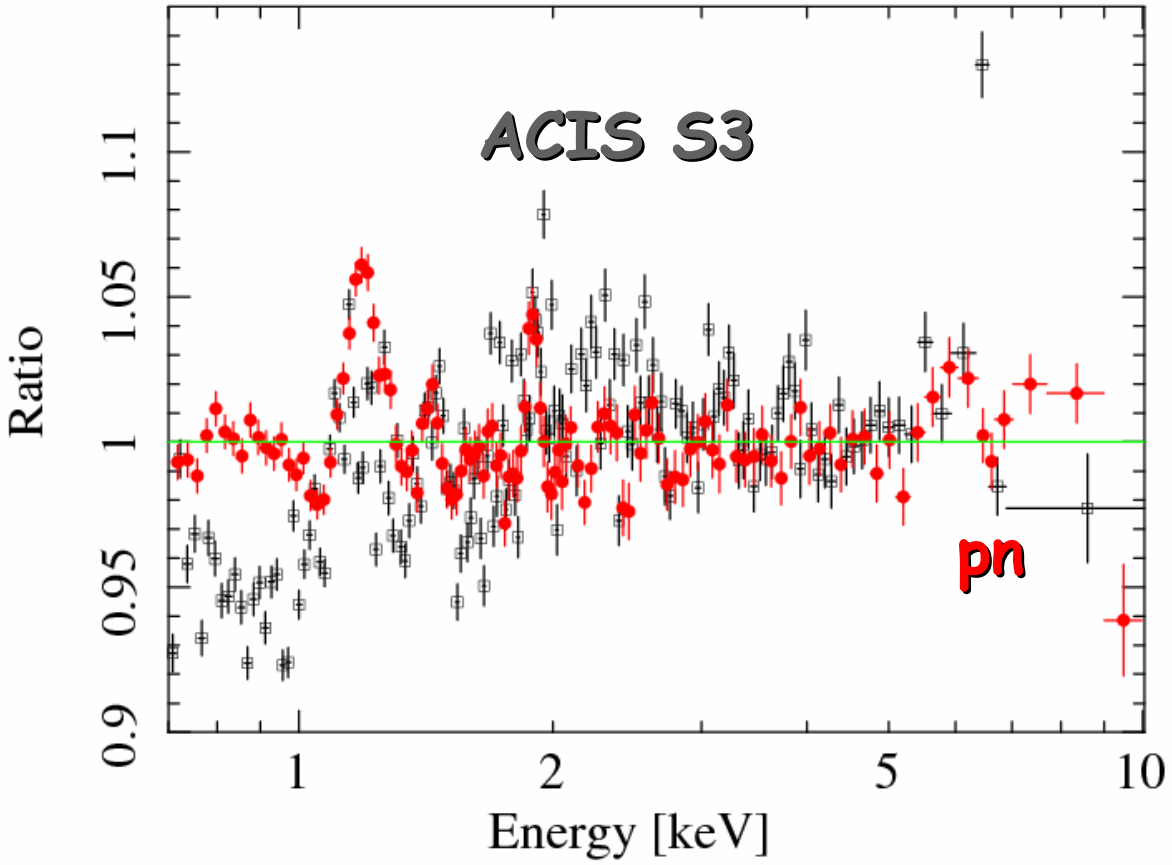

Cross Cal

pn and ACIS S3 spectral shapes are now in much better agreement!

Congratulations calibrators!

Flux cross-cal

- Both figures have renorm factors: 5% for the first; 15% for the second: let's take them out.

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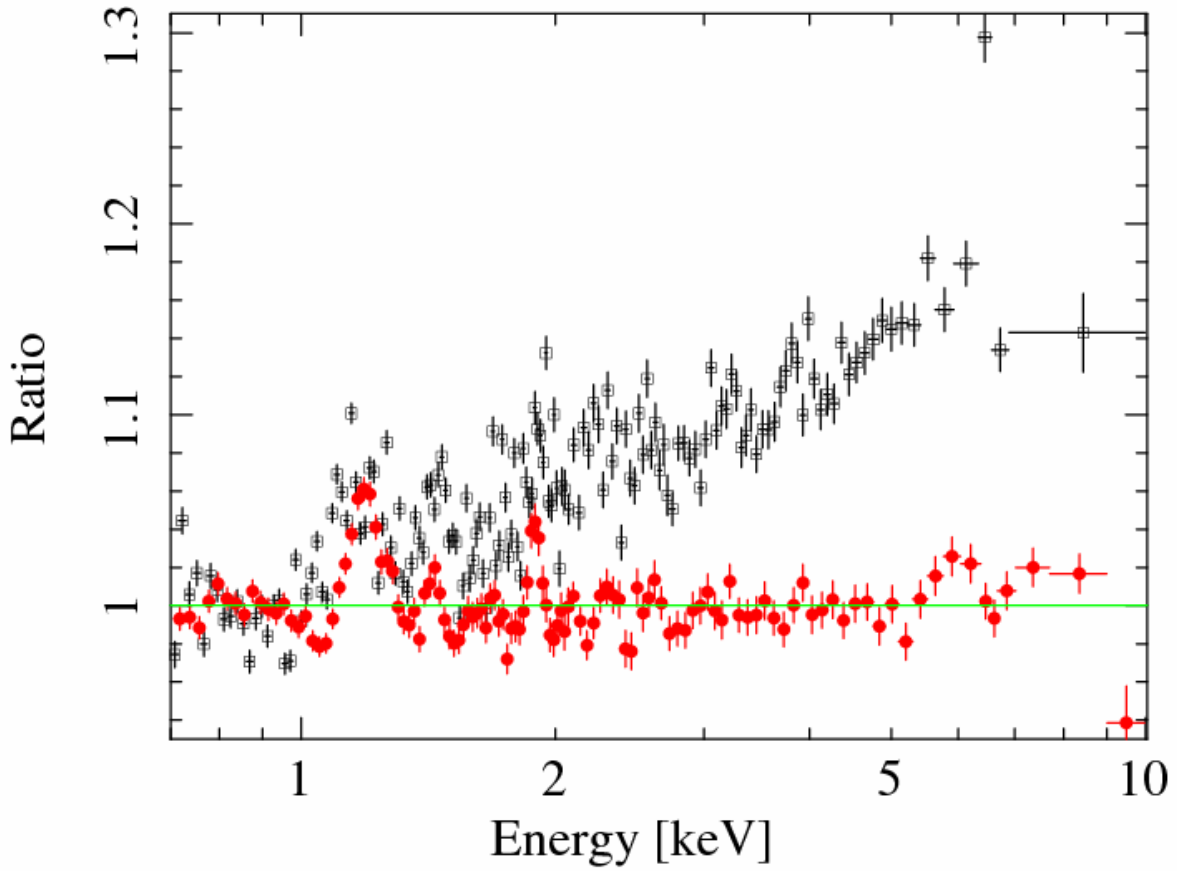

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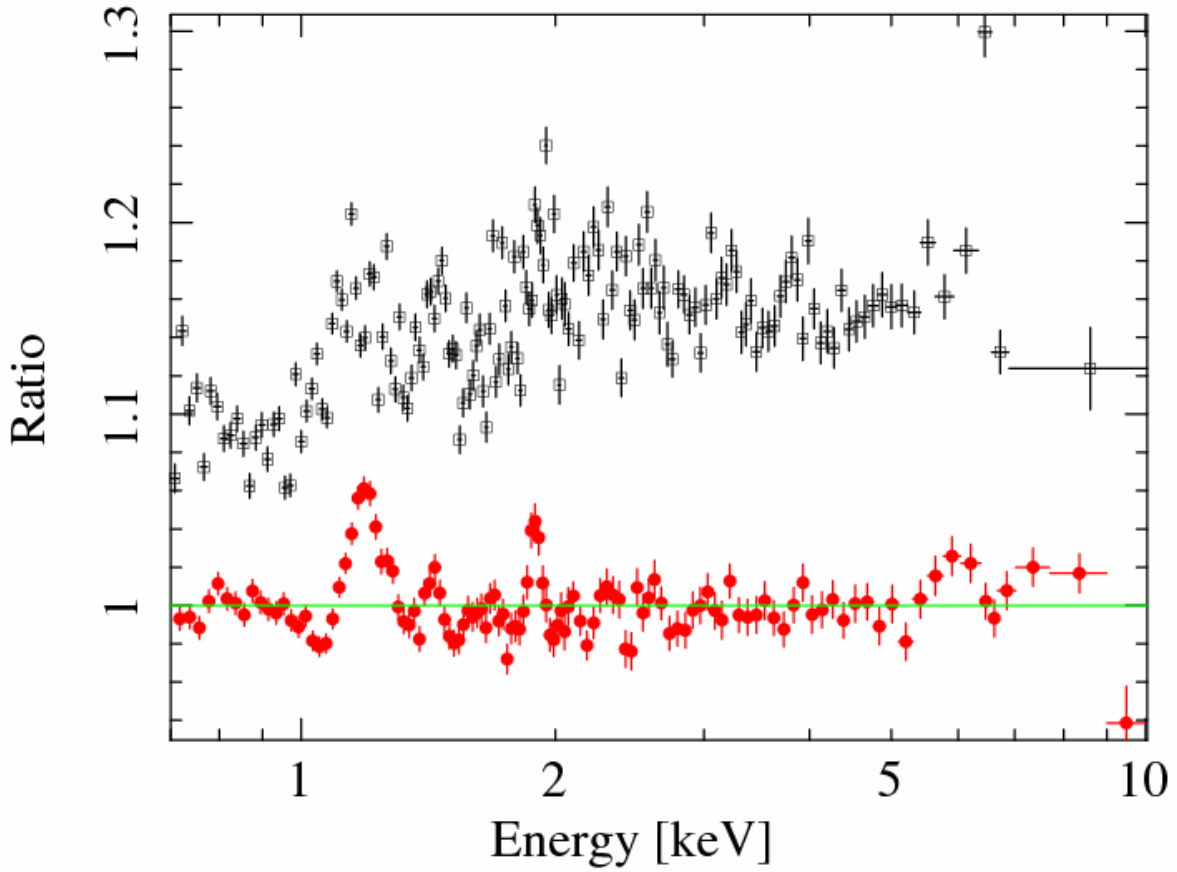

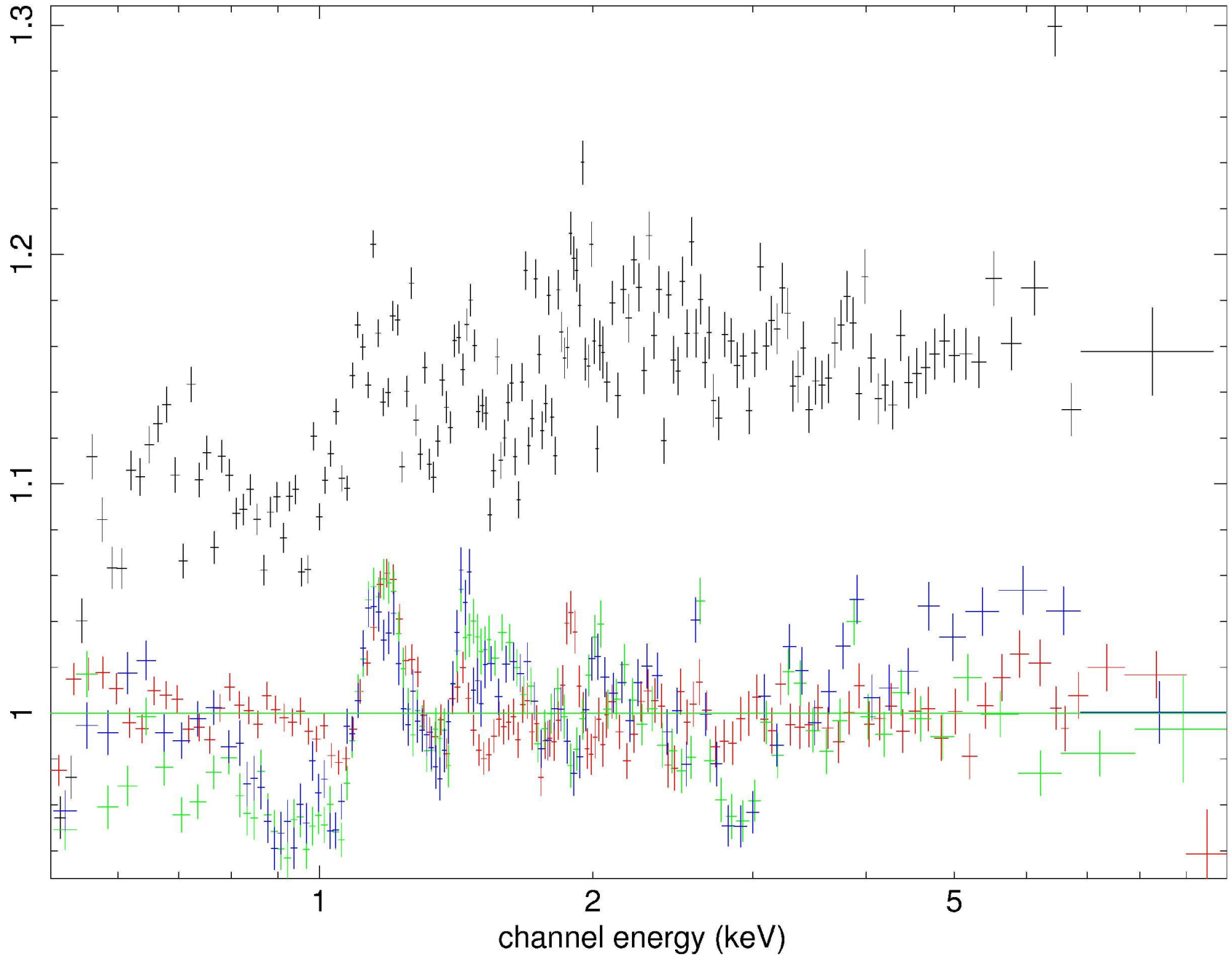
1.3
1.2
1.1
1
1
2
5
channel energy (keV)
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Flux cross-cal

- The new HRMA calibration impacts on the ACIS/EPIC flux cross calibration.
- Our analysis indicates that the flux cross calibration below ~ 2 keV will be shifted by about 10%.
- Although comparing spectra extracted from a given region of a cluster may not be the best way to go, our data indicates that the flux cross calibration change is not for the better.

Summary

- The new HRMA effective area limits ACIS S3 vs pn residual calibration errors to less than 5%

  this is no small achievement!

- The new spectral calibration modifies by about 10% Chandra fluxes below 2 keV, ACIS vs EPIC flux cross calibration will be affected