XMM-Newton Chandra Cross-Calibration with Blazars

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Cross-calibration with blazars

- Objective: Comparison of XMM-Newton — Chandra fluxes in various bands.

- Sample of Blazars observed simultaneously XMM and Chandra:

  - **PKS 2155-304**, **3C 273**, **H 1426+428**

- Featureless spectra over 0.1 – 10.0 keV

- Bright:

  - piled-up in EPIC -> PSF core excision introduces added uncertainty in flux determination

- Highly variable, even within observation timescale:

  - require XMM / Chandra / … coordinated observations

  - simultaneous GTIs across instruments

  - normalise fluxes to compare between observations

- 25 XMM-Newton observations coordinated with Chandra:

  - 40 strictly simultaneous exposures for flux comparison

- Instruments being compared are:

  - **EPIC**, **RGS**, **ACISS-L/HETG**, **HRCS-LETG**

- Data reduction:

  - SAS 17 + CCFs as of Jan 2019

  - CIAO 4.10 + CALDB 4.8.1

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Not the most recent calibration!

Data analysis

- Energy bands:
  - 0.15 – 0.33 keV (Lower EPIC - Lower RGS bound)
  - 0.33 – 0.54 keV (Up to the O-edge)
  - 0.54 – 0.85 keV ⎤
  - 0.80 – 1.20 keV ⎬ O-VII/VIII , Ne-IX/X
  - 1.20 – 1.50 keV ⎦
  - 1.50 – 1.82 keV (Up to the Si-edge)
  - 1.82 – 2.20 keV (Up to the Au-edge)
  - 2.20 – 3.50 keV
  - 3.50 – 5.50 keV
  - 5.50 – 10.0 keV

- Spectral fitting: model consists of:
  - multiple independent power laws
  - absorption with nH fixed
    - PKS 2155-304: 1.42×10^{20} cm^{-2}
    - 3C 273: 1.79×10^{20} cm^{-2}
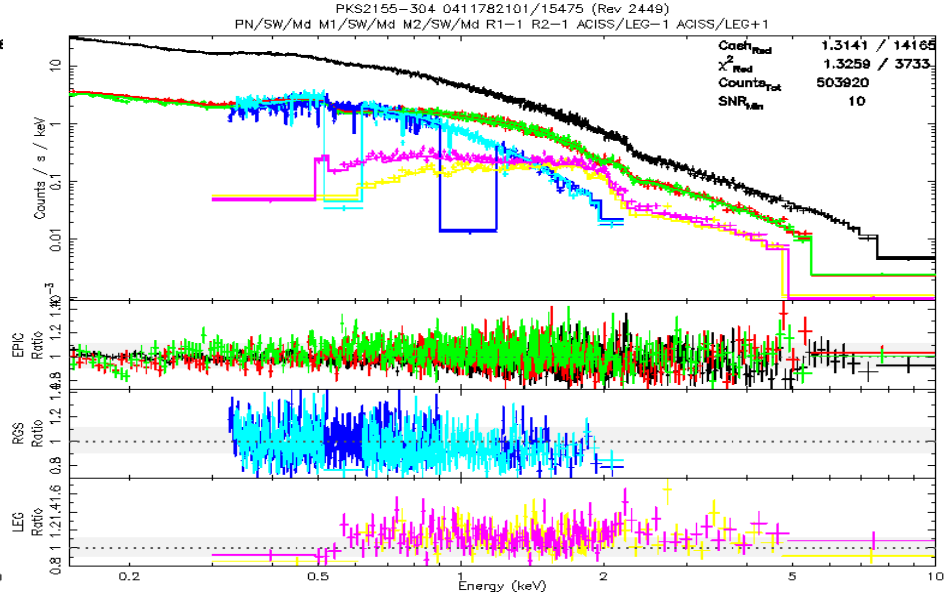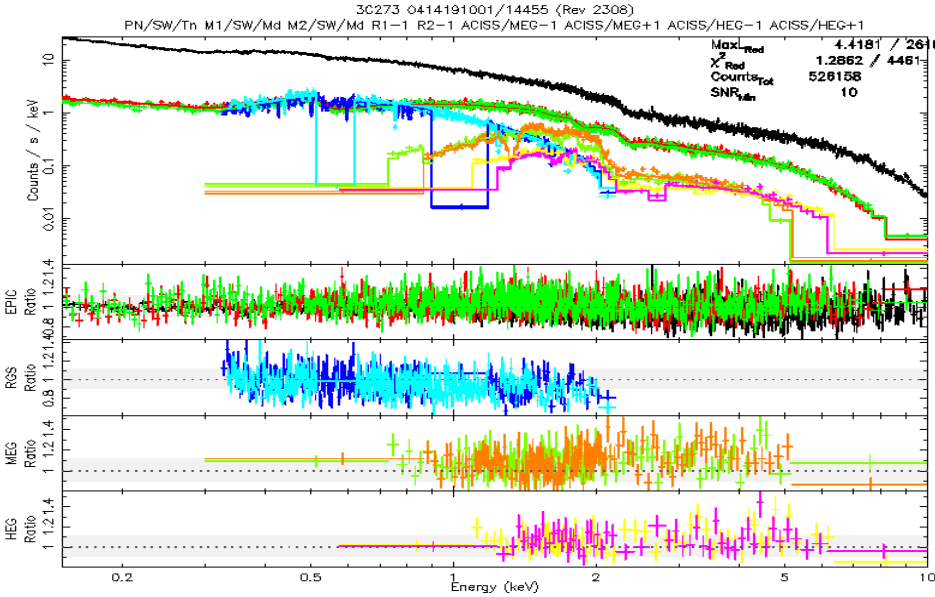   - H 1426+428: 1.36×10^{20} cm^{-2}

- Per simultaneous exposure:
  - fit each instrument independently
  - determine band fluxes from resulting best fits
  - normalise to the PN flux

Model (Tbabs*mpo)
0411780501 11965 PKS2155−304

PN
MOS1
MOS2

Example spectra
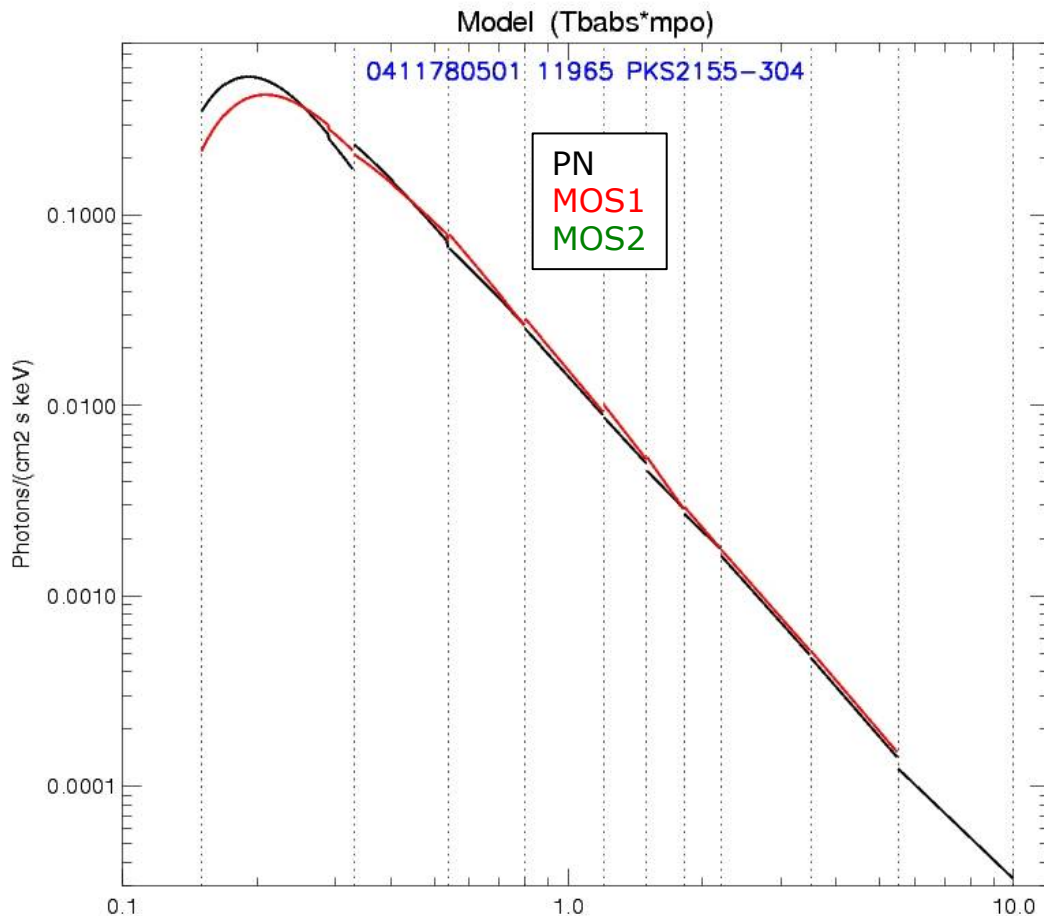
3C 273
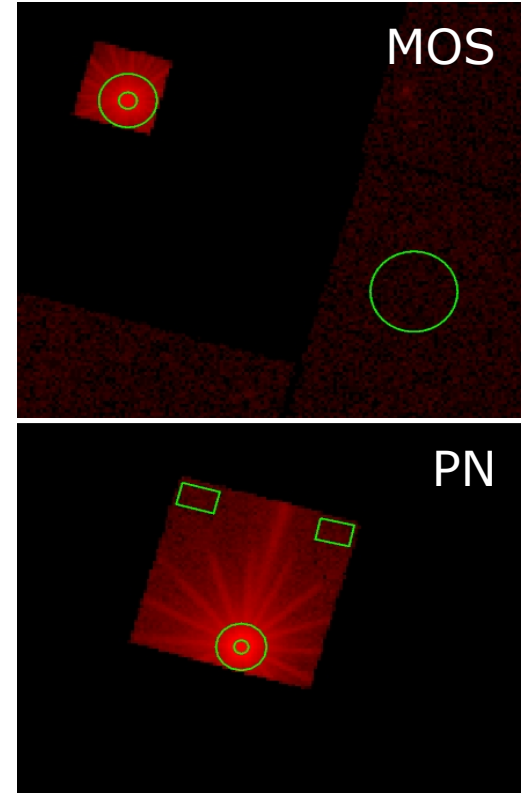(9 observations)

PKS 2155-304
(14 observations)

Data analysis

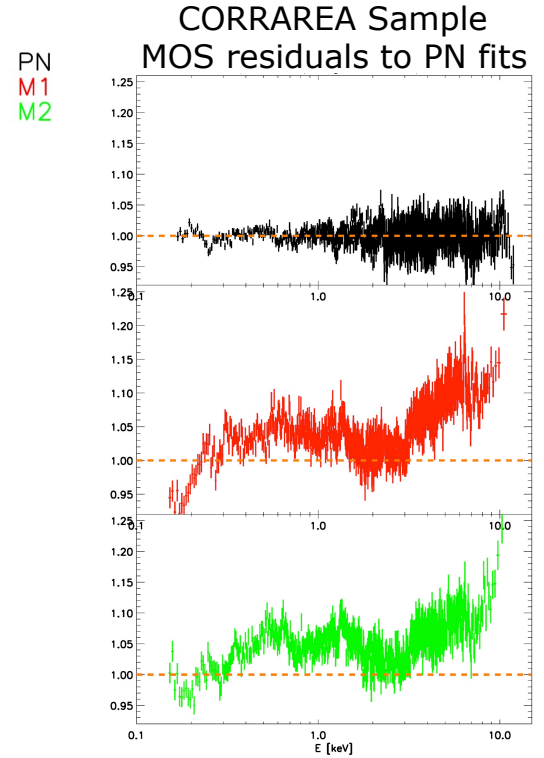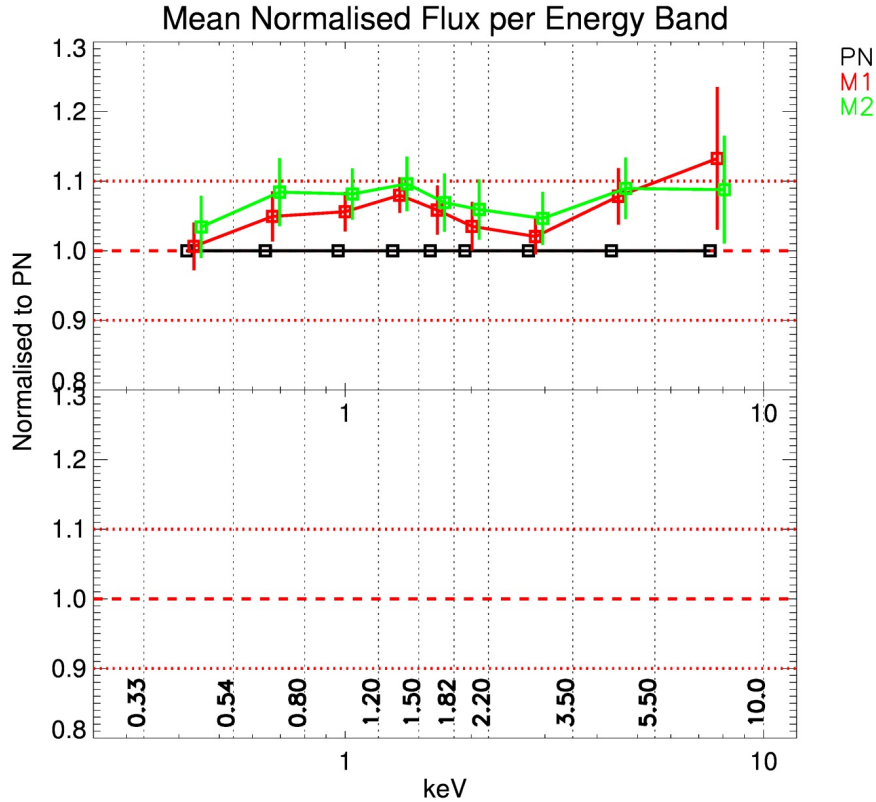Systematic uncertainties:

➢ Pile-up:

- EPIC requires excision of PSF core: use source extraction annuli.

- Per observation: for both MOSs use the largest common outer radius within window, and a common inner radius.

- However, radii vary from observation to observation, and are generally different from the PN radii.

- Differing annuli may introduce systematic uncertainties due to imperfect EE correction and RMF weighting.
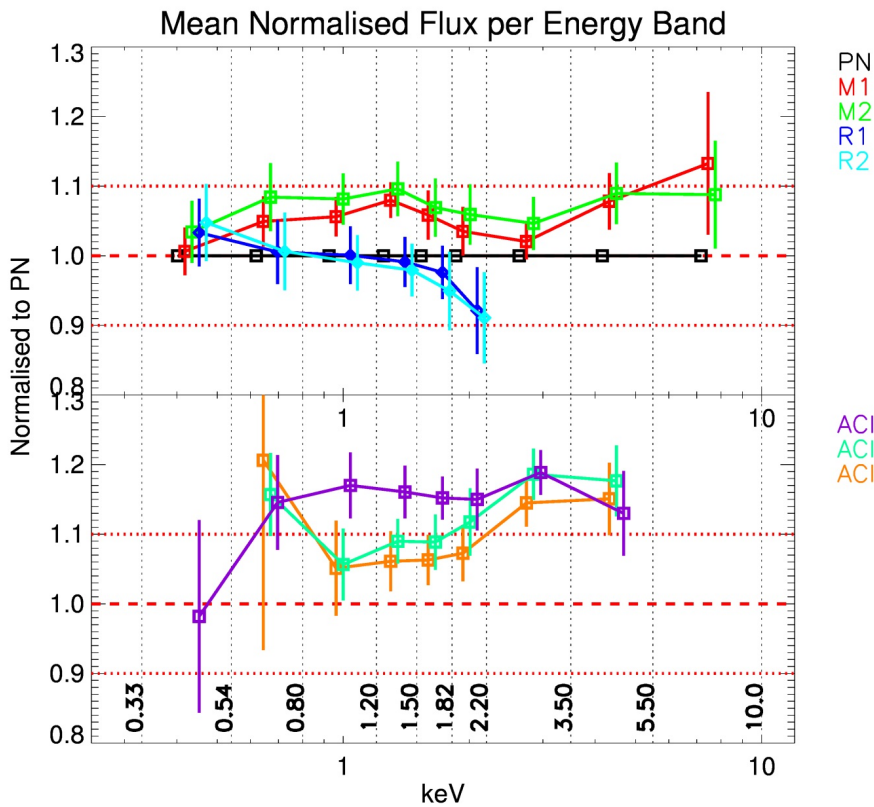
➢ PN background:

- Extracted from regions within the small window: some degree of source contamination.

MOS

PN

Mean normalised fluxes

Mean Normalised Flux per Energy Band

CORRAREA Sample
MOS residuals to PN fits

ESA UNCLASSIFIED - For Official Use   XMM-Newton Calibration Status Update | M. Smith | IACHEC 2020 On-line Symposium, 23-24 Nov 2020 | Slide 7

European Space Agency

Mean normalised fluxes

Mean Normalised Flux per Energy Band

Does **not** include
- RGS1-RGS2 corrections
- RGS rectification factors

Contaminant model of
CALDB 4.8.1

Fit statistic

chisqr *V.* **cash**

chisqr-derived fluxes /
cash-derived fluxes

European Space Agency