XMM-Newton — Chandra Blazar Flux Comparison

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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

20 XMM-Newton observations coordinated with Chandra:
- 33 strictly simultaneous GTIs for flux comparison

Instruments being compared are:
- **EPIC, RGS, ACISS-L/HETG, HRCS-LETG**
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 x 10^{20} cm^{-2}
  - 3C 273: 1.79 x 10^{20} cm^{-2}
  - H 1426+428: 1.36 x 10^{20} cm^{-2}

Per simultaneous exposure:

- fit each instrument independently
- additional “Joint Fit” of all instruments in use, to be used as reference

Determine band fluxes from resulting best fits.
Normalise fluxes within simultaneous exposures (GTIs) to compare instruments across observations:

- Preferably the same reference across all GTIs and bands.
  - PN & MOS: when in TI mode no useful data in the lowest energy band;
  - RGS: no data in the lower or higher bands;
  - Chandra instrument configurations vary from exposure to exposure.

- Use as reference the Joint Fit Flux of all instruments in use in a particular exposure.
- PN Flux

For 32 GTIs and energy bands: a total of 252 spectral fits.

Data reduction:
- SAS 13.5 + CCFs as of March 2014
- CIAO 4.6 + CALDB 4.5.9
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.
Mean Normalised Fluxes

2XMM, On-Axis
(Read et al. 2014)
Cash versus $\chi^2$