XRT PSF Investigations

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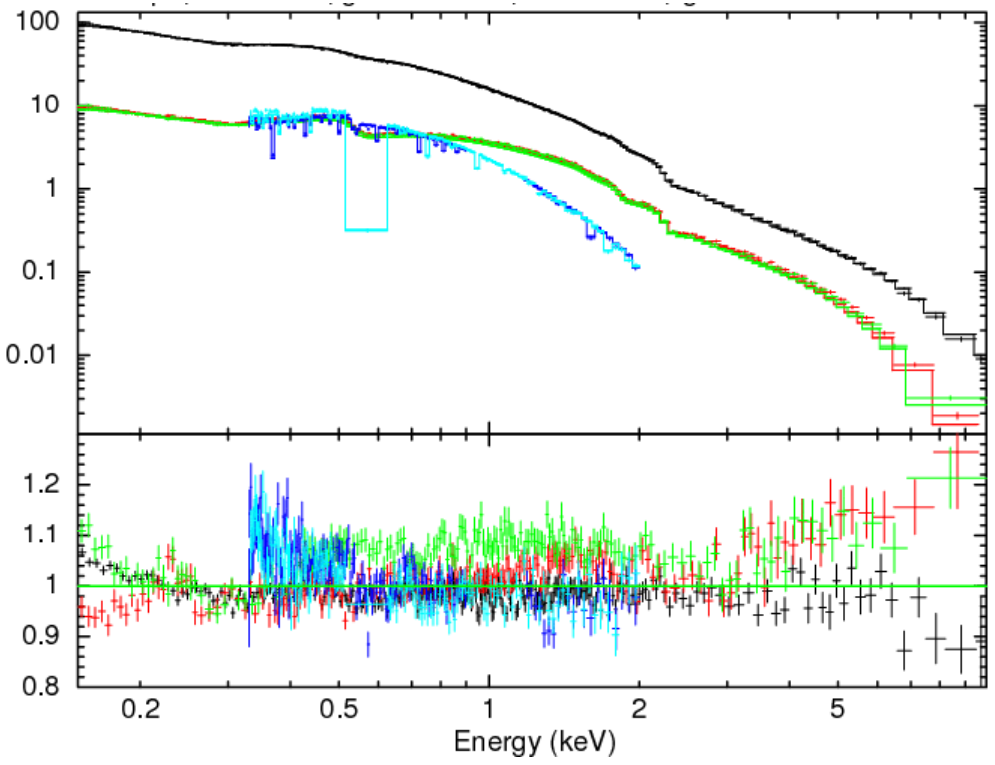
EPIC Cal Ops Meeting, MPE, 27-28 April 2017

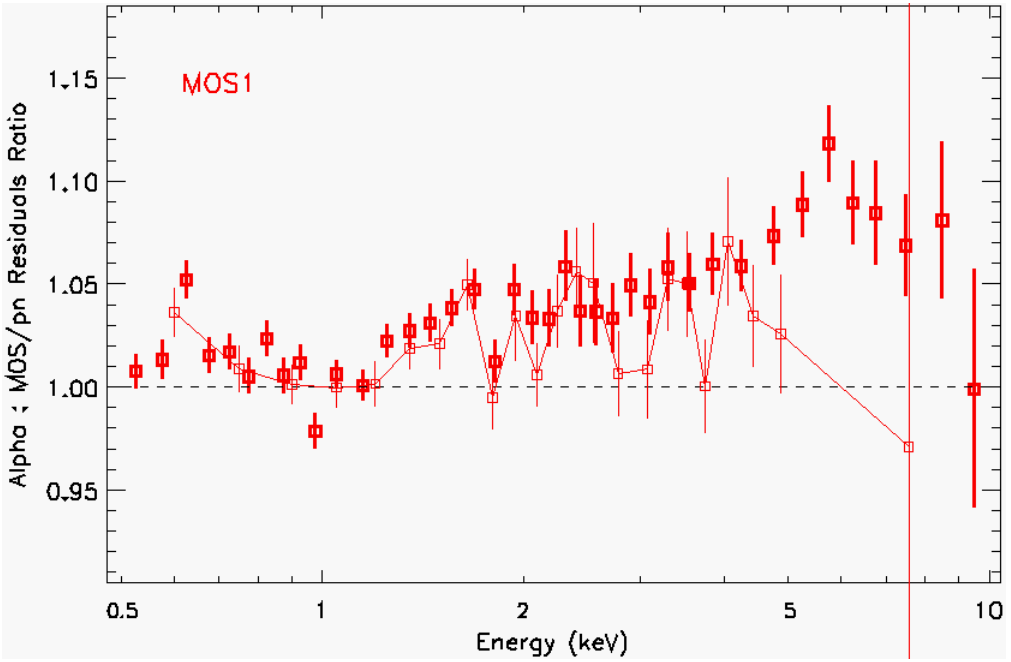
Issues with Annular Spectra

PKS 2155-304

- Piled-up
- Annular extraction regions for EPIC

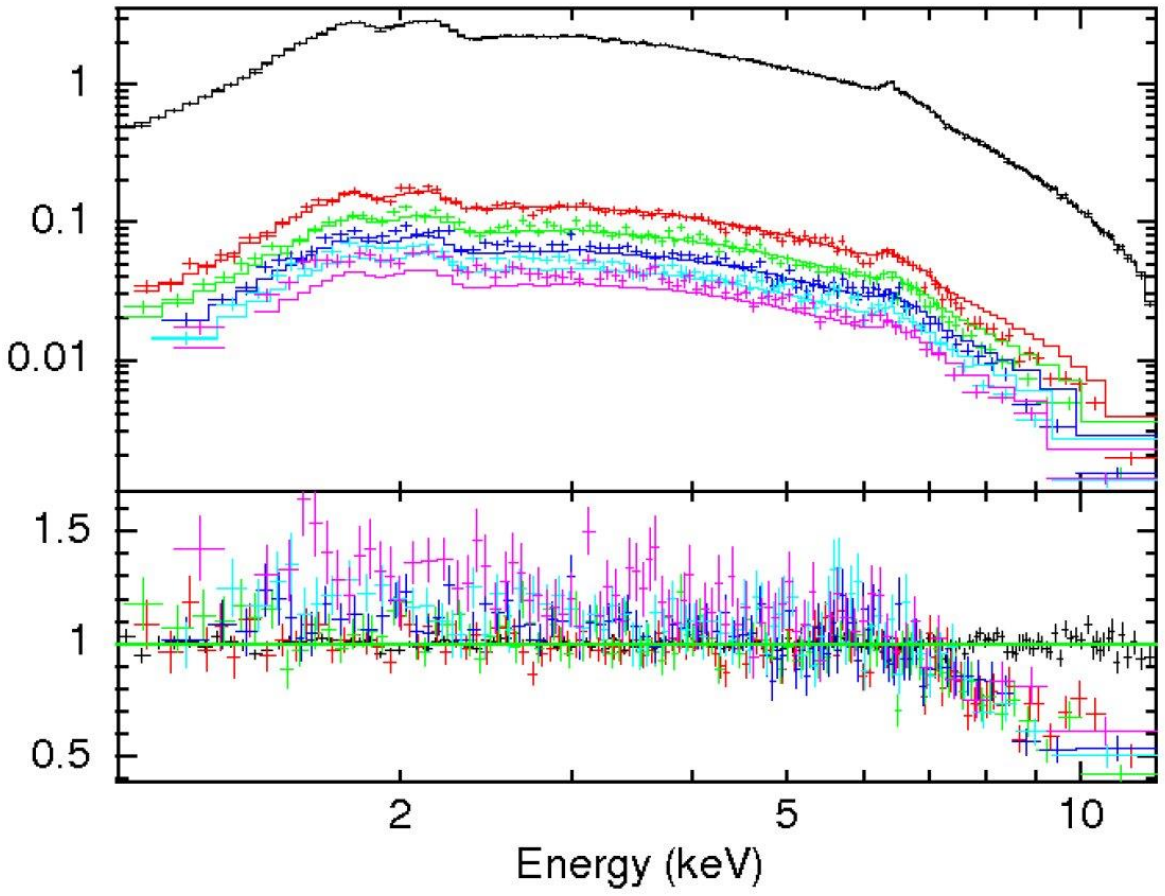


Sample of non-piled-up on-axis sources



Read el al. 2014

Issues with Annular Spectra



NGC 5506 (Seyfert 2)

Dominated (>90%) by point source emission.

PN spectral comparison:

- annuli from 20”-25” to 40”-45”
- compared with 20” circle

Similar results for HE1136-2304 (in out-burst)

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Current ELLBETA implementation: 240 parameters per XRT

- 5 PSF model parameters (r_0, α, ε, FWHM, norm)
- 8 energies (0.10, 1.50, 2.75, 4.25, 6.00, 8.00, 10.25, 15.00 keV)
- 6 off-axis angles (0’, 3’, …, 15’)

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Limit the problem to 14 parameters per XRT
- 2 PSF model parameters (r_0, α)
- 7 energies (15.00 keV ≡ 10.25 keV)
- 1 off-axis angle (0’ for MOS1, 1.2’ for MOS2 and PN)

Iterative correction scheme

Iterative scheme for the empirical correction of XRT XPSF parameters

- Per source:
  - Extract spectrum from circular region
  - Extract spectra from several annular regions
  - Create respective RMFs
  - Create respective ARFs
  - Fit model to circular region spectrum
  - Apply this reference model to the annular spectra

- For all annular spectra and all sources, determine a suitable statistic, e.g.:

$$\sum_i (d_i - m_i)^2 / e_i$$

- Modify ELLBETA parameters in order to minimise the statistic

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Source Sample

Source sample consists of 11 observations of bright non-piled-up point sources located at the nominal aim point:

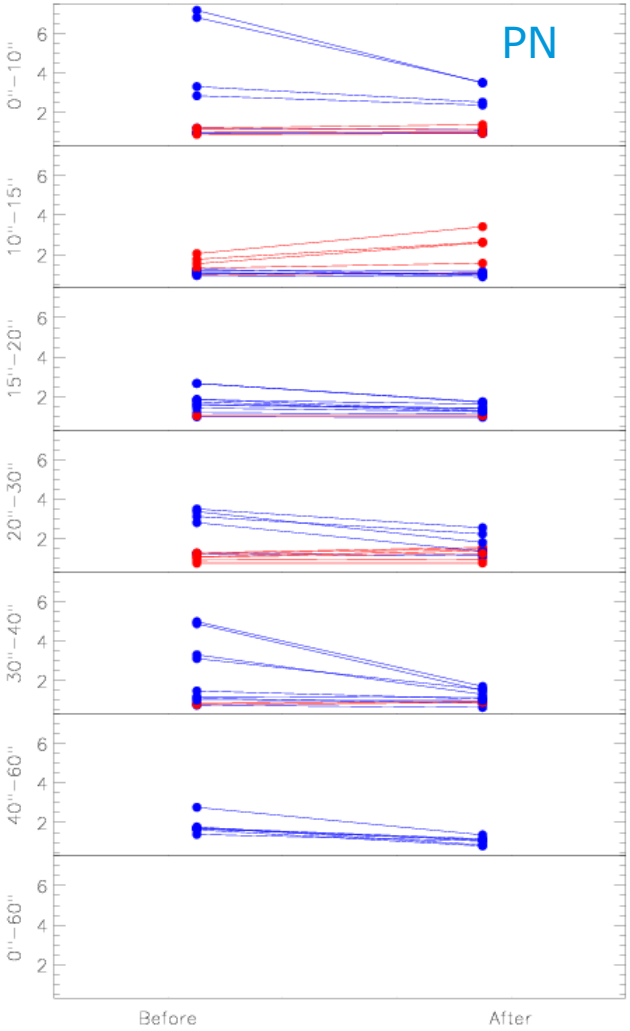
		PN	MOS1	MOS2
MS0205.7+3509	0084140101	FF	FF	FF
Holmberg IX	0112521001	FF	FF	FF
Markarian 6	0144230101	FF	FF	FF
PKS B1334-127	0147670201	FF	FF	FF
RX J0228-40	0200480101	FF	FF	FF
LBQS 1228+1116	0306630201	FF	FF	FF
NGC 5506	0554170101	SW	--	--
NGC 5506	0554170201	SW	--	--
RBS 1055	0555020201	FF	FF	FF
MCG-5-23-16	0727960101	SW	--	--
MCG-5-23-16	0727960201	SW	--	--

5-6 nested annuli being compared (up to 60” outer radius)

2 PSF model parameters (r0 and α) being varied

Change in Overall Statistic

Change in Chi2 from public to candidate CCFs



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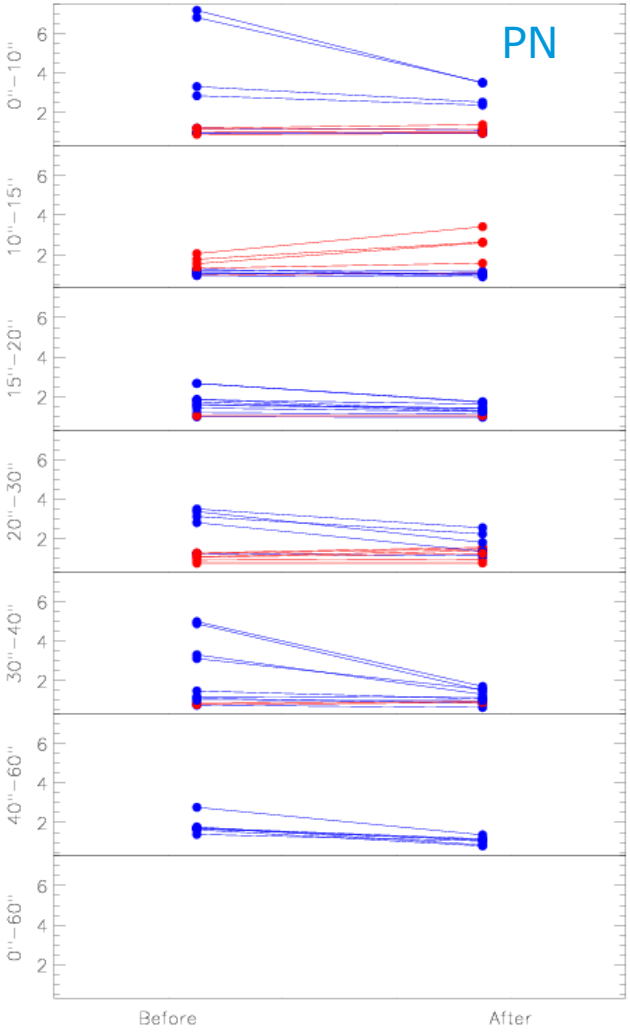

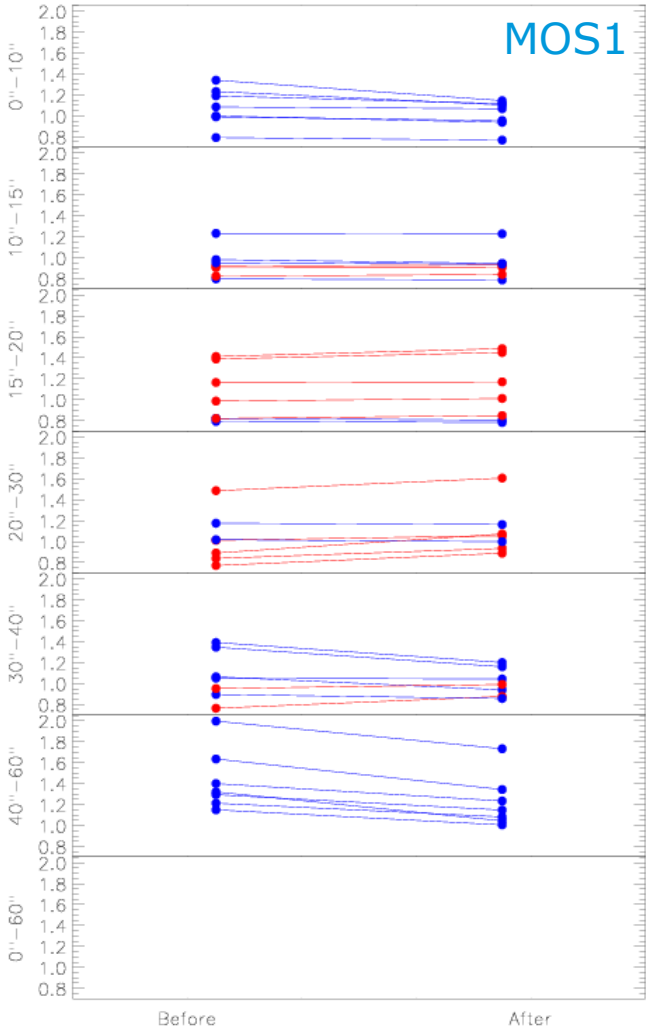

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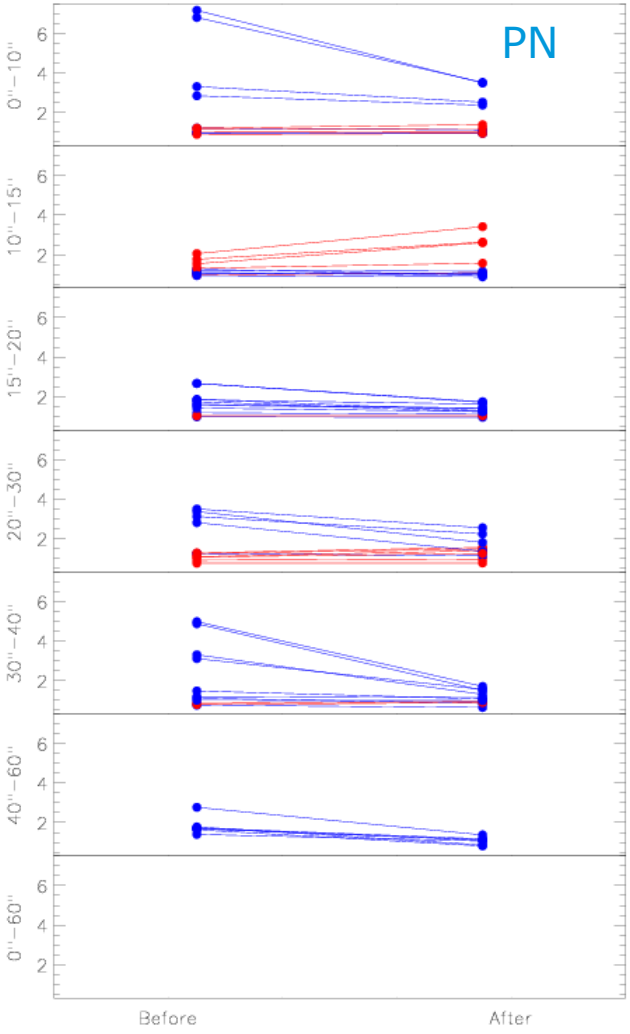
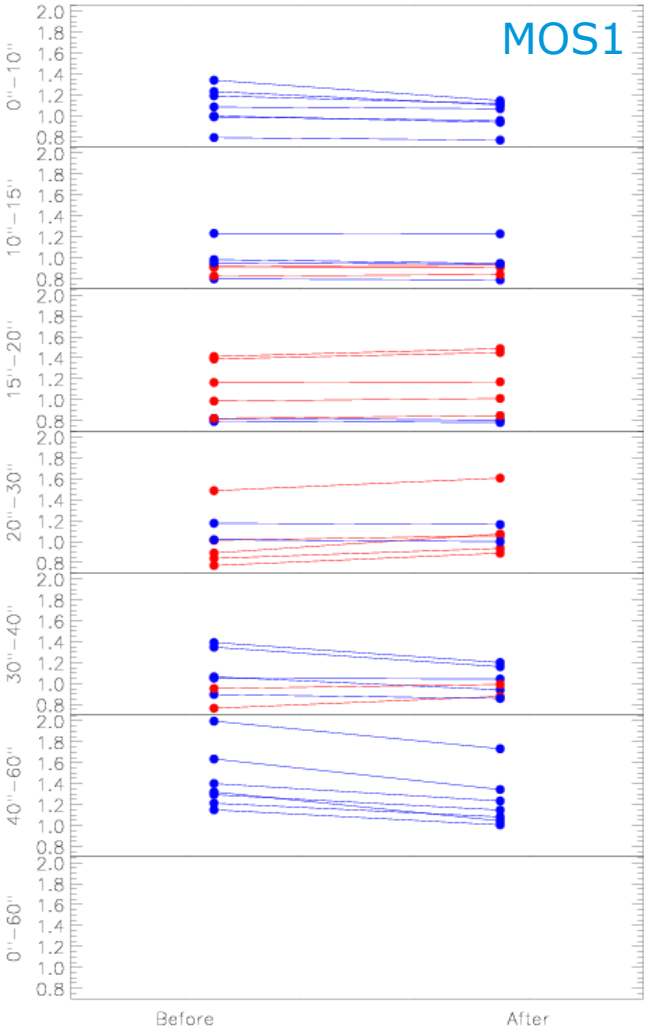
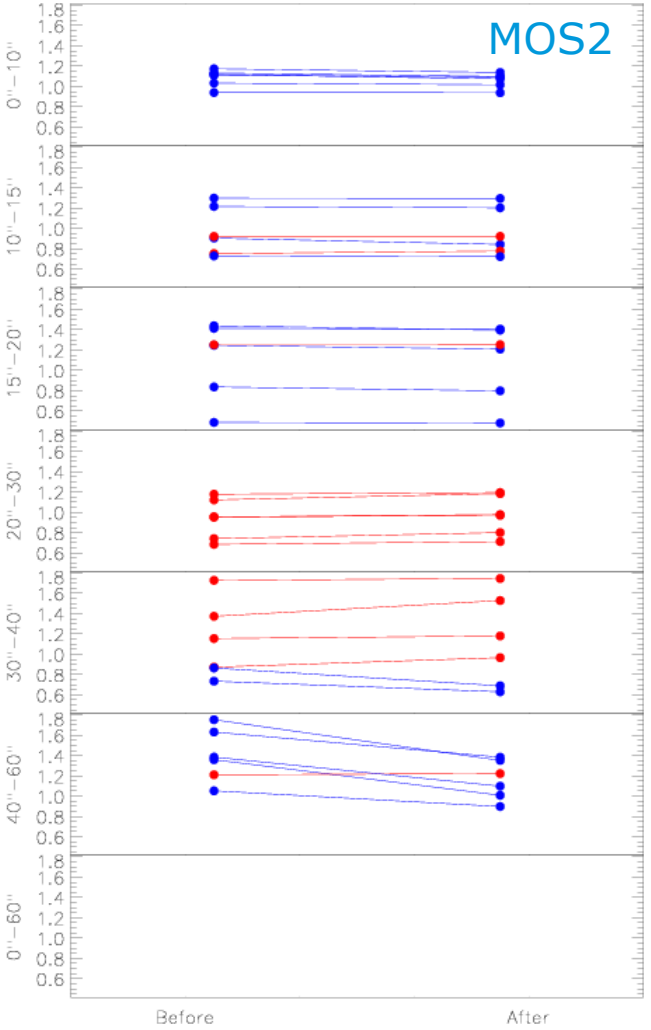
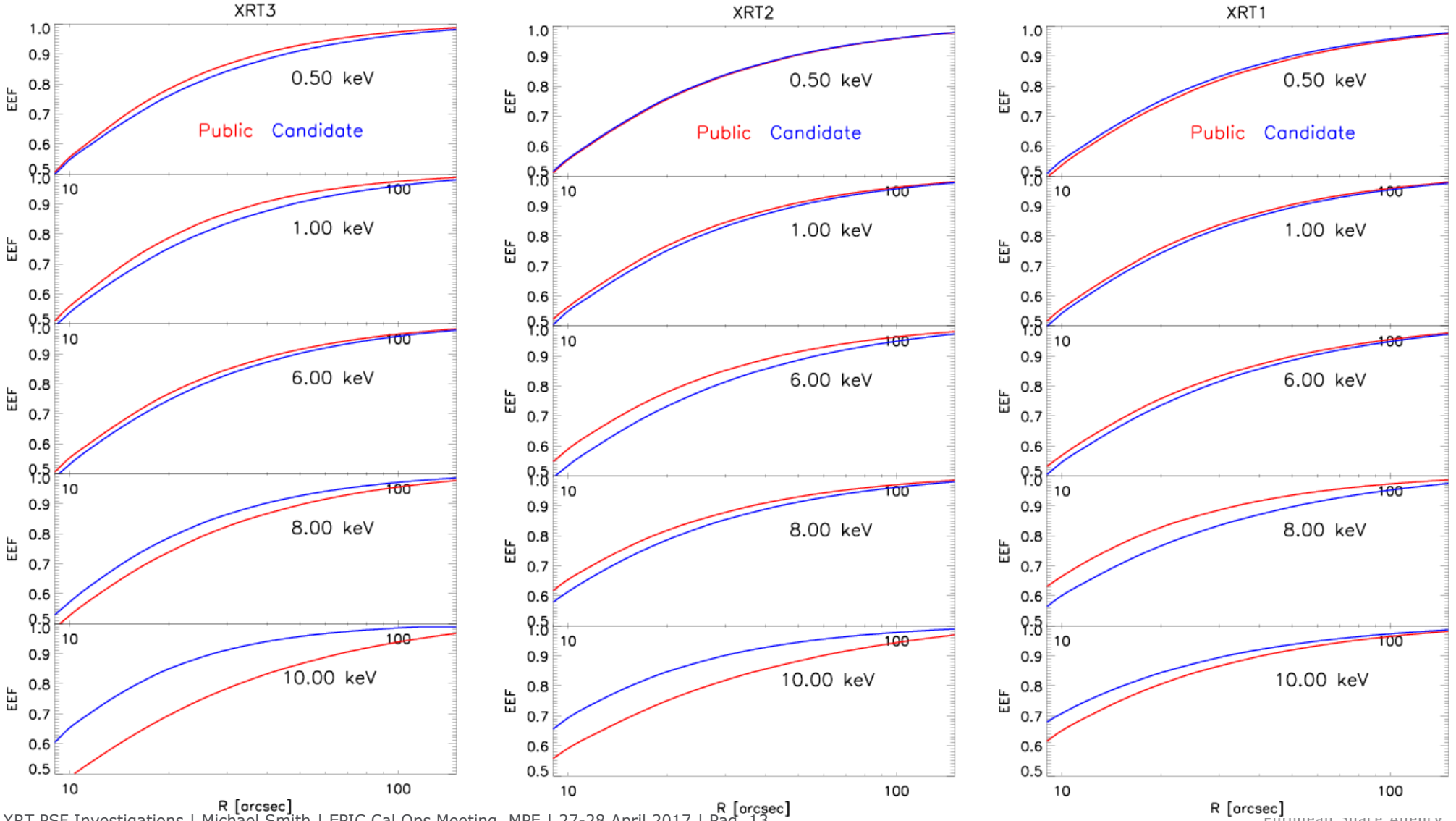


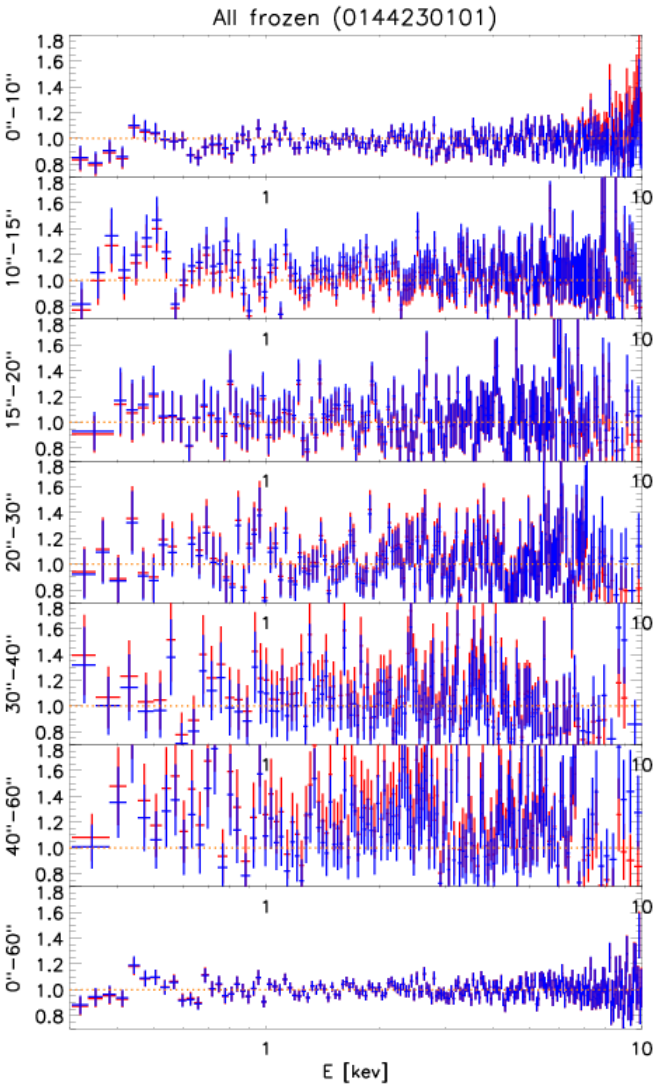


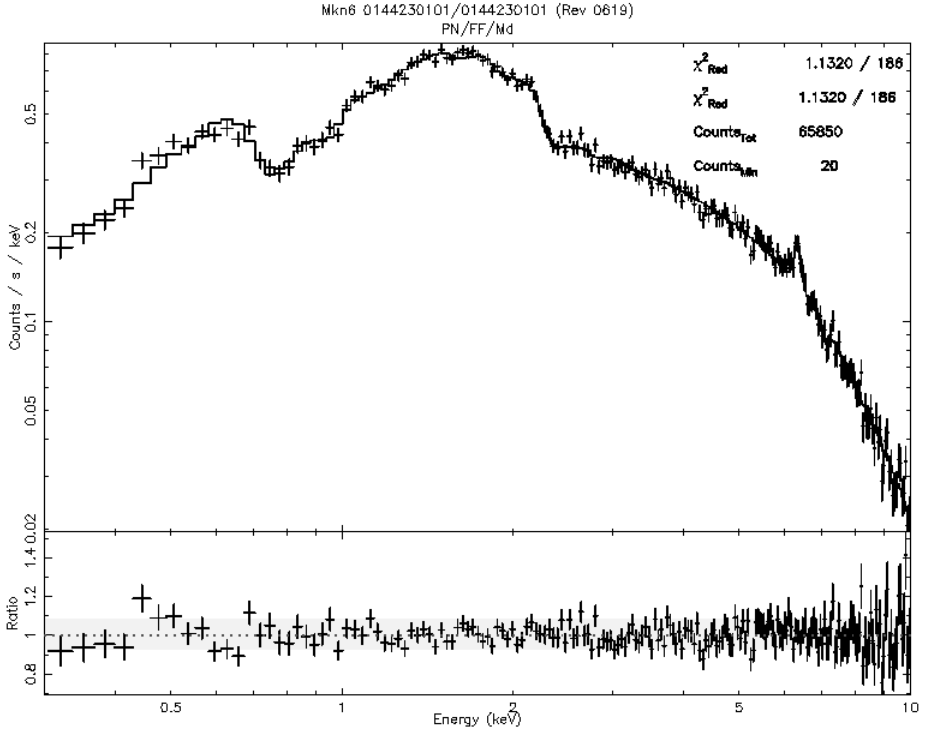


Comparison of EEFs



Results: Mkn 6 (PN)





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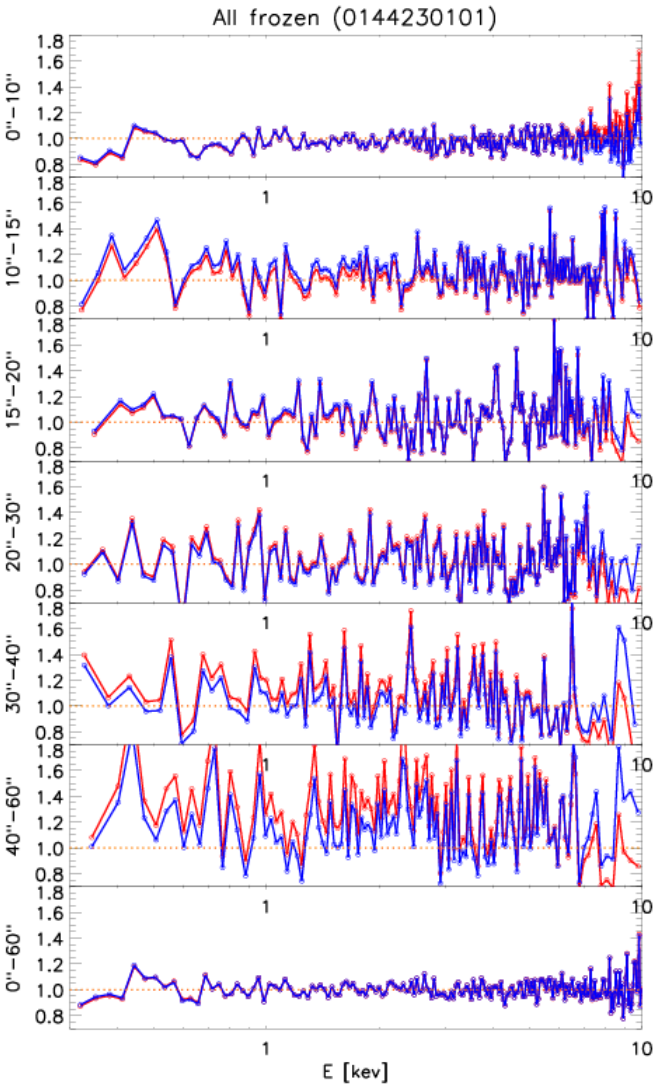
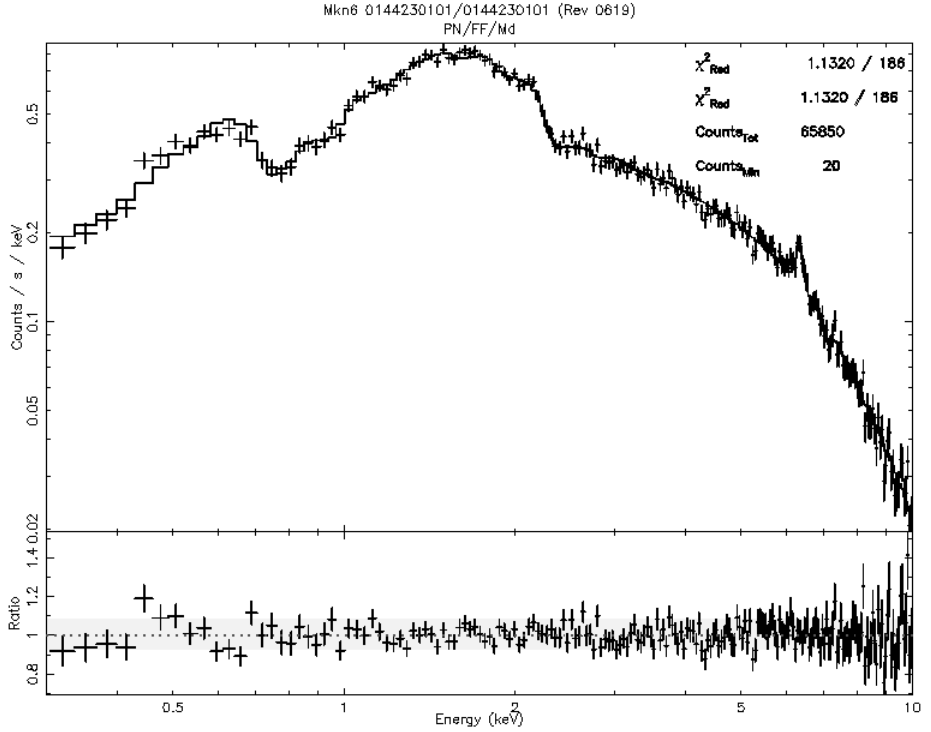
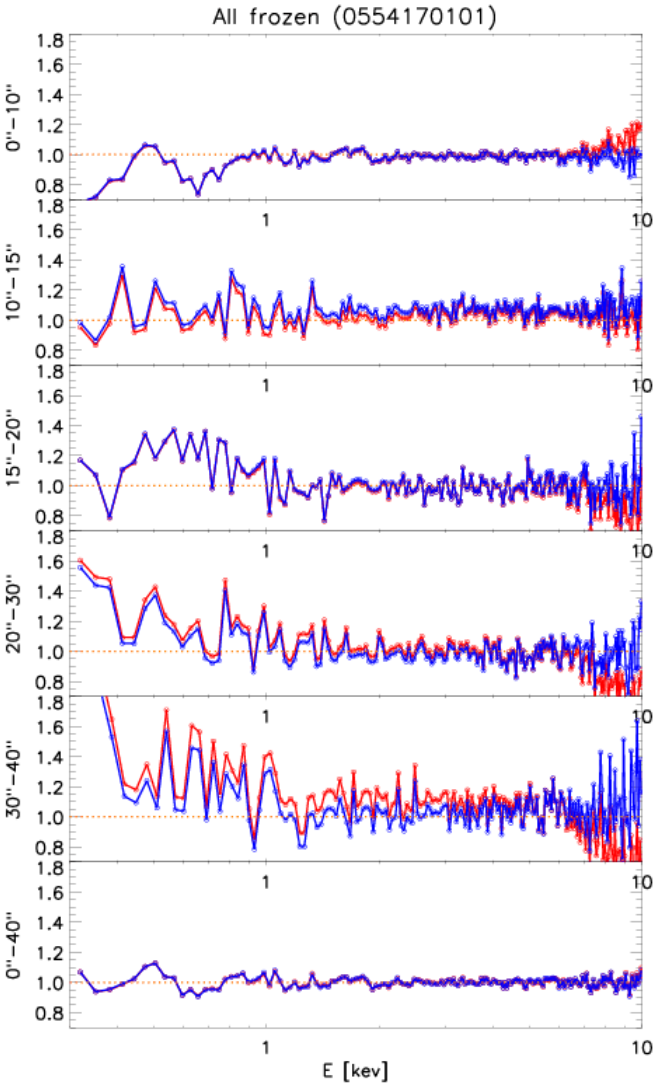
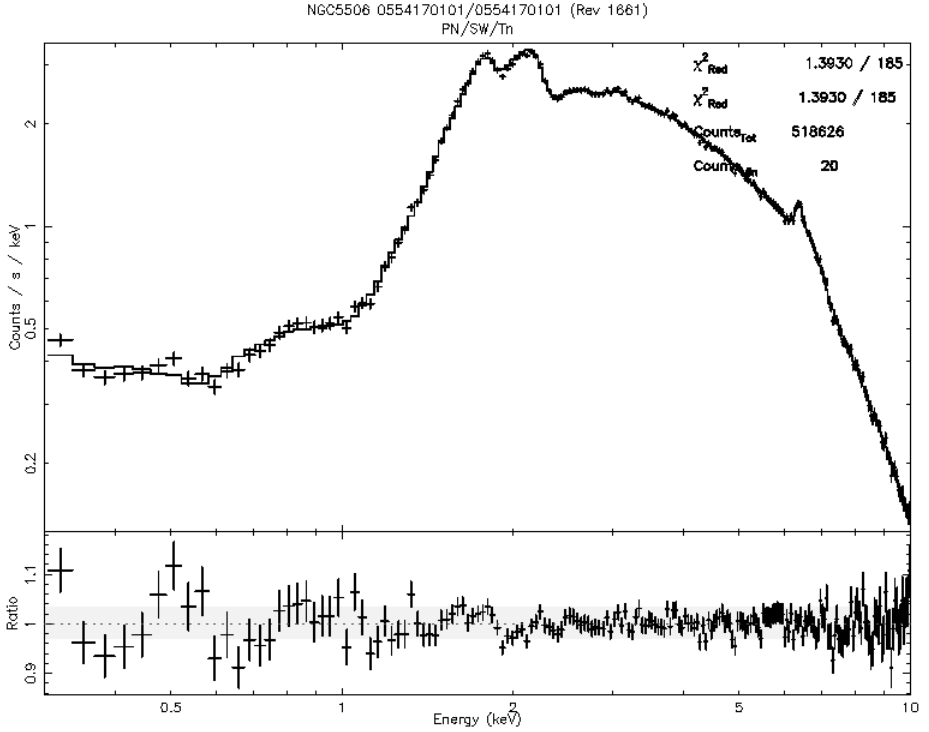


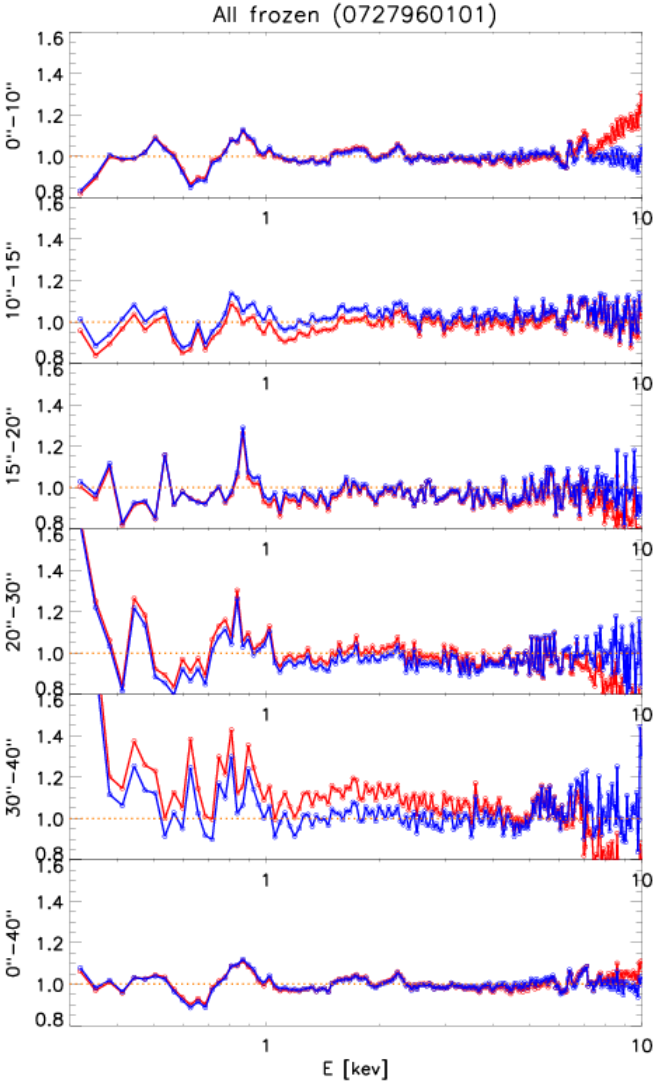


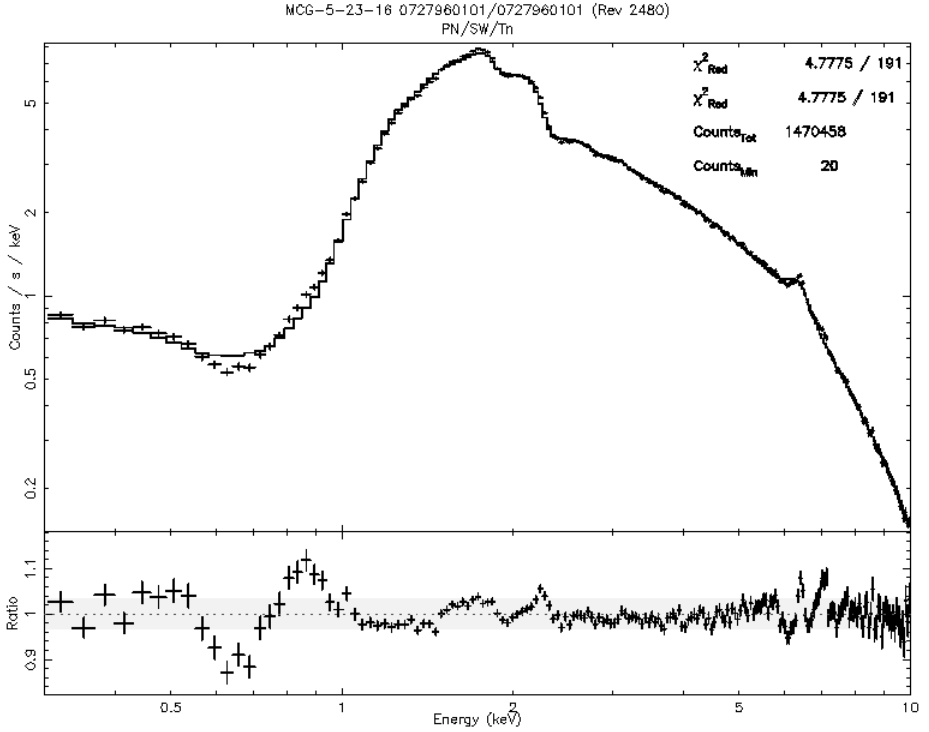
Results: NGC 5506 (PN)



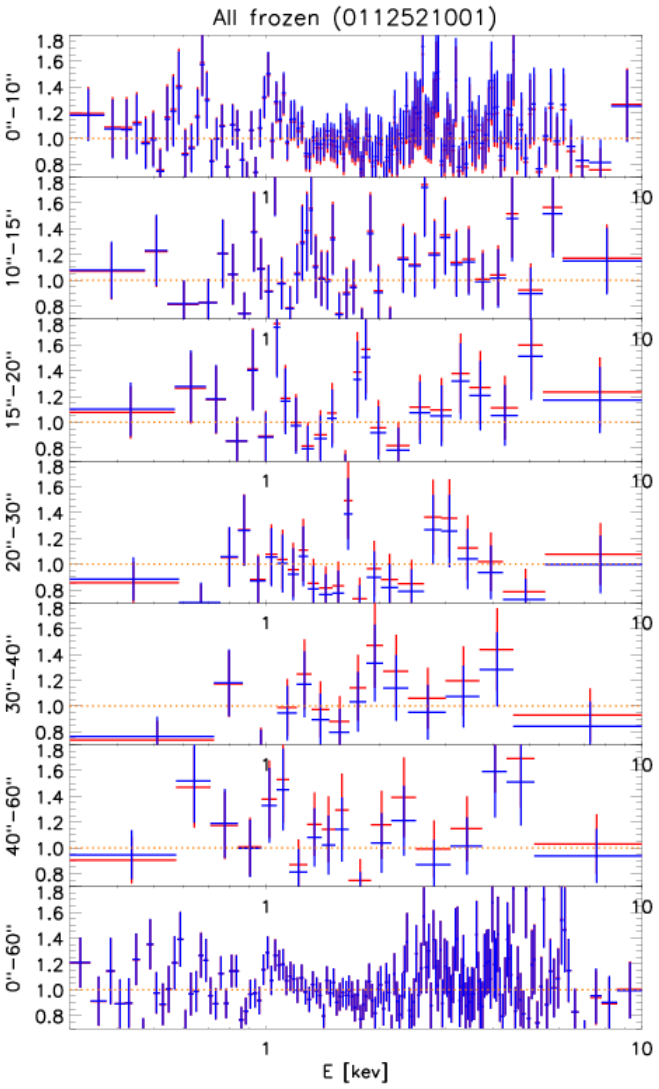


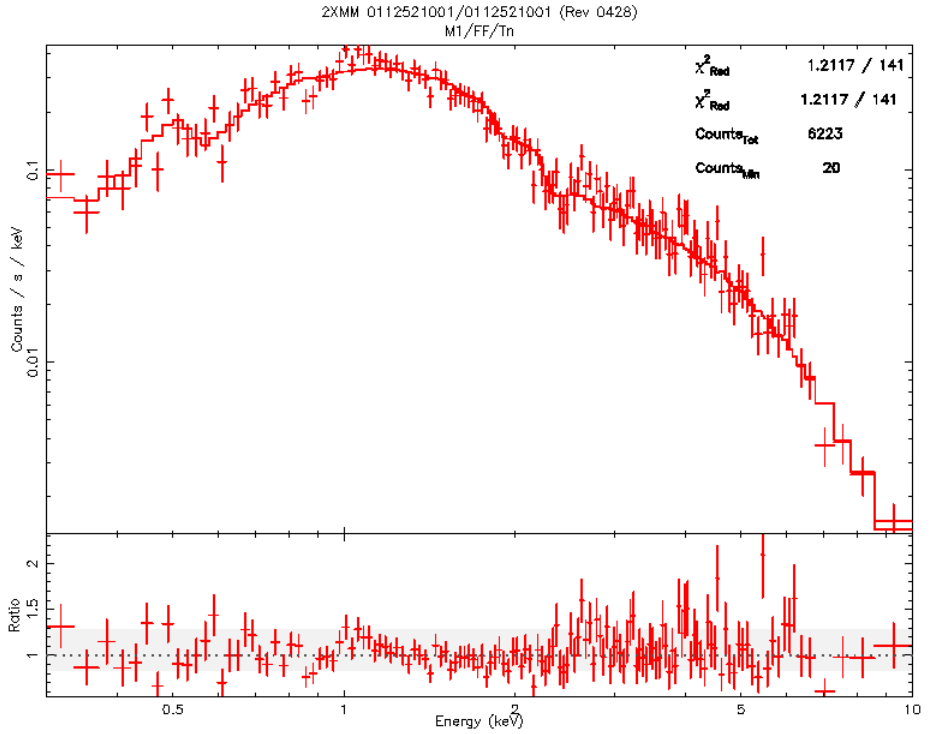
Results: MCG-5-23-18 (PN)



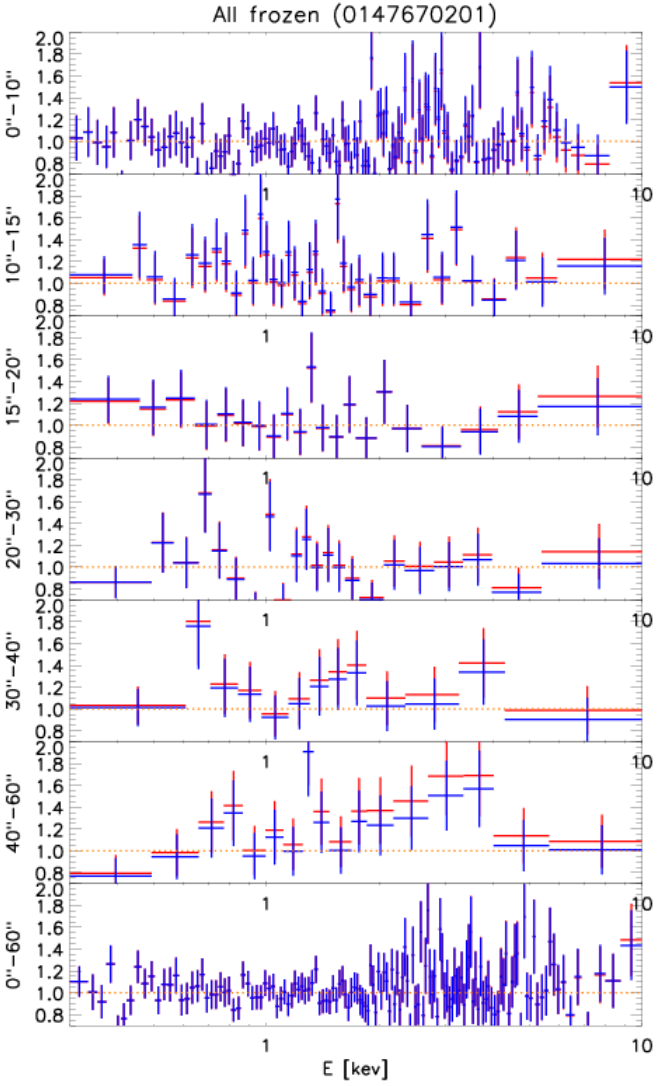


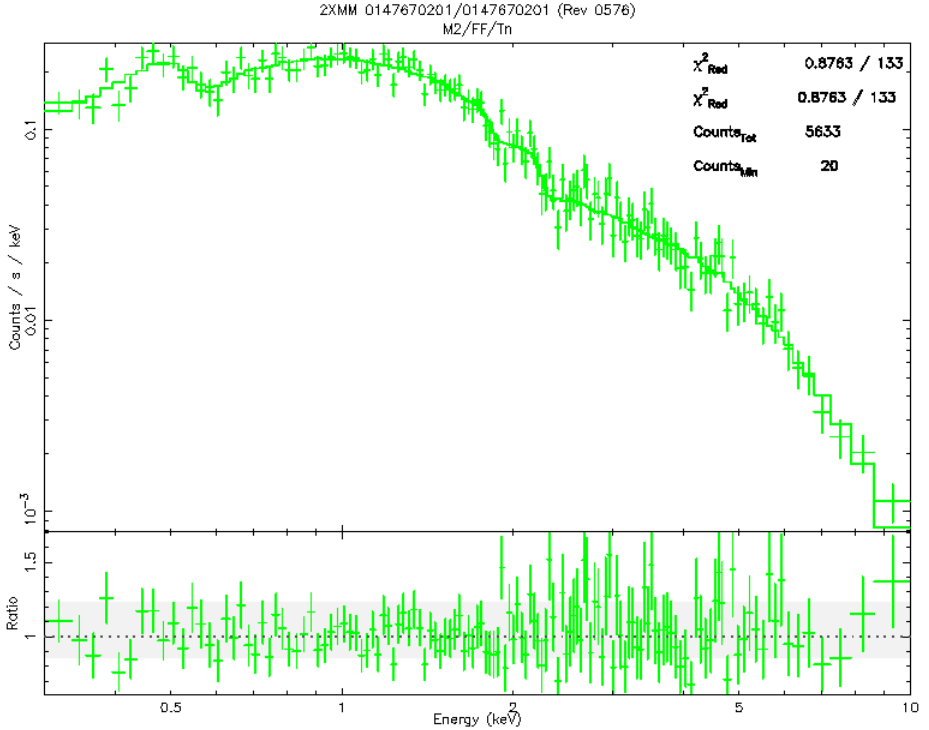
Results: Holmberg IX (MOS1)





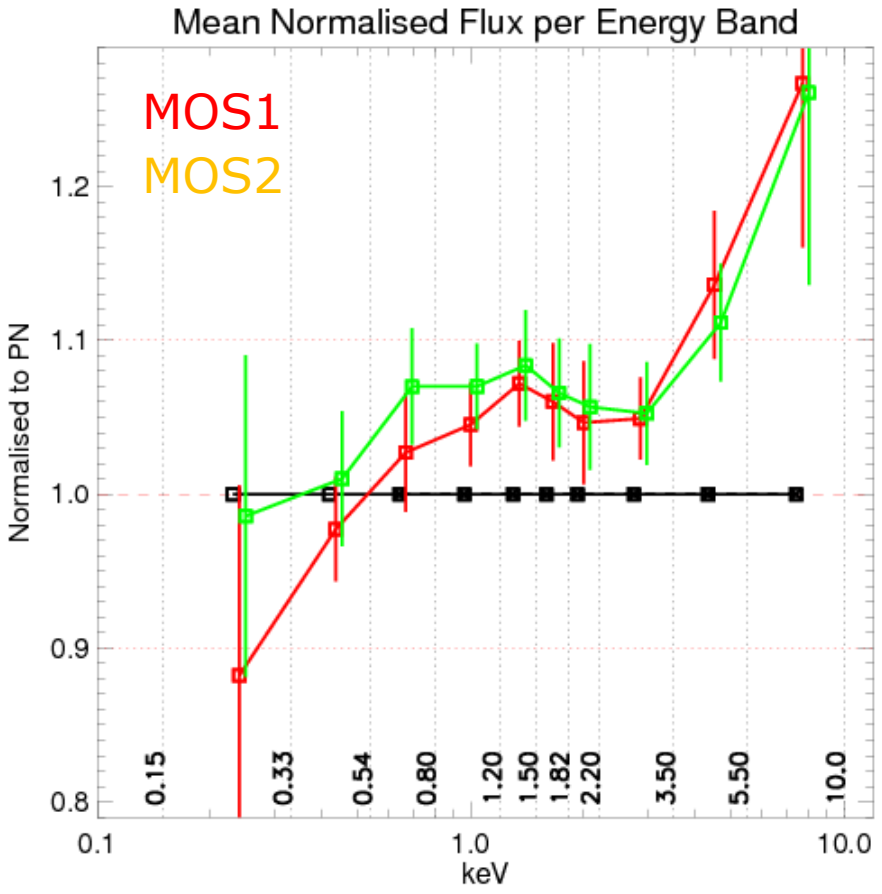
Results: PKS B1334-127 (MOS2)



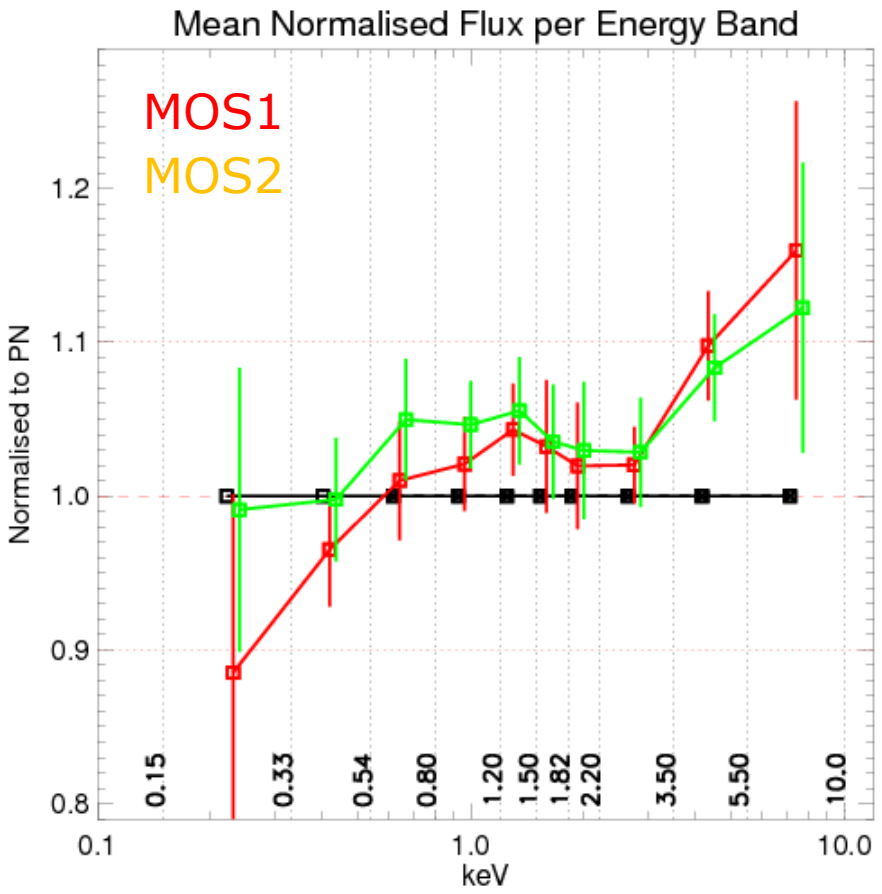


Results: Blazar Sample

Public XRTn CCFs



Candidate XRTn CCFs



Further Validation

Further validation:

- Confirm no drastic change in overall spectra
- Check > 10 keV
- Confirm no impact on source detection

XRT PSF Investigations