The Effective Area of EPIC

A comparison of MOS1, MOS2 and PN derived fluxes of 17 on-axis AGN observed between Revolutions 63 and 683

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The sample: Mixture of BL Lacs and "Soft Excess" AGN

Orbit	Source	MOS Filter	PN Filter	Inner	Mos Outer	PN Outer
63	MS0737.9+7441	Thin	Thin	0	800	550
75	Mkn 205	Medium	Medium	0	800	800
82	MS1229.2+6430	Thin	Thin	0	800	800
94	3C 273	Medium	Medium	150	00	800
95	3C 273	Me dium	Medium	150	00	800
95	3C 273	Medium	Medium	150	00	00
96	3C 273	Medium	Medium	150	00	800
107	Mkn 359	Medium	Medium	0	800	800
161	Mkn 509	Thin	Thin	0	800	800
192	Mkn 335	Medium	Medium	200	800	800
277	3C 273	Medium	Medium	150	800	800
301	MCG-6-30-15	Medium	Medium	0	800	800
451	H1419+480	Thin	Thin	0	800	800
621	MS1229.2+6430	Thin	Thin	0	800	800
655	3C 273	Thin	Thin	150	800	800
679	Ark 120	Thin	Thin	150	700	700
683	H0414+009	Thin	Thin	0	800	800

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Fluxes are derived in 4 energy bands
0.54-0.85 keV, 0.85-1.5 keV, 1.5-4.0 keV, 4.0-10 keV

Methodology: Fit tbabs*po model (nH fixed at global value) in each band to each camera separately and derive absorbed flux.

Pattern 0-12 (MOS) and Pattern 0-4 (PN)
SAS 6.5.0 with current public CCFs

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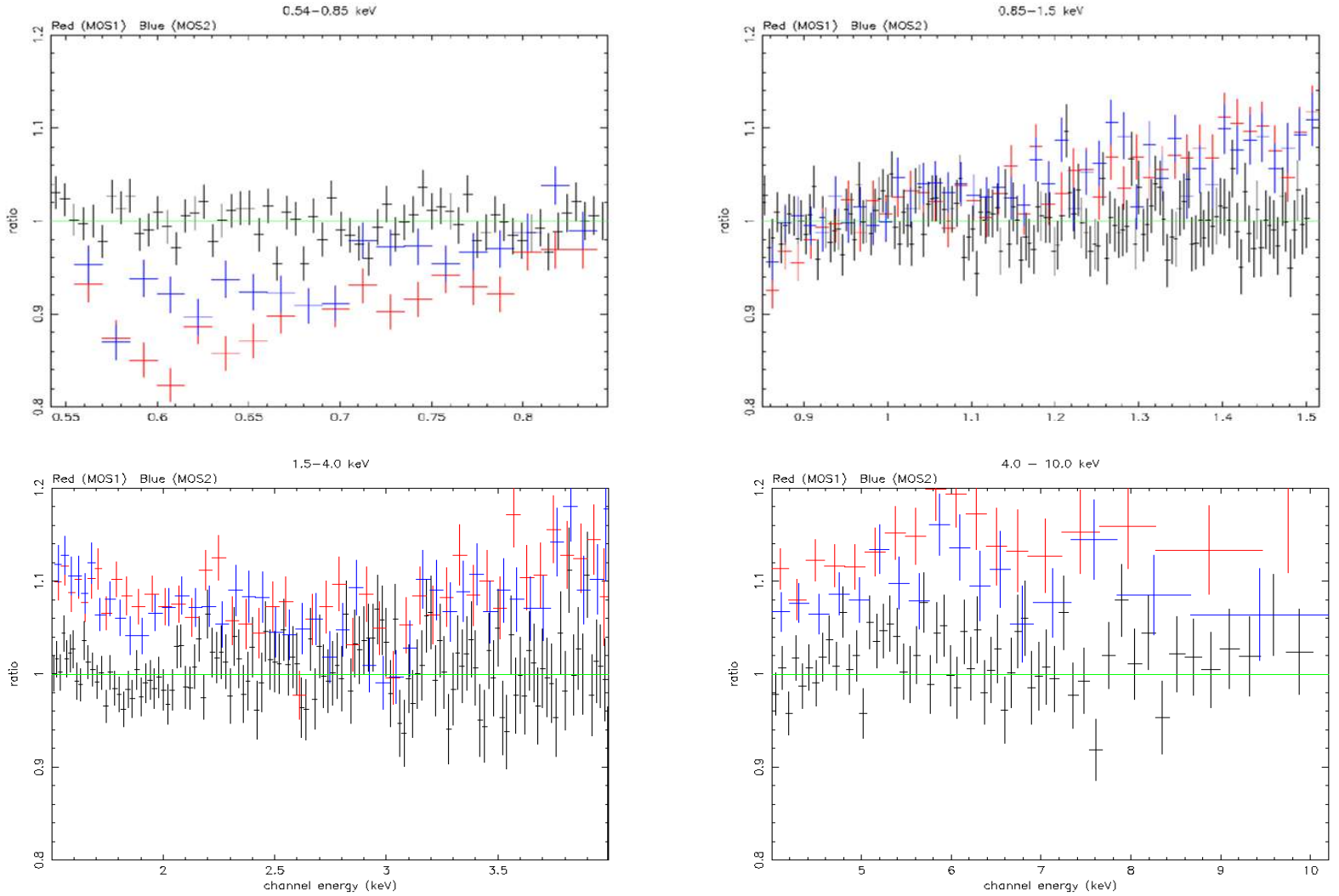
Example (3C 273) fits to PN, Model folded though MOS



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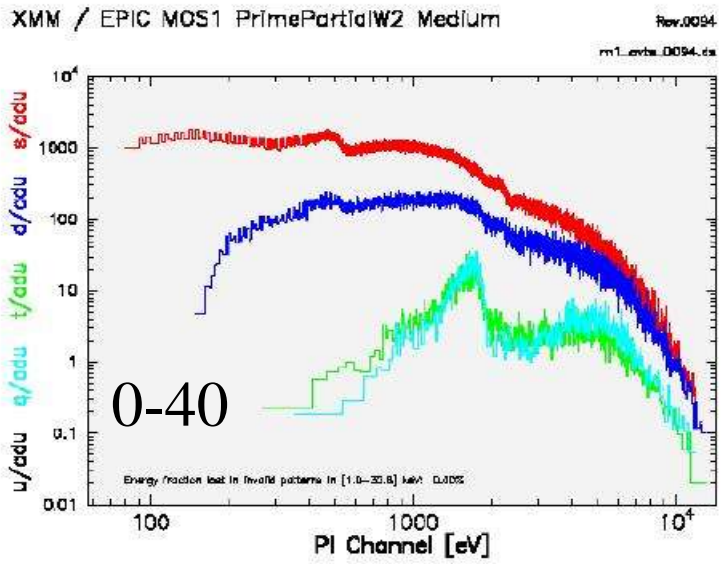
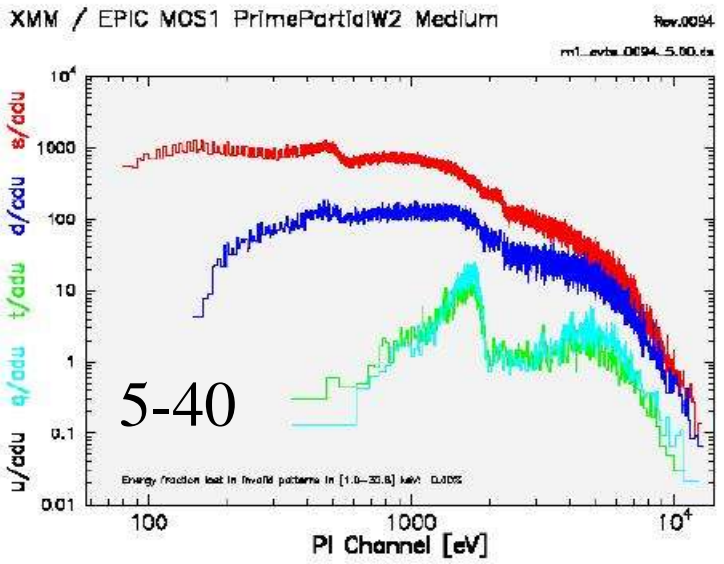
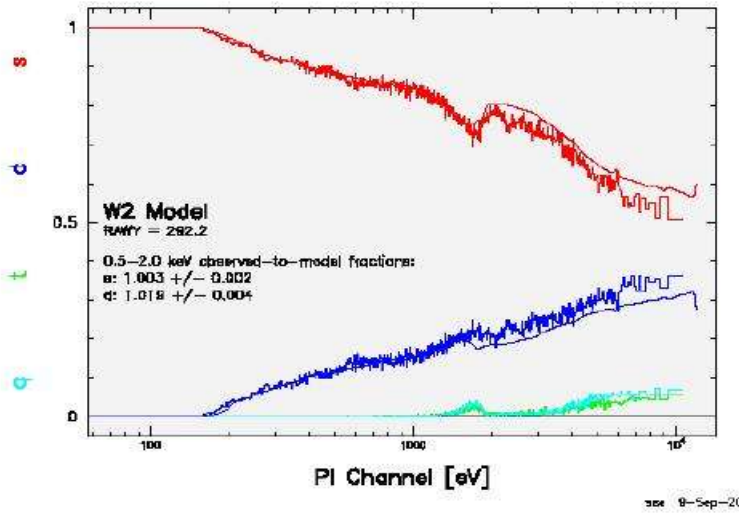
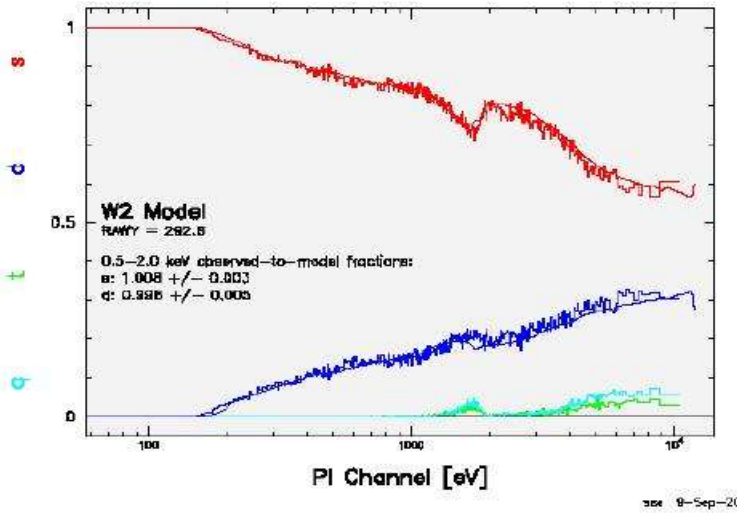
Checking for pile-up in 3C 273









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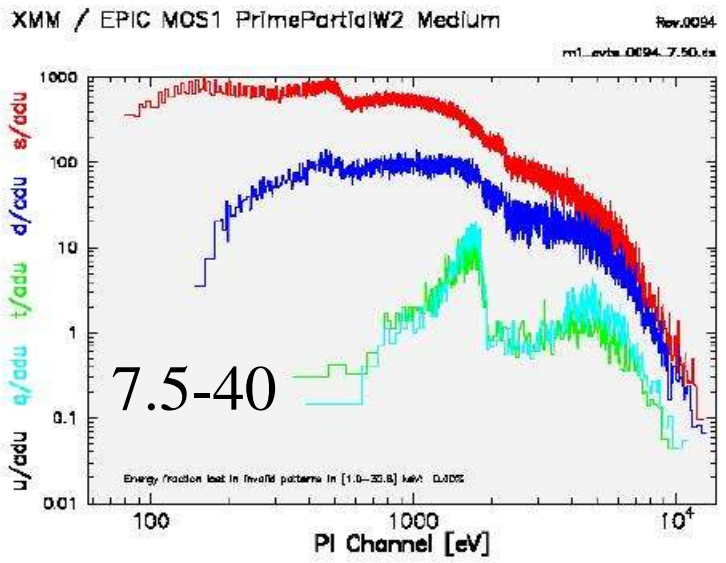

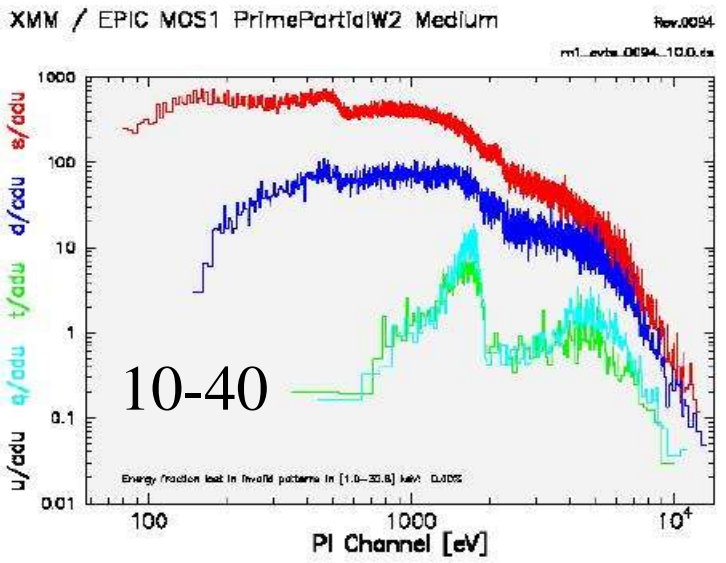

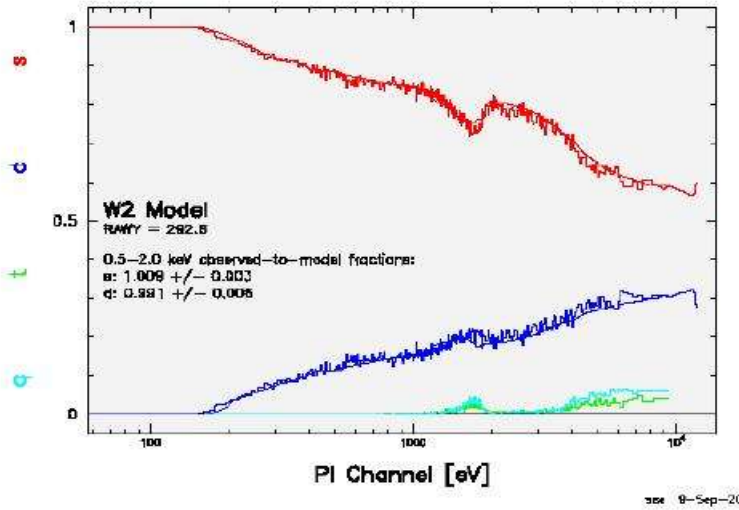

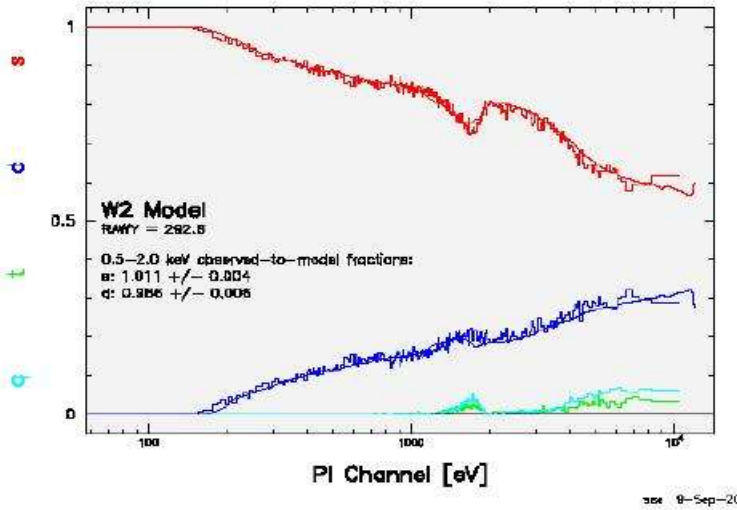

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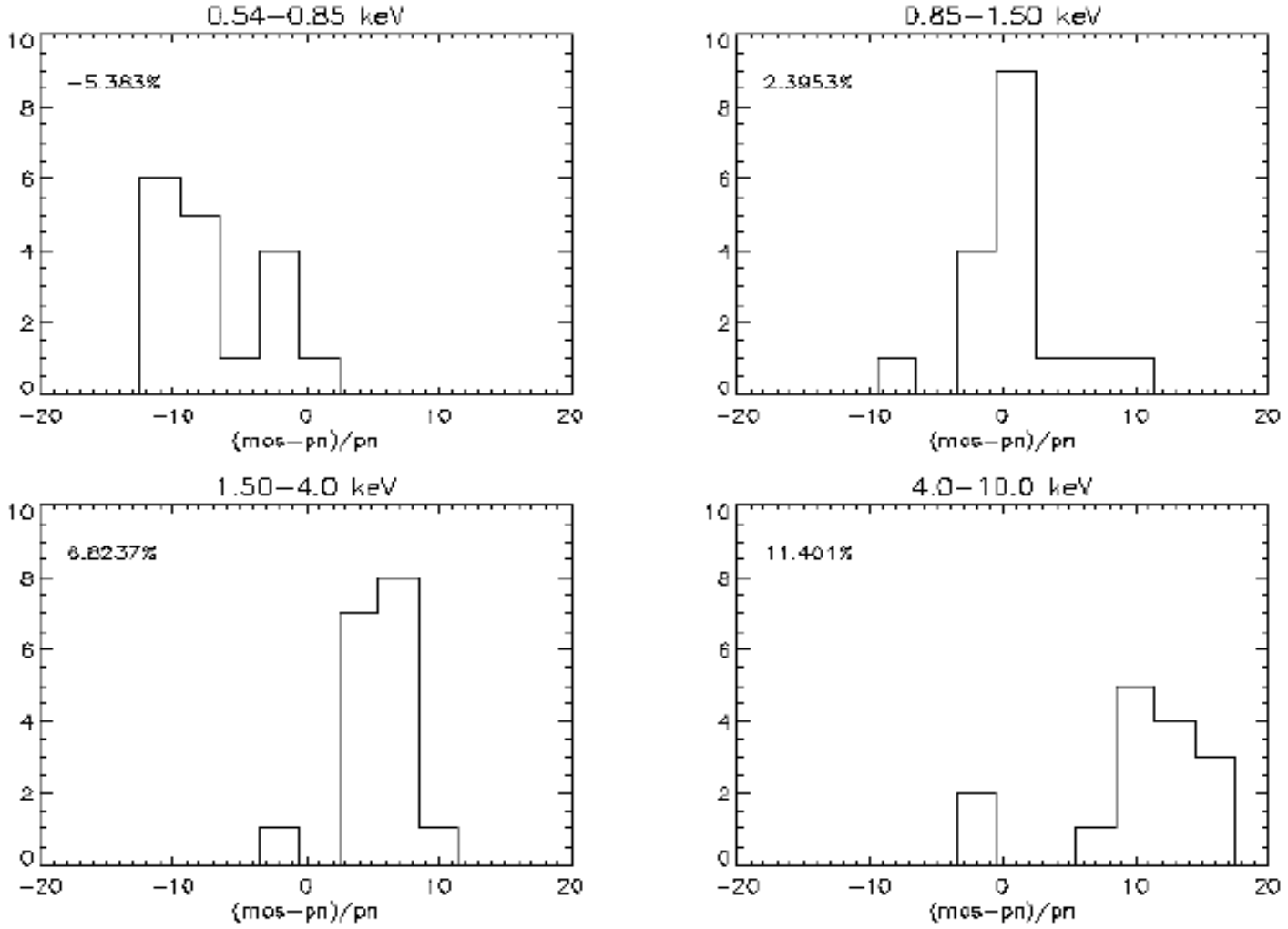
100*(MOS1-PN)/PN



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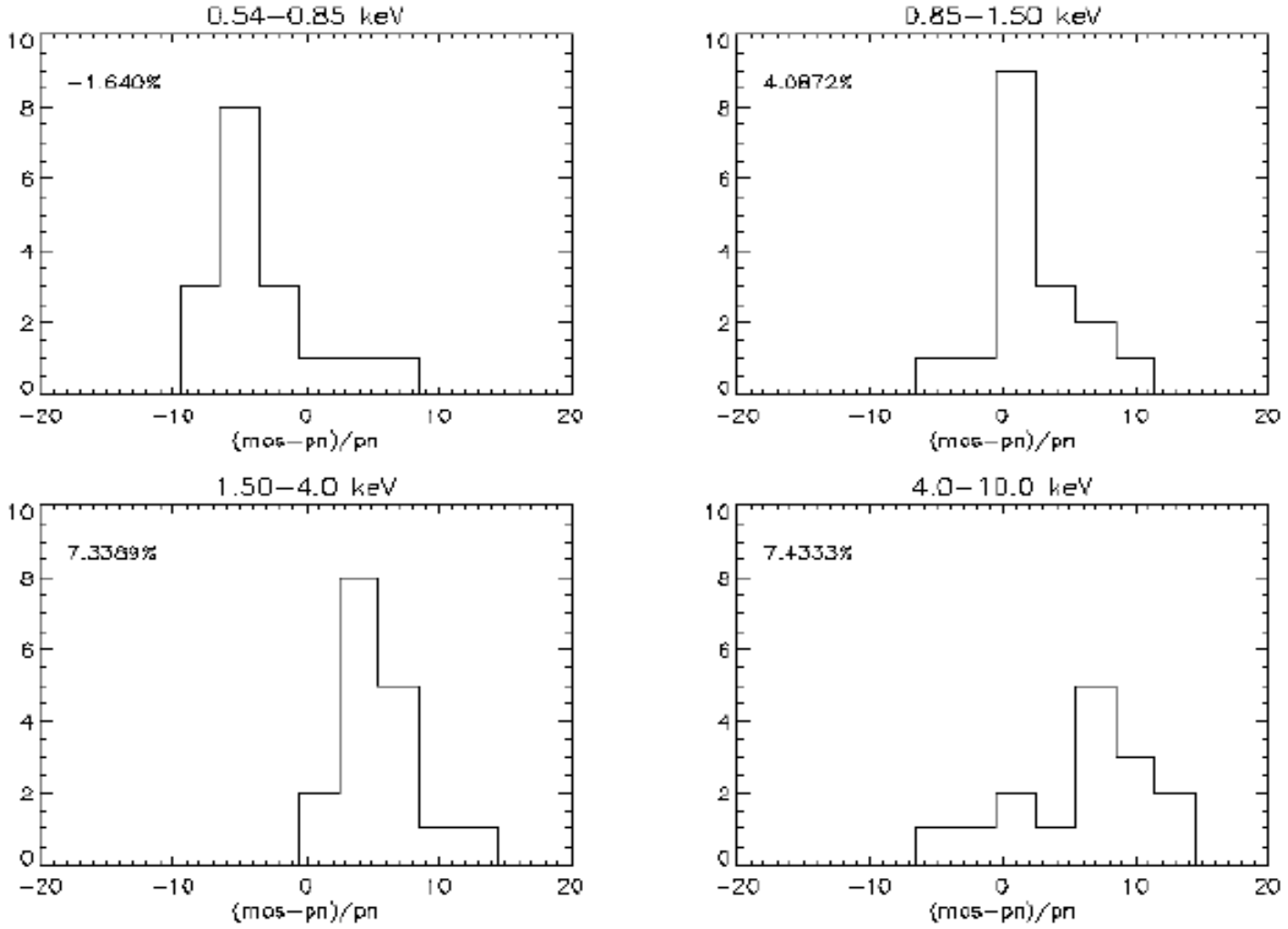
100*(MOS2-PN)/PN



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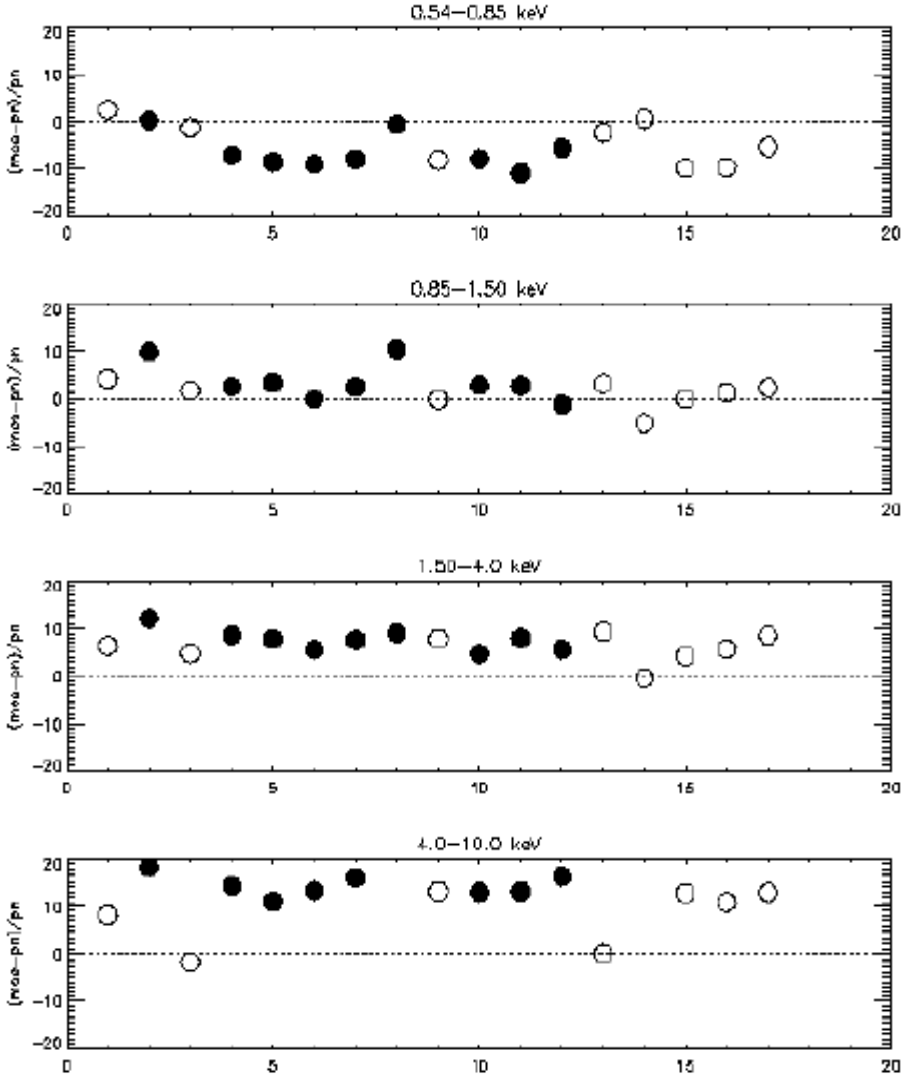
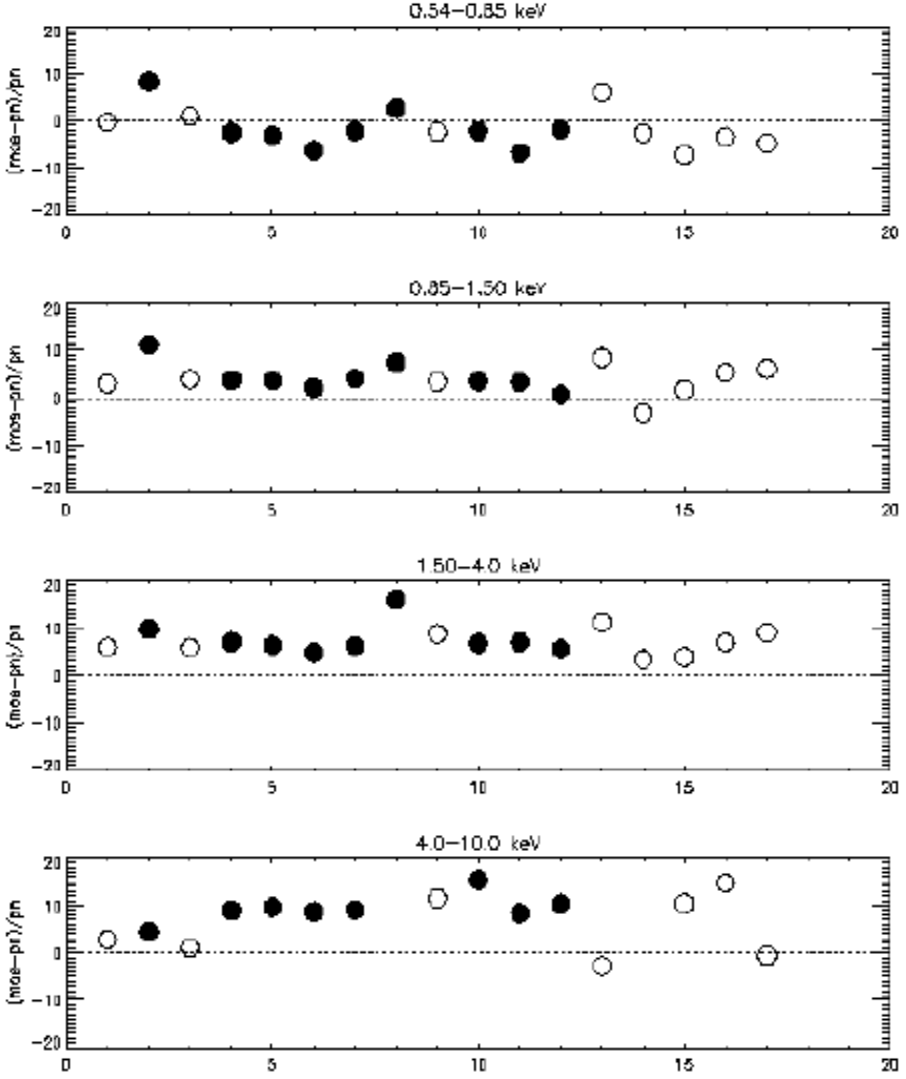
Band (keV)	(MOS1-PN)/PN	(MOS2-PN)/PN
0.54-0.85	-5.4%	-1.6%
0.85-1.50	+2.4%	+4.1%
1.50-4.0	+6.8%	+7.3%
4.0-10.0	+11.4%	+7.4%

Thin
Medium

(MOS1-PN)/PN



(MOS2-PN)/PN



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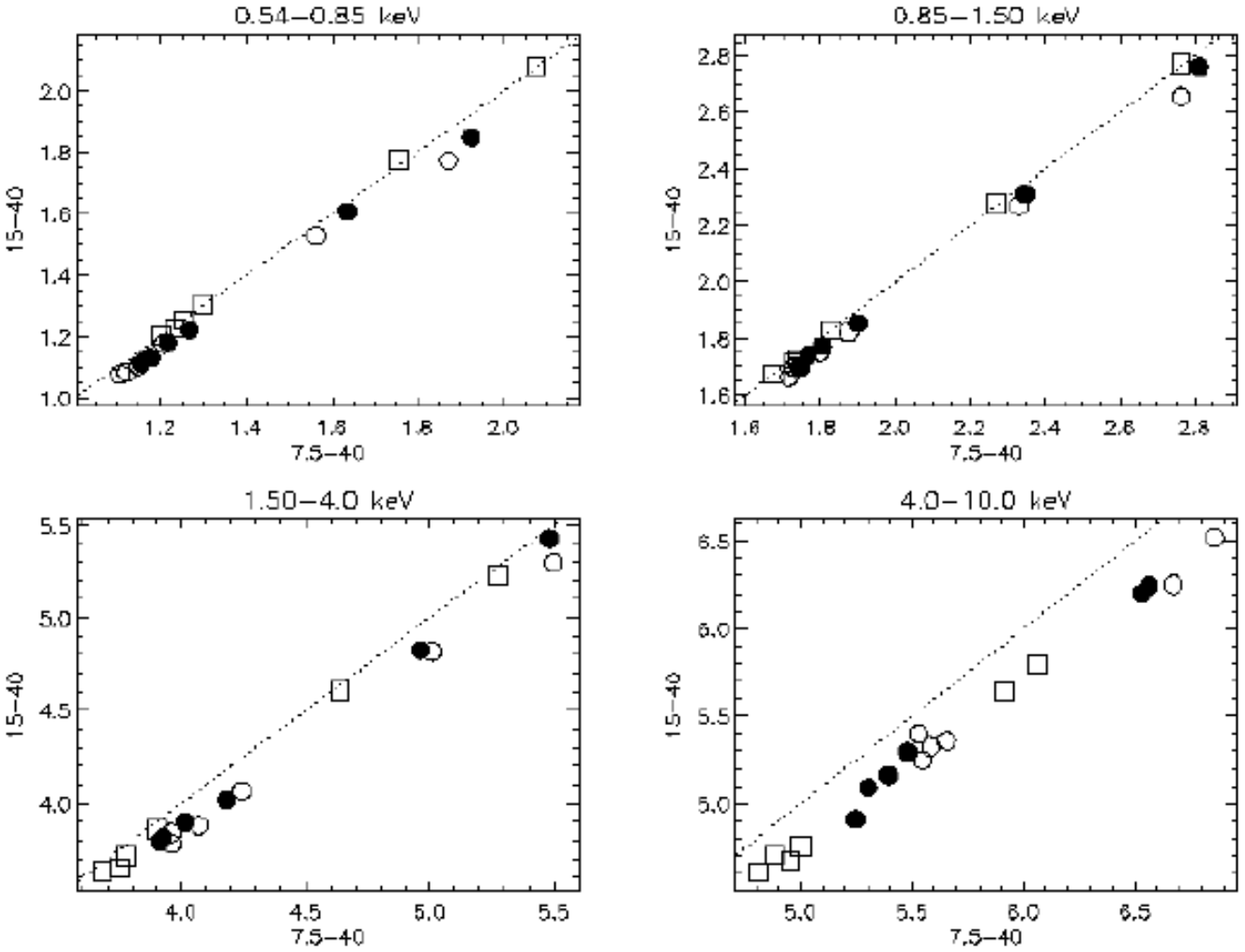
Problem with the psf? – See talk by Andy later

3c 273: Flux Comparison, 7.5”-40” v 15”-40” extraction radii

pn

MOS1

MOS2



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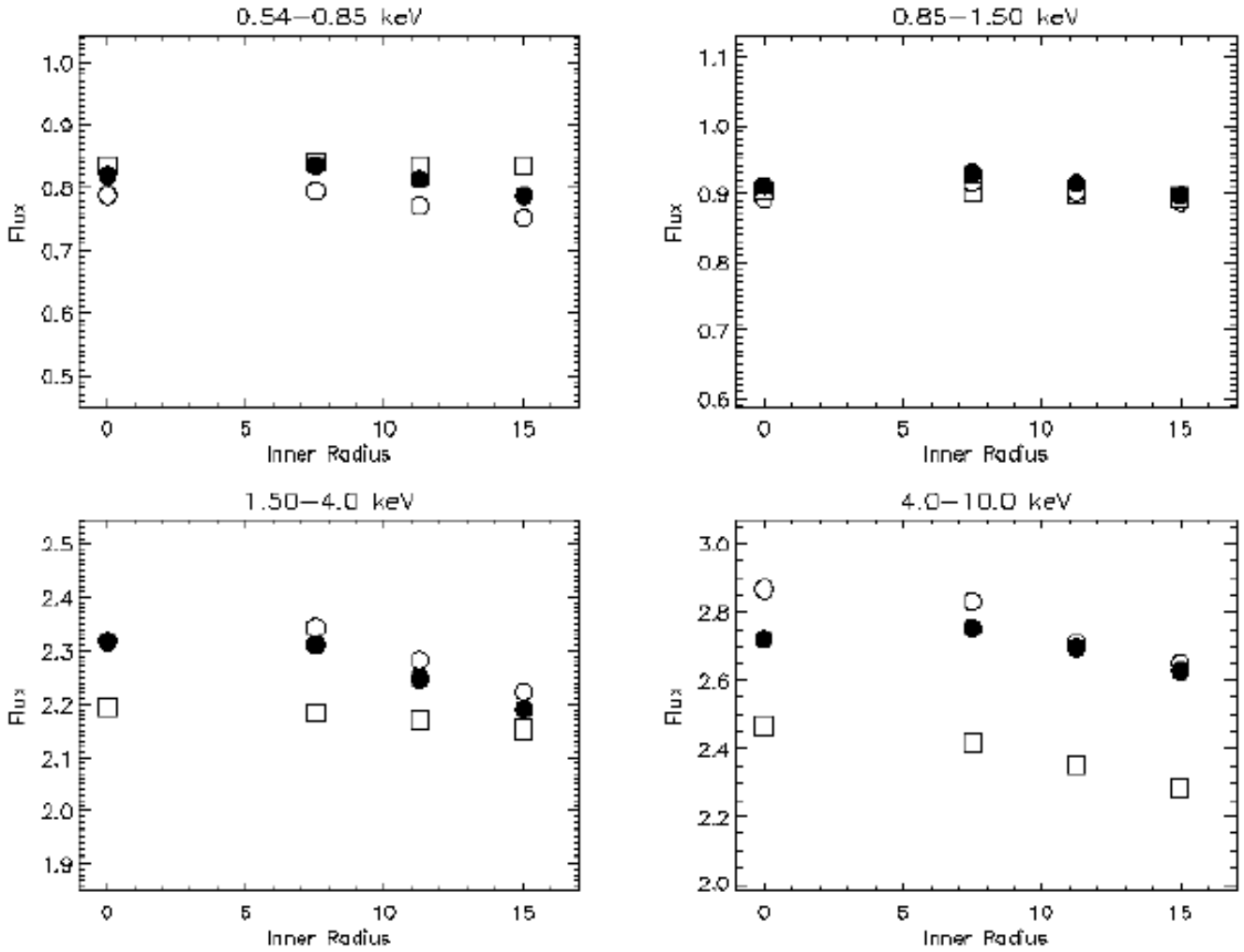
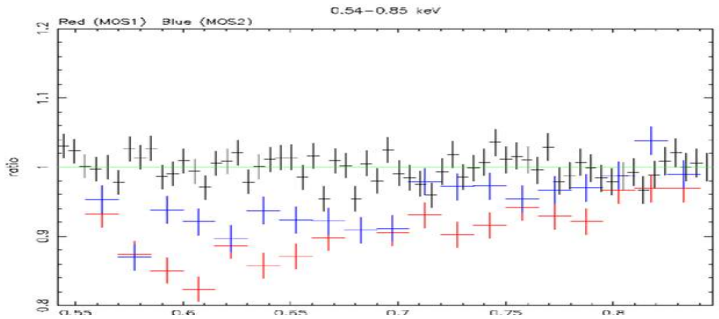
MCG-6-30-15: 0”, 7.5”, 11.25”, 15” inner extraction radii, 40” outer

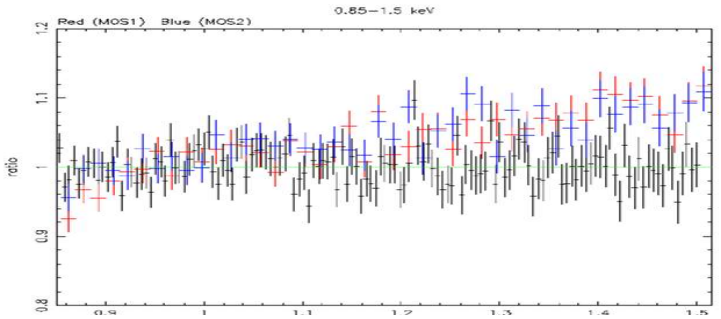
pn

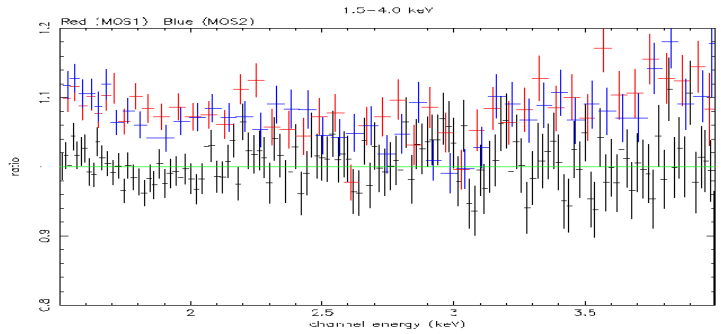
MOS1

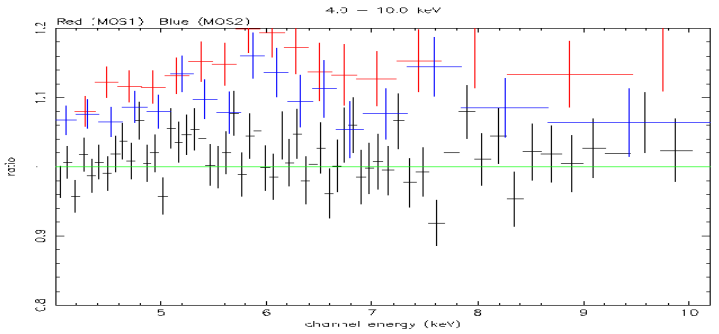
MOS2











Band (keV)	(MOS1-PN)/PN	(MOS2-PN)/PN
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4.0-10.0	+11.4%	+7.4%

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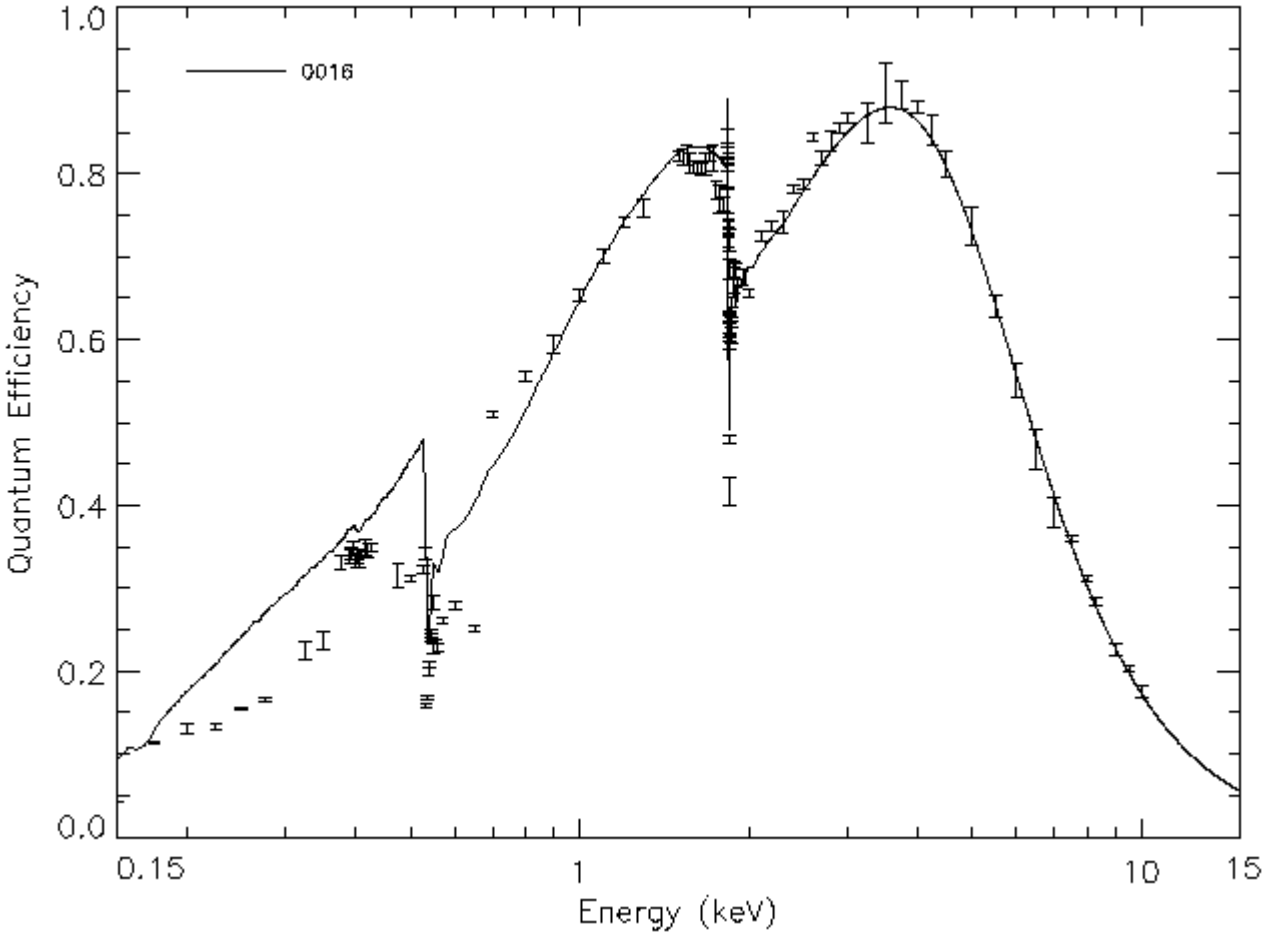
Quantum Efficiency measurements from Orsay

MOS1 – Central CCD



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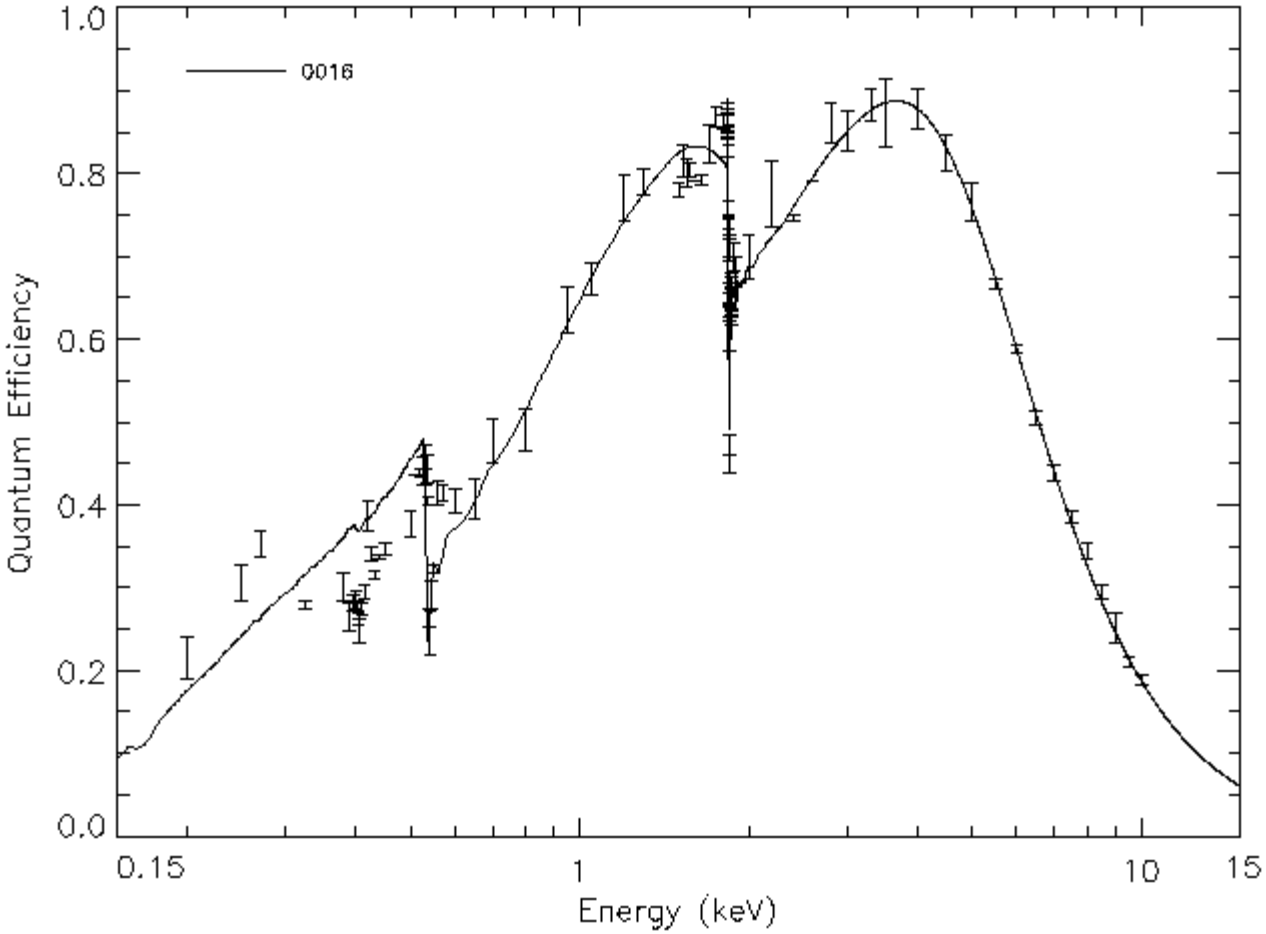
Quantum Efficiency measurements from Orsay

MOS2 – Central CCD



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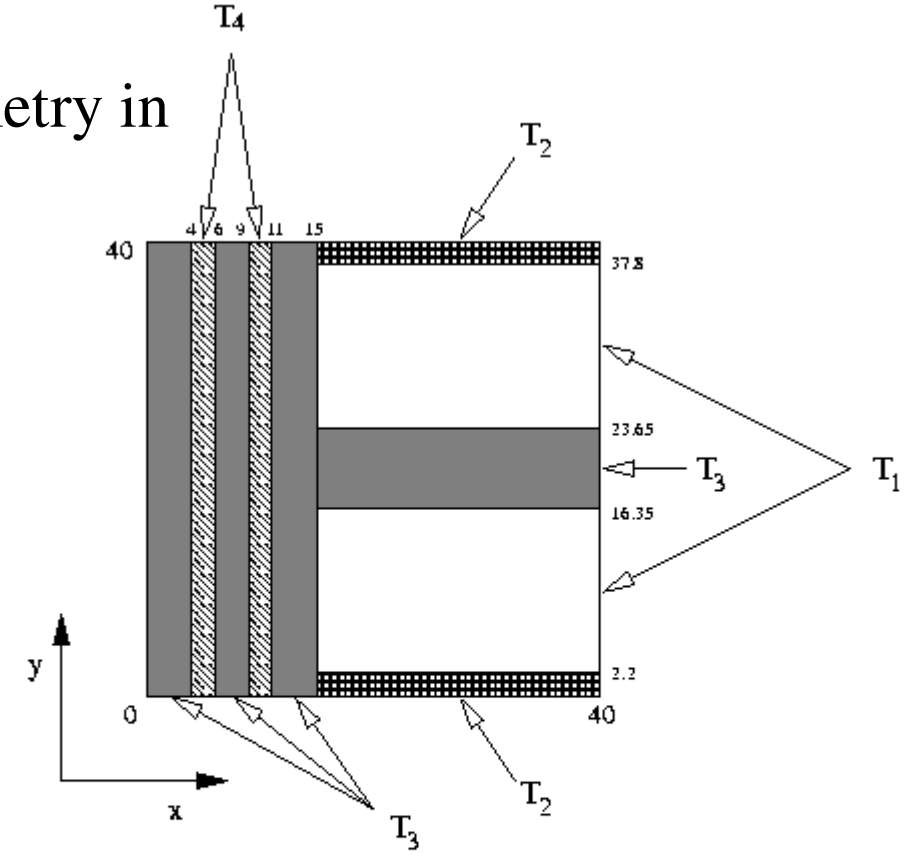
Surface Pixel Geometry in Monte Carlo model



Transmission functions for the various regions (dimensions in microns):

$$
\begin{aligned}
T_1 &= \exp(-0.1\,\mu_{SiO_2}) \\
T_2 &= T_1 \exp(-0.1\,\mu_{Si_3N_4}) \exp(-0.4\,\mu_{SiO_2}) \\
T_3 &= T_2 \exp(-0.25\,\mu_{Si}) \exp(-0.3\,\mu_{SiO_2}) \\
T_4 &= T_3 \exp(-0.25\,\mu_{Si}) \exp(-0.4\,\mu_{SiO_2})
\end{aligned}
$$

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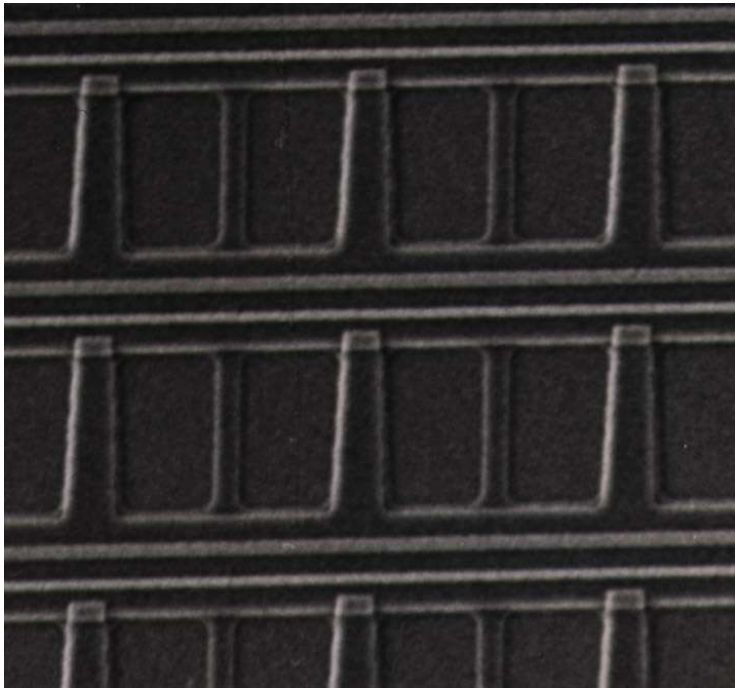
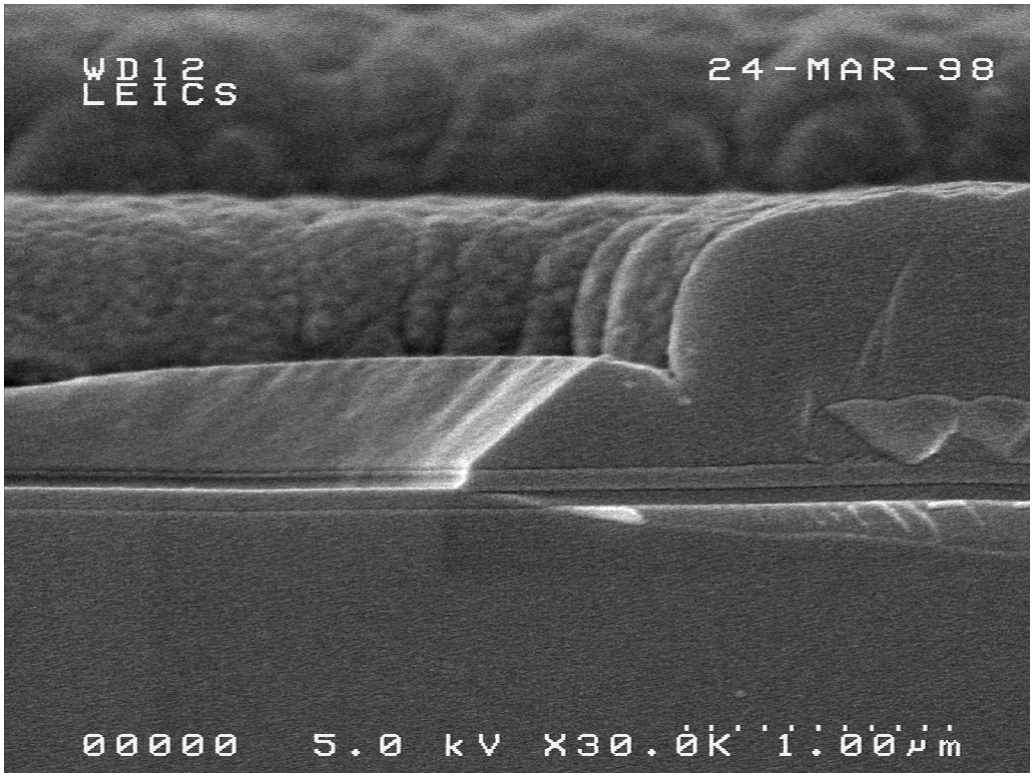
SEM Pictures



Top View

Side View



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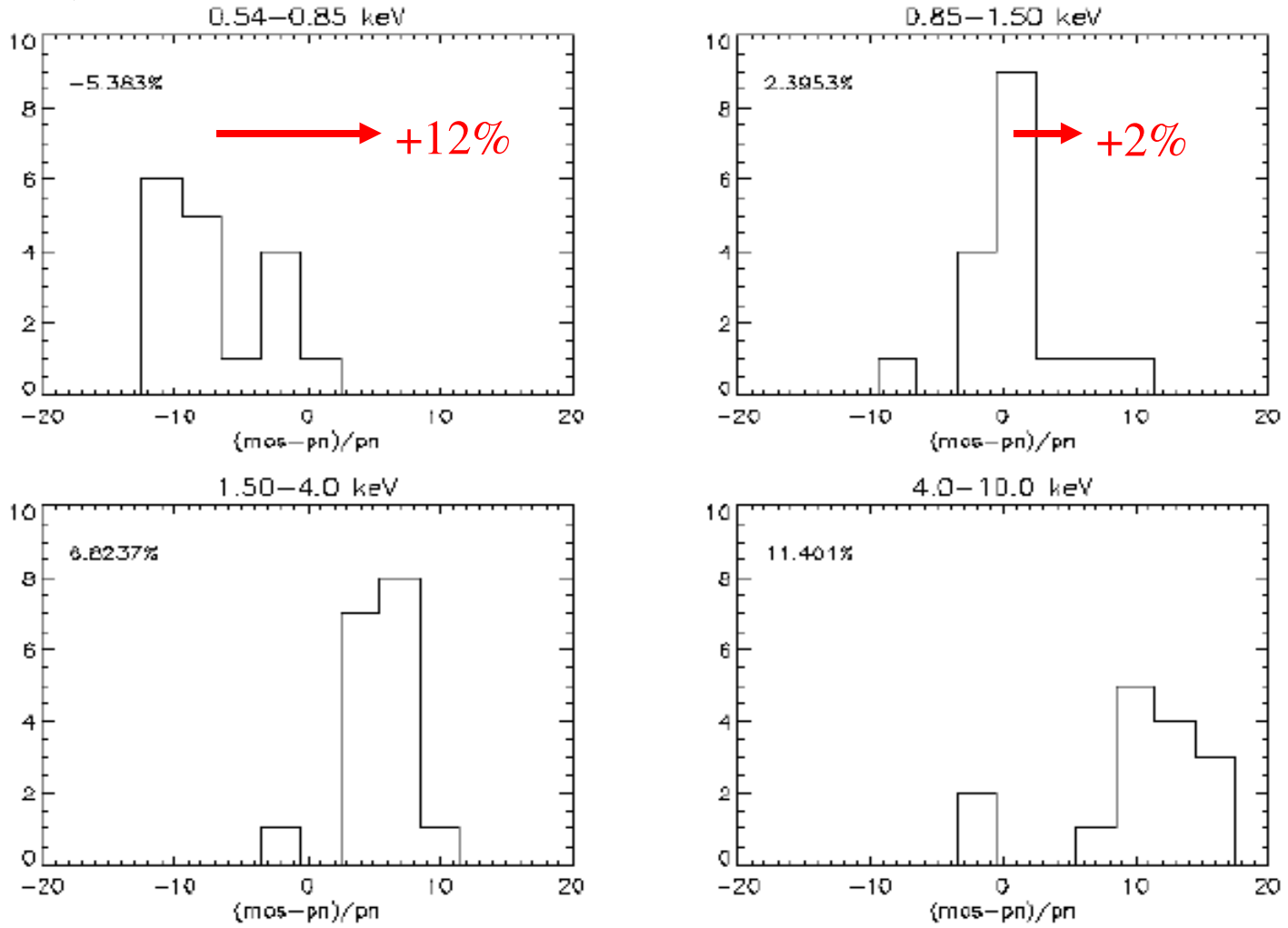
(MOS1-PN)/PN



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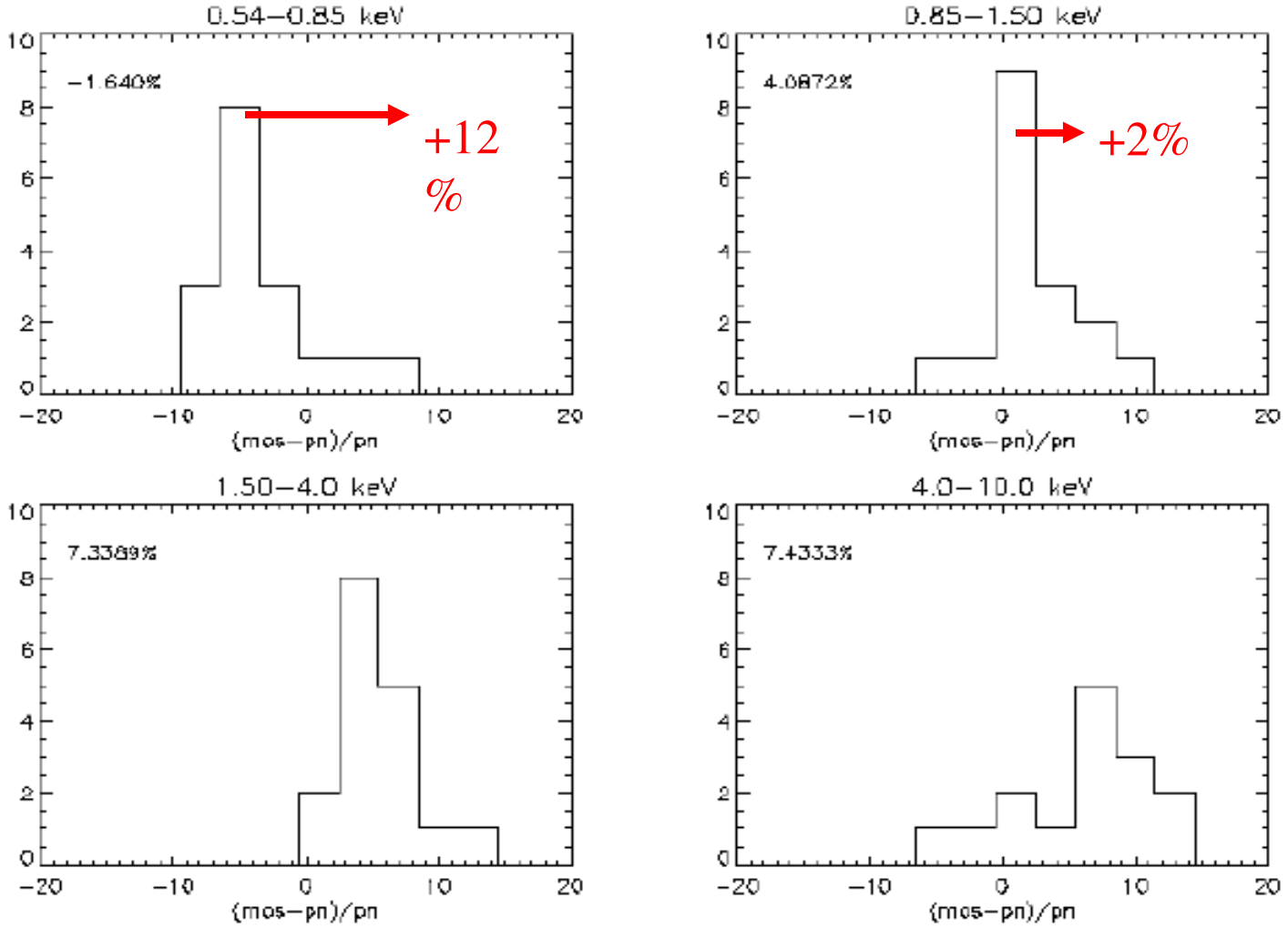
(MOS2-PN)/PN



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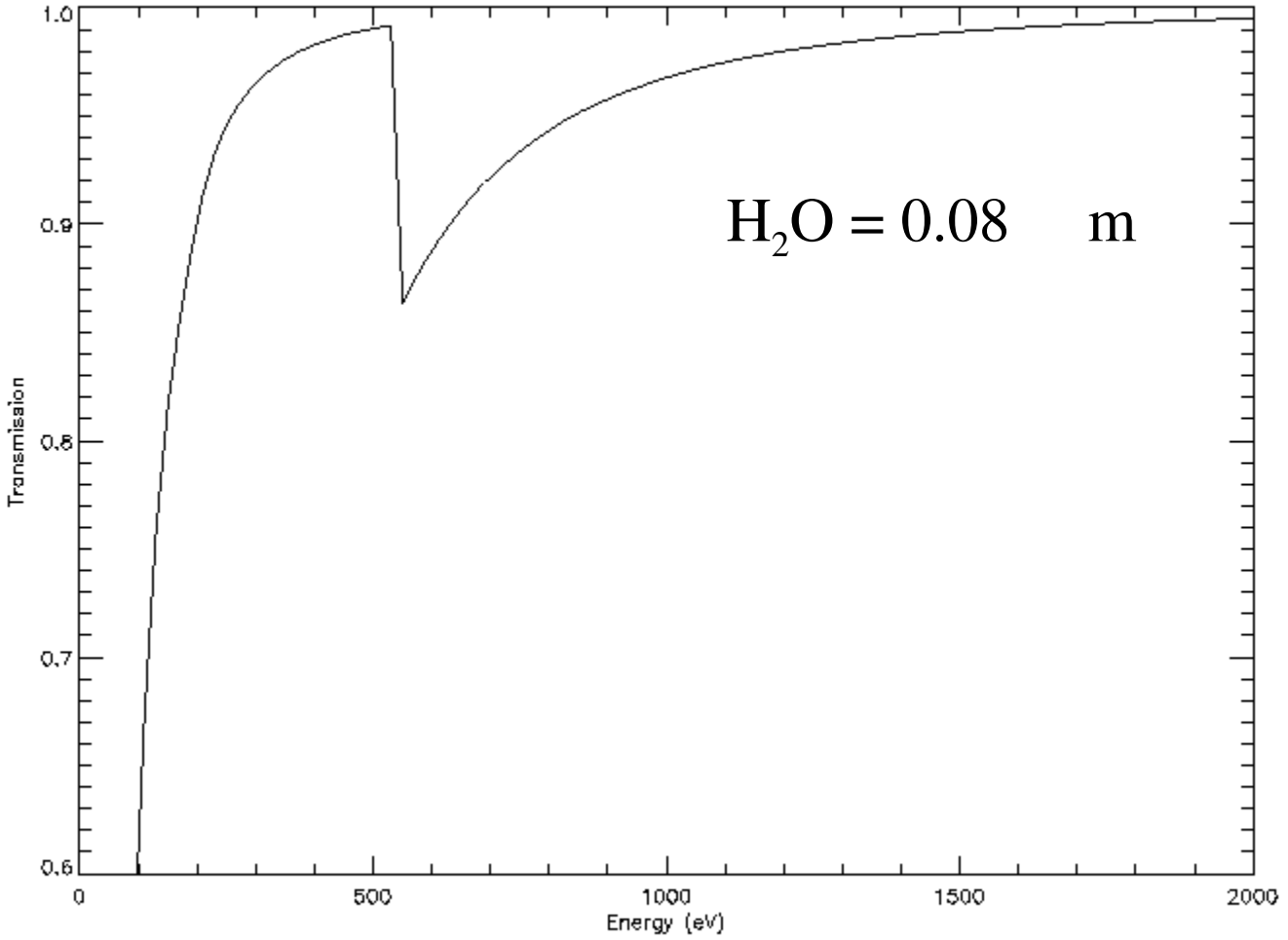

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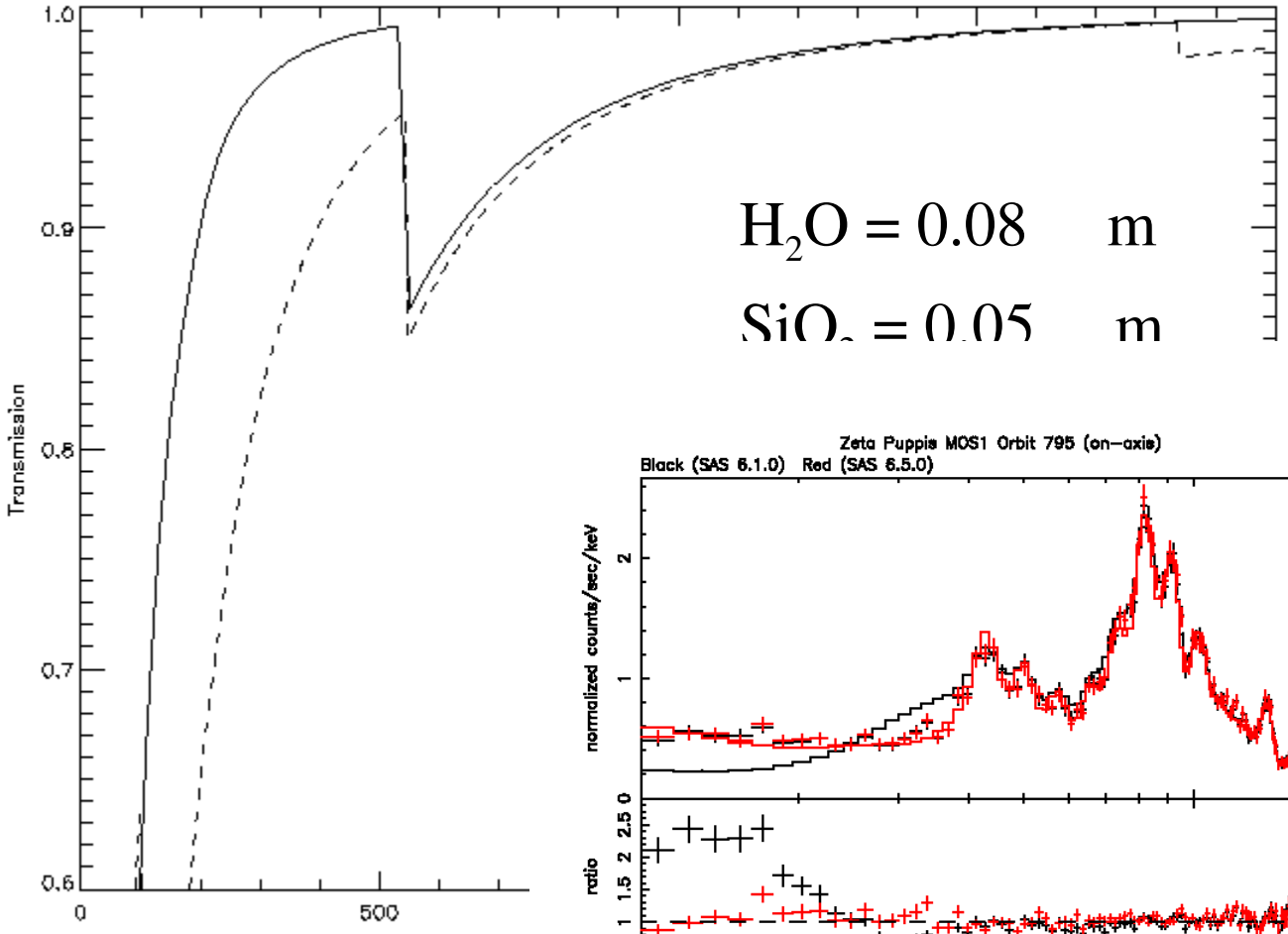

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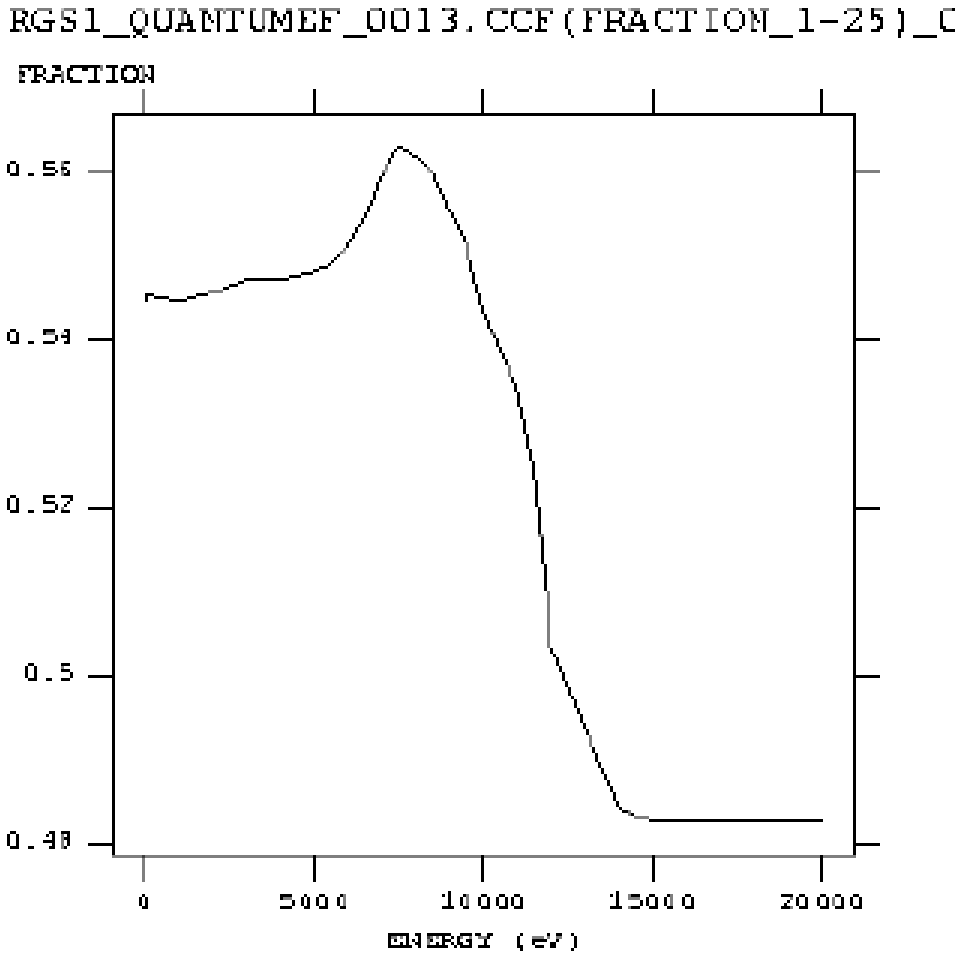

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Summary:

Shape of the MOS/PN discrepancy suggests problem lies with the quantum efficiency

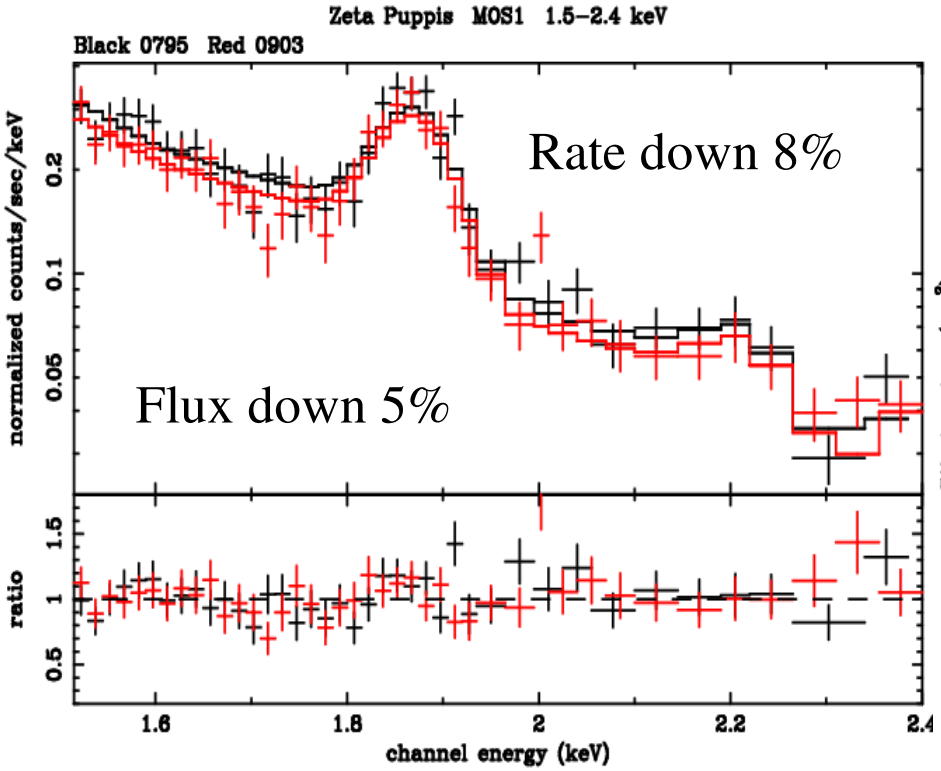
Adjustment of the MOS QE would be consistent with Orsay measurements and probable uncertainties in model

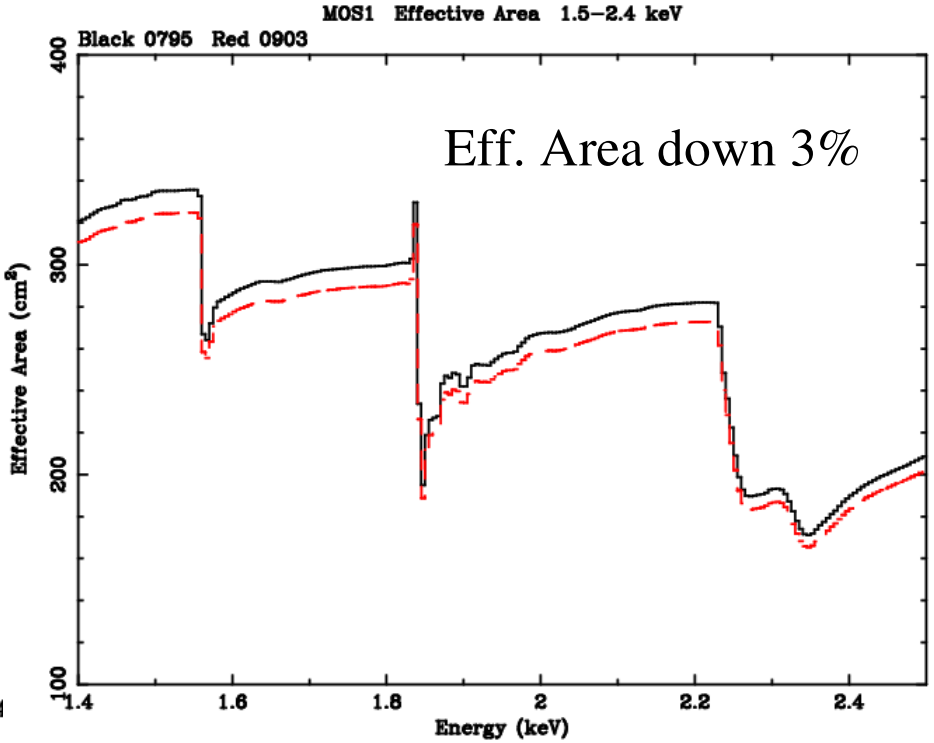
Adjusting the QE would leave a residual normalisation offset of about 5-7% between MOS and PN

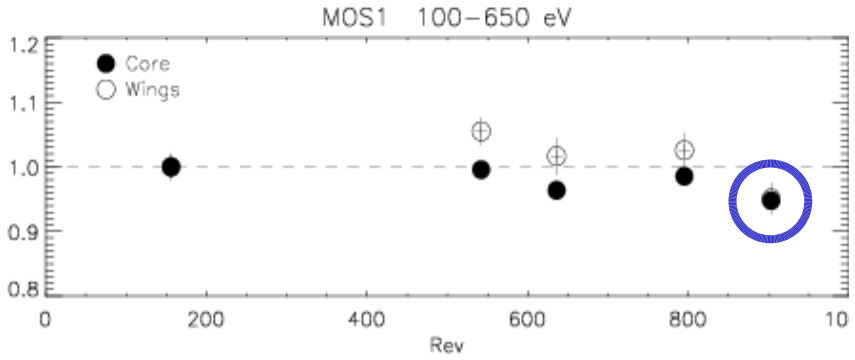
Would need to increase MOS global effective area or decrease PN global effective area to achieve absolute consistency

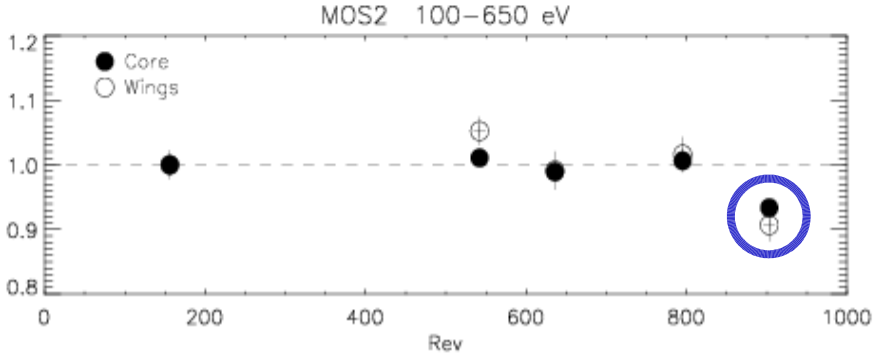
MOS low energy rmf would need re-calibration for consistency with any change in the QE

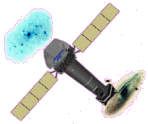
Comparison of high energy portion of the spectra from 795 and 903











XMM
EPIC
MOS

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