Cross-calibration of the EPIC MOS and PN cameras on-board XMM-Newton using narrow spectral emission features

F. Haberl, P. Bennie, U. Briel, K. Dennerl, Ph. Ferrando, M. Freyberg, G. Griffith, J.-W. van den Herder, D. Lumb, S. Molendi, R. Saxton, S. Sembay, S. Zavlin

Supernova remnants in the Magellanic Clouds

- ***N132D in the LMC***
- ***1E0102-72.3 in the SMC***

Coronal emission from stars

- ***YY Gem***

Frank Haberl

fwh@mpe.mpg.de

Noordwijk, 26-30 November 2001

Data products

Event files:

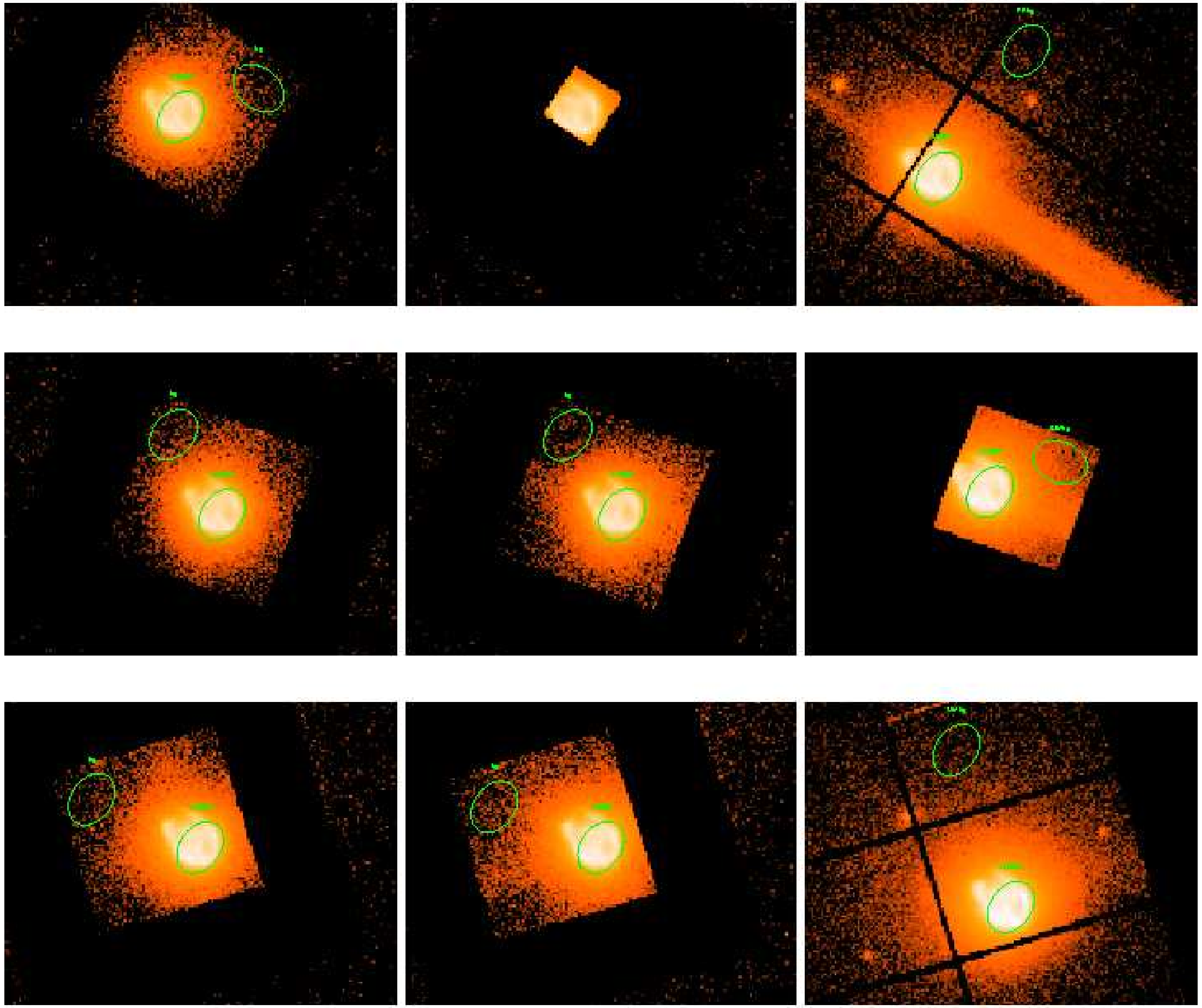
- ***MOS: SAS 5.2***
- ***PN: SAS 5.2 for FF,***
  developer version for SW (20011106_0515)
- ***YY Gem: SAS 5.0***

Response files from hardware groups:

- ***m<1/2><filter>v9q20t5r6_all_15.rsp***
- ***epn_<ff/sw/lw>20_<s/d>Y9_<filter>.rsp version 6.1***

N132D -- EPIC observations

MOS1 **MOS2** **PN**



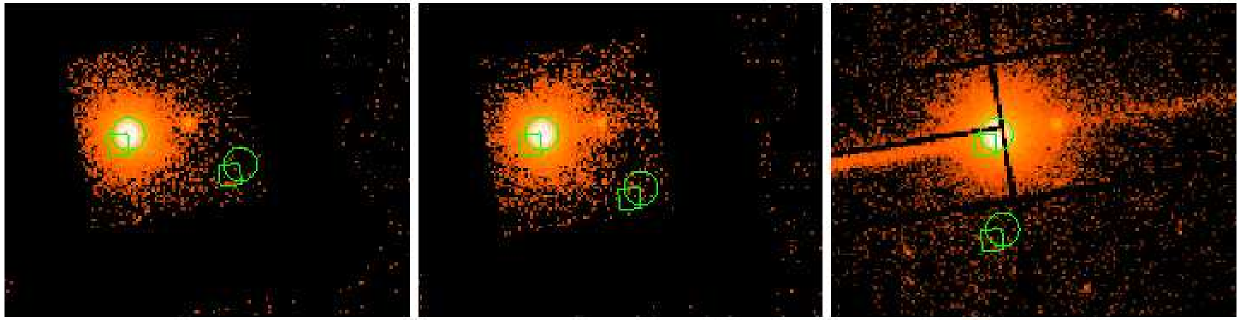
0076
0123910101M1S009 LW med
0123910101M2S010 SW med
0123910101PNS008 FF med

0083
0125100201M1U009 LW med
0125100201M2U009 LW med
0125100201PNS001 SW med

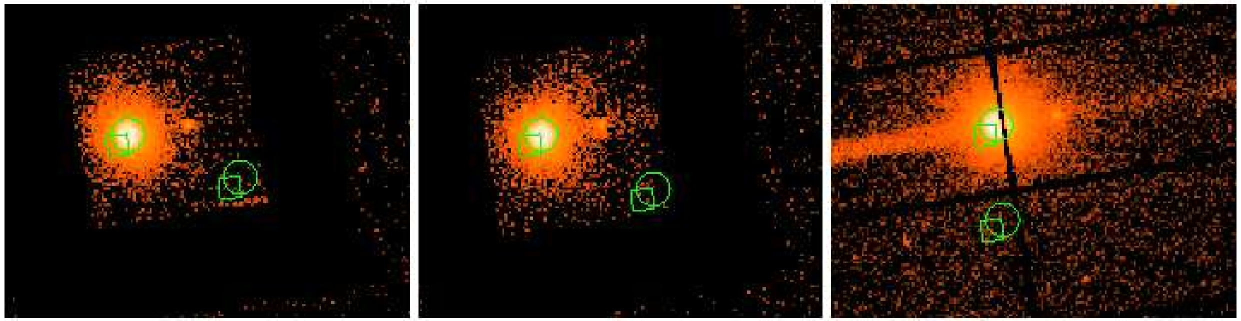
0283
0129340801M1S002 LW thin
0129340801M2S003 LW thin
0129340801PNS001 LW med

1E0102-72.3 -- EPIC observations

MOS1 **MOS2** **PN**



0063
0123110201M1S003 LW thin1
0123110201M2S005 LW thin1
0123110201PNS001 FF thin1



0063
0123110301M1S004 LW med
0123110301M2S006 LW med
0123110301PNS002 FF med

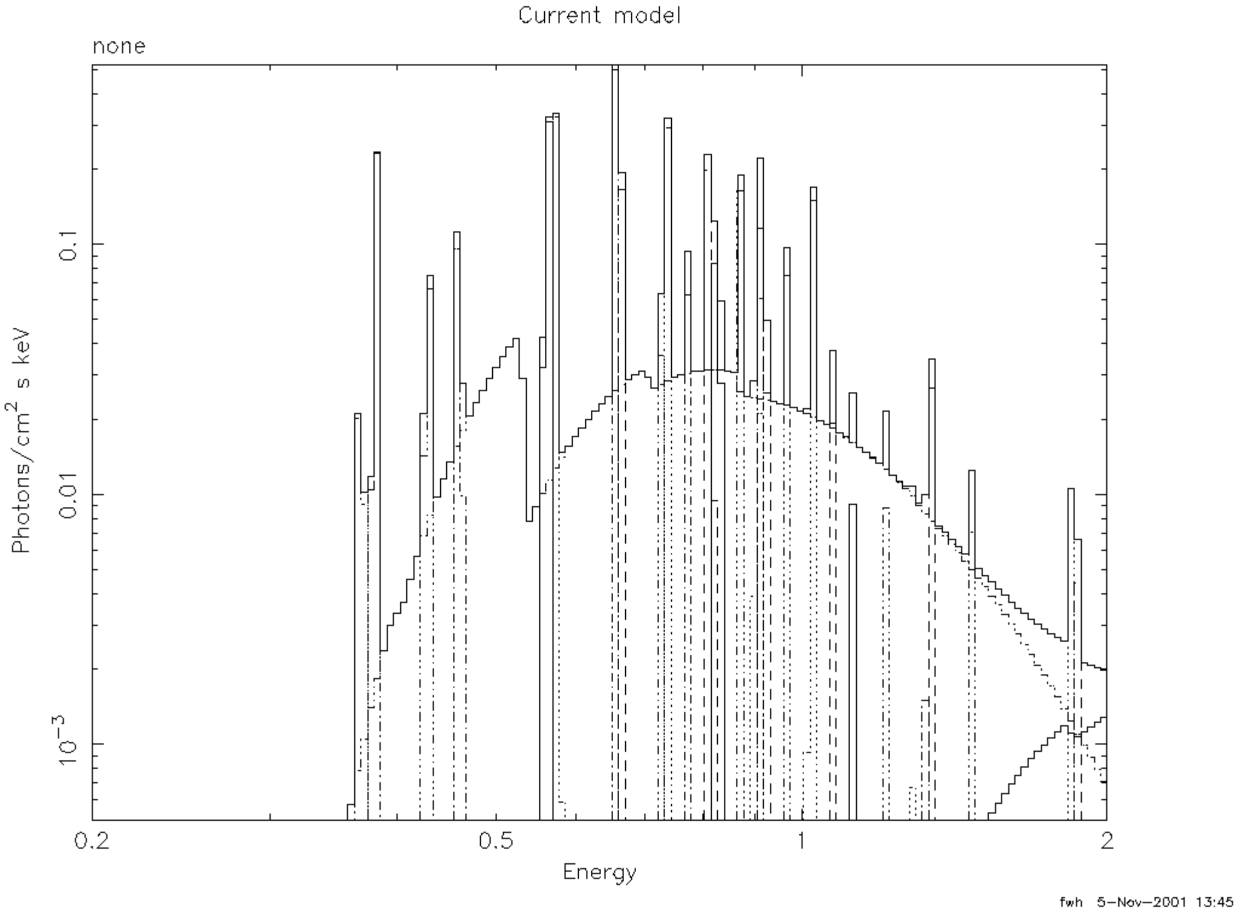
The spectral model

38 Emission lines (Behar et al. 2001, A&A 365, L242)

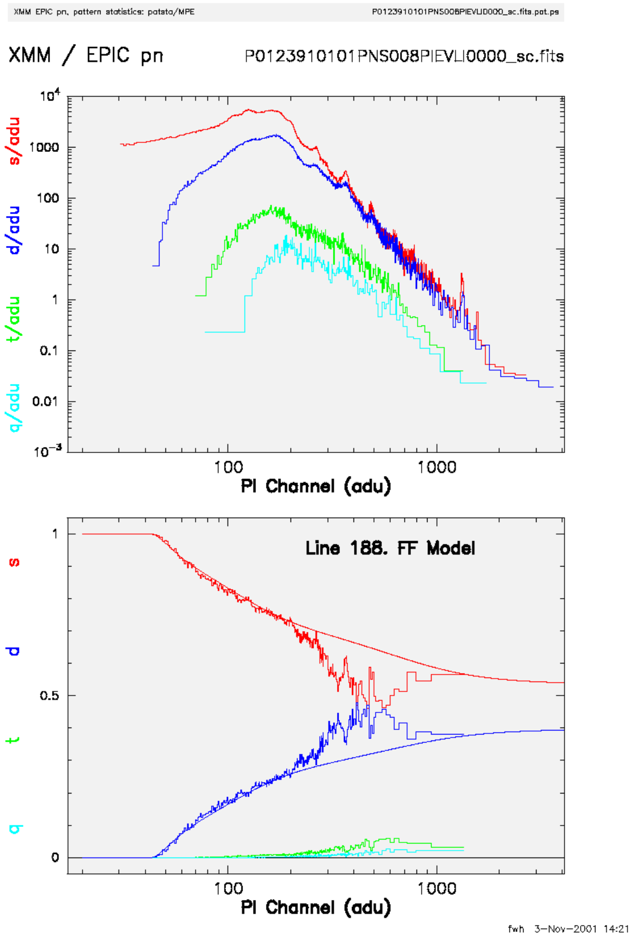
Continuum: bremsstrahlung + powerlaw

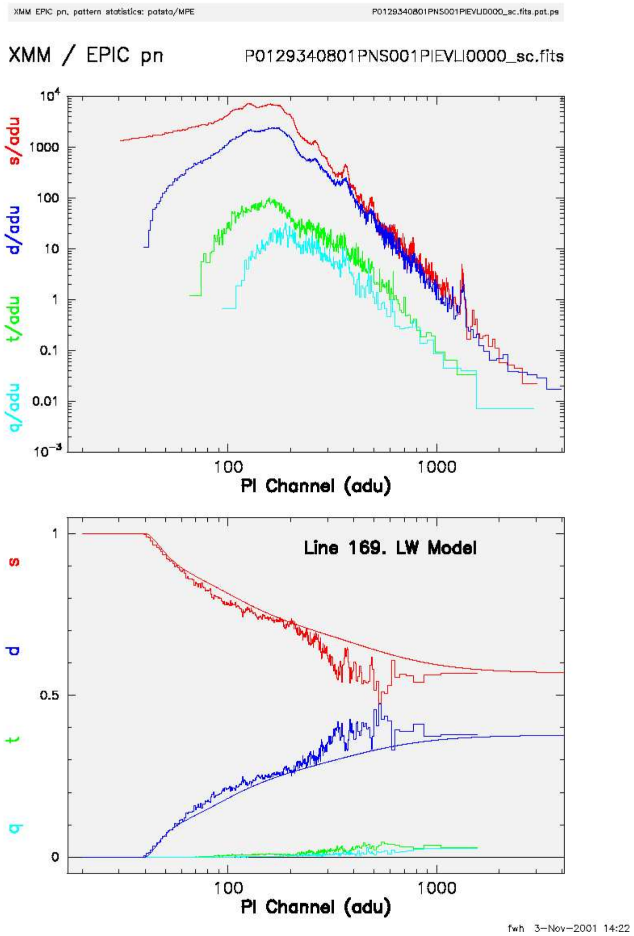
N132D: kT = 0.28 keV $\gamma \sim 2.5$

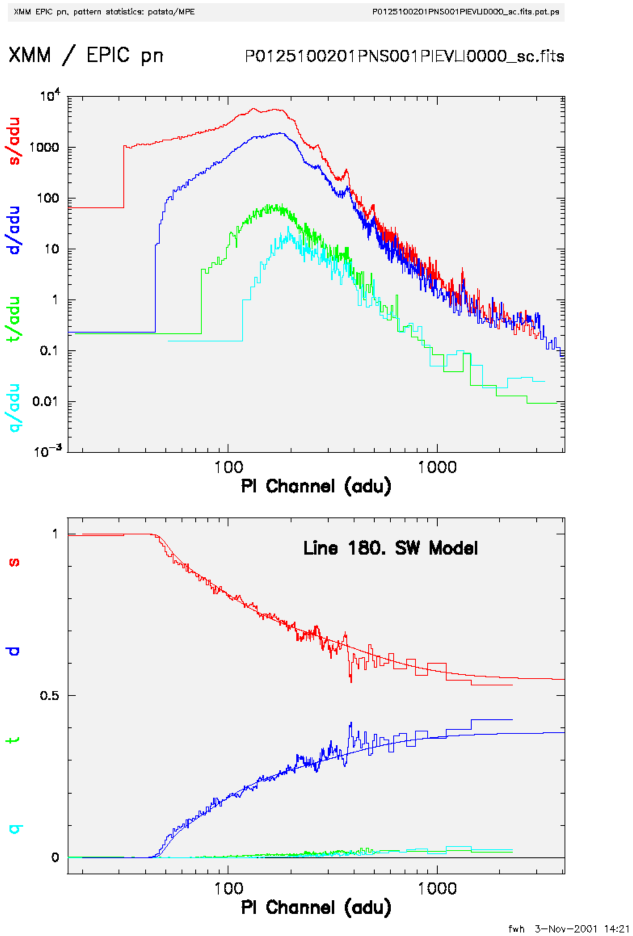
1E0102-72.3: kT = 0.27 keV $\gamma \sim 2.5$



N132D -- EPIC PN pattern statistics

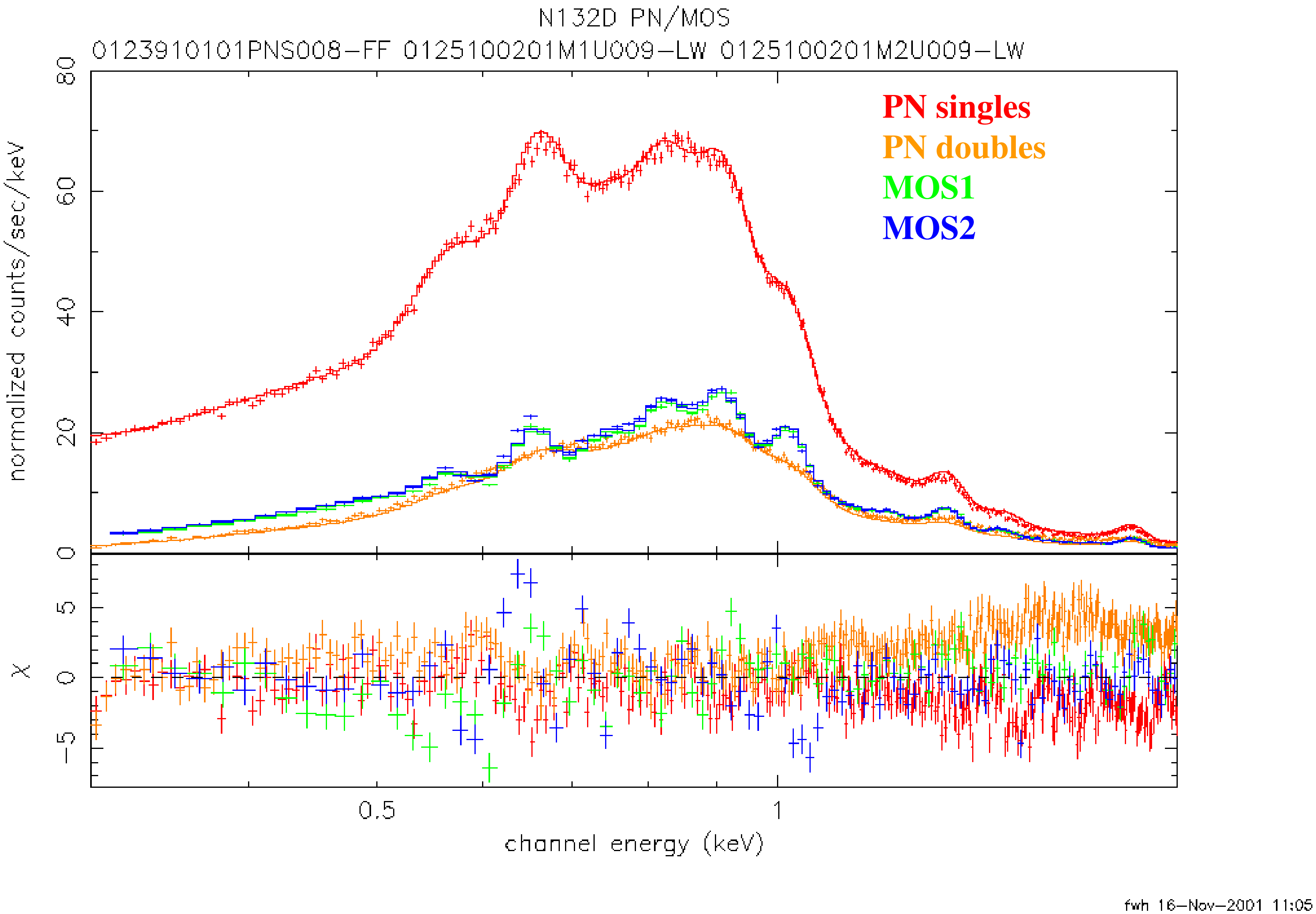




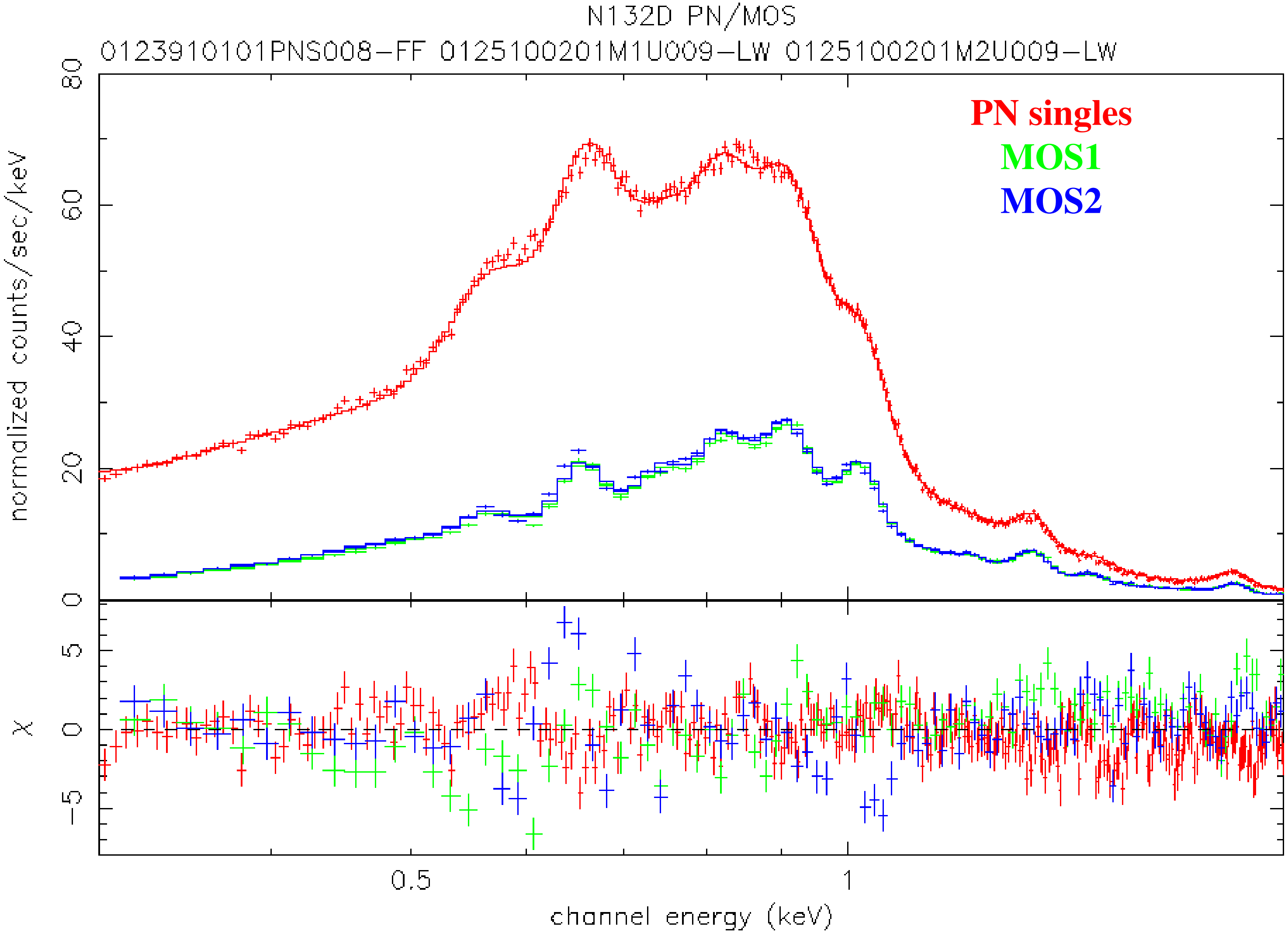


SAS task eppatplot

N132D – PN FF s/d + MOS LW

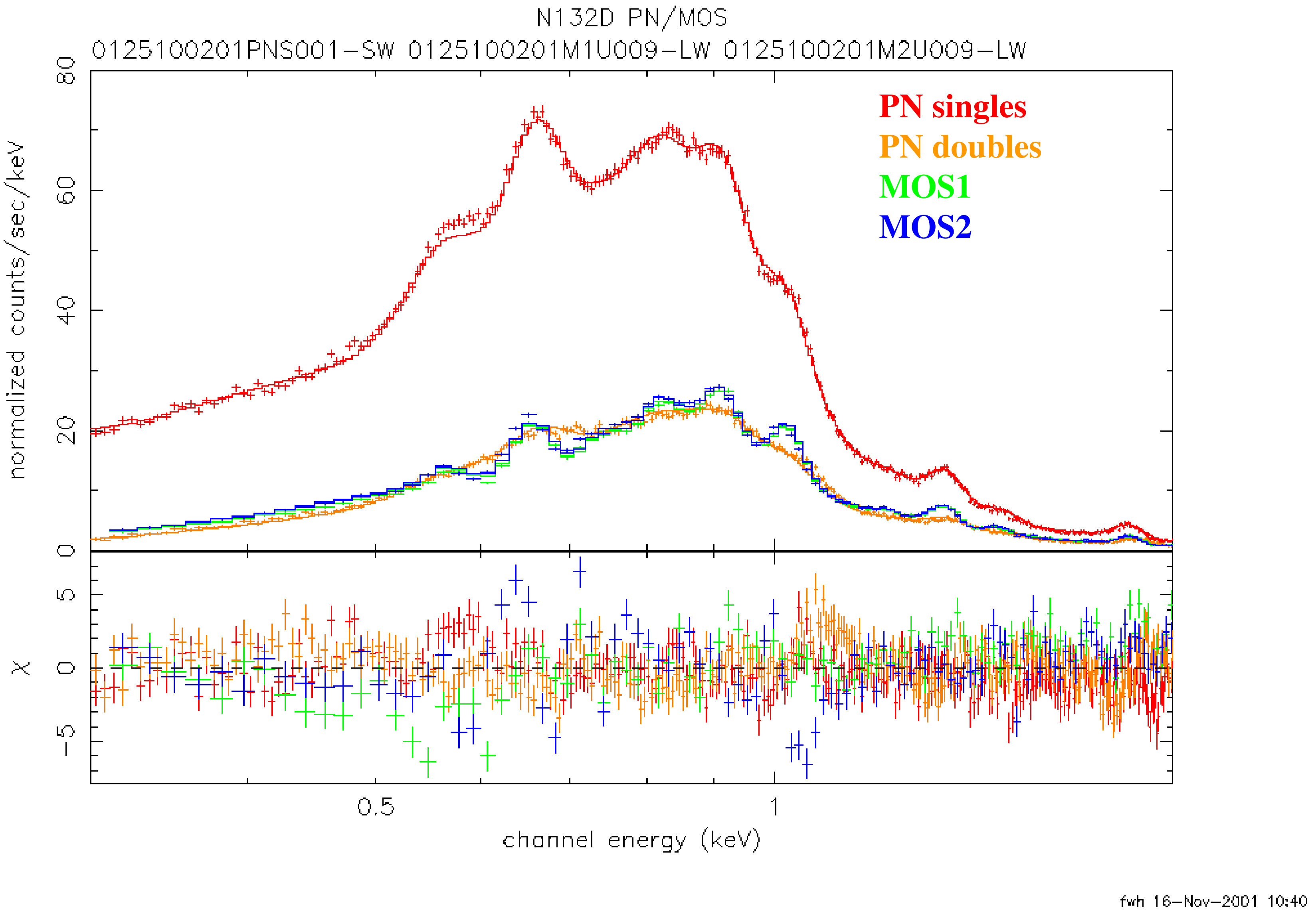


N132D – PN FF s + MOS LW

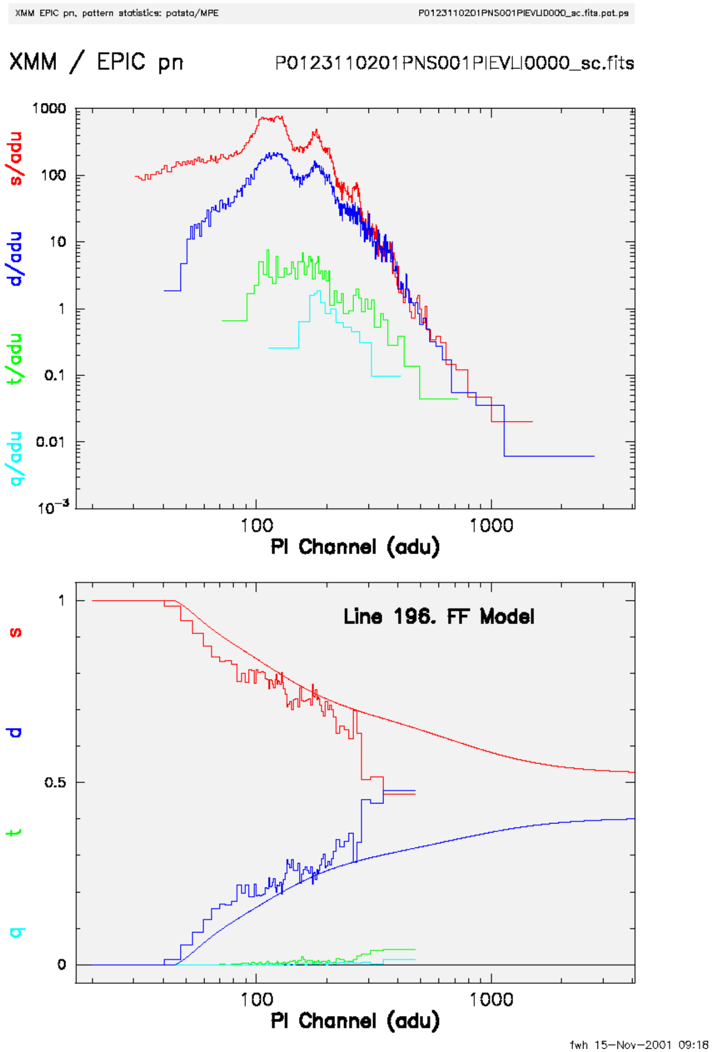


fwh 16-Nov-2001 11:05

N132D – PN SW s/d + MOS LW

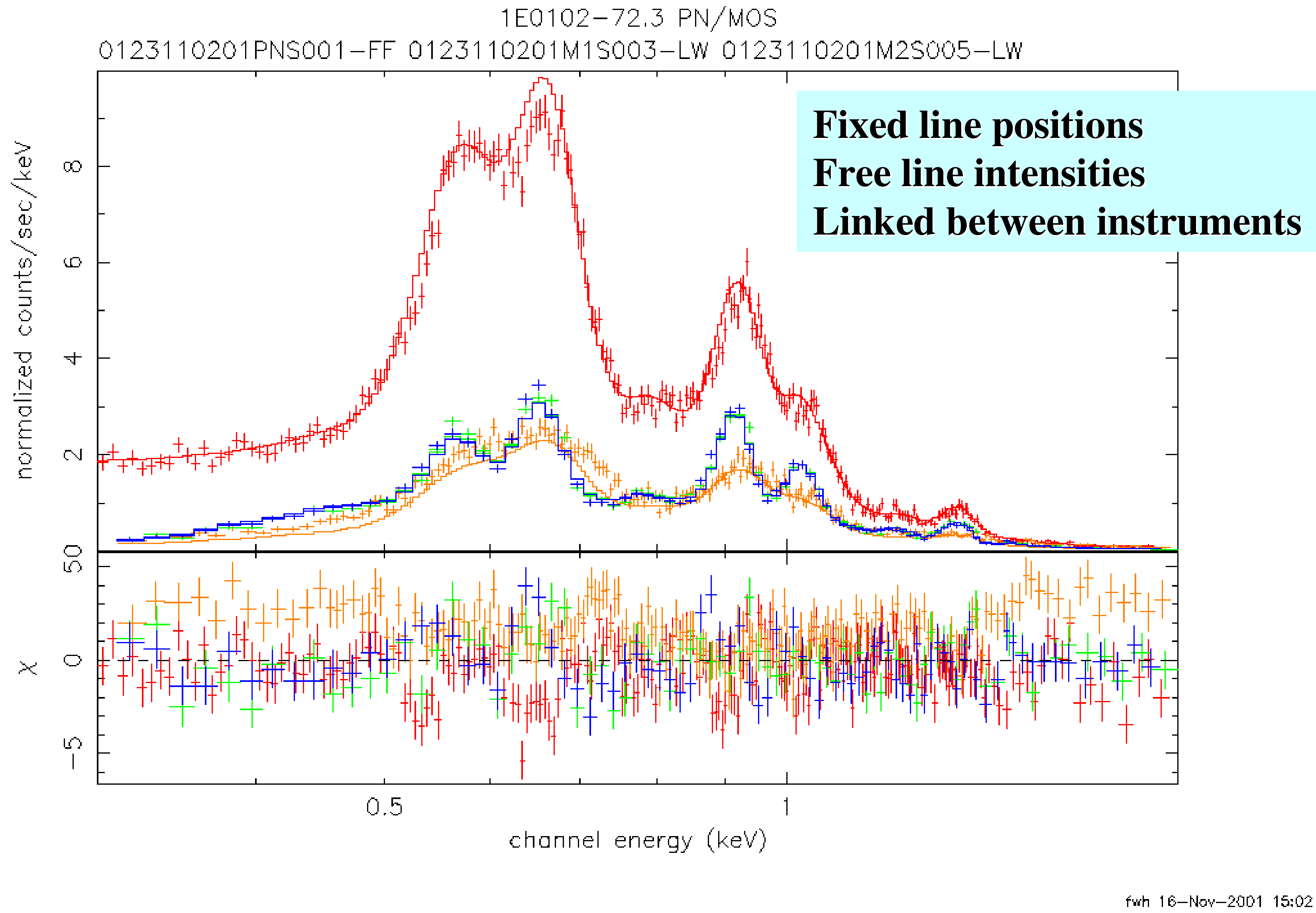


1E0102-72.3 -- EPIC PN pattern statistics



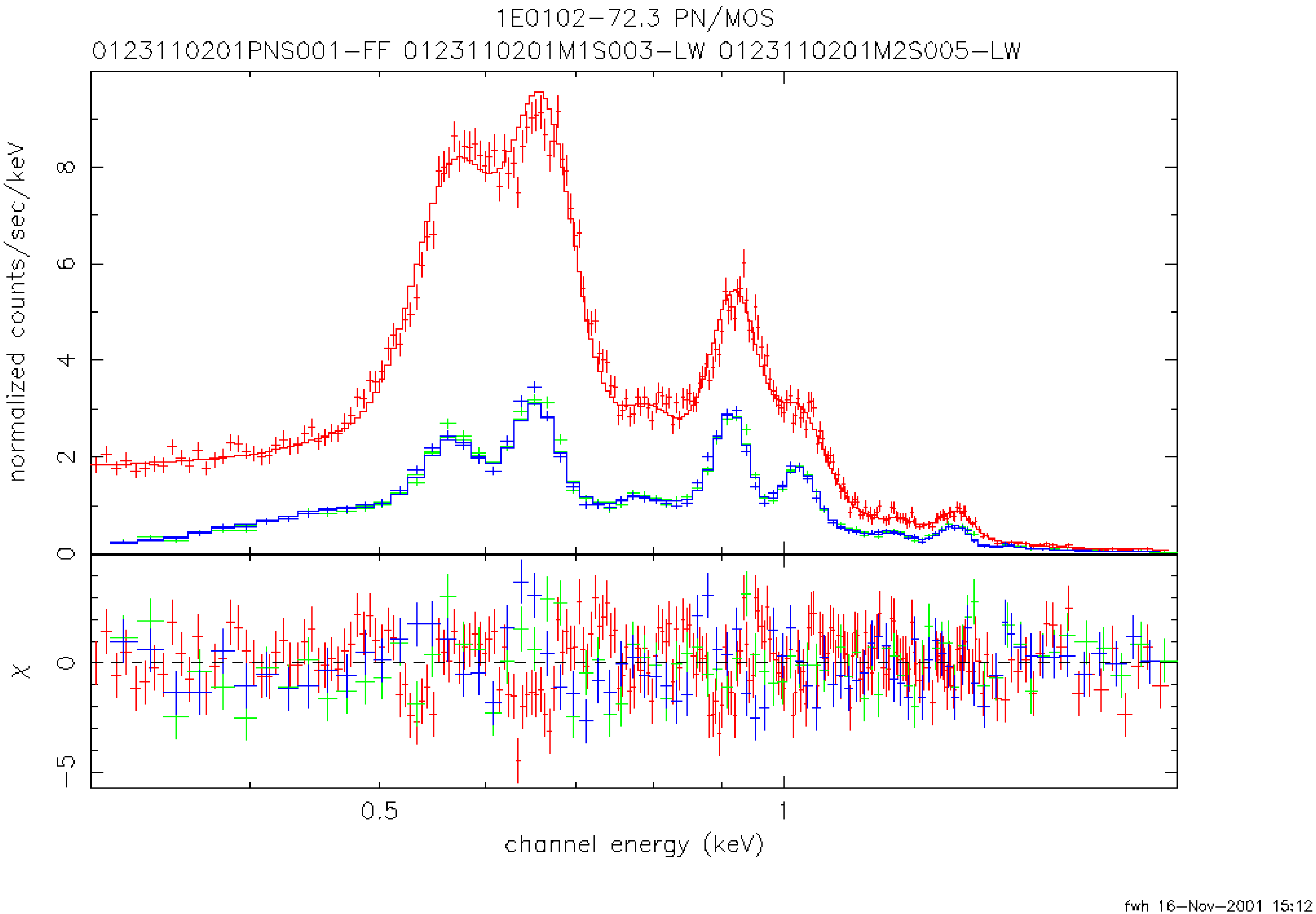
- Pile up
- Extraction from CCD opposite to focus CCD

1E0102-72.3 rev0063 thin filter
PN FF s/d + MOS LW



Fixed line positions
Free line intensities
Linked between instruments

1E0102-72.3 rev0063 thin filter
PN FF s + MOS LW



1E0102-72.3 rev0063 RGS

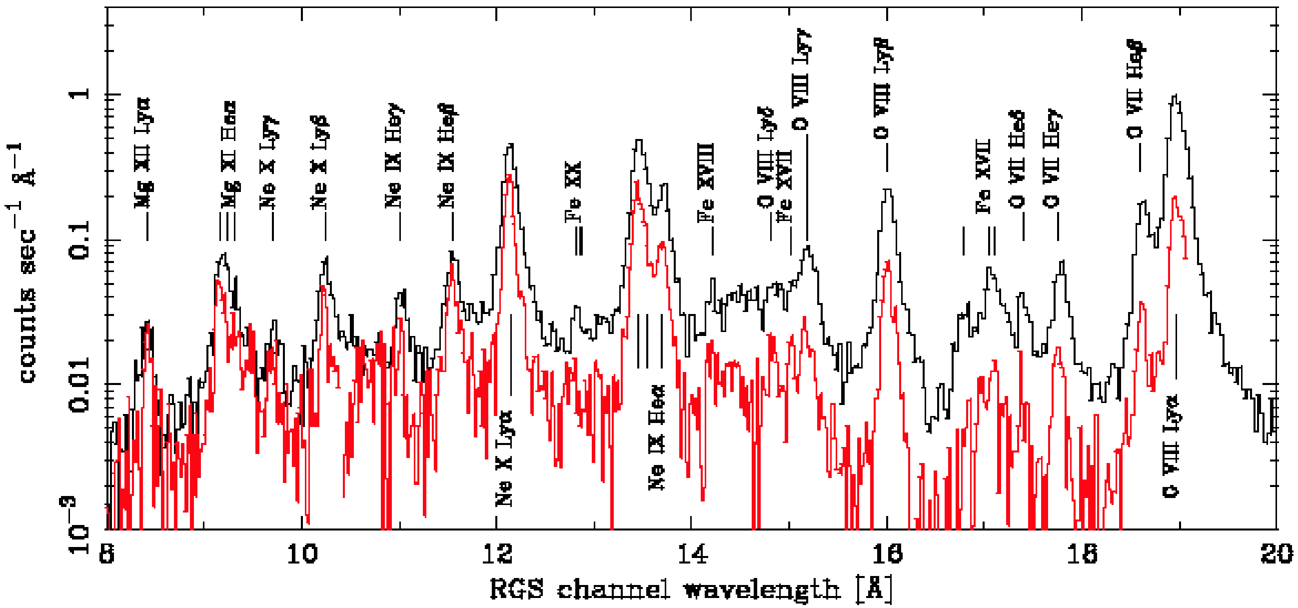
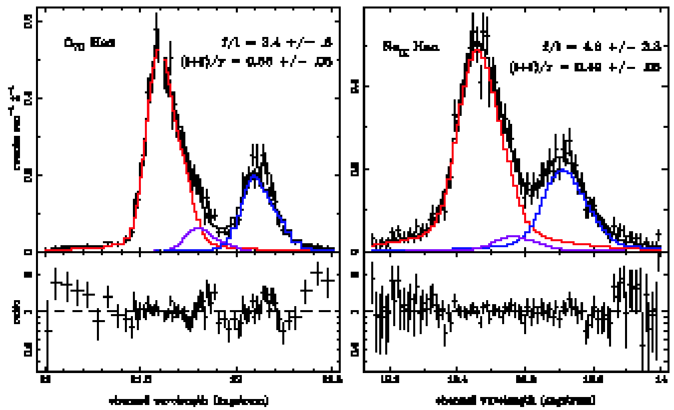
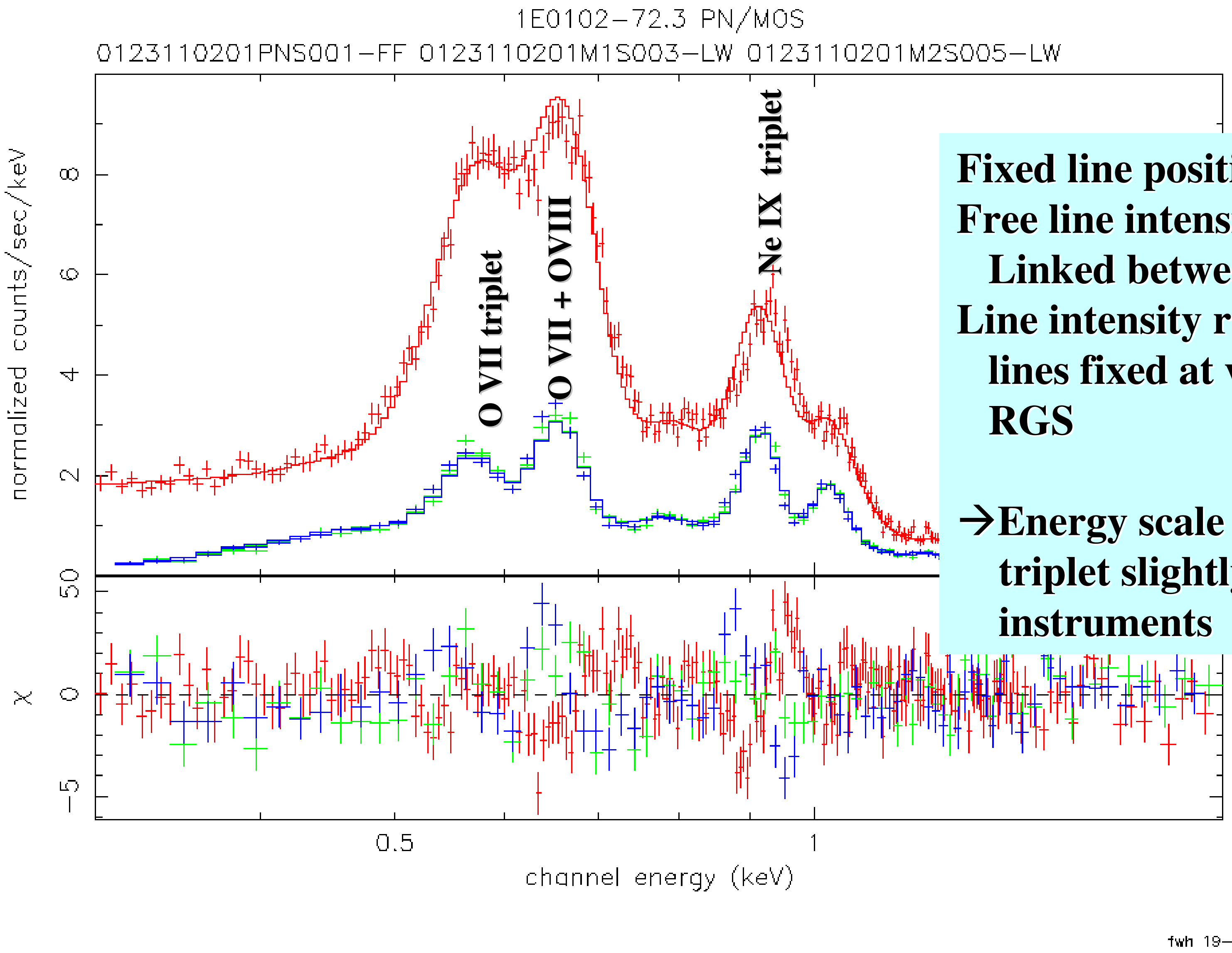


Fig. 2. Detail of the 8–20 Å region of the RGS data. First and second order extractions are plotted separately ($m = -1$ in black, $m = -2$ in red) to facilitate line identification. The data from the two spectrometers have been averaged for each order extraction. The higher spectral resolution and resilience to source extent in is clearly seen in $m = -2$, where some line complexes blended in $m = -1$ are resolved



Rasmussen et al. 2001
A&A 365, L231

1E0102-72.3 rev0063 thin filter PN FF s + MOS LW



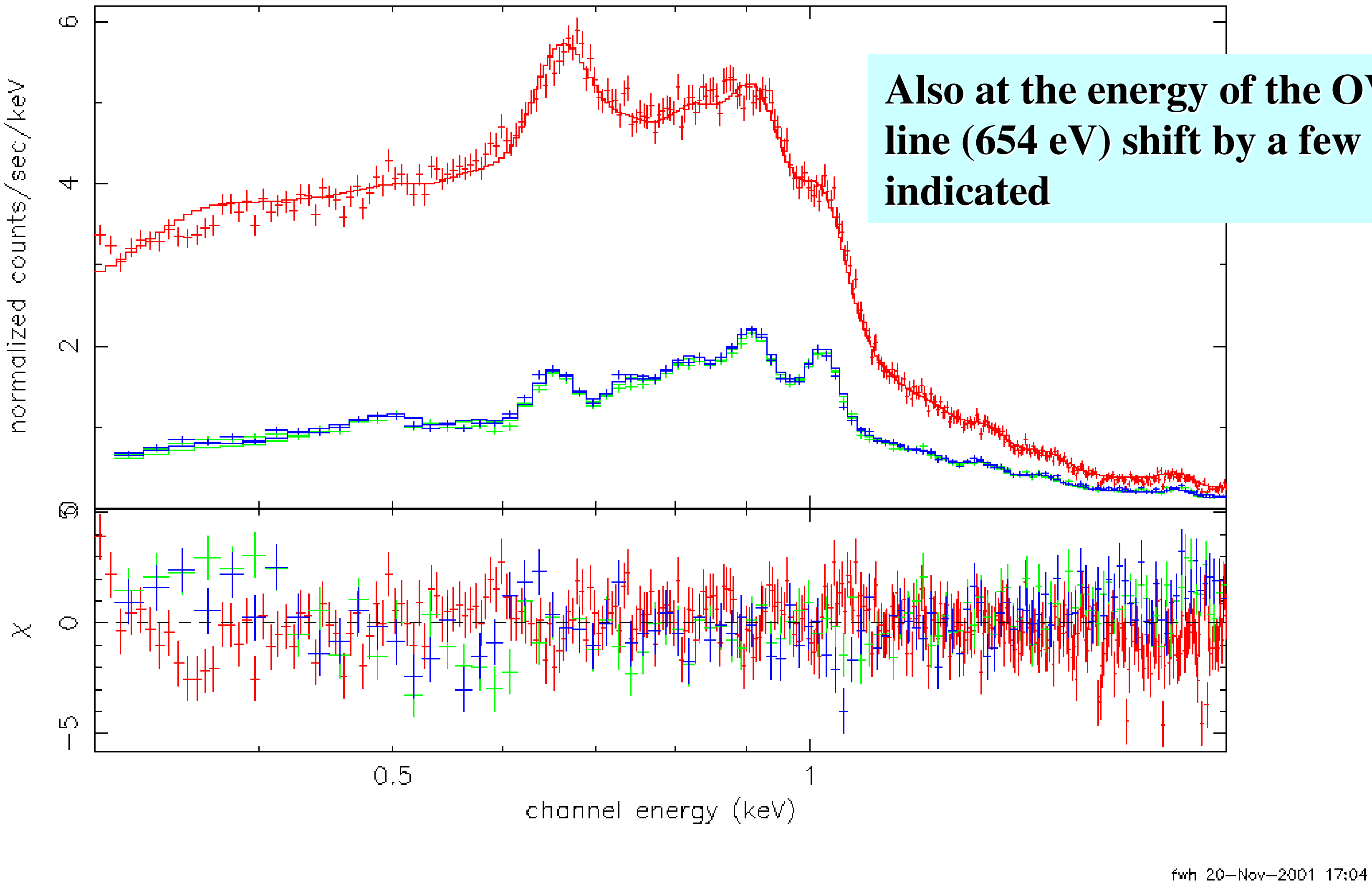
Fixed line positions

Free line intensities for weak lines
Linked between instruments

Line intensity ratios for strongest lines fixed at values measured by RGS

→Energy scale at the Ne IX triplet slightly wrong in all 3 instruments

YY Gem rev0146 thick filter PN FF s + MOS FF



Also at the energy of the OVIII line (654 eV) shift by a few eV indicated

Summary

	expected	PN	MOS1	MOS2
O VIII Lyα	653.8 eV	656 eV	651 eV	651 eV
Ne IX Heα r	922.1 eV	929 eV	916 eV	913 eV

other isolated lines to be investigated:

Si XIII Heα r	1865 eV	N103B Cas A
O VII Heα r	574.0 eV	Vela

Release of the PN response matrices:

Fullframe mode and extended Fullframe mode

Now: epn_<ef/ff>20_<s/d>Y<0-9>_<filter>.rsp

Further refinement of the energy scale in FF

Small window mode

Improvement of the CTE correction (see poster of Zavlin et al.)

Together with SAS 5.3: epn_sw20_<s/d>Y<7-9>_<filter>.rsp