N132D/XMM-Newton Data Analysis

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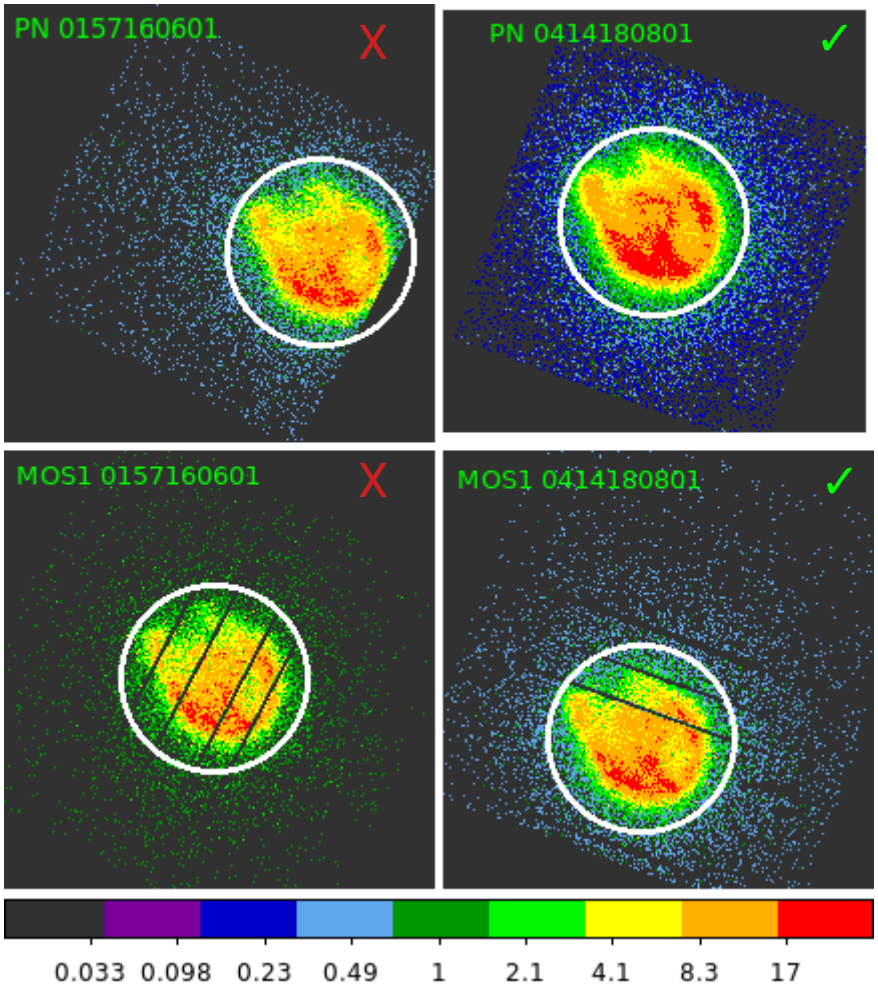
Data Summary

EPIC PN & MOS data over 20 years.

Data kept if:
- Medium or Thin Filter
- >85/90% of remnant on good pixels for MOS/PN

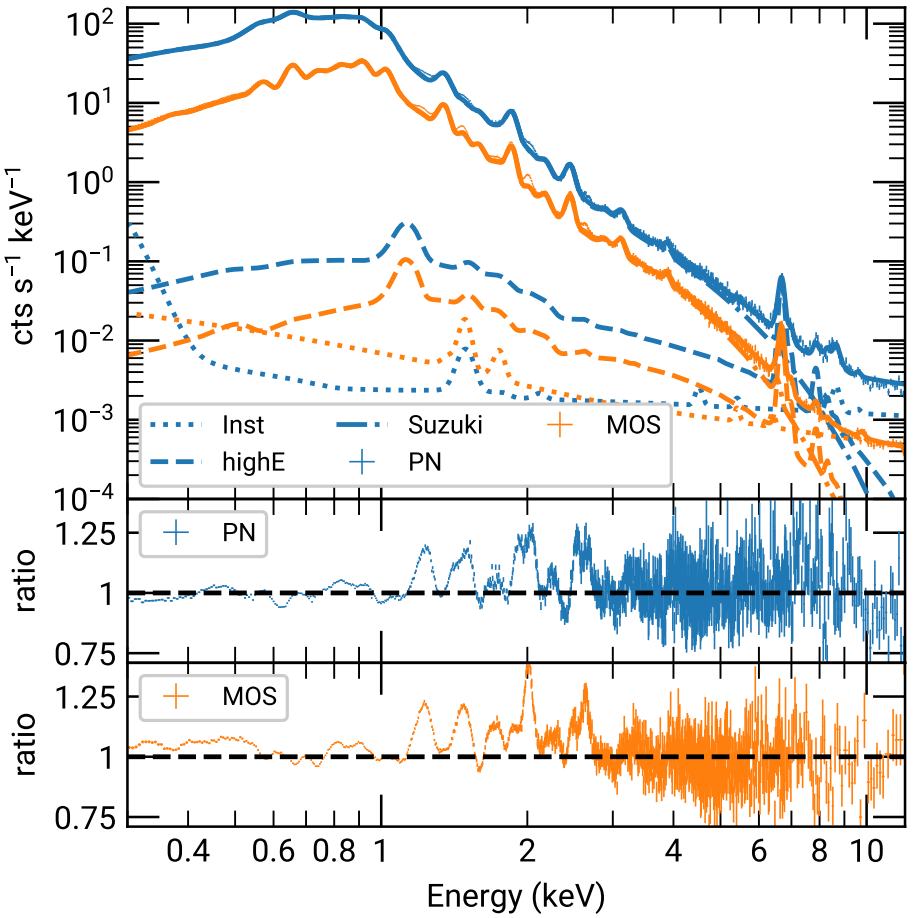
Totals:
- 353 ks PN
- 785 ks MOS1
- 813 ks MOS2



Initial Model:

Hitomi Suzuki model (RGS 3rd order data):

3*NEI model:
kT = 0.2, 0.563 and 1.36 keV
τ = 9.8e10 cm^{-3} s



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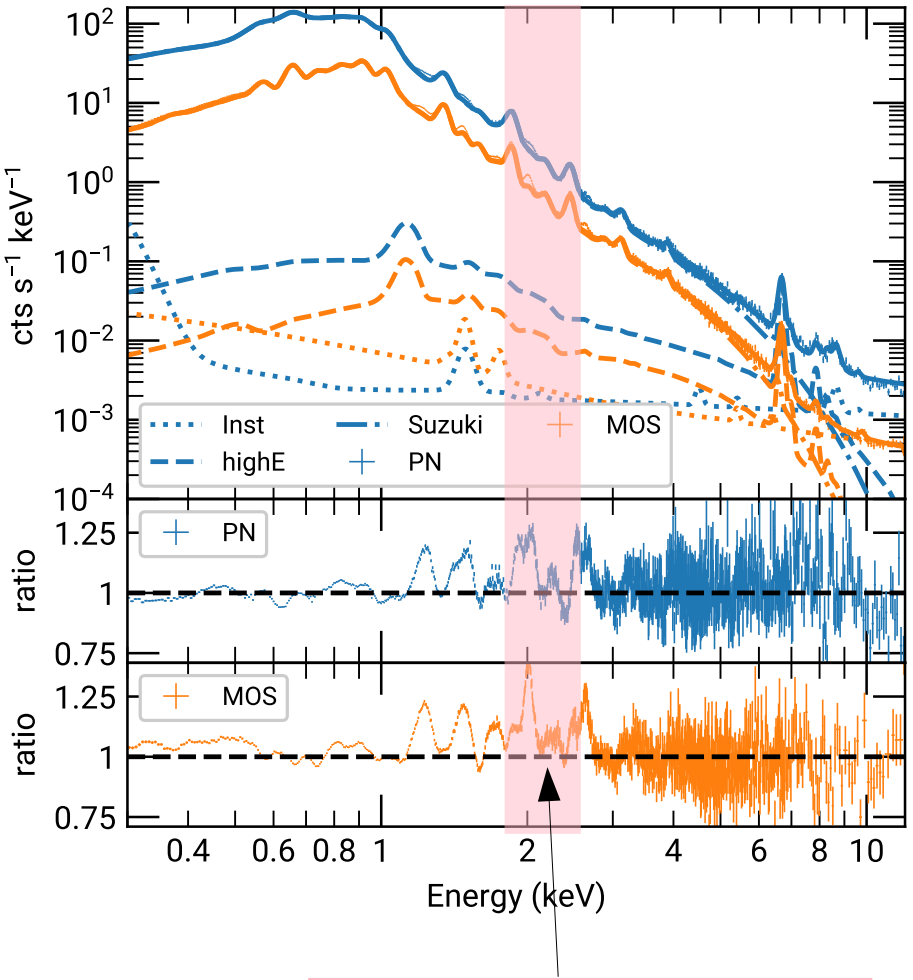
Hitomi Suzuki model (RGS 3rd order data, 10.3847/1538-4357/aba524):

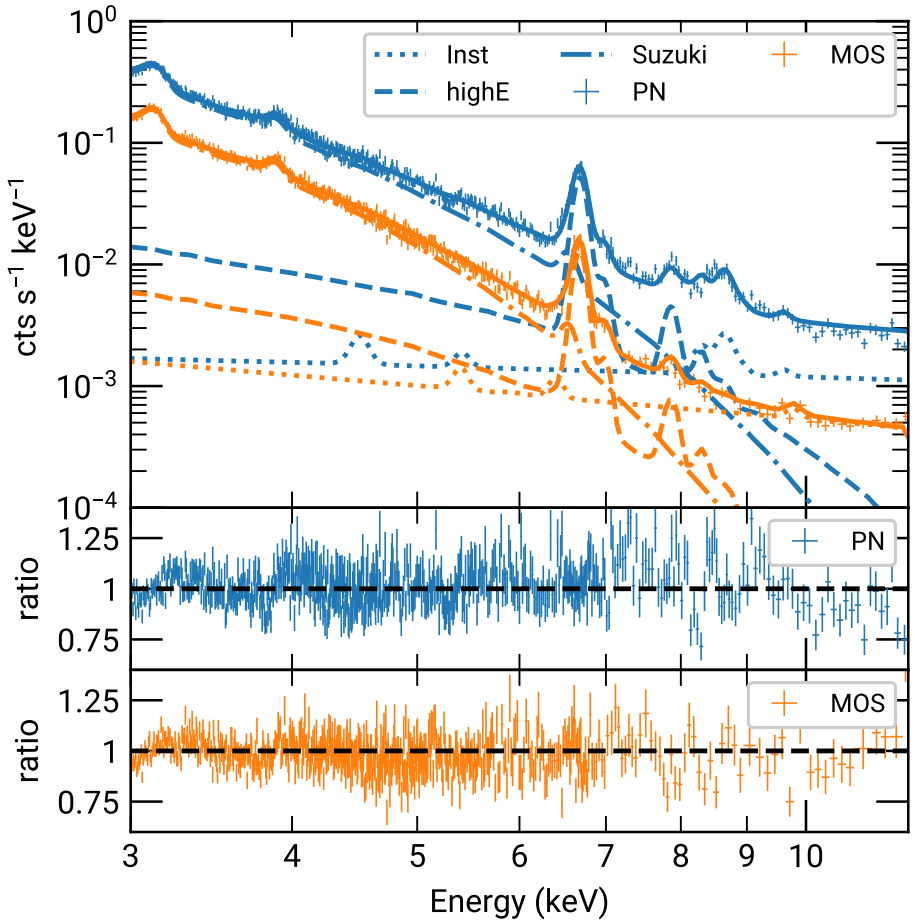
3*NEI model:
kT = 0.2, 0.563 and 1.36 keV
τ = 9.8e10 cm^{-3} s
Notably, Ca abundance =0.05.

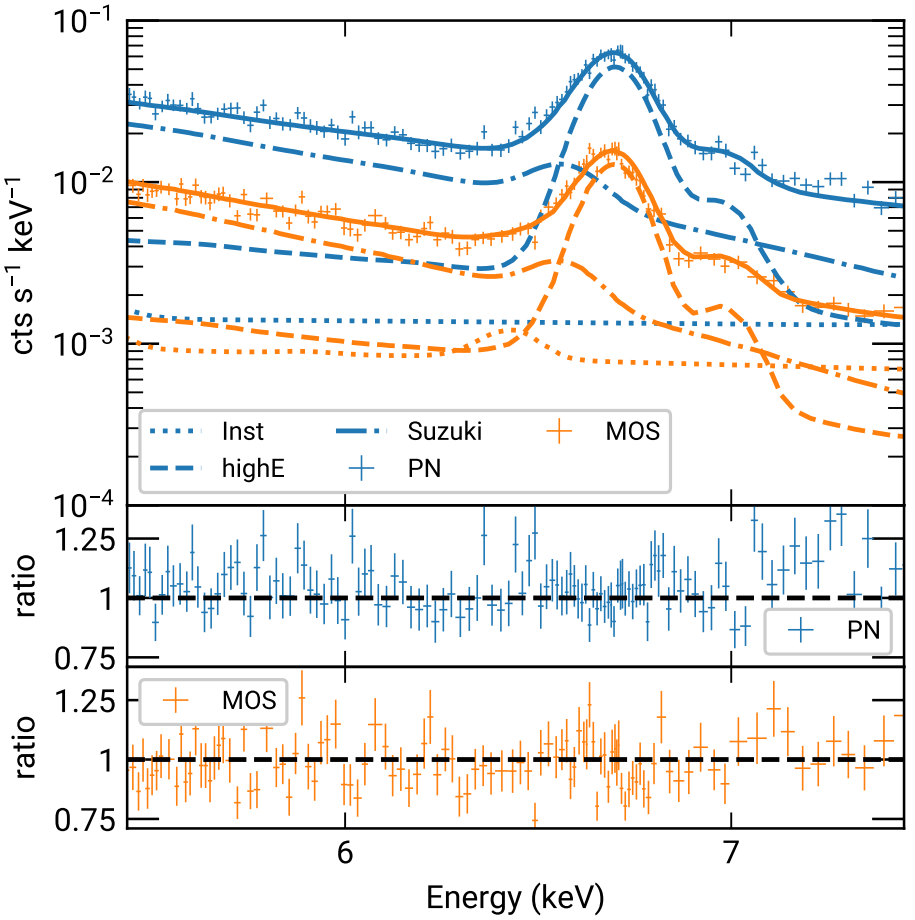
Our model:
Suzuki model, with adjustments:

- Add high T component (kT > 2keV), free its timescale
- free normalization of 1.36keV component
- Freeze/ignore 0.2 & 0.563 components
- Cannot match data around 2keV (PN and MOS are inconsistent) → focus above 3keV
- Instrumental background from fits to filter wheel closed data



Inconsistent Residuals: Cannot model (...without serious work on ARF?)





Emission dominated by 1.36keV component below 6.7keV.
H like Fe clearly observed
Ionizing iron (~6.6keV) observed
Ca abundance required to be increased

Table 2. Joint fits using PN and MOS for the $3 < E_\gamma < 10$ keV. The $\mathrm{Ca_{Suz}}$ and $\mathrm{norm_{Suz}}$ refer to the $kT = 1.36$ keV component of the Suzuki et al. (2020) model.

Component	Equilibrium	Ionizing	Recombining
kT[a]*	$4.50^{+0.13}_{-0.07}$	$9.98^{-0.29}_{-3.06}$	$4.50^{+0.06}_{-0.24}$
Ca[b]	$8.60^{+3.21}_{-1.99}$	$14.24^{+1.53}_{-3.08}$	$9.59^{+3.30}_{-1.06}$
Fe[b]	$7.29^{+0.79}_{-0.44}$	$7.99^{+0.52}_{-0.79}$	$7.25^{+0.99}_{-0.23}$
Ni[b]	$8.87^{+2.61}_{-1.53}$	$5.17^{+3.03}_{-1.96}$	$9.35^{+3.71}_{-1.39}$
τ[c]	N/A	$0.24^{+0.12}_{+0.01}$	$2.91^{-0.07}_{-1.12}$
norm[d]	$3.27^{+0.18}_{-0.33}$	$1.91^{+0.44}_{+0.00}$	$3.29^{+0.16}_{-0.35}$
$\mathrm{Ca_{Suz}}$[b]	$0.94^{+0.04}_{-0.05}$	$0.83^{+0.09}_{-0.03}$	$0.91^{+0.03}_{-0.05}$
$\mathrm{norm_{Suz}}$[e]	$2.96^{+0.02}_{-0.01}$	$3.00^{+0.00}_{-0.03}$	$2.96^{+0.02}_{-0.01}$
d.o.f.	156592	156591	156591
cstat	119840	119843	119841

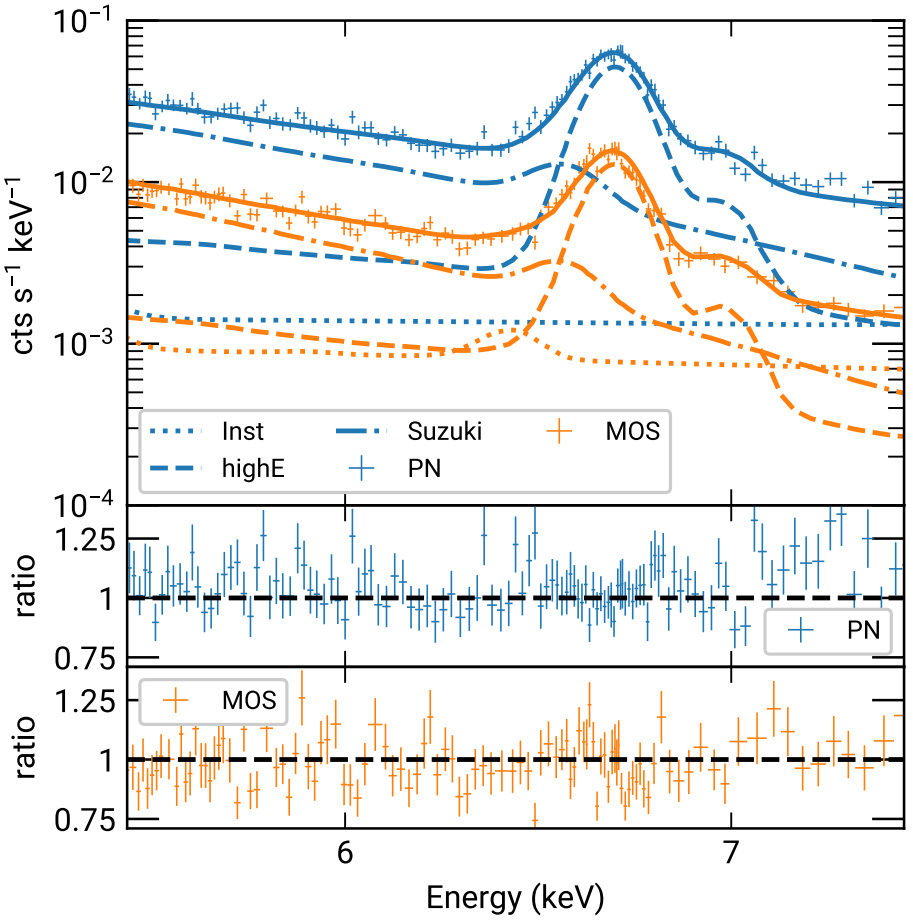
[a] in keV

[b] in interstellar medium values (Wilms et al. 2000)

[c] in 10^{12} $\mathrm{cm^{-3}s}$

[d] in $10^{10}\mathrm{cm^{-5}}$

[e] in $10^{12}\mathrm{cm^{-5}}$



Cannot meaningfully distinguish ionization/recombination/equilibrium plasma.
All 3 combos give similar ion fractions for Li/He/H like.

Line Centroids

Gaussian fits for Ca and Fe using nlapec+Gaussian

Element	Fit Range (keV)	Centroid (keV)
Ca	$3.5 \leq E\gamma \leq 4.3$	$3.903^{+0.002}_{-0.003}$
Fe	$5.5 \leq E\gamma \leq 7.5$	$6.670^{+0.001}_{-0.001}$

Neutral iron line (6.4keV) not detected, norm < 7.9E-8 $cm^3 s^{-1}$