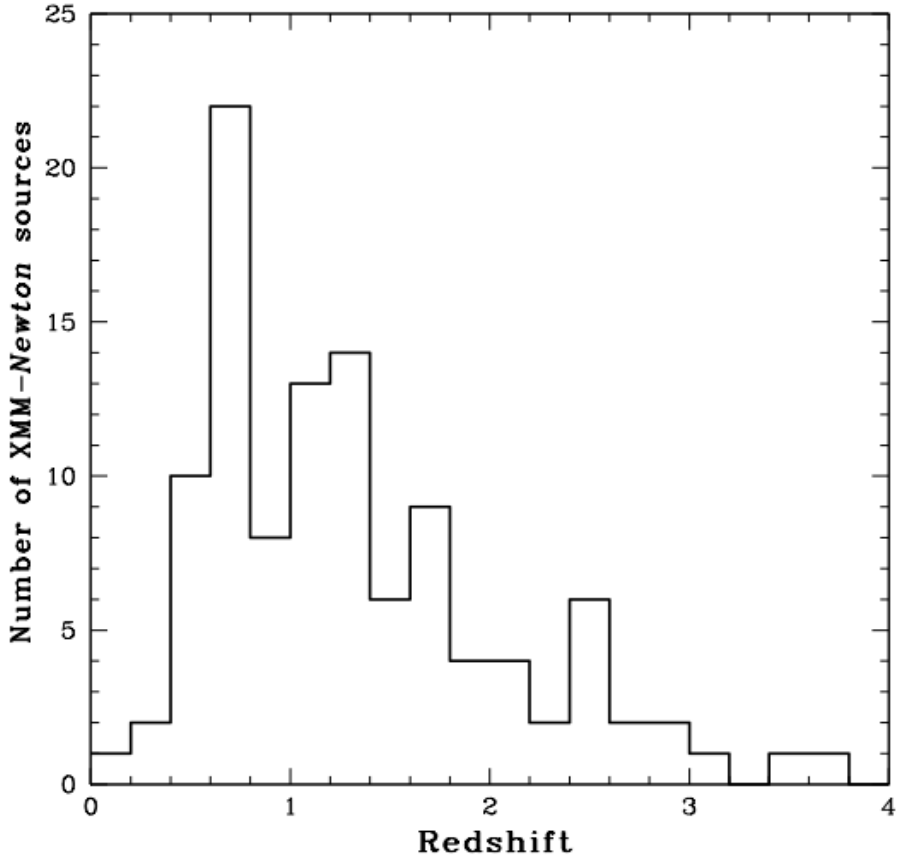
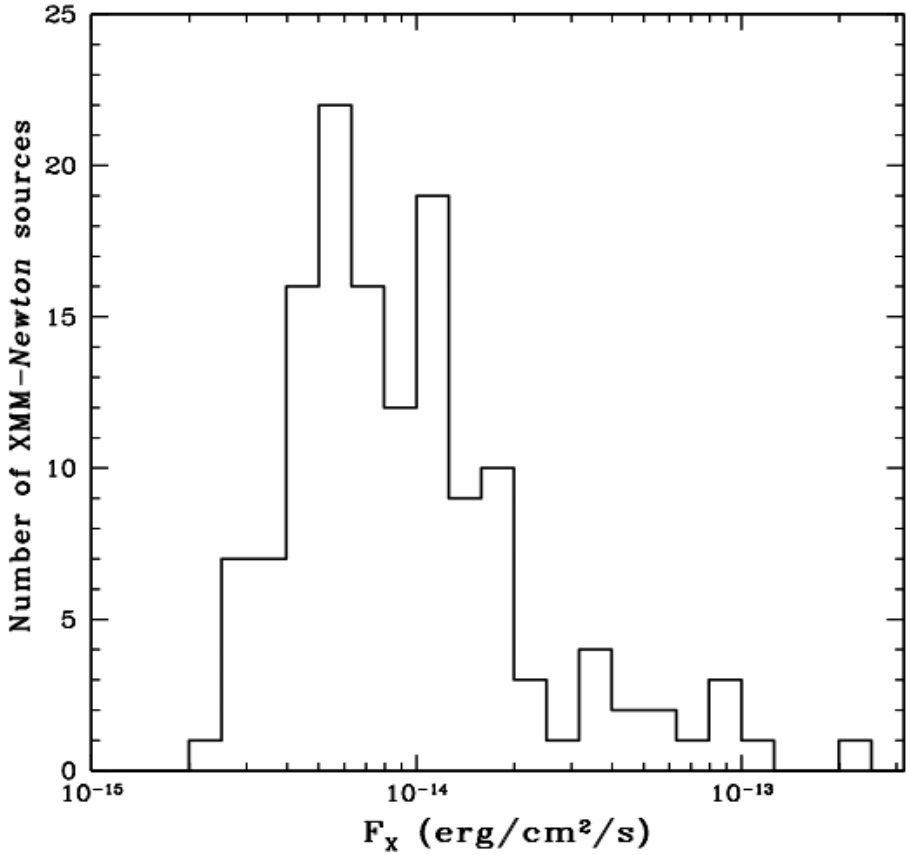
X-ray spectral catalogue Overview

- Something which has to be done …
- Legacy (?) value
- Parent sample for more interesting analyses … some interesting surprises are emerging (Piero352)
- …

Spectral Analysis

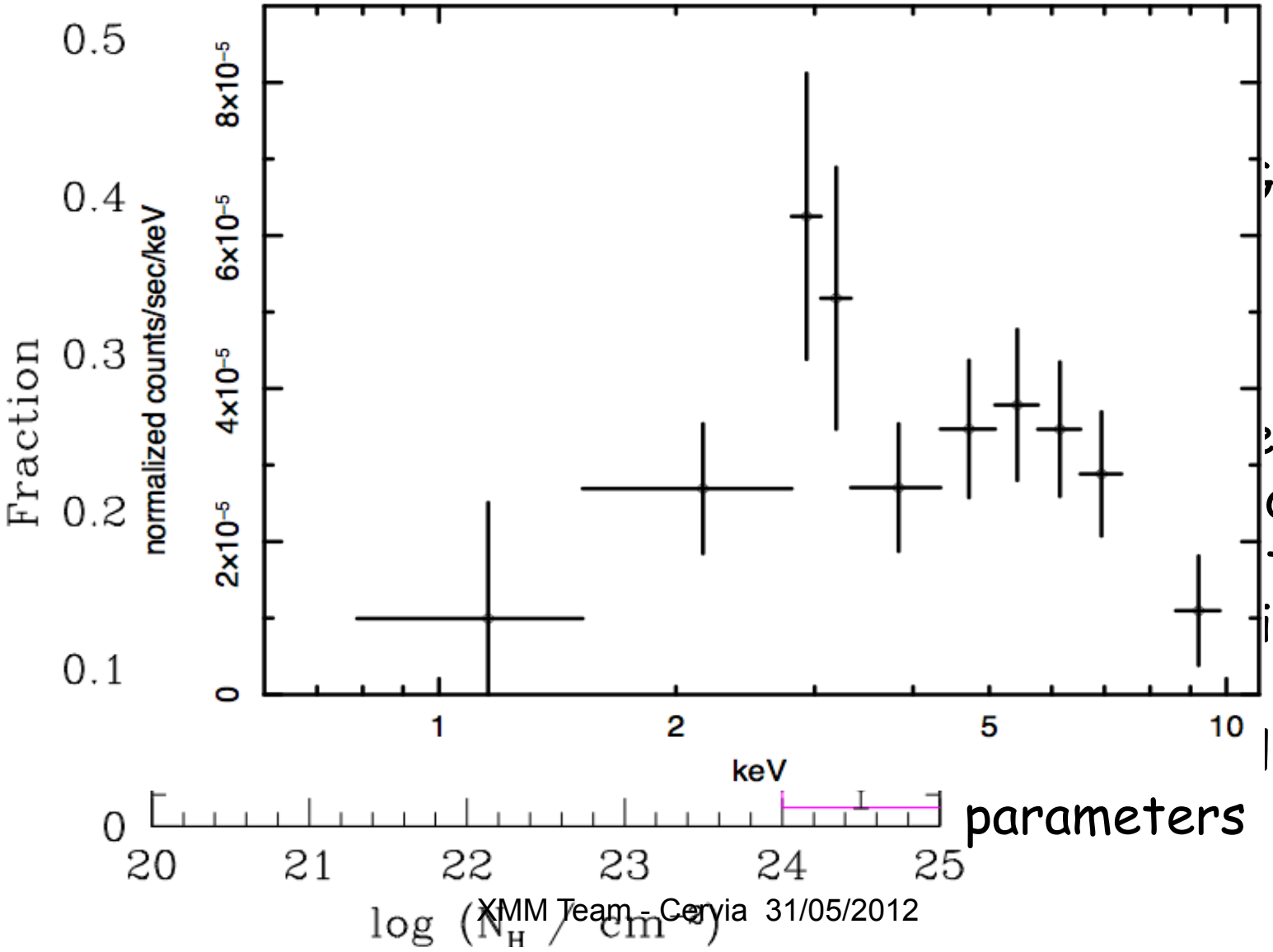
2-10 keV, >10σ AND 1 Ms exposure -> 130 sources





2-10 keV

Absorption Distribution



CH07)

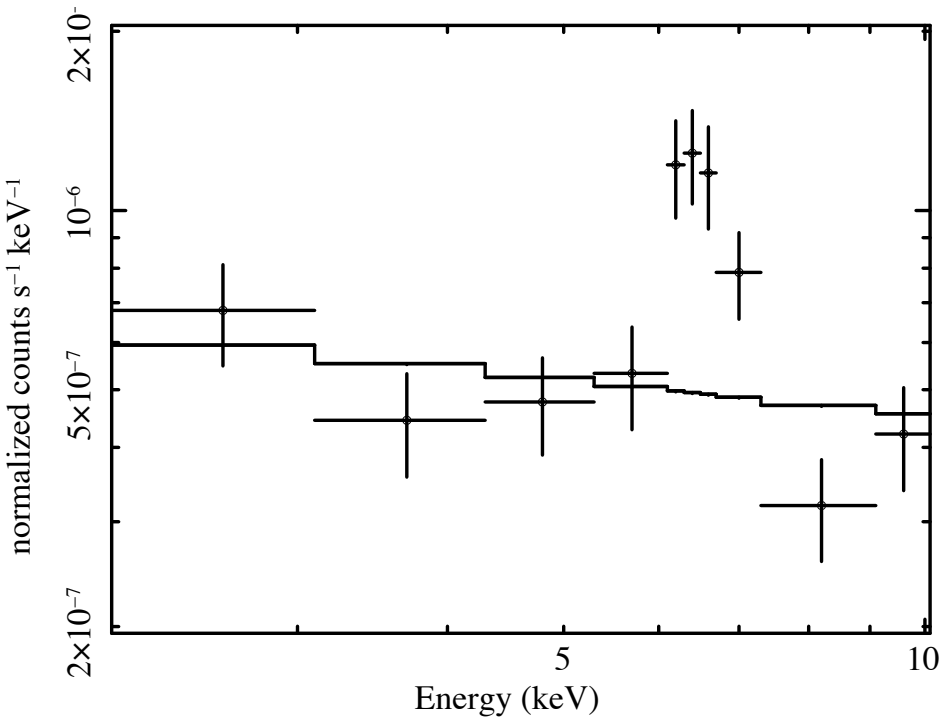
es

o N_H

ts at low

ities

parameters

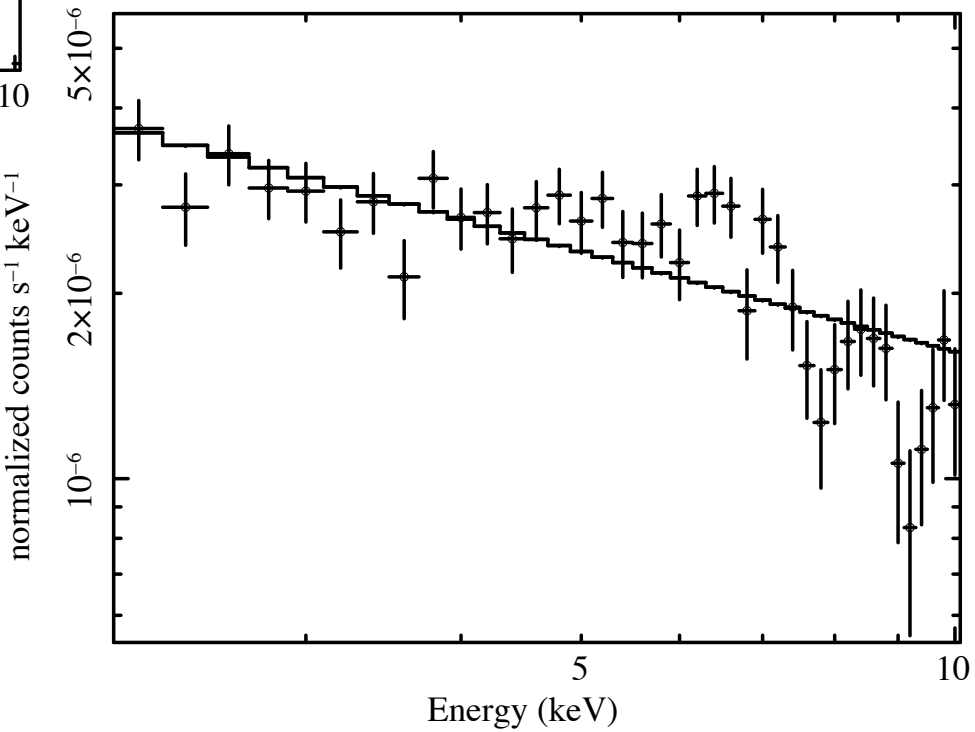


Flat 5

64, 66, 324, (144,147 C11)

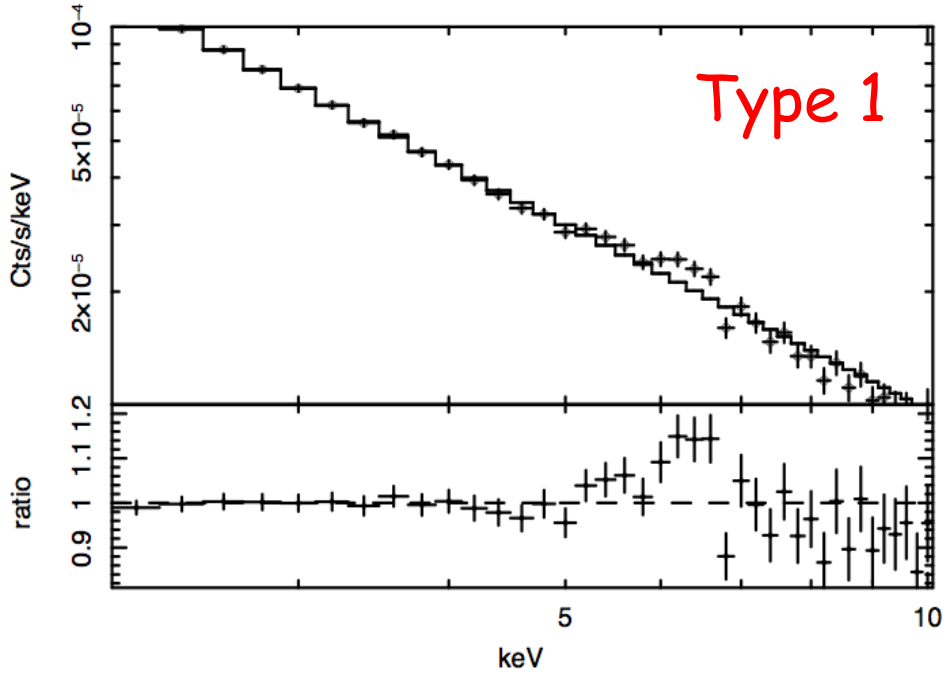
Flat 10

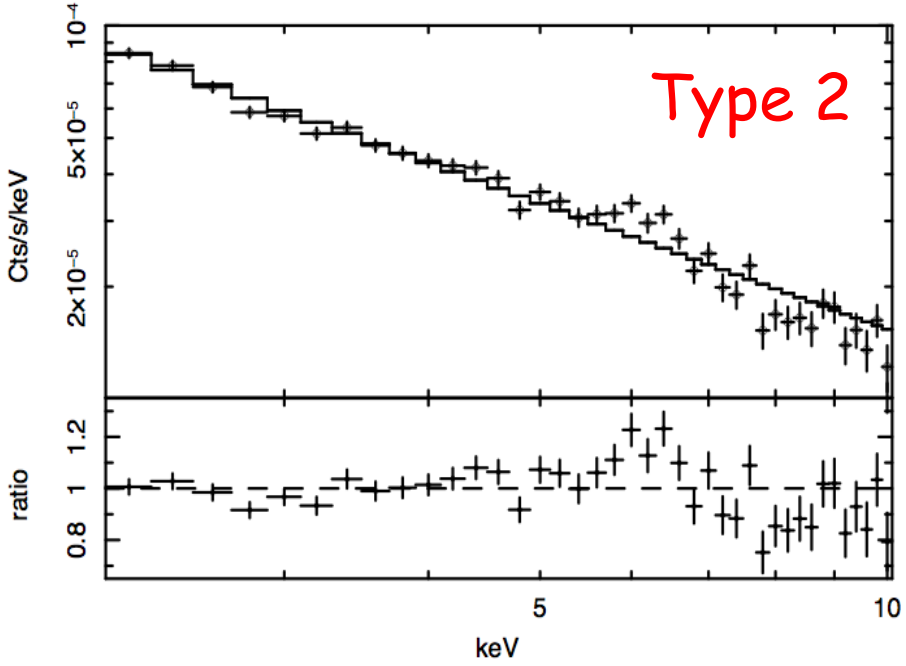
48, 214, 222, 245, 285
64, 66, 324, (144,147 C11)



Herschel sources N_H
Rovilos+12 & talk

Stacking-XMM-CDFS



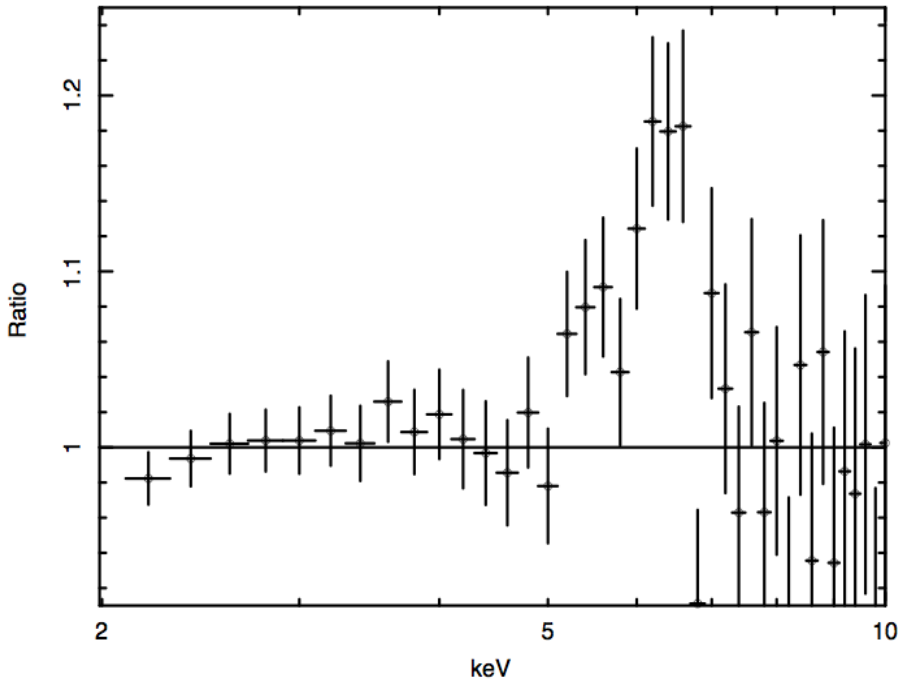


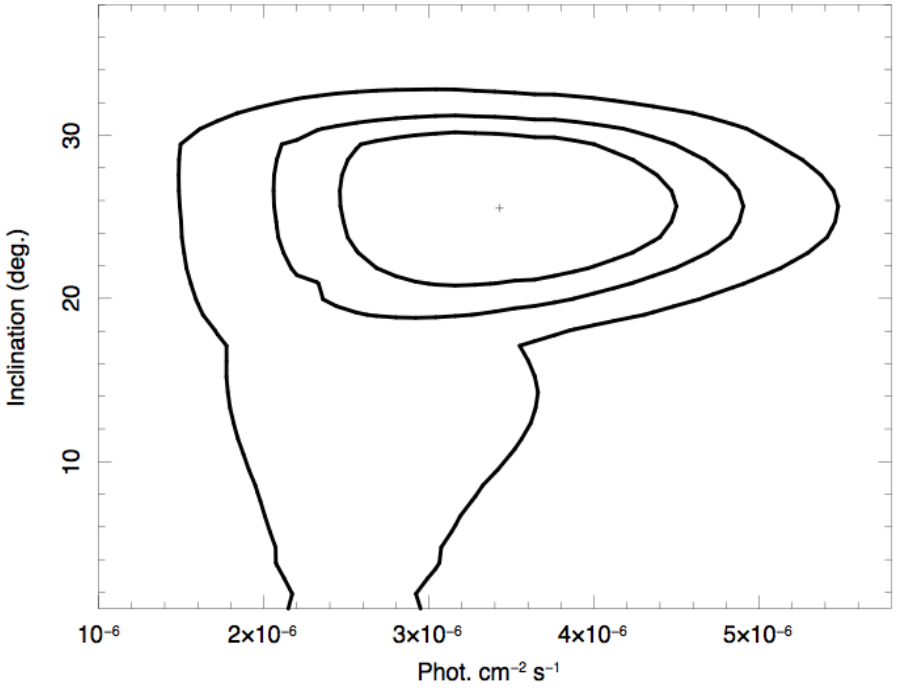
6.4 & 6 keV lines
Photo-z unc?

> 100,000 counts "Type1" un-obscured NOTBLAGN
>~ 60,000 counts "Type 2" obscured -NOT Type 1

Falocco et al in preparation

Stacking-XMM-CDFS





Residuals wrt Power law

fit $\Gamma \sim 1.7$

Line EQW ~ 170 eV

Power law plus R=1 reflection component plus disk line

Phase 2 Spectral Analysis

Define a flux limited sample and perform "accurate" spectral fitting:

- 118 $> 5.0 \times 10^{-15}$ cgs
- 137 $> 4.0 \times 10^{-15}$ cgs 2-10 keV
- 180 $> 1.8 \times 10^{-15}$ cgs

Baseline model : po+zwa*(po+zgaus)

plus Galactic absorption at 8×10^{19} cm^{-2}

(obviously not always the best fit)

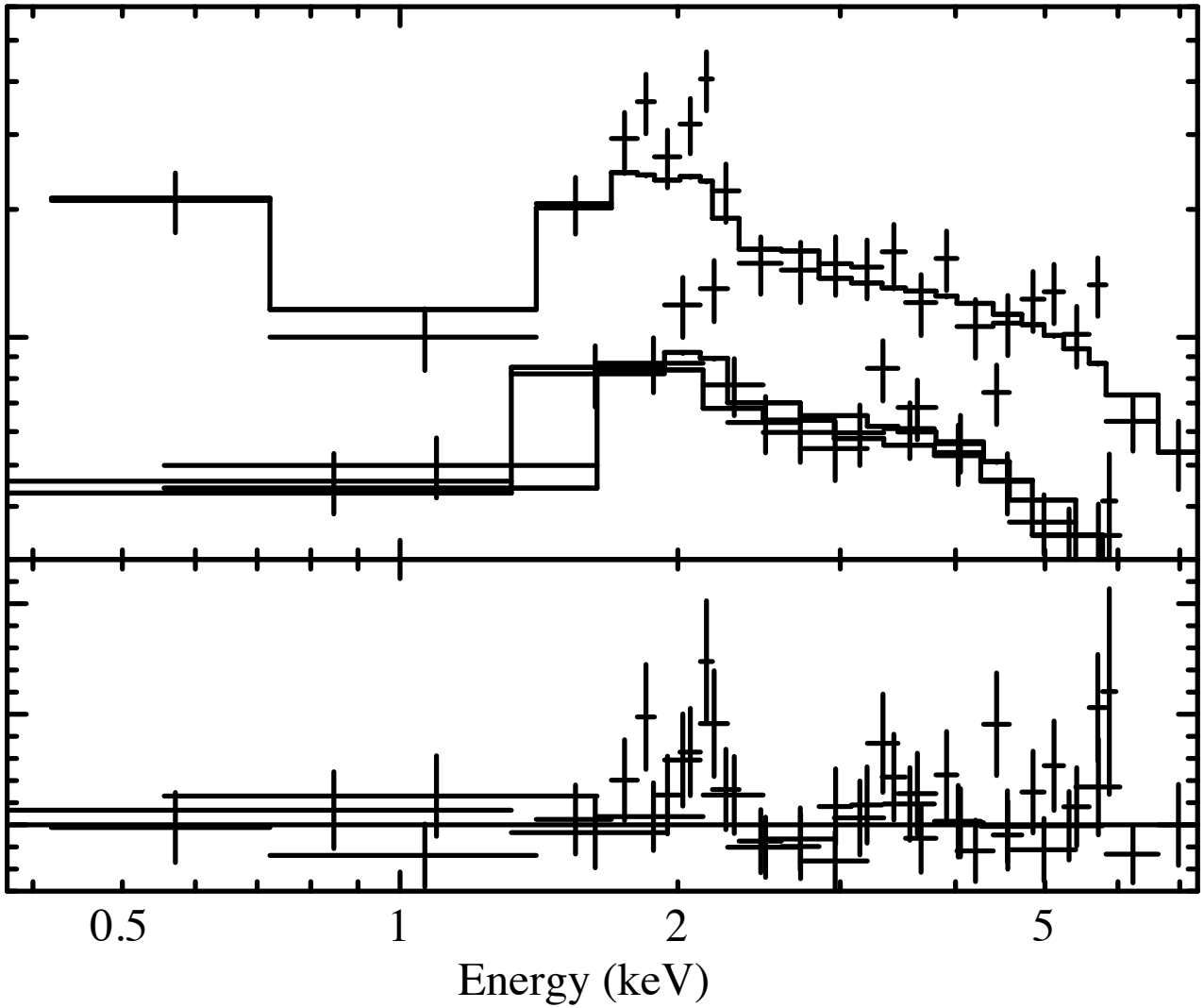
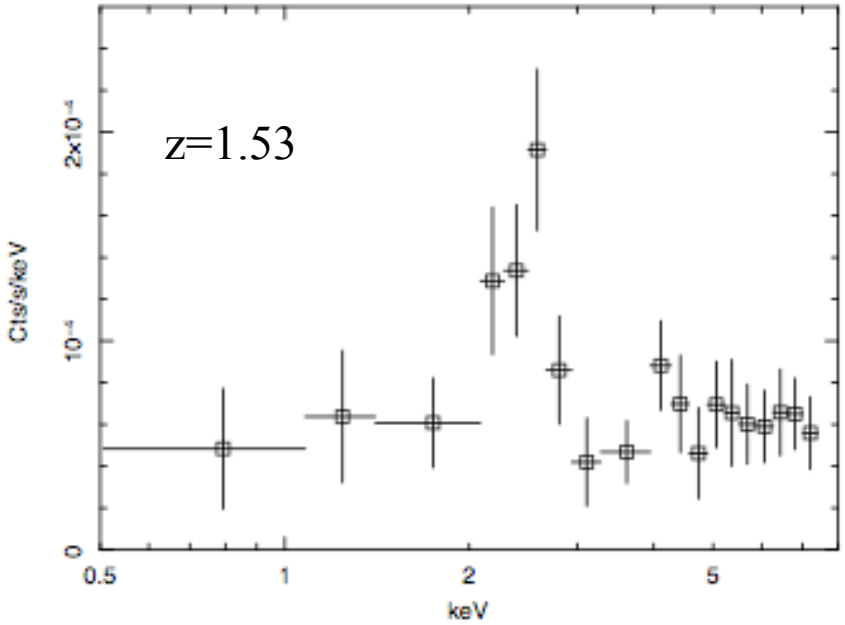


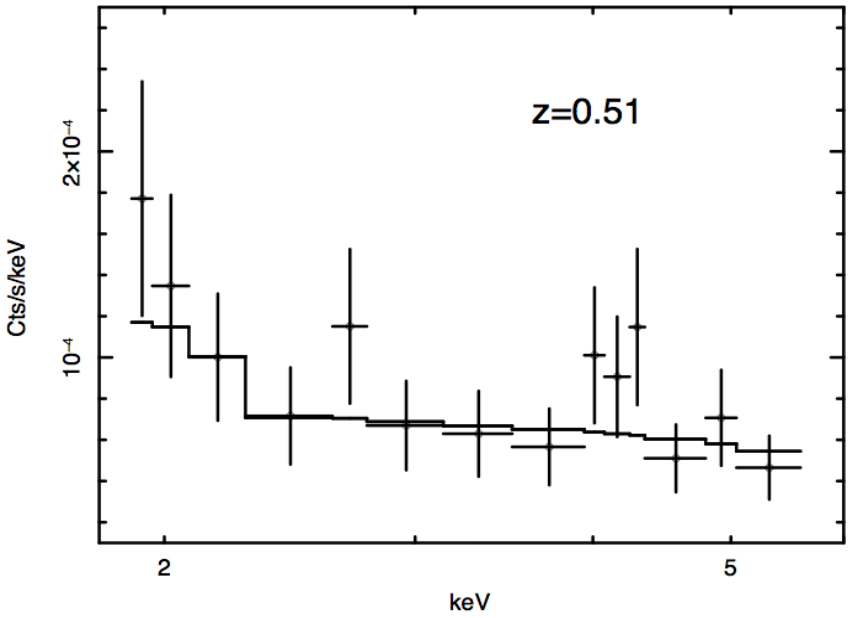
Photo-z ~ 1.5

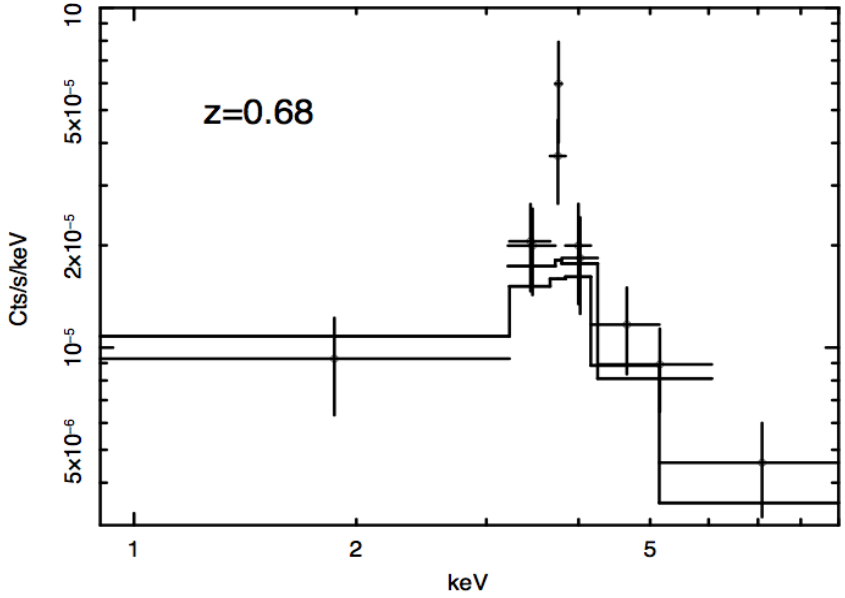
Xray-z=2.03+-0.04
(1sigma-1 par)

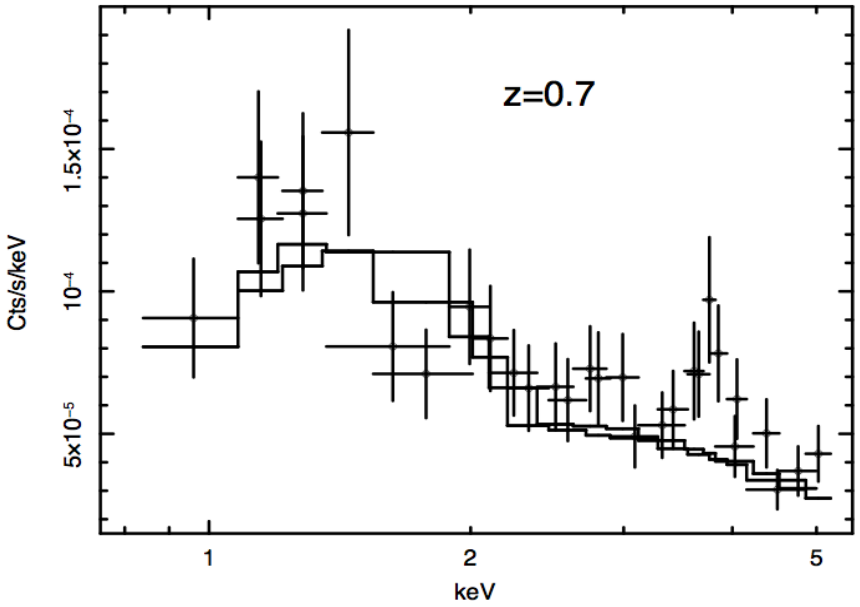
Gamma~ 1.05
(reflection dom?)
Line EW ~ 100 eV
Obs frame…
Gamma=1.9 fixed
N_H ~ 4 x 10^{23}

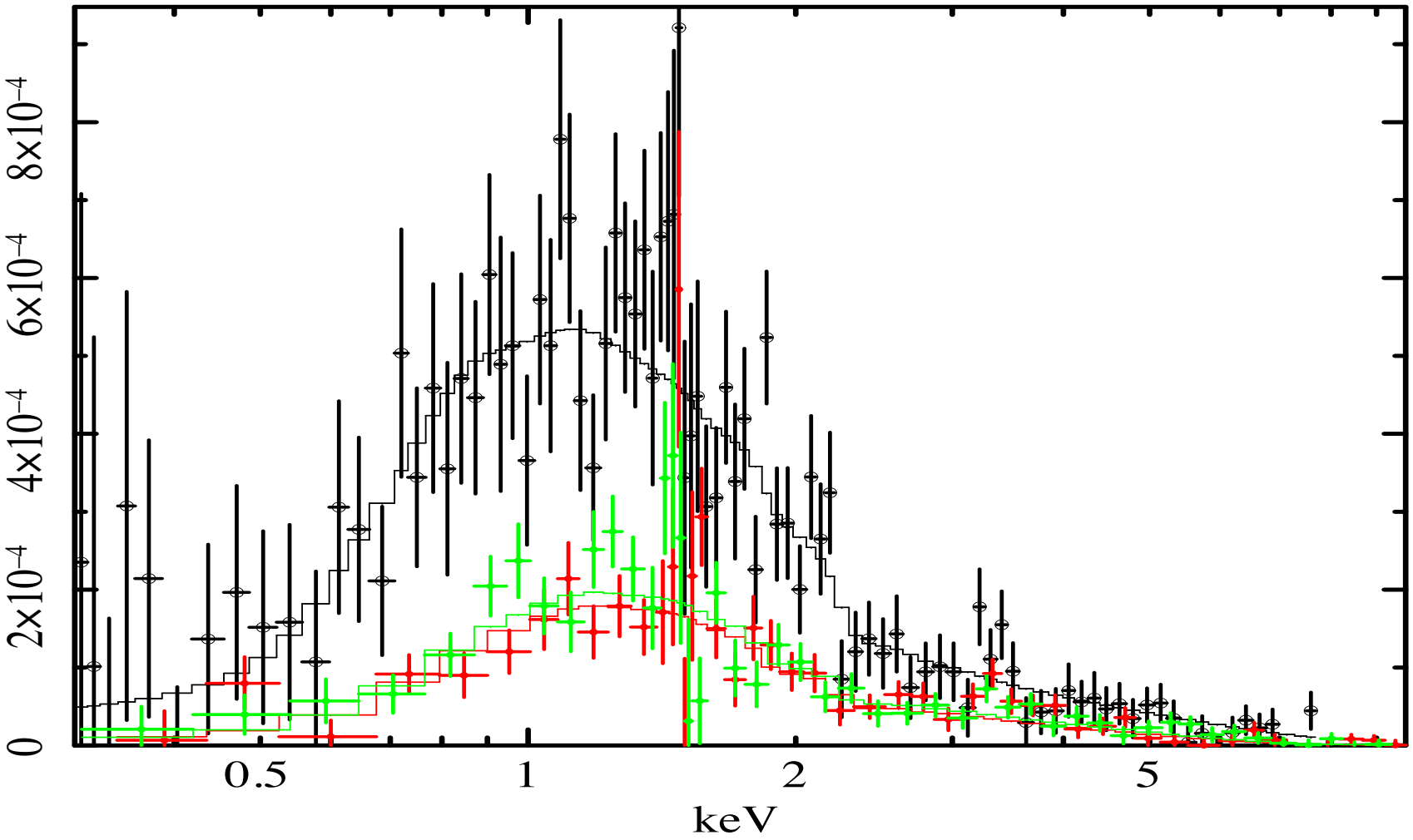
Distant C-thick AGN in the XMM-CDFS











P311 X-rayz=0.90+- 0.02

0.98 tentative Silverman – z(spec)=2.09?

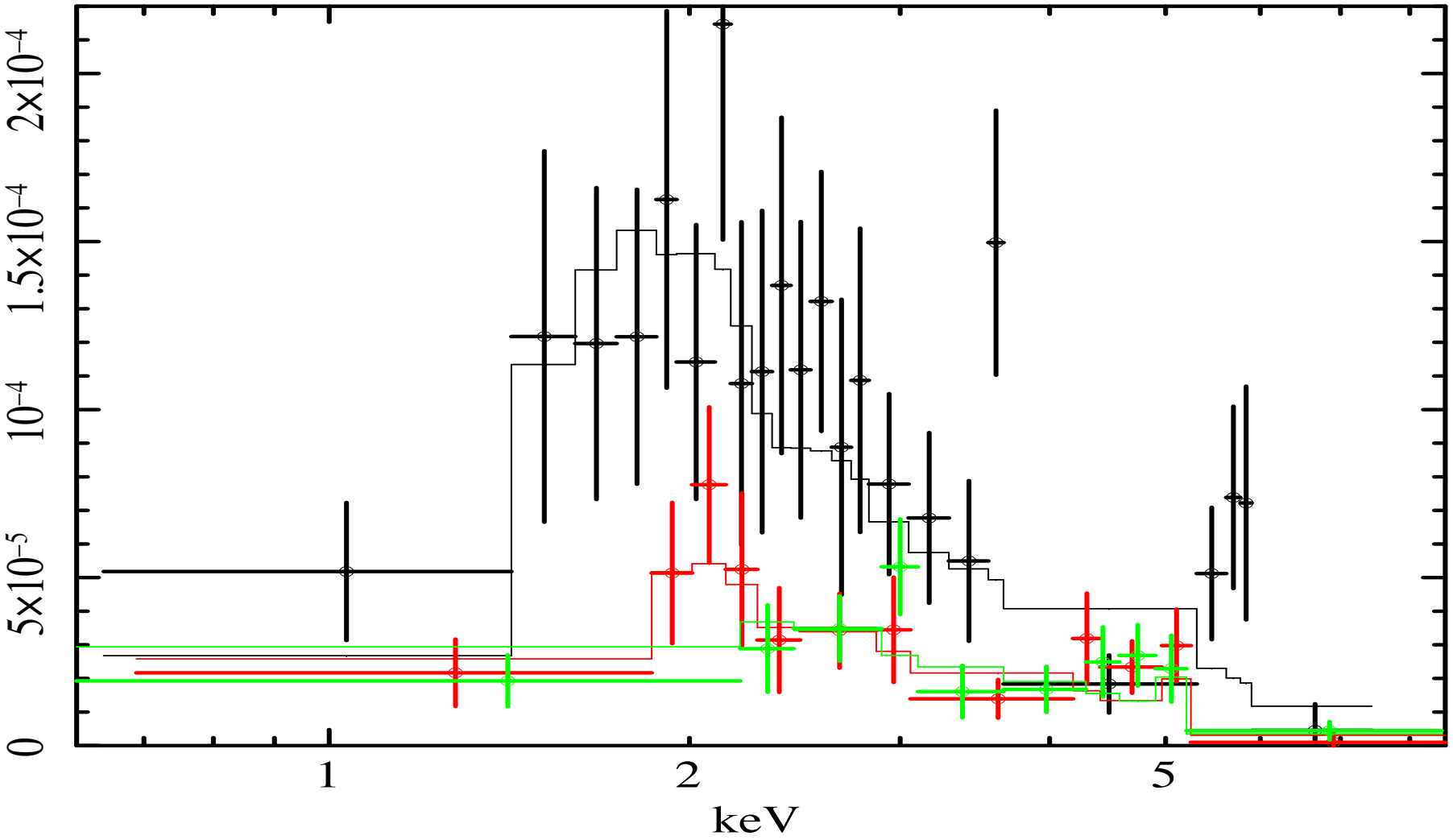
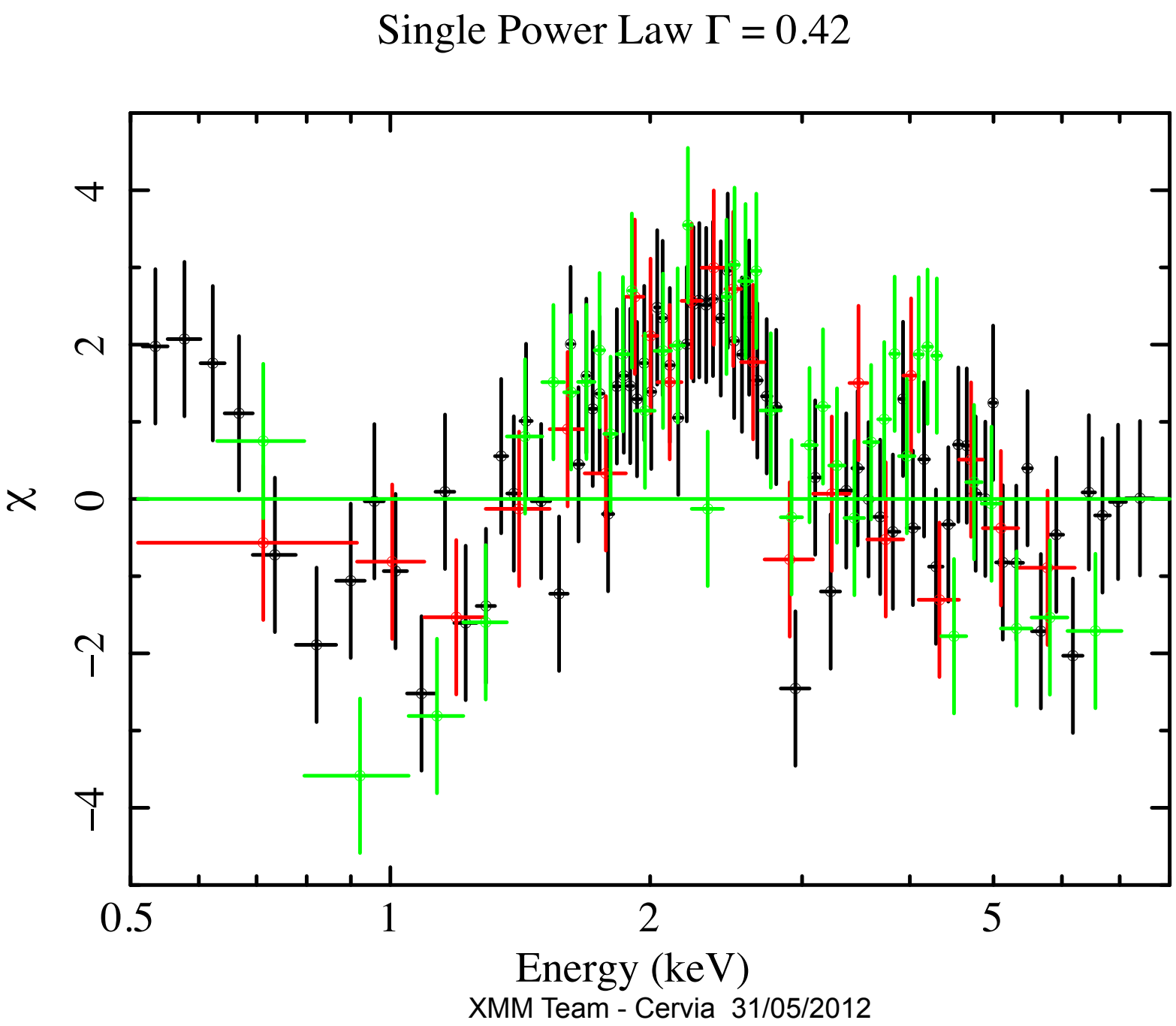
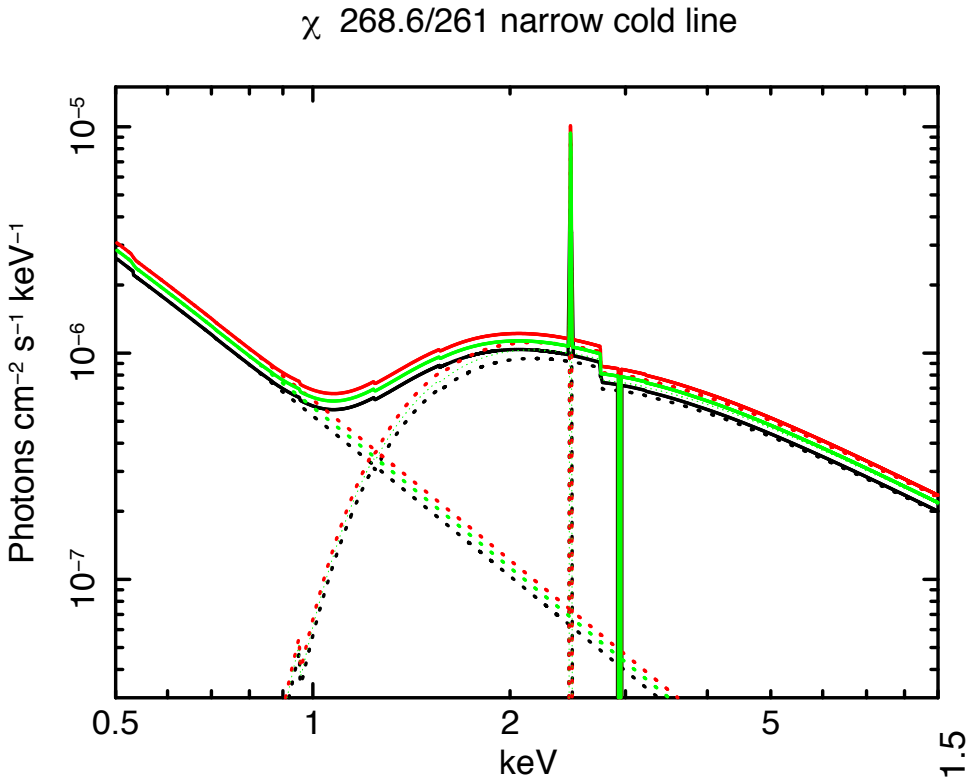


Photo-z 1.45, Highly obscured 2 x 10^{23}

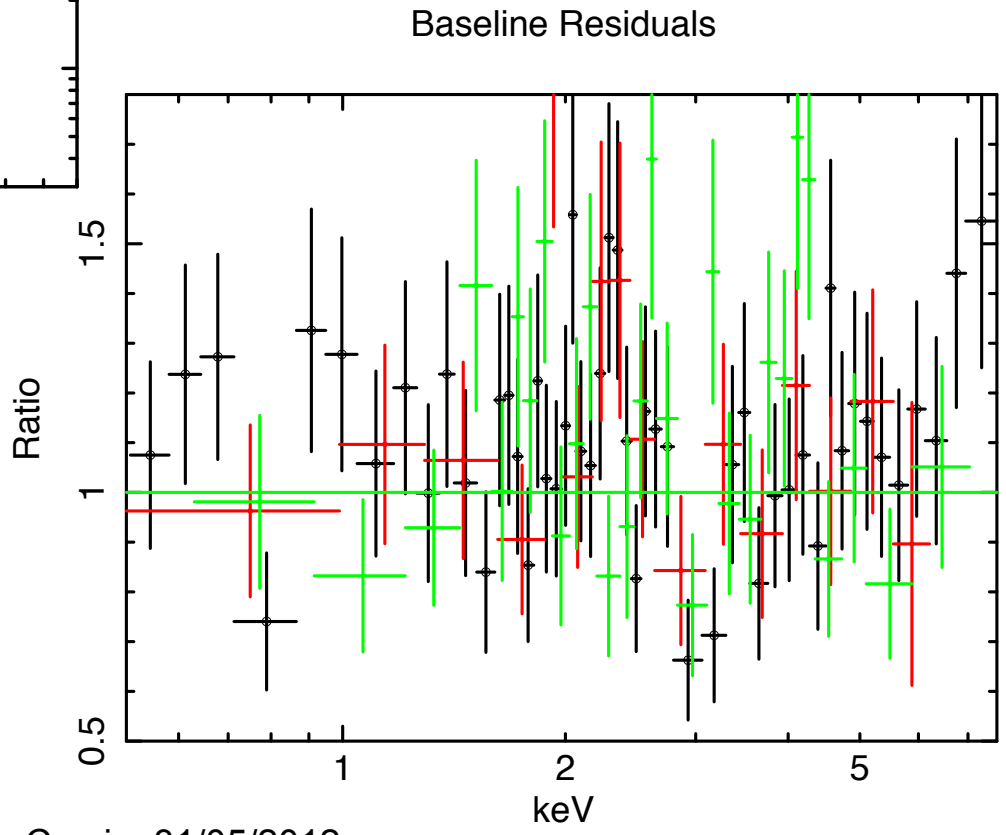
Excess (pn only) above 5 keV ??


Single Power Law Γ = 0.42
χ
4
2
0
−2
−4
0.5
1
2
5
Energy (keV)
XMM Team - Cervia 31/05/2012

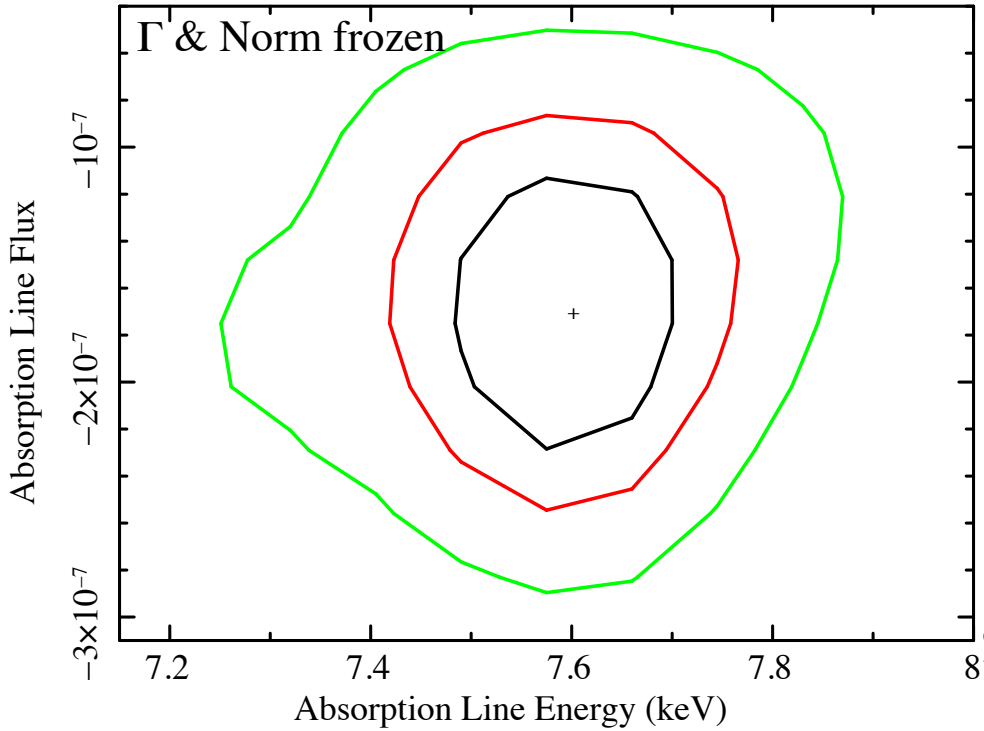


Best Fit model 1

Baseline plus narrow absorption line
Best fit Redshift ~ 1.58+-0.02
Formal 1 sigma error

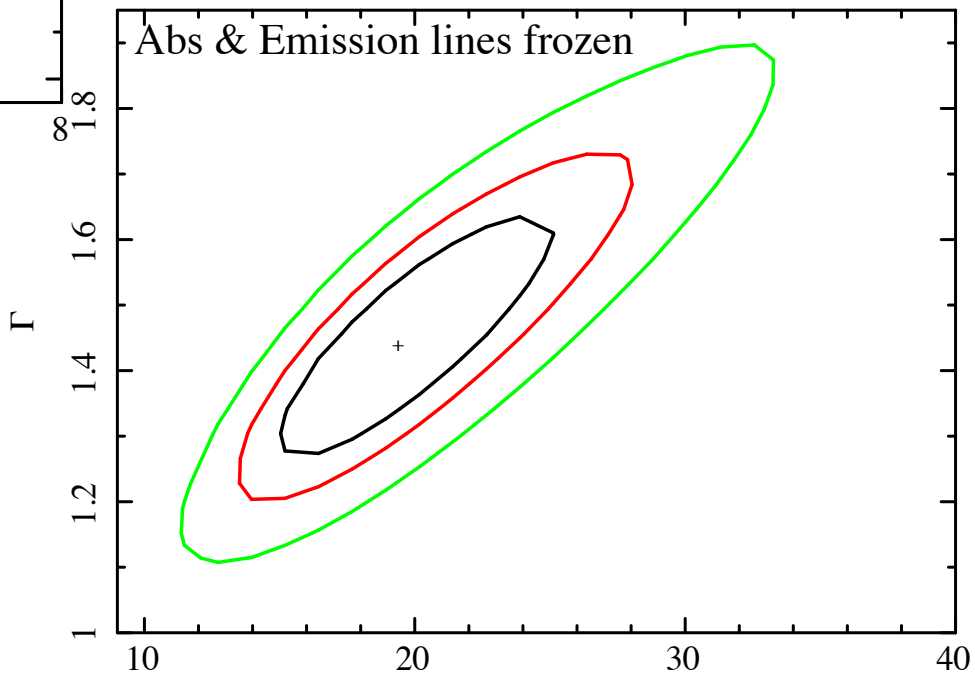


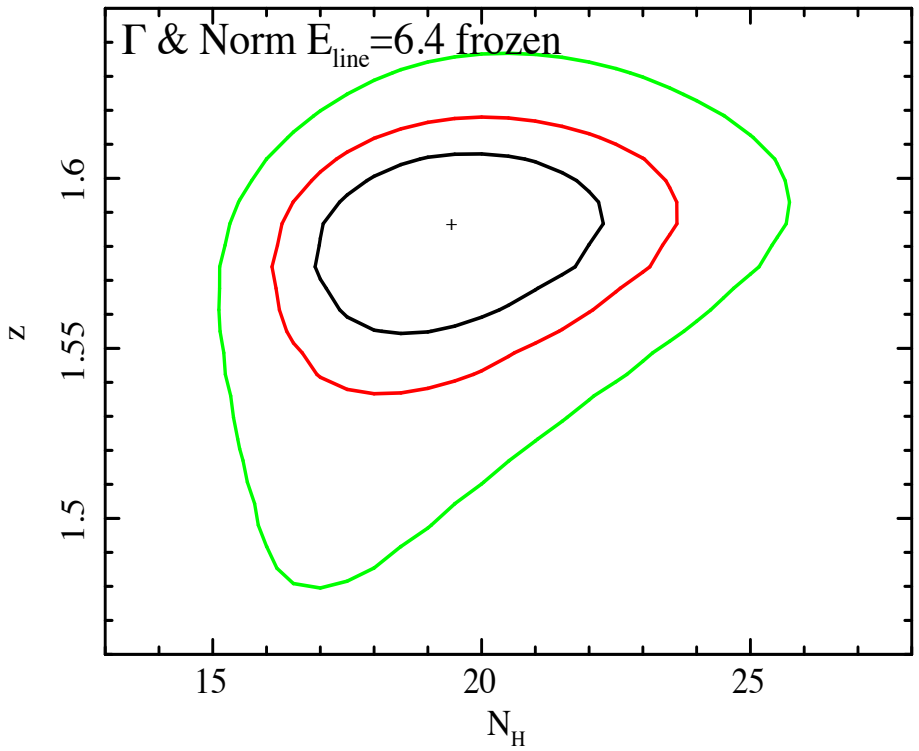
Residuals/Ratios wrt best fit "pure" baseline Deltachi ~ 18
Absorption feature is preferred to an edge



Narrow absorption line
Energy vs Flux
Need to freeze continuum parameters:
If resonant ionized iron line @ 6.96 keV then the outflow velocity <~ 0.1 c

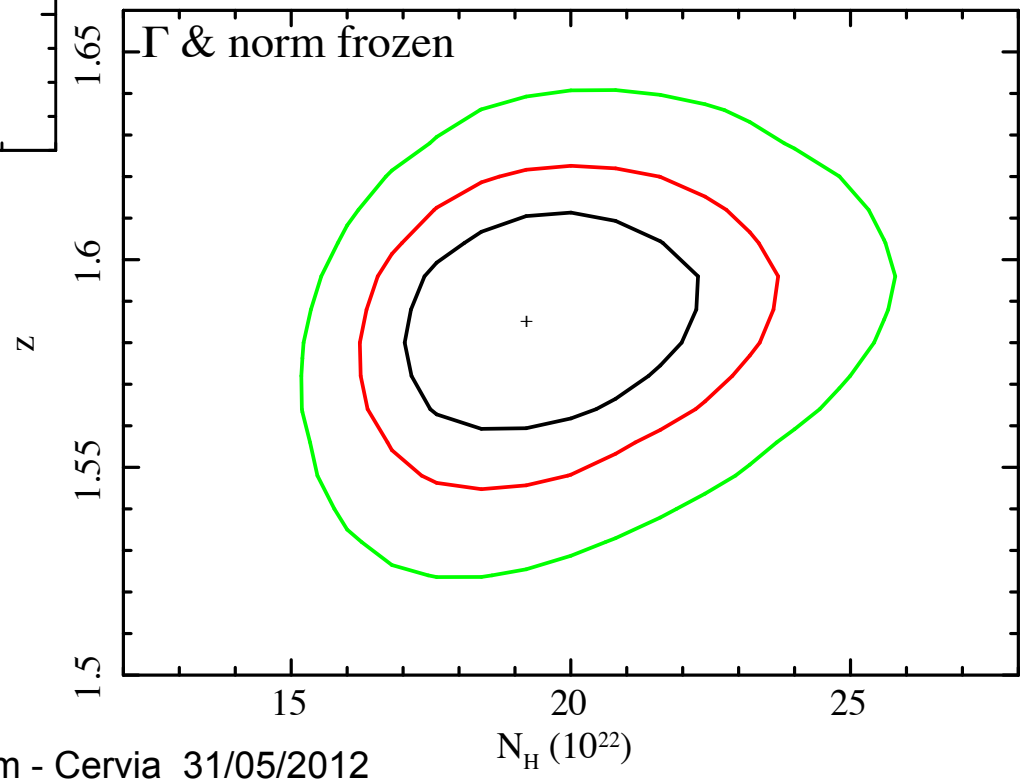
Flattish Power law plus plus strong absorption (again freezing the line parameters)



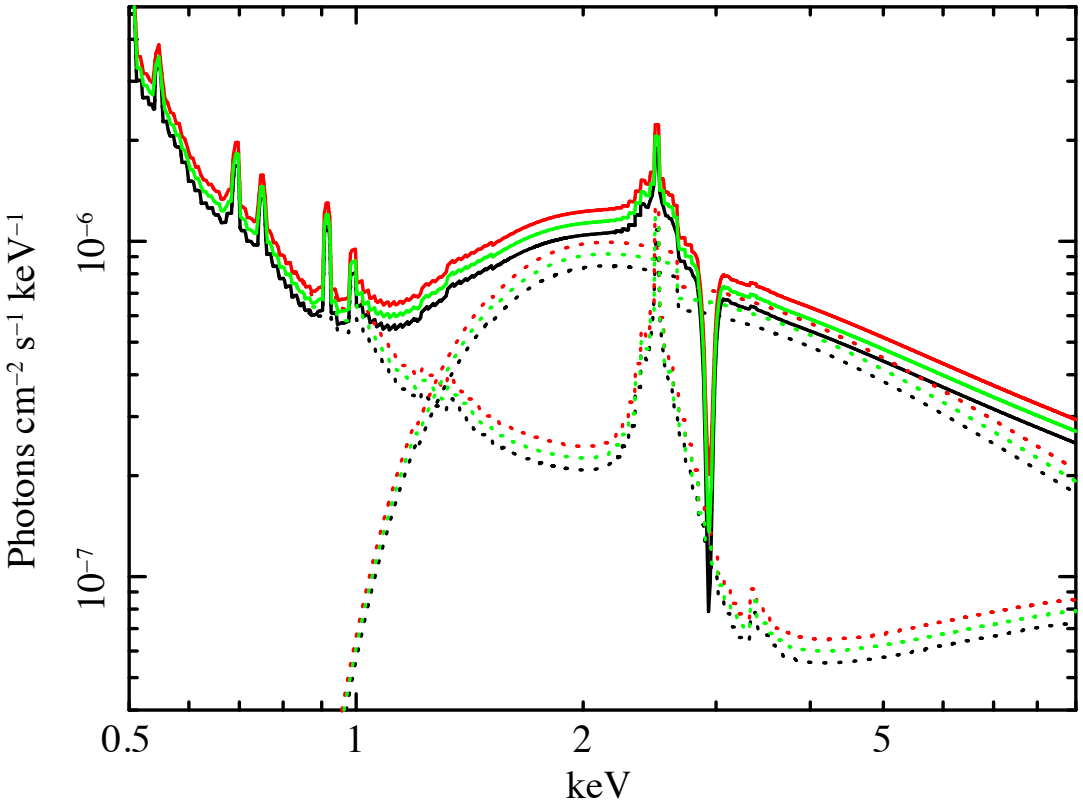


EQW emission line ~85 eV
EQW absorption line ~ -90 eV

Unabsorbed luminosity (2-10 keV)
3×10^{44} erg s^{-1} @ z ~ 1.58

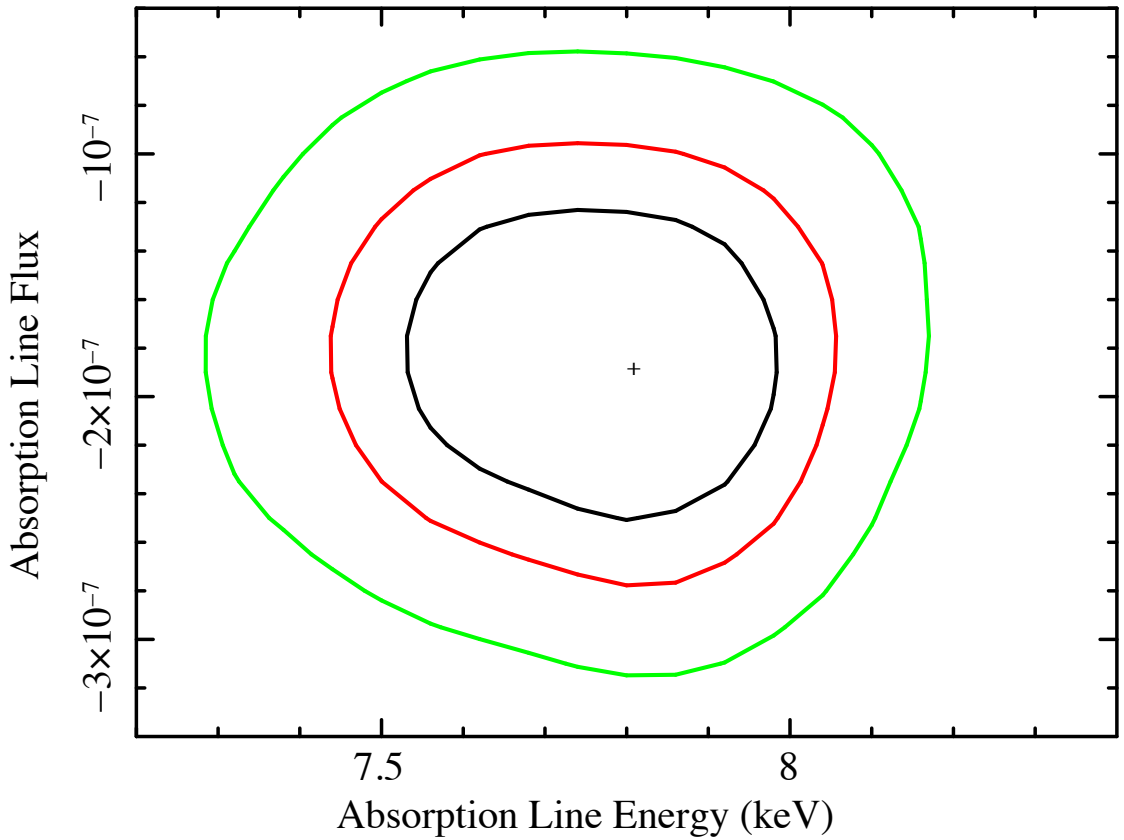


z_X~1.67; [Fe]~5; χ^2~264/259



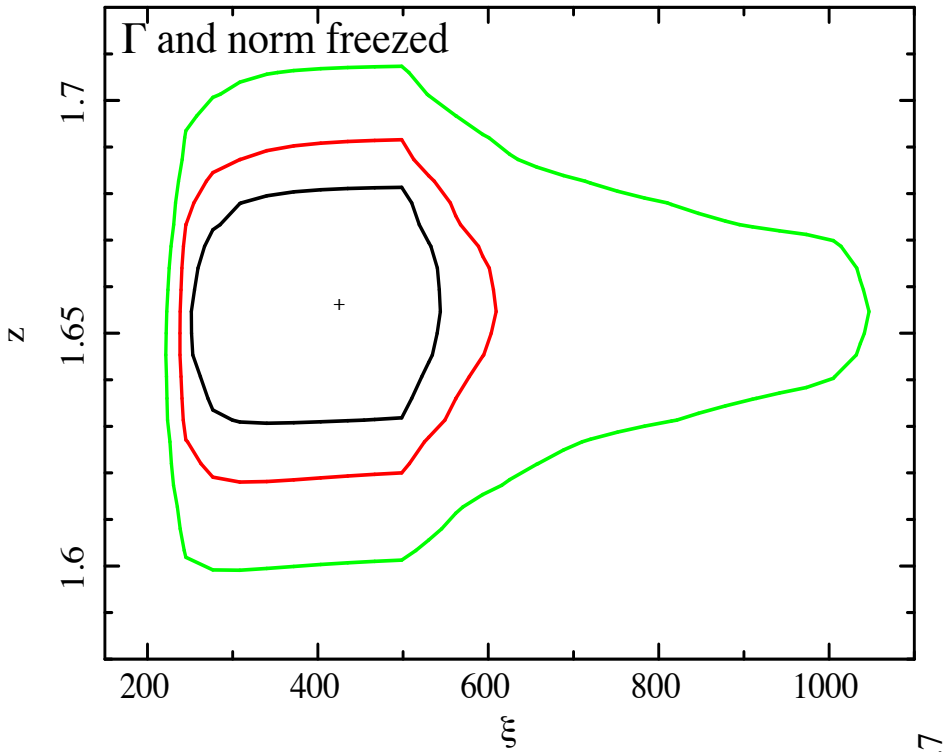
More physical model
Absorbed power law plus ionized reflection
Both emission line feature and soft excess are accounted for

Fix Iron to Solar abundances and absorption line width to zero
Chi^2 ~ 271

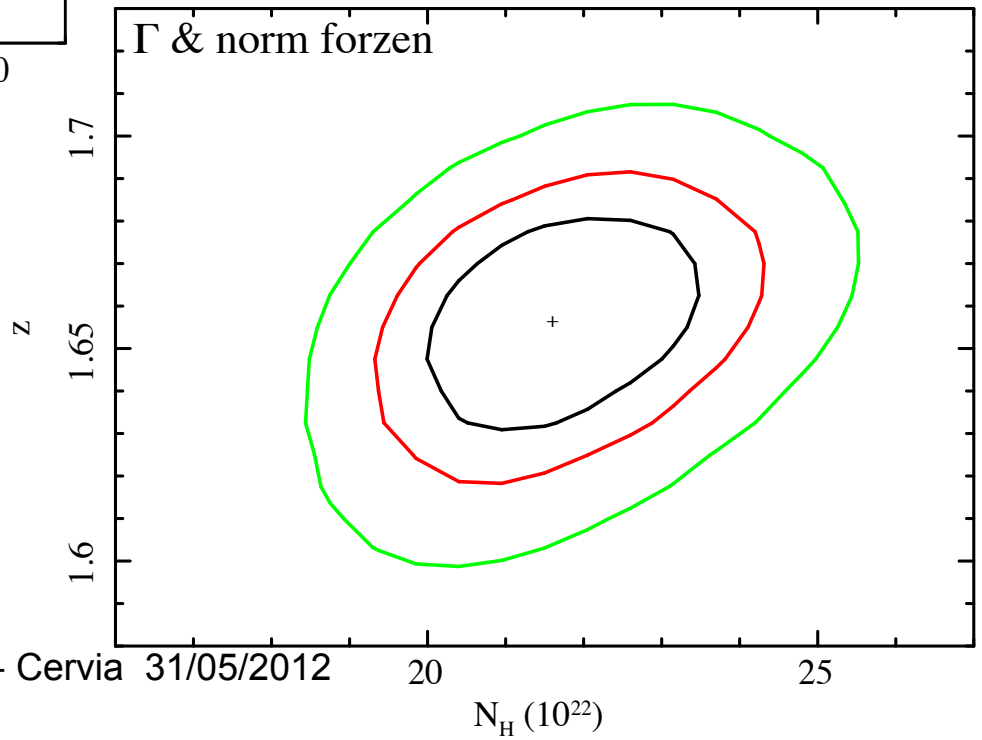


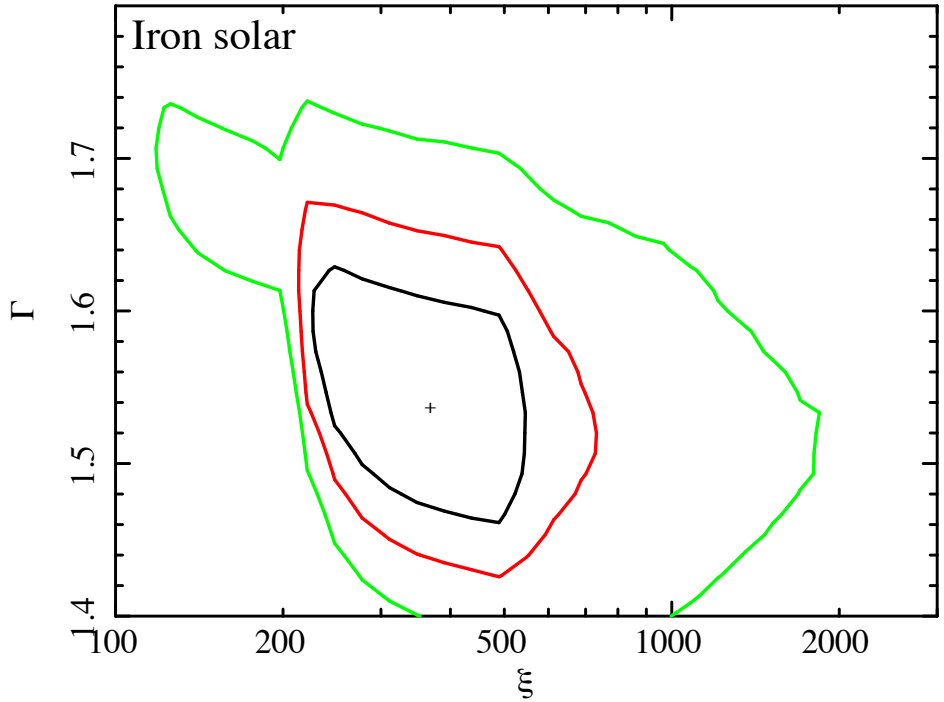
Absorption line energy vs flux
Freezing power law parameters

E ~ 7.8 keV @ z ~ 1.66
Outflow if resonant iron
0.12 c
EQW ~ -95 eV observed frame
250 rest frame



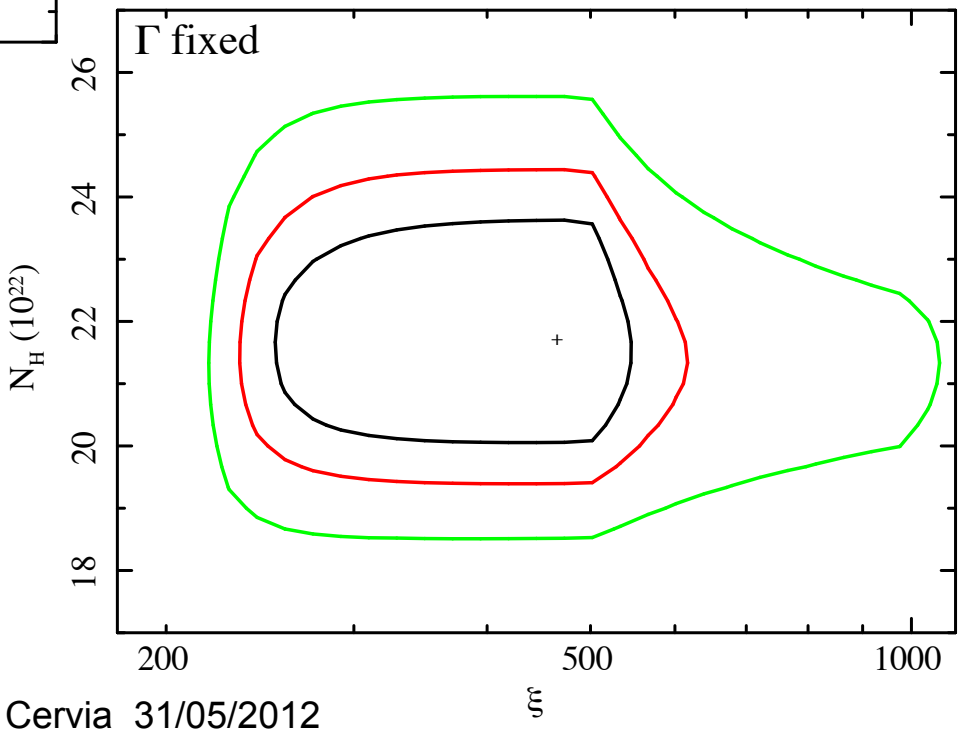
Constrain the redshift from the continuum cold absorption and ionized reflection

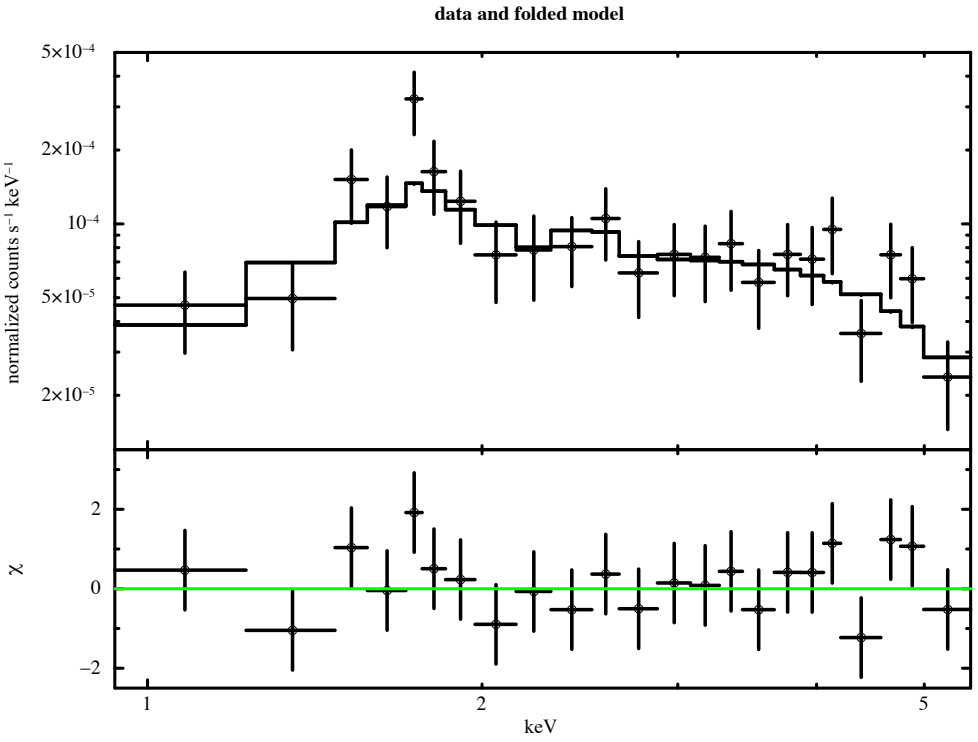




Flat continuum

Very good constraint to the
Cold absorption

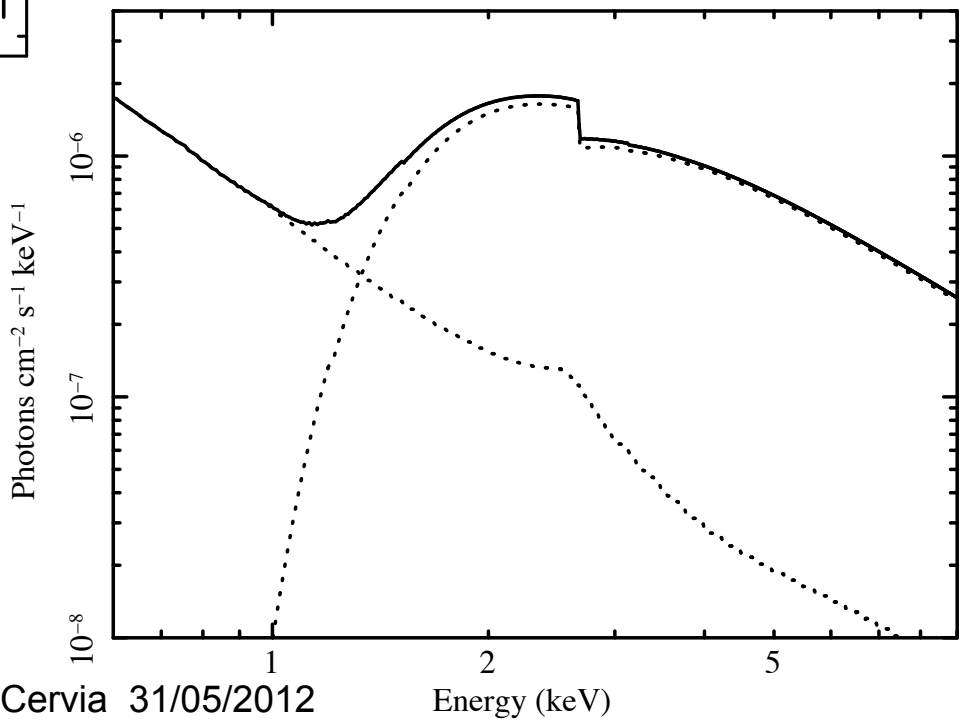




CHANDRA Spectrum

Power law plus Ionized Reflection
not very different from baseline
Chi^2 ~ 14.4/18

N_H ~ 3.5 x 10^{23}
Gamma ~ 1.86
Csi ~ 3000 (mimic a power law)
Redshift fixed @ the XMM value
~ 1.66



Summary Baseline

Baseline + Emission Line $\chi^2 = 286/262$

Some obvious Residuals

Improved by addition of:

1) Reflection Component $\Delta\chi^2 = 17$ / 1 dof (269/261) PEXRAV norm.

BUT $R \sim 9$ Reflection dominated

2) Additional Abs Edge $E \sim 7.2$ keV (neutral) $\tau = 0.48$ $\Delta\chi^2 = 18.7/2$ (267.3/260)

Physical meaning of extra abs edge?

3) Absorption line $E \sim 7.60$ $EW \sim 90$ eV (obs) $\Delta\chi^2 = 17.4/2$ (268.6/260)

$\Gamma_{soft} = 2.41^{+0.45}_{-0.42}$

$N_H = 19^{+4}_{-3}$

$\Gamma_2 = 1.44^{+0.13}_{-0.11}$

$z = 1.58 \pm 0.01$

$EW = 88 \pm 22$ (4σ)

$0.09c \pm 0.01$

$E_{ABS} = 7.60^{+0.06}_{-0.08}$

$EW = 91 \pm 21$

HAPPENS TO BE THE BEST FIT ALSO IN CHANDRA

SUMMARY IONIZED REFLECTION

IRON ABUNDANCE ≡ SOLAR

Absorption line improvement 290.7/263 → 271.4/261

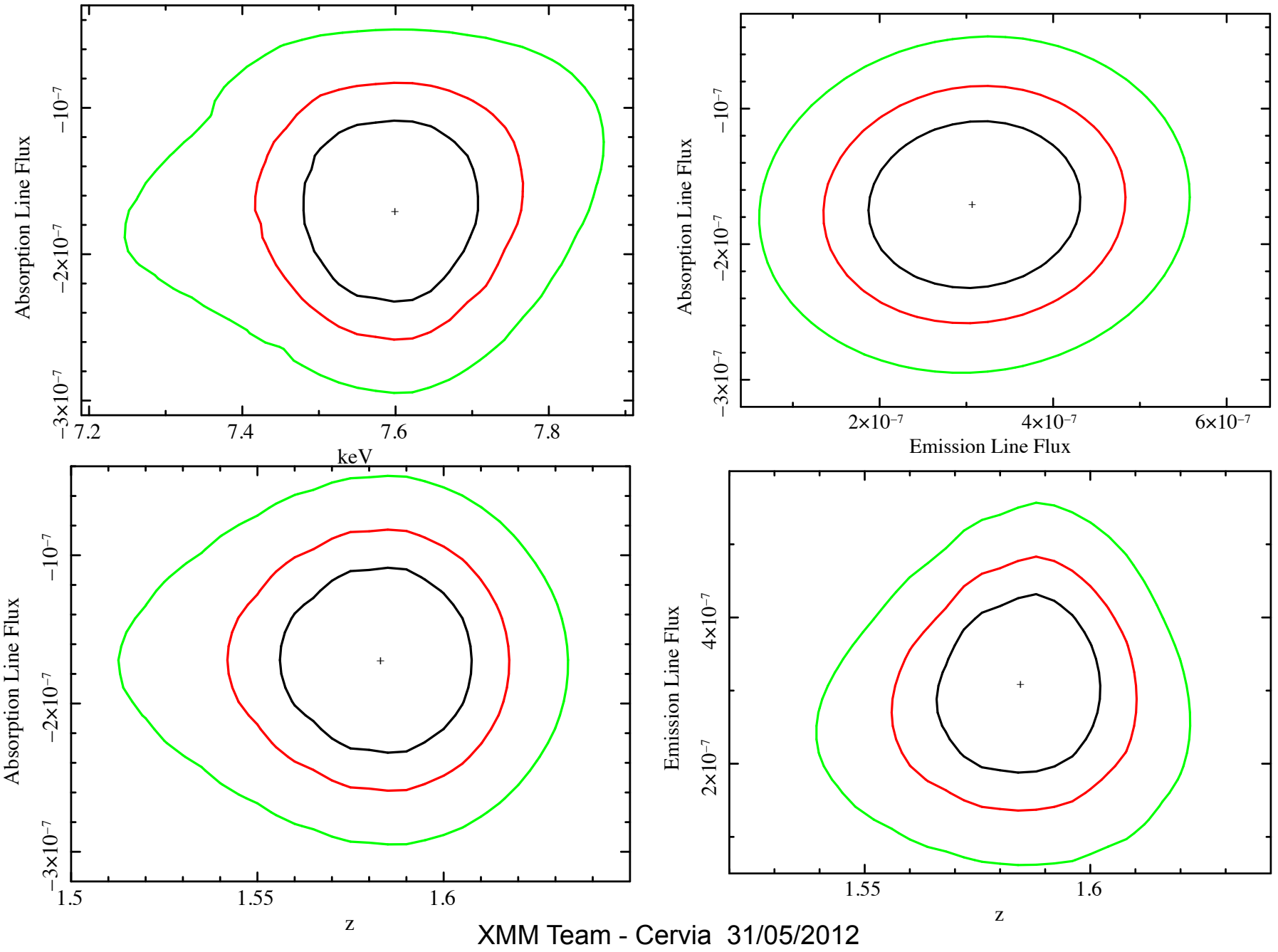
$\Delta\chi^2 = 19/2$

IRON ABUND ≡ SUPERSOLAR ~ 2.5 – 5

Absorption line impr. 282.2/262 → 264.2/260

$\Delta\chi^2 = 18/2$

IRON	$= 50^{+2.6}_{-1.2}$	$2.0^{+1.6}_{-0.6}$
$\mathcal{G}$	$= 515^{+37}_{-12}$	235^{+114}_{-24}
ξ	$= 1.67 \pm 0.03$	1.65 ± 0.04
N_H	$\approx 21^{+2}_{-3}$	28 ± 2
E	$= 7.83^{+0.10}_{-0.17}$	$7.79^{+0.11}_{-0.15}$
EQW	$= -90 \pm 22$	-94 ± 22
Γ	$= 1.42^{+0.07}_{-0.02}$ (f)	$\Gamma = 1.8$ (f)
	264.2/260	$\chi^2 = 276.5/261$



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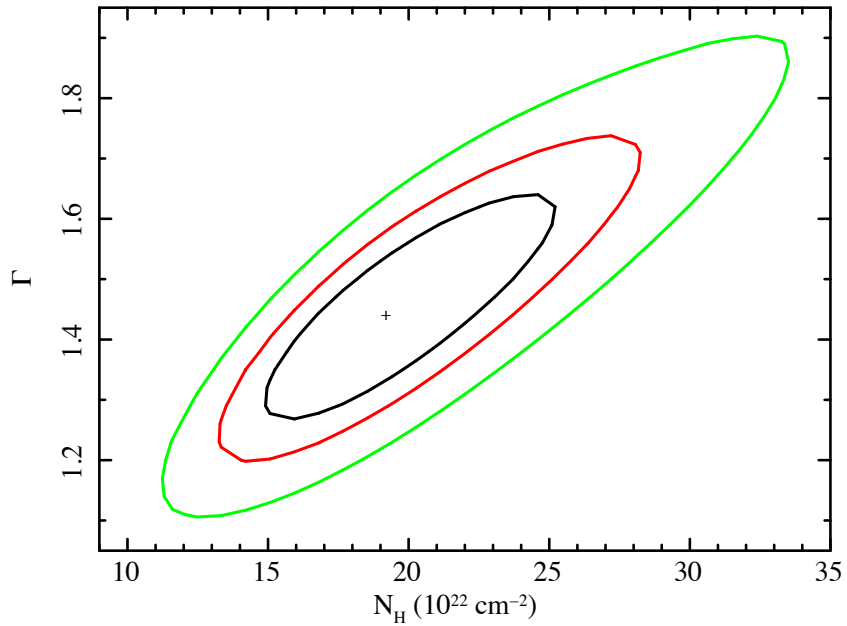
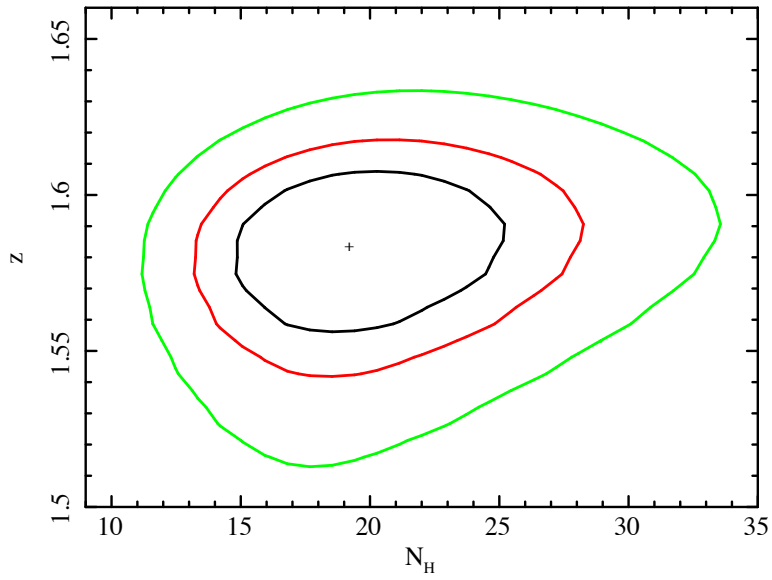
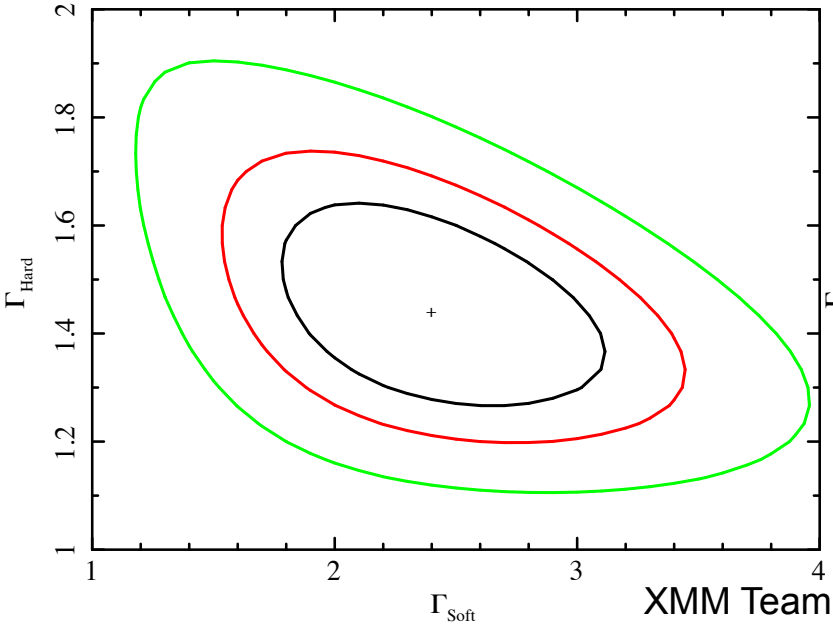
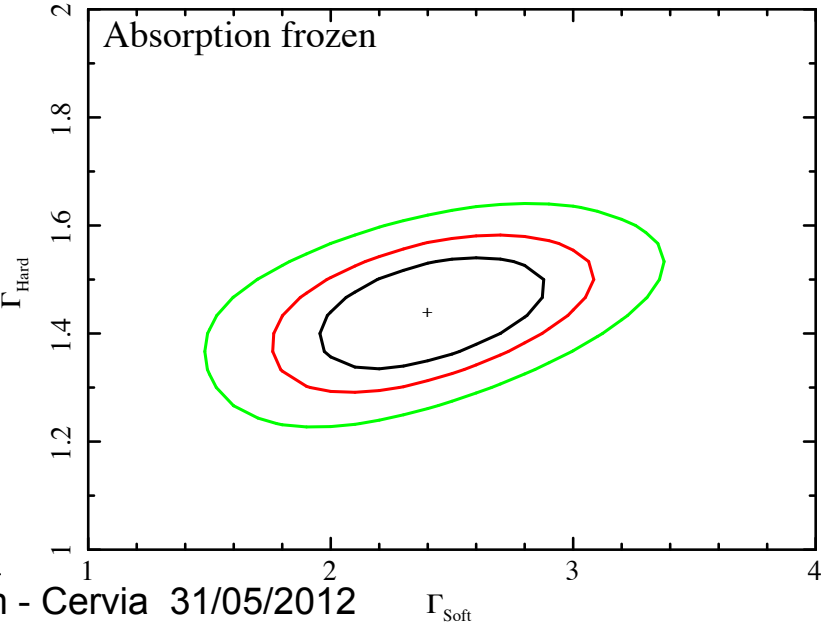
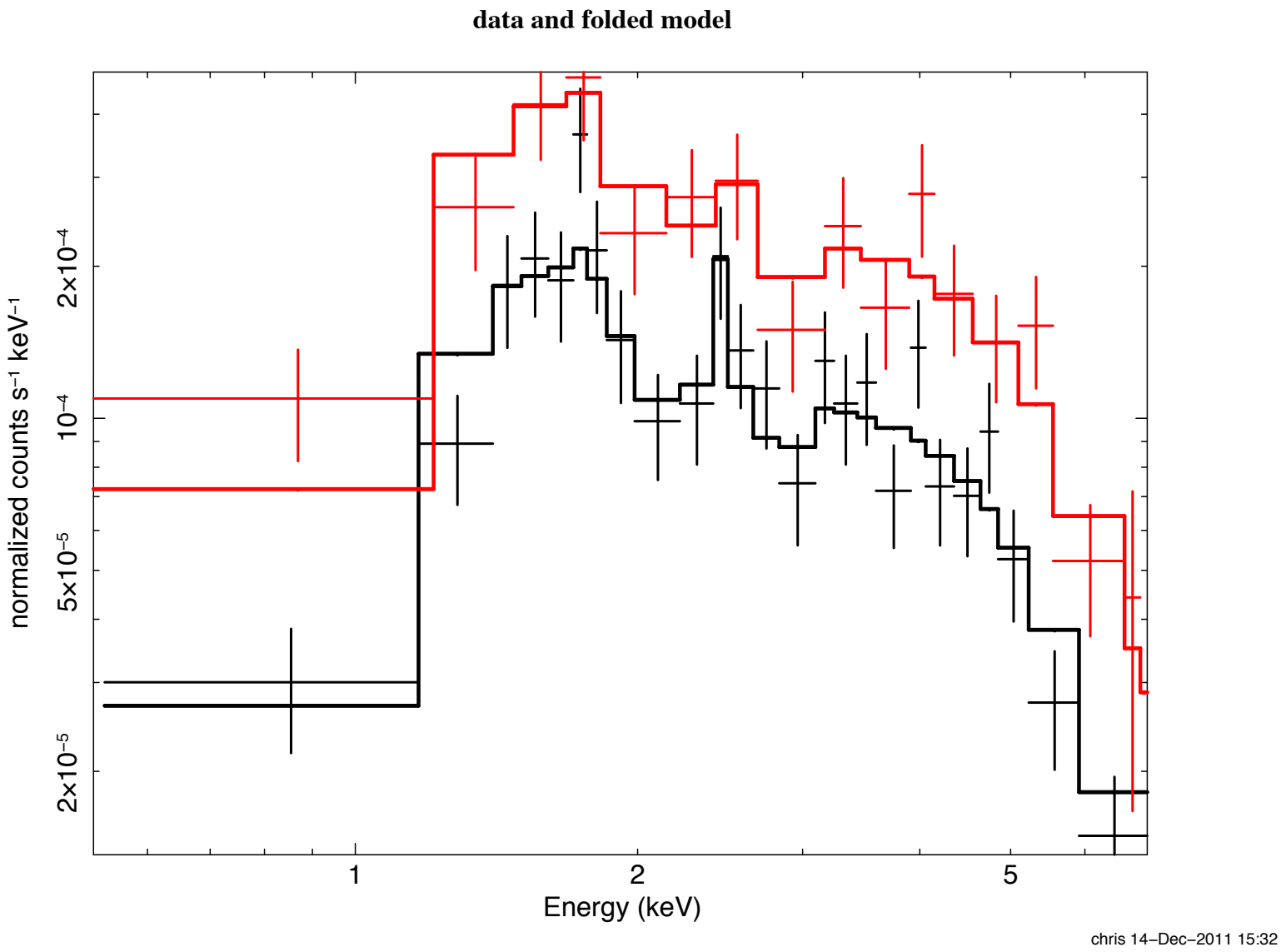
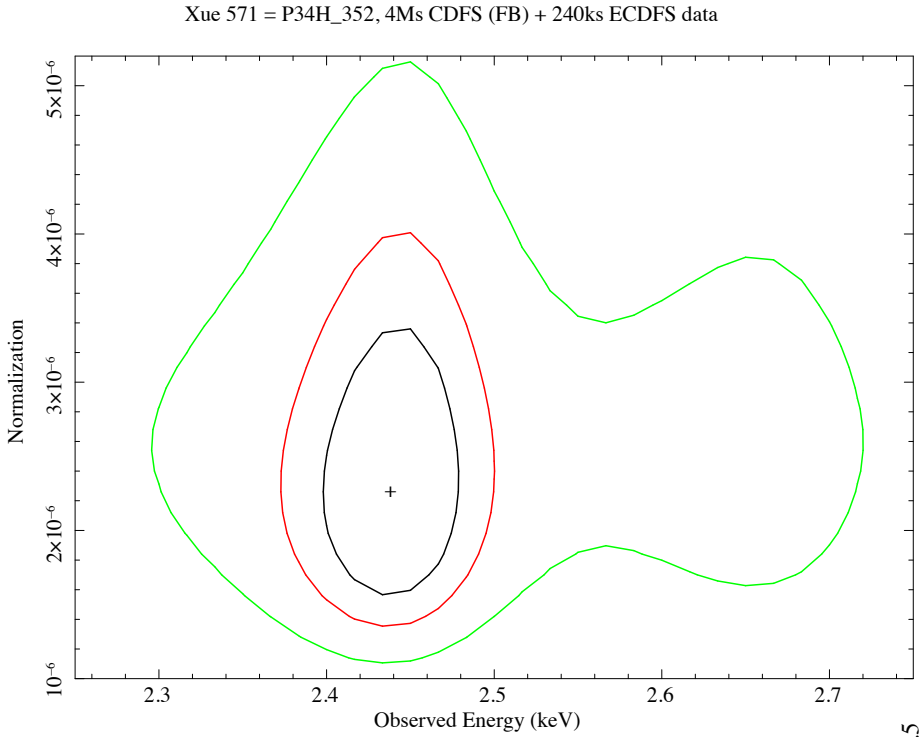

Γ
1.2
1.4
1.6
1.8
10
15
20
25
30
35
N_H (10^22 cm^-2)

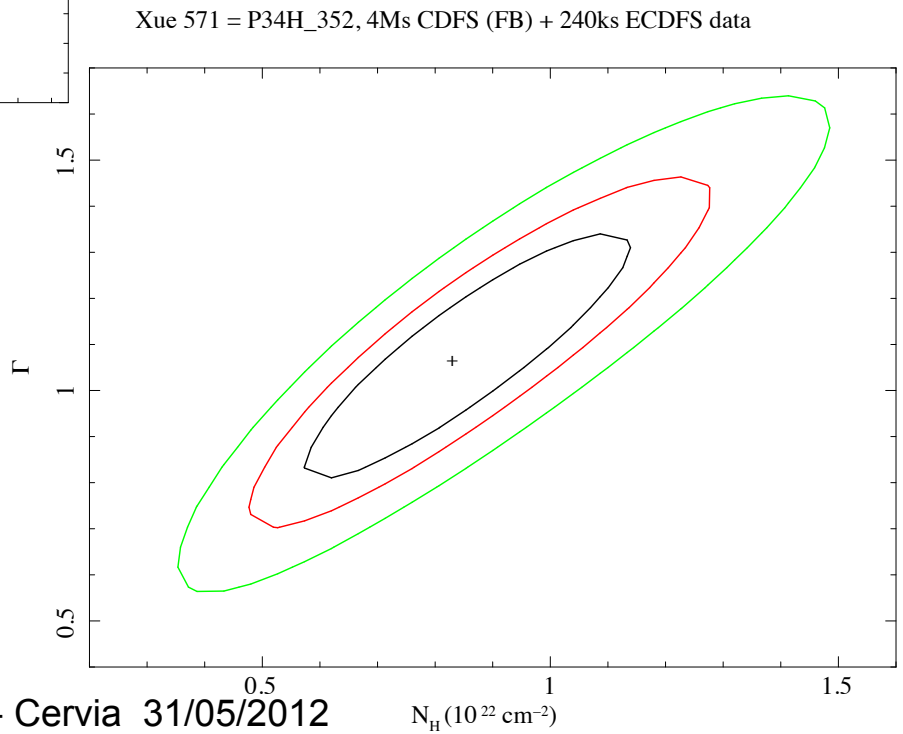

z
1.5
1.55
1.6
1.65
10
15
20
25
30
35
N_H


Γ_Hard
1
1.2
1.4
1.6
1.8
2
1
2
3
4
Γ_Soft

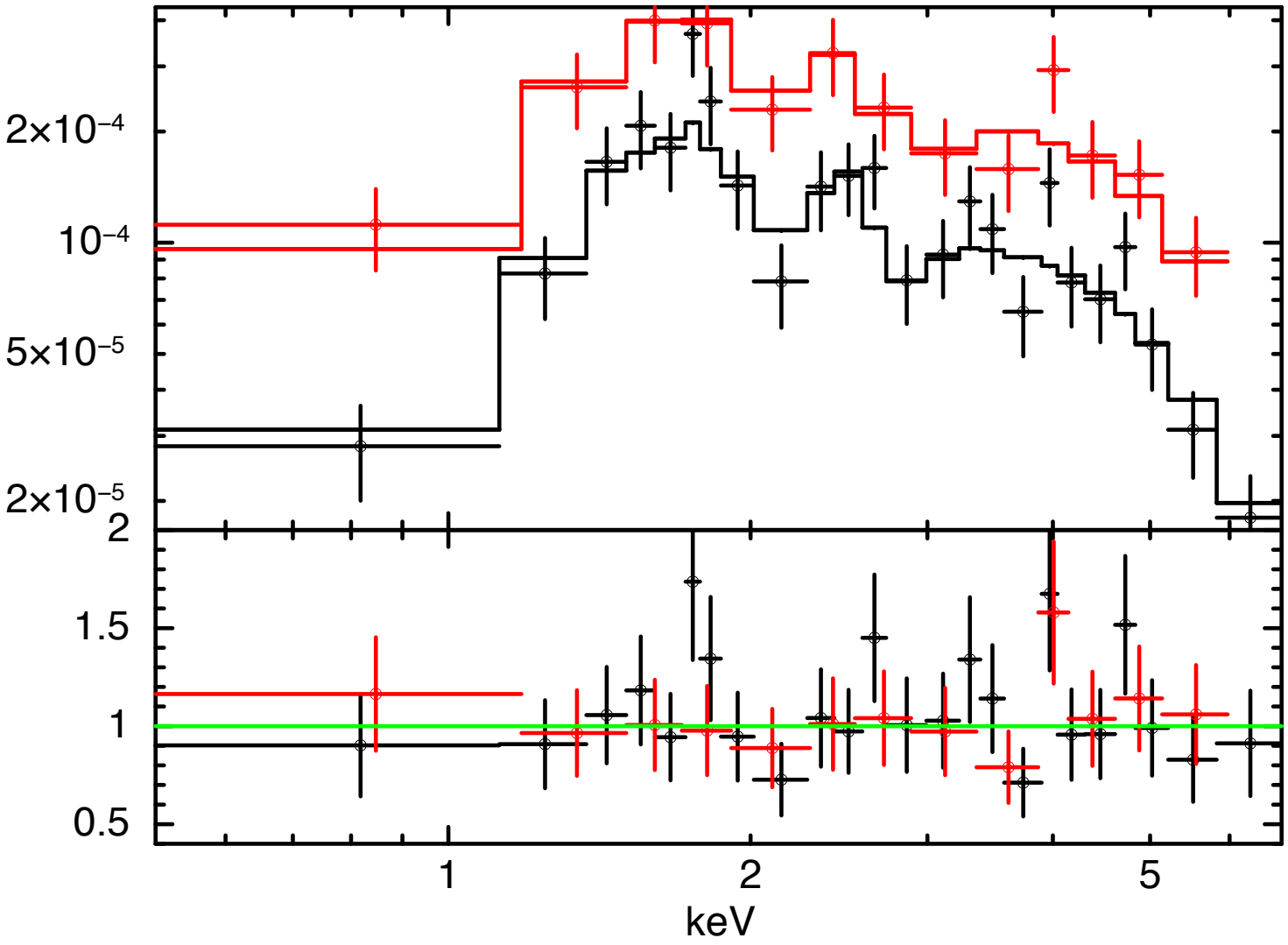

Absorption frozen
Γ_Hard
1
1.2
1.4
1.6
1.8
2
1
2
3
4
Γ_Soft


data and folded model
normalized counts s^{-1} keV^{-1}
2x10^{-4}
10^{-4}
5x10^{-5}
2x10^{-5}
1
2
5
Energy (keV)
chris 14–Dec–2011 15:32


Xue 571 = P34H_352, 4Ms CDFS (FB) + 240ks ECDFS data
Normalization
5×10⁻⁶
4×10⁻⁶
3×10⁻⁶
2×10⁻⁶
10⁻⁶
2.3
2.4
2.5
2.6
2.7
Observed Energy (keV)


Xue 571 = P34H_352, 4Ms CDFS (FB) + 240ks ECDFS data
Γ
1.5
1
0.5
0.5
1
1.5
N_H (10^22 cm^-2)

Ionized Reflection plus absorbed power law



Summary

- Background subtraction/fit
- …