Spectral fitting of absorption iron lines in 4U1630-472

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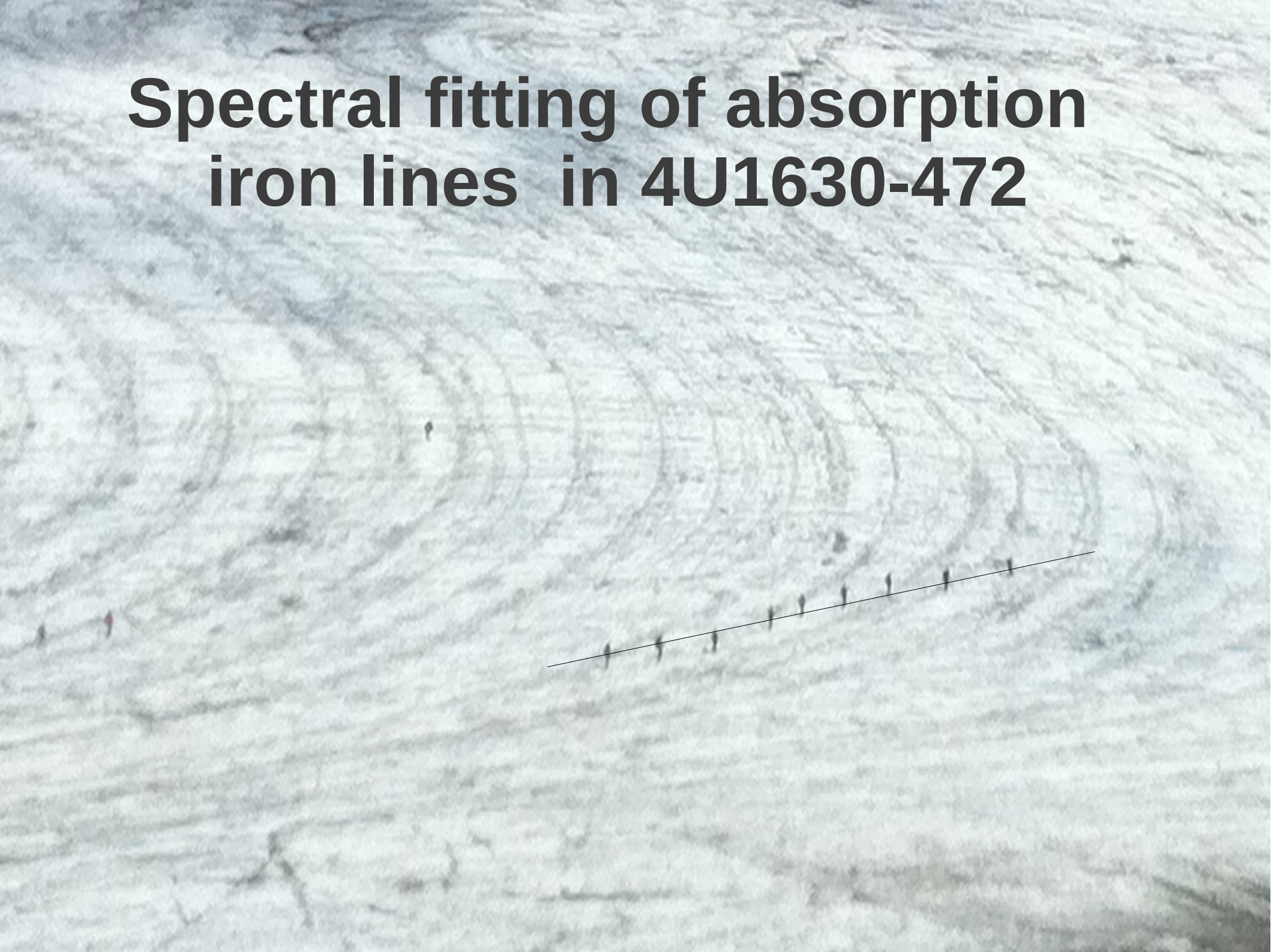
FERO 2012

Spectral fitting of absorption iron lines in 4U1630-472



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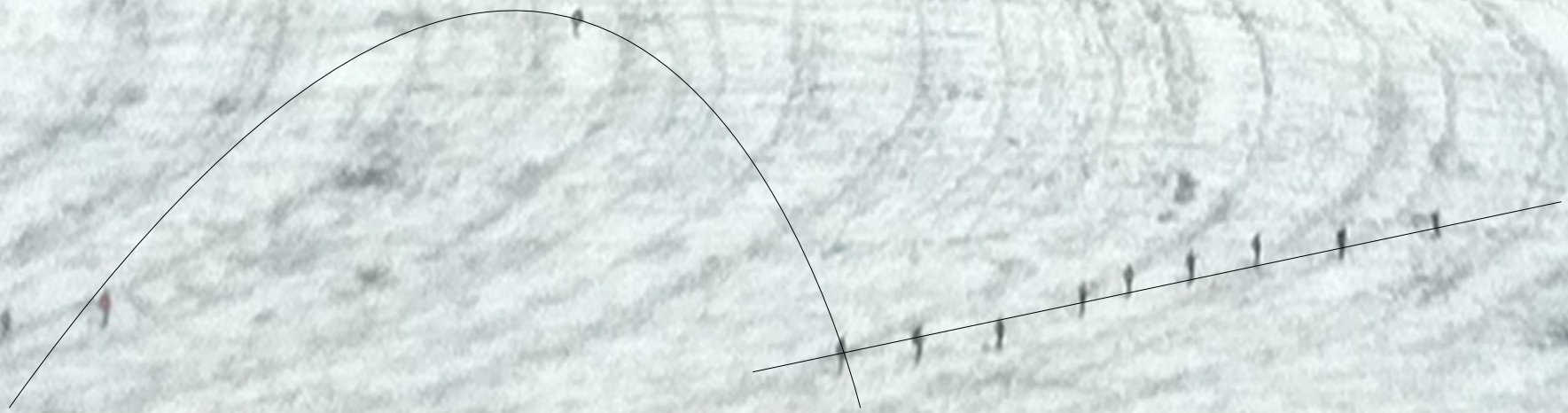
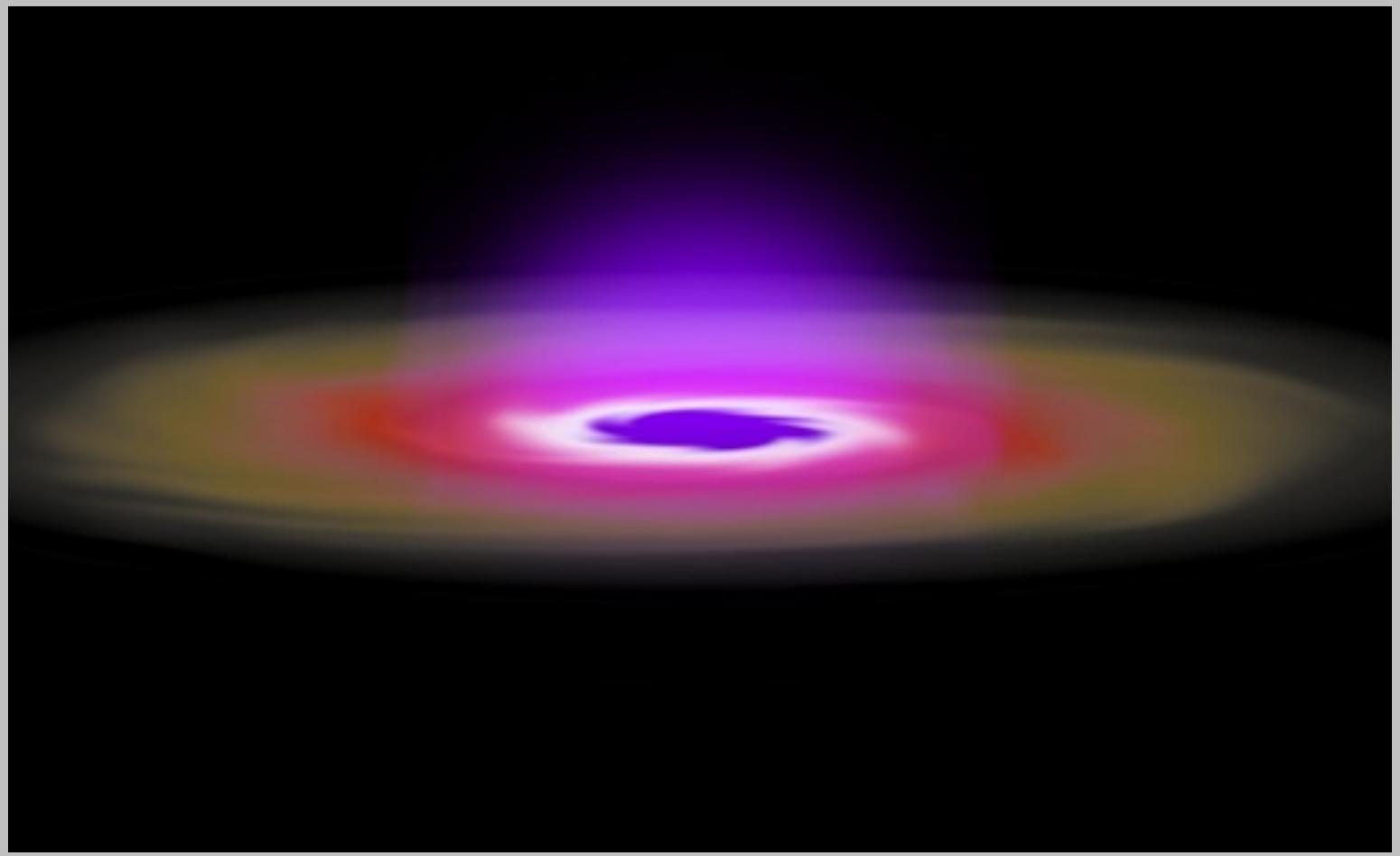


Total spectra integrated over disk surface:

$$I_E^{tot}(\mu) = 2\pi \sum_{n=1}^{n=N} I_E^{(n)}(\mu)\, R_n\, \Delta R_n$$

$\mu = \cos(i)$ cosine of viewing angle



$$\mu \frac{\delta I_\nu}{\delta \tau_\nu} = I_\nu - \epsilon_\nu B_\nu - (1-\epsilon_\nu) J_\nu - \sum_{i=\alpha,\beta} \frac{E^i_{fl} \phi^i_\nu}{\kappa_\nu + \sigma_\nu}$$
$$+(1-\epsilon_\nu) J_\nu \int \Phi_1(\nu,\nu')\, d\nu' - (1-\epsilon_\nu) \int (J_{\nu'} + U_{\nu'}) \Phi_2(\nu,\nu')\, d\nu'$$

$N_\tau \times M_\nu, \quad 175 \times 2200$

Hubeny et al. 2001

Multiple Compton scattering of hard radiation, up to 400 keV, on electrons of the temperatures up to 10^8 K, Pomraning 1973 “Radiation Hydrodynamics”.

Kompaneets equation, valid for no relativistic photons and electrons.

Irradiation by external source and iron fluorescent emission are fully taken into account. .

Irradiation is NOT included.

LTE equation of state.
We assume solar abundance of:
H, He, C, N, O, Ne, Mg, Si, S, Fe.
Verner & Yakovlev 1995, A&AS, 109, 125.

No-LTE equation of state.
Solar abundances.

Local vertical temperature structure of an accretion disks without irradiation in BHBs:

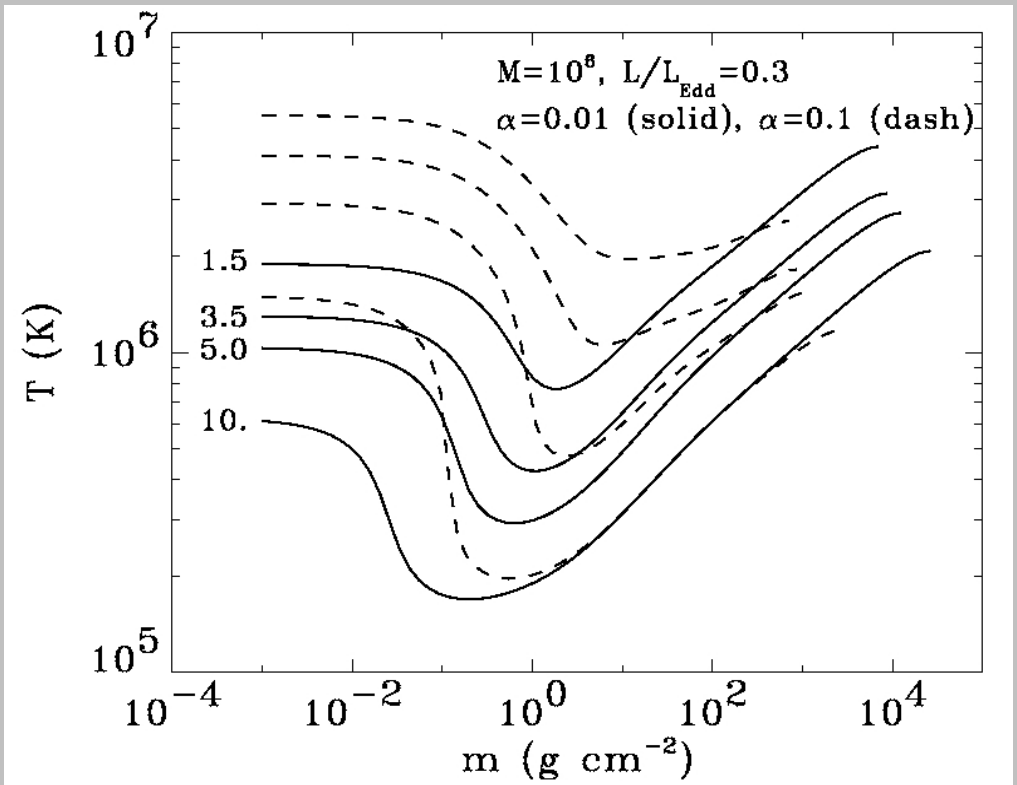
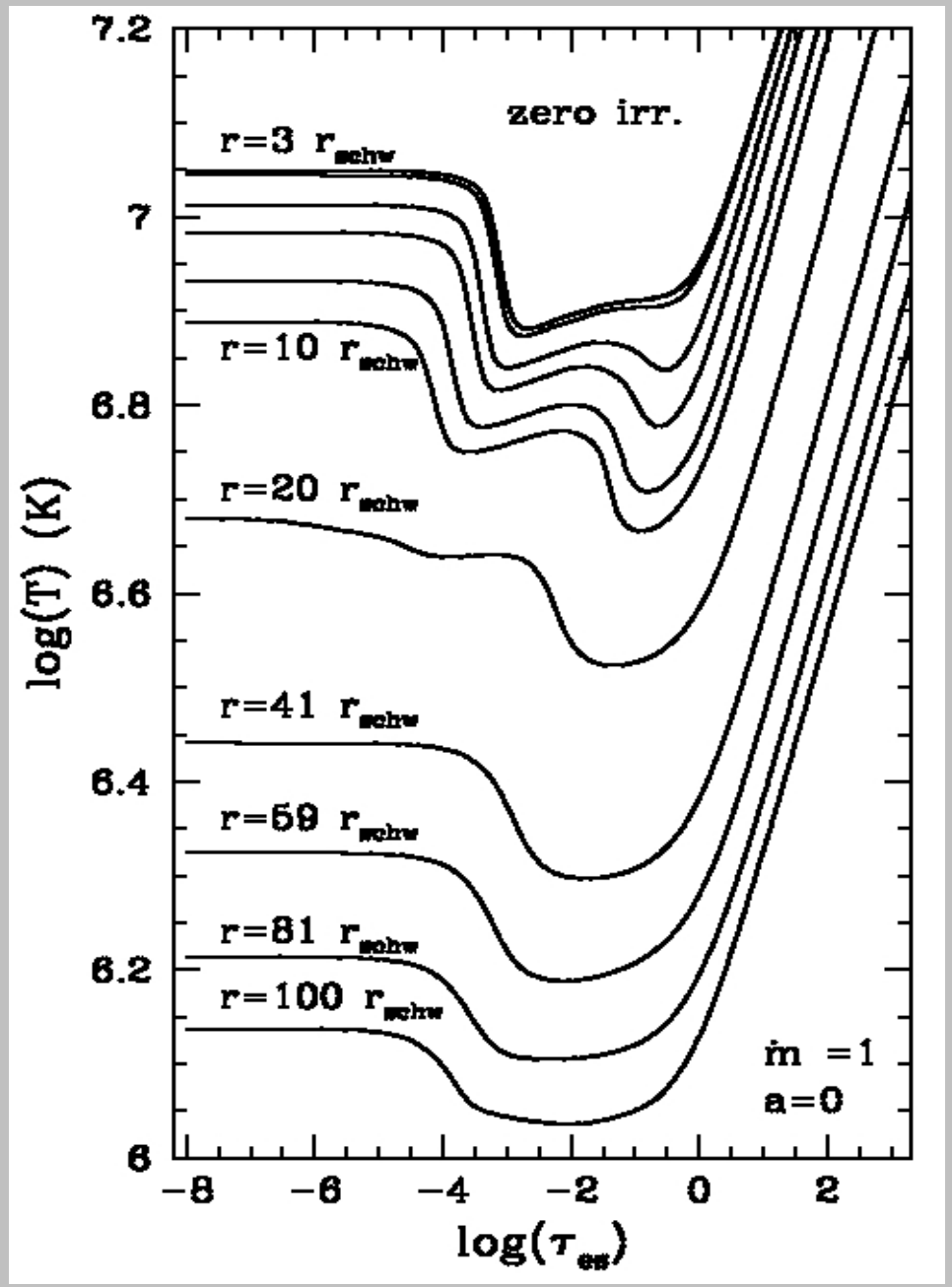


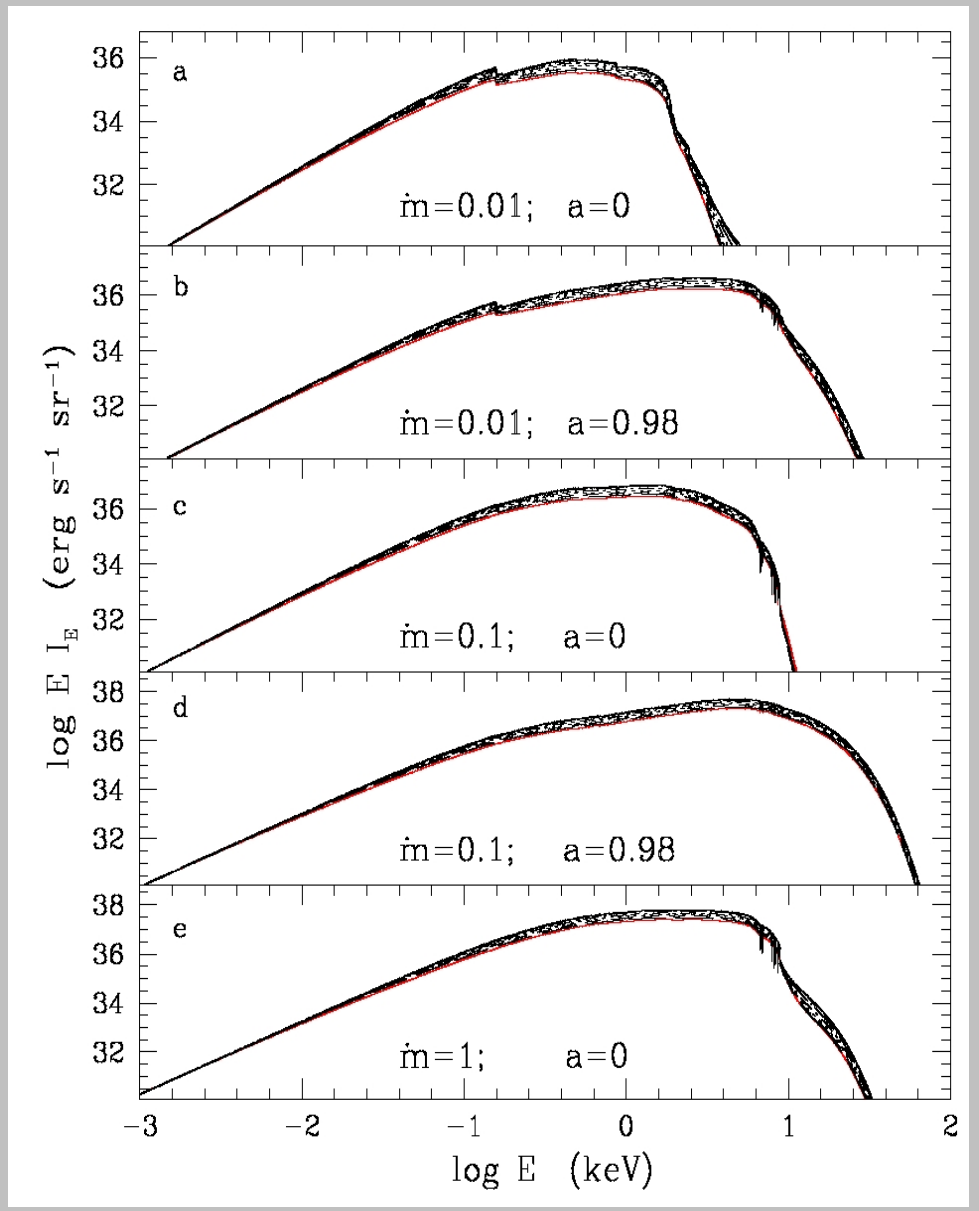
FIG. 10.—Temperature as a function of depth for several representative annuli of the disk for $M = 10^6 M_\odot$, $L/L_{\rm Edd} \approx 0.3$; with $\alpha = 0.01$ (*solid lines*) and 0.1 (*dashed lines*). From top to bottom, the curves correspond to radii $R/R_g = 1.5$, 3.5, 5, and 10.

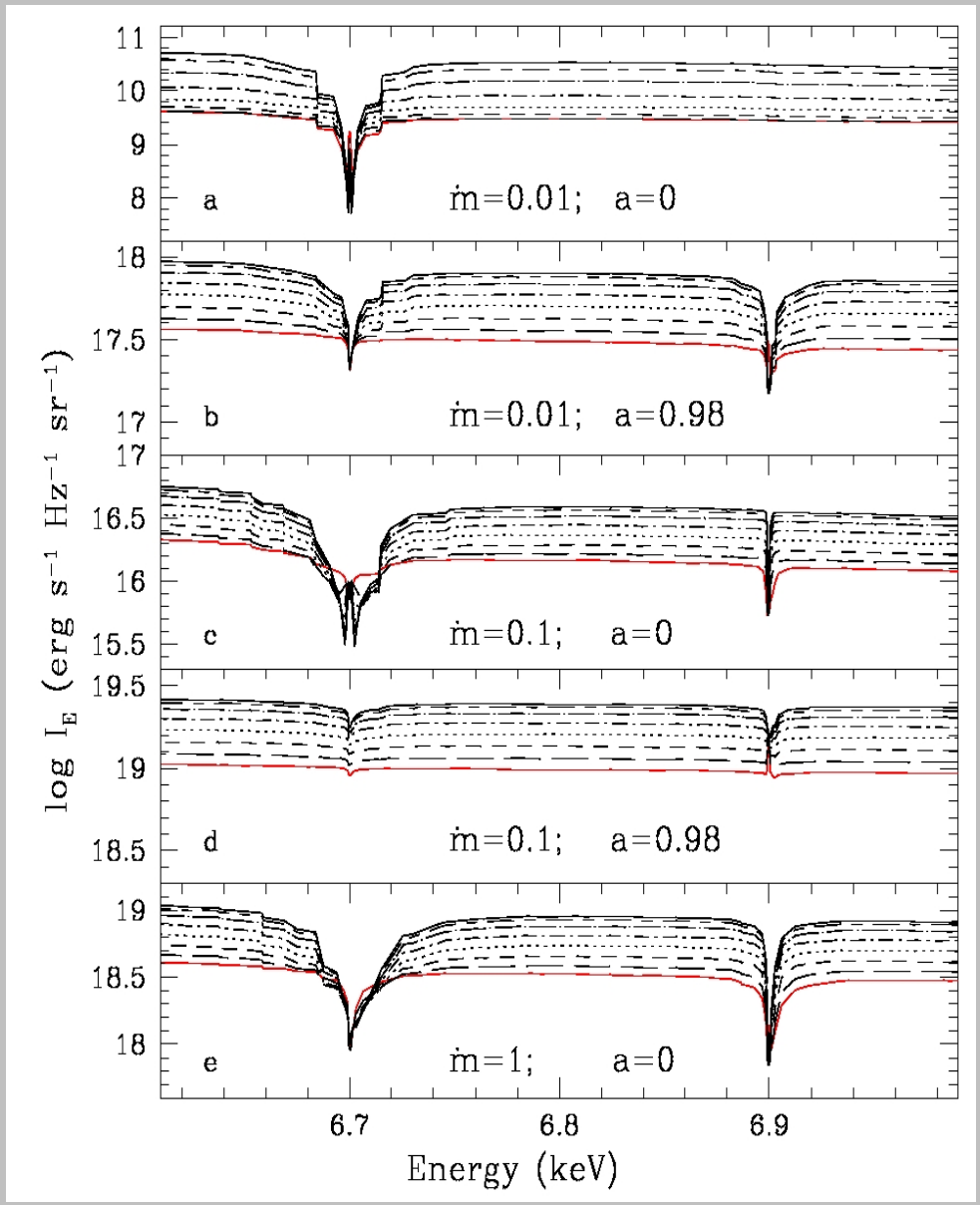
Hubeny & Blaes et al. 2001



Różańska Madej Konorski Sądowski 2011

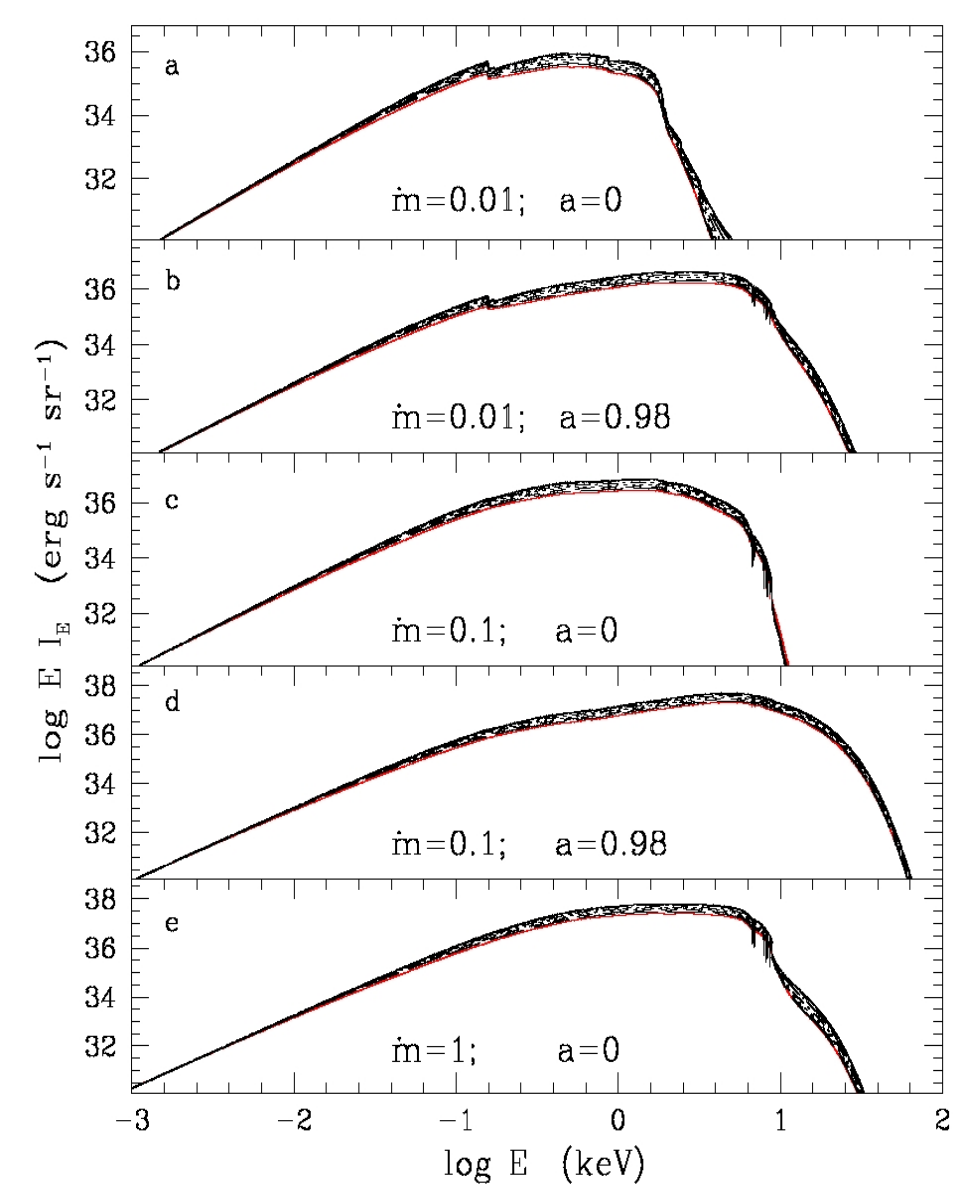
Total spectra integrated over disk surface:

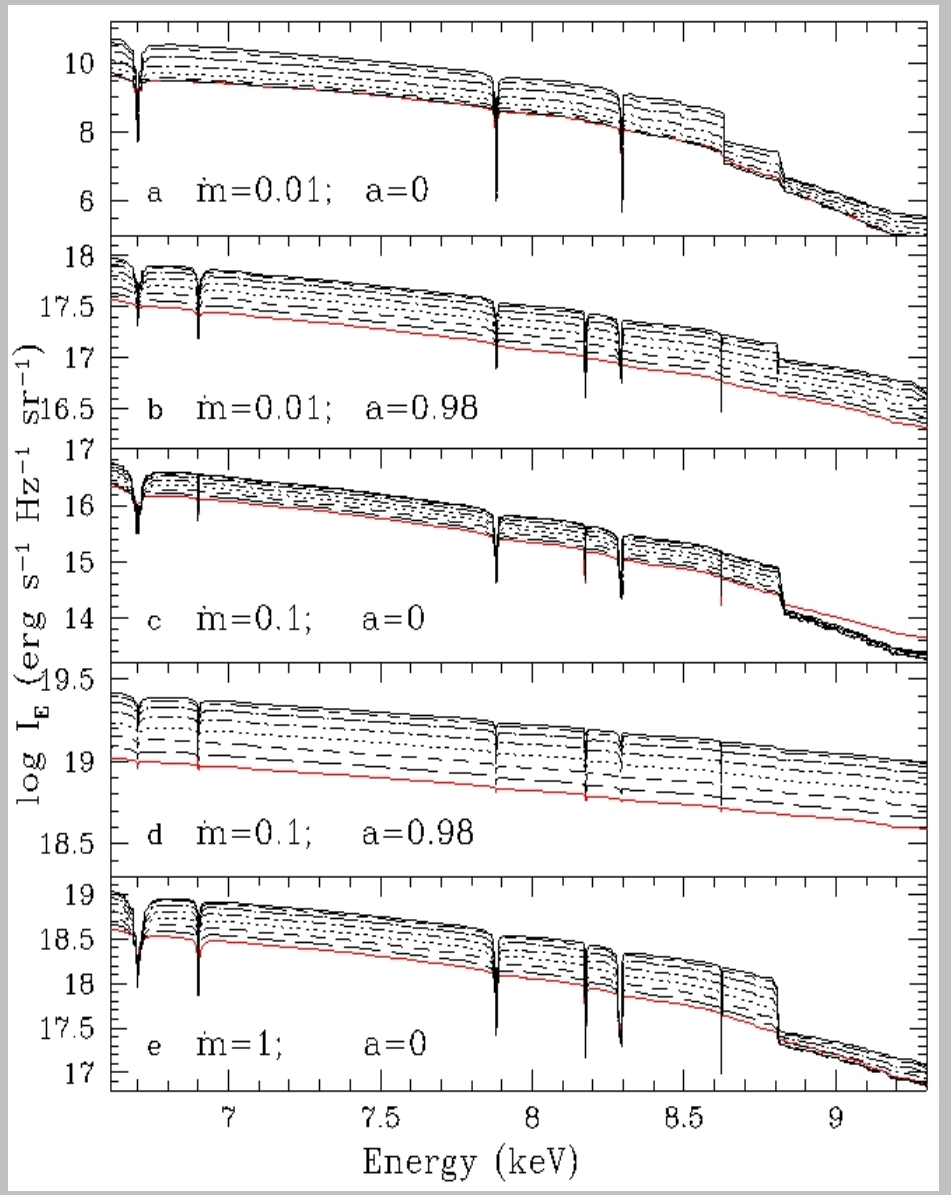




lines: 6690. eV - He-like iron EW ~15 eV (face -off) ~41 eV (face -on)
lines: 6898. eV - H-like iron EW ~ 9 eV (face -off) ~10 eV (face -on)

Total spectra integrated over disk surface:





FeXXIV Edge =8690.
FeXXV Edge =8828.1 lines: 6640. 7881. 8226. 8829 eV - He-like iron
FeXXVI Edge =9278. lines: 6898. 8172. 8621. 8829. eV - H-like iron

4U 1630-472 Suzaku XIS

Kubota et al. 2007

black hole candidate from similar X-ray spectral and timing properties,

X-ray outbursts 600 – 690 days,

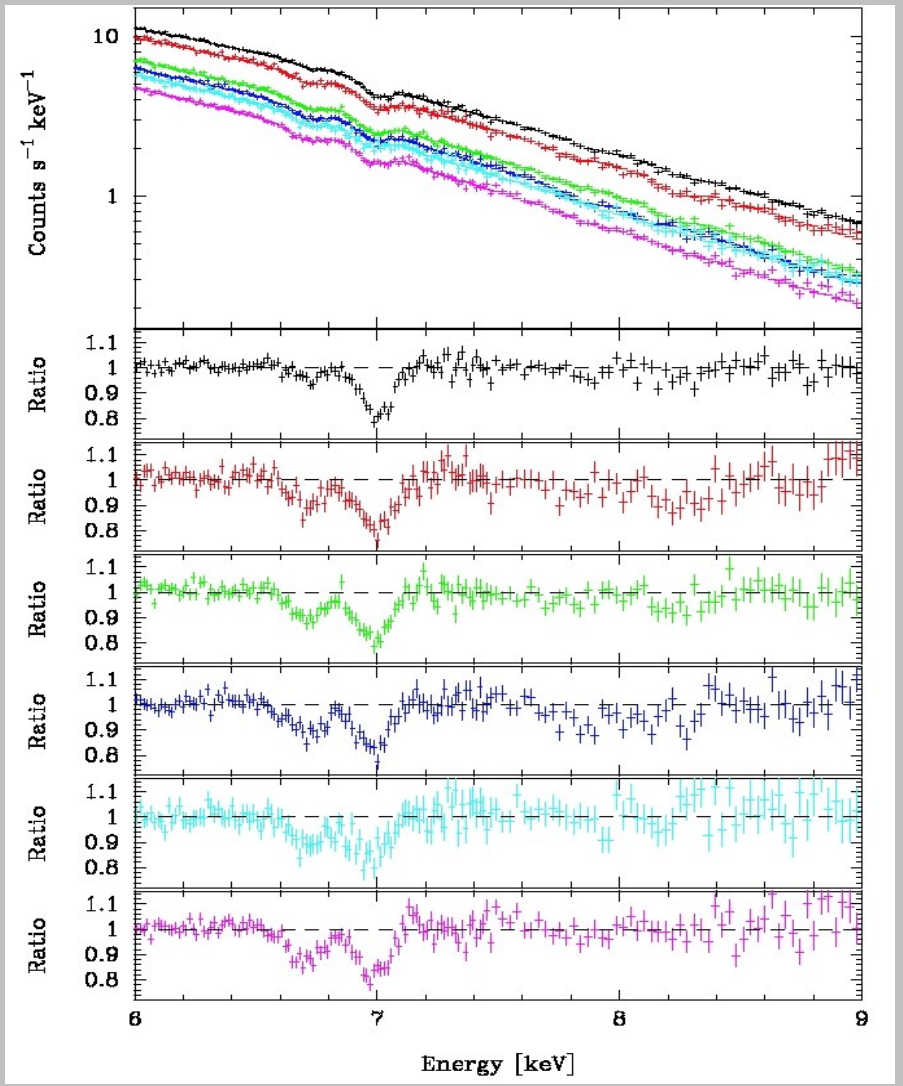
EXOSAT, Beppo SAX, ASCA, Chandra,

heavily absorbed,

NH = 5-12 x 10^{22} cm^{-2}

no optical counterparts are known,

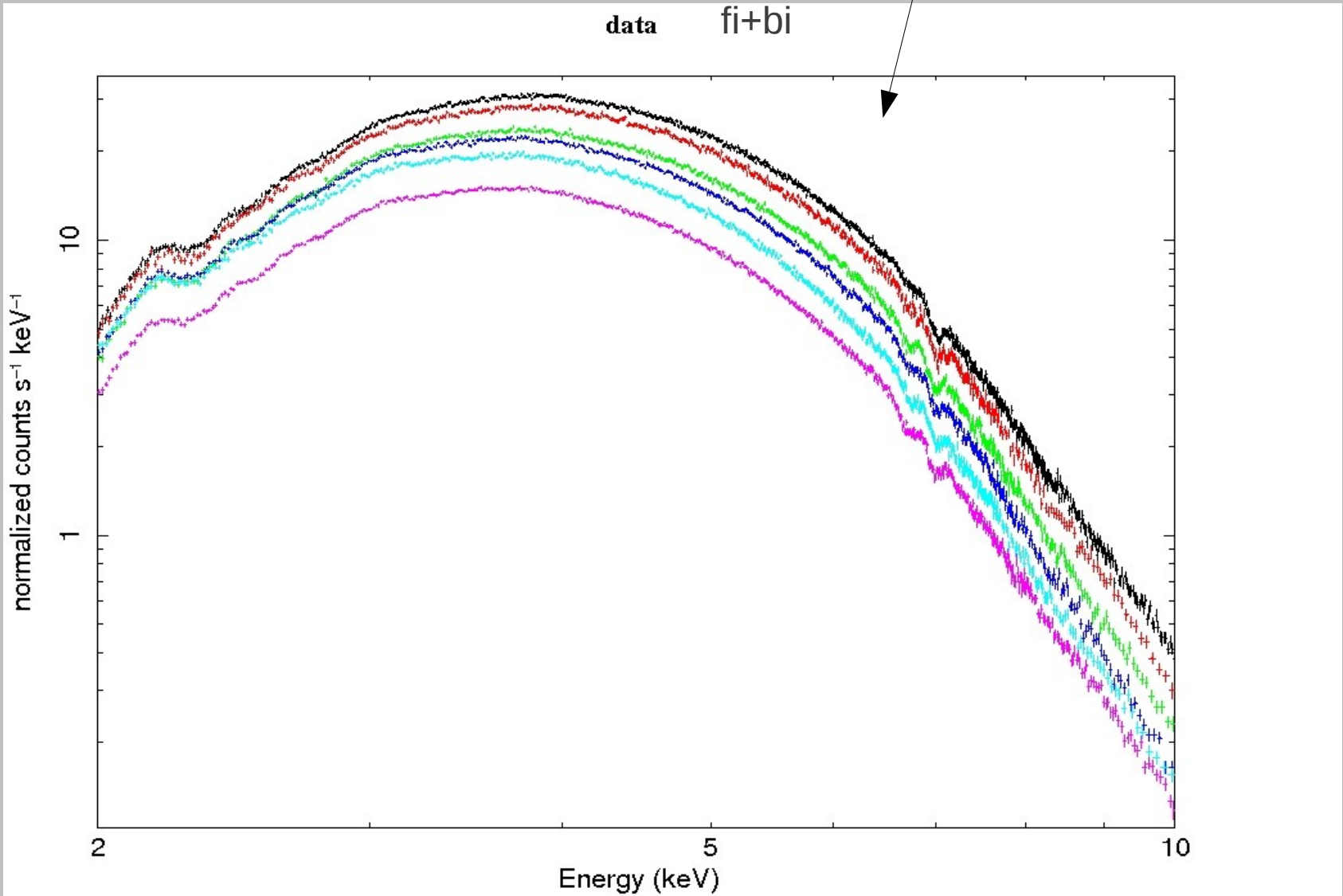
inclination angle from absorption dips around 60 deg.



EWs of lines of the order of ~ 20 < 60 eVs

4U 1630-472 **Suzaku XIS** *Bagińska 2012*

XIS0 , XIS2 , XIS3 - front illuminated (fi) CCD (*Kubota 2007*)
XIS1 - back illuminated (bi) CCD (added by *Bagińska 2012)*



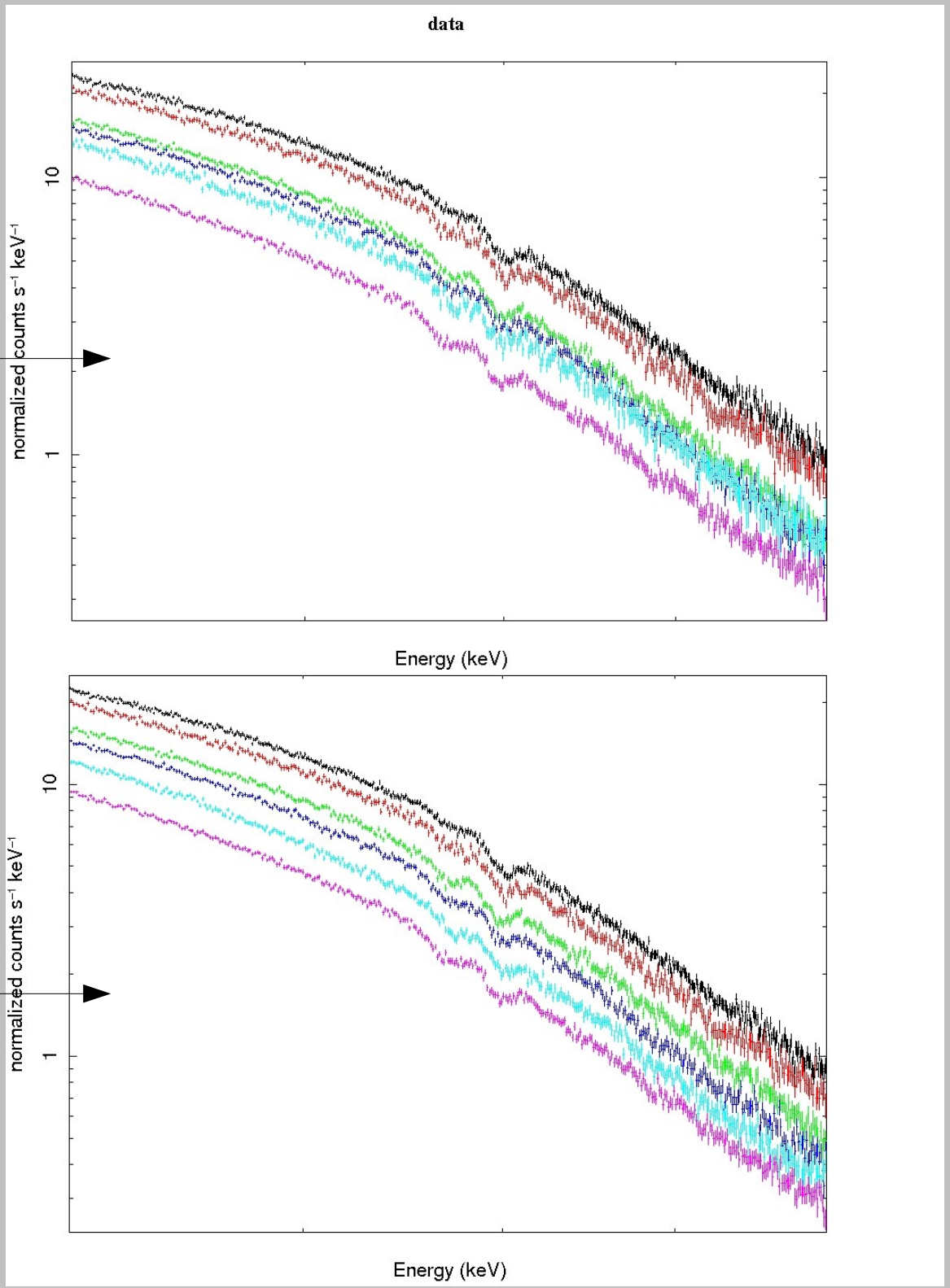
4U 1630-472 Suzaku XIS

Bagińska 2012

Iron line region
in 6 obs.
about 21 ksec each.

fi

fi+bi



Model: **wabs*(diskbb + gauss1 + gauss2 + gaussN)** *Kubota 2007*

Following this fitting:

$N_H = 8.2 \pm 0.2 .... 8.5$

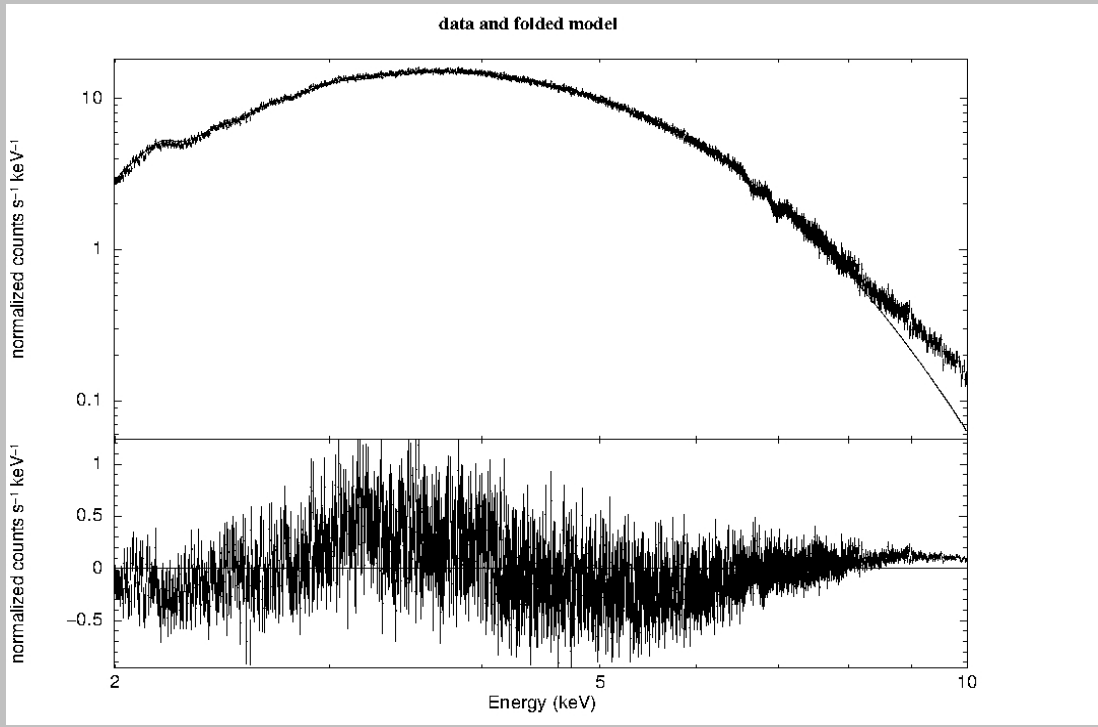
$T_{inner} = 1.22 \pm 0.03 ..... 1.24$

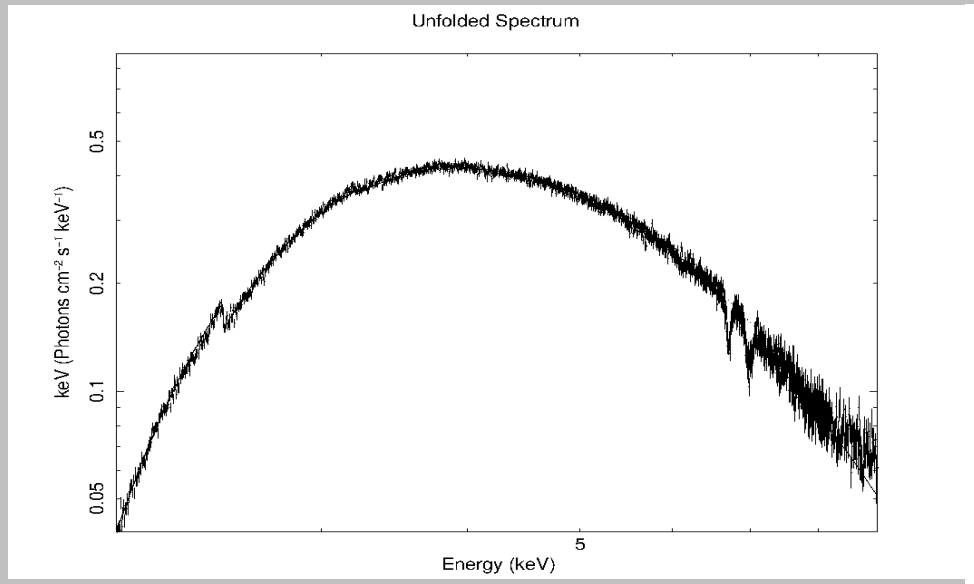
$E_{(He-like)} = 6.689 \pm 6.5 * 10^{-3}$

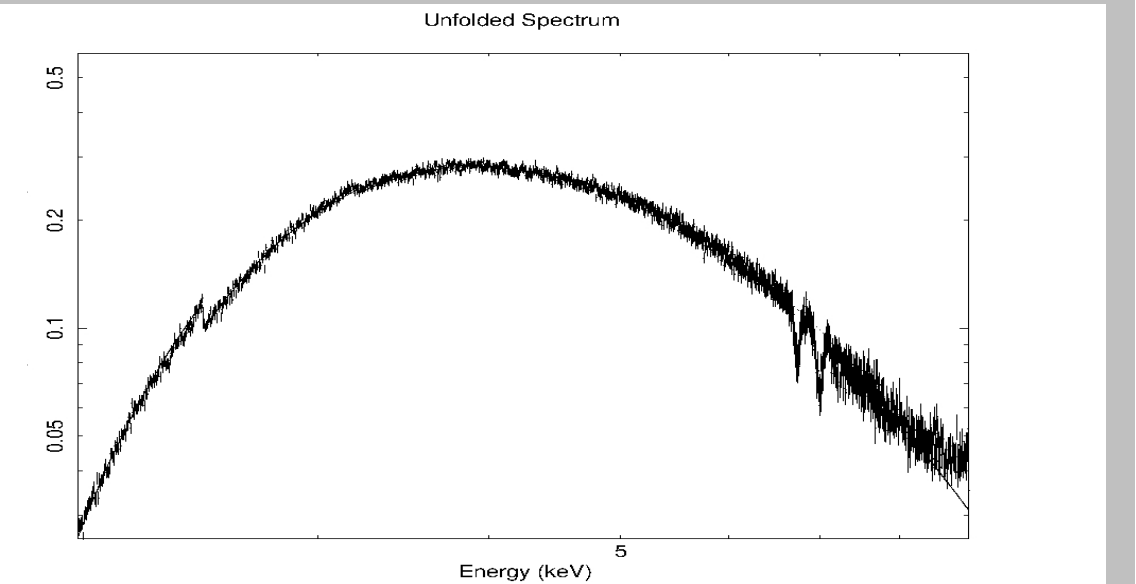
$E_{(H-line)} = 6.965 \pm 5.9 * 10^{-3}$

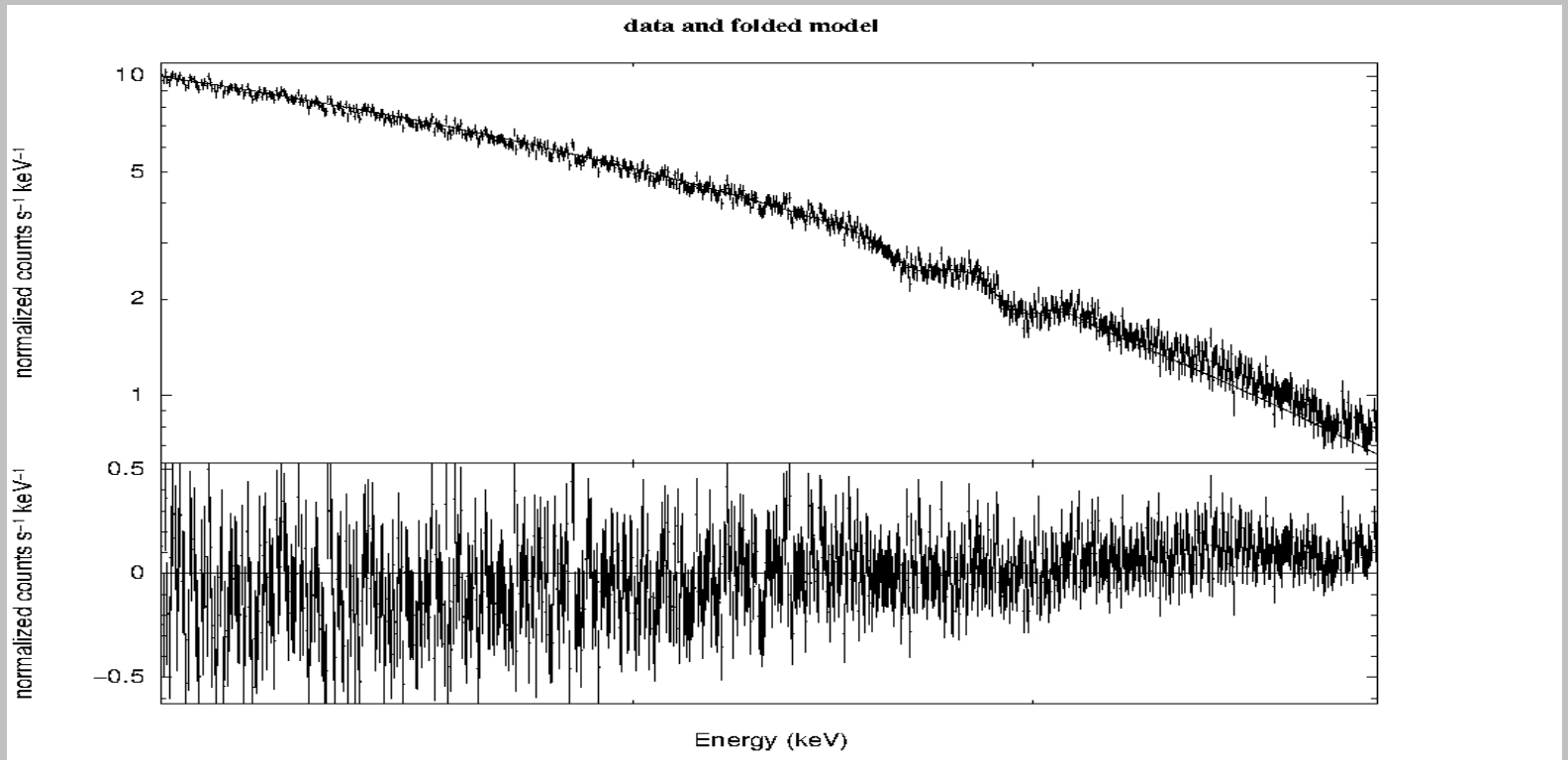
$\sigma \approx 20 - 60\, eV$

$X^2 = 1.23$





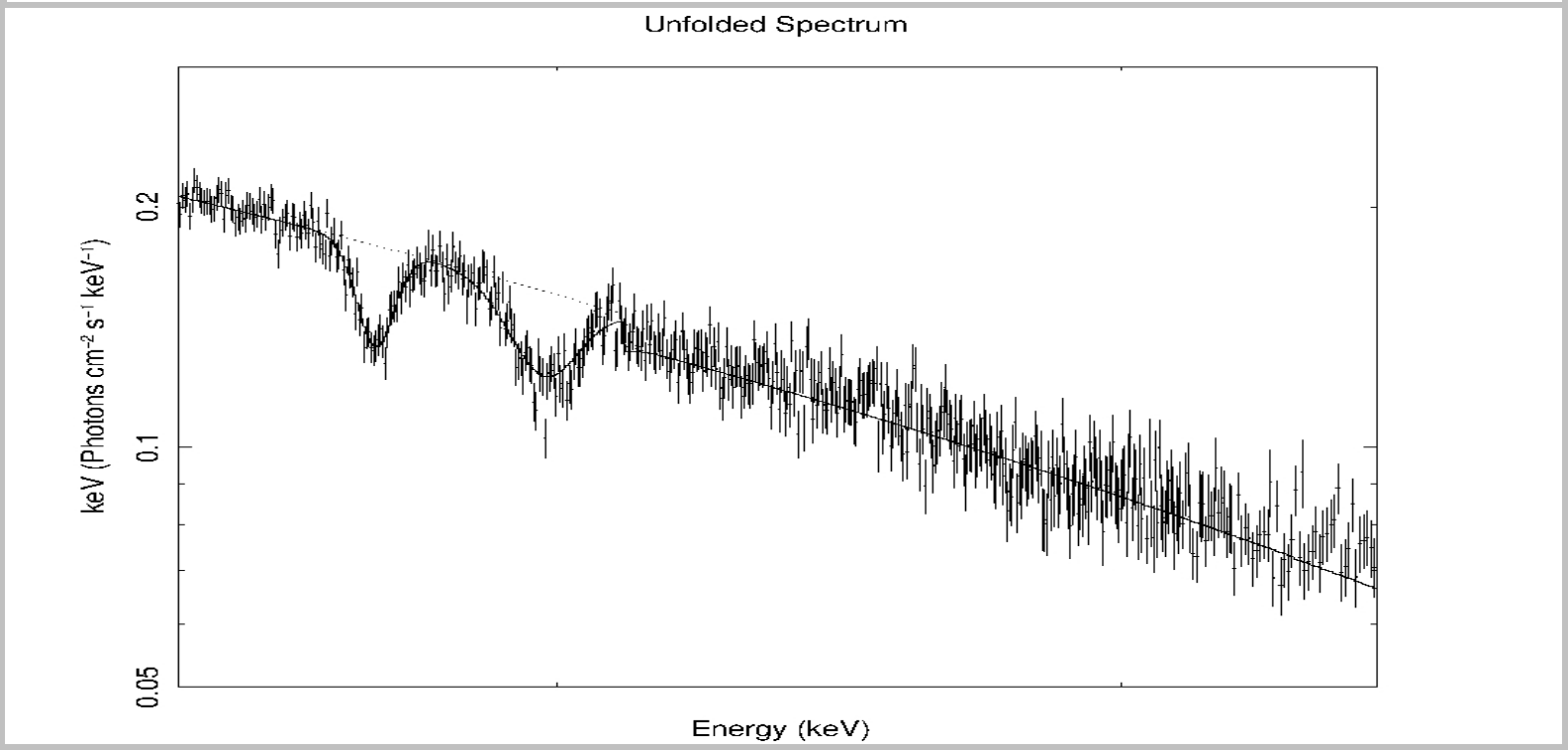




Iron line by two Gaussians

EWs ~ 20-30 eV

6th obs.



5th obs

Model: **wabs*(disk atmospheres + powerlaw)** *Us 2012*

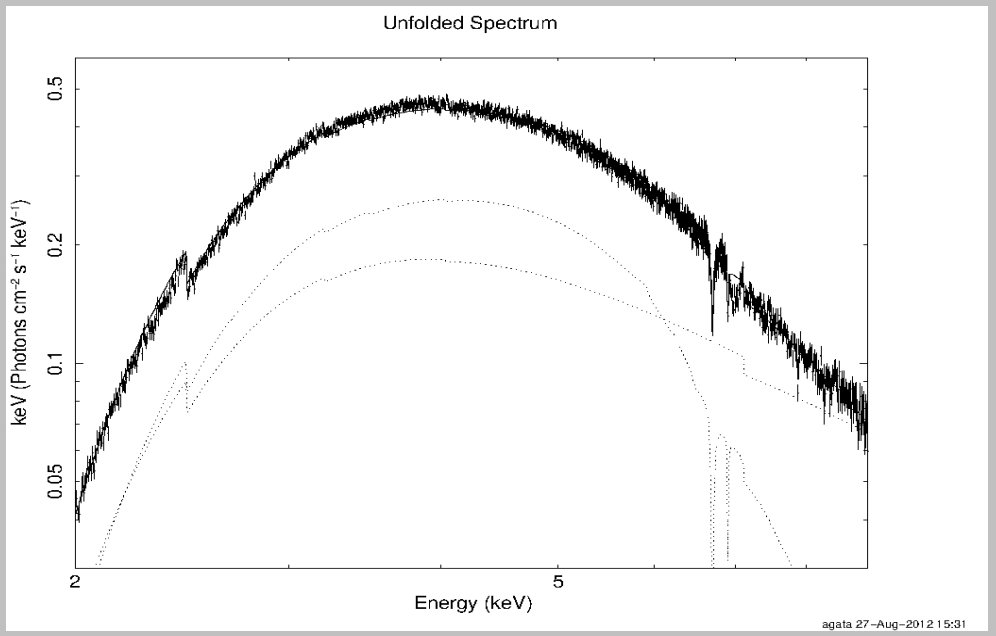
Fitting:

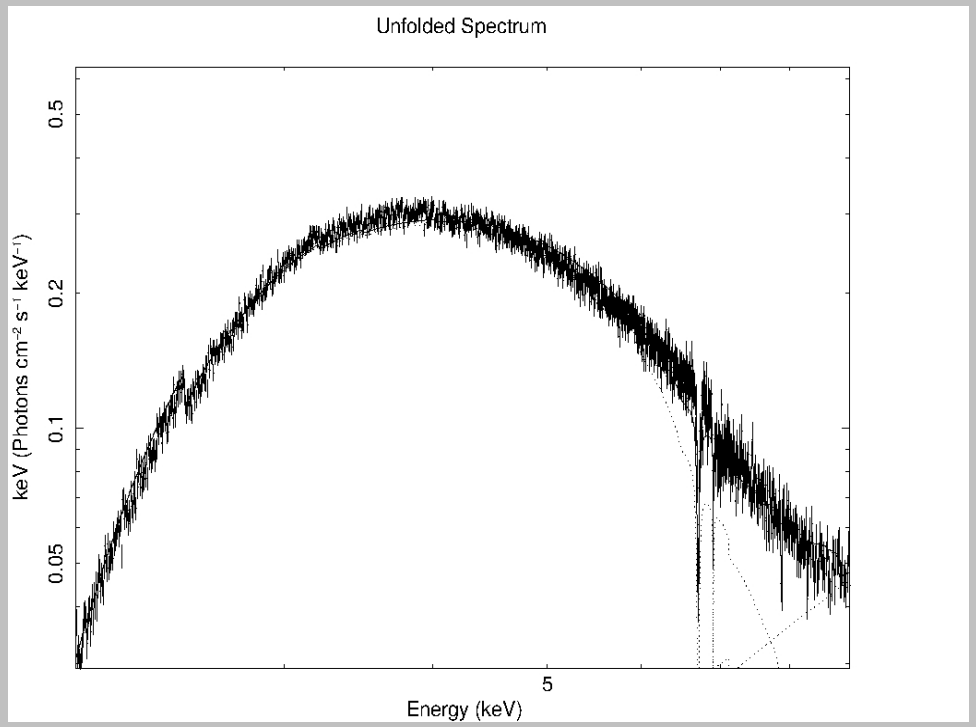
$N_H = 8.5 \pm 0.2 .... 9.0$

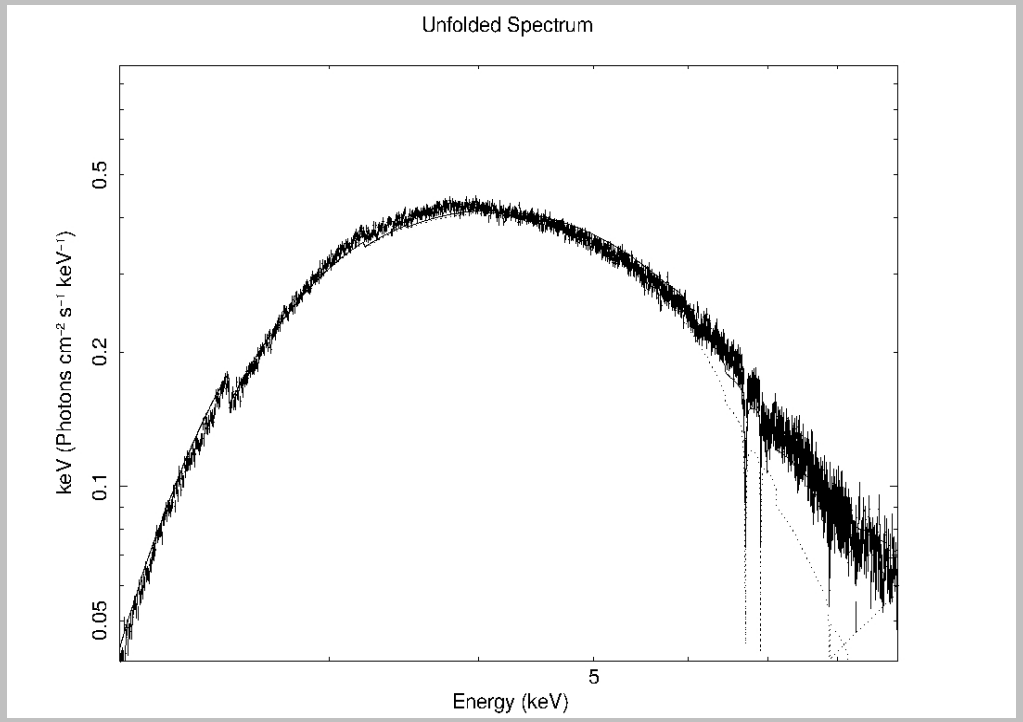
$inclination = 11 - face - on\, disk$

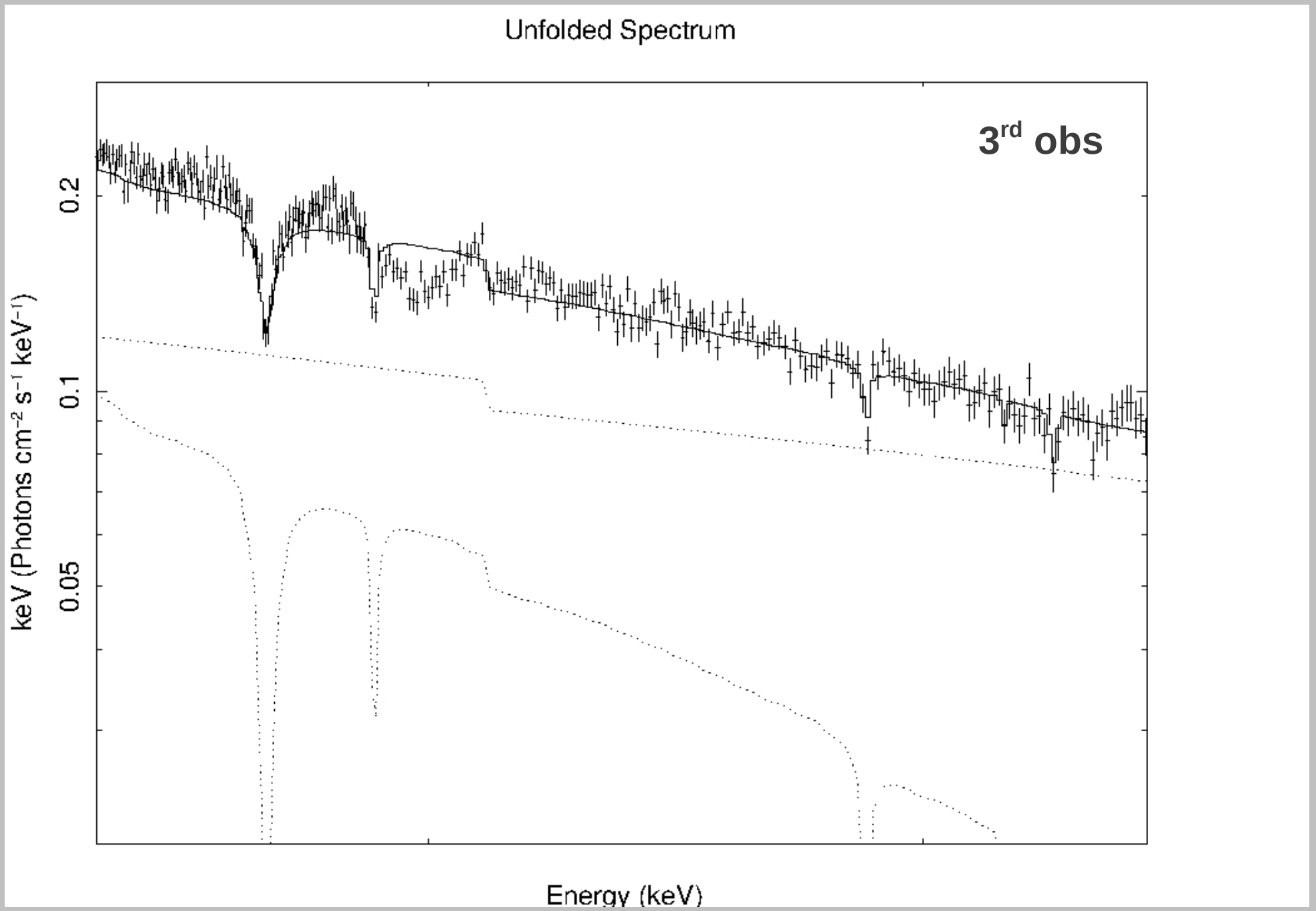
$\Gamma = -0.6 - 2.4\, bimodal\, distribution$

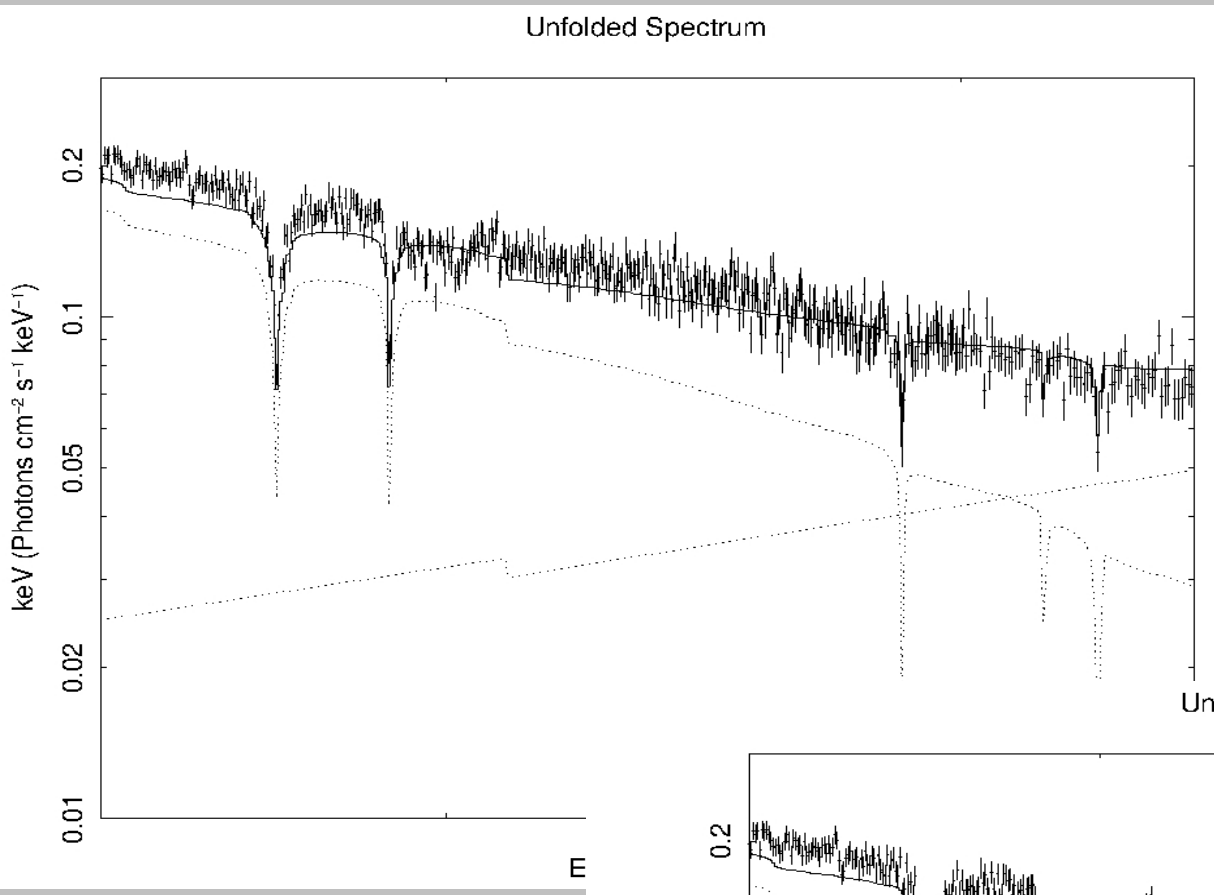
$X^2 = 1.83$



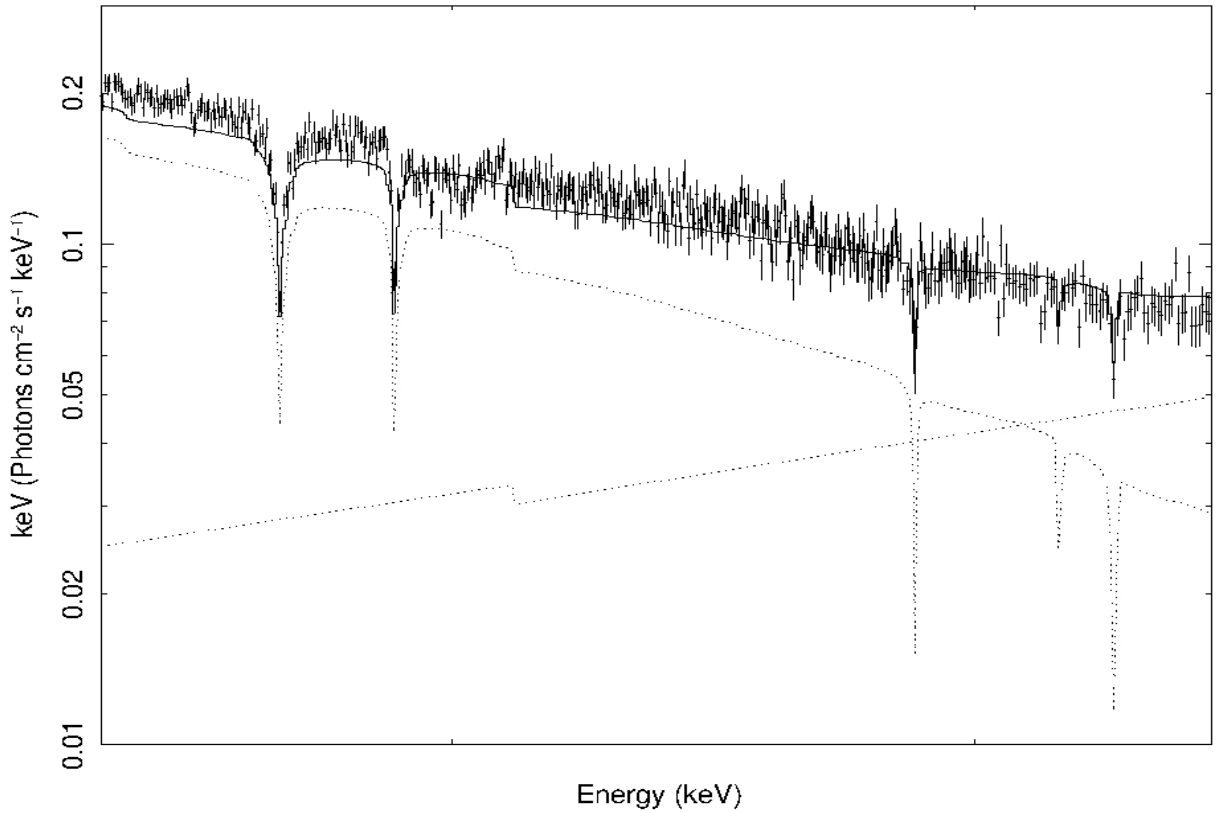




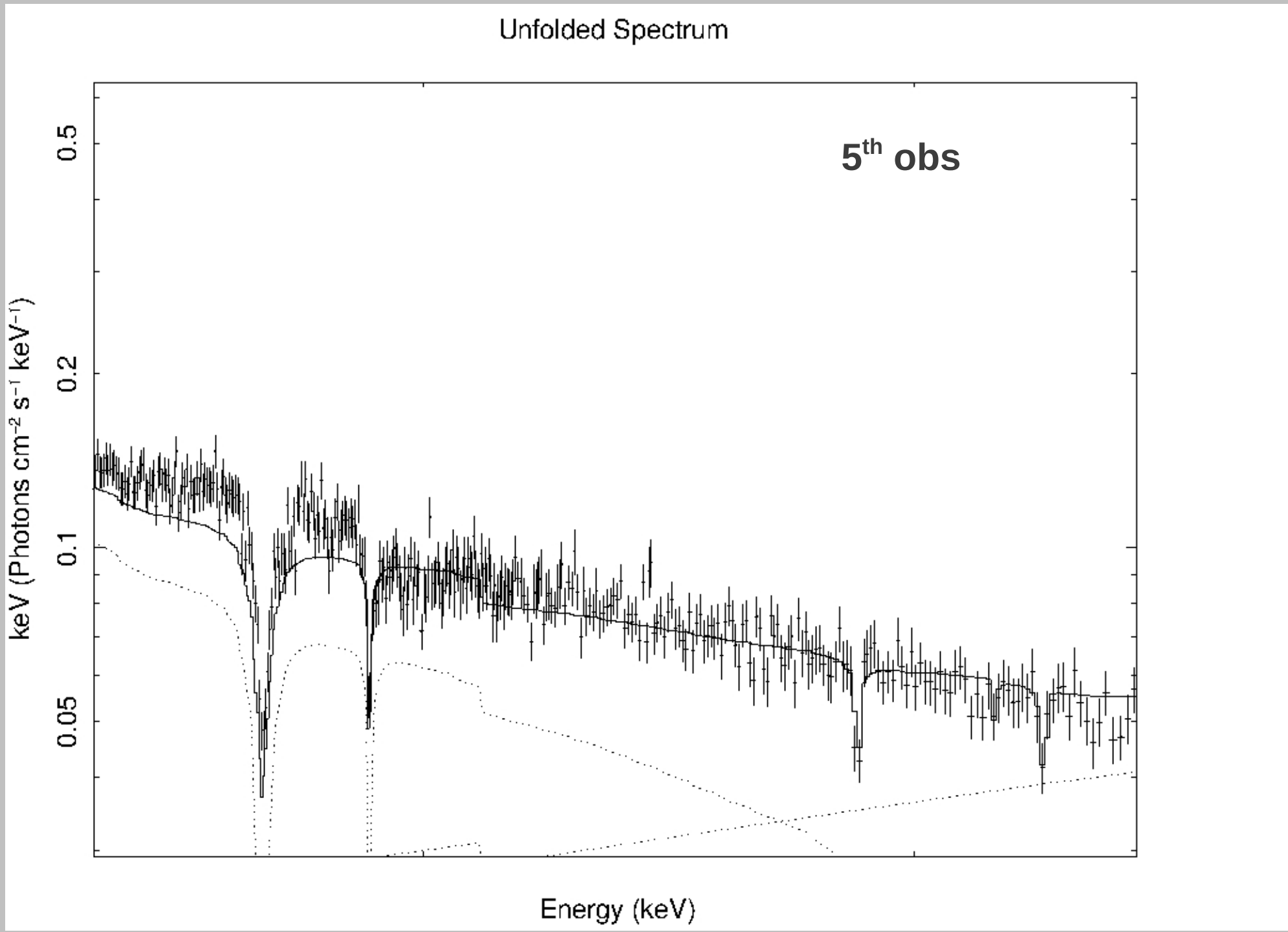

Unfolded Spectrum
3rd obs
keV (Photons cm-2 s-1 keV-1)
0.2
0.1
0.05
Energy (keV)

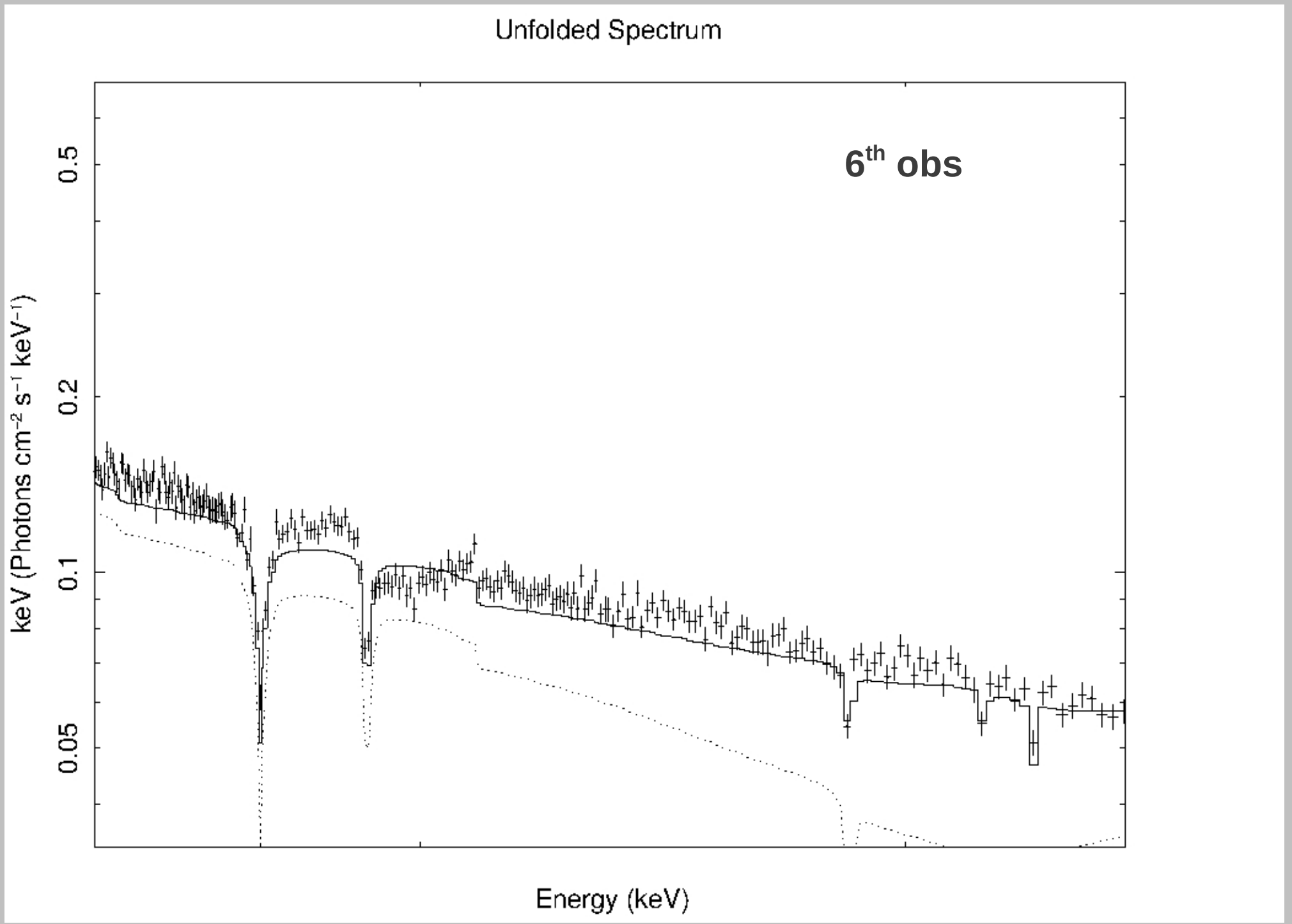


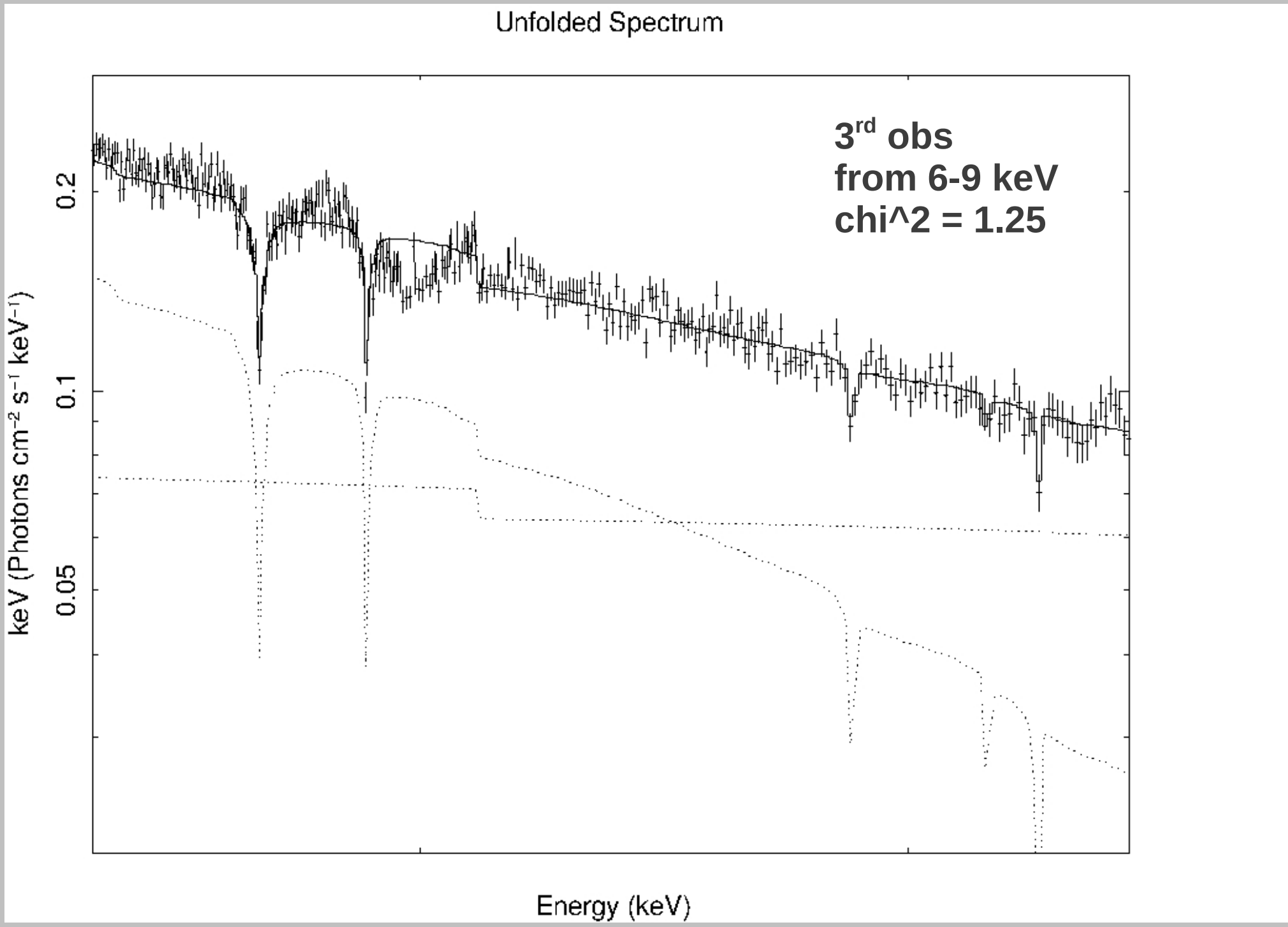
fibi 4th obs



fi 4th obs


Unfolded Spectrum
5th obs
keV (Photons cm-2 s-1 keV-1)
0.5
0.2
0.1
0.05
Energy (keV)


Unfolded Spectrum
6th obs
0.5
0.2
0.1
0.05
keV (Photons cm-2 s-1 keV-1)
Energy (keV)


Unfolded Spectrum
3rd obs
from 6-9 keV
chi^2 = 1.25
keV (Photons cm-2 s-1 keV-1)
0.2
0.1
0.05
Energy (keV)

Conclusions:

Am I on the wrong conference ?????

Conclusions:

Absorption lines from the static atmosphere or from the wind cannot be recognized by working satellites – line profiles ????

Conclusions:

Line profiles ??
Can be Gaussian … see Gabriele talk...
but emitting surface matters: