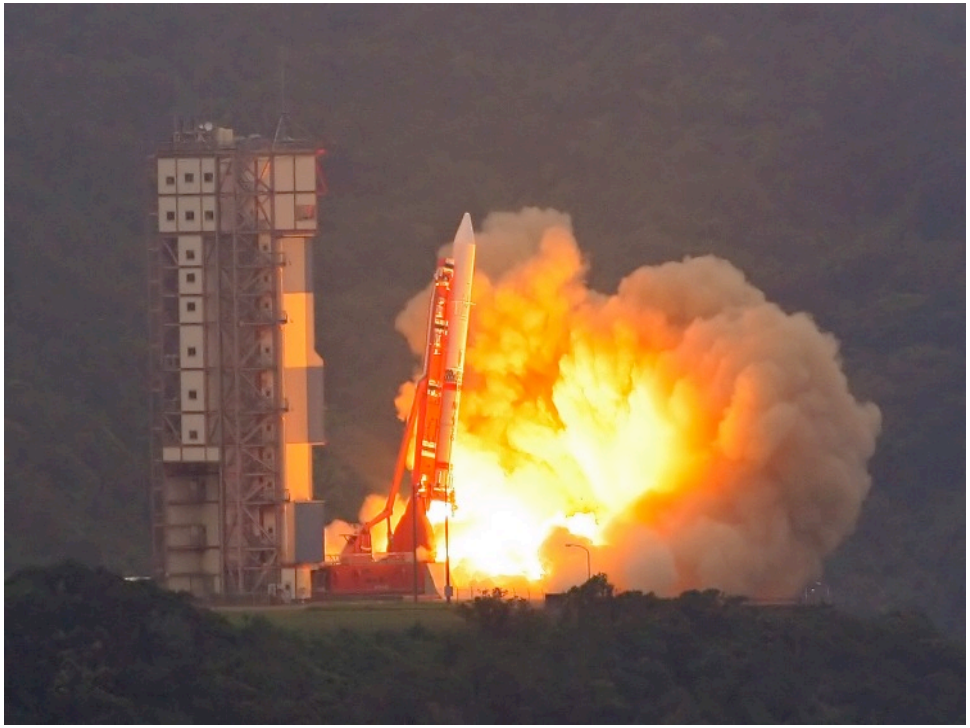
SUZAKU OBSERVATIONS OF OBSCURED AGN

Iron Lines Reflection-Absorption



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Obscured AGN and UNIFIED MODEL

All AGN powered by central black hole & viewing angle of the obscuring torus explains **the different "flavors" of AGN.**

How well does this hold up with current observations?

✓X-ray observations unveiled the non-uniformity in the covering fraction of Compton-thick and C-thin matter between different AGN.

✓Not a single zone of absorbing matter

✓Rapid variability of the absorber: clumpy and/or closer absorber than the torus. Within the torus or BLR and most likely associated with a high column disk wind

✓Covering factor can be much higher than the prediction from the torus model

✓What is the distribution and state of the obscuring matter?

X-ray emission of AGN

Sensitive X-ray observations are a key to disentangle the contributions from warm and cold gas in AGN

Warm gas photoionized by the central engine:

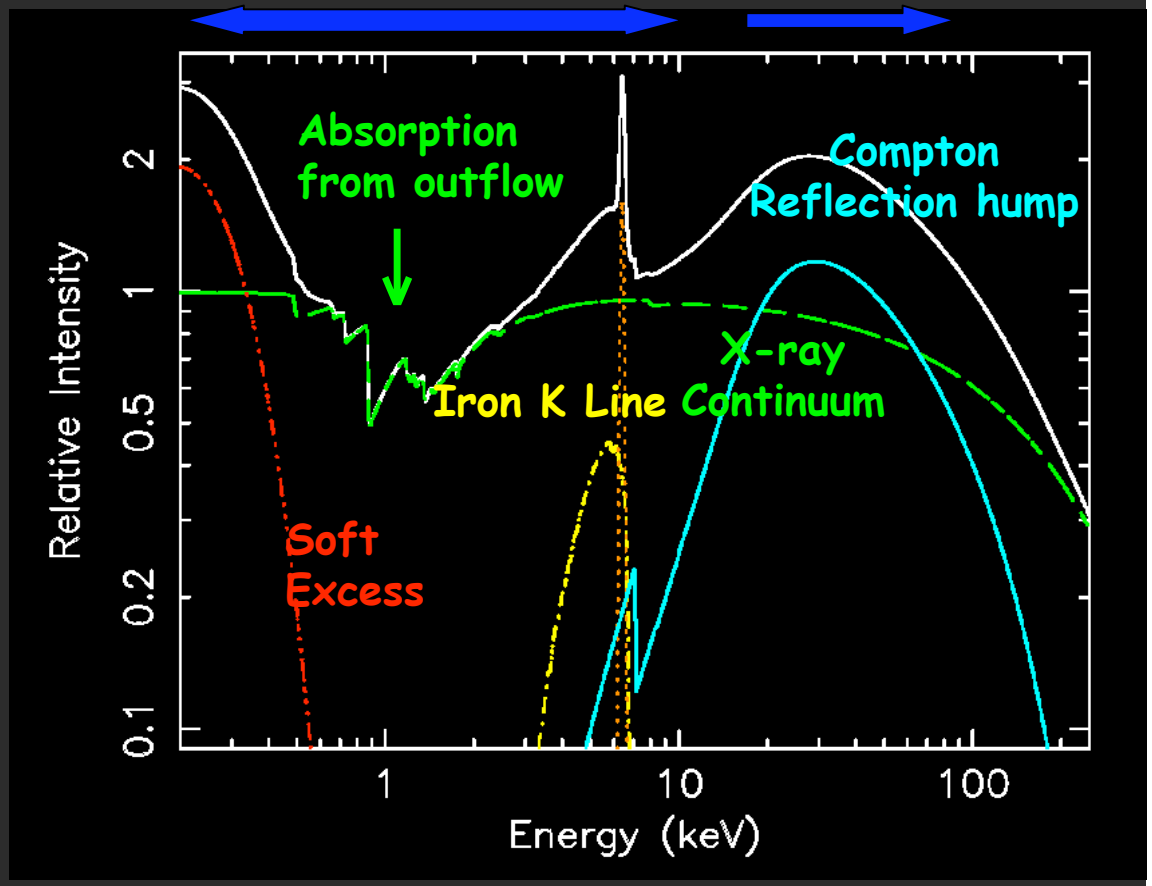
-X-ray emission/absorption features (O, N, Ne Mg, Si and Fe) detected in Sy 1 and Sy2 and QSOs

-high velocity outflowing gas

Cold gas:

-Fe K line at 6.4 keV

-compton Reflection hump



To understand the absorber Fe K line EW, Fe edge strength of the reflected component need to be measured simultaneously

They are all related to the the geometry and physics of the absorbing matter

The 10 brightest C-thin Sey2 observed by Suzaku

AIM: investigate in deeper detail the nature of the absorbers.

NEED:

- ❒ good eff area at 6-8 keV to have high SN spectra
- ❒ spectral resolution to resolve the Fe complex
- ❒ broad band to constrain the underlying continuum…

➪Bright sample: F (15-100 keV)> 8×10^{-11} erg cm^{-2} s^{-1}
to obtain a high quality 0.5-100 keV broad-band spectrum with reasonable exposure time (60-80 ksec).

NGC4507,NGC6300, MCG-5-23-16,NGC2110, NGC4388
NGC1365, NGC7172,ESO 103-G035,MRK348,NGC5506

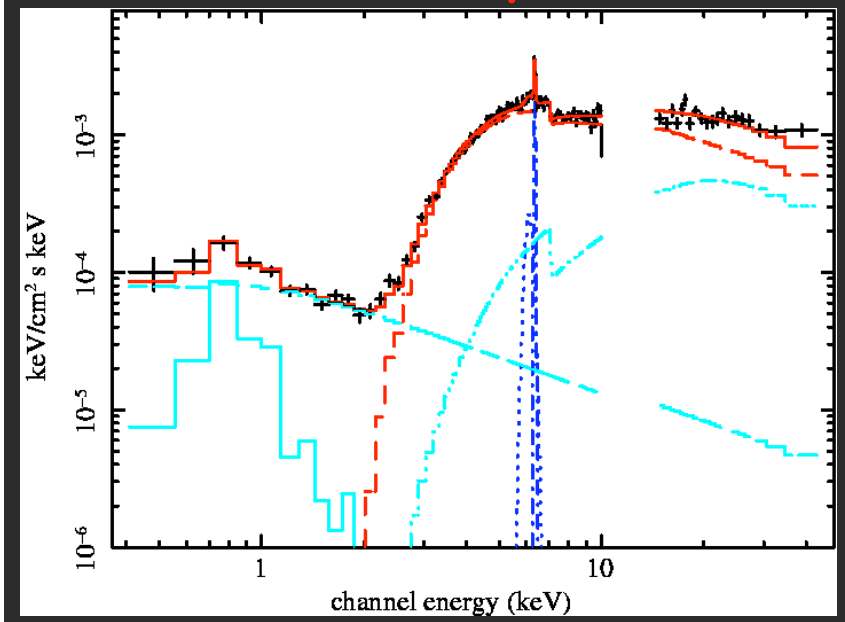
Most of them previously observed with Chandra, XMM and SAX

Chandra and XMM good for the Fe line parameters but they lack of broad bandpass

SAX had the bandpass but not enough sensitivity and resolution below 10 keV to measure simultaneously the Fe line

NGC6300

A surprise from a changing look AGN

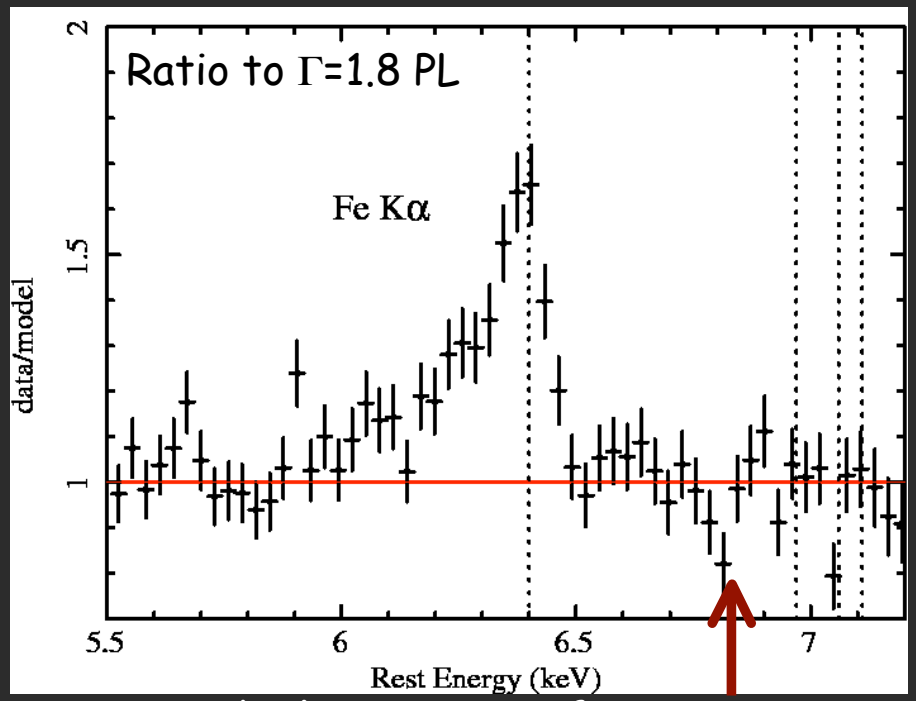


Changed from Thick (Leighly '99) to C-Thin (Guainazzi et al. 2002)

N_H=2x10^{23} cm^{-2}

R~1 Γ=1.87

Similar flux level and spectral shape as SAX and XMM observation…

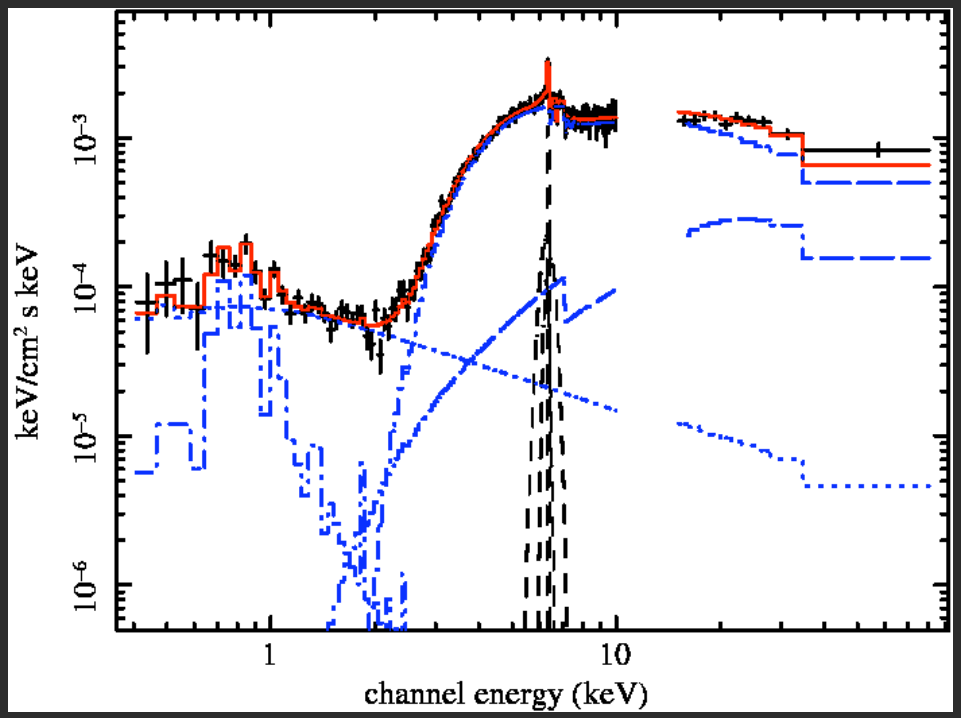


Profile of the 6.4 keV line suggests a possible red-wing

Residuals weak abs feature..

NGC6300 Very preliminary results....

Reeves et al. in prep.



The best fit includes C-thick matter responsible for the reflection component

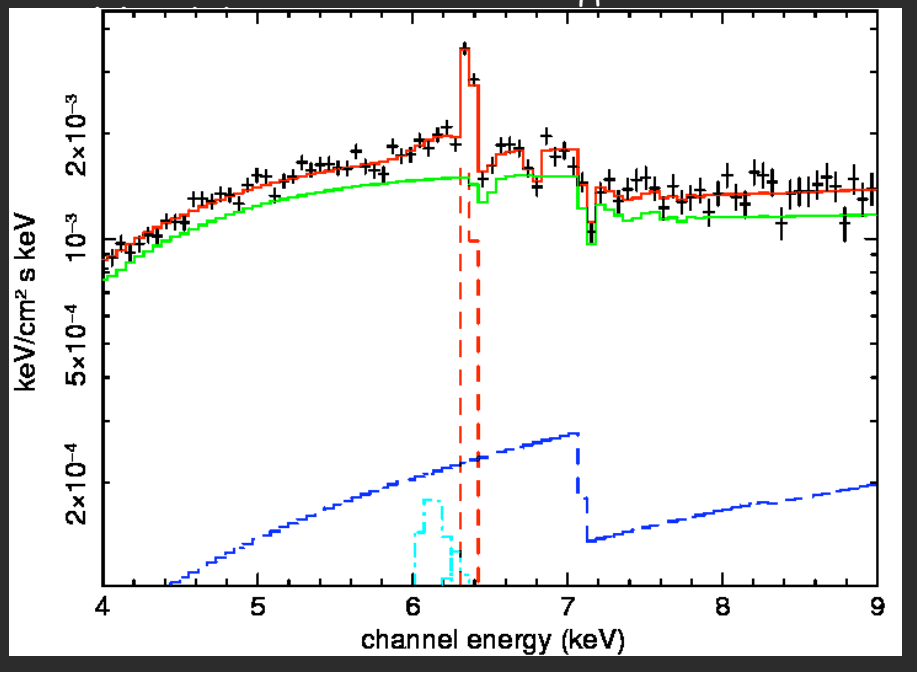
The absorber is complex with at least two absorbers:

A neutral fully covering absorber with N_H~10^{23} cm^{-2}

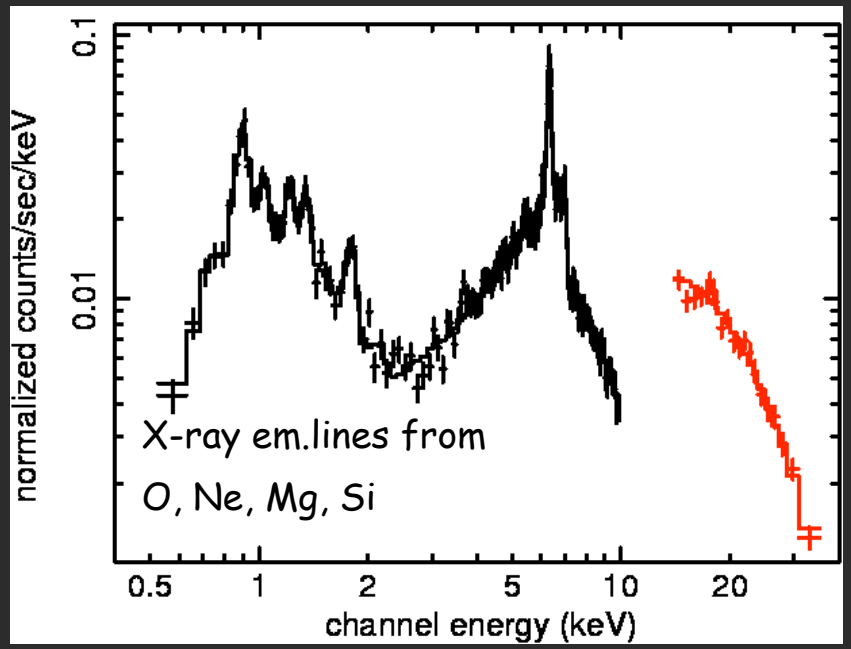
and a partial covering and/or a mildly ionized absorber with N_H~$10^{23}$$cm^{-2}$

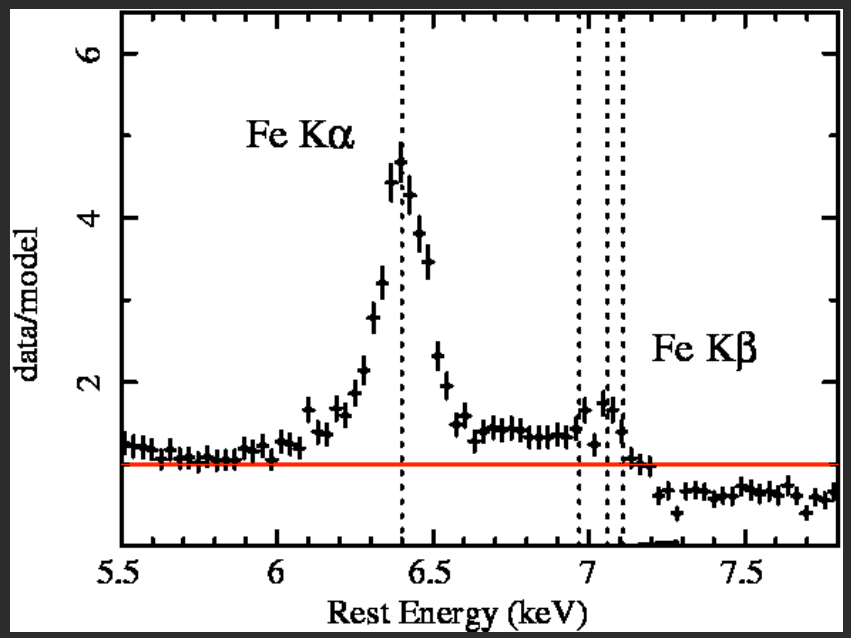
Residuals are present after reflection, complex absorption, and narrow Fe Kα line are added

EW_N~80eV
EW_B~70eV FWHM~20000Km/s



NGC4507





Sey 1.9 at z=0.0118

F(2-10 keV)~10^{-11} erg cm^{-2} s^{-1}

F(20-100 keV)~1.-2x 10^{-10} erg cm^{-2} s^{-1}

Spectrum is reflection dominated R~2.4

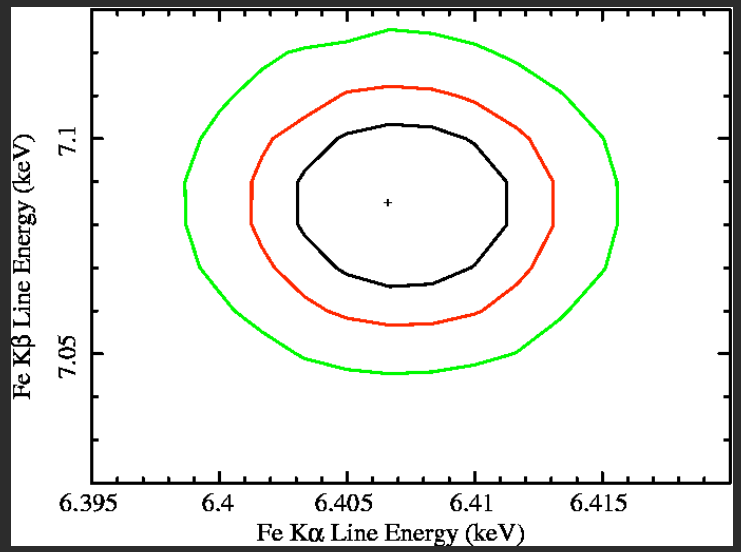
Γ=1.77 ±0.06 N_H~8x10^{23} cm^{-2}

Fe Kα line

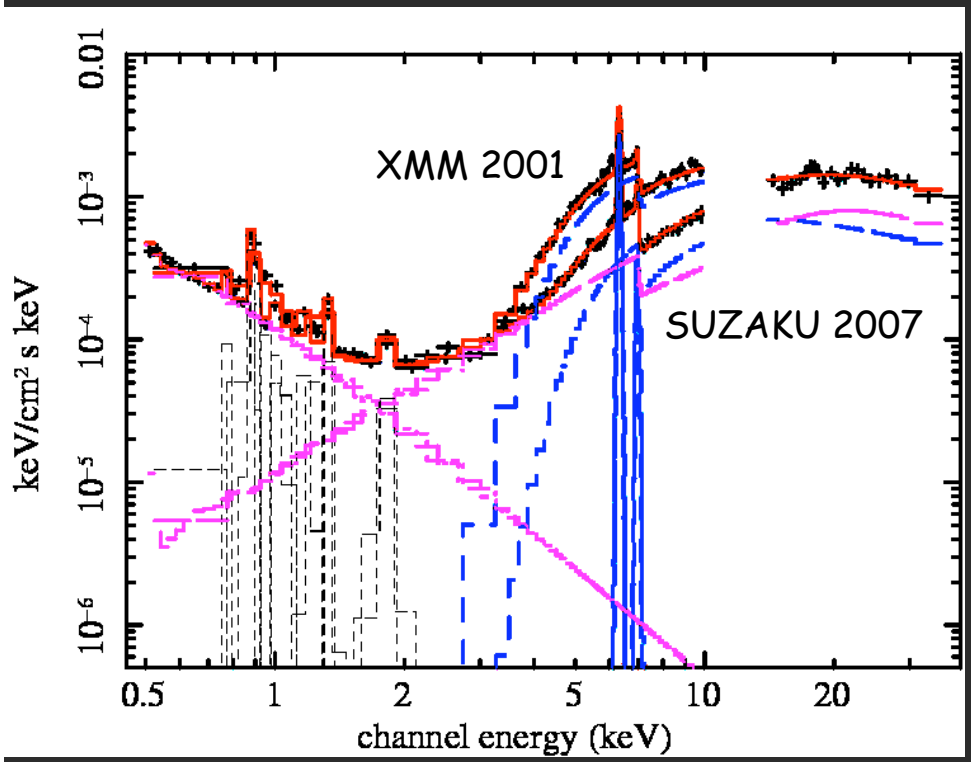
E=6.41±0.01 keV σ=40 ±10 eV

EW~560 eV wrt the obs continuum

Fe Kβ 13.7% Fe Kα



Variablity



Soft X-ray emission at the same level

The 2-10 keV emission varied in flux and curvature

N_H from~ 4 to $8 \times 10^{23} cm^{-2}$.

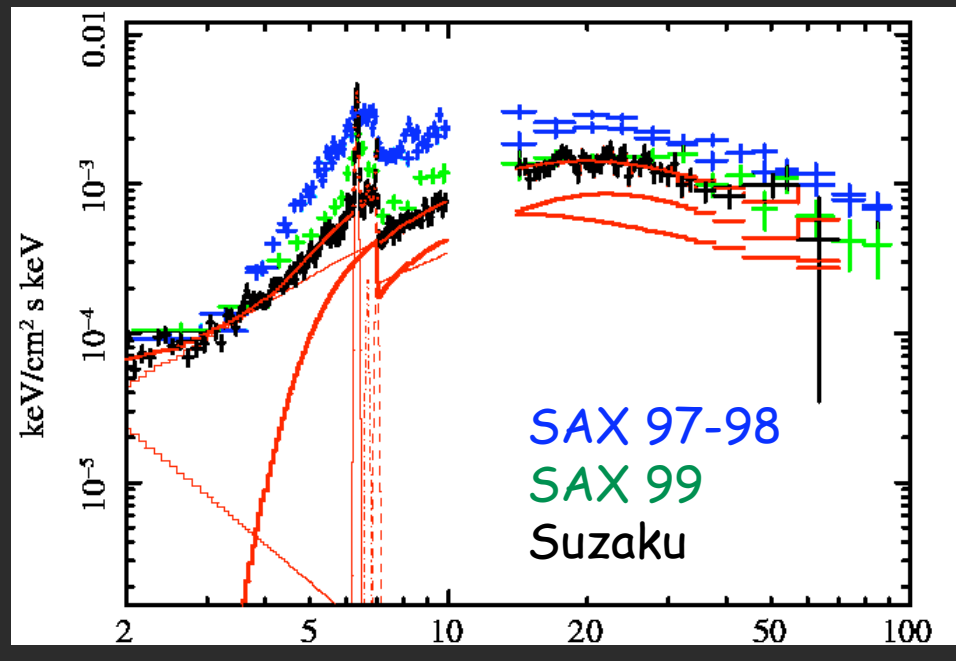
Variable covering factor of the absorber?

Comparison with SAX

Cannot be explained with only flux variability

All the diff state can be explained with a constant Γ, + variable absorbed component.

Similar to the case of NCG7582 (Bianchi et al. 2009)



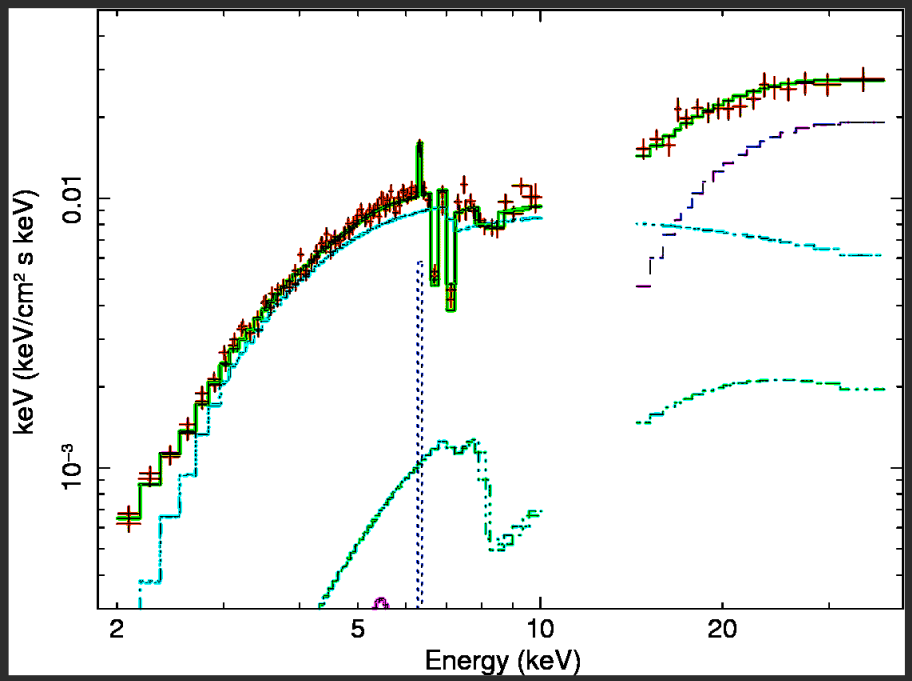
Another surprise from NGC1365

Risaliti et al in prep.

NGC1365 (z=0.0055) is remarkable for:

Extreme variability of the covering factor of the absorber

Presence of variable absorption lines in the 6.7-8 keV energy range, indicative of a variable high ionization high velocity outflow.



We confirm the presence of the absorption features due to blue shifted He and H-like Fe kα and Kβ.

The inferred outflow velocity is ~3300km/s

The HXD data show a factor of 3-5 increase in flux above 10 keV wrt the extrapolation of the 0.5-10 keV best fit model.

To account for this hard X-ray emission a high column density absorber, possibly located close to the X-ray source, is required.

Conclusion

Suzaku allows us to break the degeneracy and uncertainties in the modelling of the continuum (absorption, reflection) and the broad & narrow Fe lines wrt the presence of complex absorption.

Need of a new spectral model to fit the Fe K line, reflected/scattered continua and absorption features.

Confirm the absorber is complex with more than one region and a large variety of geometry for the absorbers.

More evidences of variable absorbers (NGC7582, NGC4388, NGC4507).

Other examples of low scattering AGN (e.g. MRK 348 and NGC7172), high covering absorber with no or weak reflection.

Suzaku data allows the resolution of 'narrow' Fe K lines with errors similar to that of the Chandra HETG (e.g. MCG-5-23-16, NGC4507)