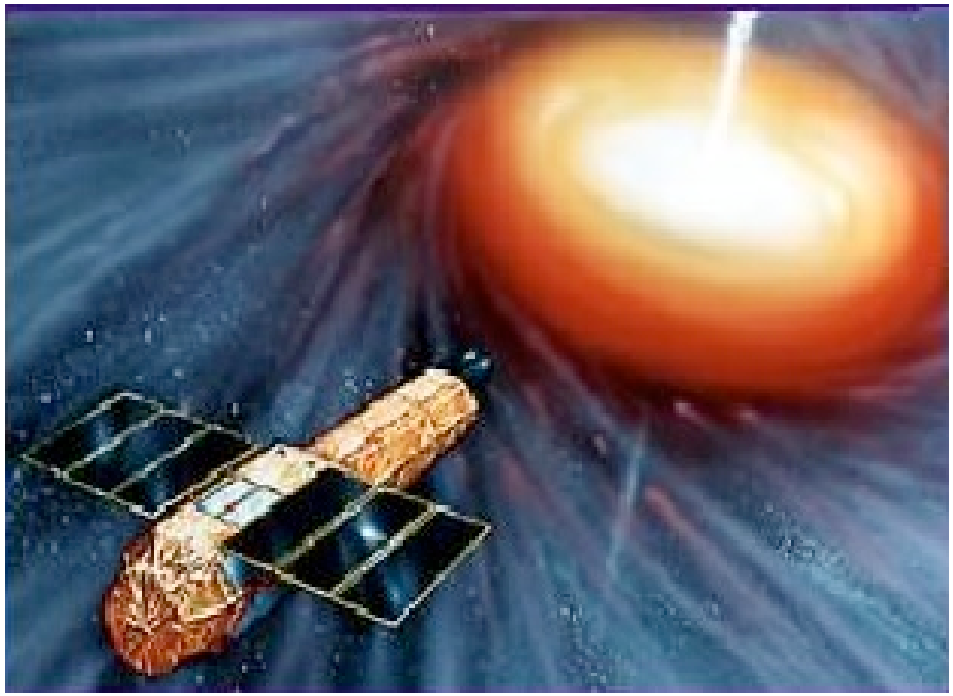
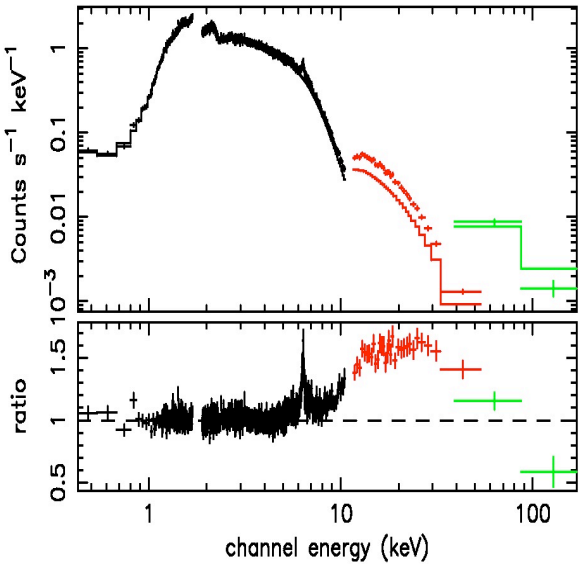
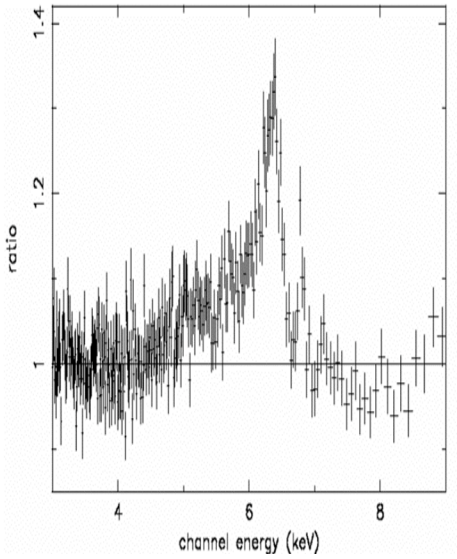
Suzaku Observations of Iron Lines and Reflection in AGN



James Reeves (JHU/GSFC), Richard Mushotzky (GSFC), Alex Markowitz (NRC/GSFC) and all the Suzaku/SWG team





Suzaku Observations of AGN (SWG Program)

- ***Establish 'reality' of broad Fe K lines-***
  - NGC3516, MCG-5-23-16, MCG-6-30-15, NGC2992….
- ***Determine accurate reflection parameters and comparison of Fe K line to reflection -***
  - NGC2110 (no reflection)
  - MCG-5-23-16,MCG-6-30-15, NGC3516
- ***Precision measurements of Fe line parameters***

Time variability of spectral components and their connection

Results are presented here on MCG-5-23-16, MCG-6-30-15 and NGC 4051.

Does the reflection (+Fe line) vary with the continuum?

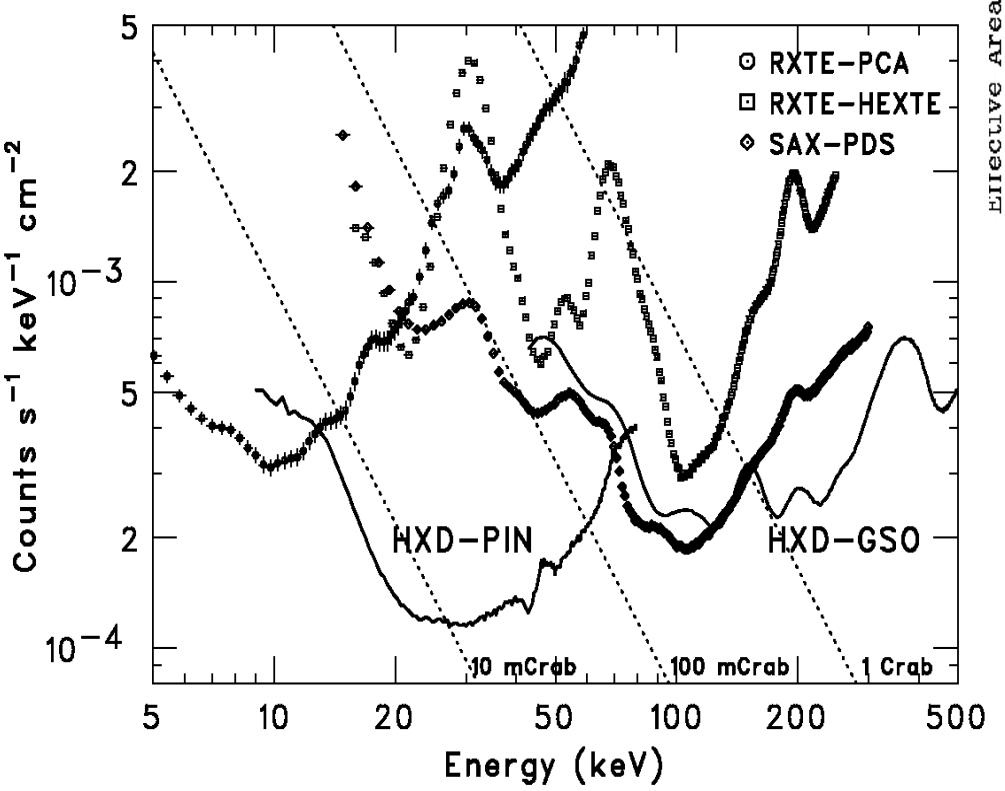
High energy cutoffs- and connection to x-ray background (in progress)

NGC4388, NGC4945, MCG -5-23-16, Cen-A, NGC2110

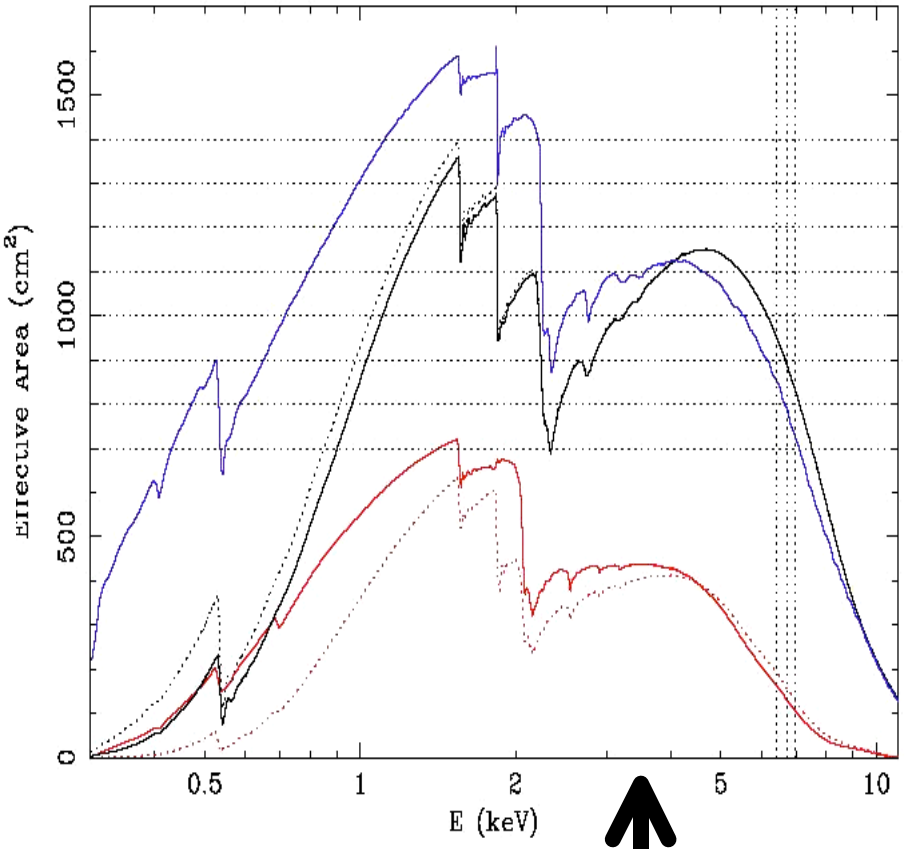
Also see Poster 7.10 A. Markowitz et al.
Poster 7.14 Y. Fukazawa & Suzaku/SWG

Comparison of Suzaku with other missions

Below 10 keV Suzaku has similar effective area to XMM EPIC (but better spectral resolution). ***Hard X-ray detector has lower background than Beppo-SAX over most of bandpass.***

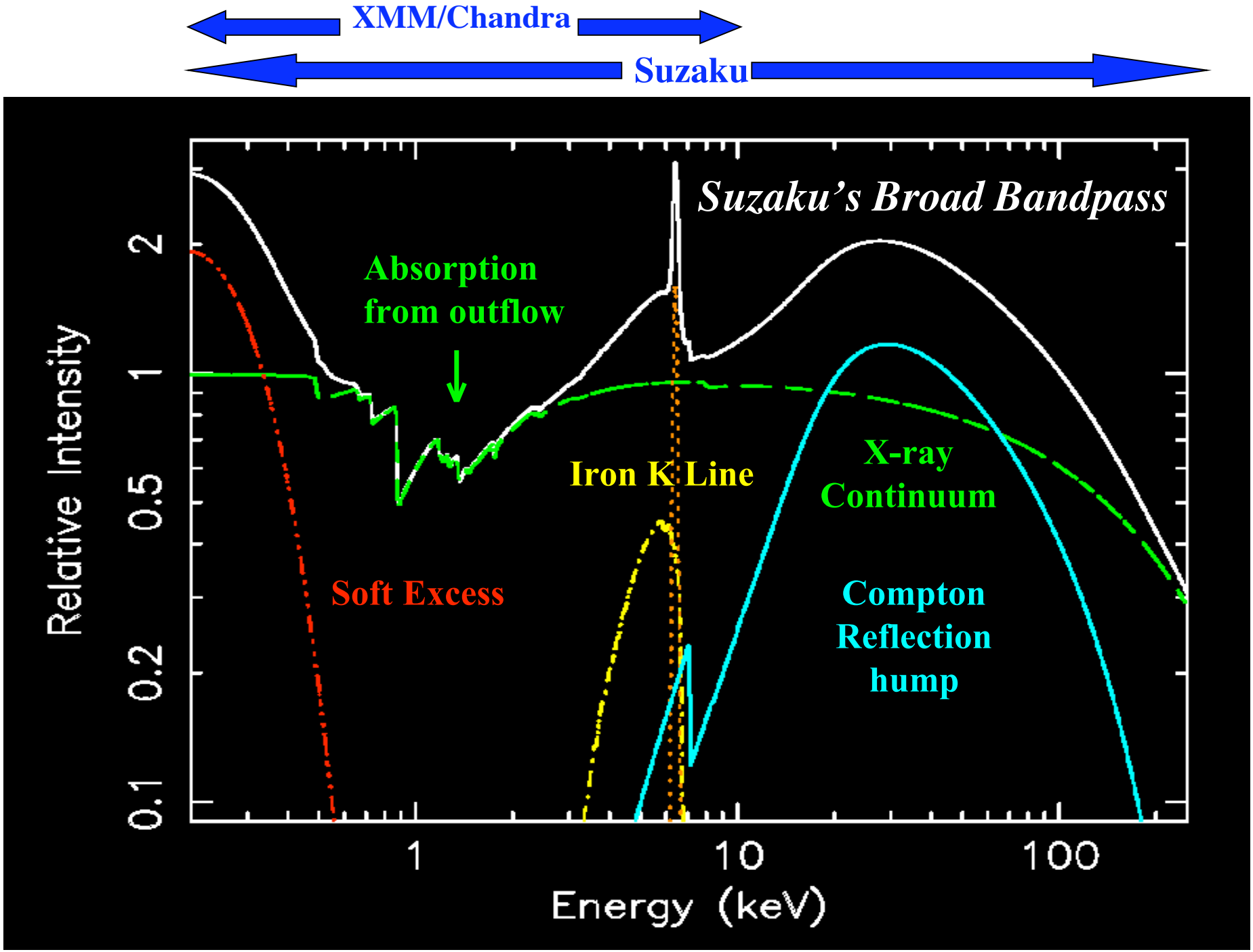


Hard X-ray background in Suzaku, RXTE and Beppo-SAX



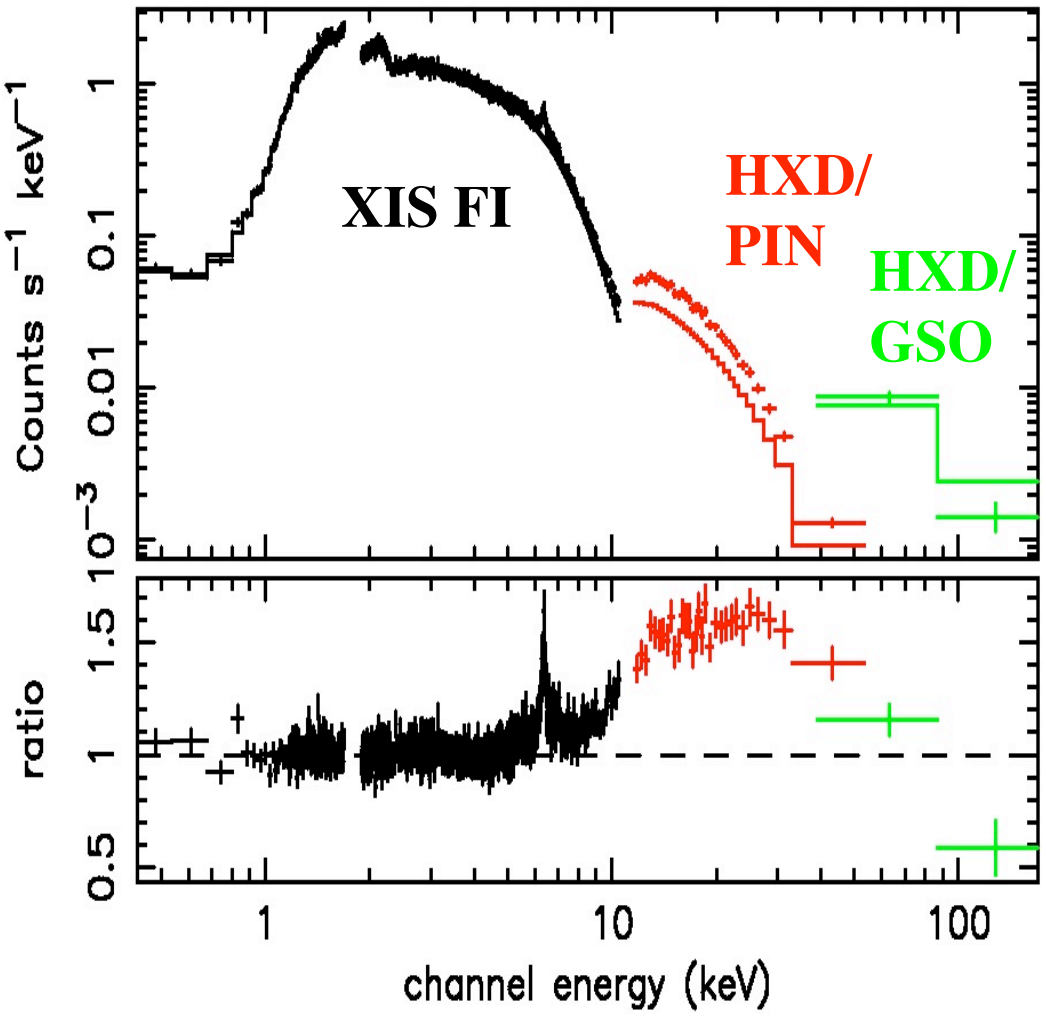
Effective areas

- ***Suzaku in black***
- XMM in blue
- Chandra (ACIS) red


XMM/Chandra
Suzaku
Suzaku's Broad Bandpass
Absorption
from outflow
Iron K Line
X-ray
Continuum
Soft Excess
Compton
Reflection
hump
Relative Intensity
0.1
0.2
0.5
1
2
1
10
100
Energy (keV)

Broad-band Suzaku Spectrum of MCG -5-23-16

(Compton-thin Seyfert 2, z=0.008486; Reeves et al. 2006, PASJ)



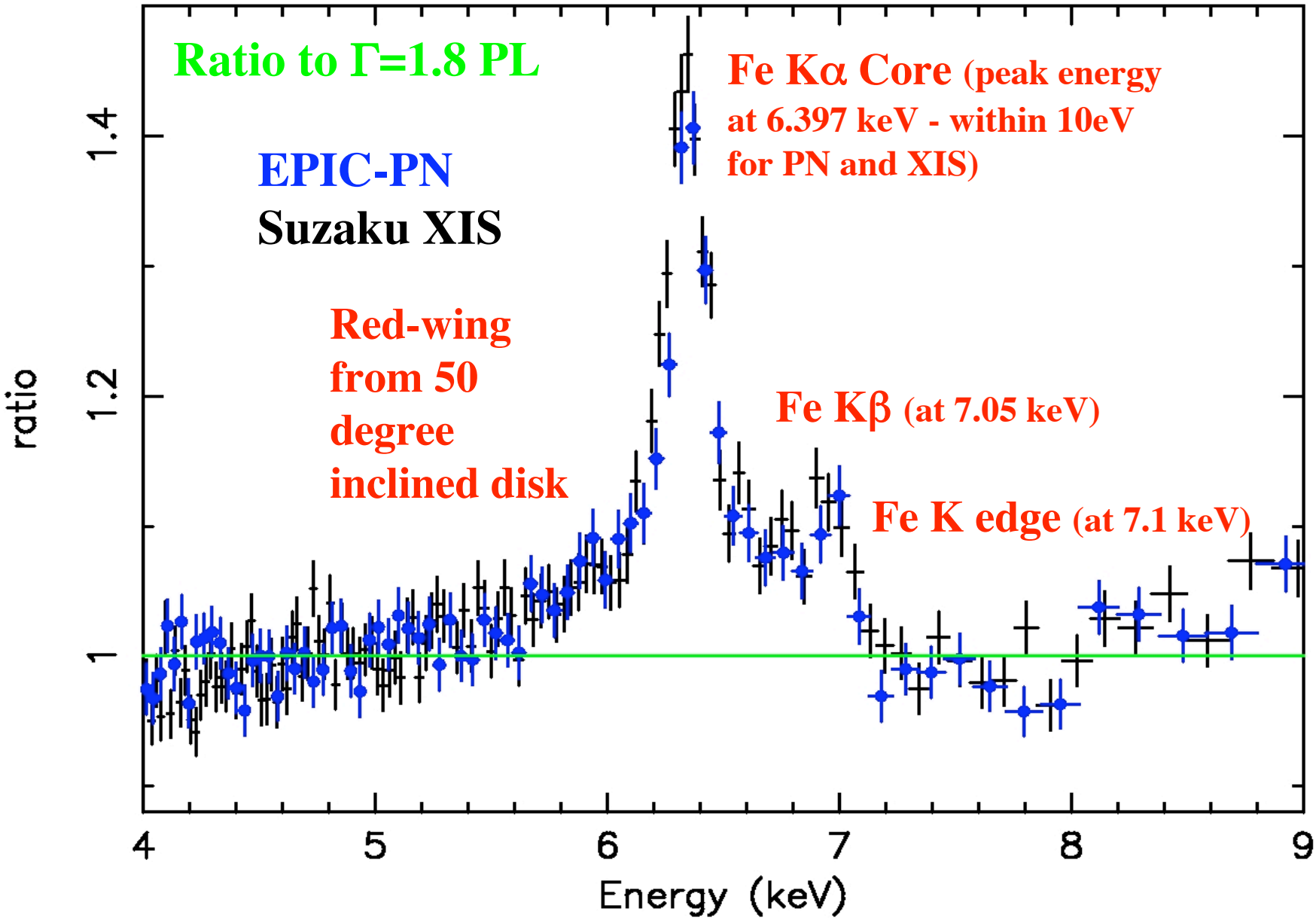
Observed Flux 9e-11 cgs (2-10 keV) and 1.8e-10 cgs (15-100keV).

Fe K line present between 6-7 keV and reflection hump clearly detected above 10 keV in HXD.

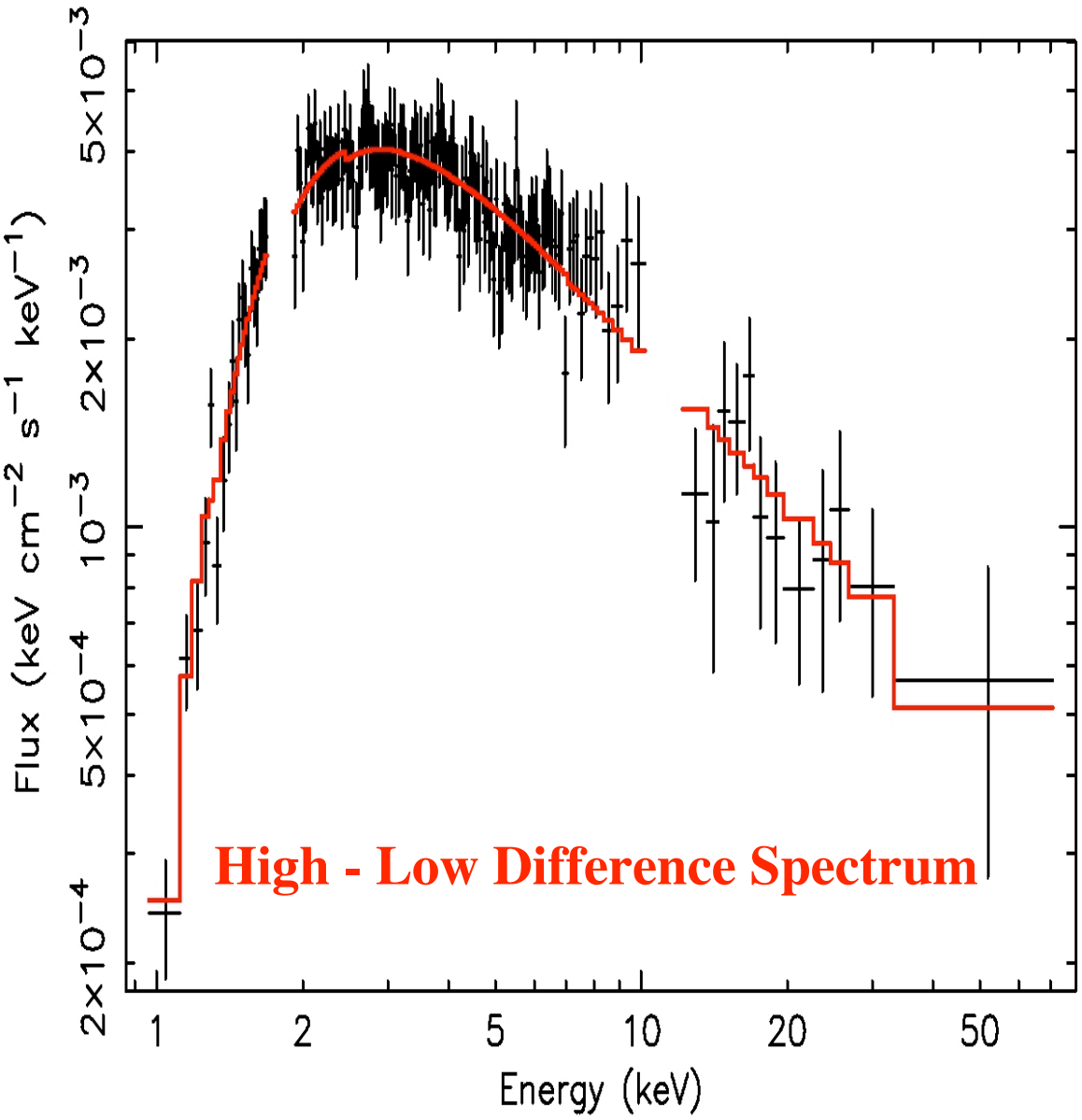
The reflection component is well constrained with R=1.1+/-0.2, with an Fe abundance of 0.5x solar and a cut-off of ~200 keV

The edge at 7.1 keV and the Compton hump allows us to determine both parameters.

Simultaneous Suzaku and XMM-Newton Observation of MCG -5-23-16 - *notice the excellent agreement on Fe K line shape*



The variable emission component from MCG -5-23-16



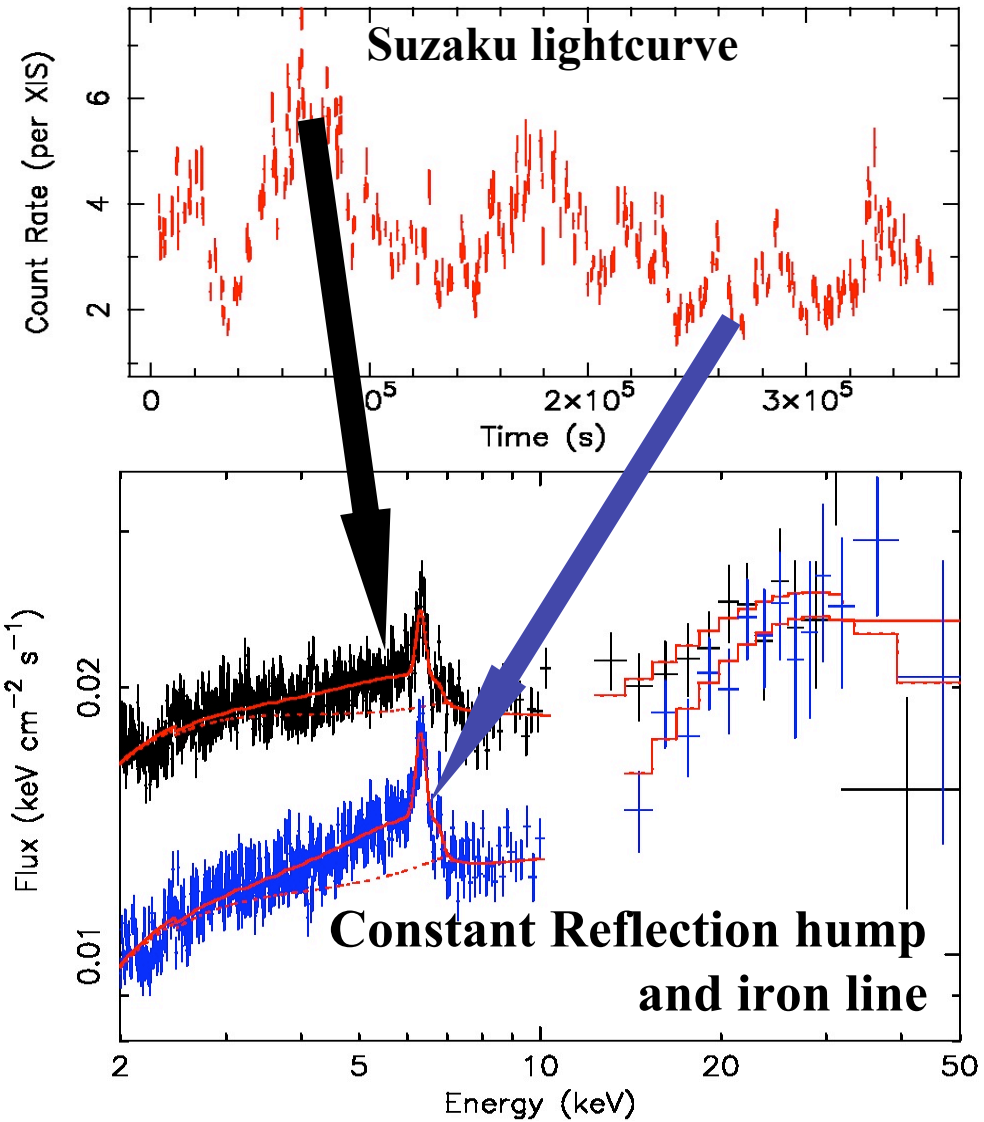
Source continuum varies by about 40% over Suzaku observation (220ks duration).

High - low spectrum shows that the variable component is just a power-law (Γ=1.9), modified by absorption.

Line and reflection hump appear constant (to <20%) over observation.

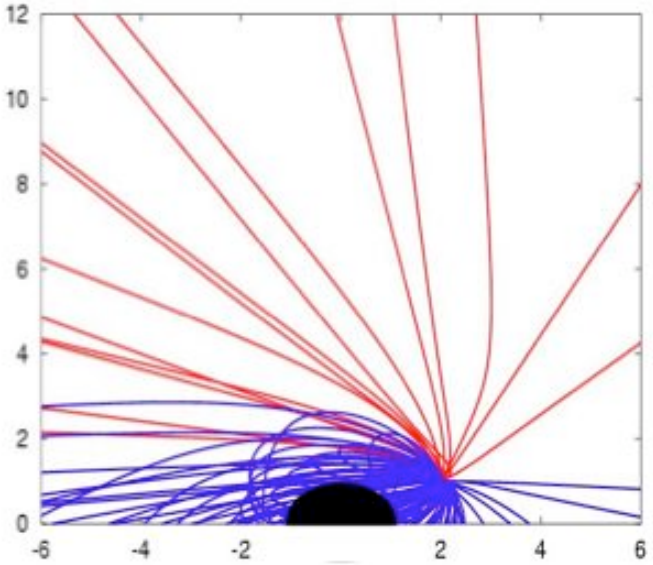
Variability of Iron line and Reflection in MCG-6-30-15

(Miniutti et al. 2006, PASJ, in press)

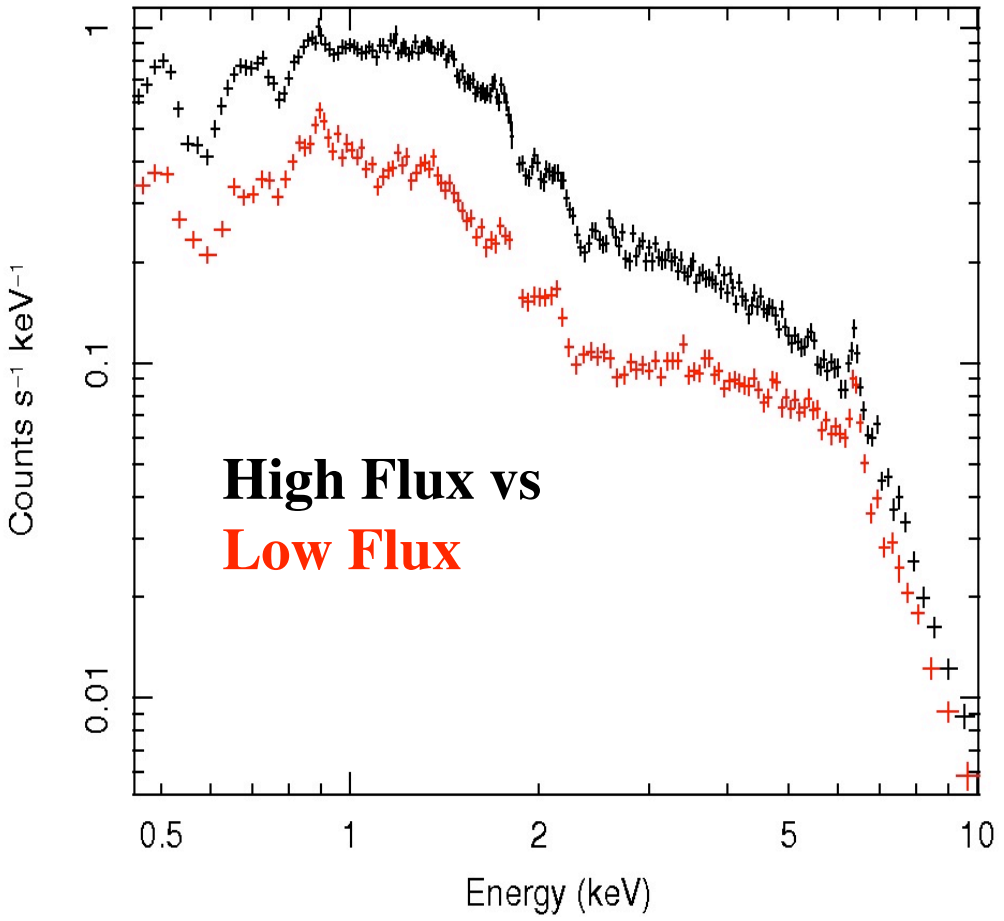


Strong iron K line and disk reflection from around a Kerr (spinning) black hole

No variations in Fe line/reflection - **gravitational light bending around a Kerr BH?** (Miniutti & Fabian 2004)



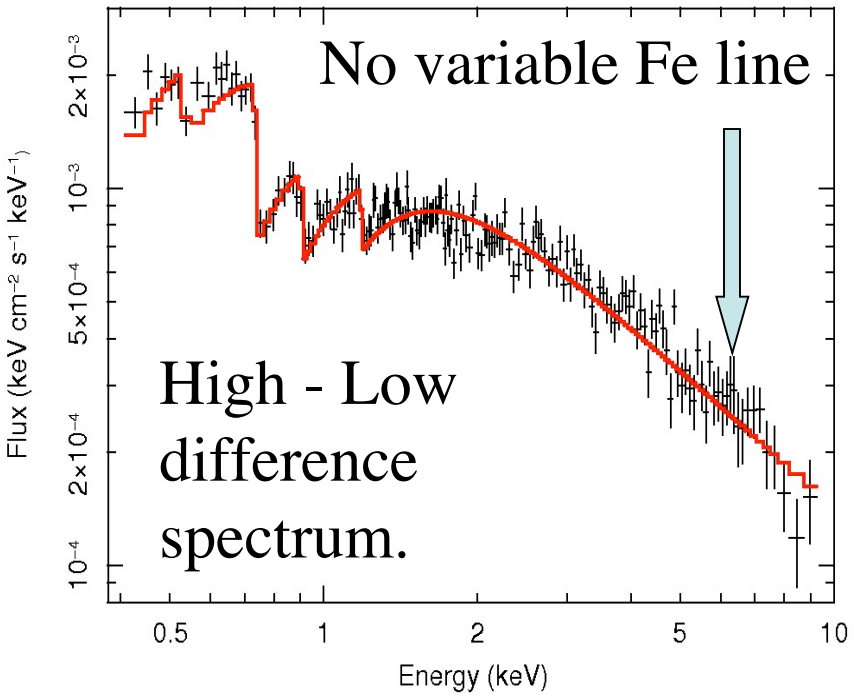
Spectral Variability in the NLS1, NGC 4051.



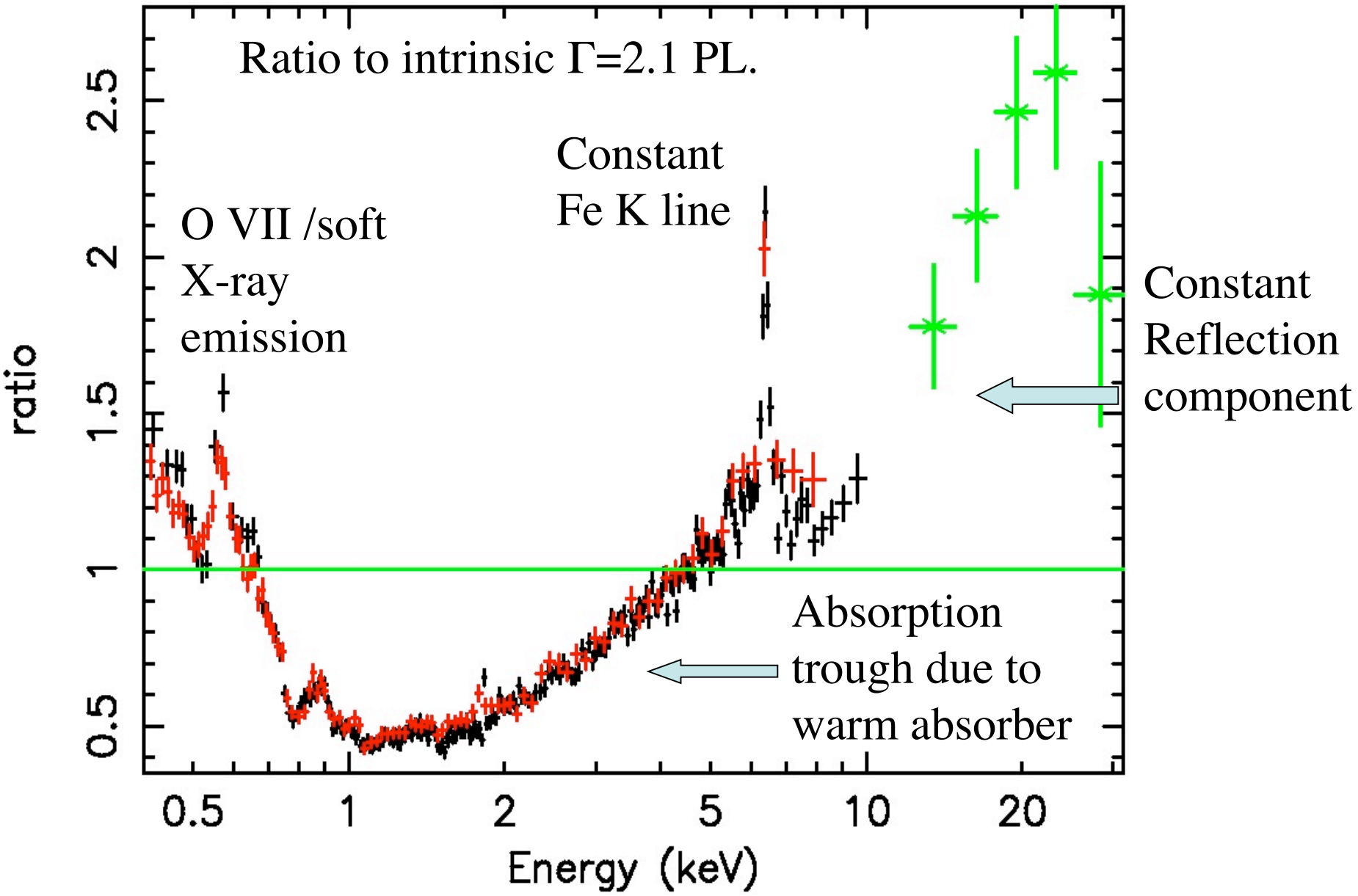
NGC 4051 spectrum is much less variable in the hard band

Spectral variability breaks into two components. Steep (Γ=2.1) variable power-law modified by absorption.

Constant hard component (Fe line + reflection?)



NGC 4051 - broad band spectral deconvolution



Conclusions

- The broad bandpass of Suzaku enables us to ***break the degeneracies in modeling the broad iron line***. Uncertainties in the modeling of continuum shape, absorption and reflection component are removed.

- Broad Fe lines are detected in a number of sources - MCG -6-30-15, MCG -5-23-16, NGC 3516, NGC 2992, 3C120, NGC 4051 - ***7/8 AGN show broad lines in Suzaku Compton-thin Seyfert sample***.

- Narrow line origin not ubiquitous. Some (e.g. MCG -5-23-16) originate from Compton-thick matter (torus?). In others (Cen A, NGC 2110), no reflection is present.

- A constant hard component appears to be present in a number of spectra (MCG -6-30-15, NGC 4051, MCG -5-23-16). ***Fe line and reflection component do not respond simply to continuum flux***.

- In the future, a large sample of AGN (**>200 from Swift/BAT survey**) can be studied with Suzaku XIS+HXD (R Mushotzky talk)