Active galaxy 4U 1344-60:

Did the relativistic line dissappear?

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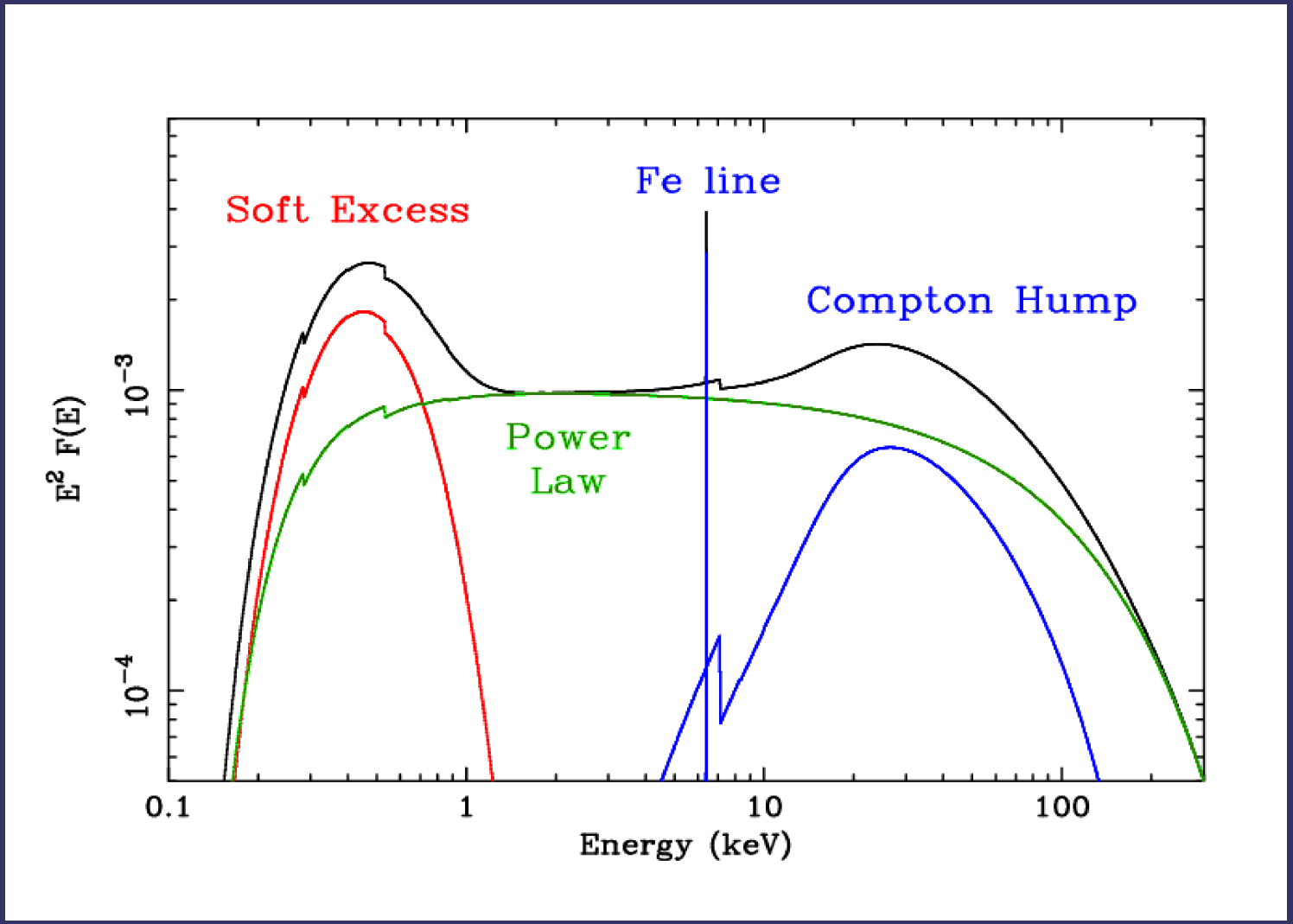
Outline

- Introduction
- Recent observation with Suzaku
- Comparison with archival XMM-Newton data
- Conclusions

Seyfert galaxies

- nearby galaxies with bright nuclei exhibiting strong spectral line emission from highly ionised gas
- black holes with 10^7-10^8 solar masses in the nuclei
- optical spectral lines: narrow-line and broad-line region (Doppler effect due to orbital motion, extended accretion disc or molecular clouds)
- X-ray emission from hot corona where the thermal UV photons from an accretion disc are inversely Compton-ised to higher enegies (power-law spectral shape)

X-ray spectra of Seyfert galaxies

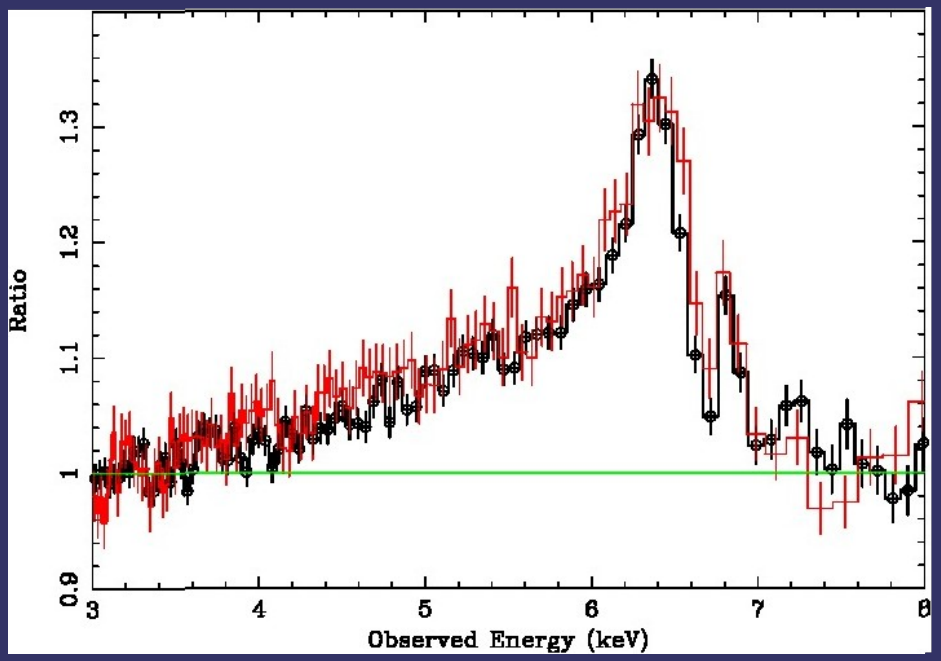


Fabian et al., 2006

Relativistic iron lines in Seyferts

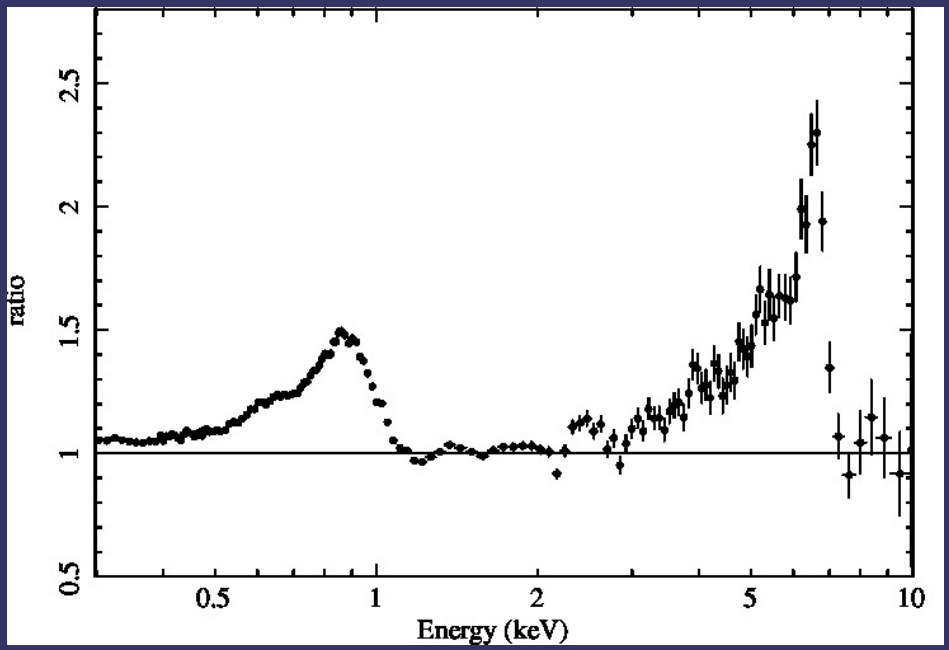
- examples:

MCG -6-30-15



Miniutti et al., 2007

1H 0707-495



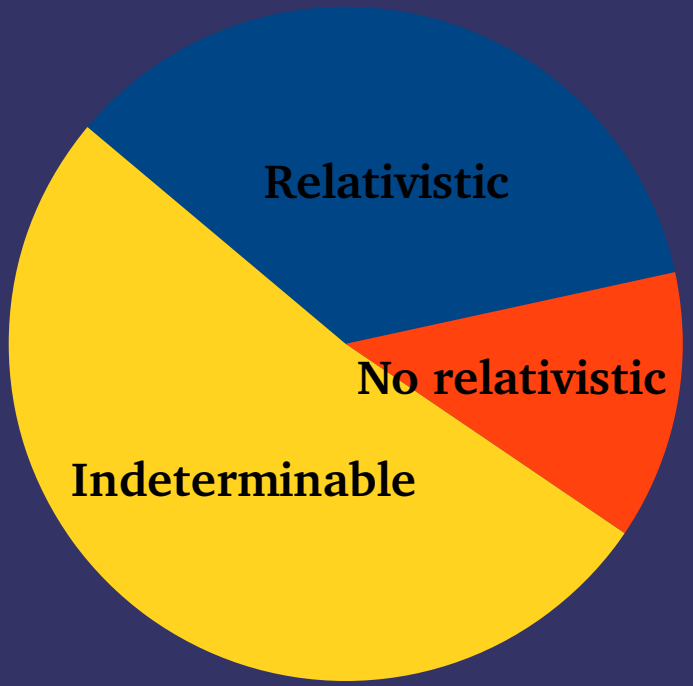
Fabian et al., 2009

Which fraction of AGNs does show a relativistic iron line?

- study of samples (Guainazzi et al. 2006, Nandra et al. 2007, de La Calle Peréz et al. 2010, Bhayani & Nandra 2011, Guainazzi et al. 2012)
- FERO result on a flux-limited sample of AGN: (de La Calle Peréz et al. 2010)

relativistic line	number of sources	relative number
YES	11	35%
NO*	4	13%
?	16	52%

*EW < 40 eV

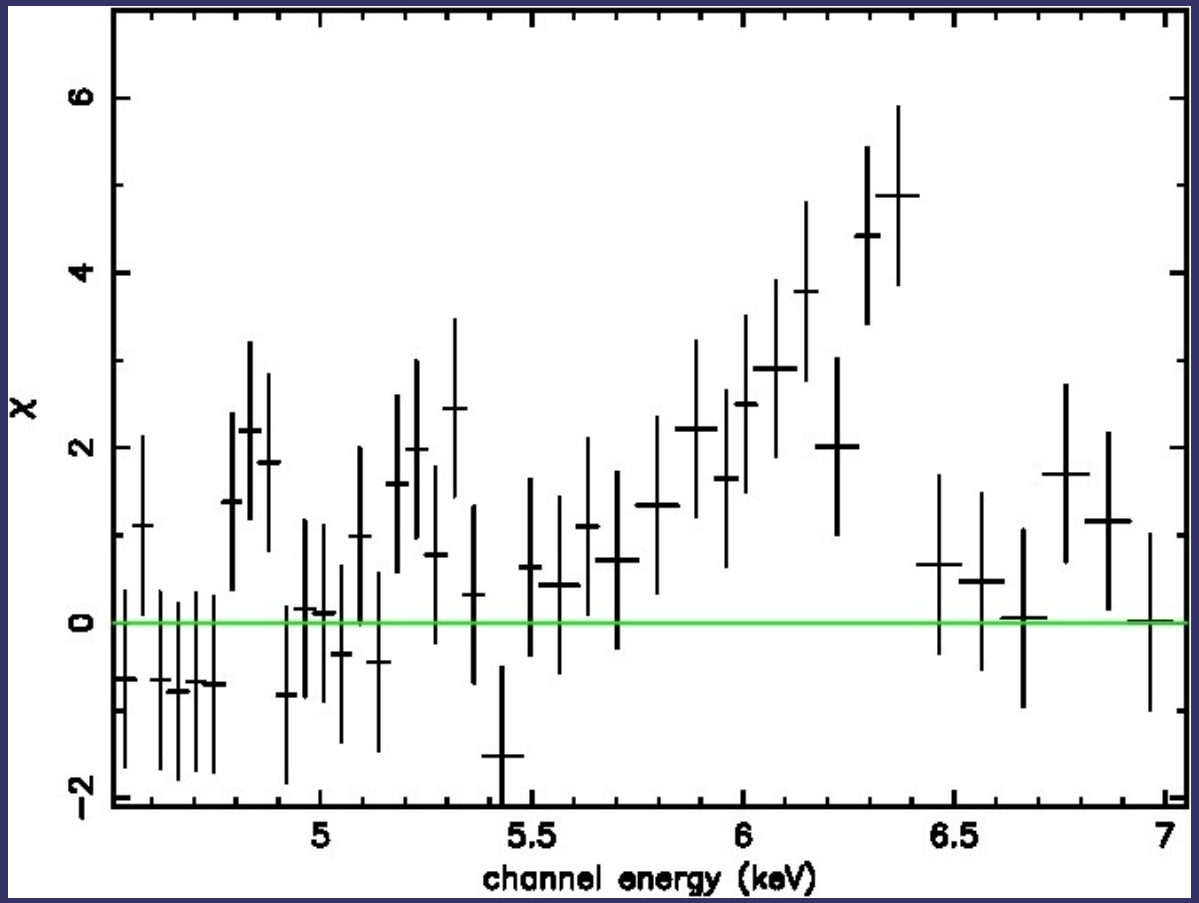


4U 1344-60

- nearby (z=0.012) and bright (about 2 millicrabs) intermediate-type Seyfert galaxy
- low Galactic latitude (b=1.5°)
- proximity to a radio-loud galaxy Centaurus B
  - separation radius only 13'
- appeared at the EPIC-PN field of an archival XMM-Newton observation of Centaurus B (Piconcelli et al., 2006)

XMM-Newton observation

- performed in Aug 2001, 37 ks exposure time
- a mildly relativistic profile was revealed



Piconcelli et al. (2006)

Suzaku observation

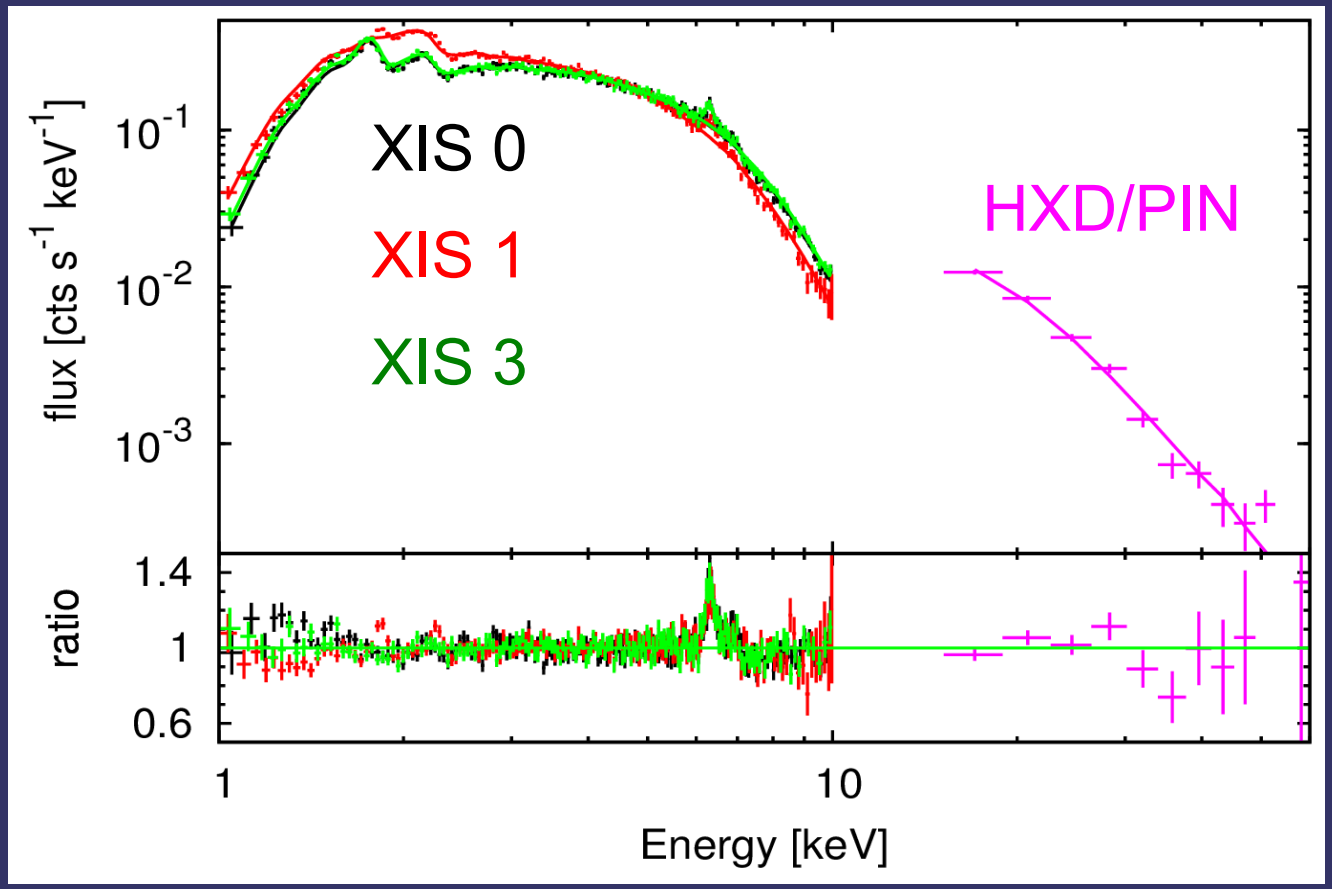
- performed in Jan 2011, 100 ks exposure time
- accompanied with 10 ks observation of Cen B
  - to estimate the contamination of HXD/PIN detector
- flux measurements [10^{-11} erg cm^{-2} s^{-1}]:

	2-10 keV	15-60 keV
4U 1344-60	4	8
Centaurus B	0.4	0.8*

* predicted from XIS measurements

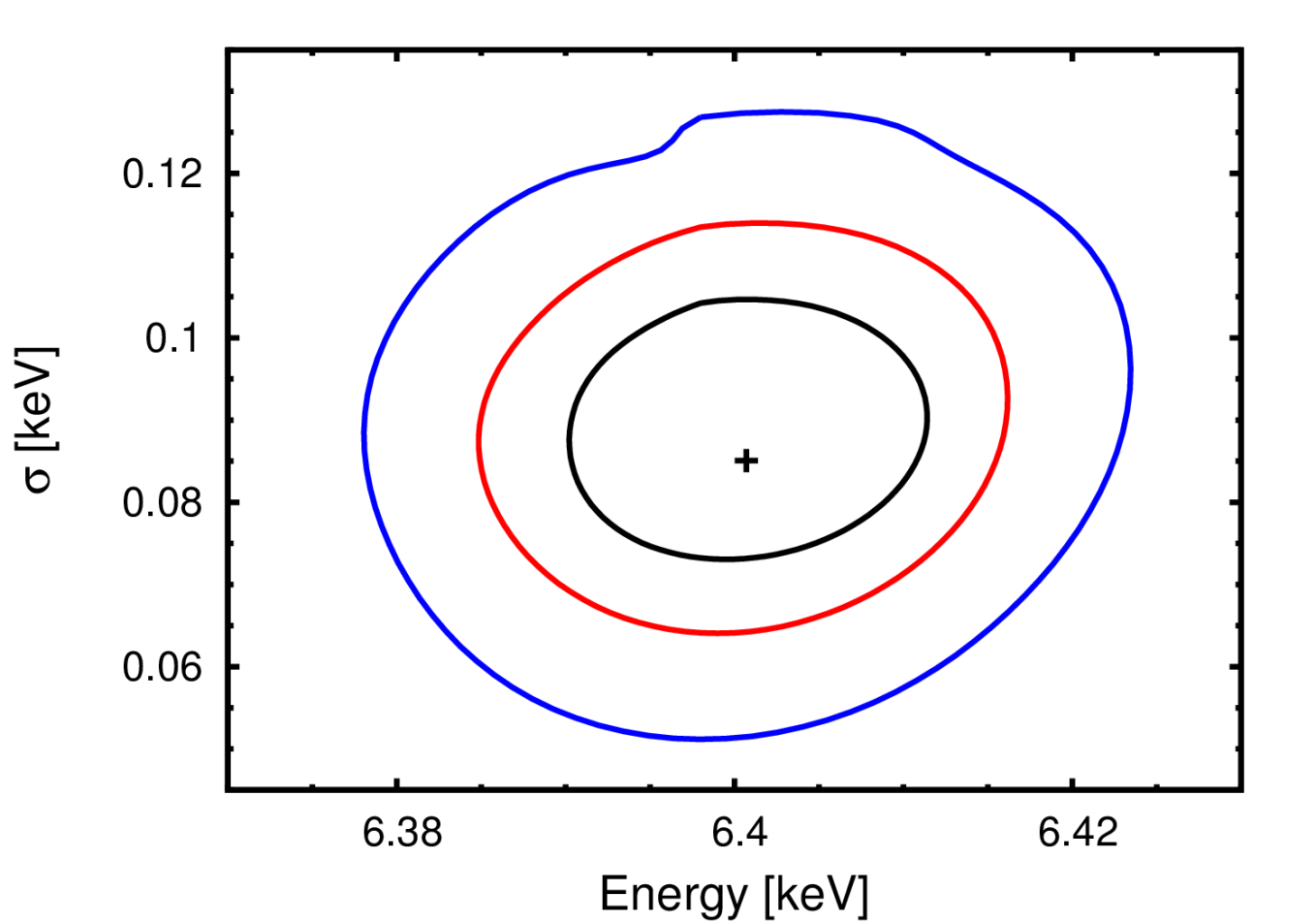
- contribution from Cen B ($\Gamma = 1.6$) is negligible
  - less than 5% in HXD/PIN spectrum produced with the XIS-nominal position of 4U 1344-60

Suzaku view of 4U 1344-60



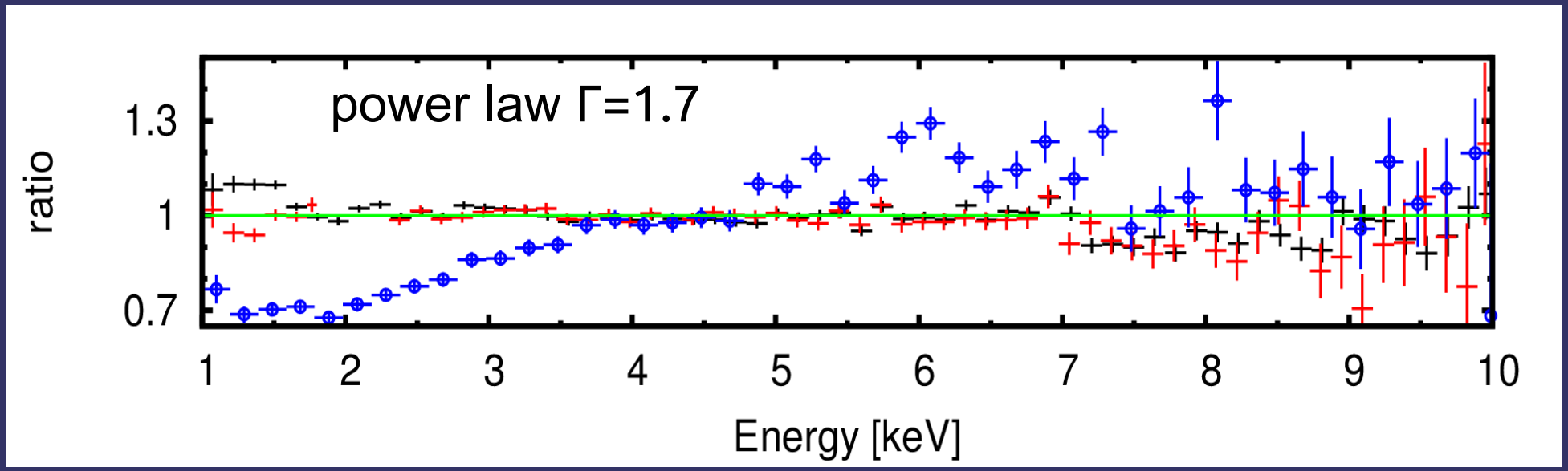
- model: an absorbed power law with Γ = 1.7
- narrow iron line at E = 6.4 keV revealed

Properties of the iron line



- σ ~ 90 eV corresponds to FWHM 8800 km s^{-1}
  (about twice larger than optical BLR)

Comparison with the XMM-Newton spectrum



- XMM-Newton spectrum (blue) is harder than Suzaku XIS 0 and 3 (black), XIS 1 (red)
- changes in the photon index of the power law or the properties of the absorber?

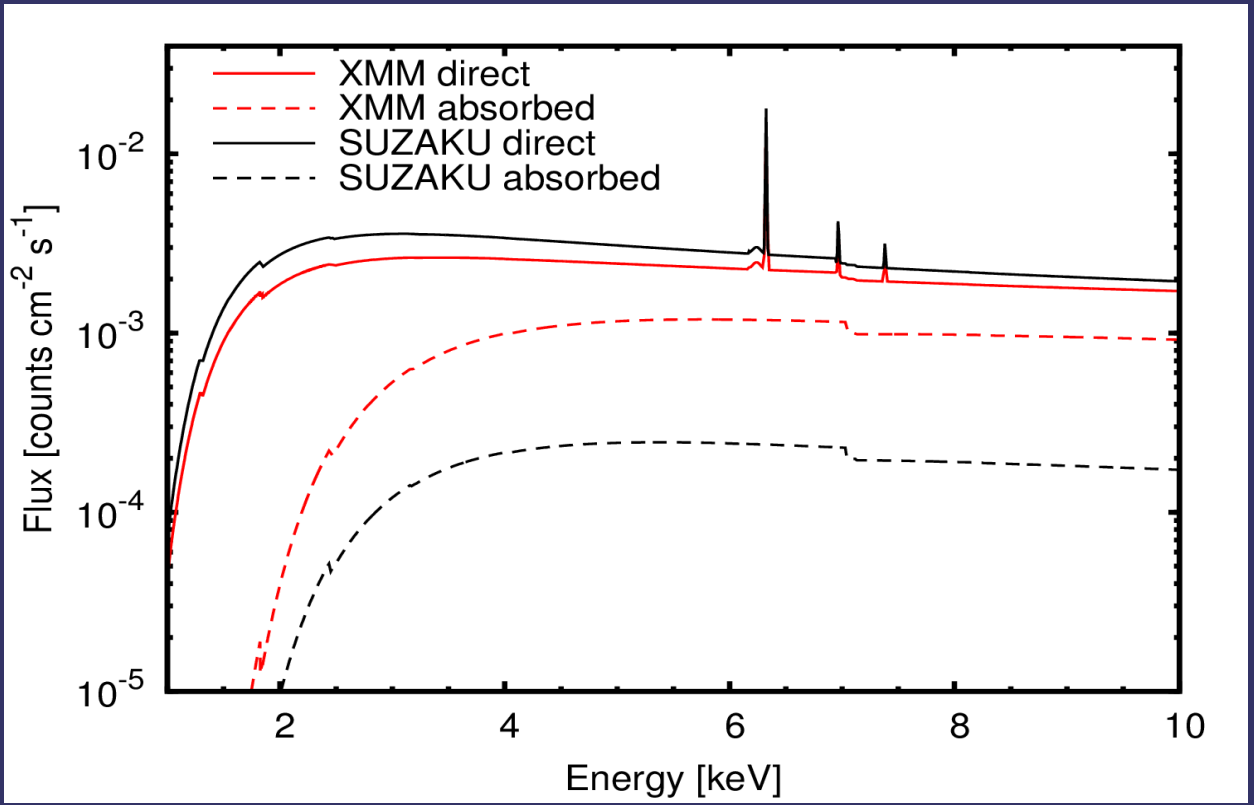
Variable power-law slope

- XMM – flat power law
  - photon index $\Gamma = 1.24 \pm 0.04$
  - iron line can be modelled with a relativistic profile
- issues:
  - narrow iron line in Suzaku observation
  - inconsistency with hard-X-ray flux measurements

flux [10^{-11} erg cm^{-2} s^{-1}]	20-40 keV	40-100 keV
XMM flat Γ	7.7(1)	19.0(2)
Suzaku	3.3(1)	4.1(1)
Integral	3.2(1)	4.1(2)
Swift	2.7(1)	4.0(2)

Complex absorber's variability

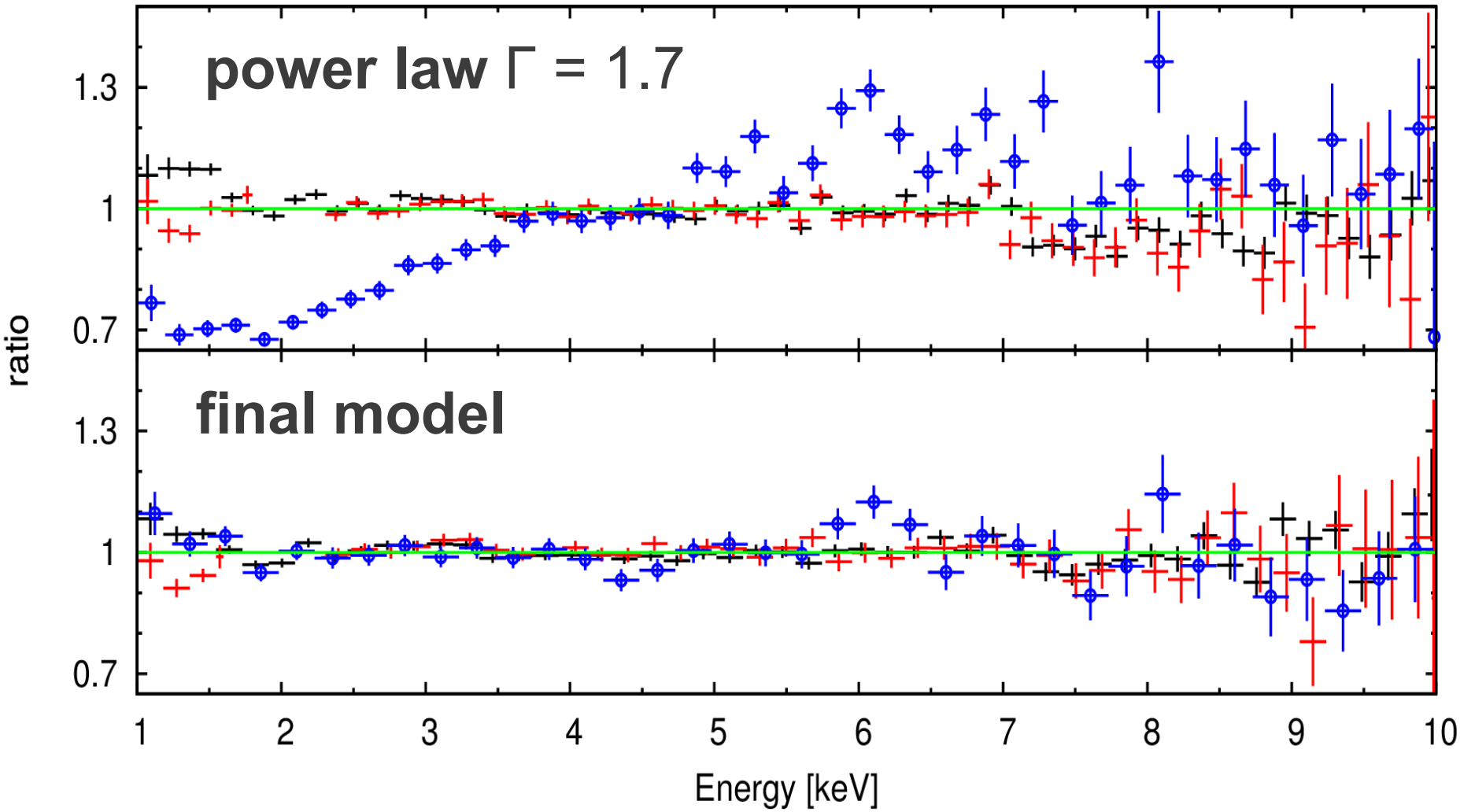
- power law remains the same ($\Gamma = 1.7$)
- an additional partially-covering absorber with a variable covering fraction is required (with $N_H \sim 8\times10^{22}$ cm^{-2})



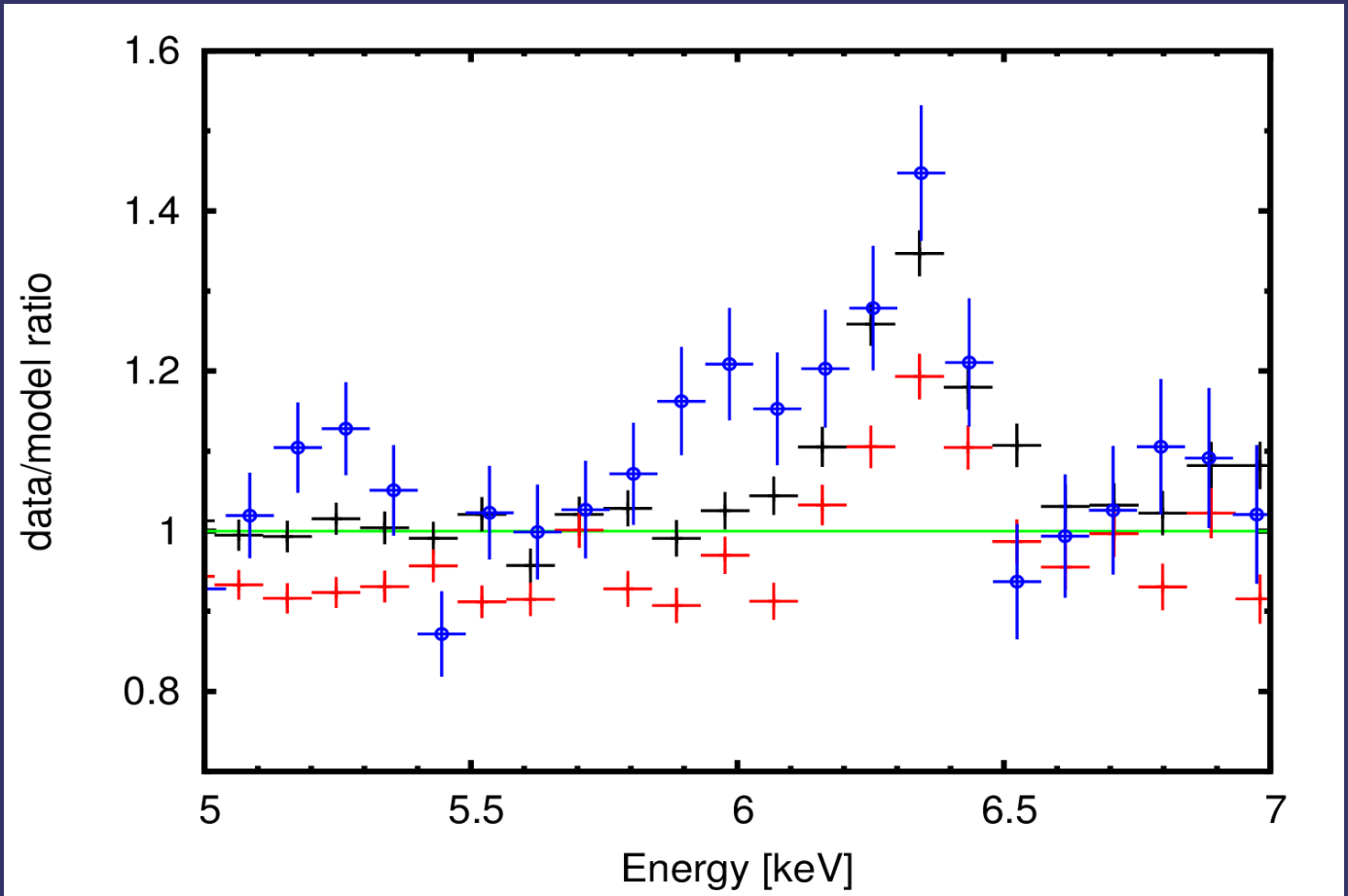
covering factor:

- XMM **~ 45%**
- Suzaku **<10%**

Comparison with the XMM-Newton spectrum II



A detailed look at the iron line



- some residuals at E ~ 6.1 keV still present in the XMM-Newton spectrum (blue)

Transient iron line feature

- can be explained as a temporarily enhanced emission from the innermost accretion disc
  - equivalent width ~ 100 eV
  - no timing study was possible with ~35ks exposure
  - model by Gaussian line:

energy [keV]	6.1 ± 0.1
width [keV]	0.2 ± 0.1
normalisation [10^{-5}]	6 ± 2

- or decreased ionisation in the accretion disc?
- a similar transient feature at E ~ 6.1 keV was reported in NGC 3516 (Bianchi+ 04, Iwasawa+ 04)

Conclusions I

- X-ray continuum of 4U 1344-60 is dominated by a power law with $\Gamma = 1.7$
- harder XMM-Newton spectrum can be explained either by a variable photon index or by the presence of partially covering absorber
- the latter is more consistent with hard X-ray flux measurements and Suzaku observation

Conclusions II

- iron line detected by Suzaku is relatively narrow without any relativistic signatures
- regarding this, we interpret the iron-line complex in the XMM-Newton spectrum as a narrow iron line (with the same parameters as for Suzaku) plus an additional temporarily enhanced emission from the innermost accretion disc