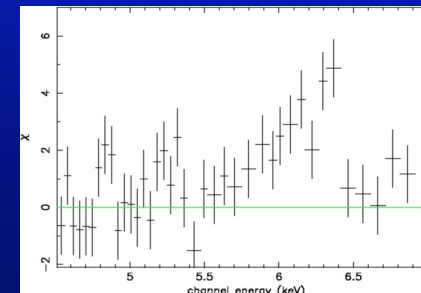


XMM-Newton Discovery of a Strong Relativistic Fe $K\alpha$ Emission Line in 4U 1344-60



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Relativistic Fe $K\alpha$ Emission Line in 4U 1344-60

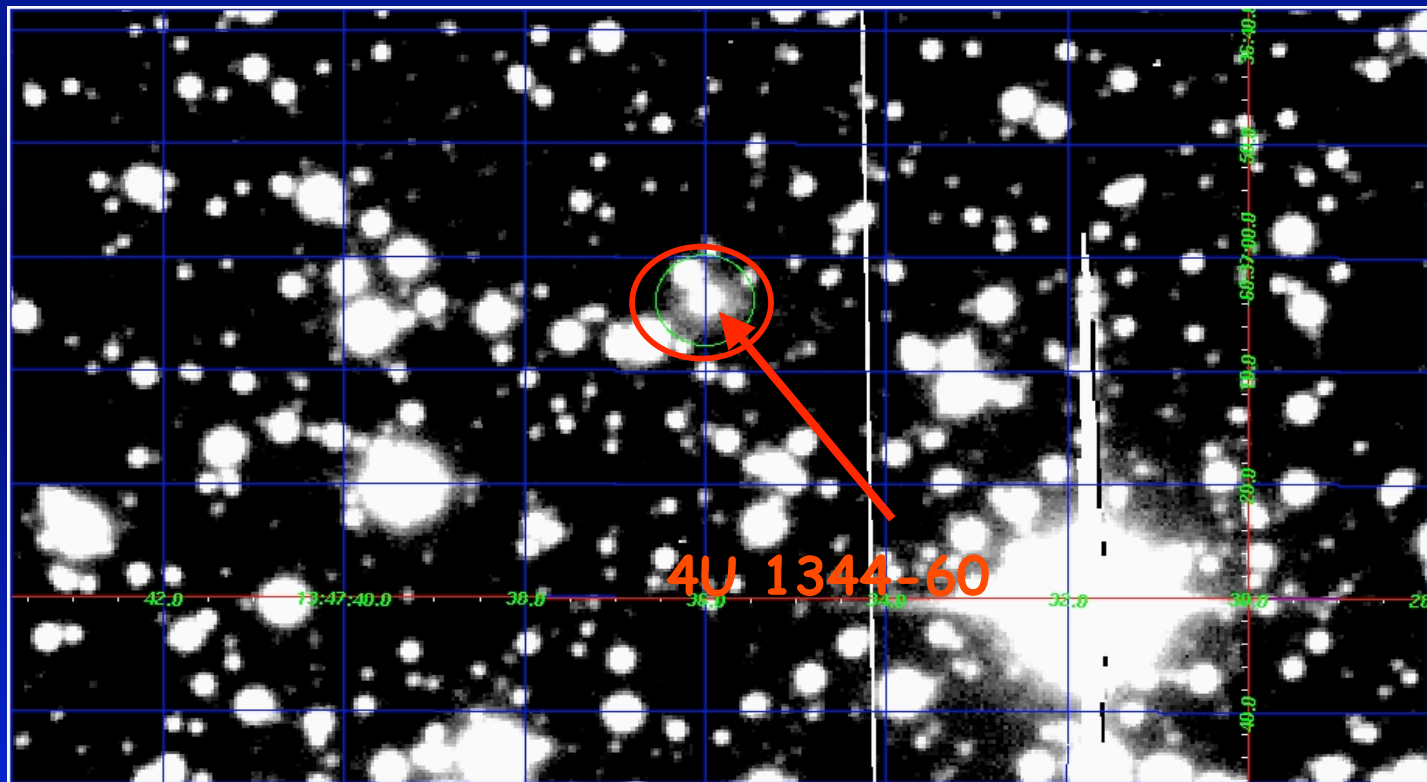
- Introduction to 4U 1344-60
- Optical data analysis
- *X-ray* spectral analysis
 - The continuum emission
 - The feature $\sim 6\text{keV}$: **Fe- $K\alpha$ broad emission line**
 - Other spectral features
- Conclusions and future work

History of 4U 1344-60

- Discovered by *UHURU* (Forman et al. 78)
- Detected in the *HEAO-1* $F_x \sim 2 \times 10^{-11} \text{ erg cm}^{-2}\text{s}^{-1}$
- First position measurement *EXOSAT* (Warwick et al. 88)
- 4U 1344-60 lies $\sim 14'$ from the radiogalaxy Centaurus B
 - ♦ 4U 1344-60 lies in the **Galactic Plane** ($b = 1^\circ.51$)
 - ♦ **NO** easily accessible at all wavelengths
- The inclusion in the First *INTEGRAL* AGN catalog (Beckmann et al. 06) has re-awoken interest in this source.

Optical data of 4U 1344-60

- Identification programme of the *XMM-Newton* Survey Science Centre
(Motch et al. 03; Watson et al 01) EFOSC2 ESO 3.6m

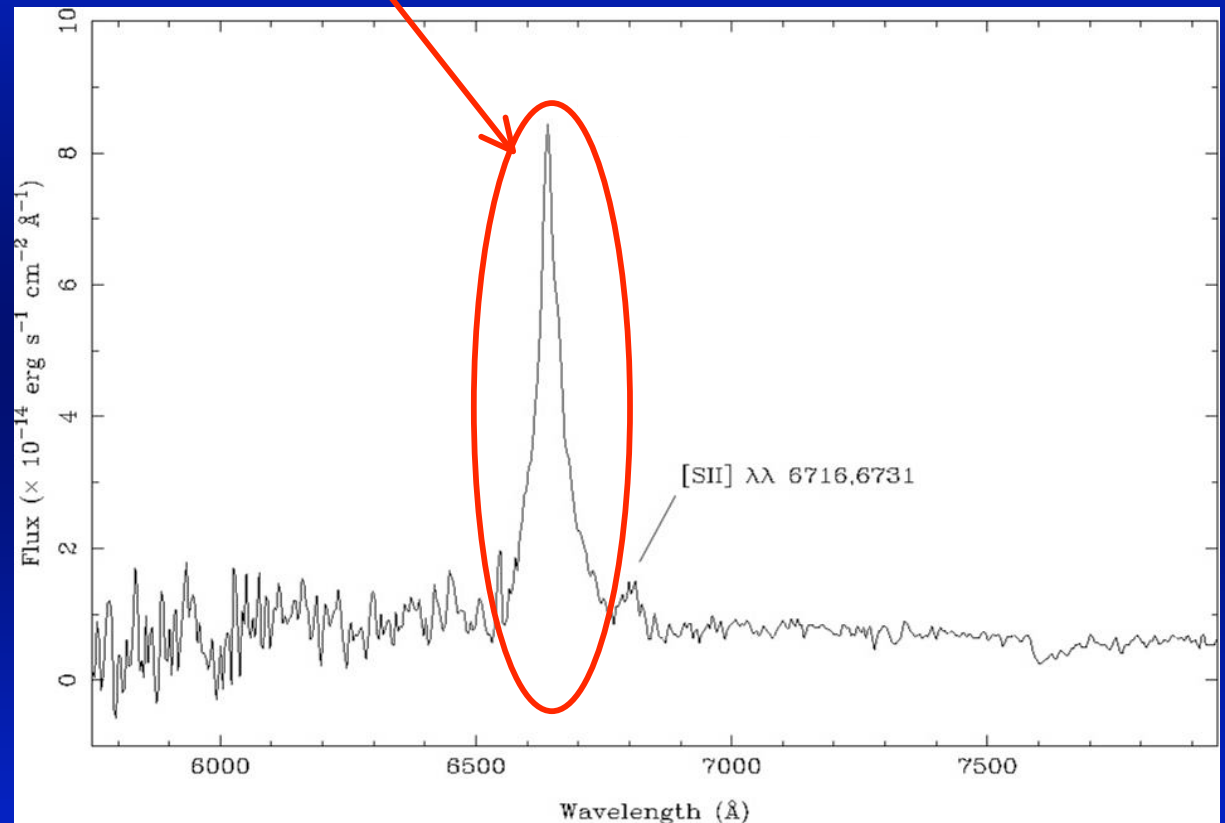


Masetti et al.
2006

Optical data of 4U 1344-60

Identification programme of the ~~XMM-Newton Survey Science Centre~~ (Motch et al. 03; Watson et al 01) ~~EOSC2 ESO 3.6m~~ $H_{\alpha}^{\text{broad}} + H_{\alpha}^{\text{narrow}} + [\text{NII}] \lambda 6548 \text{ \AA} + [\text{NII}] \lambda 6583 \text{ \AA}$

- $H_{\alpha}^{\text{narrow}} \rightarrow z=0.012 \pm 0.001$
- $H_{\alpha} / [\text{SII}] \sim 3 \rightarrow \text{AGN-like}$
- $H_{\alpha}^{\text{broad}}$ width ~ 4400 km/s
 $\rightarrow \text{Seyfert 1.x}$
- Seyfert Type:
 $1 + [I(H_{\alpha}^{\text{narrow}}) / I(H_{\alpha}^{\text{broad}})]^{0.4}$
 $\rightarrow \text{Seyfert 1.5 (-1.8) Netzer 90}$

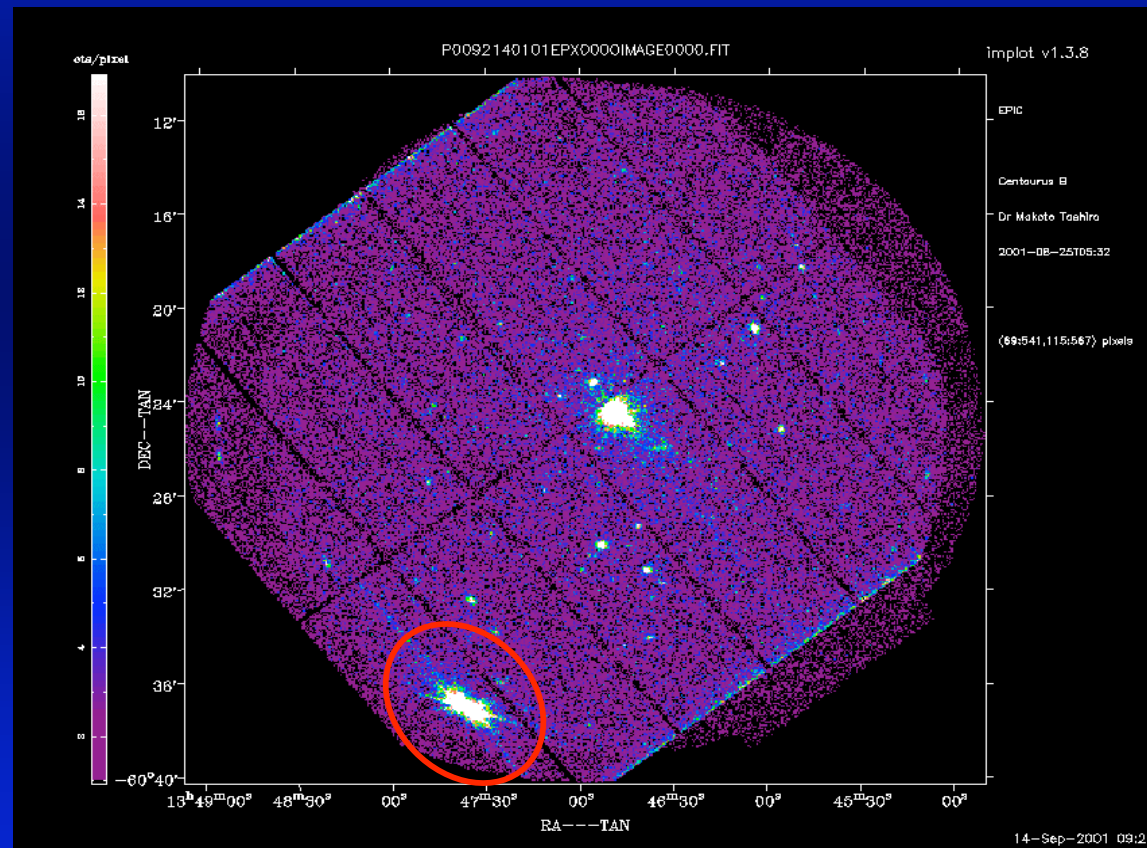


Masetti et al. 2006

XMM-Newton data analysis

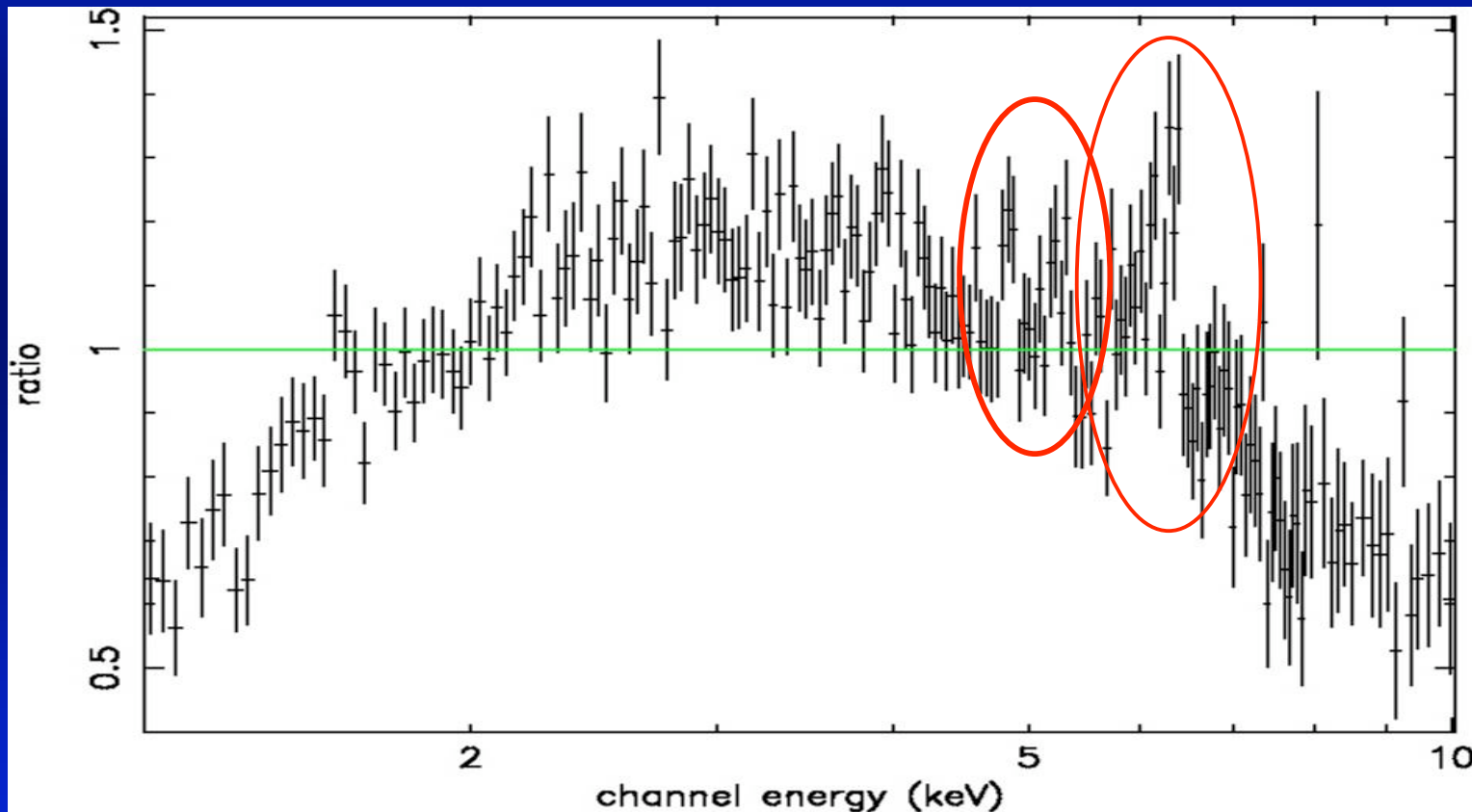
No on-axis X-ray observation of the source

BUT... XMM-Newton off-axis observation Main target: Centaurus B



XMM-Newton data spectral analysis

Very complex spectrum:
high absorption and several spectral features



XMM-Newton: continuum emission

Several tested models: neutrally absorbed power law, *pexrav*,
partial (& full) covering model

$$N_{\mathrm{H}}^{\mathrm{f}} = 0.9 \pm 0.2 \times 10^{22} \text{ cm}^{-2} \quad (N_{\mathrm{H}}^{\mathrm{gal}} = 1.08 \times 10^{22} \text{ cm}^{-2})$$

$$N_{\mathrm{H}}^{\mathrm{p}} = 5 \pm 2 \times 10^{22} \text{ cm}^{-2} \leftarrow 50\% \text{ of the primary emission}$$

$$\Gamma = 1.6 \pm 0.1$$

$$\chi^2_{\mathrm{v}} = 0.95 \text{ (138 for 145 dof)}$$

XMM-Newton: continuum emission

Comparison with *INTEGRAL* results

20 - 40 keV significance map

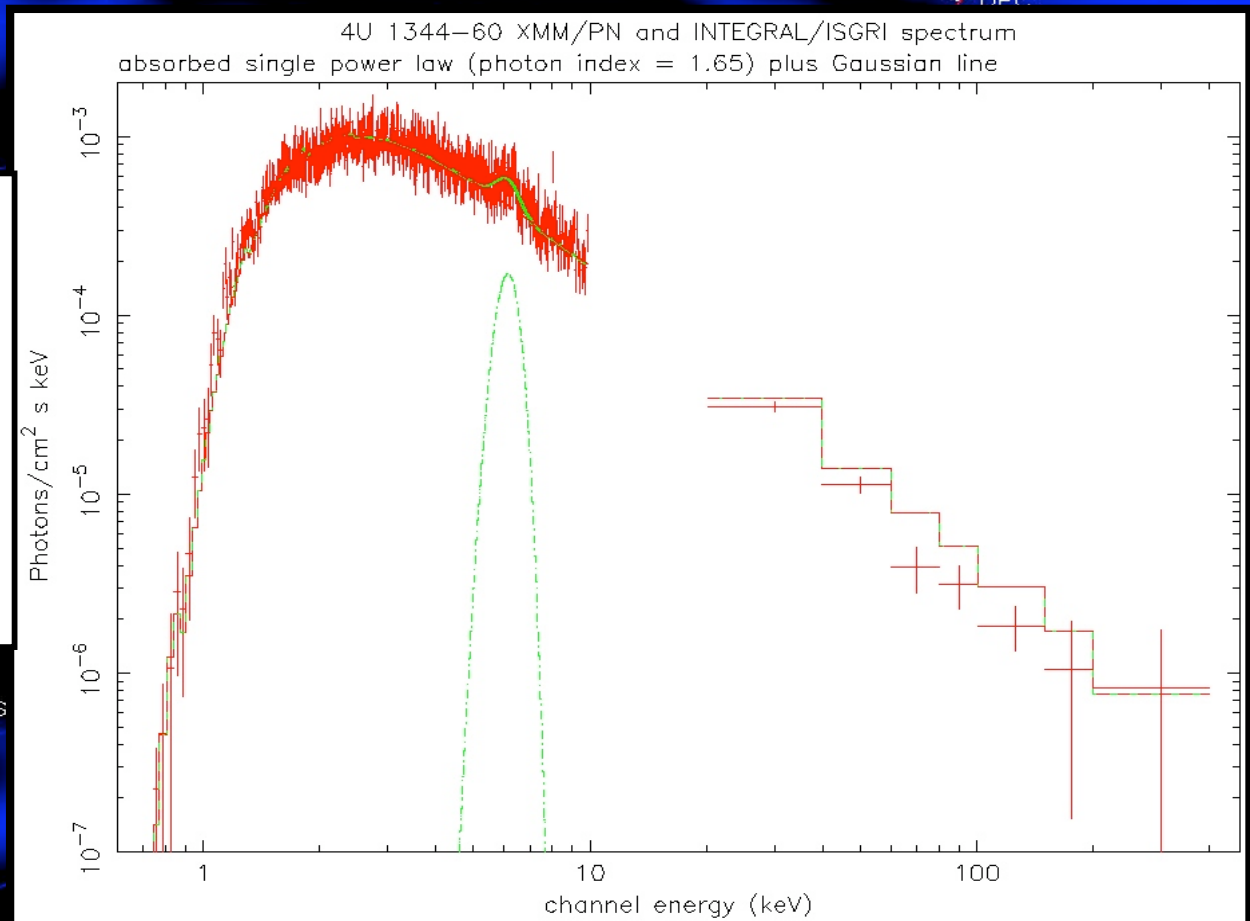
INTEGRAL DATA

$$\Gamma = 1.65 \pm 0.03 \quad (1.59 \pm 0.11)$$

$$n_H = 2.64 \pm 0.07 \times 10^{-22} \text{ cm}^{-2}$$

$$(5 \pm 2 \times 10^{22} \text{ cm}^{-2})$$

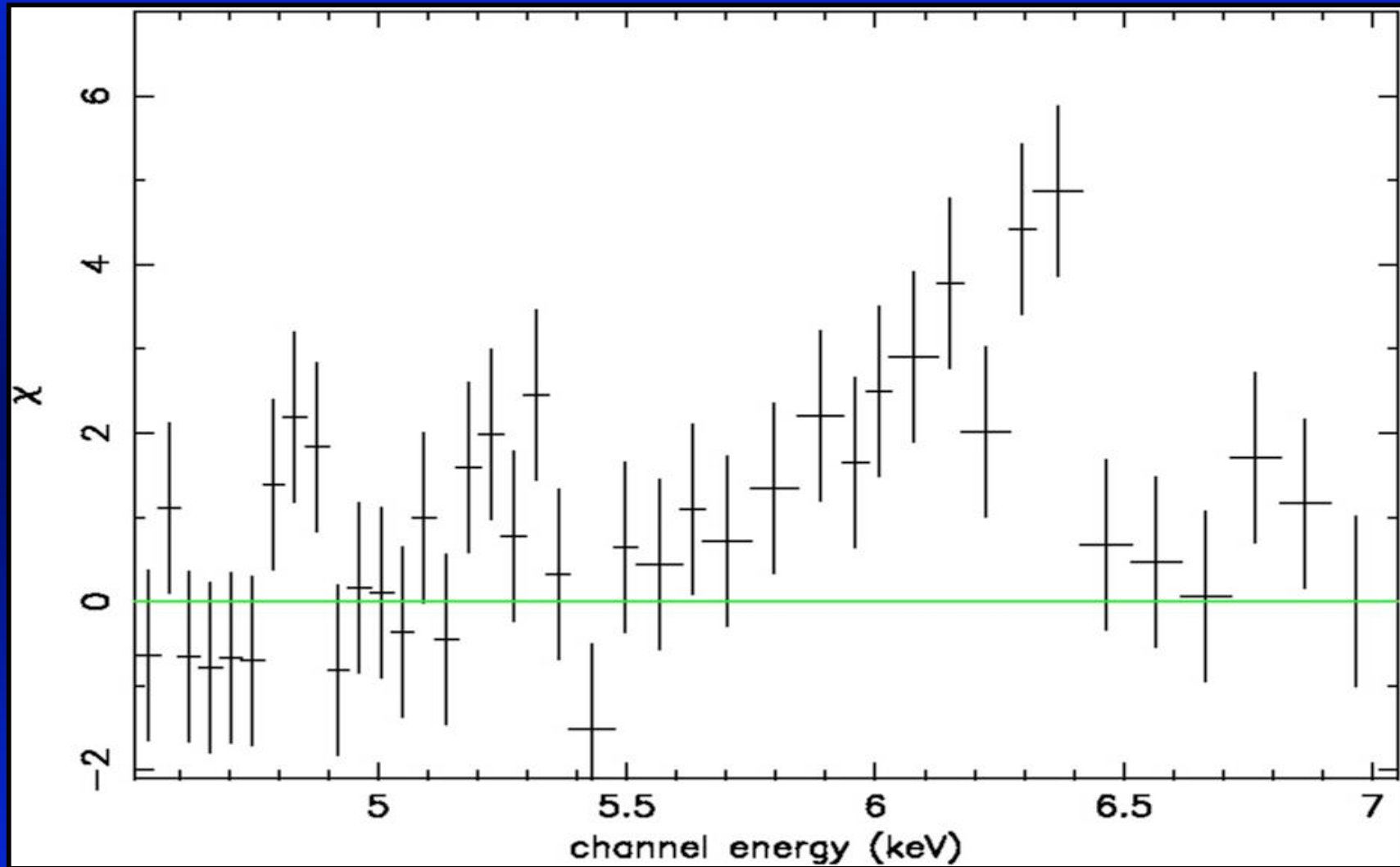
Beckmann et al. 2006



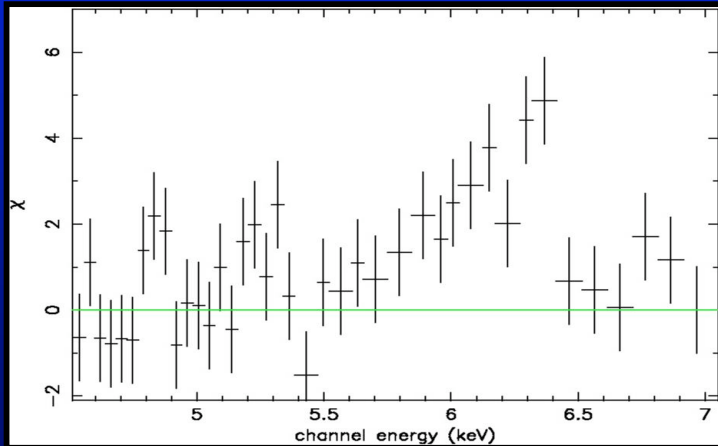
V. Beckmann (NASA/GSFC) SPI data analysis

RA

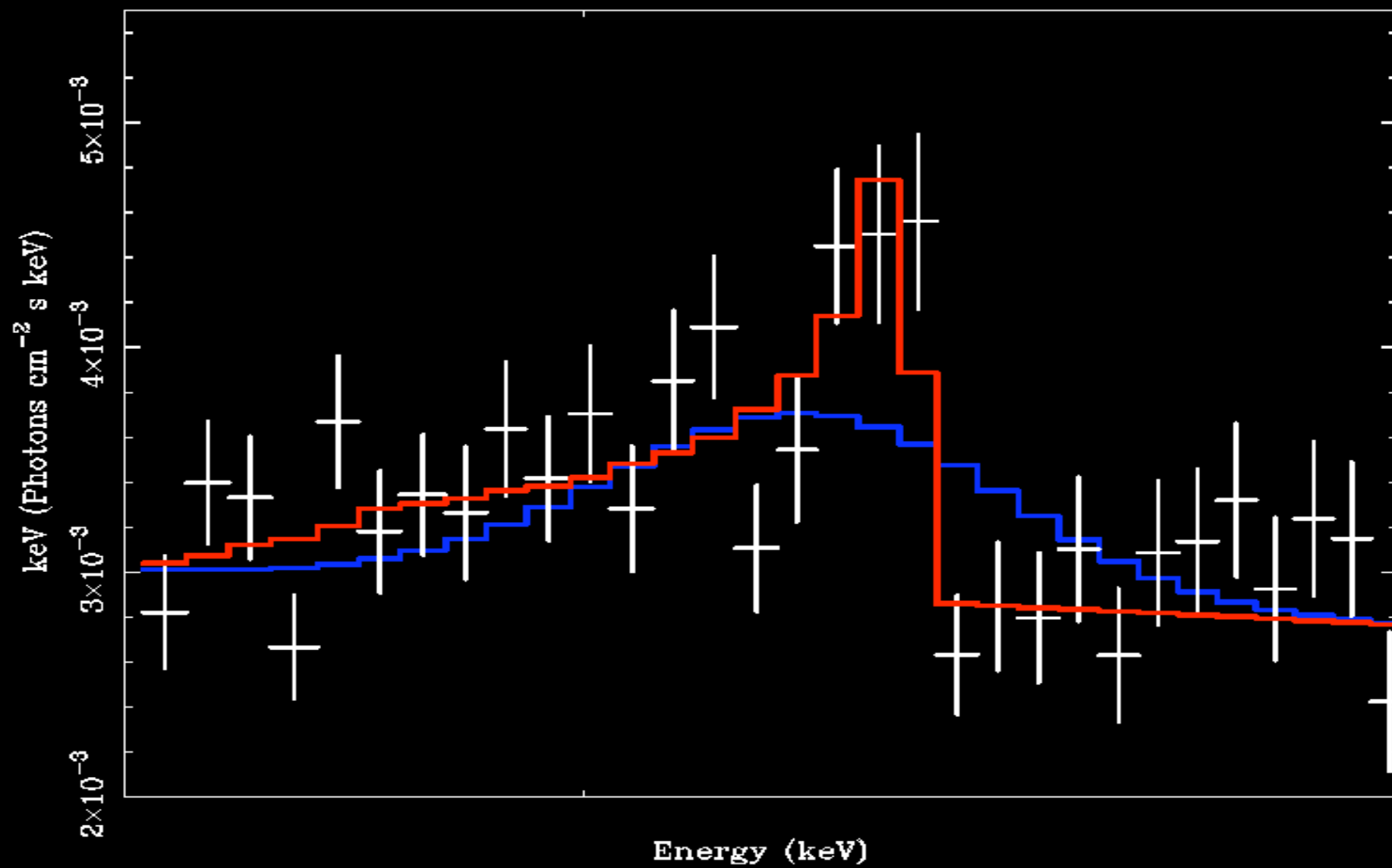
XMM-Newton: Feature ~6 keV



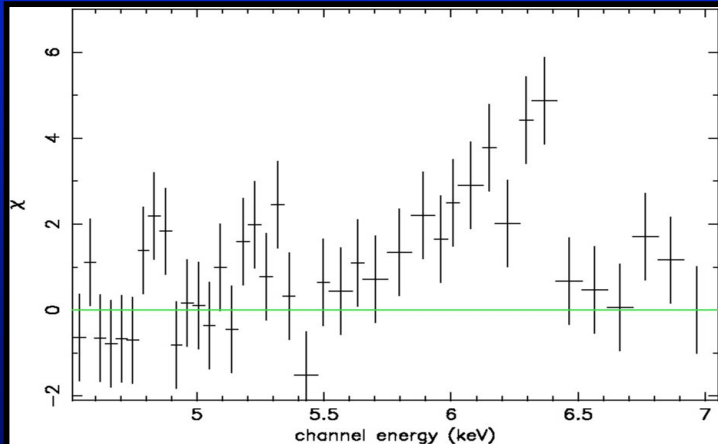
XMM-Newton: The Broad Fe K α line



Independent of the model applied to the underlying continuum



XMM-Newton: The Broad Fe K α line



Independent of the model applied to the underlying continuum

Gaussian profile does **NOT** fit properly the residuals

Disk inclination $< 45^\circ$

Disk outer radius $\equiv 100R_G$

Disk inner radius $>$ marginally stable orbit (MSO)

EW ~ 350 eV

It is not possible to distinguish between

Schwarzschild and **Kerr** BH

No narrow core is required (**Chandra proposal**)

Fluorescence takes place $R \geq 10 R_G$

...Why not down to the MSO?

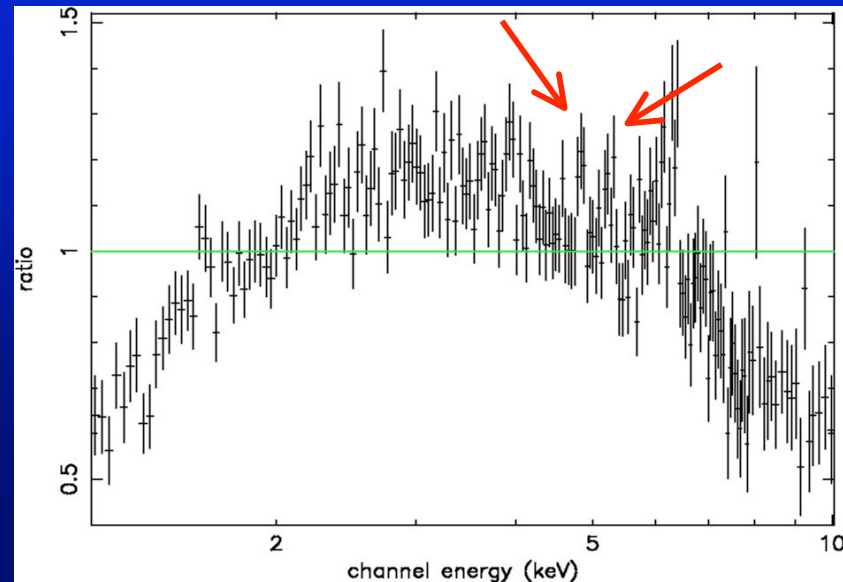
- * Disk truncated disk?
- * Ionized disc $\rightarrow$ Fe stripped?
- * No X-ray emitting active region at $< 10R_G$?

XMM-Newton: Other spectral signatures

$E = 5.32 \pm 0.05$ keV $\rightarrow$ 98.5%

$E = 4.9 \pm 0.04$ keV $\rightarrow$ 95.5%

Similar features in bright
Seyfert galaxies (e.g. Turner et
al. 02; Guainazzi et al. 03; Della
Ceca et al. 05)



Assuming redshifted Fe $K\alpha$ 6.4 keV line
 $i = 0-20^\circ$ $R = 6-10 R_g$

Disc is not truncated (G. Matt talk)

Conclusions

4U 1344-60 is a very bright ($F_X \sim 10^{-11}$ cgs) X-ray source in the Zone of Avoidance. On the basis of optical data we propose to classify 4U as an intermediate type Seyfert galaxy (Sey1.5) at $z=0.012$. X-ray data lend support to the optical classification

4U exhibits a broad and skewed Fe K line. Fluorescence at $>10 R_g$, no narrow core observed (**NB** the determination of the line/disk parameters hampered by “low-quality” XMM-Newton data $\rightarrow$ *X-ray satellites proposal*)

Marginal presence of two emission lines at ~ 5 keV. Highly-redshifted Fe line from orbiting spots? (the simultaneous presence of the broad line reinforces this hypothesis)

Thanks to its brightness 4U is an ideal source for deeply investigating such spectral features, rarely detected in AGN.

Future XMM, HETG Chandra, Suzaku observations of 4U 1344-60 are needed!!

4U 1344-60: a bright intermediate Seyfert galaxy at $z=0.012$ with a relativistic Fe K α emission line A&A in press astro-ph/0603713