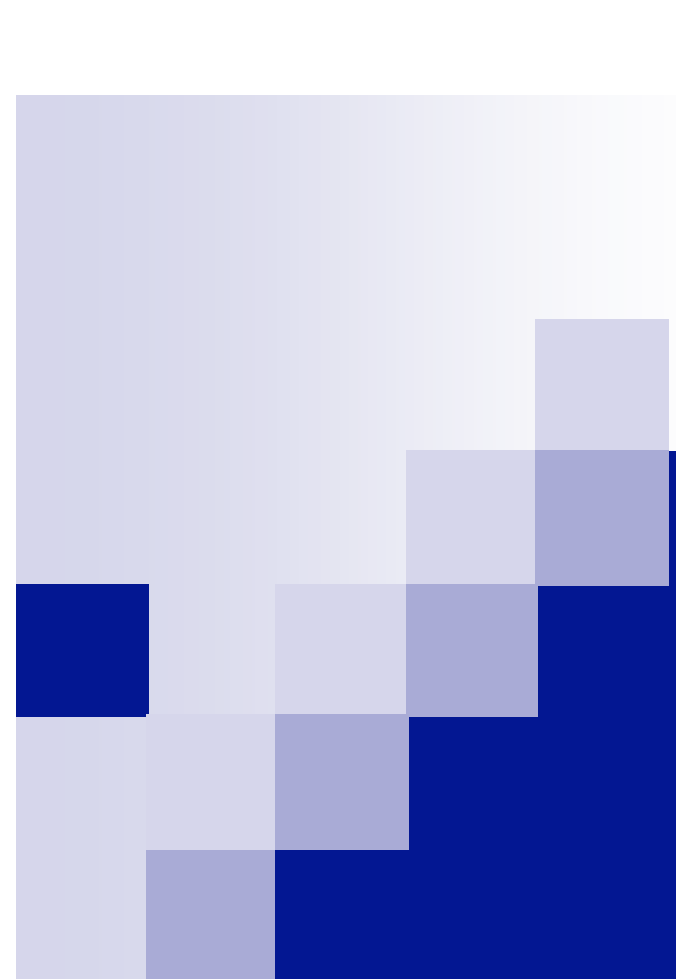




AN XMM SURVEY OF BROAD IRON LINES

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THE ASCA STORY

Tanaka et al. 1995; Fabian et al. 1995; Iwasawa et al. 1996; Nandra et al. 1997; Nandra et al. 1999

- Unambiguous disk line in MCG-6-30-15
- BLs common, $\langle \text{FWHM} \rangle = 30,000 \text{ km s}^{-1}$
- Evidence for BH spin
- Redshifted absorption - infall onto BH?

Concerns:

- Number of high S/N lines small
- Limited spectral resolution: deconvolution
- Complex lines: narrow components, blends
- Complex continua: reflection, warm absorbers



ASCA Broad line results

	ASCA	XMM
BL fraction	77% (14/18)	?
Energy	6.34 ± 0.04	?
Width	0.43 ± 0.12	?
EW	$160 \pm 30 \text{ eV}$	?
Narrow EW	30 eV	?

THE USUAL SUSPECTS



Akn 120, Akn 564, ESO 198-G24, Fairall 9, HE 1143-1810, IC4329A, MCG-5-23-16, MCG-6-30-15, MCG+8-11-11, Mrk 110, Mrk 279, Mrk 335, Mrk 509, Mrk 590, Mrk 6, Mrk 766, NGC 2110, NGC 2992, NGC 3516, NGC 3783, NGC 4051, NGC 4151, NGC 4395, NGC 4593, NGC 526A, NGC 5506, NGC 5548, NGC 7213, NGC 7314, NGC 7469

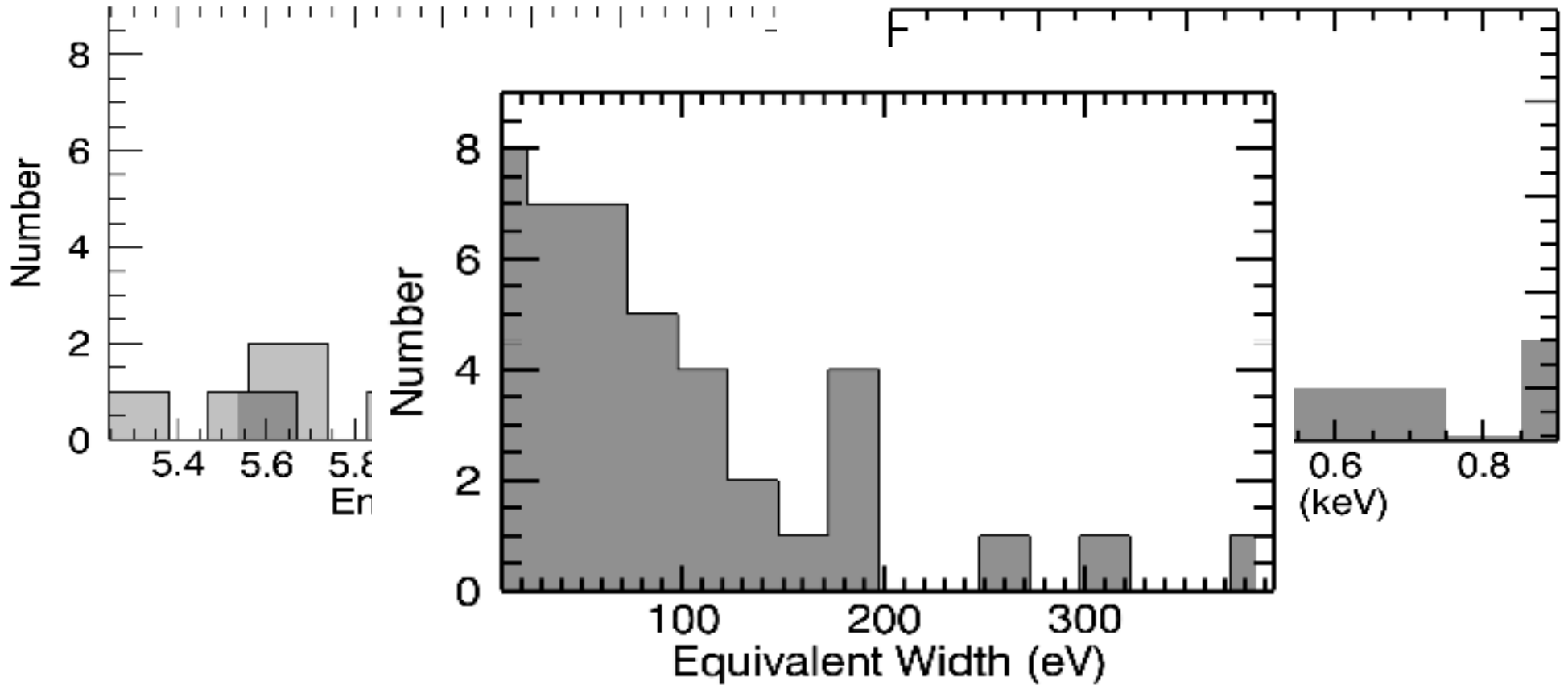


XMM SEYFERT SAMPLE

- **41 obs of 30 objects** , conservative data screening
- Sy 1-1.9, $z < 0.05$, **>30k cts 2-10 keV EPIC pn**
- Basic model 2.5-10 keV includes:
 - Power law
 - Narrow 6.4 keV core
 - Fe $K\beta$, Ni $K\alpha$, Compton shoulder (Matt et al. 2002)
 - Self-consistent Compton reflection (George & Fabian
 - Warm absorber (XSTAR) as needed
 - ***Add another gaussian...***

Nandra et al. (2006)

GAUSSIAN LINE PARAMETERS



XMM vs. ASCA

	ASCA	XMM
Fraction*	77% (14/18)	?
Energy (keV)	6.34 ± 0.04	?
Width (keV)	0.43 ± 0.12	?
EW (eV)	160 ± 30	?
	N97	N06

***Fraction with broad or complex lines**



XMM vs. ASCA

	ASCA	XMM
Fraction*	77% (14/18)	73% (22/30)
Energy (keV)	6.34 ± 0.04	?
Width (keV)	0.43 ± 0.12	?
EW (eV)	160 ± 30	?
	N97	N06

***Fraction with broad or complex lines**



XMM vs. ASCA

	ASCA	XMM
Fraction*	77% (14/18)	73% (22/30)
Energy (keV)	6.34 ± 0.04	6.32
Width (keV)	0.43 ± 0.12	?
EW (eV)	160 ± 30	?
	N97	N06

***Fraction with broad or complex lines**



XMM vs. ASCA

	ASCA	XMM
Fraction*	77% (14/18)	73% (22/30)
Energy (keV)	6.34 ± 0.04	6.32
Width (keV)	0.43 ± 0.12	0.36
EW (eV)	160 ± 30	?
	N97	N06

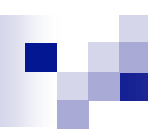
***Fraction with broad or complex lines**



XMM vs. ASCA

	ASCA	XMM
Fraction*	77% (14/18)	73% (22/30)
Energy (keV)	6.34 ± 0.04	6.32
Width (keV)	0.43 ± 0.12	0.36
EW (eV)	160 ± 30	110
	N97	N06

***Fraction with broad or complex lines**



χMM THE ~~ASCA~~ STORY

Tanaka et al. 1995; Fabian et al. 1995; Iwasawa et al. 1996; Nandra et al. 1997; Nandra et al. 1999

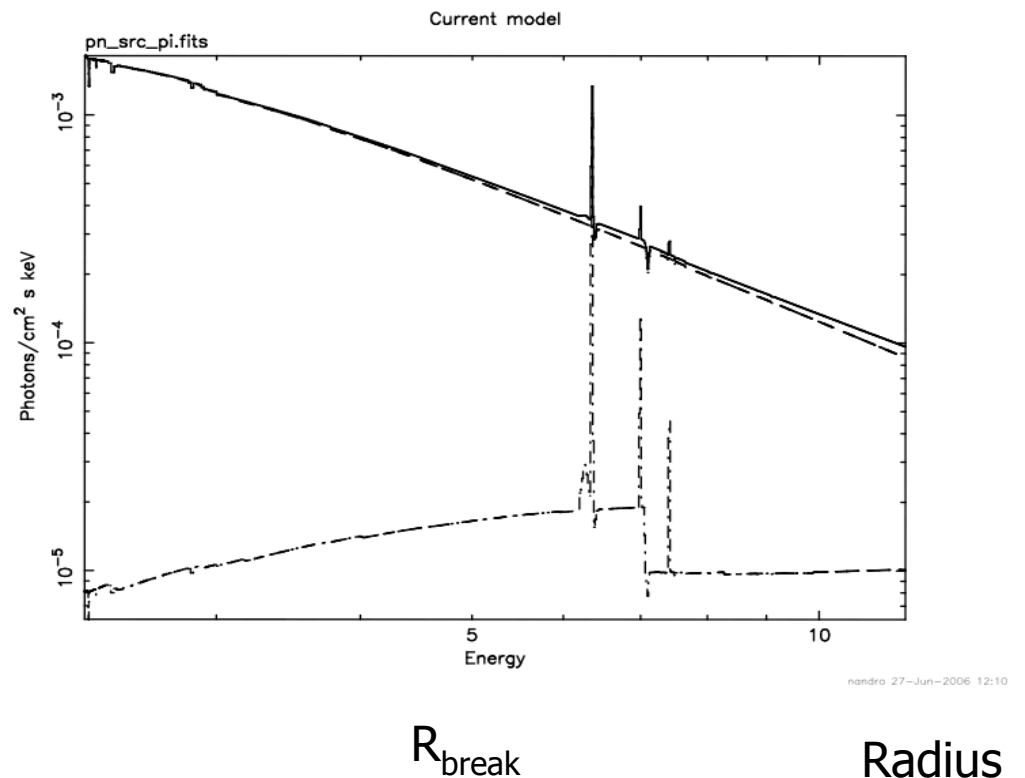
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Disk line modeling

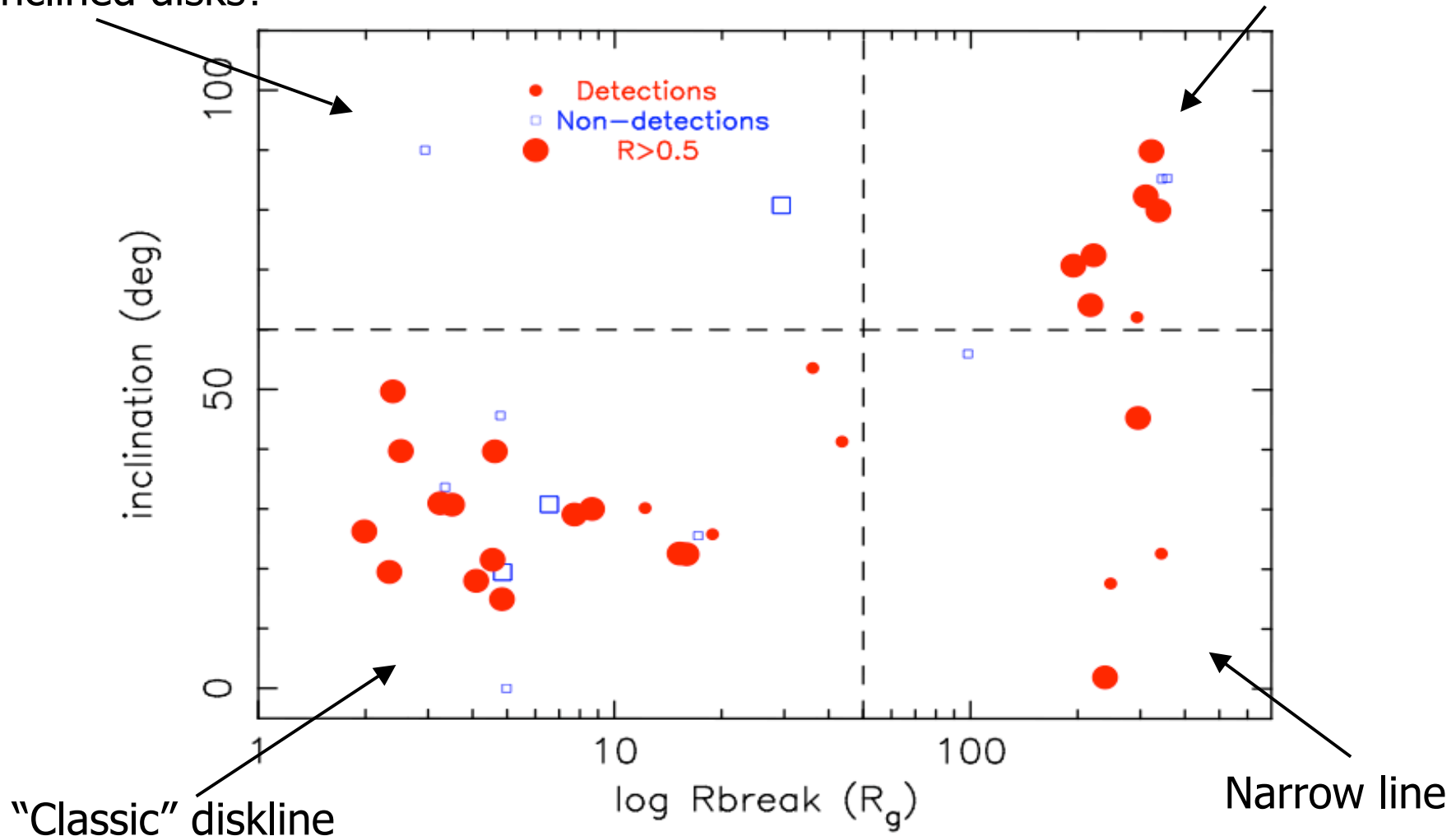
- Base model:
 - Narrow 6.4 line (+K β +Ni α)
 - Compton reflector
 - XSTAR if needed
- Add neutral reflector with relativistic blurring (kdblur2: Fabian et al. 2002)
- Fix emissivity (Newtonian)
- Parameterize by strength, inclination, R_{break}
- Fits similar to gaussian



Disk line modeling

Inclined disks?

Ionized disks?



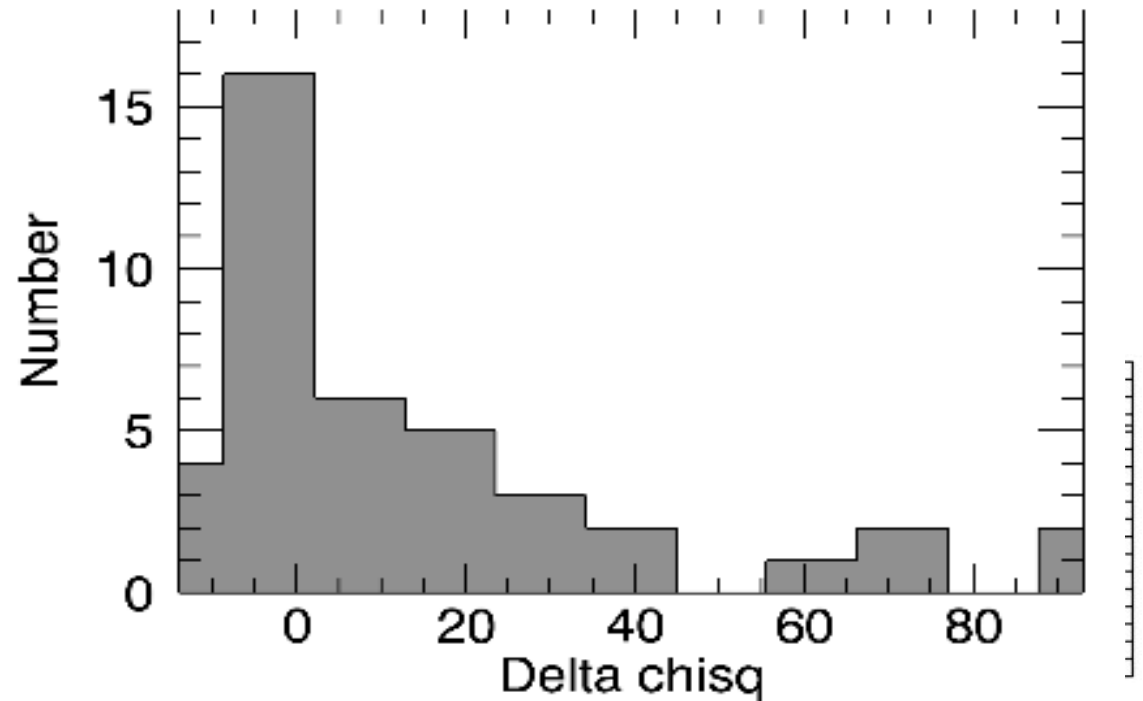


“Poor modeling of the continuum could result in a spurious broad emission line. In particular, all of the sources with apparently broad emission lines show evidence for a warm absorber, which could significantly affect the continuum parameterization around the line.”

(Nandra & Pounds 1994)

AN ALTERNATIVE MODEL

- Warm absorber can mimic red wing
- Blends can make blue
- Alternative model:
 - High NH warm absorber
 - He-like line
 - H-like line
 - Intermediate (6.4-6.7 keV line)
 - 2 additional free parameters



RED WING?

↑6.7 keV abs.

(Reeves et al. 2004)



High ionization warm absorbers and line blends **cannot*** account for a large number of the broad features.

⇒ *We are almost certainly seeing relativistic effects in **many** AGN*

**But can be important in individual cases:*

NGC 3783 (Reeves et al. 2004)

NGC 4151 (Schurch et al. 2003)

NGC 5506 (Matt et al. 2001)

NGC 7213 (Starling et al. 2005)

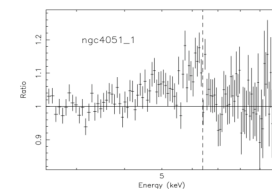
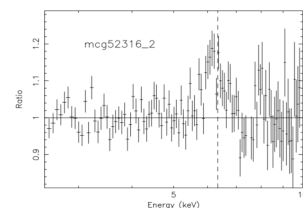
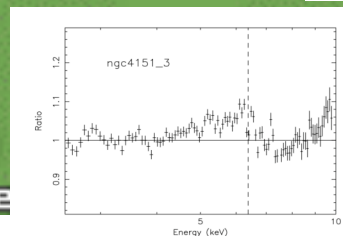
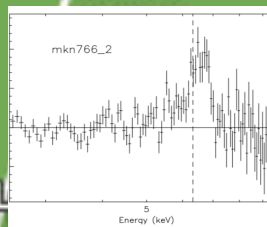
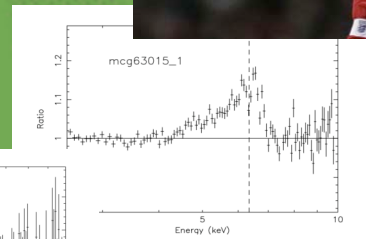
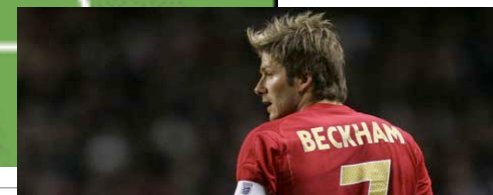
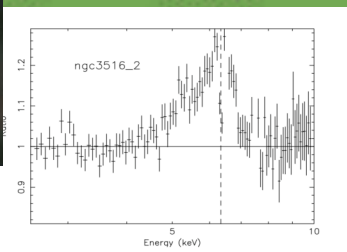


BROAD LINE HALL OF FAME

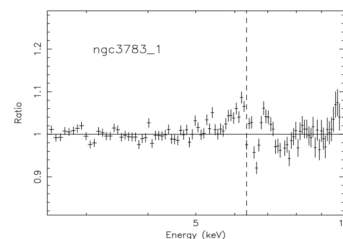
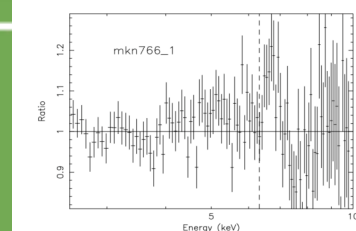
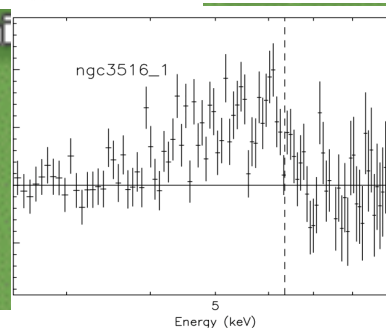
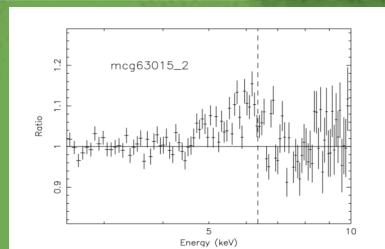
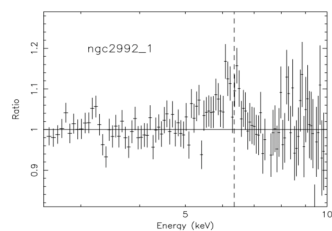
$\Delta\chi^2 > 10$ cf. blend/absorber $R_{\text{break}} < 20 R_g$

- **MCG-5-23-16**
- **MCG-6-30-15 (2)**
- **Mrk 766 (2)**
- **NGC 2992**
- **NGC 3516 (2)**
- **NGC 3783**
- **NGC 4051**
- **NGC 4151**

RELATIVISTIC LINE "DREAM TEAM"

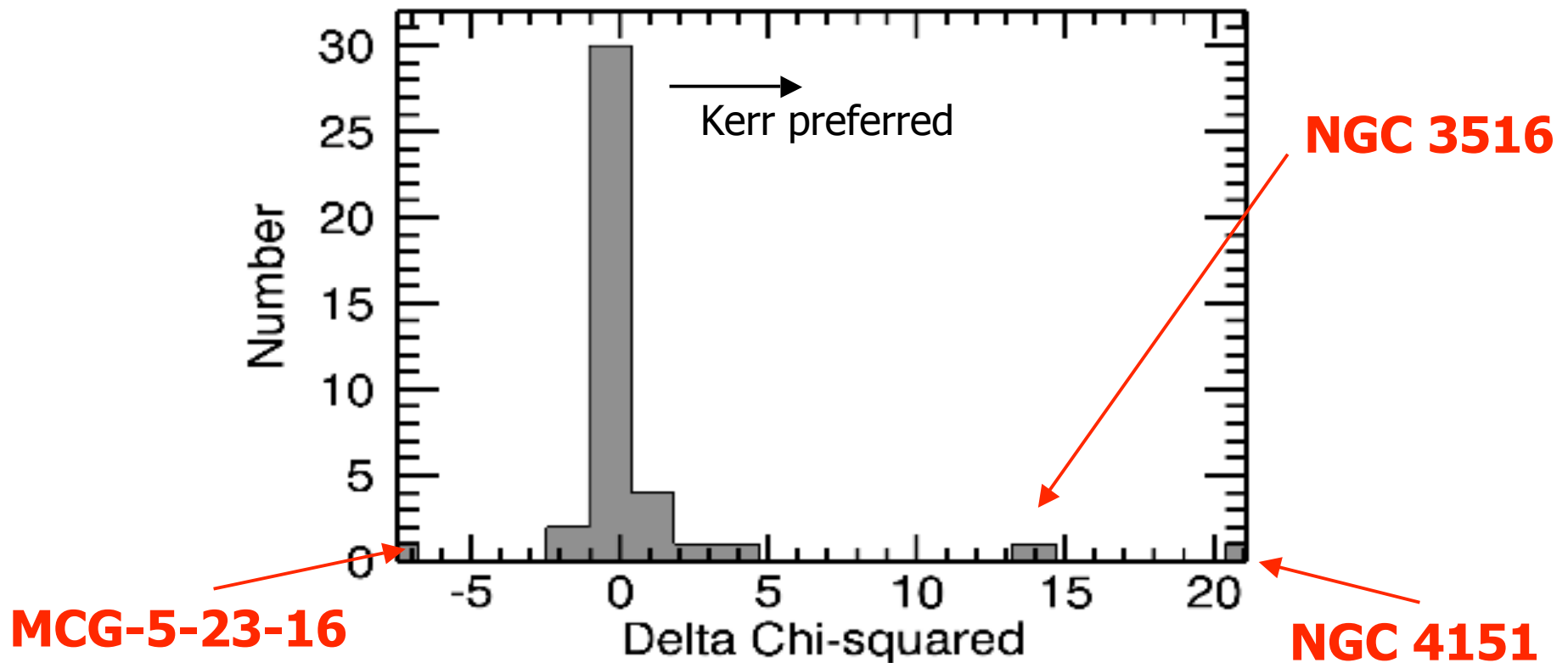


ht midfield



EVIDENCE FOR SPIN?

$R_{in}=6$ vs $R_{in}=1.235$



BUT NOT: MCG-6-30-15!

(cf. Wilms et al. 2001; Fabian et al. 2002; Reynolds et al. 2005)

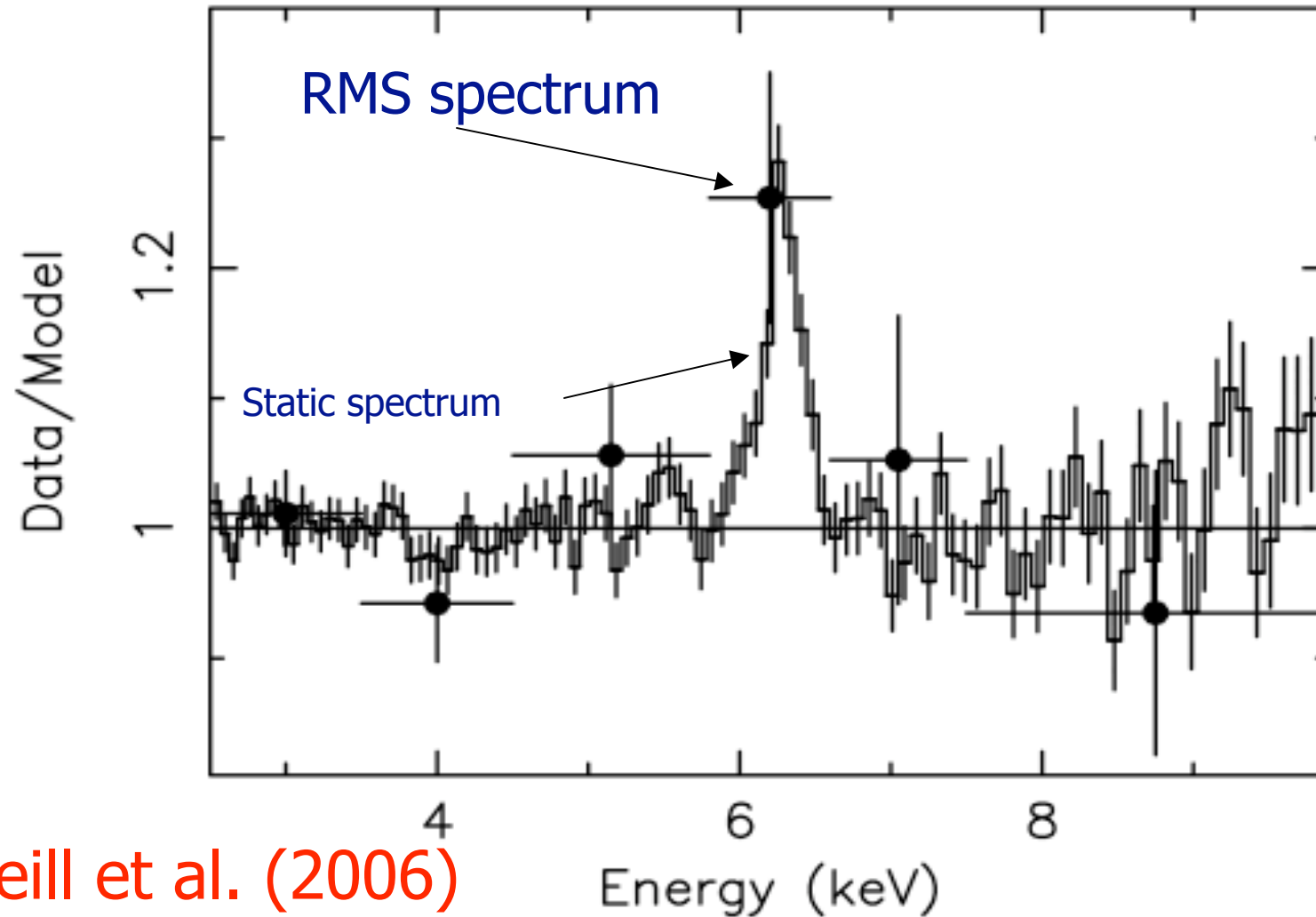


GOOD NEWS AND BAD NEWS

- **The Good News: we *are* seeing relativistic effects in AGN, not a conspiracy of absorbers and blends.**
- **The Bad News: No strong evidence (yet) for black hole spin**

NGC 5548

also Mrk 841 (Petrucci et al.(2002); Longinotti et al. 2004)



O'Neill et al. (2006)

PARTIAL COVERING

