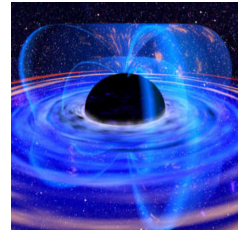
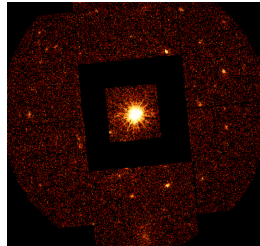
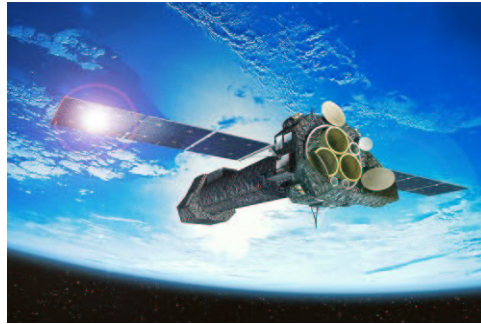


Observations of the iron  
K line with XMM-  
Newton and Chandra

**James Reeves**

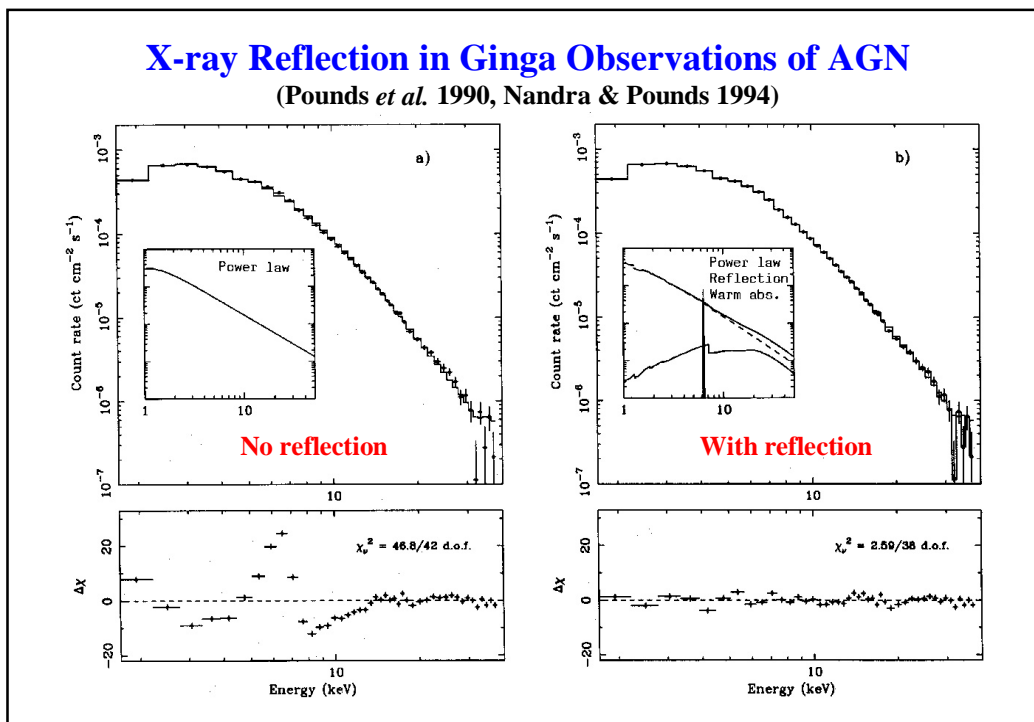
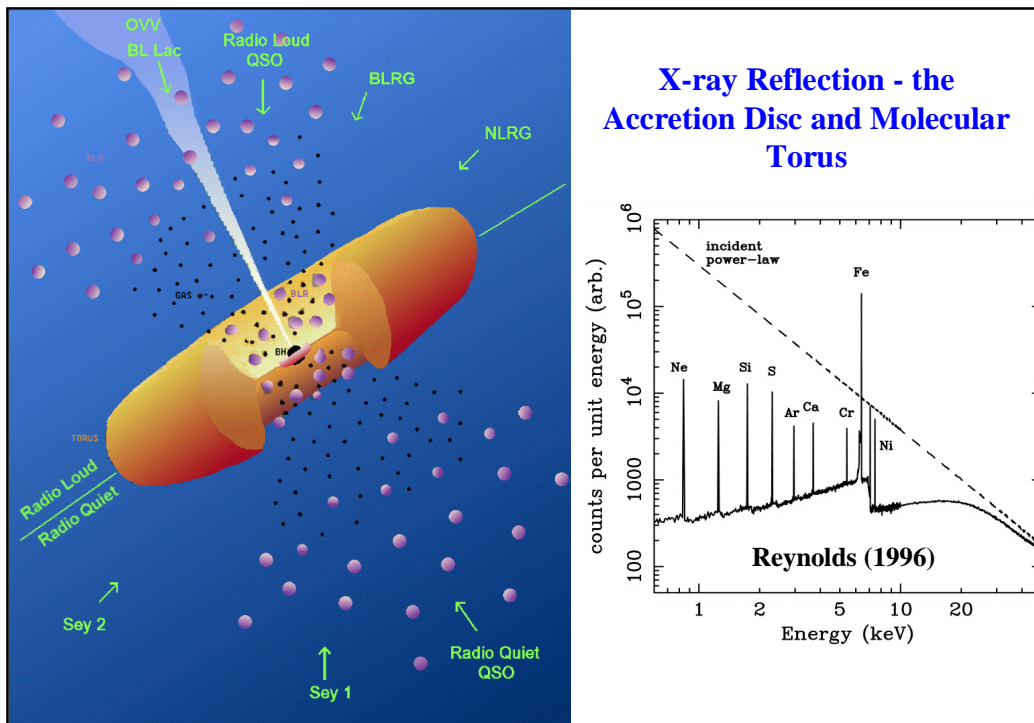
**X-ray and Observational  
Astronomy Group**

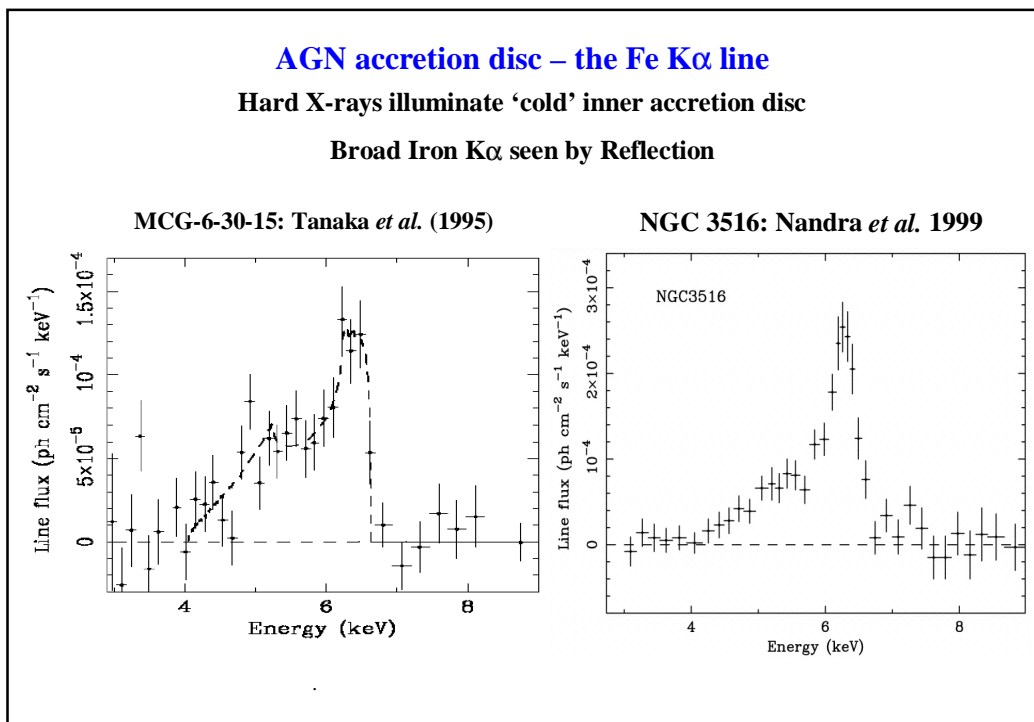
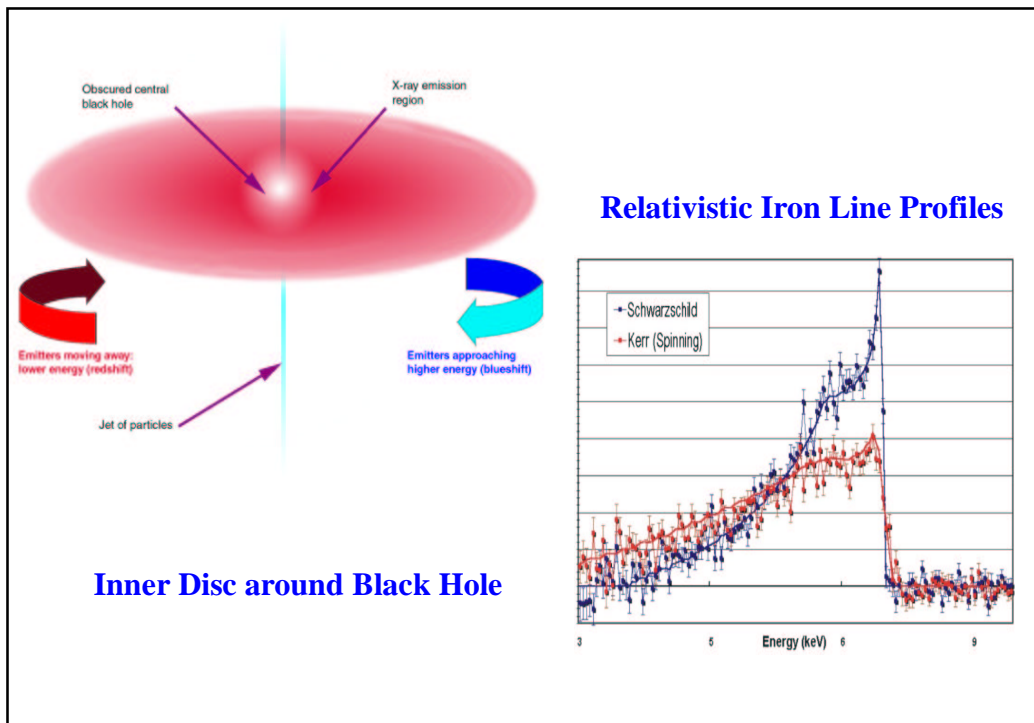
**University of Leicester, UK.**

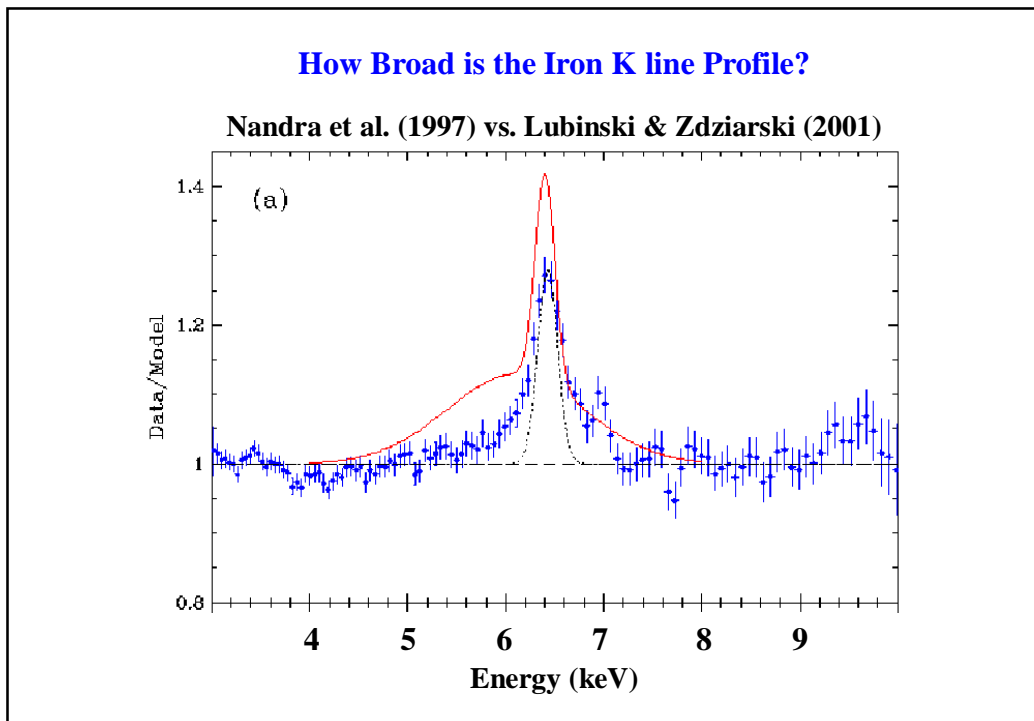


**Observations of the Iron K line profile**

- Review of previous observations of the iron K line
- *XMM-Newton* and *Chandra* observations of the iron K line - **how broad is the iron K line - is there a distant (narrow) component - what is the effect of photoionisation?**
- Evidence for the Kerr Metric from Iron K line Observations - **MCG -6-30-15, XTE J1650-500.**
- Iron K edge like features in NLS1s (**1H 0707-495, PG 1211+143, PDS 456**) - reflection dominated disc or complex absorption
- Evolution of the X-ray Spectra of AGN
- Iron K line variability - prospects for reverberation mapping







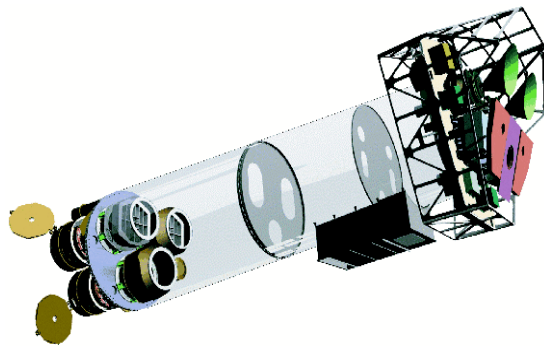
## The XMM-Newton Observatory

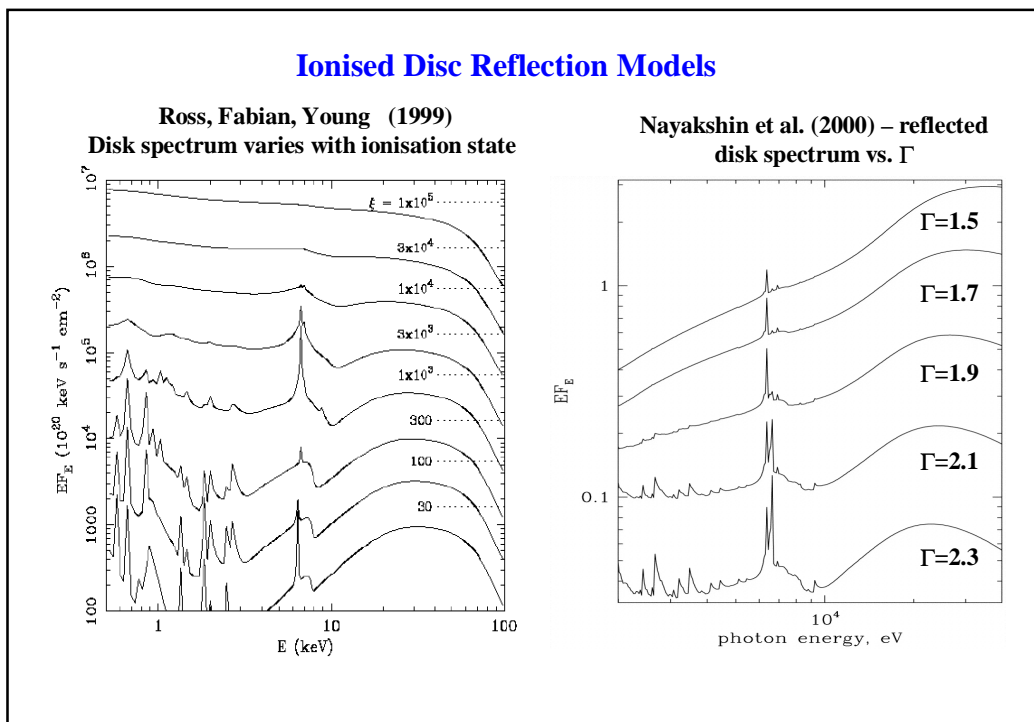
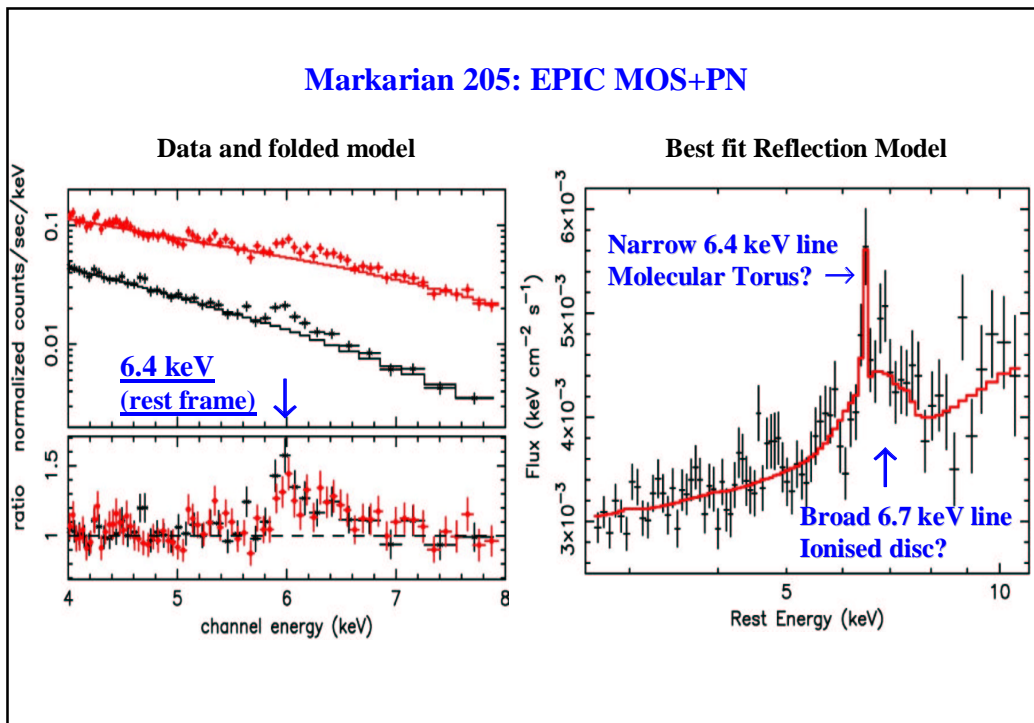
**XMM-Newton** is comprised of 3 main science instruments:-

**EPIC** (European Photon Imaging Camera): X-ray Imaging Spectroscopy using 3 CCDs (2 MOS, 1 PN)

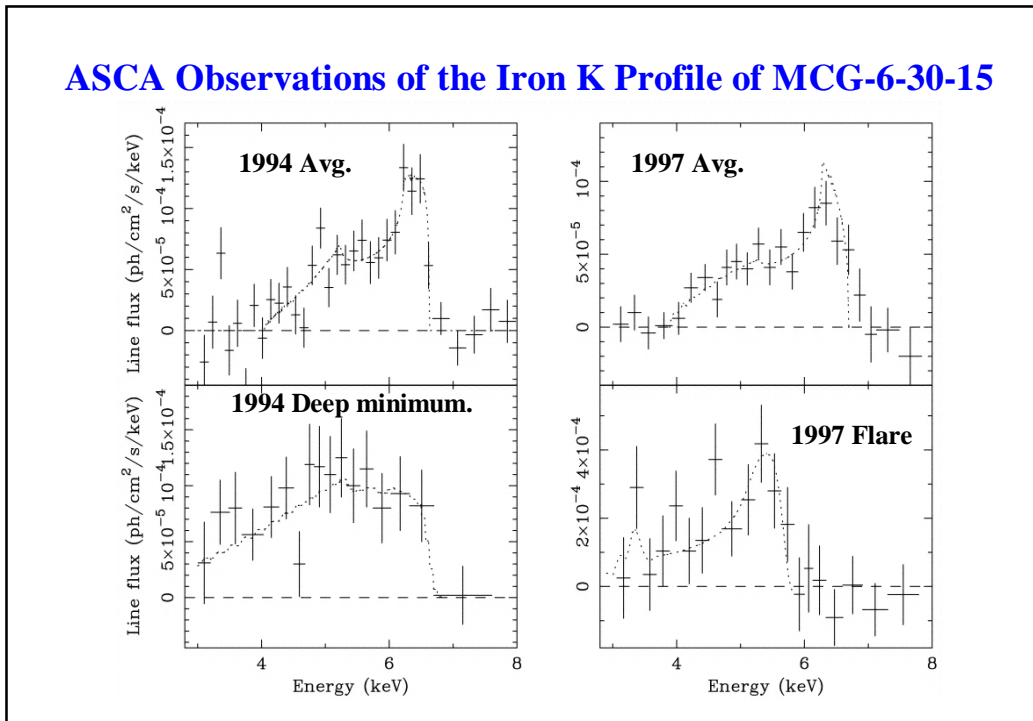
**RGS** (Reflection Grating Spectrometer): High resolution Spectroscopy from 5 to 35 Å

**OM** (Optical Monitor) – Optical/UV imaging, photometry and spectroscopy

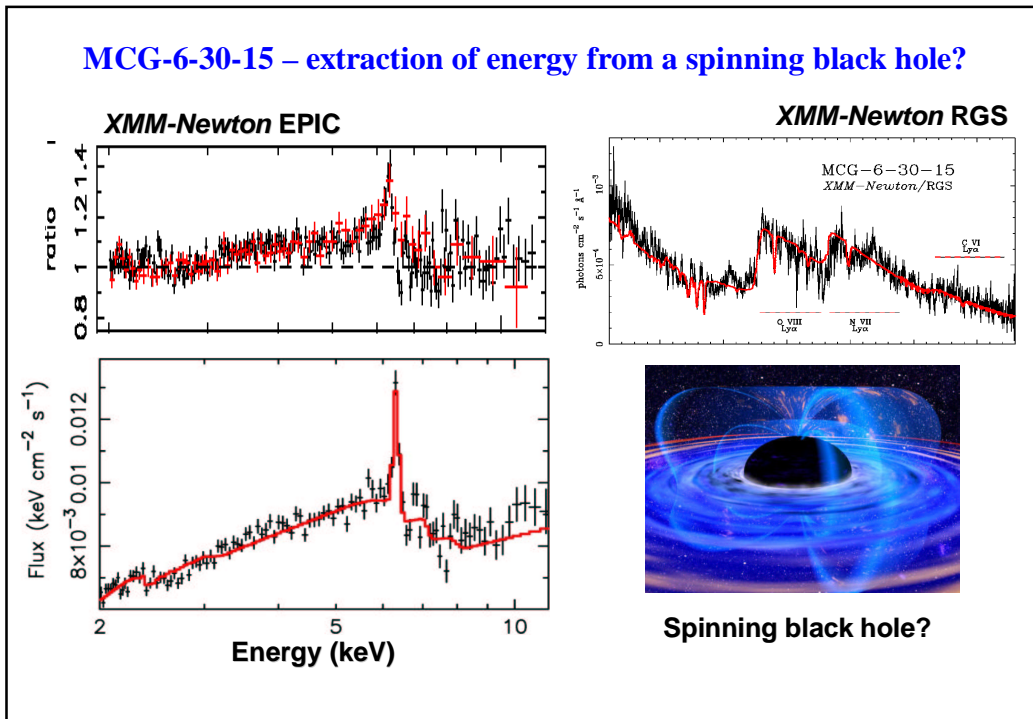


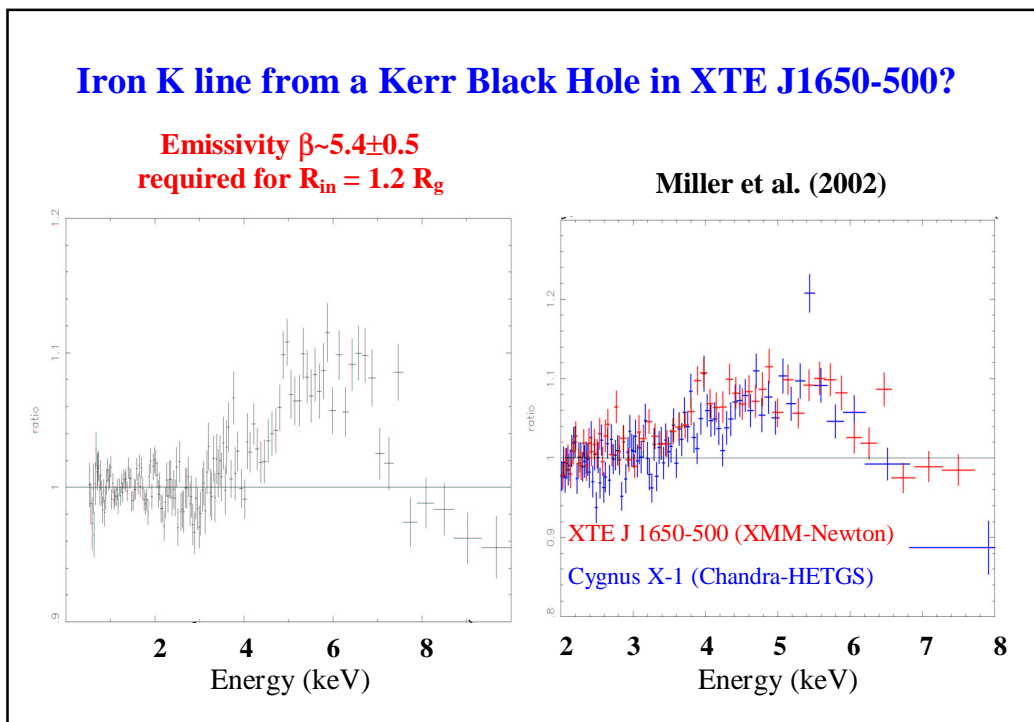
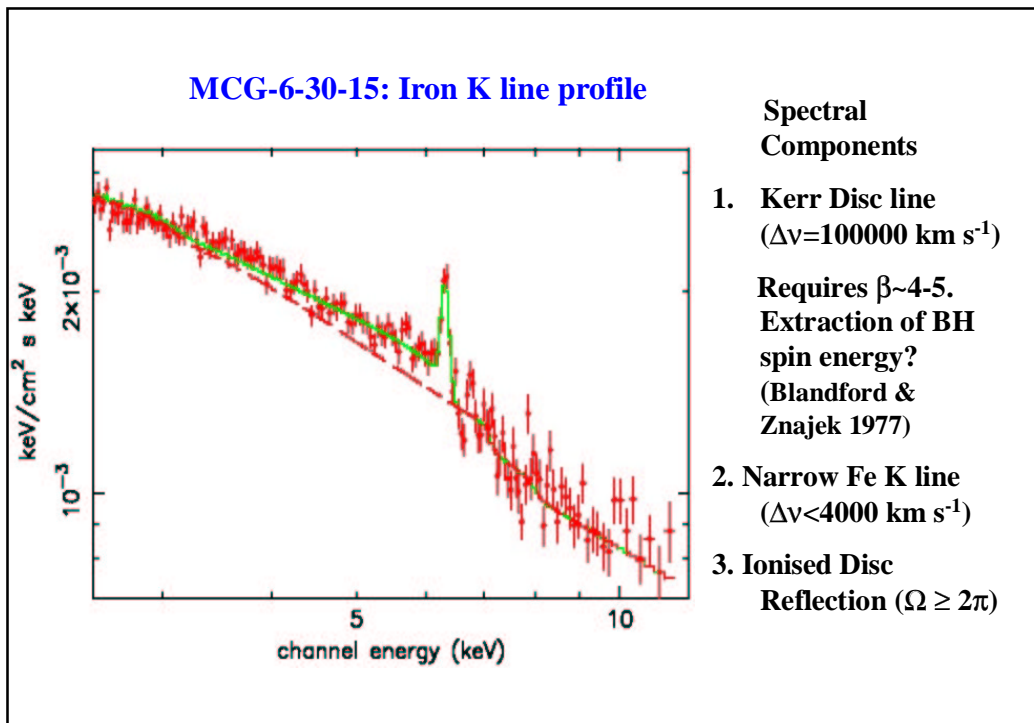


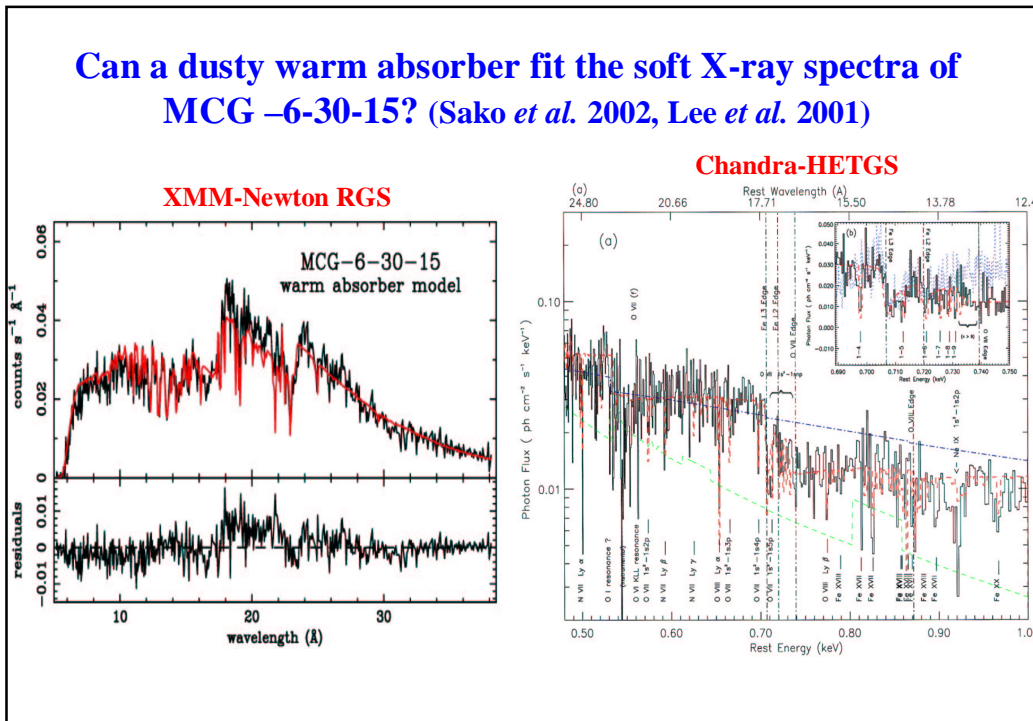
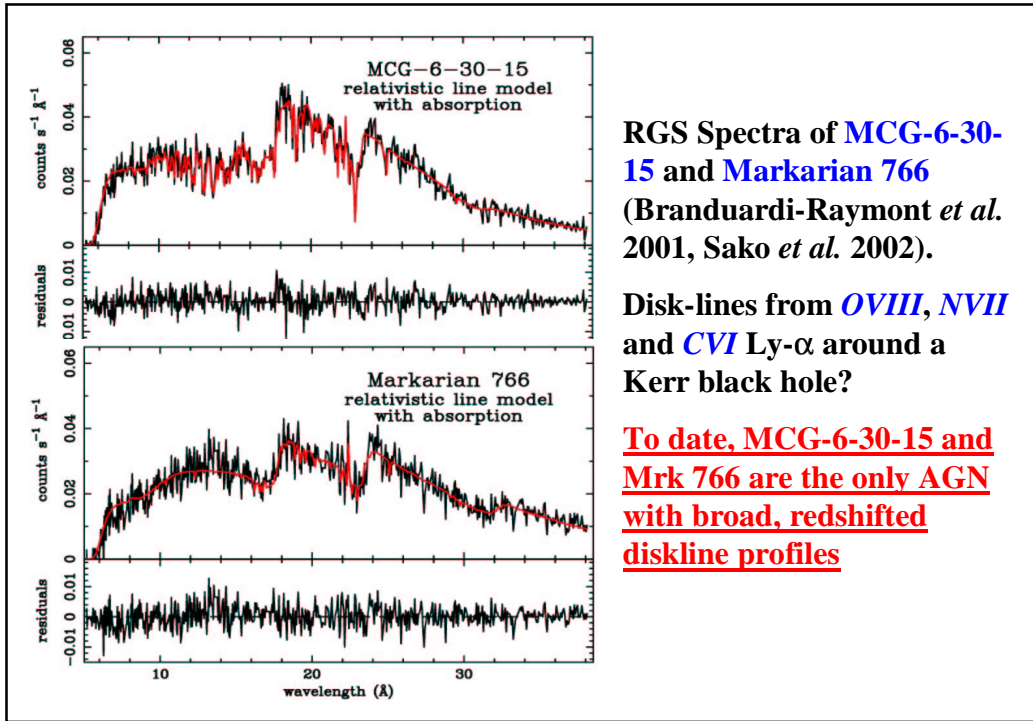
### ASCA Observations of the Iron K Profile of MCG-6-30-15



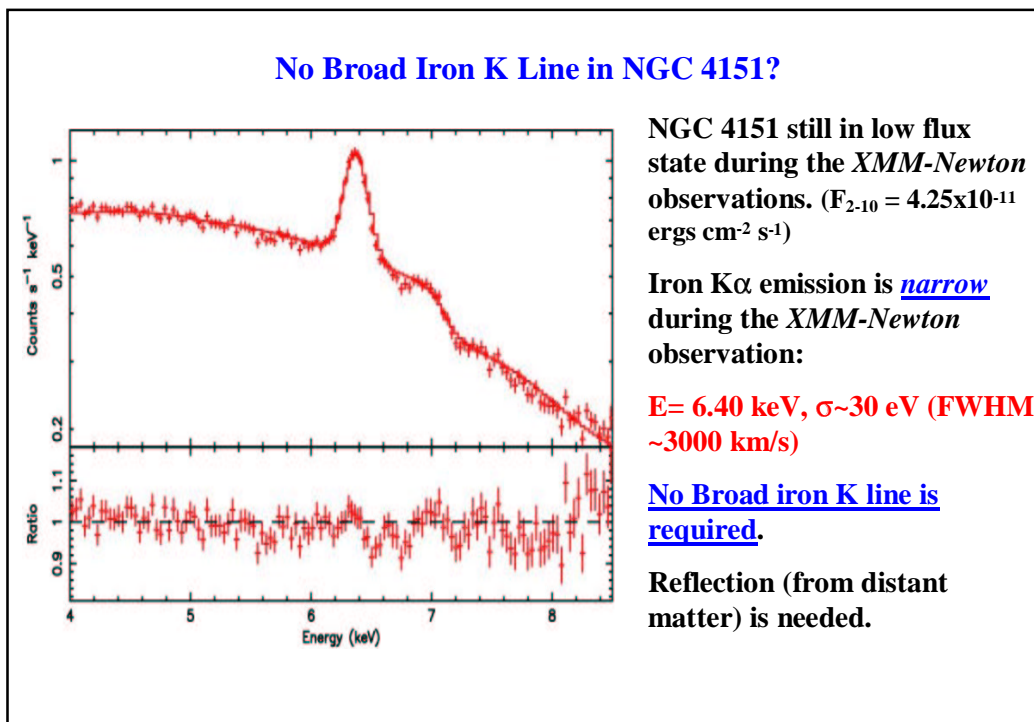
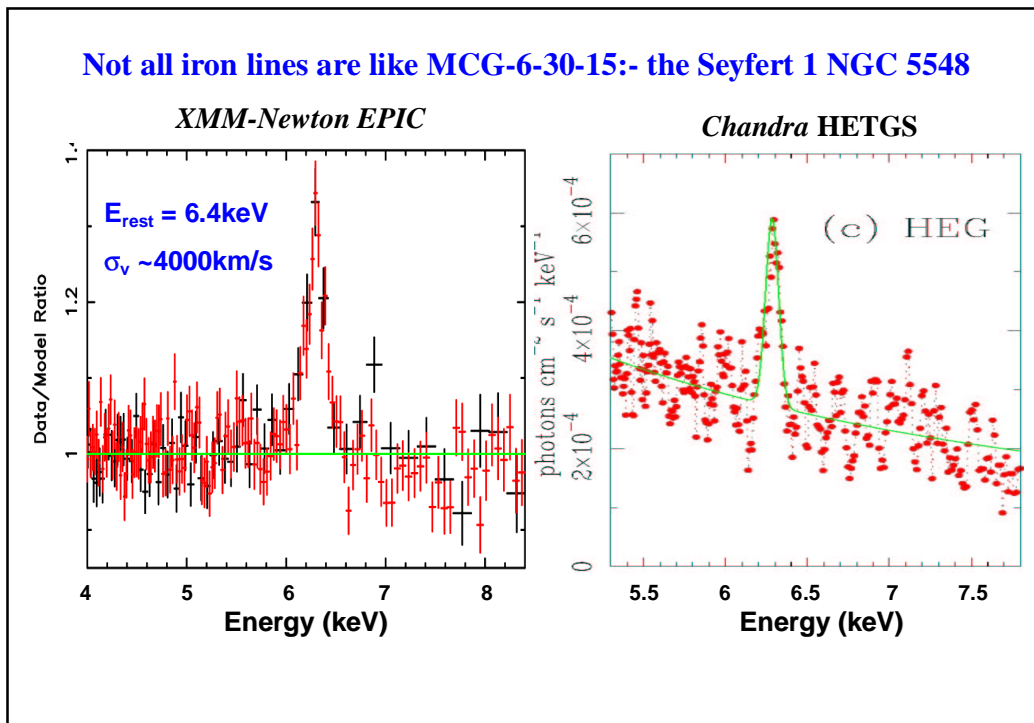
### MCG-6-30-15 – extraction of energy from a spinning black hole?

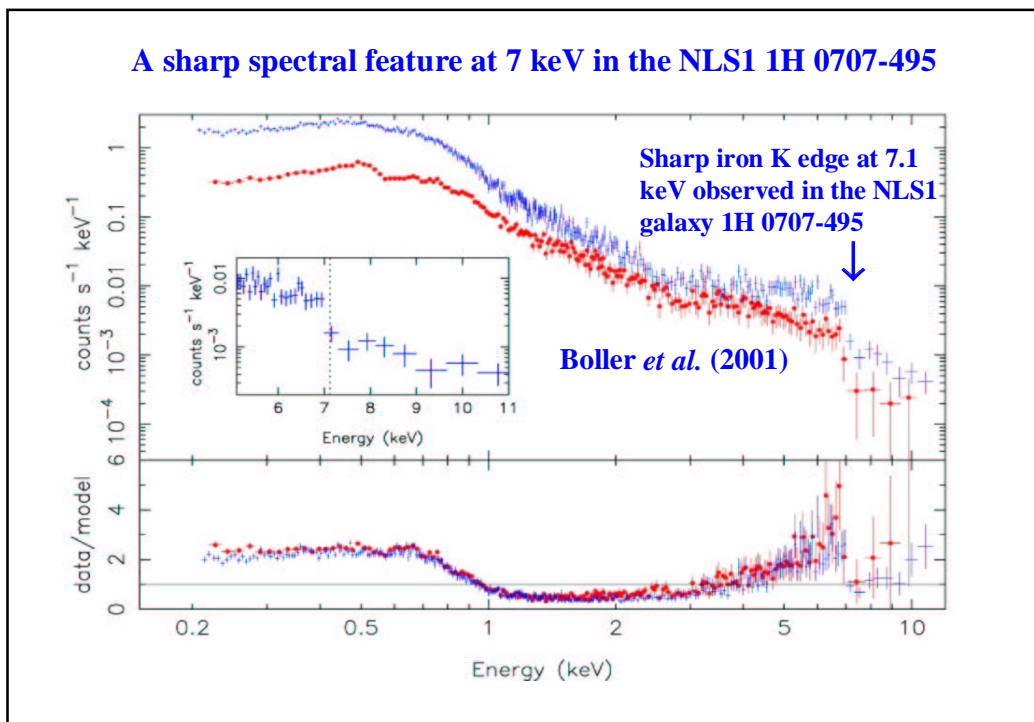
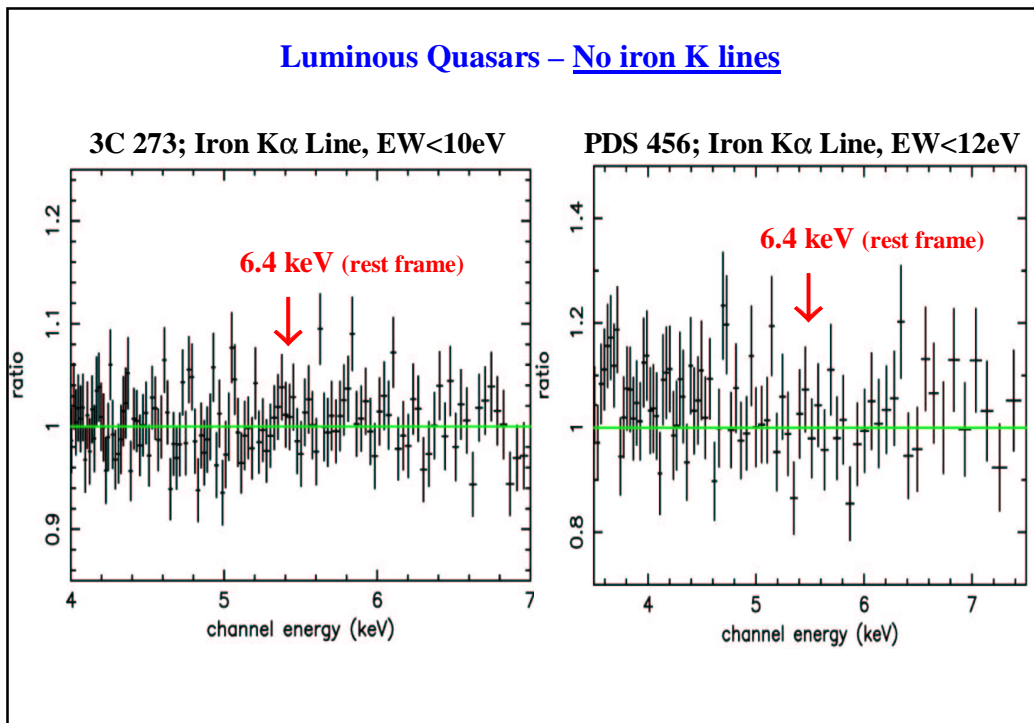


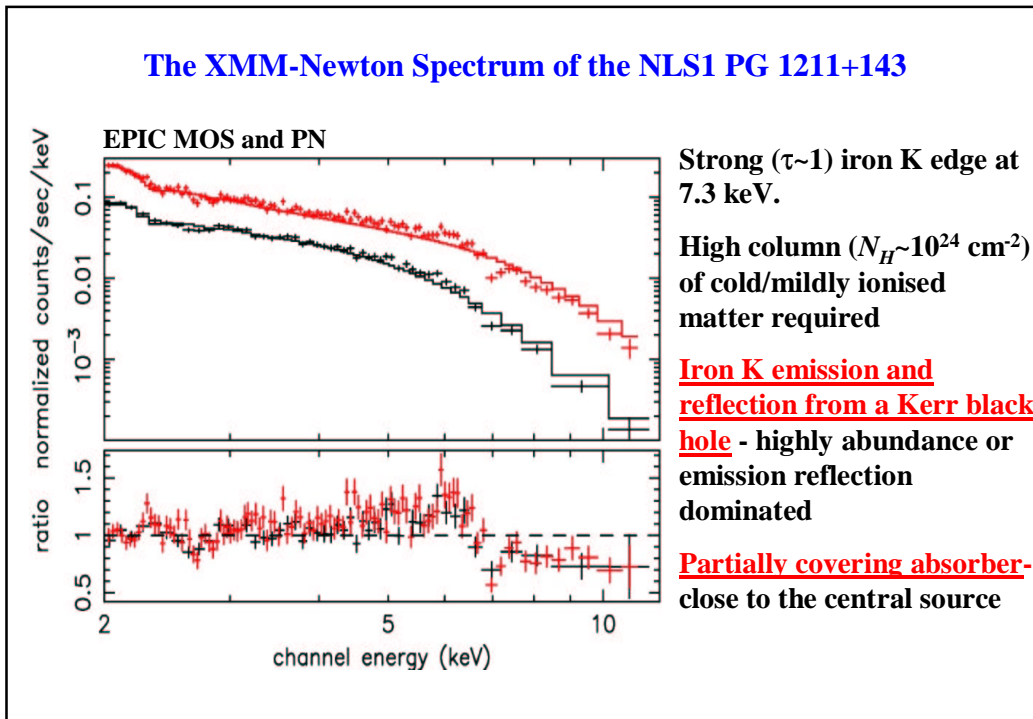
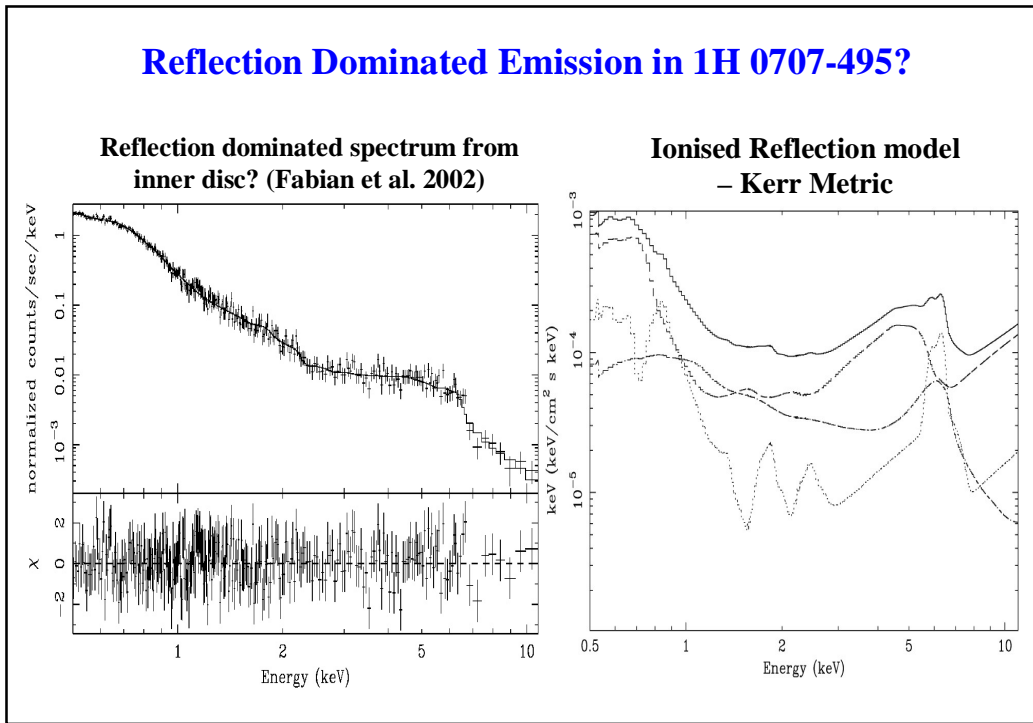


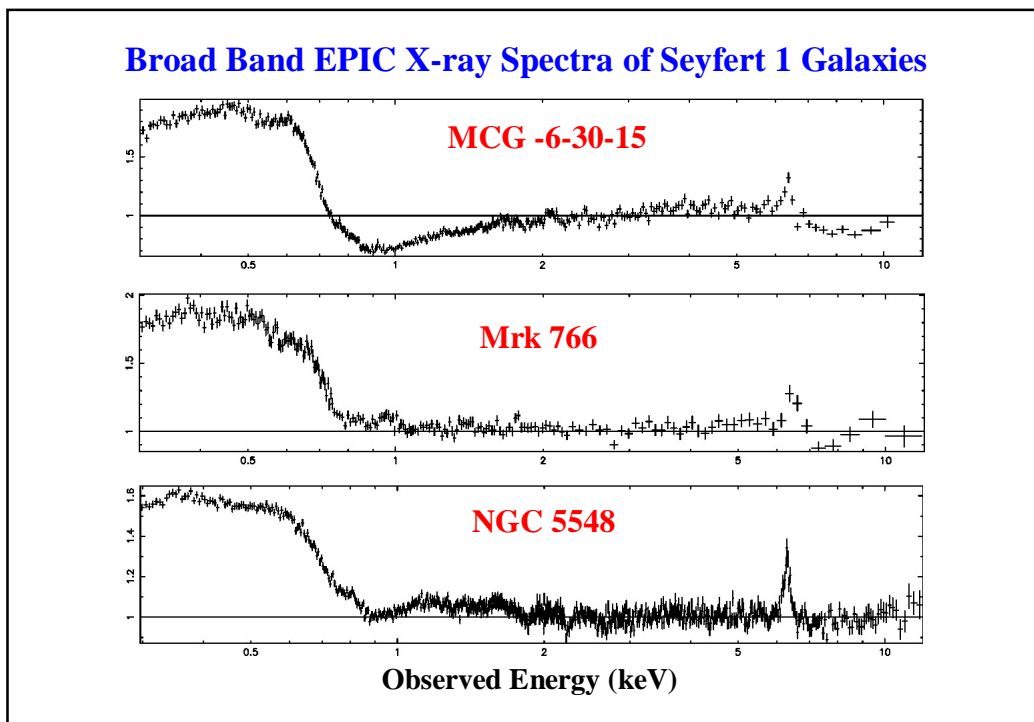
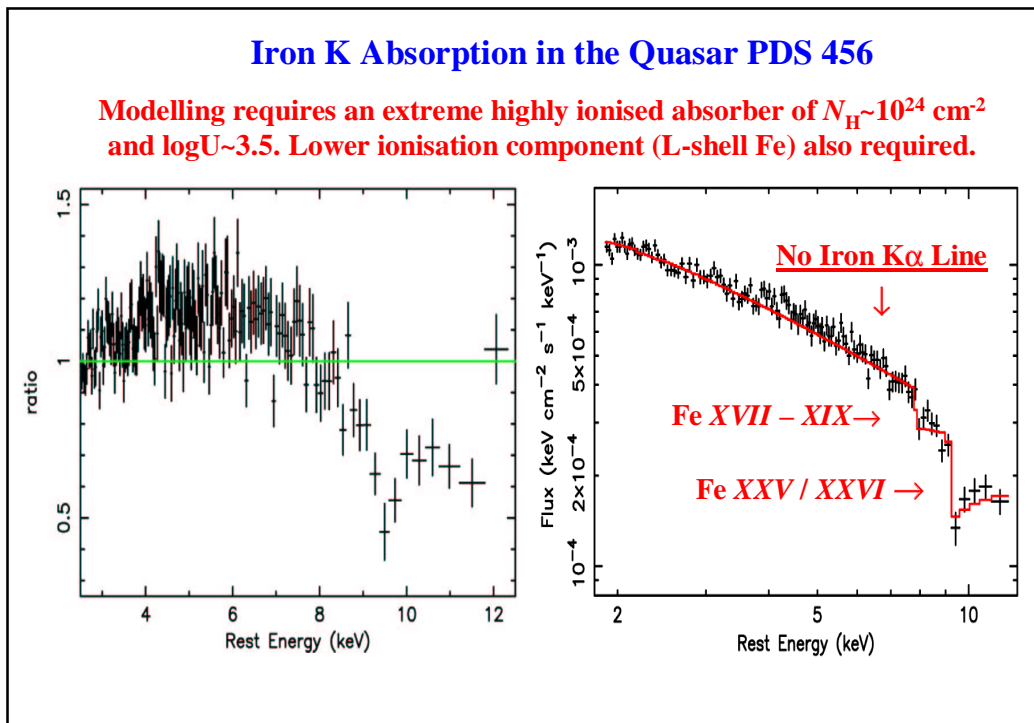


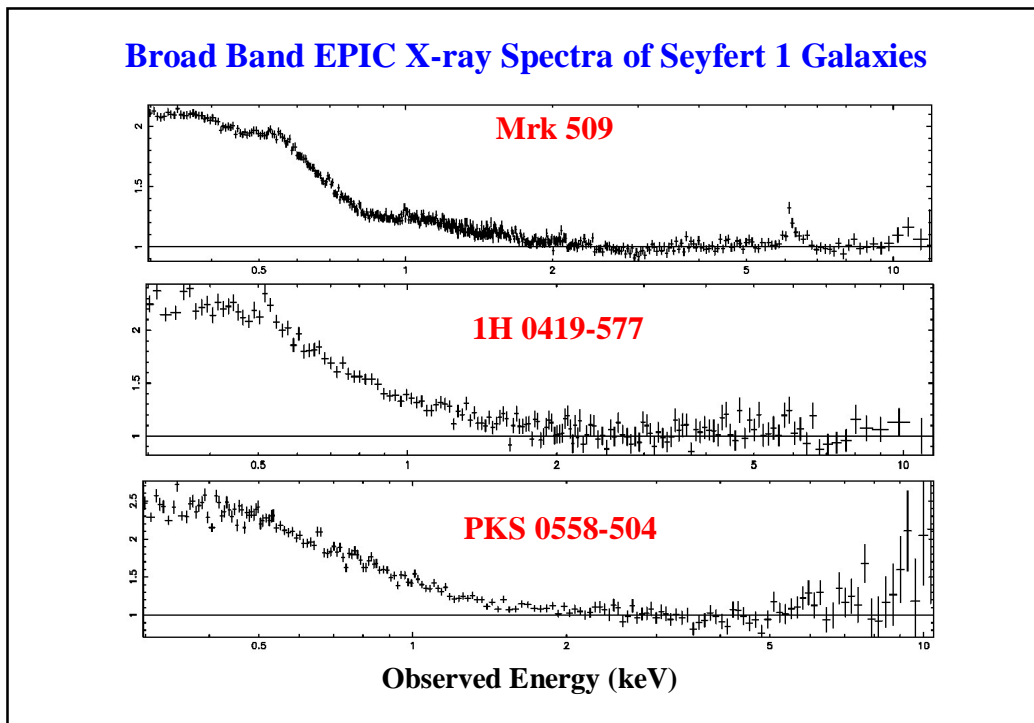












**An evolutionary scheme?**

**Lower Luminosity**  
(BLSy1)

**Higher Luminosity**  
(NLSy1, QSO)

Strong narrow iron line  
(via molecular torus, BLR)

→

No narrow iron line  
(no torus and no QSO II?)

Disc emission lines

→

Featureless reflected continuum?

Soft X-ray absorption  
(lower ionisation)

→

Transparent spectrum  
(higher ionisation)

Flat X-ray continuum  
(less comptonised)

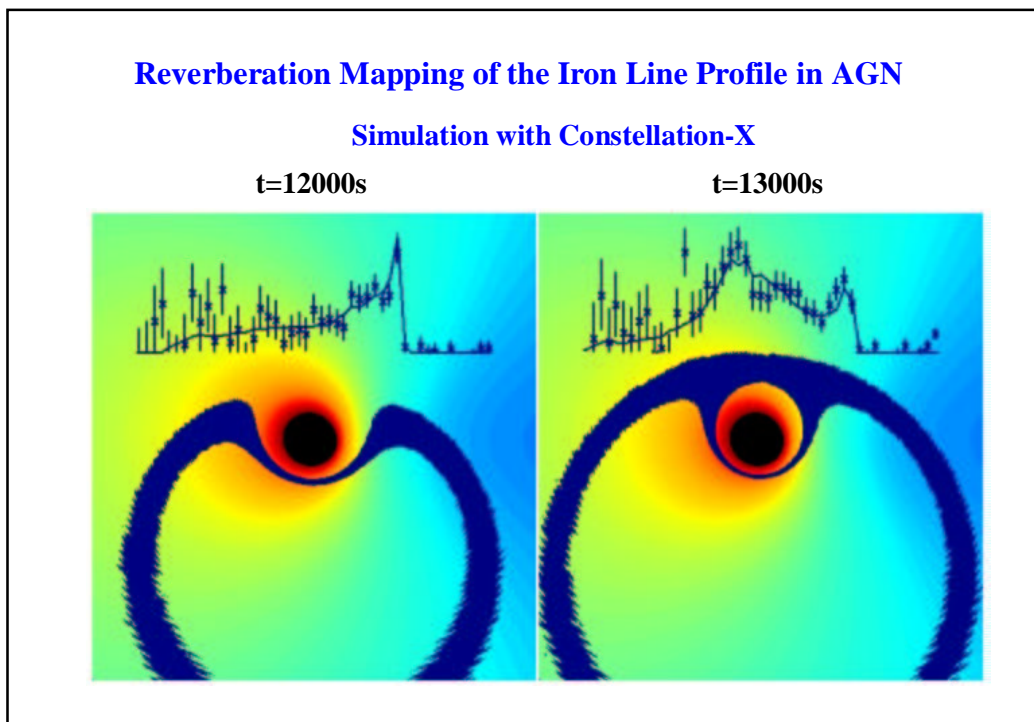
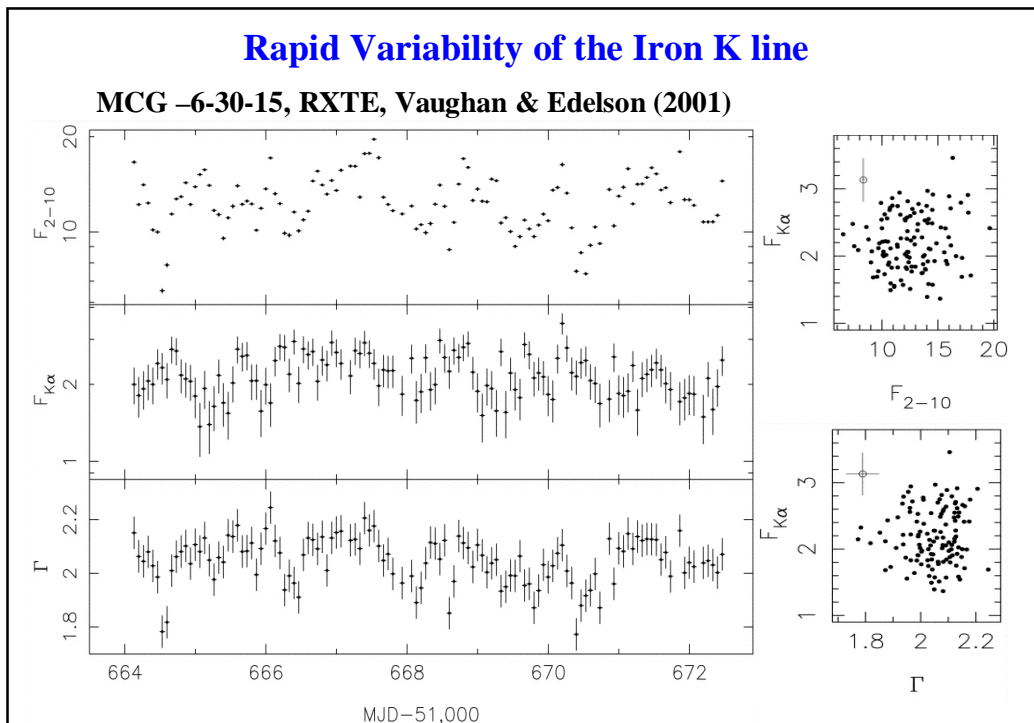
→

Strongly curved continuum  
(more comptonised)

Low  $\dot{m}$

→

High  $\dot{m}$



### Conclusions - Observations of the iron K line

- **Broad, redshifted iron K lines are only observed in the Seyfert 1 galaxies, Mrk 766 and MCG-6-30-15** - linked to RGS disc lines?
- Recent *XMM-Newton* discovery of Kerr profile in **XTE J1650-500**
- ***But Ionised Fe K disc emission*** is found in luminous Seyfert 1s, **Mrk 205** and **Mrk 509**, centred near 6.7 keV.
- **Broad lines: Mrk 766 and MCG -6-30-15**
- **Ionised (broad) lines: Mrk 205 and Mrk 509**
- **Narrow Lines only: NGC 4151, Mrk 359, IC 4329A, Fairall 9 (Gondoin et al. 2001), NGC 5548, NGC 3783 (Chandra, Kaspi et al. 2001)**
- **No iron K lines: 3C 273 and PDS 456**
- **Assumptions of a standard, cool accretion disc probably too simplistic?**

### Conclusions...

- **Narrow iron K line emission appears ubiquitous in Seyfert 1s**  
Widths / Strengths of lines are similar ( $\sigma < 5000 \text{ km s}^{-1}$ ;  $EW \sim 75 \text{ eV}$ ).  
Origin of narrow component *Molecular Torus* and/or *outer BLR*
- Narrow iron line missing in luminous quasars. **Implications for the existence of classic type II quasars.**
- **New X-ray spectral features found in the NLS1s, PG 1211+143, PDS 456 and 1H 0707-495.** Consists of strong edge-like feature near 7 keV.
- Originates close to central engine. **Partial covering absorber from dense clouds** in vicinity of disc **or further examples of extremal Kerr line profiles**
- **How common is the Kerr Metric for Iron K lines in AGN and GBHC**