Partial Covering and Reflection in Narrow-Line Seyfert 1 Galaxies

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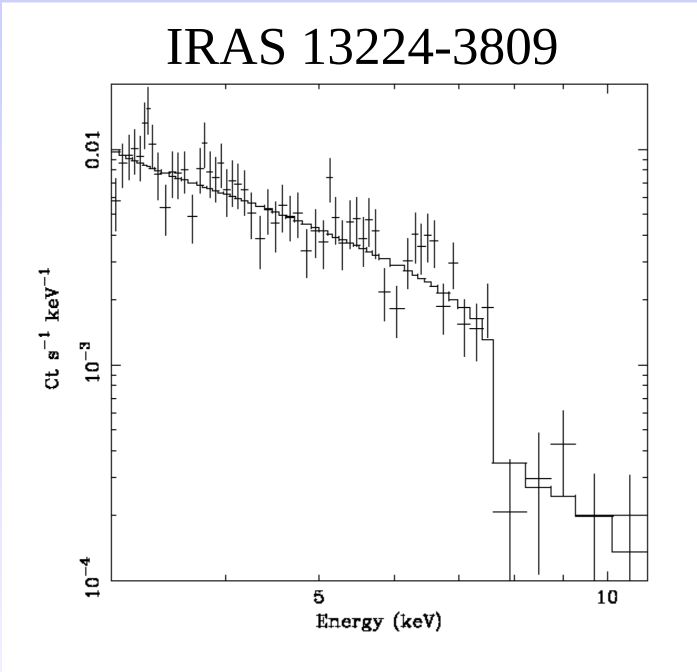
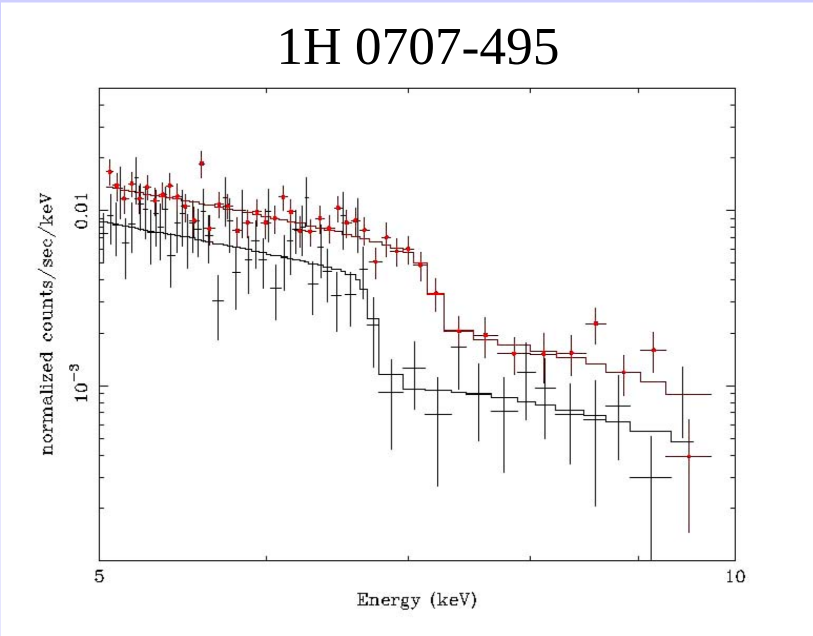
Th. Boller, Y. Tanaka, A. Fabian,
N. Brandt, S. Vaughan

Discovery of sharp spectral drops at E > 7 keV





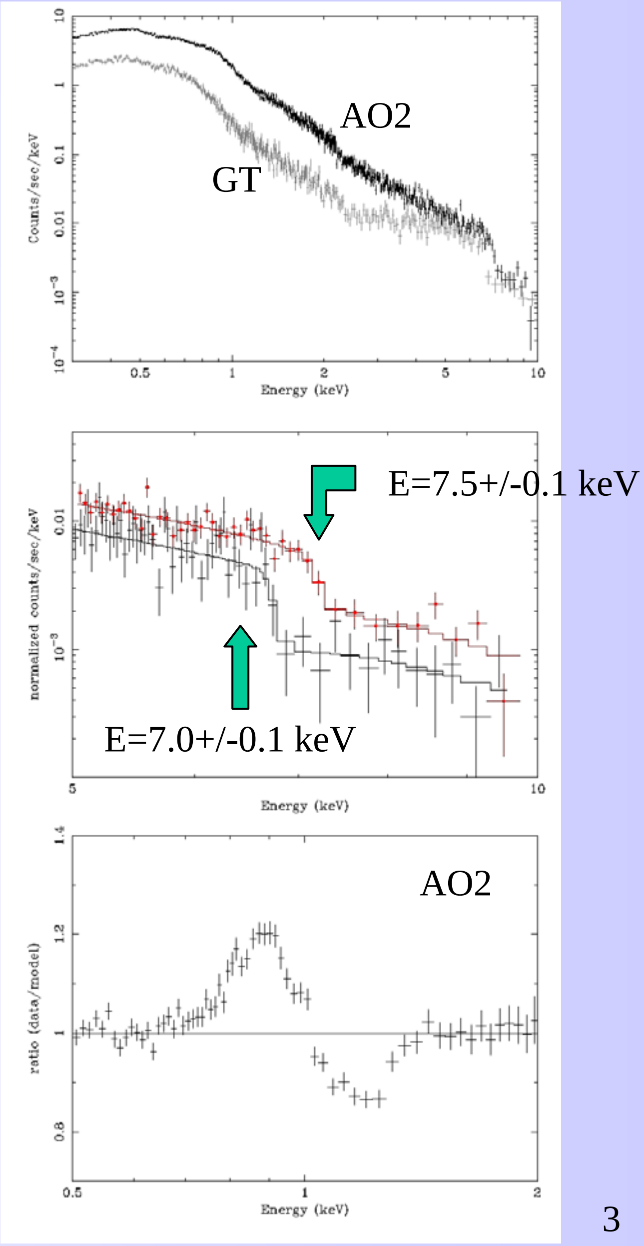
- width is < 160 – 300 eV
- no detection of accompanying Fe emission
- drop energy changes with time

Similar features in e.g.: PG 1211+143 (Pounds et al.), NGC 4051 (Pounds et al.; Uttley et al.), IRAS 13349+2438 (Longinotti et al.), PG 1402+261 (Reeves et al.)

1H 0707-495

2 XMM observations
seperated by 2 years

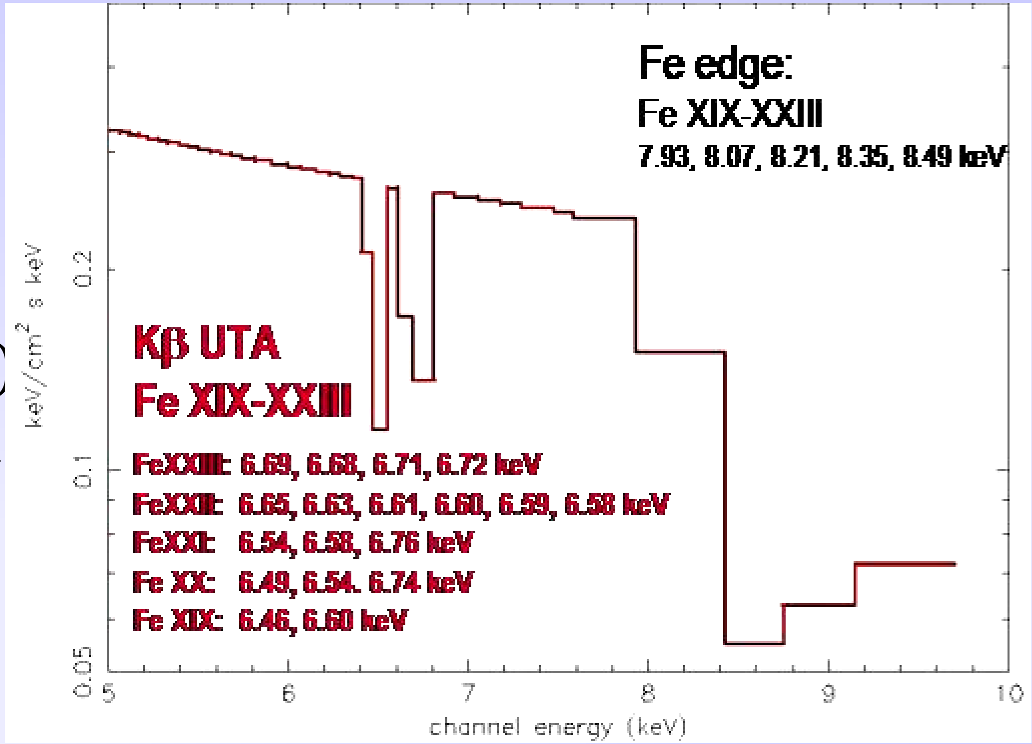
- source flux increases
  by a factor of ~ 5
- harder spectrum during GT
- drop energy increases
- drop depth decreases
- soft-excess shifted to
  higher energies
- emergence of an
  absorption/emission type
  feature at ~ 1 keV



Photoionisation ?

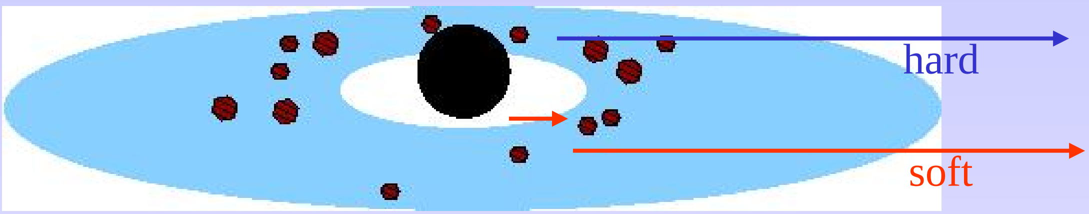
Probably not.

Edge energies correspond to:
FeVII-X (1H0707-495)
FeXVIII-XX (IRAS13224-3809)
requiring a high photoionisation parameter (ξ).
Palmeri et al. (2002) predict:
• broad edge
•Kβ UTA



Partial Covering

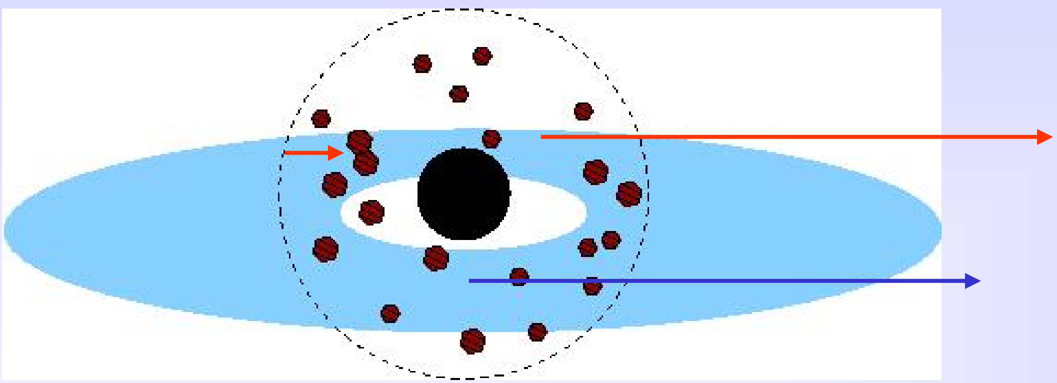
(eg. Holt et al. 1980, Tennant 1989, Tanaka et al. 2004)



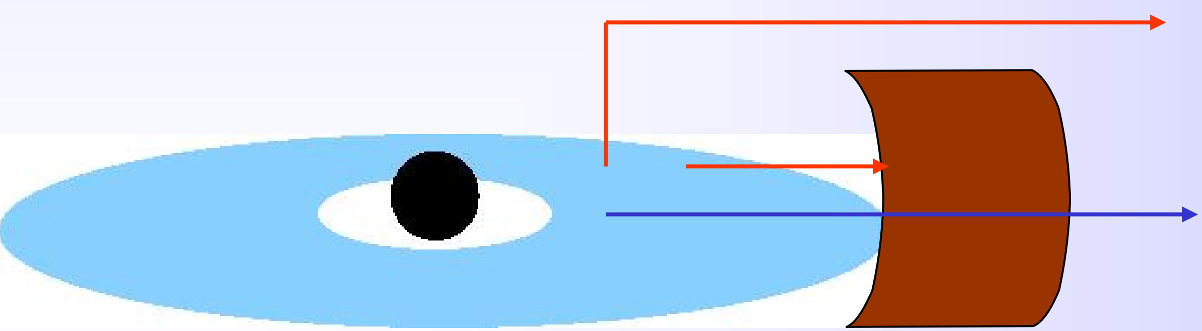
„lumpy accretion“

„patch absorber“

fluorescent yield discrepency



no fluorescent yield discrepency necessarily



„slab-type absorber“

polarized light

Partial Covering on 1H0707-495

Neutral absorber

<u>AO2</u>

3x solar Fe

v = 0.05c

edge E = 7.5 keV

$\Gamma = 2$

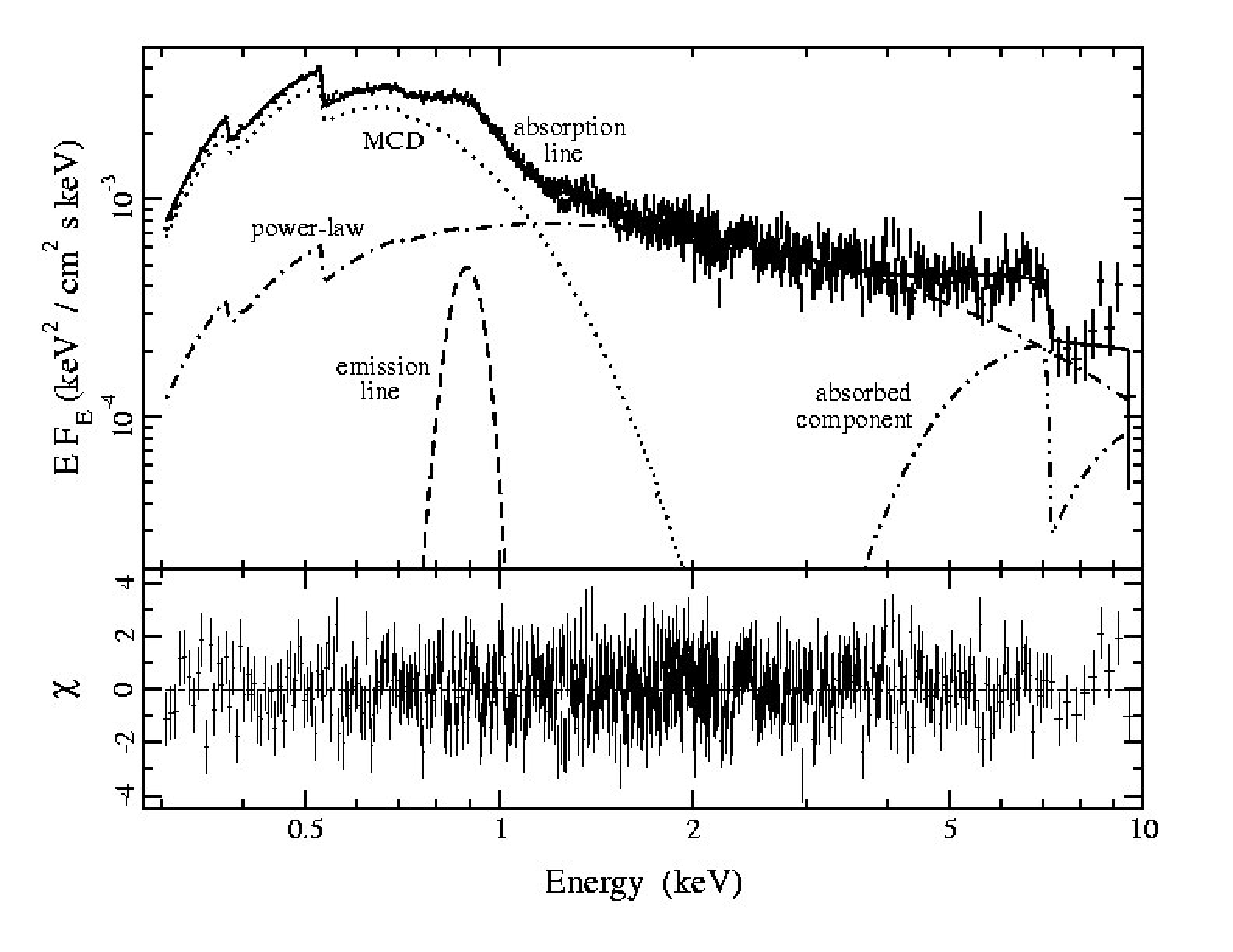
<u>GT</u>

3x solar Fe

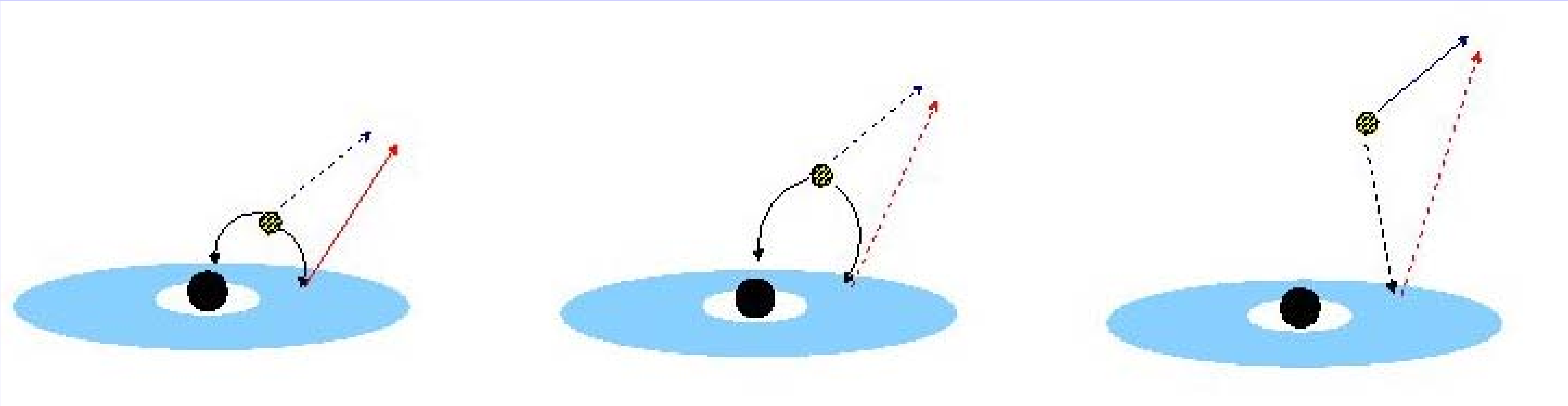
v = 0.0

edge E = 7.1 keV

$\Gamma = 2$



Reflection and Light Bending



Reflection dominated spectrum

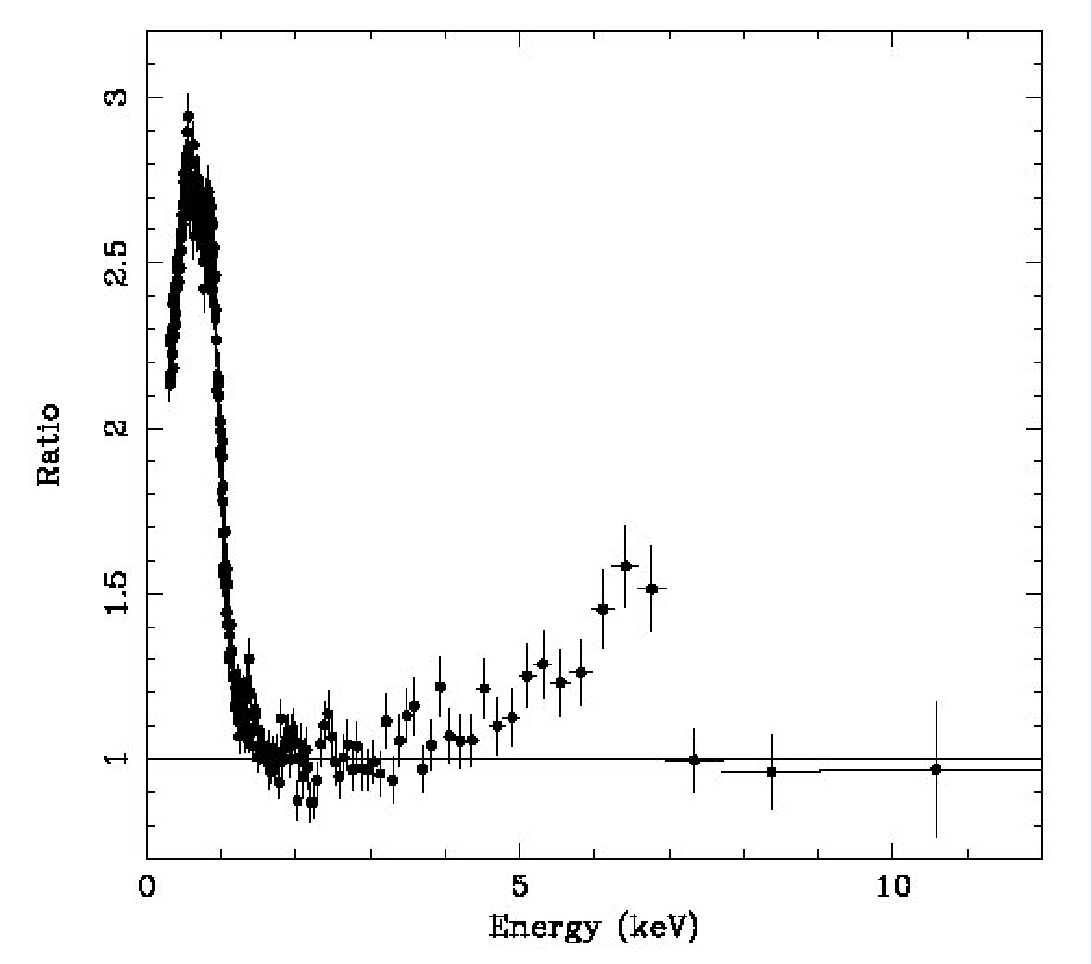
Continuum dominated spectrum

Is there a line in 1H0707-495?

$\Gamma = 2.8$

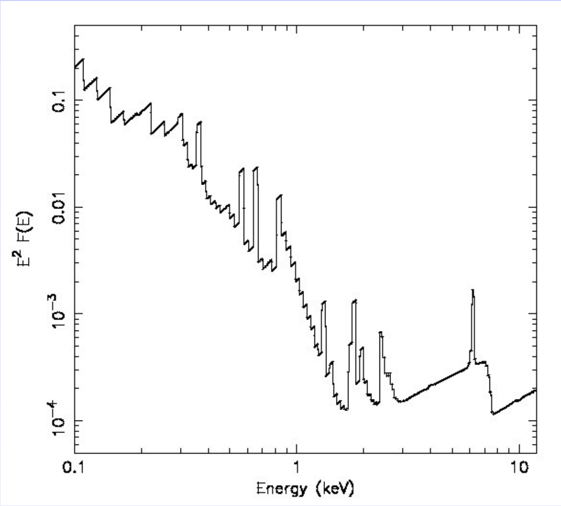
Laor line:

- E = 6.7 keV
- EW = 1.8 keV

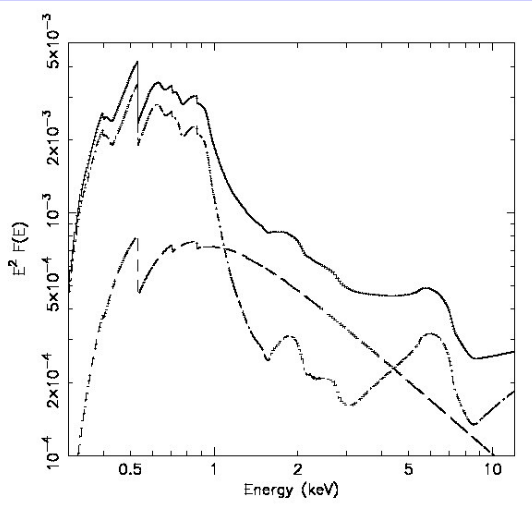


Ionised reflector in 1H0707-495

unblurred reflection spectrum



plus power-law and blur



<u>AO2</u>

q=5.1

r = 2.5-100 Rg

i = 50 degr, 3x solar Fe

$\log\xi = 2.8$

<u>GT</u>

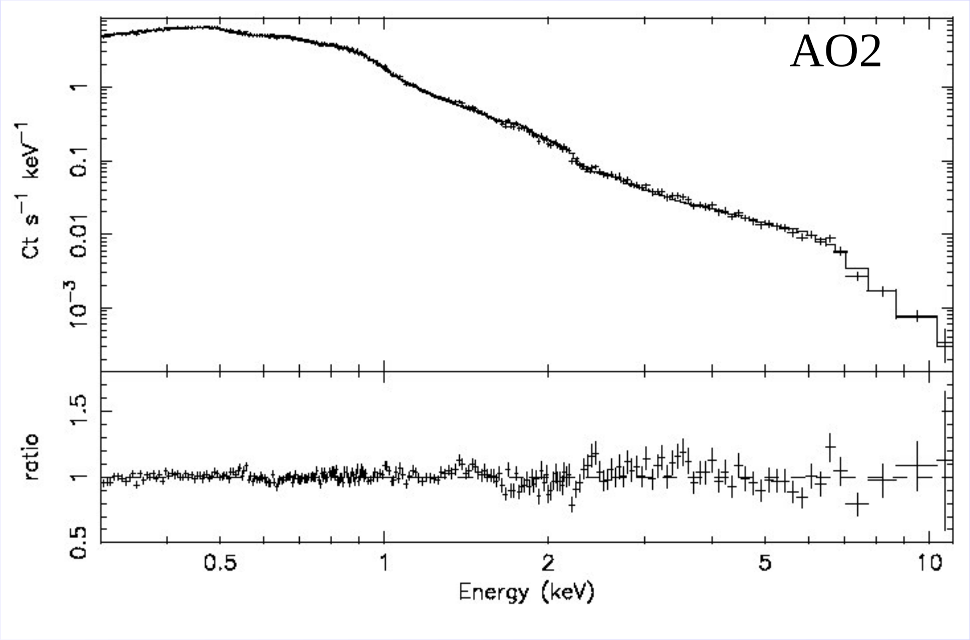
q=7

r = 2.5-100 Rg

i = 50 degr, 3x solar Fe

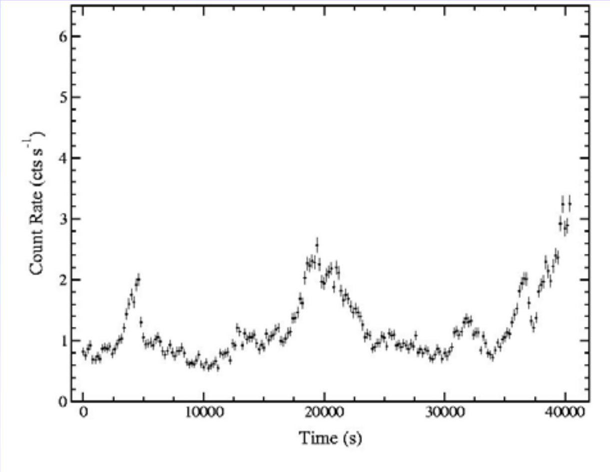
$\log\xi = 2$

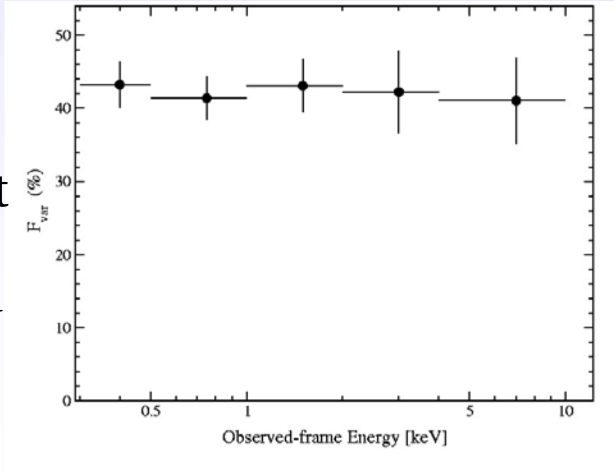
no power-law present



Short term flux & spectal variability

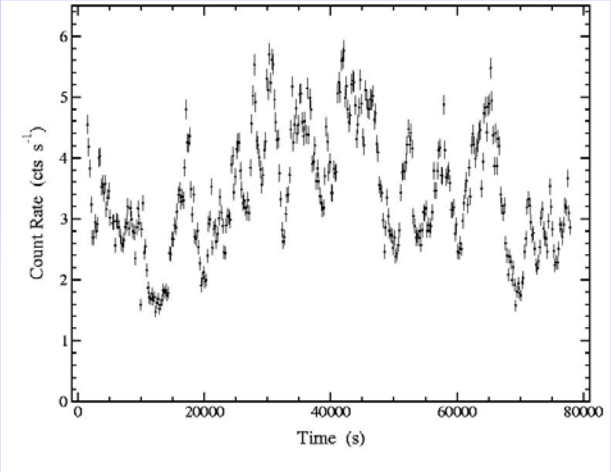
GT

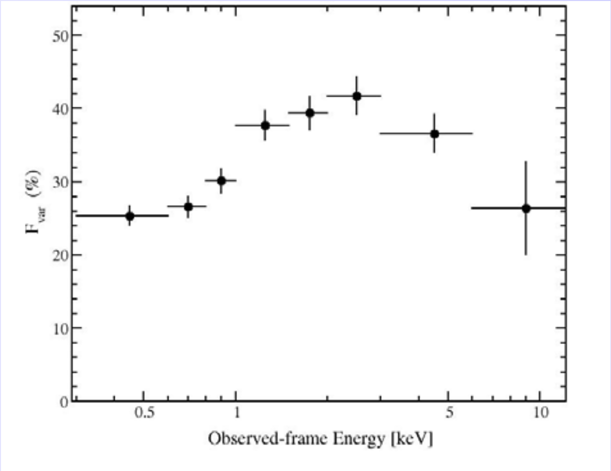




no significant spectral variability

AO2



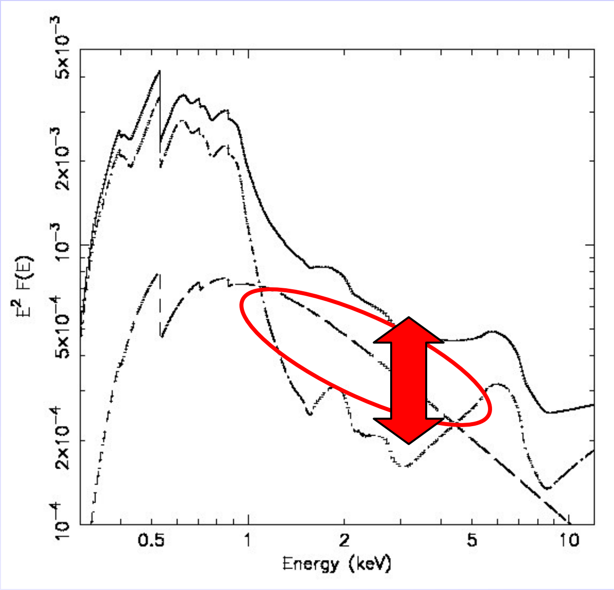


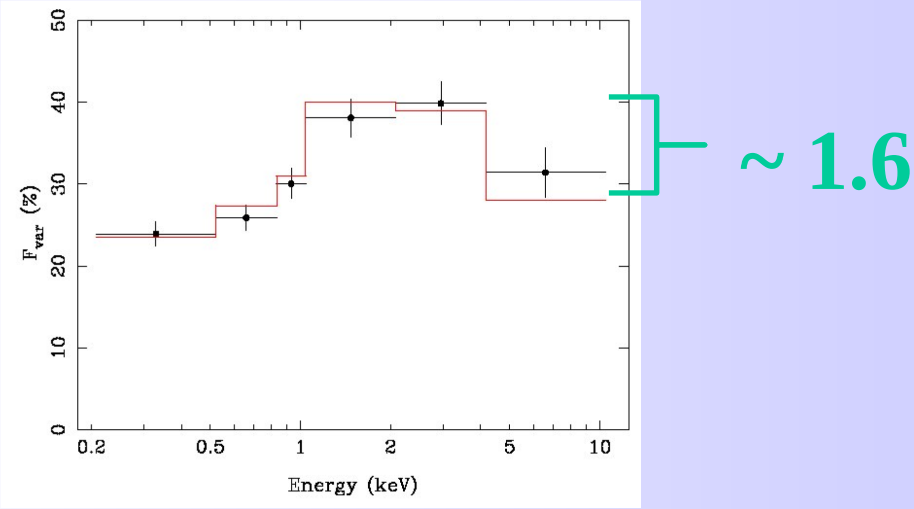
strong spectral variability

Two component variability model

Following
Taylor et al. (2003)
One variable
component (power-law)
plus one less variable
component (reflection)

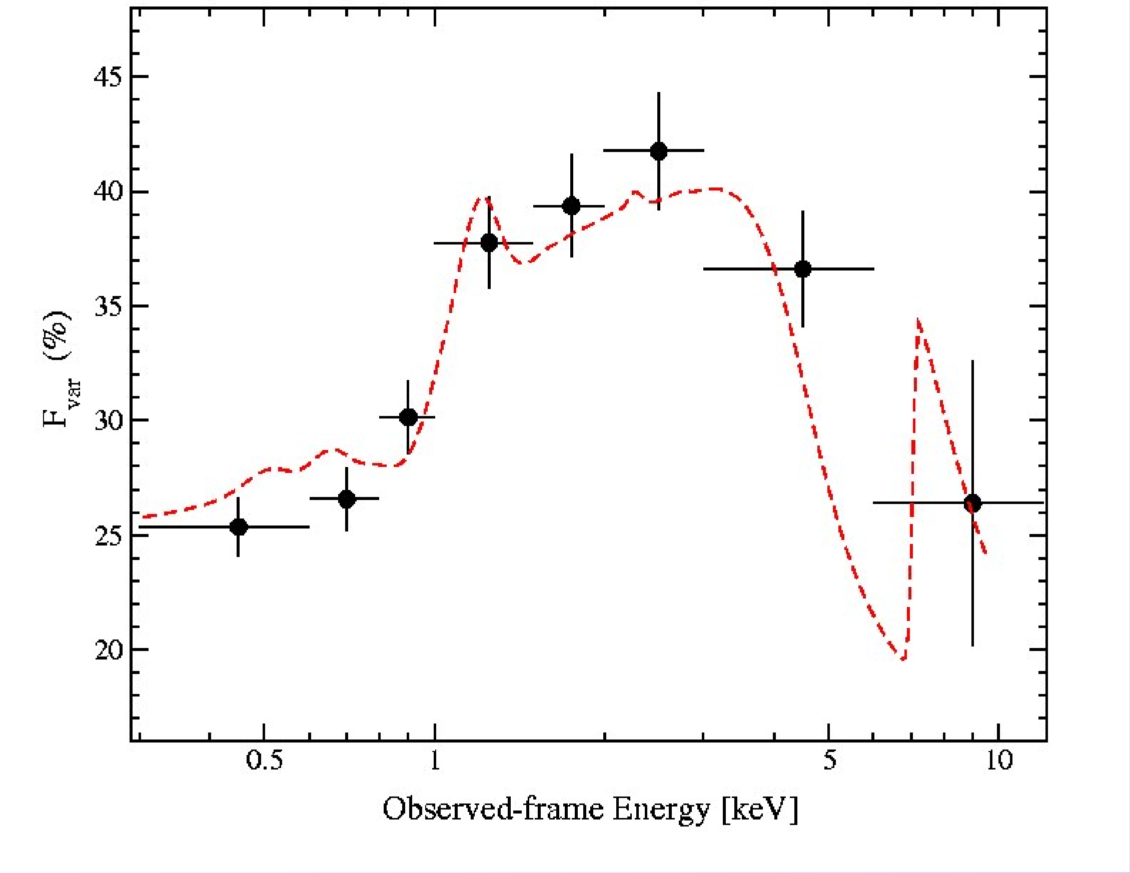
power-law is
~1.6x more variable
than the reflection





Double partial covering

difference between low- and high-flux state
can be described by changes in *only* the covering
fraction of the absorbers

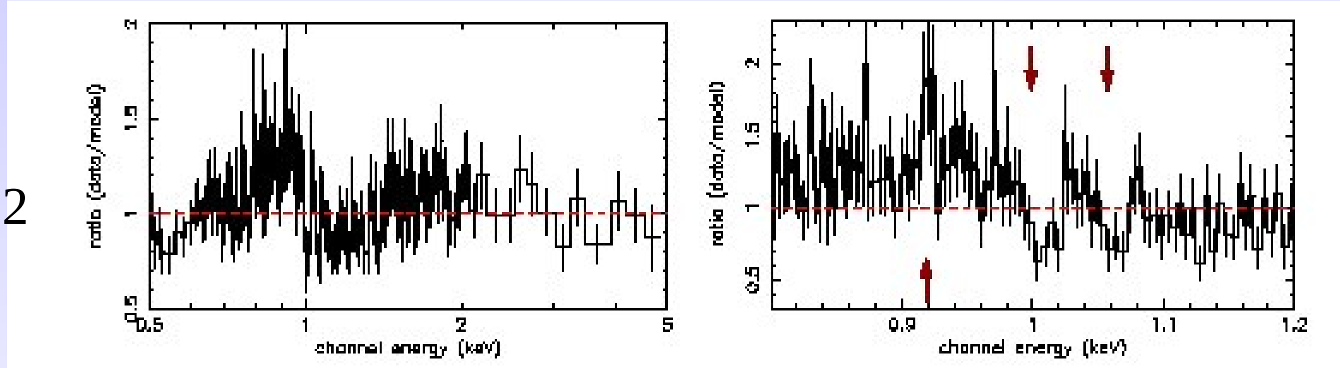


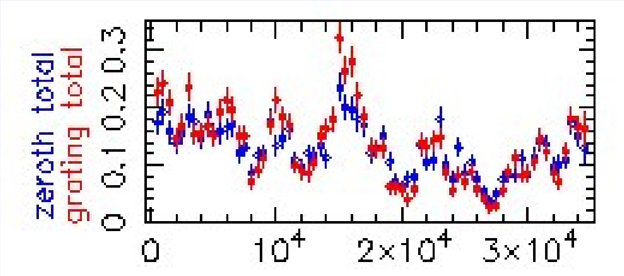
Chandra observation of 1H0707-495

Leighly et al. (2002)

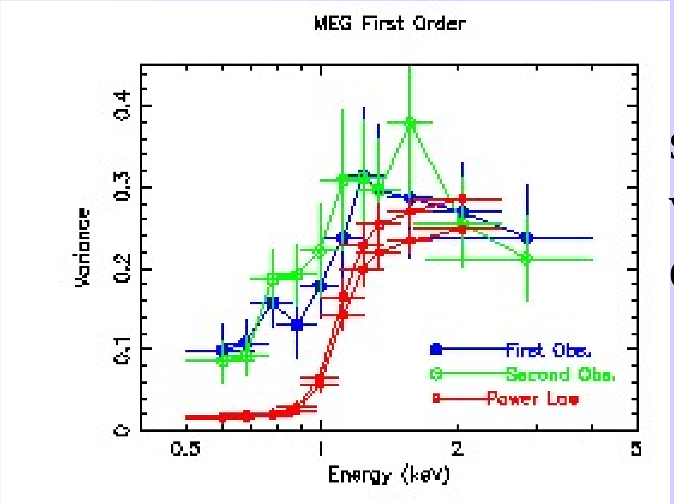
- observed 2 months after first (GT) XMM observation
- flux was ~ 10x the GT observation and 2x the AO2

similar emission/absorption feature as seen in AO2





usual flux variability



similar spectral variability as seen during AO2

Comparison between the two observations of 1H0707-495

	Reflection	Part. Covering
Harder spectrum during low-luminosity	Y	Y
Nature of soft-excess	Y	Y
Nature of warm emission/absorption	Y	Y
Edge sharpness	N	Y
Shift in drop energy	~	~
Flux variability	Y	Y
Spectral variability	Y	Y

but see IRAS13224-3809 (Gallo et al. 2004)

Conclusions

- two XMM observations of the NLS1 1H0707-495 seperated by two years
- spectral and short-term timing properties can be explained by either partial covering or reflection
- partial covering requires an outflow of ~ 0.05c
- reflection dominated spectrum requires light bending considerations very close to black hole
- partial covering and reflection appear very different in a high-flux state
- detection of 1H0707-495 in various (and a high-flux) state can reveal the correct model
- or a very high signal-to-noise spectrum to examine the spectrum above the edge

Thank you!