Absorption Dominated Models for the Observed X-ray Properties of AGN

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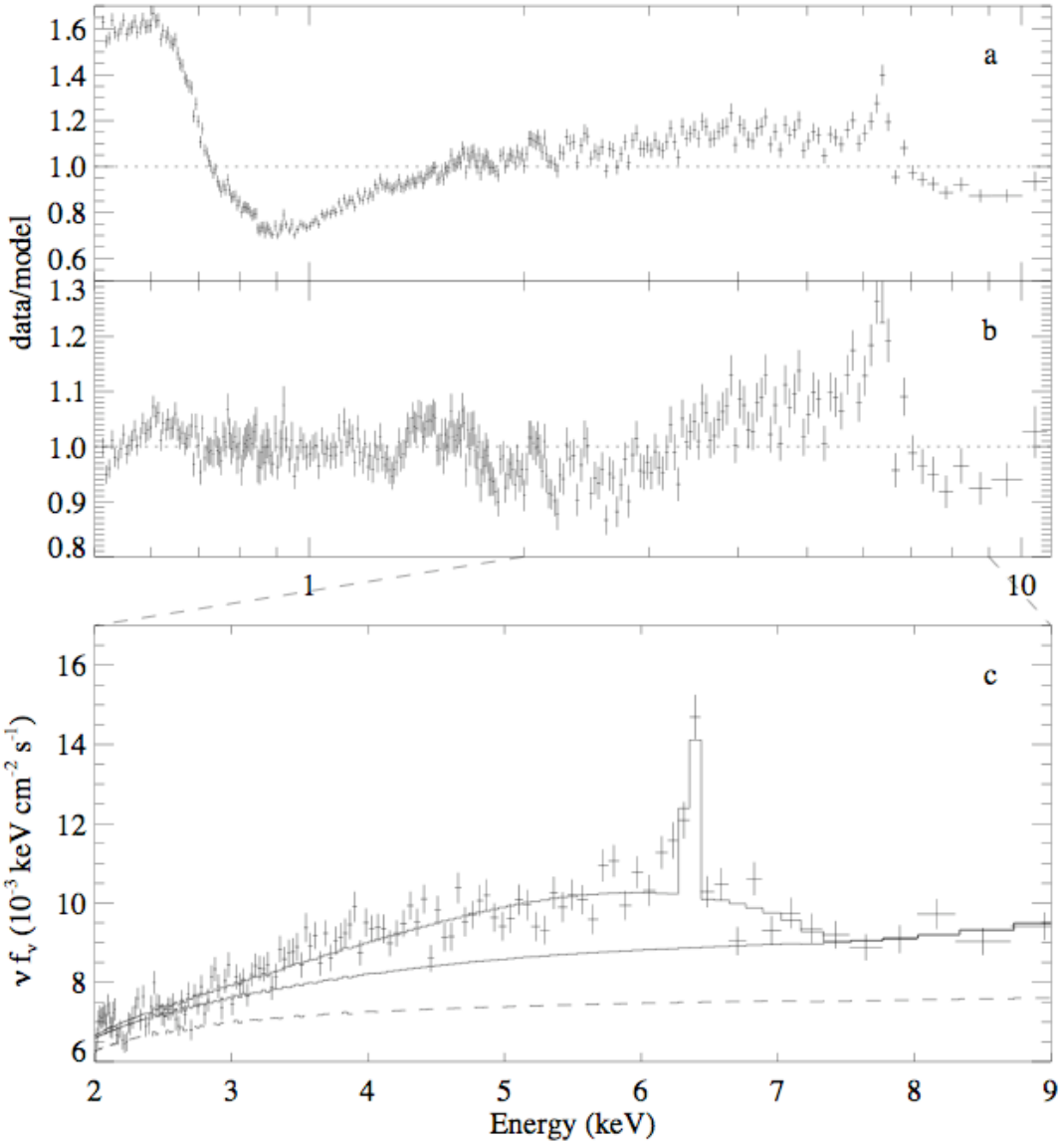
The Problem: e.g. MCG-6-30-15



Wilms et al 2001

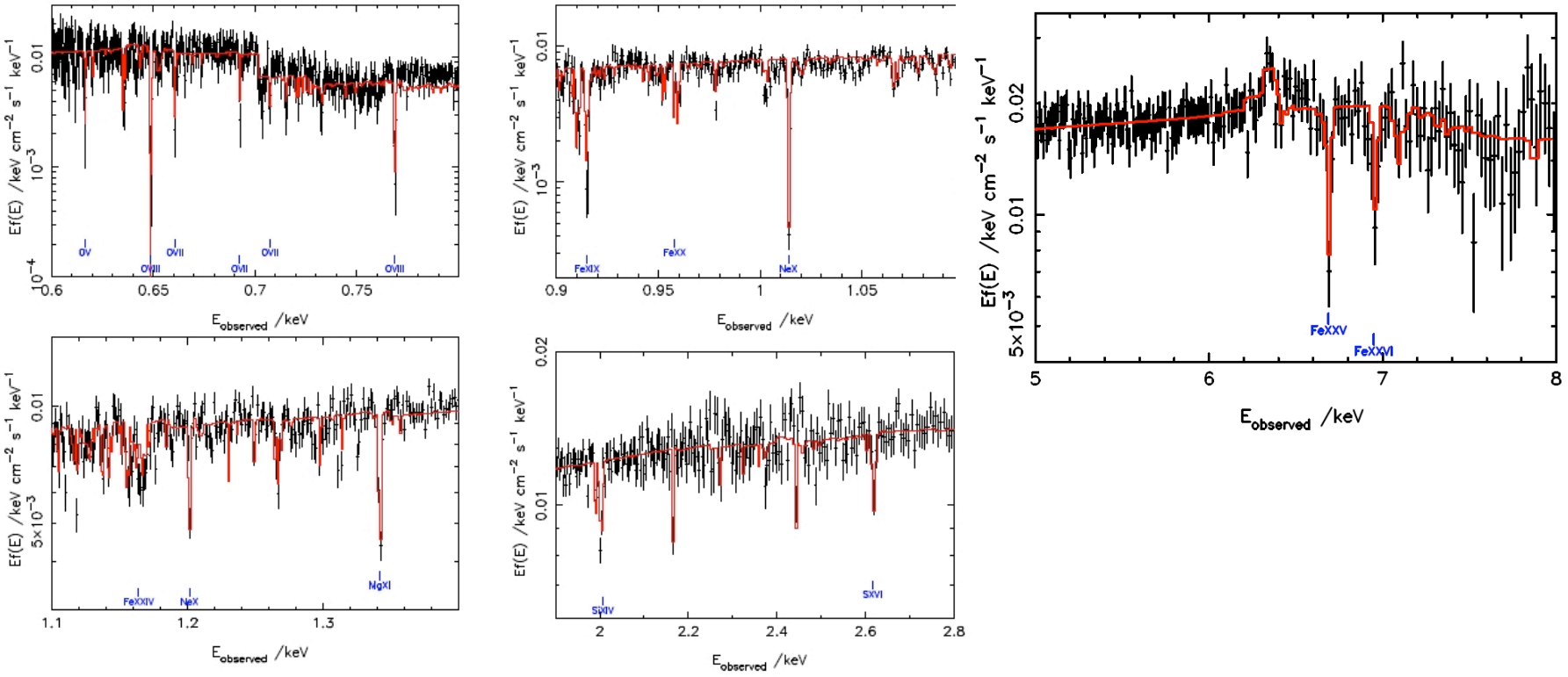
ratio to power-law

ratio to empirical warm absorber

the residual - blurred line or absorption signature?

e.g. Piro et al 1992; Inoue & Matsumoto 2003

3 WA zones in grating data for MCG-6-30-15 (Lee et al 2001, A.Turner et al 2003, 2004, Miller et al 08, Young et al 2005, Miniutti et al 2007)



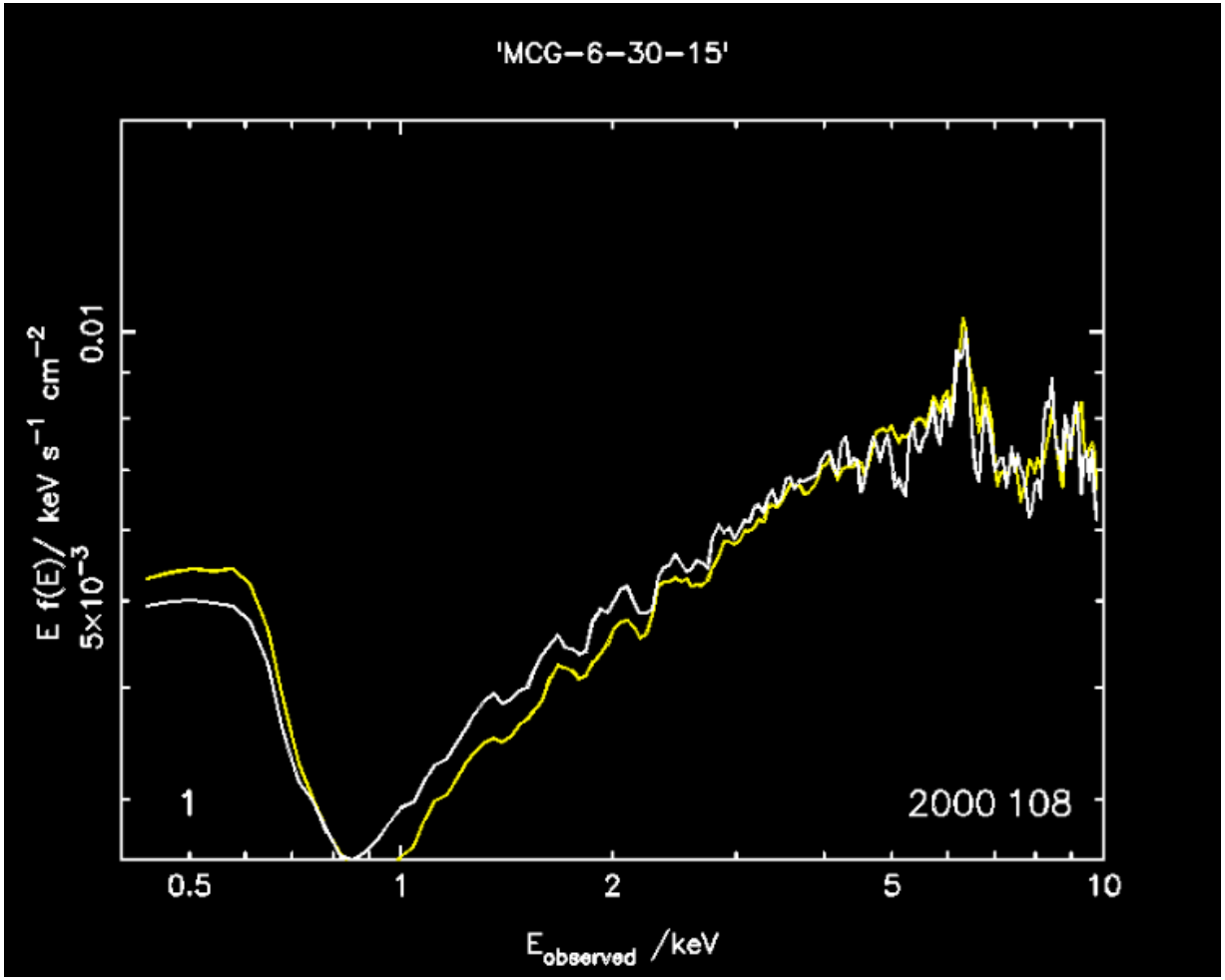
Results typical of other nearby AGN (e.g. Blustin et al '05)
AGN have outflows with column densities and ξ detected over at least 4 orders of mag

Case Study MCG-6-30-15

L Miller, Turner & Reeves 2008

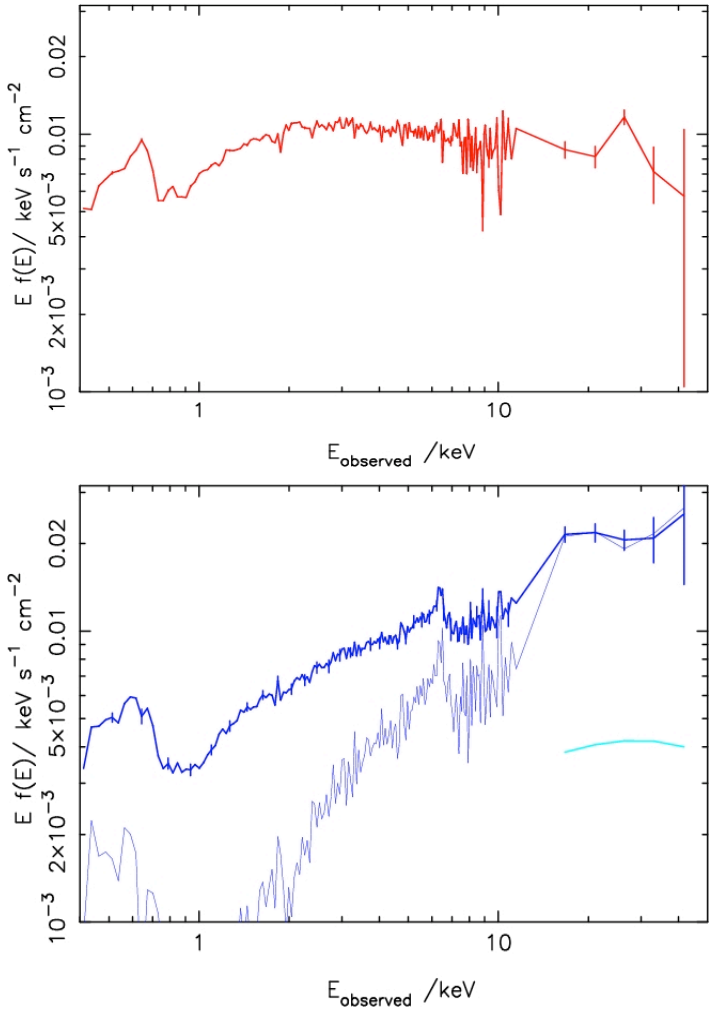
MCG-6-30-15	2000	2001	2004	2006	total
XMM-Newton pn + rgs	89ks	330ks			419ks
Chandra HETGS			522ks		522ks
Suzaku xis + pin				253ks	253ks

Generally see large systematic spectral variability -there is something important to be understood



Here **MCG-6-30-15** (also see e.g. Vaughan & Fabian ‘04) -also **Mkn 766**, L Miller et al ‘07, Turner et al ‘07; **NGC 3516** Netzer et al ‘02 Turner et al ‘05 & ‘08; **1H0419-577** Pounds et al 2004 etc)

MCG-6-30-15

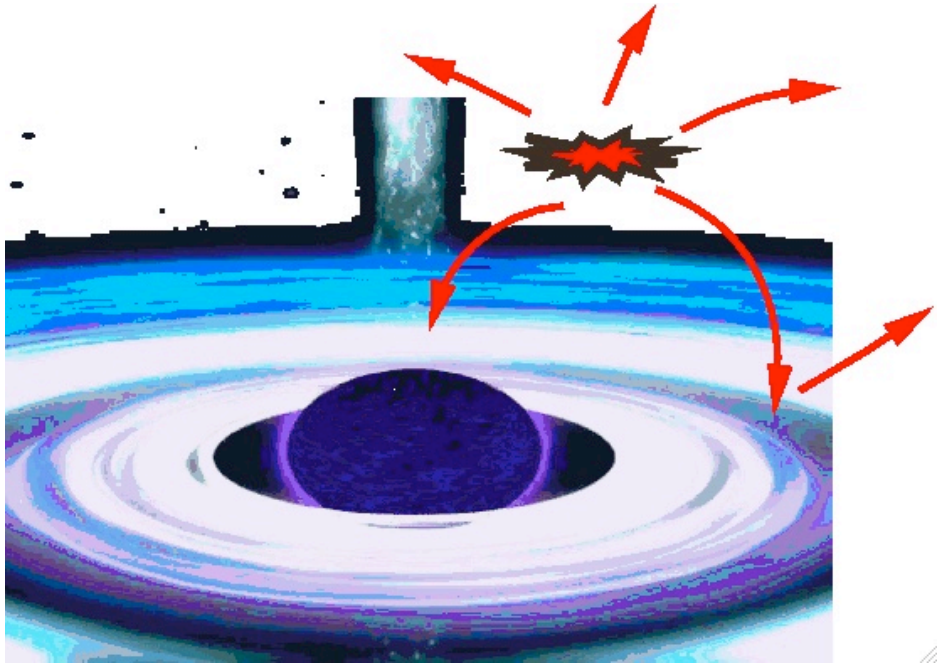


Variable component is absorbed PL

Offset component very hard: reflection or heavily absorbed fraction of PL

Variable covering absorption can also explain offset component and observed spectral variability

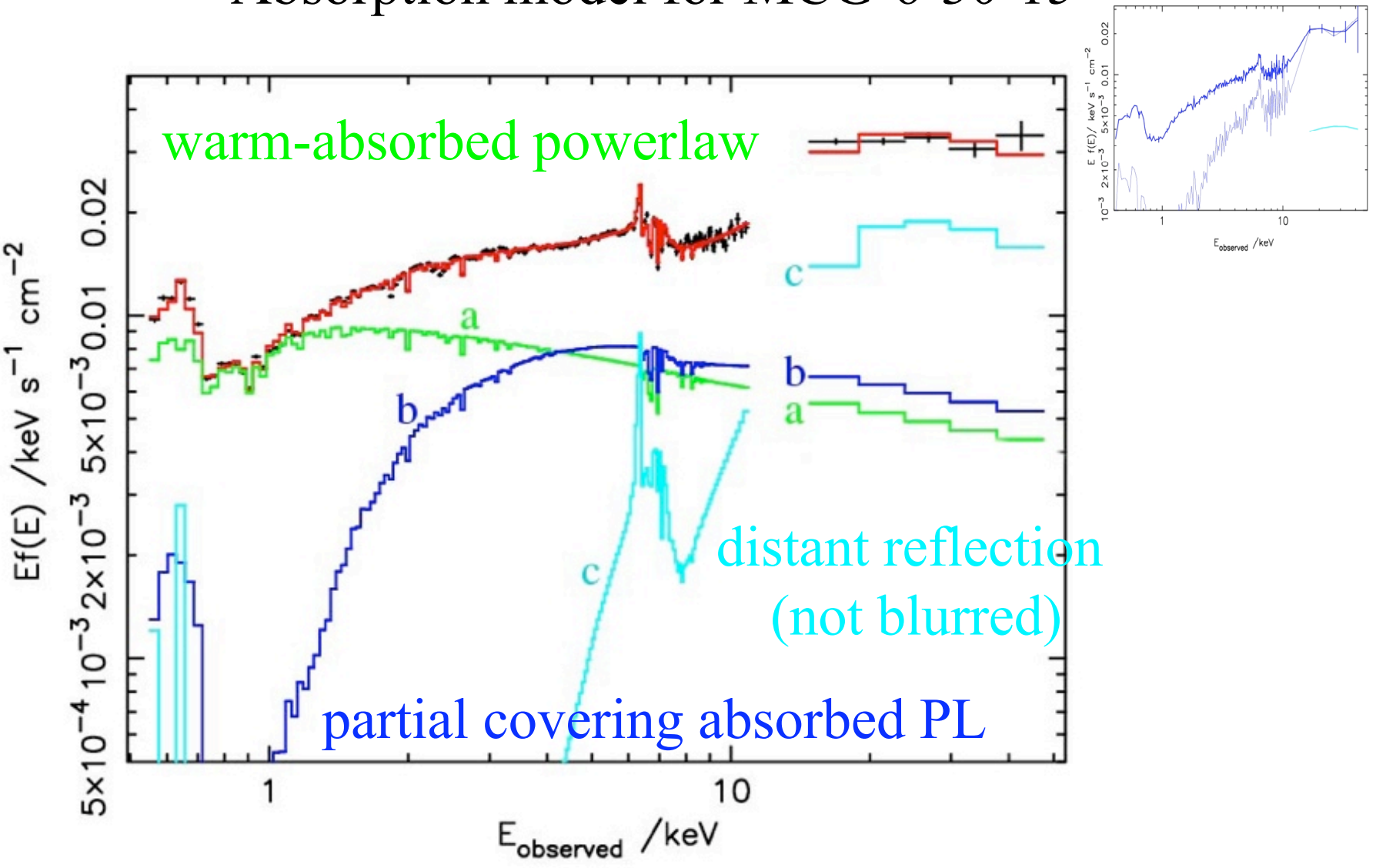
light bending



Fabian & Vaughan 2003
Miniutti et al. 2003
Miniutti & Fabian 2004

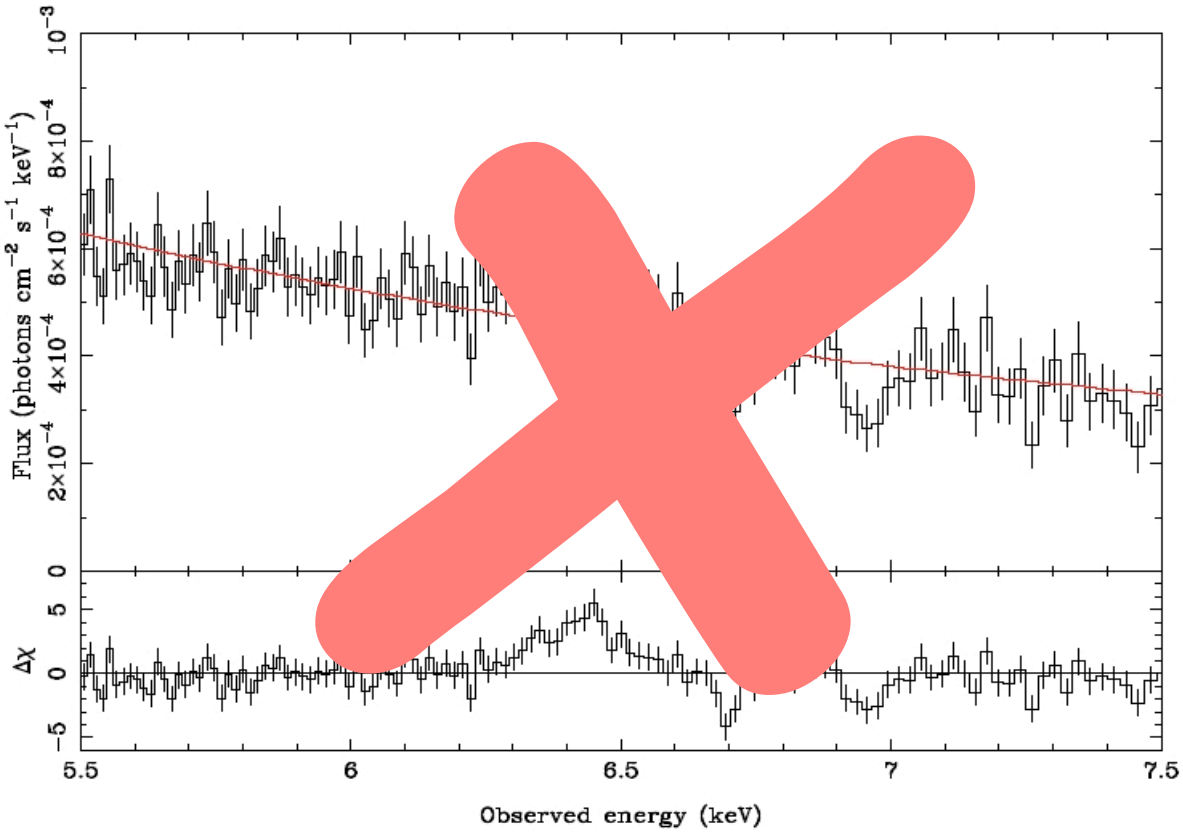
- light rays are bent more onto the disk as the hotspot moves closer to the BH
- reflected intensity more constant than direct intensity
- only inner-disc reflection model that also explains very high reflection albedo (R>3) inferred from hard X-ray band if all that emission is assumed to be unabsorbed reflection

Absorption model for MCG-6-30-15



Too complex? - 3 zones of gas included in blurred refln models
-also, this explains all the data

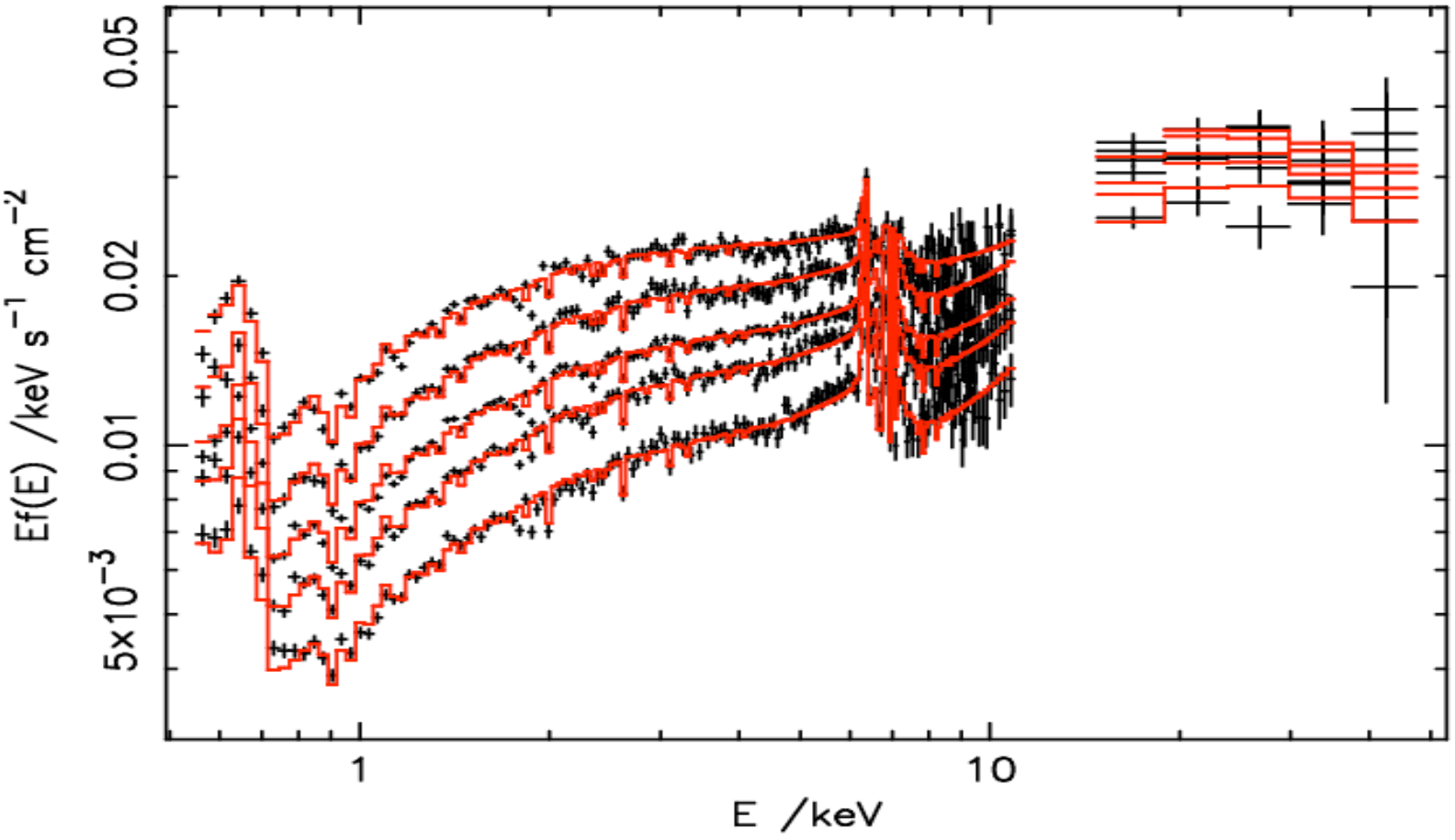
Absence of 6.5 keV absorption does not rule out our model



Young et al (2005) claimed absorption models do not explain the red wing because they would predict 6.5keV Fe Kα absorption, which is not observed

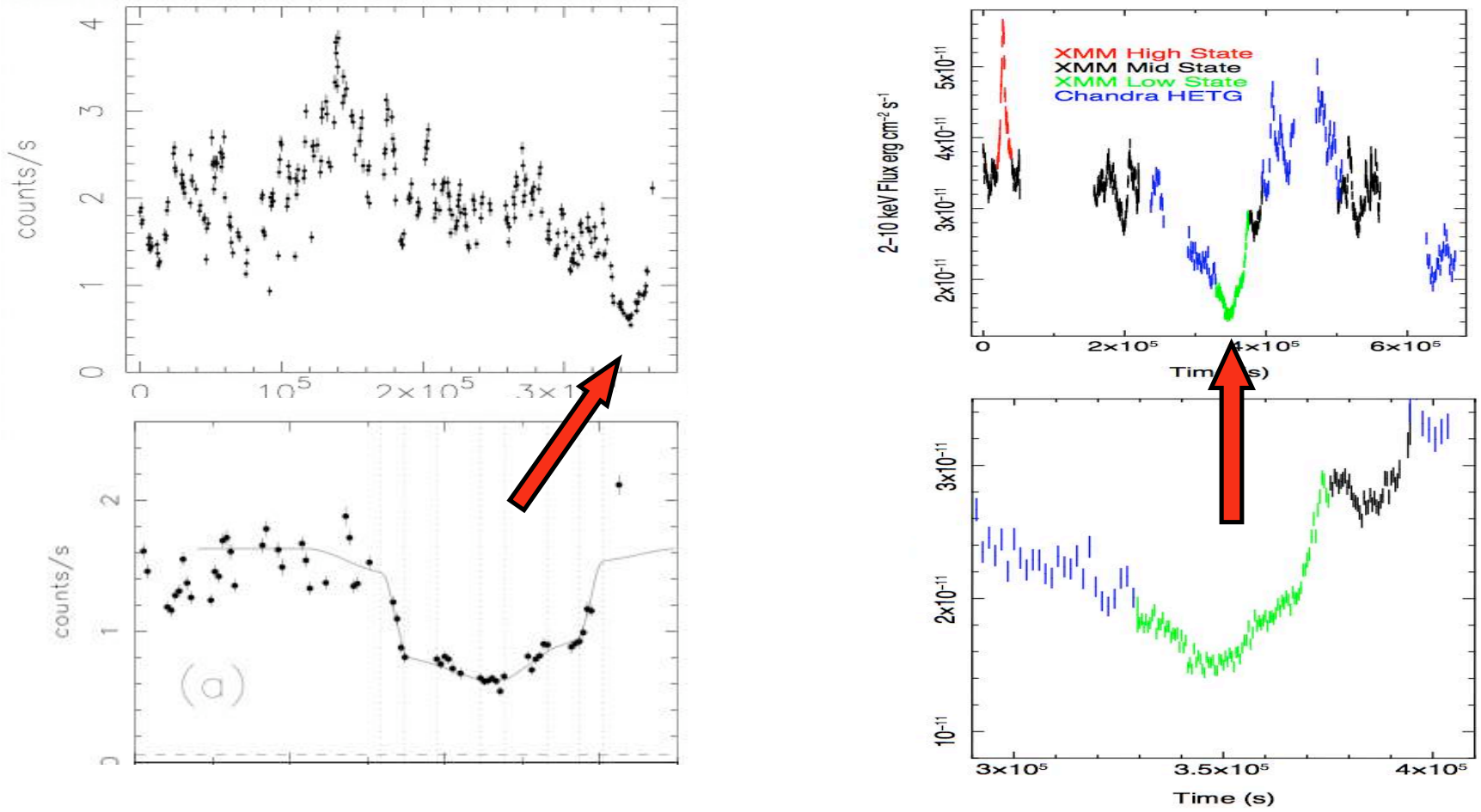
Not a constraint if the zone is allowed to be partially covering continuum. In such a case The PC zone has ionization < 100 erg cm s^{-1} so the Fe L shell is filled and there is no Kα absorption

model fits to multiple flux states - Suzaku xis & pin simultaneous fit



model also an excellent fit to RGS and HETG data

Flat bottomed dips- Occultation/Eclipse events in MCG-6-30-15 & NGC 3516 ?



MCG-6-30-15 McKernan & Yaqoob '98 - dip shape inhomogeneities in emitter or absorber-same for NGC 3516 (Turner et al 2008)

Effective resolution x10^6 greater than with current X-ray optics

Summary

- Fitting mean AGN spectra - insufficient information to diagnose emission/absorption regions - studying spectral variability is key
- MCG-6-30-15 well fit by complex absorption model
  - explains the 2-6 keV ‘red wing’
  - explains relative constancy of the hard X-ray flux
  - reduces the otherwise R>>1 reflection albedo
  - explains the soft excess
- Variable-covering absorption models work for other Seyferts, contribution from blurred reflection component not ruled out-but this is not required
- Physical explanation - disk winds - developing models look promising
- Need IXO to make the distinction between these possibilities