Light bending models in AGNs and BHCs

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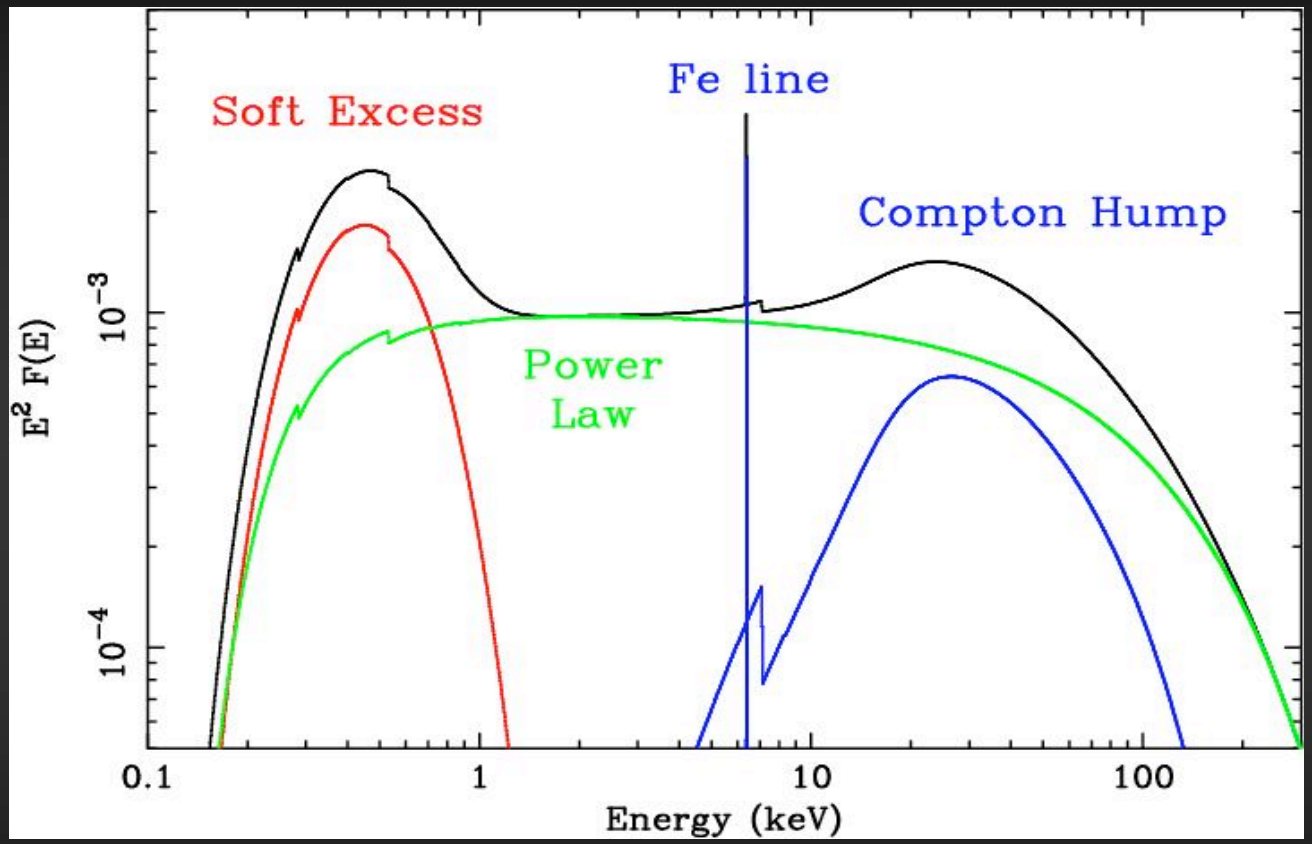
Accreting BHs: main spectral components



Soft excess

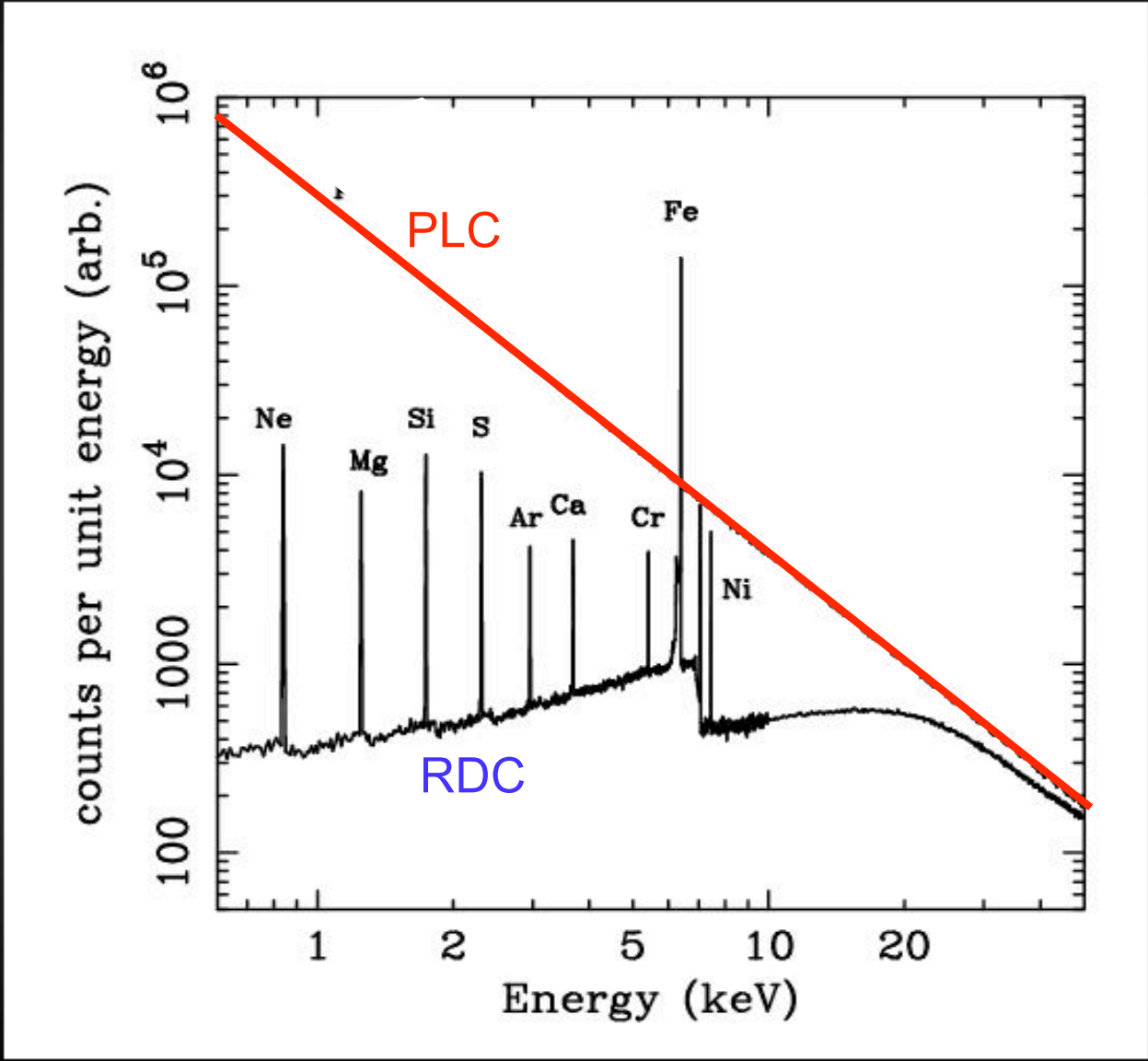
Power law

X-ray reflection

e.g. Fabian & Miniutti (CUP, in press)

all modified by absorption (Galactic and/or intrinsic)

The X-ray reflection spectrum



Reynolds 96

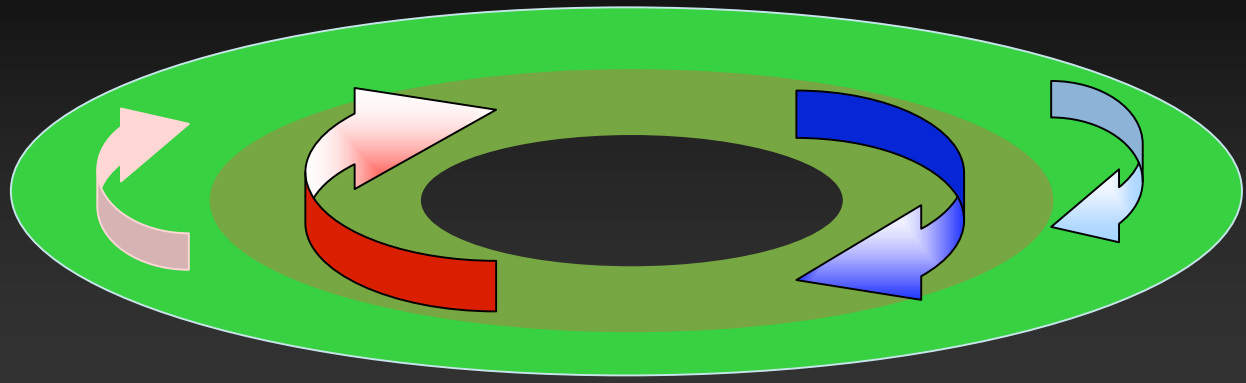
X-ray reflection: relativistic effects

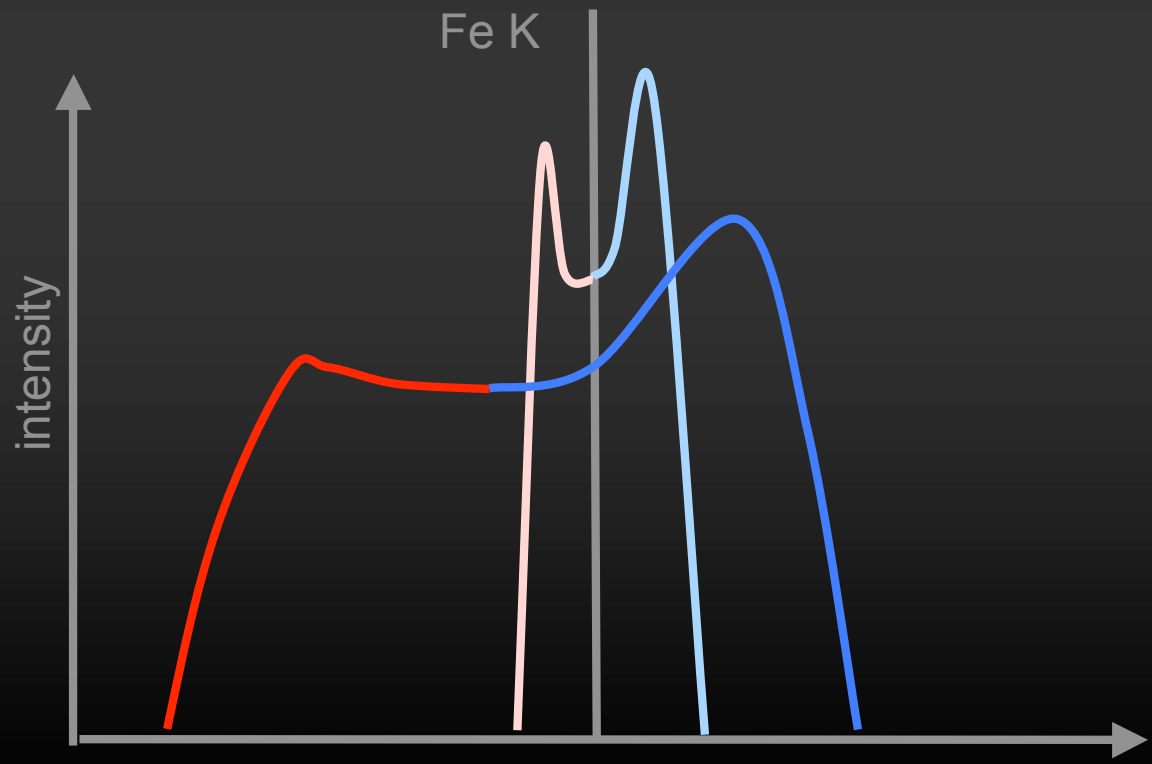
Doppler shifts

relativistic beaming

gravitational redshift

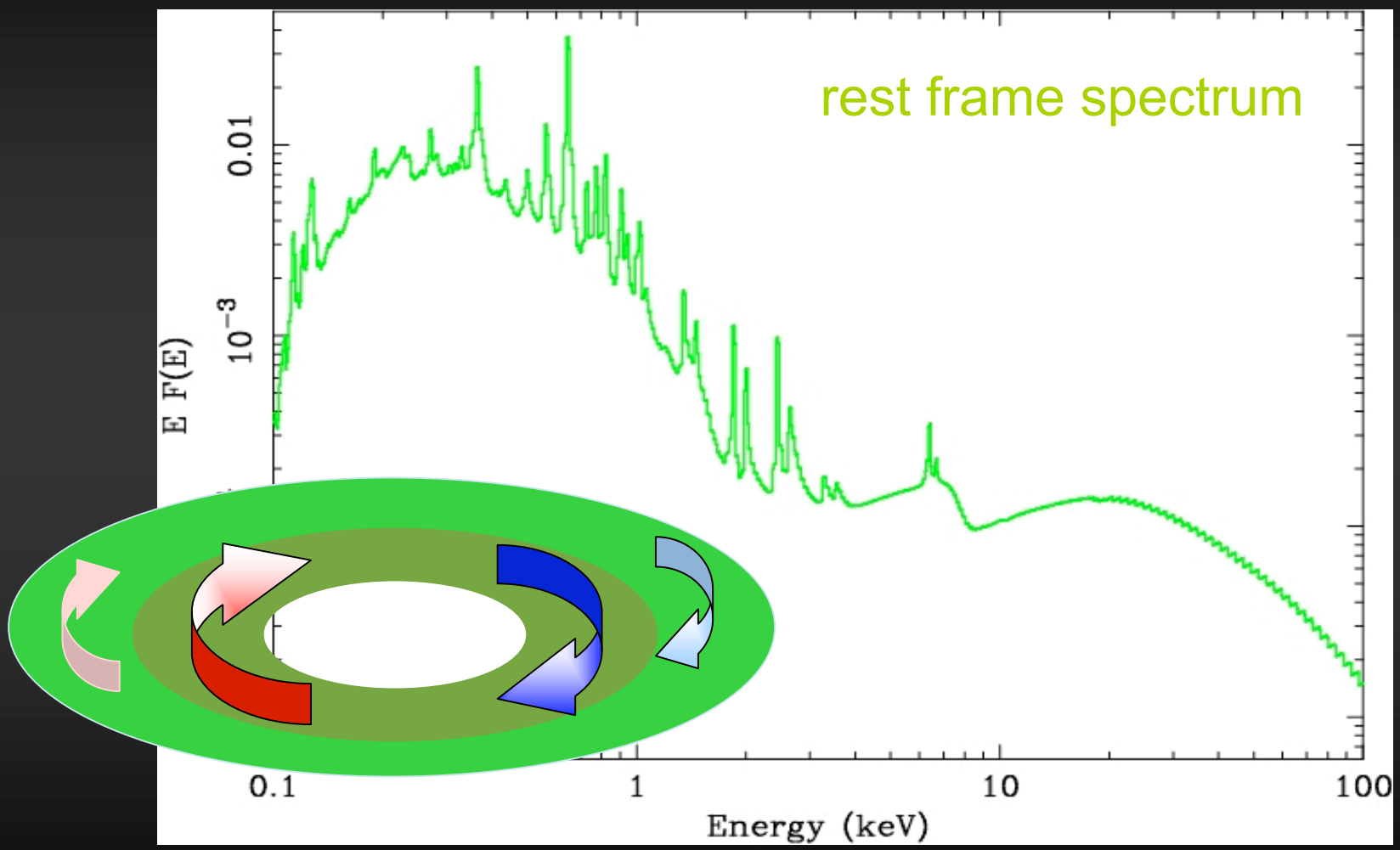
gravitational light bending





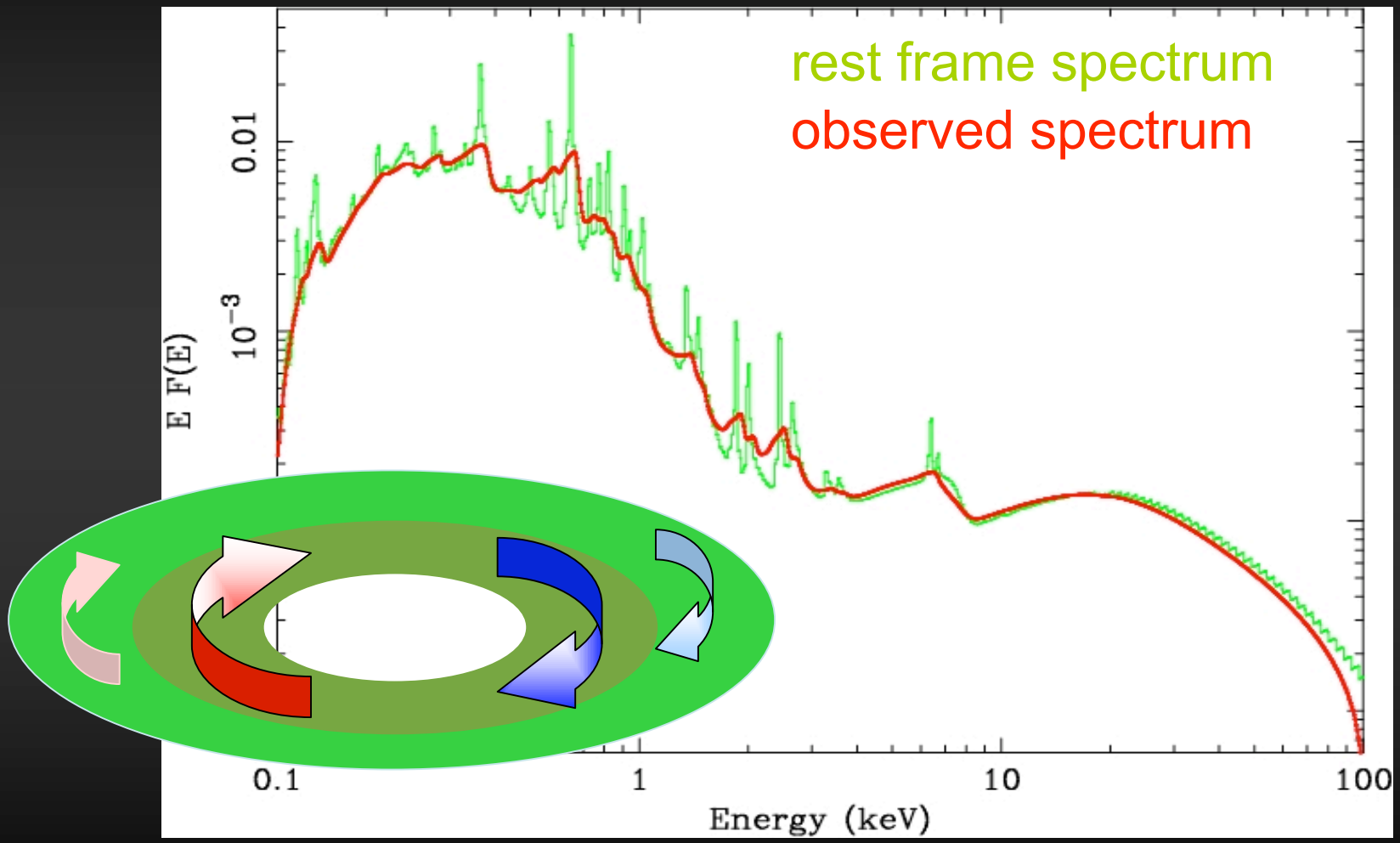
e.g. Fabian, Rees, Stella & White 89

The X-ray reflection spectrum



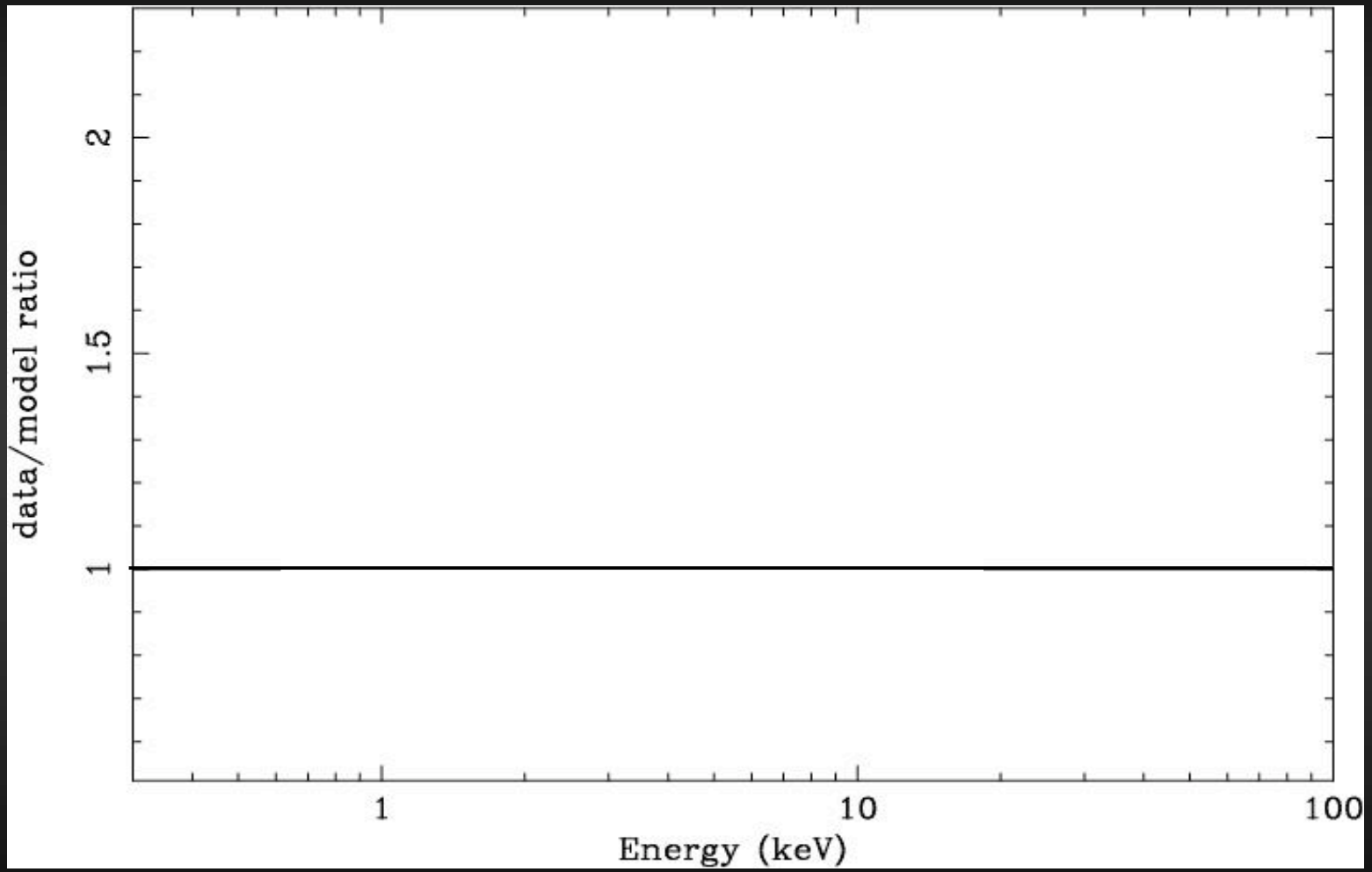
reflection code from Ross & Fabian 05

The X-ray reflection spectrum



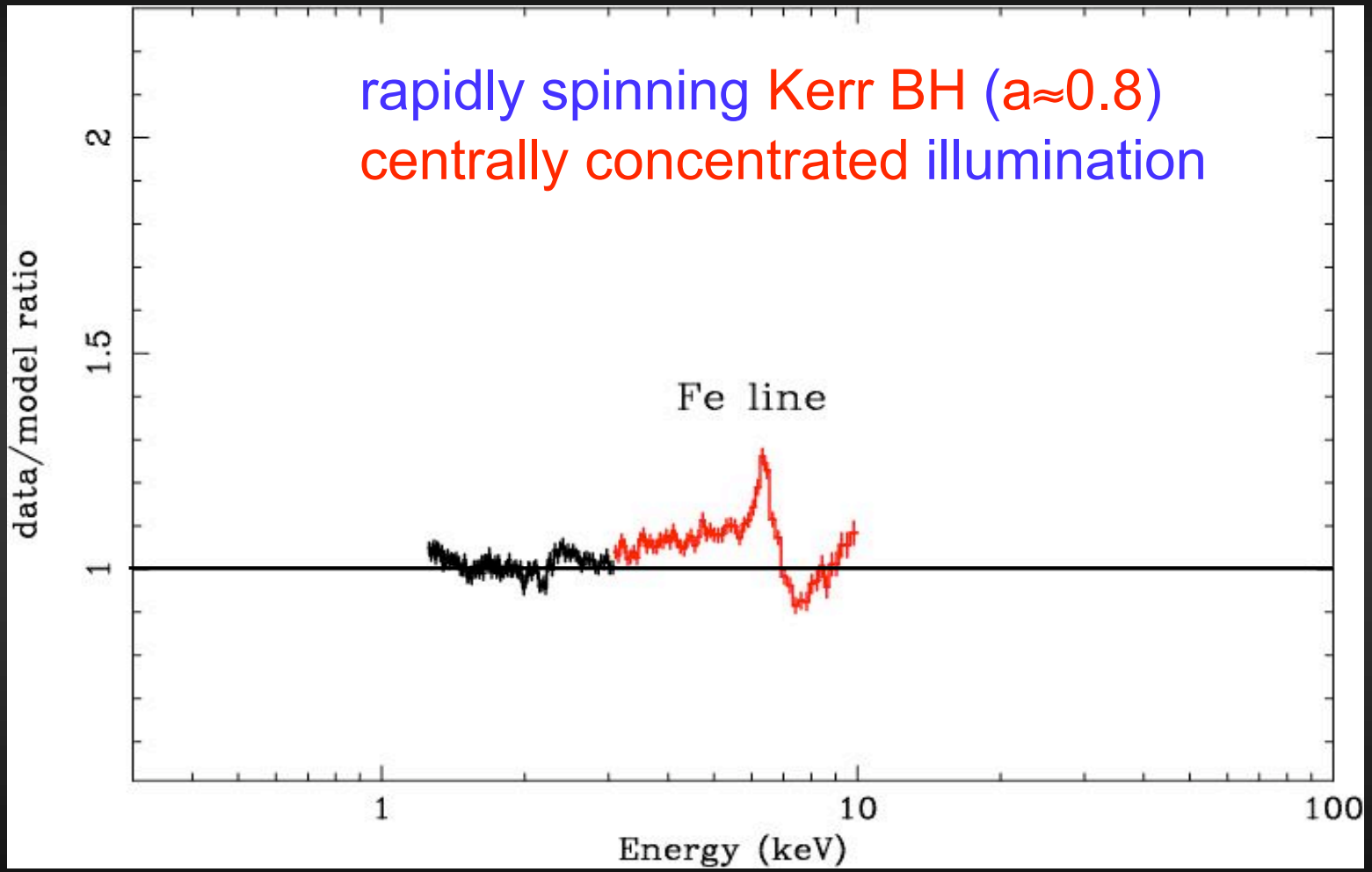
reflection code from Ross & Fabian 05

A case of study: MCG-6-30-15



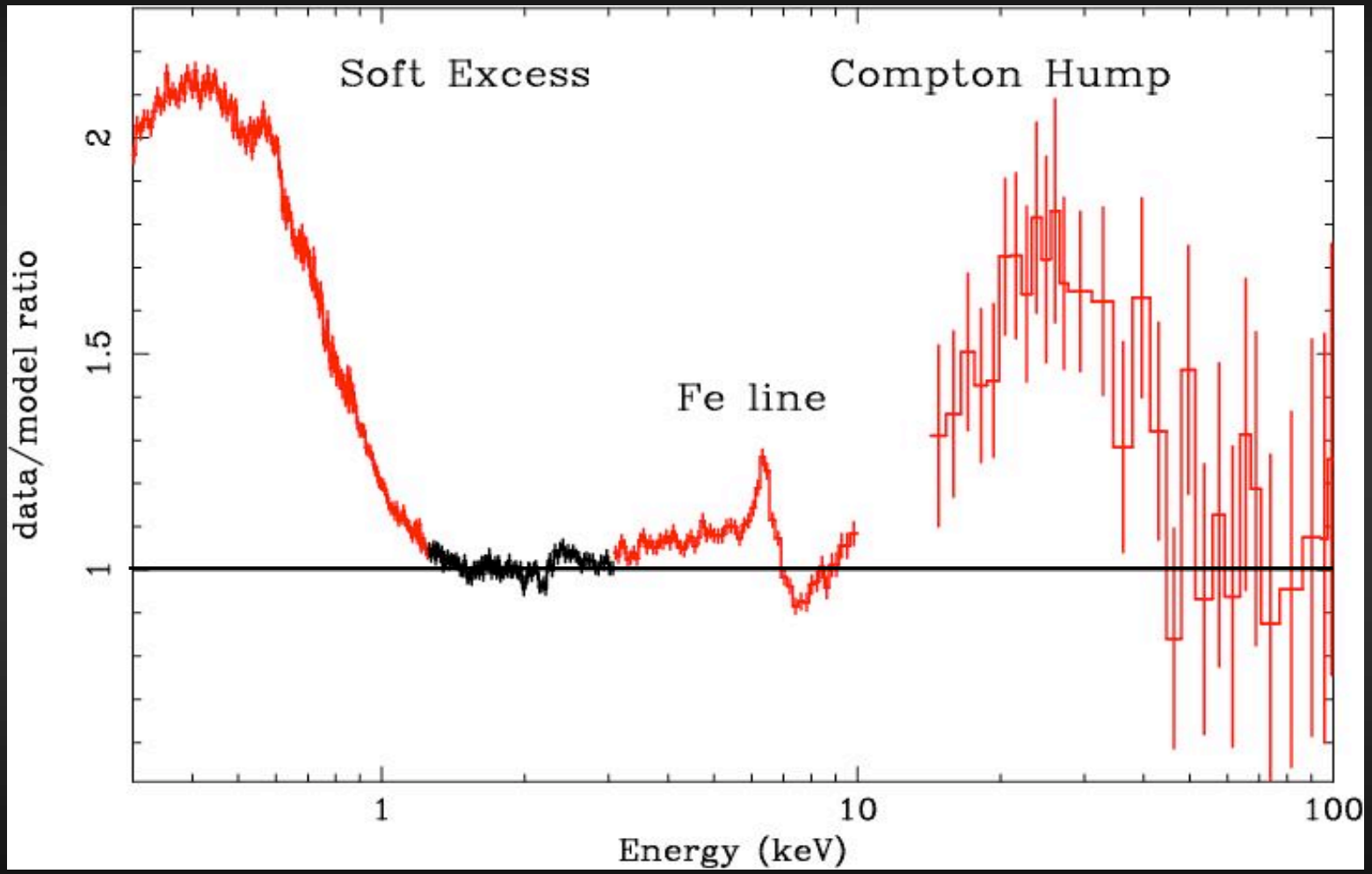
Fabian et al 02, Miniutti & Fabian 05

A case of study: MCG-6-30-15



Fabian et al 02, Miniutti & Fabian 05

A case of study: MCG-6-30-15



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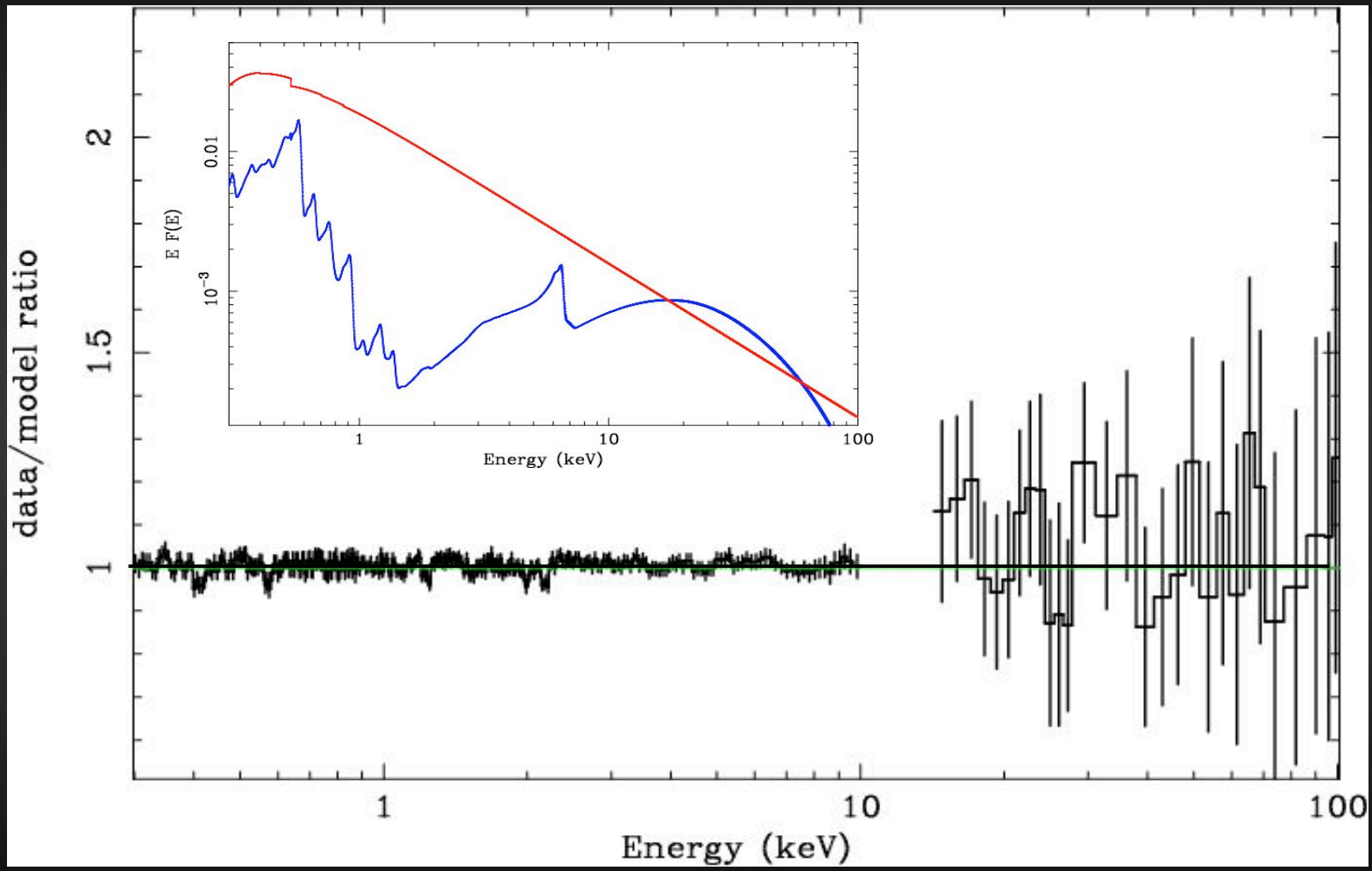
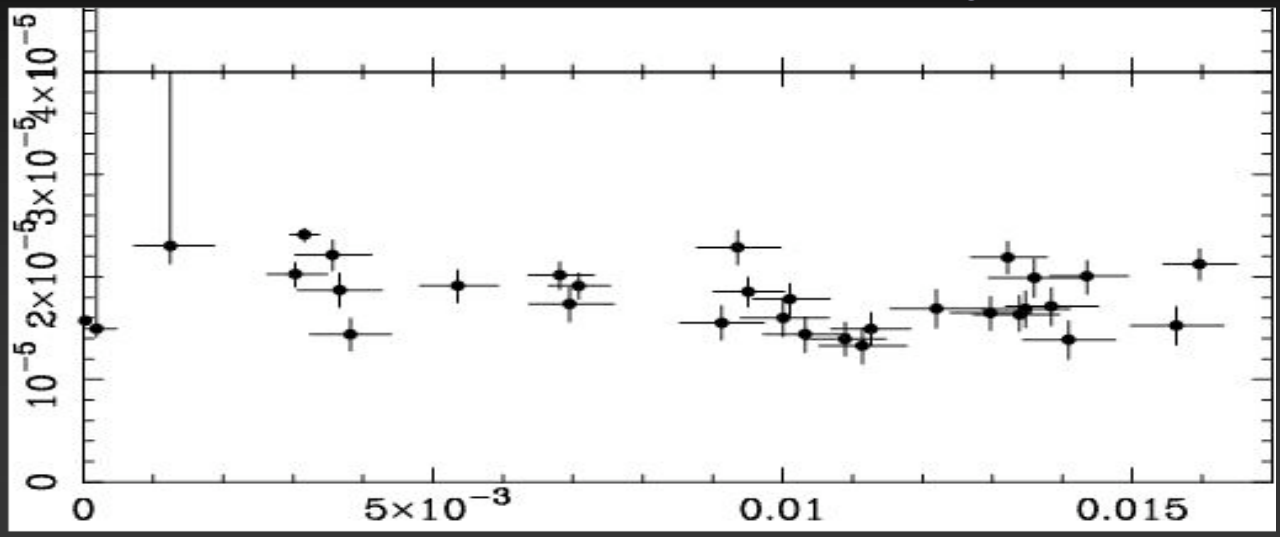


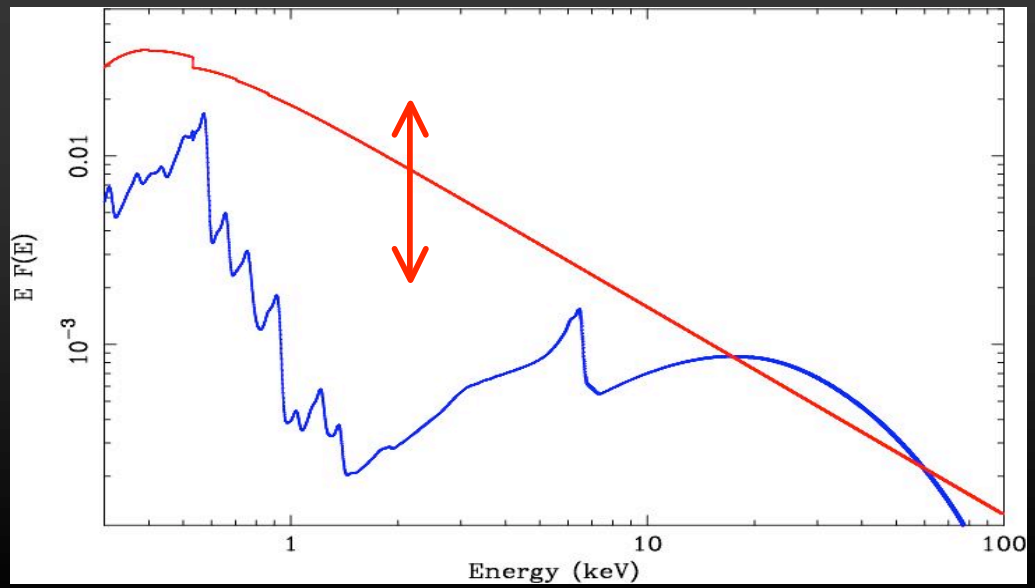
A puzzling variability

Fabian & Vaughan 03

RDC



PLC



highly variable PLC
almost constant RDC

The light bending model

we know that both the PLC and the RDC come from close to the BH

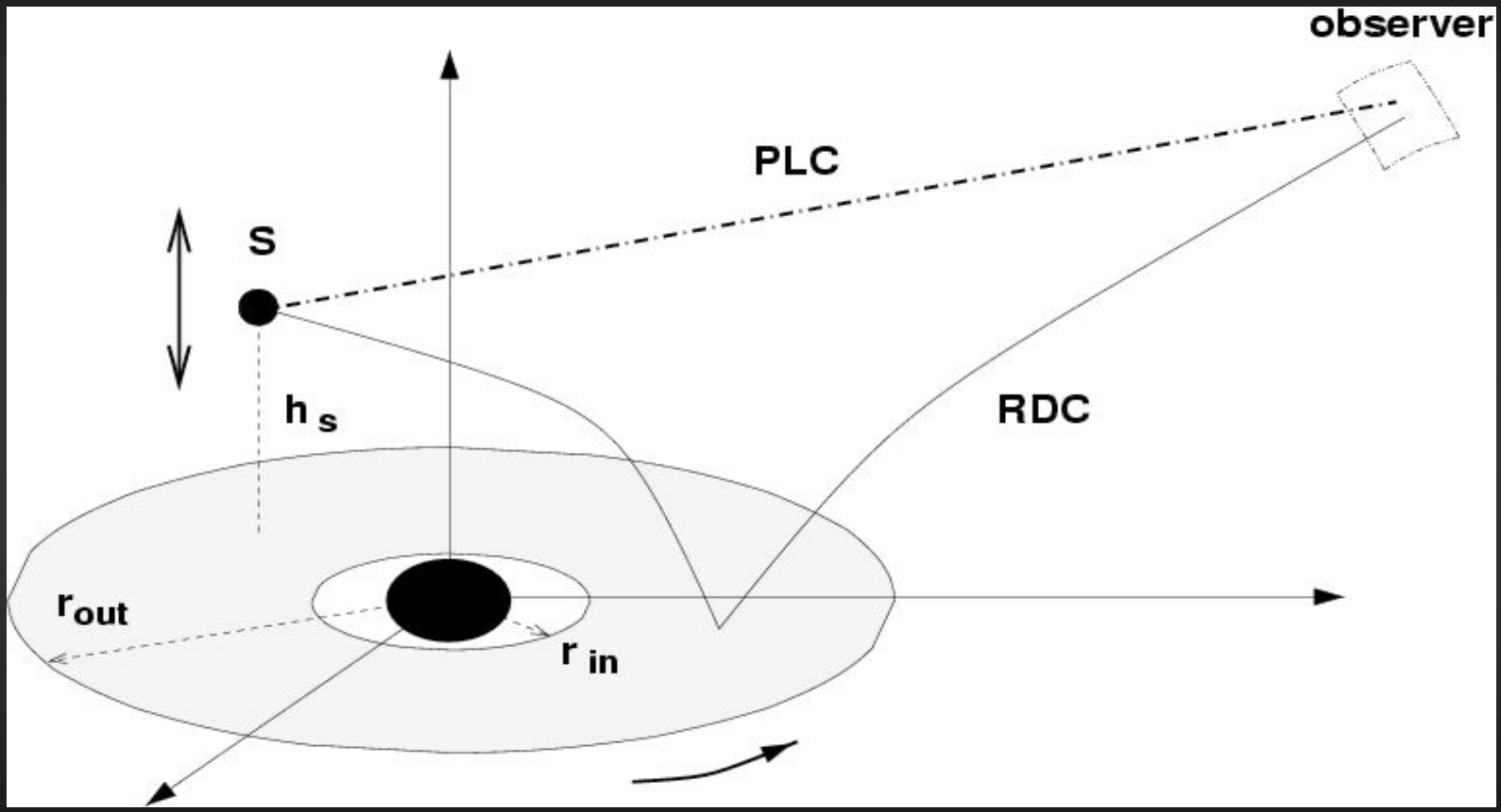
we know that the PLC source is compact

if the X-ray variability is due to intrinsic luminosity variation of the PLC we expect correlated variability (and we don't see it)

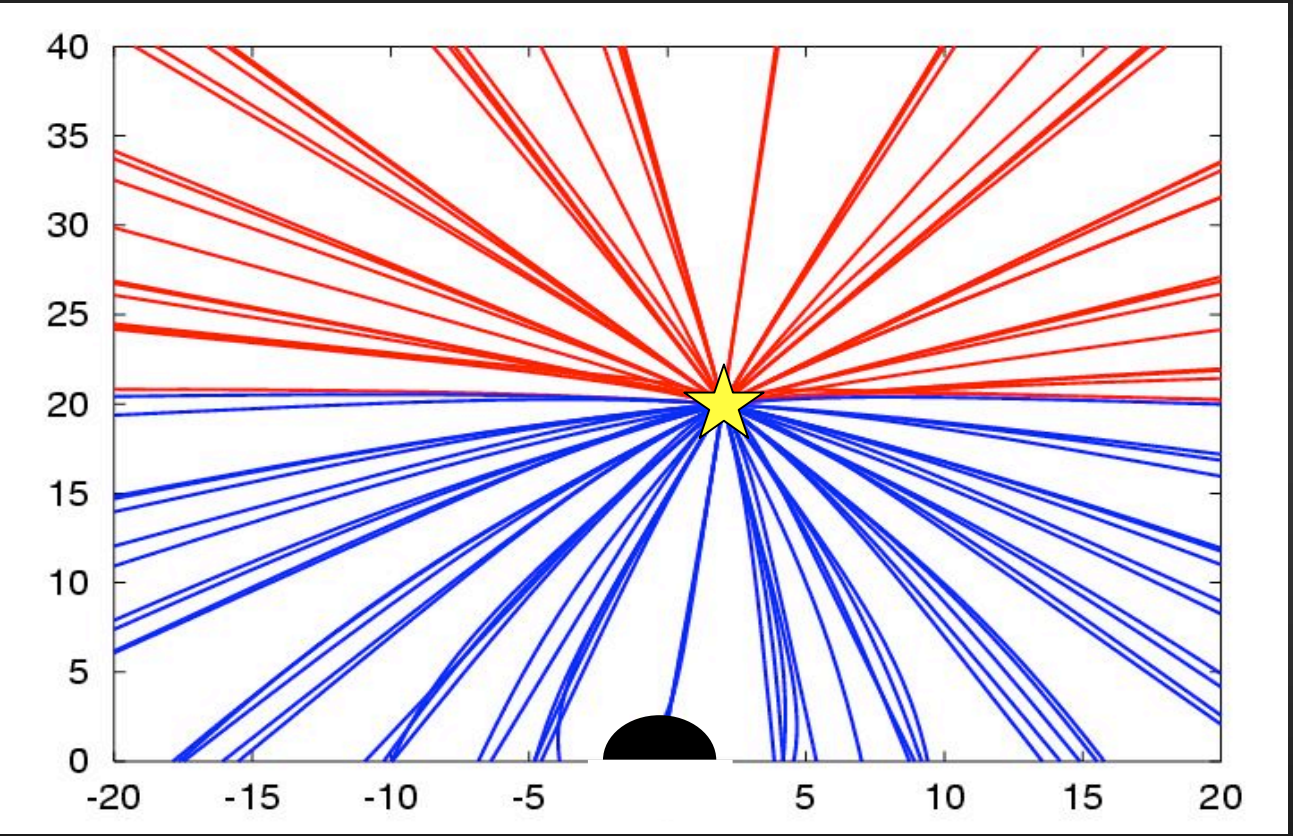
how can we disconnect RDC and PLC ?

relativitstic effects on the PLC as well?

The light bending model



The light bending model



Miniutti et al 03; Miniutti & Fabian 04

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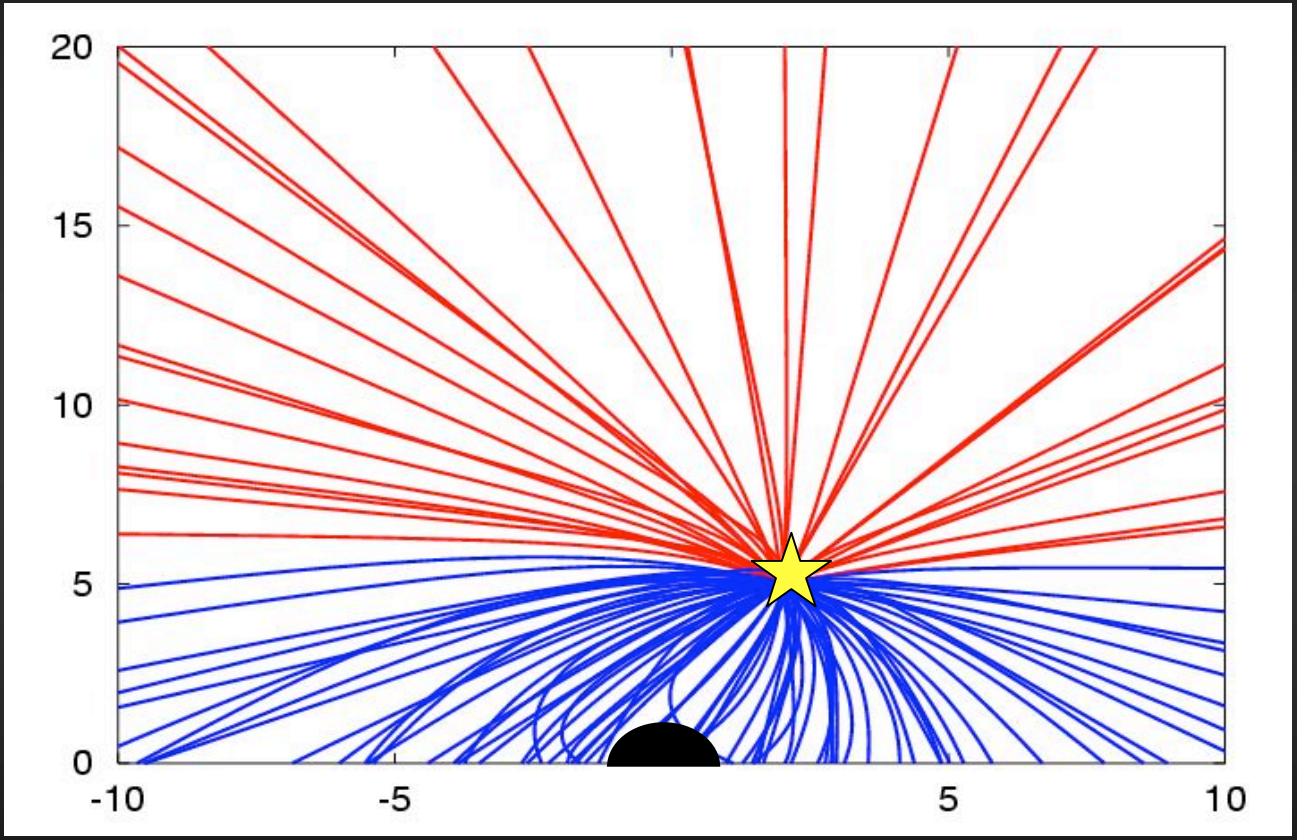

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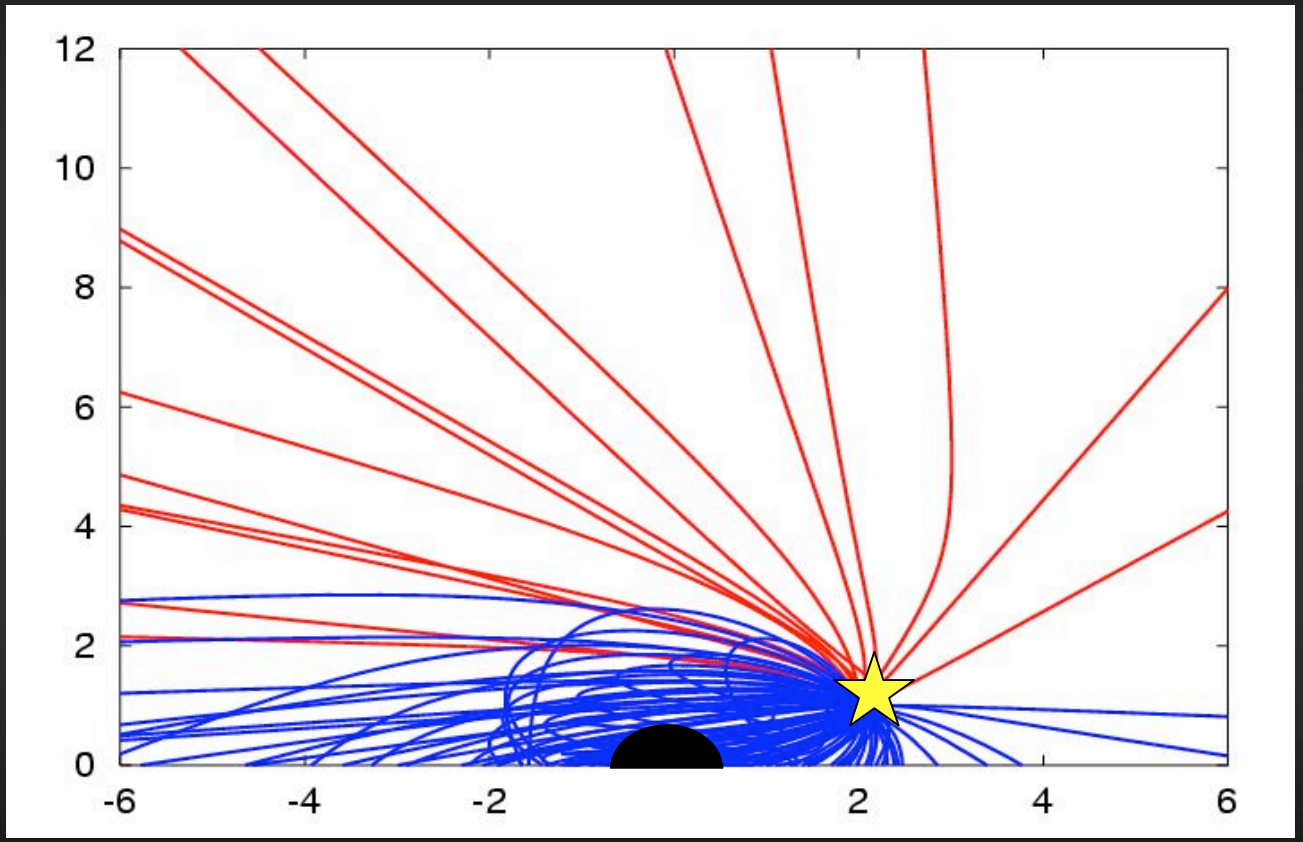

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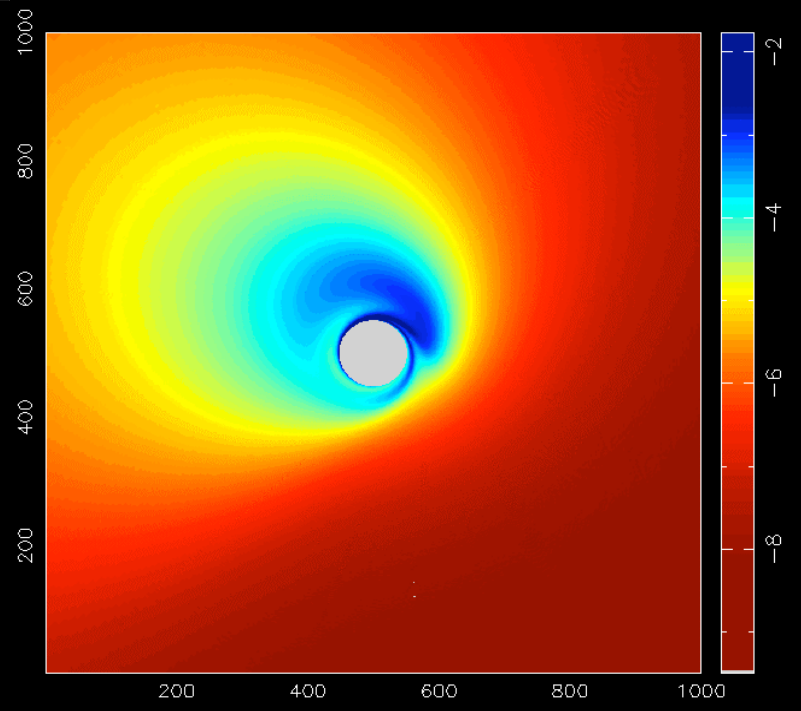
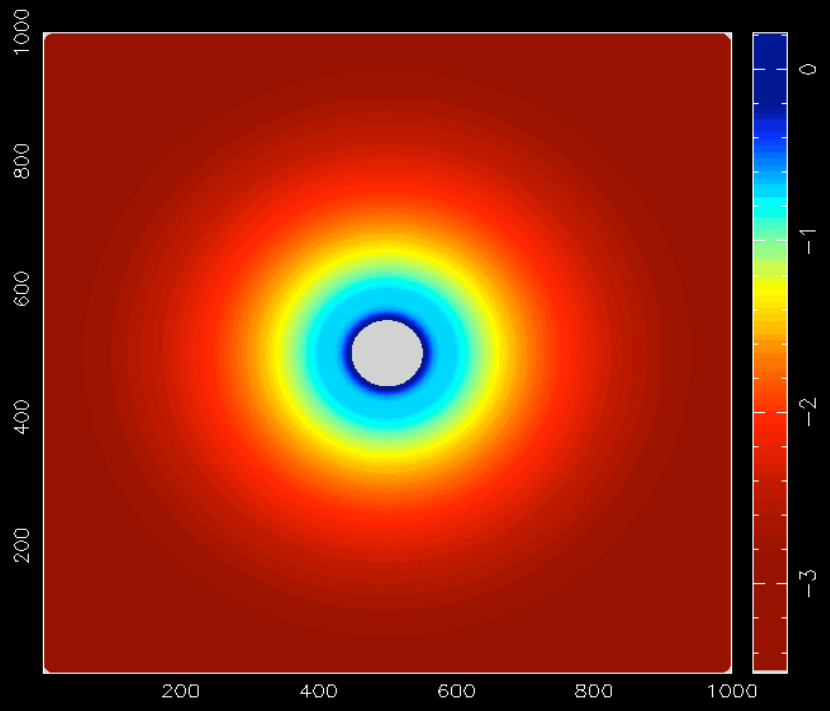


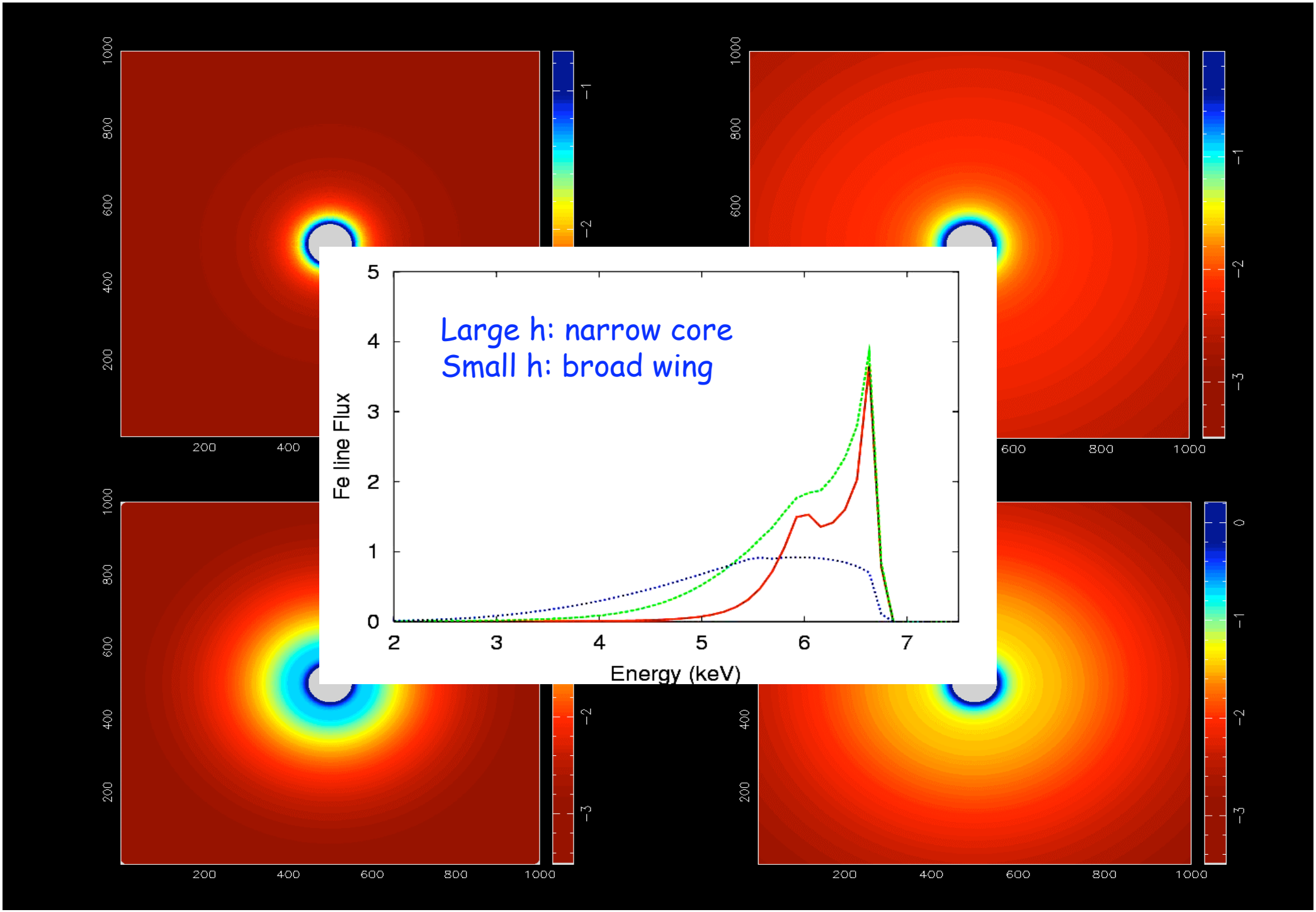


non-averaged (point-like)

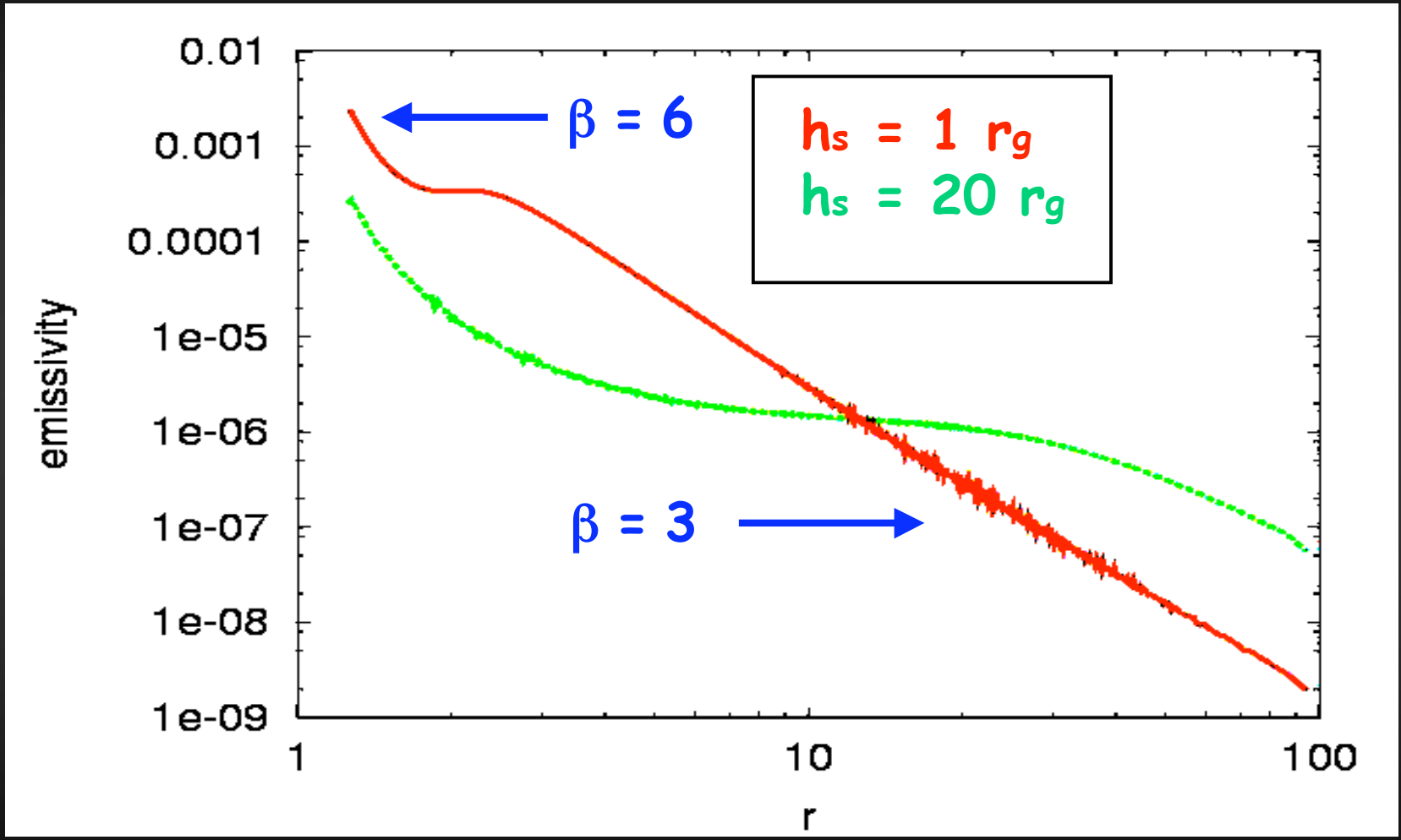
future X-ray missions

averaged (ring-like)

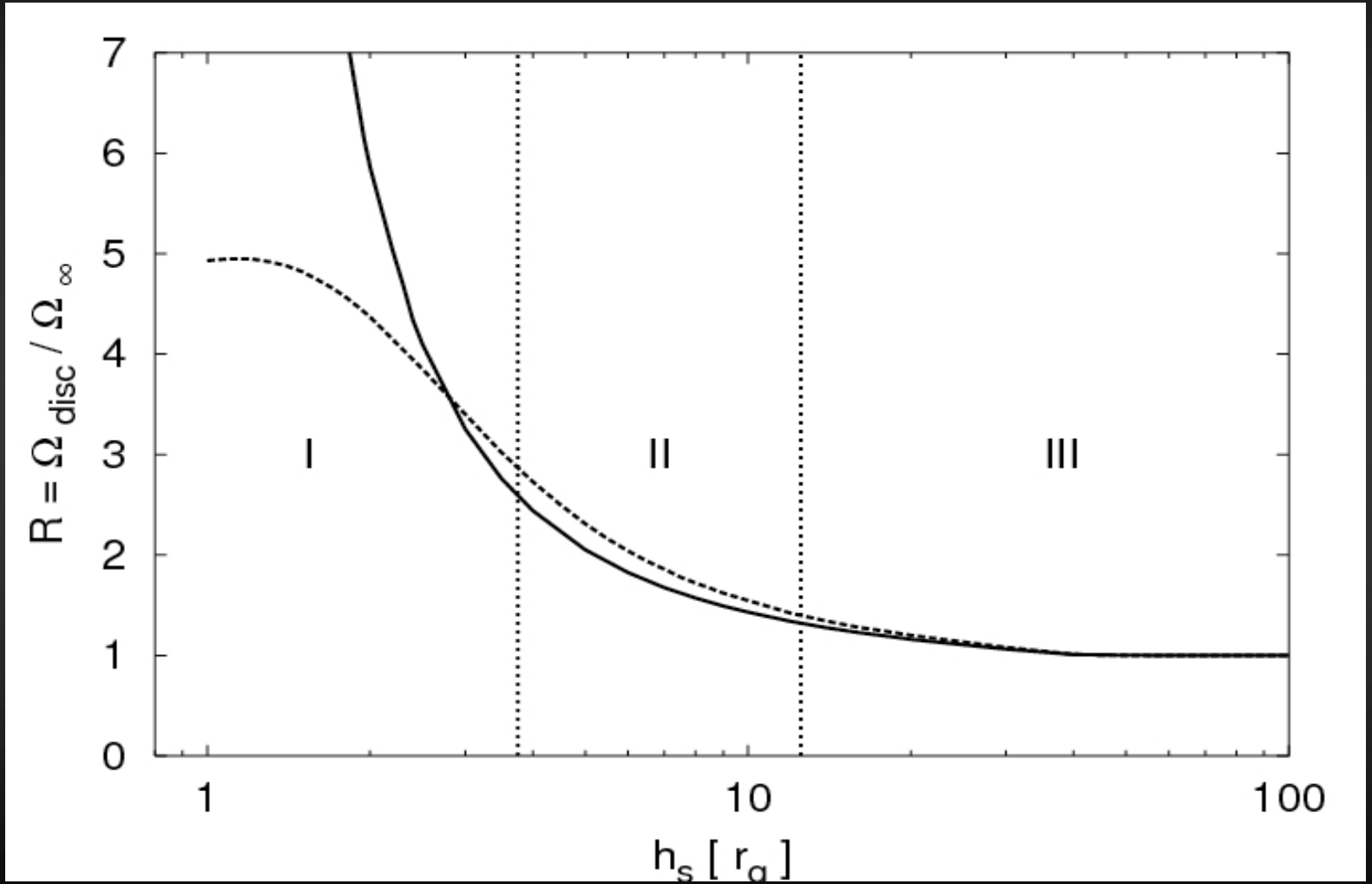
present X-ray missions


Large h: narrow core
Small h: broad wing
Fe line Flux
Energy (keV)
0
1
2
3
4
5
2
3
4
5
6
7

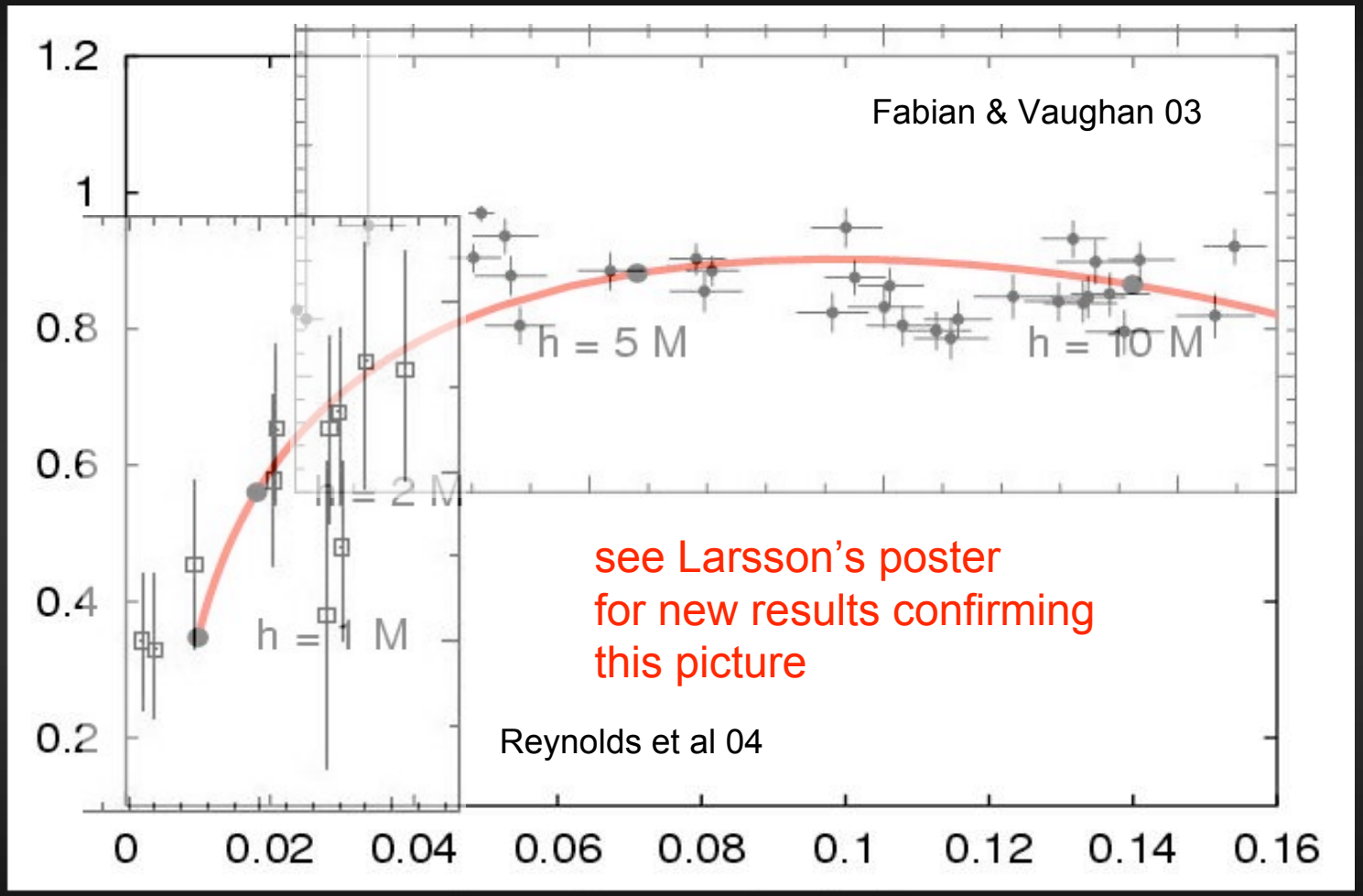
The light bending model



The light bending model

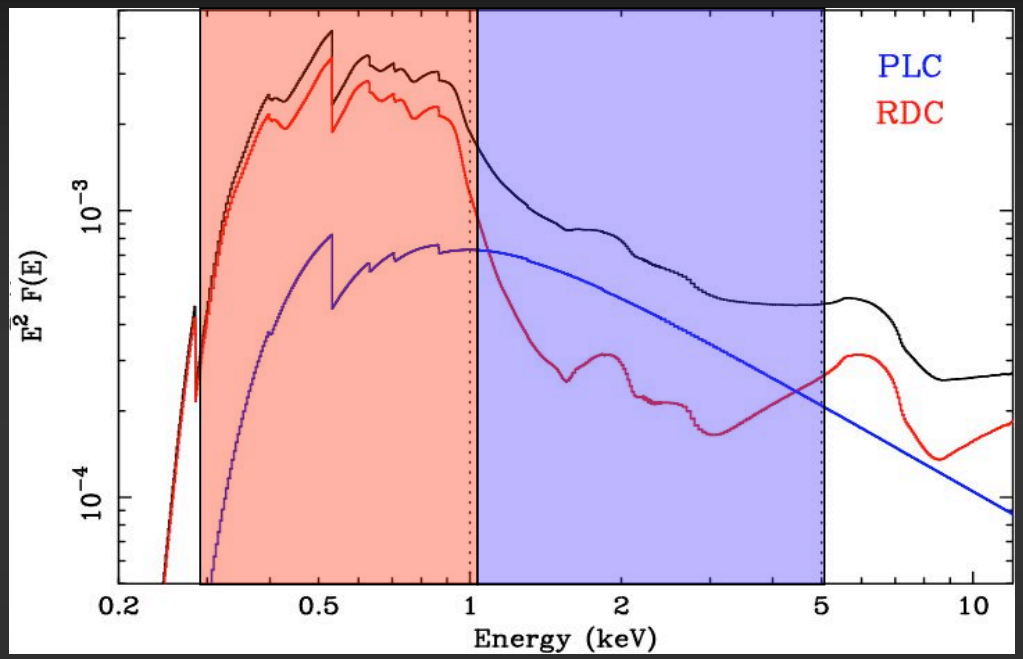


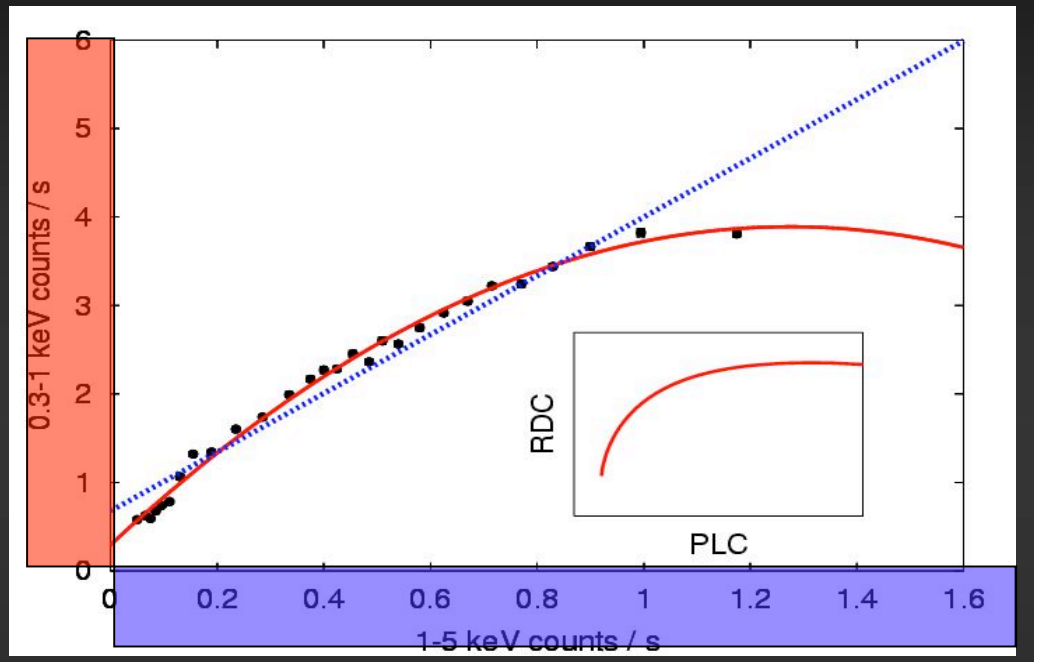
The light bending model



Miniutti & Fabian 04

Other AGNs (1H0707, 1H0419, NGC 4051, NGC 3516 …)



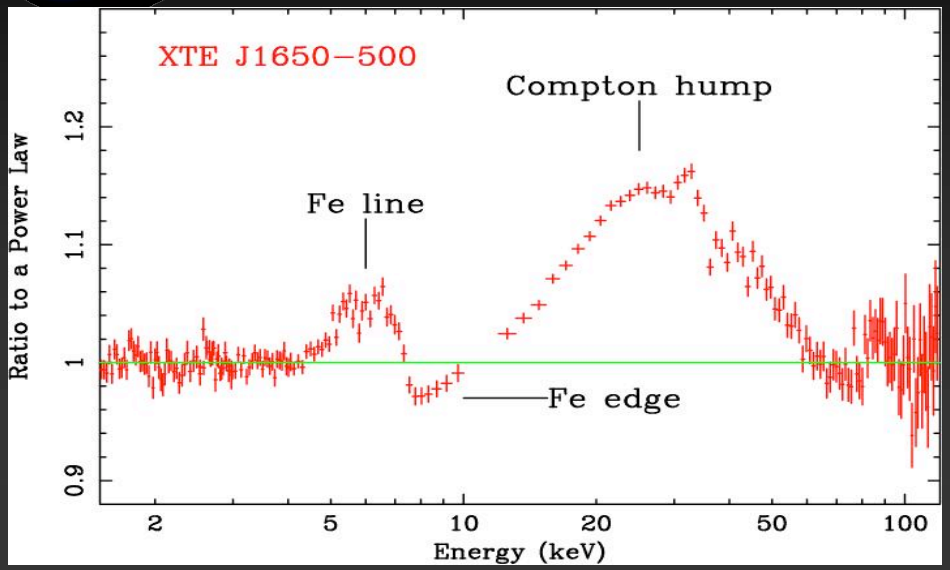


Fabian et al 05

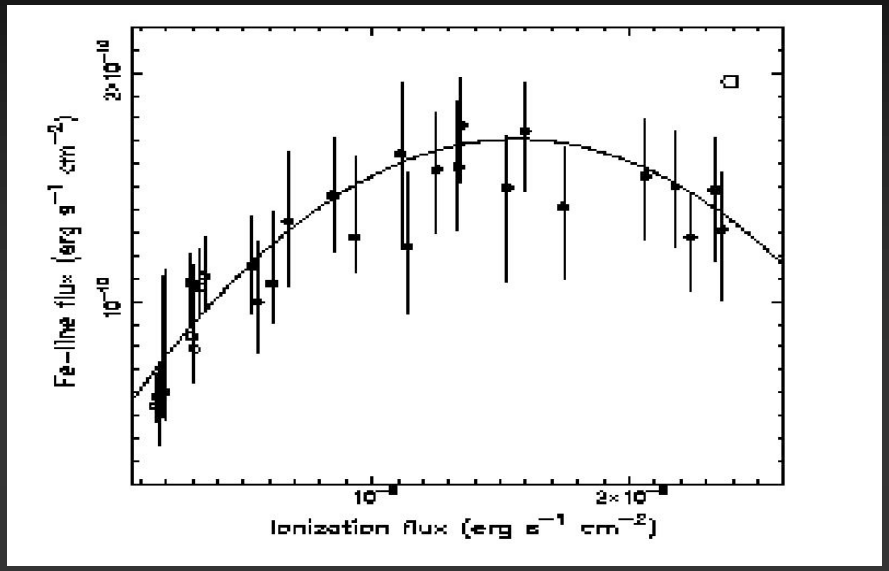
1H 0707- 495

Boller et al 02, Fabian et al 02, Gallo et al 05

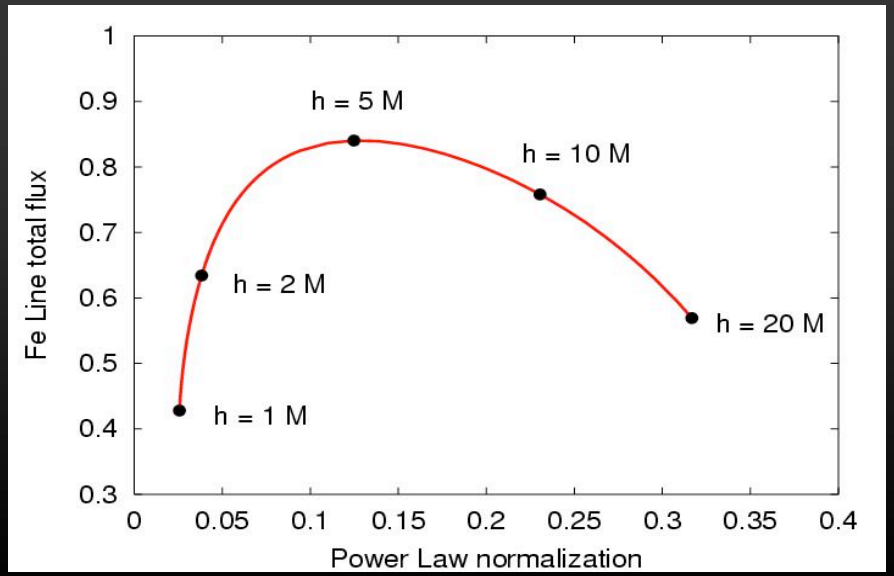
Other AGNs … and even BH binaries (IS or VHS)



Miniutti, Fabian & Miller 04



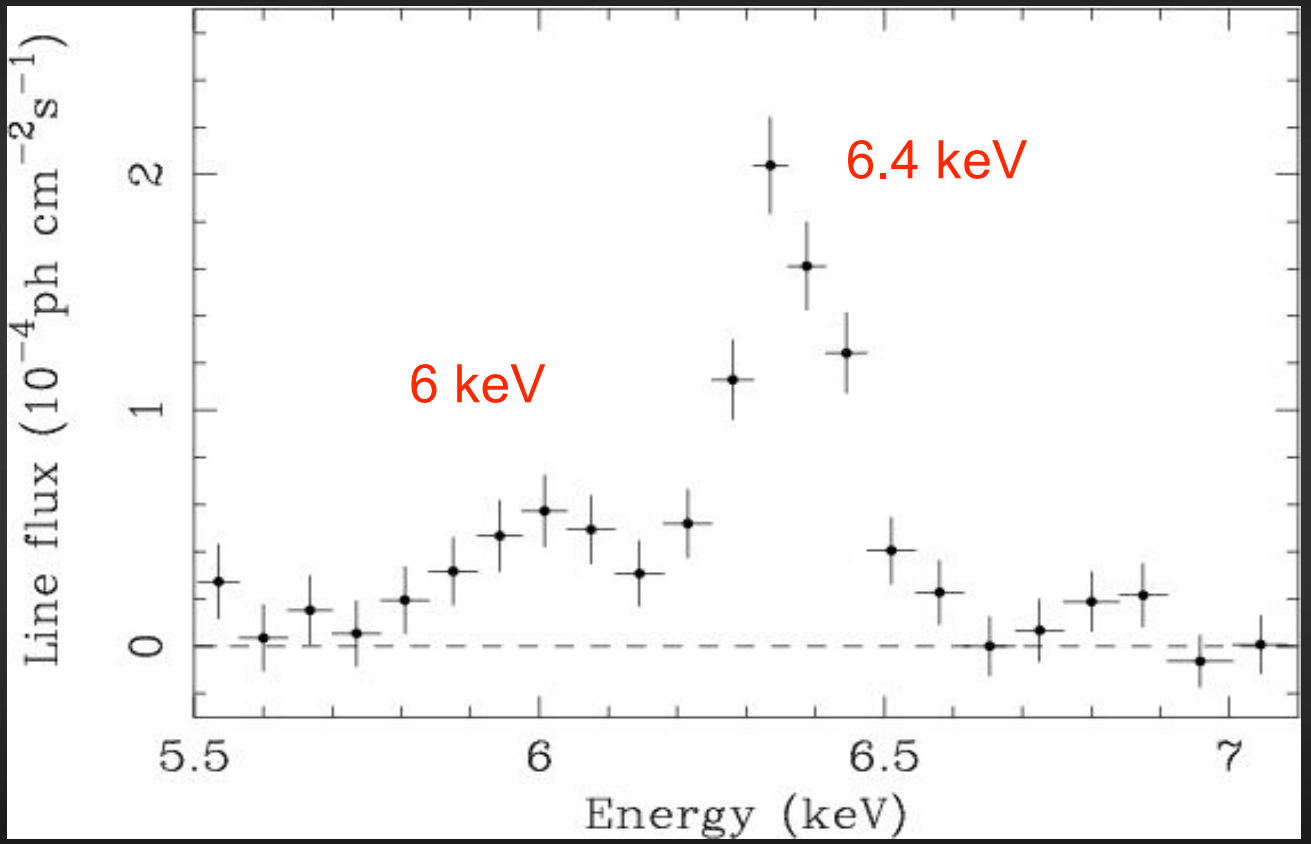
Rossi et al 05



Miniutti & Fabian 04

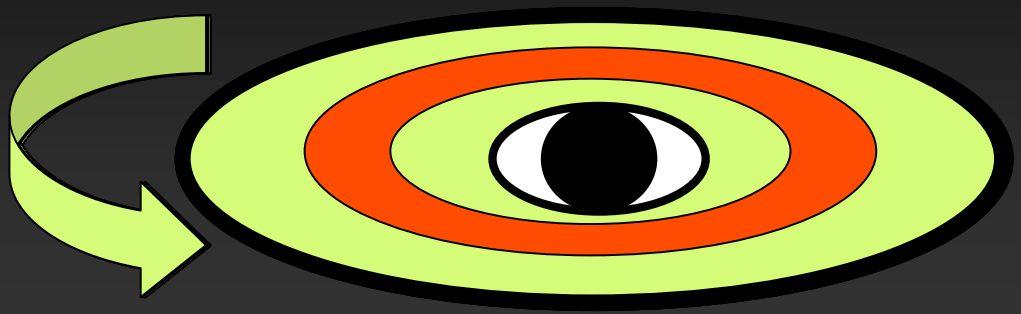
Dreams come true: Fe K line reverberation

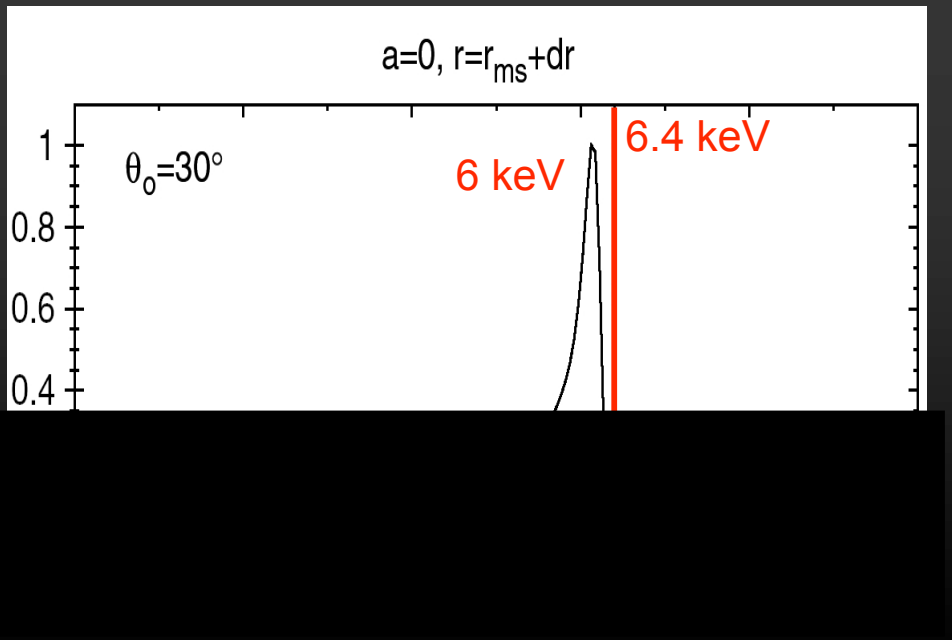
shifted Fe K: Turner et al 02, 04; Yaqoob et al 04; Porquet et al 04; Guainazzi 04; Dovciak et al 04 …

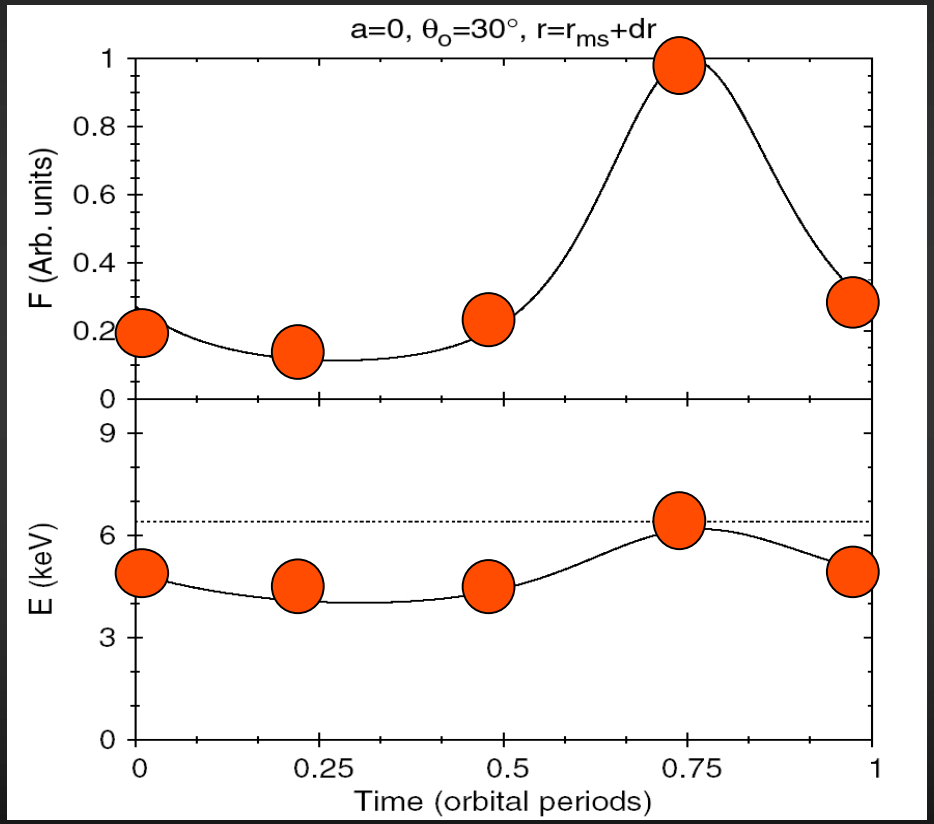


NGC 3516: Iwasawa, Miniutti & Fabian 04

Dreams come true: Fe K line reverberation

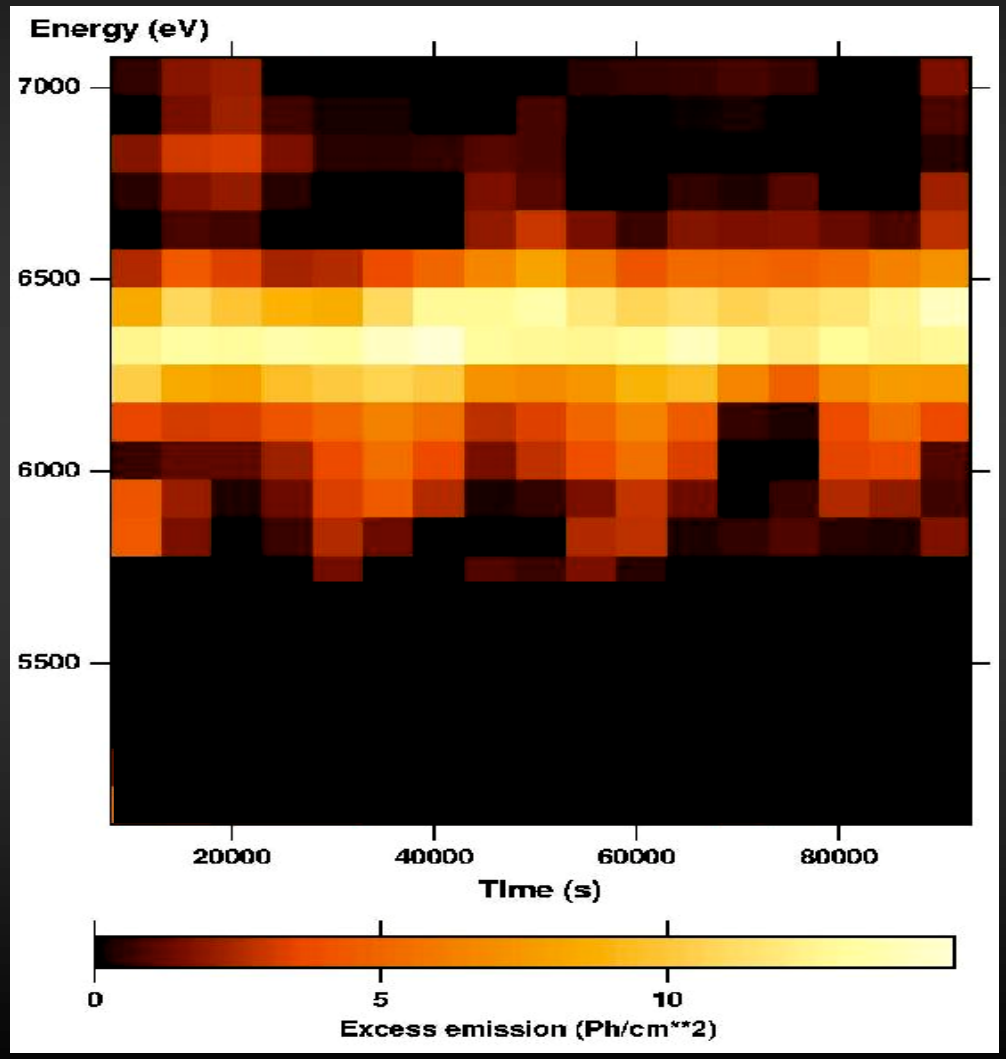


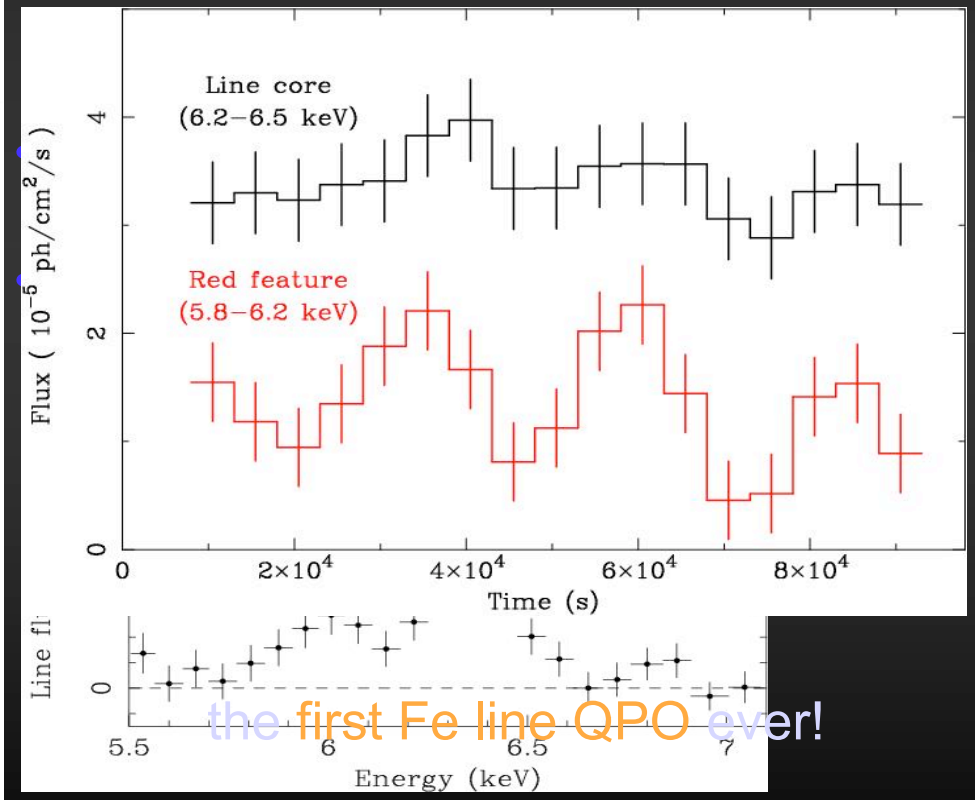




Dovciak et al 04

Dreams come true: Fe K line reverberation

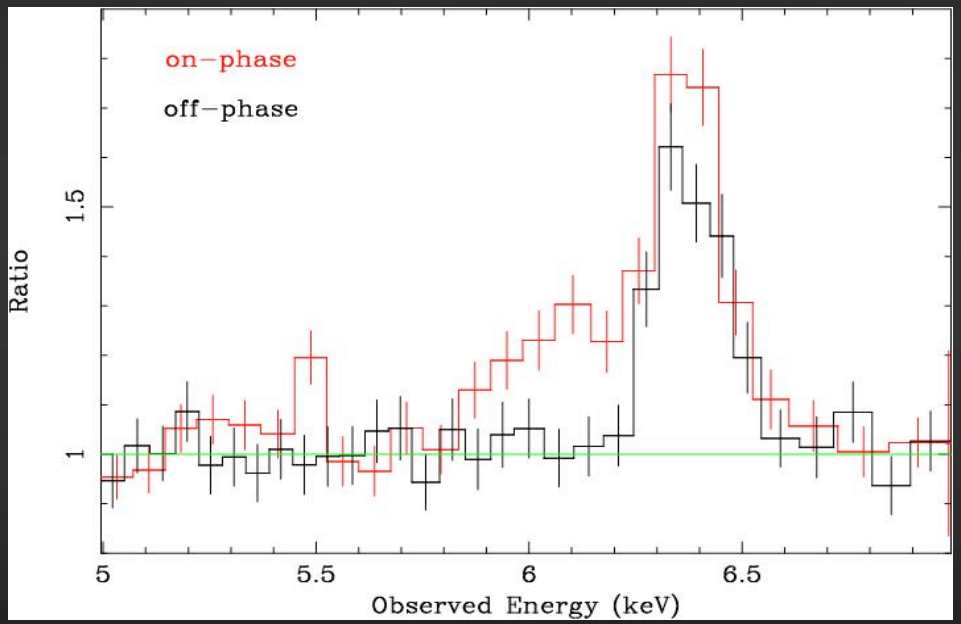


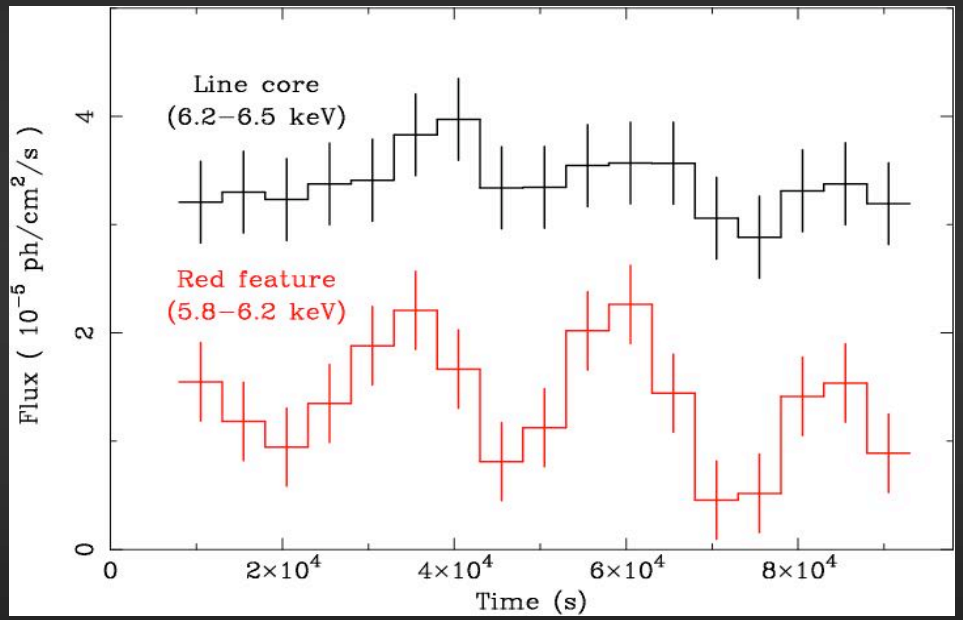


the first Fe line QPO ever!

Iwasawa, Miniutti & Fabian 04

Dreams come true: Fe K line reverberation

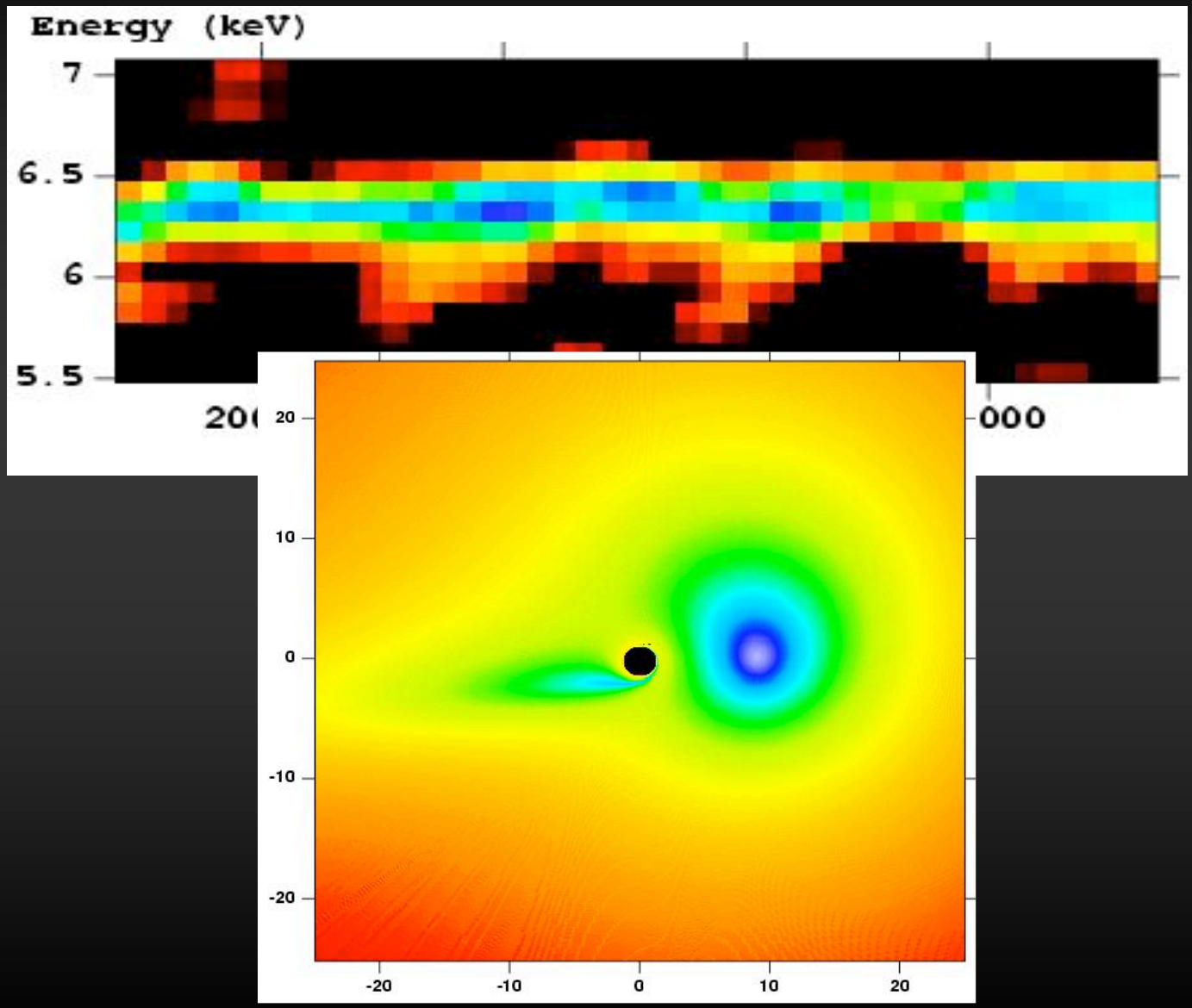




we have flux modulation: what about energy?

Dreams come true: Fe K line reverberation

DATA



Dreams come true: Fe K line reverberation

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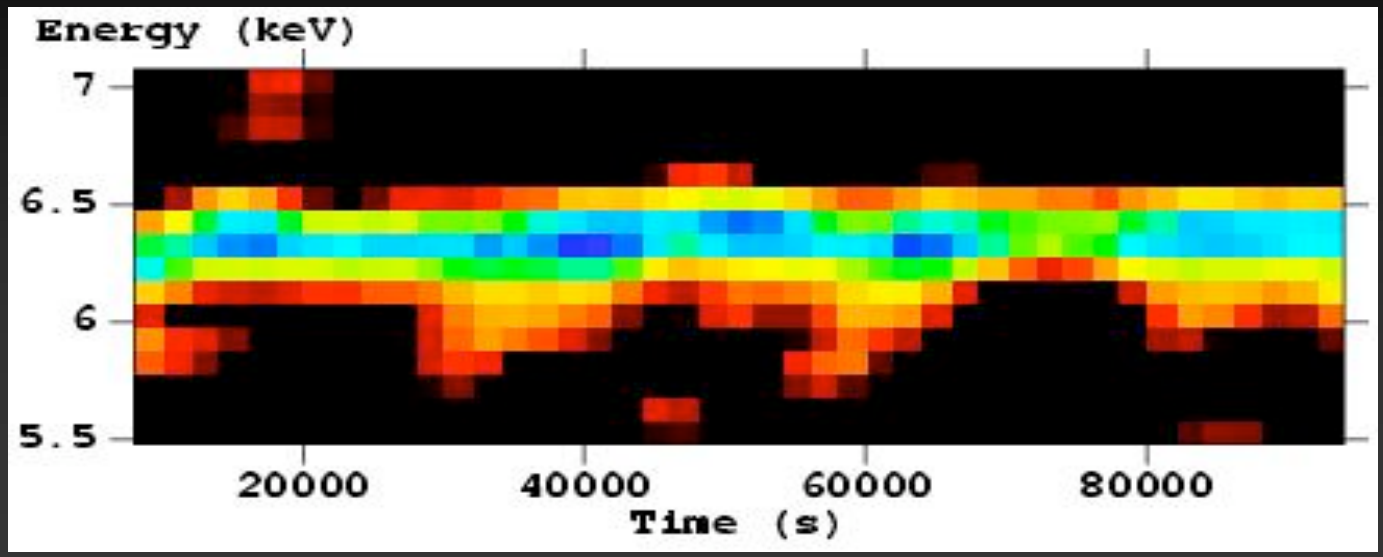
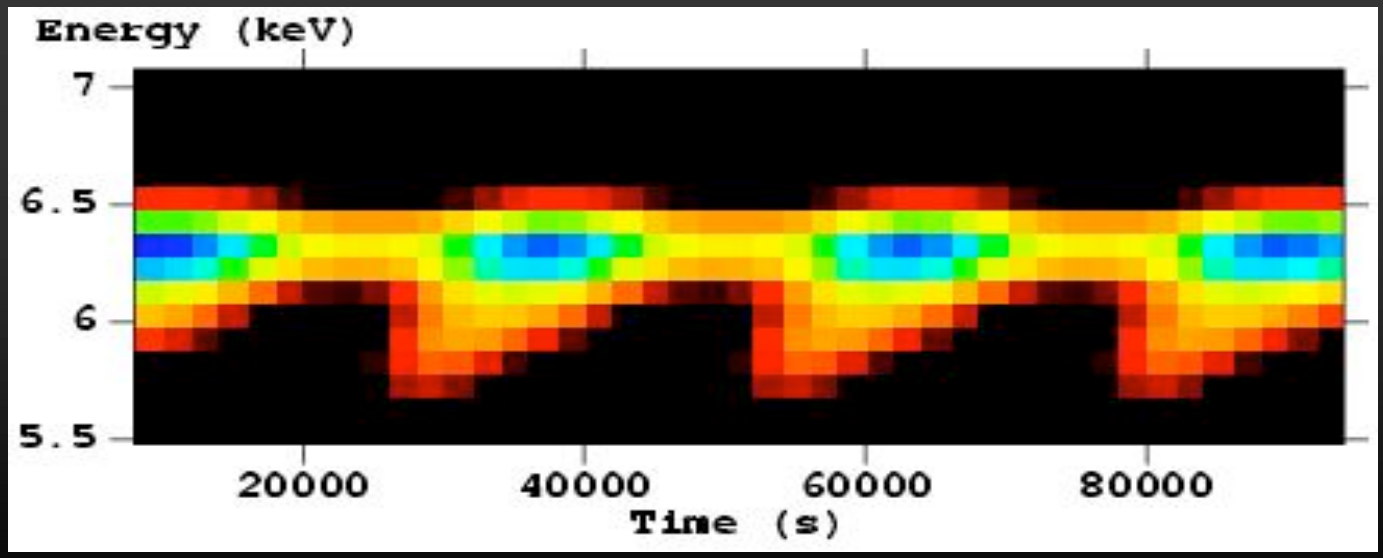


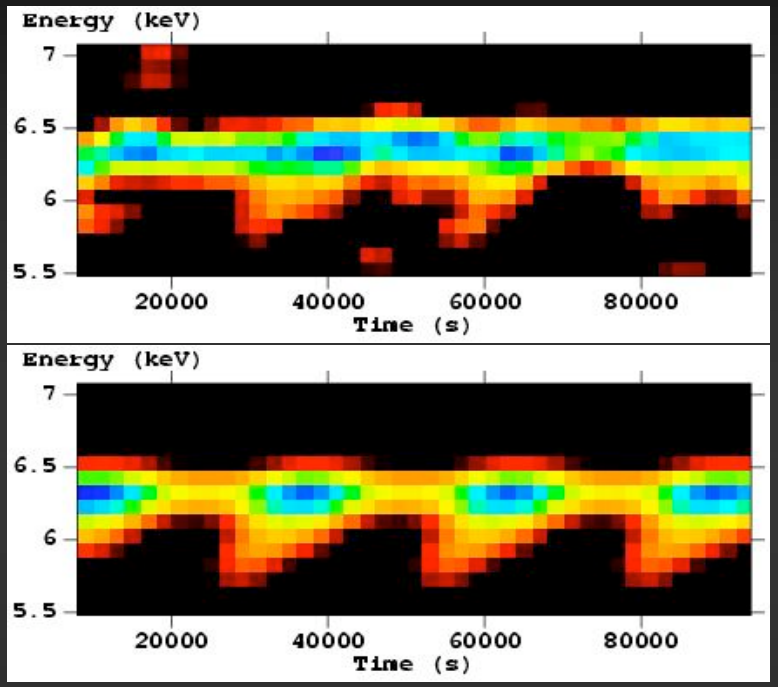
MODEL



Dreams come true: Fe K line reverberation

DATA

MODEL



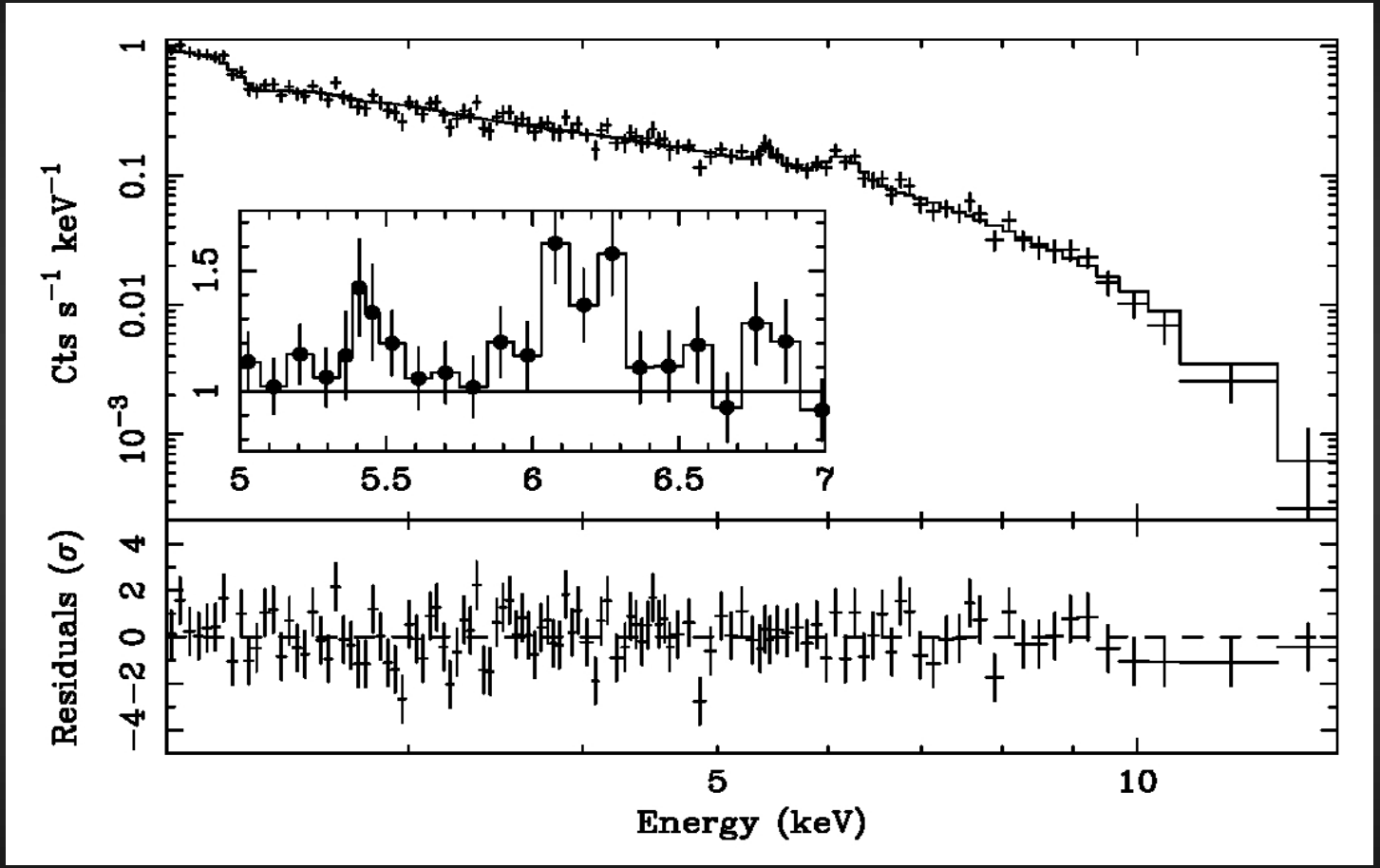
we produced a large number of theoretical maps by varying the spot radius, disc inclination …

we find good agreement for R between 7 and 16 R_g

since $T = 310 (a + R^{3/2}) M_7 M_\odot$ [seconds]
by combining our estimate on R with the orbital period (T=25 ks)

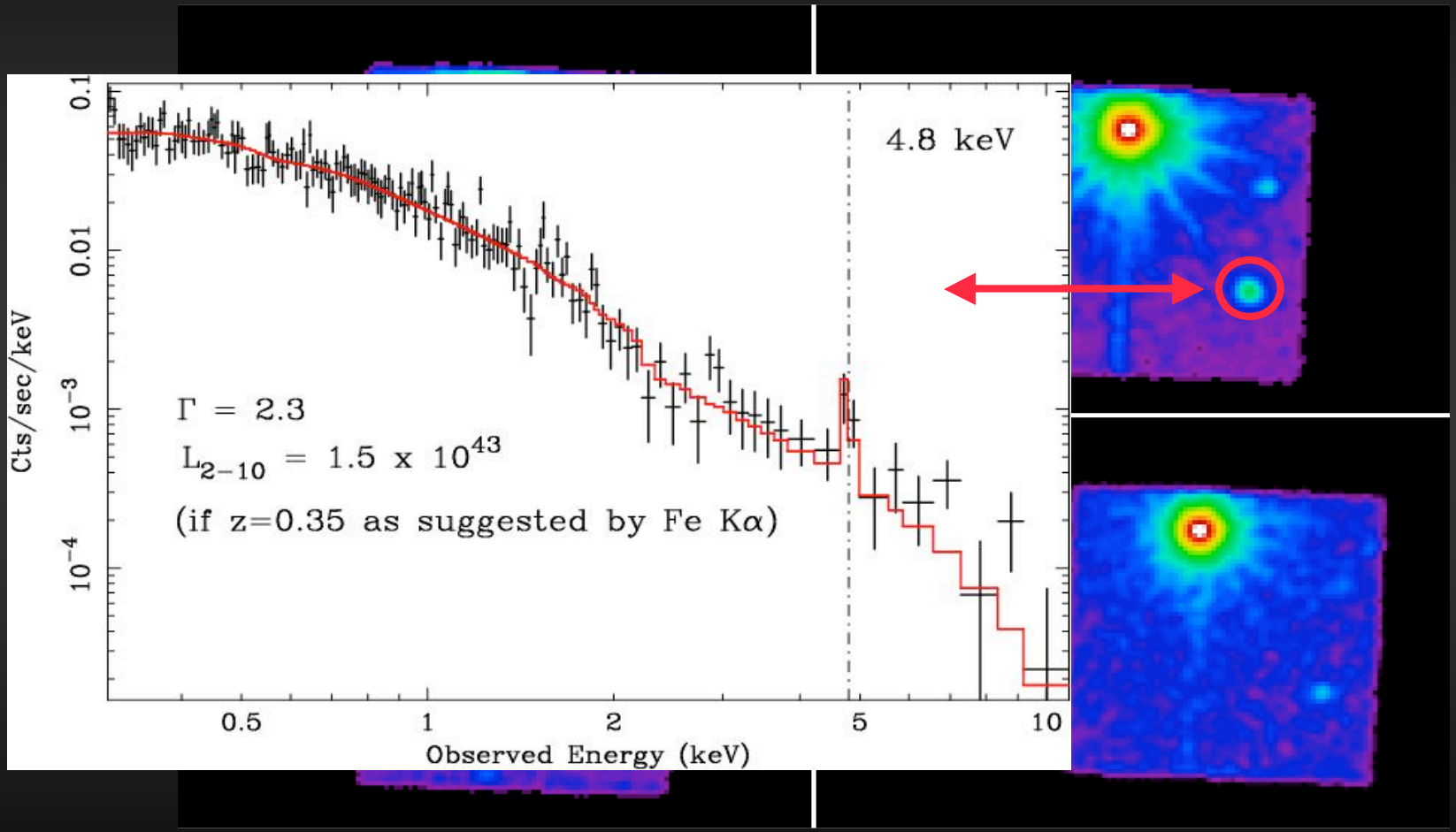
we can estimate $M_{BH} = (1\text{-}5) \times 10^7 M_\odot$ (Onken et al 03)

Looking for confirmations: ESO 198-G24



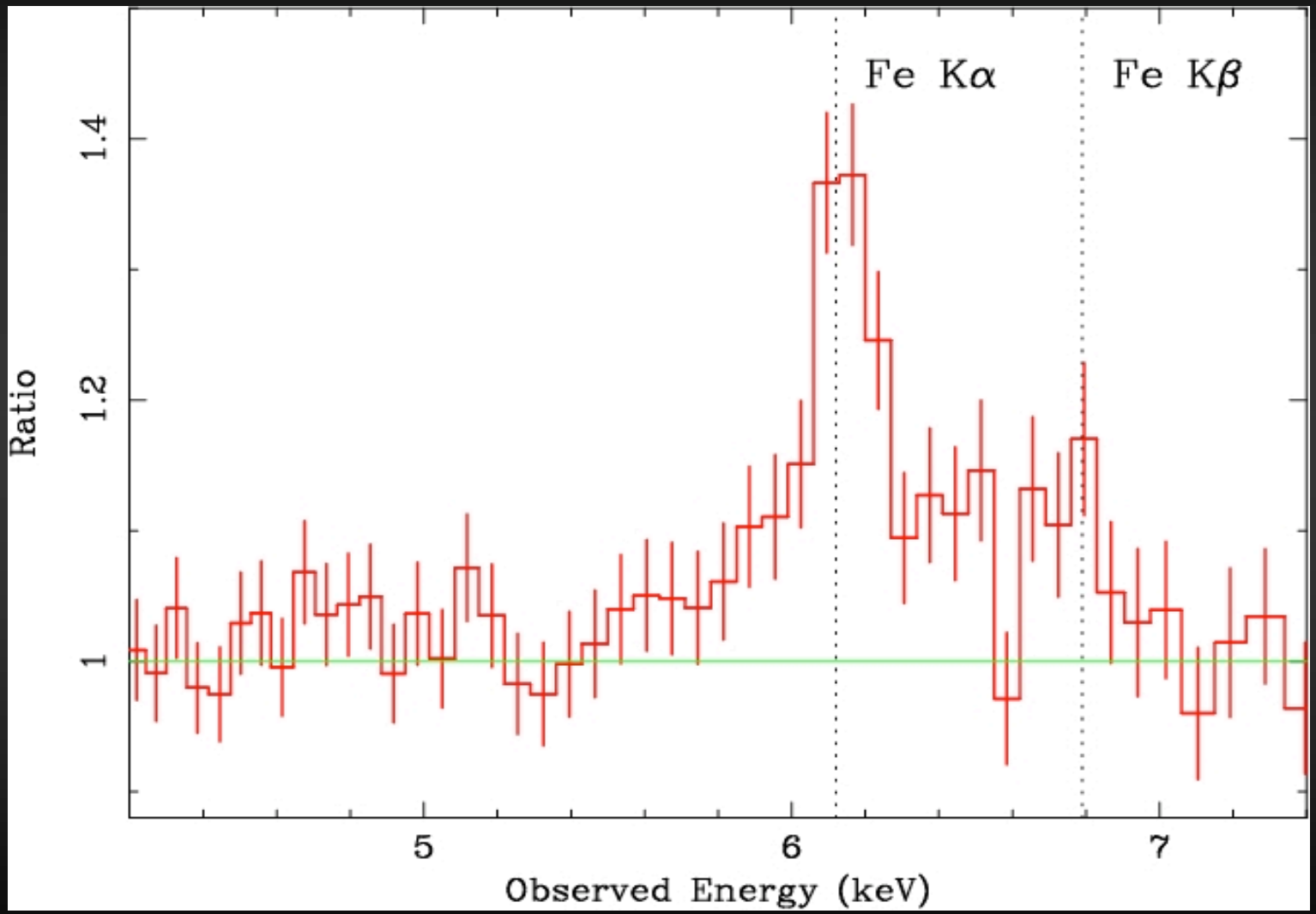
Guainazzi 04

Looking for confirmations: ESO 198-G24



Miniutti et al in prep

Looking for confirmations: ESO 198-G24



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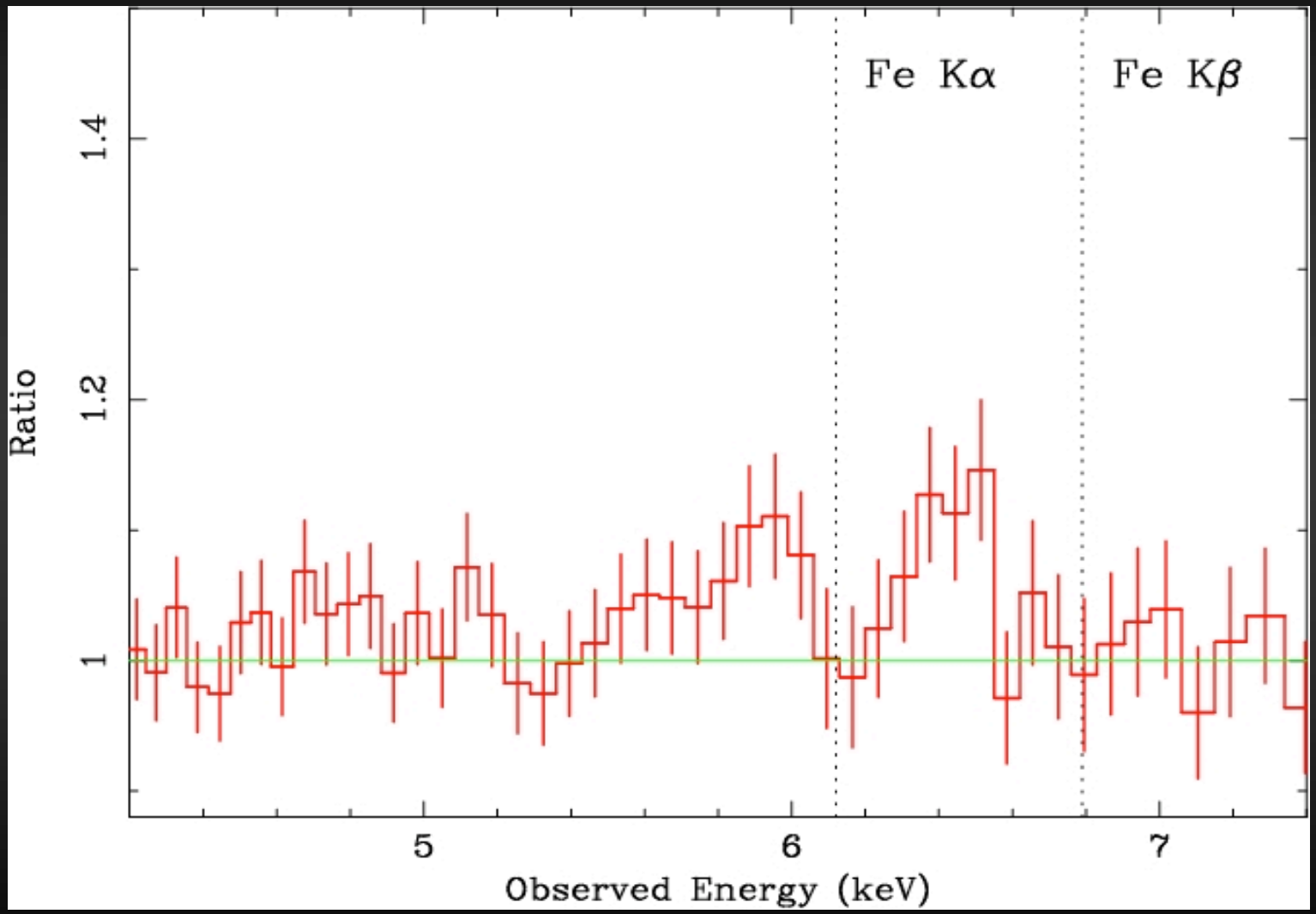

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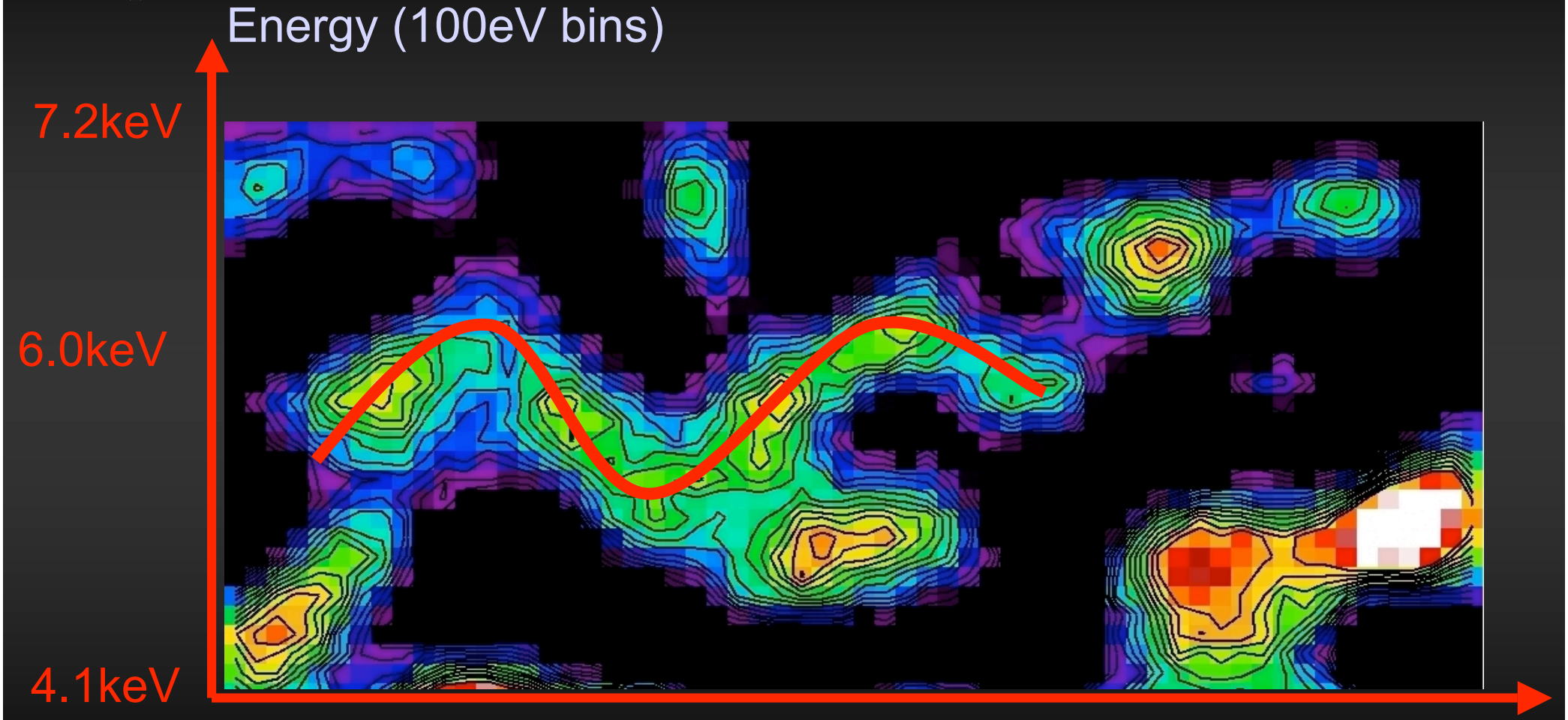
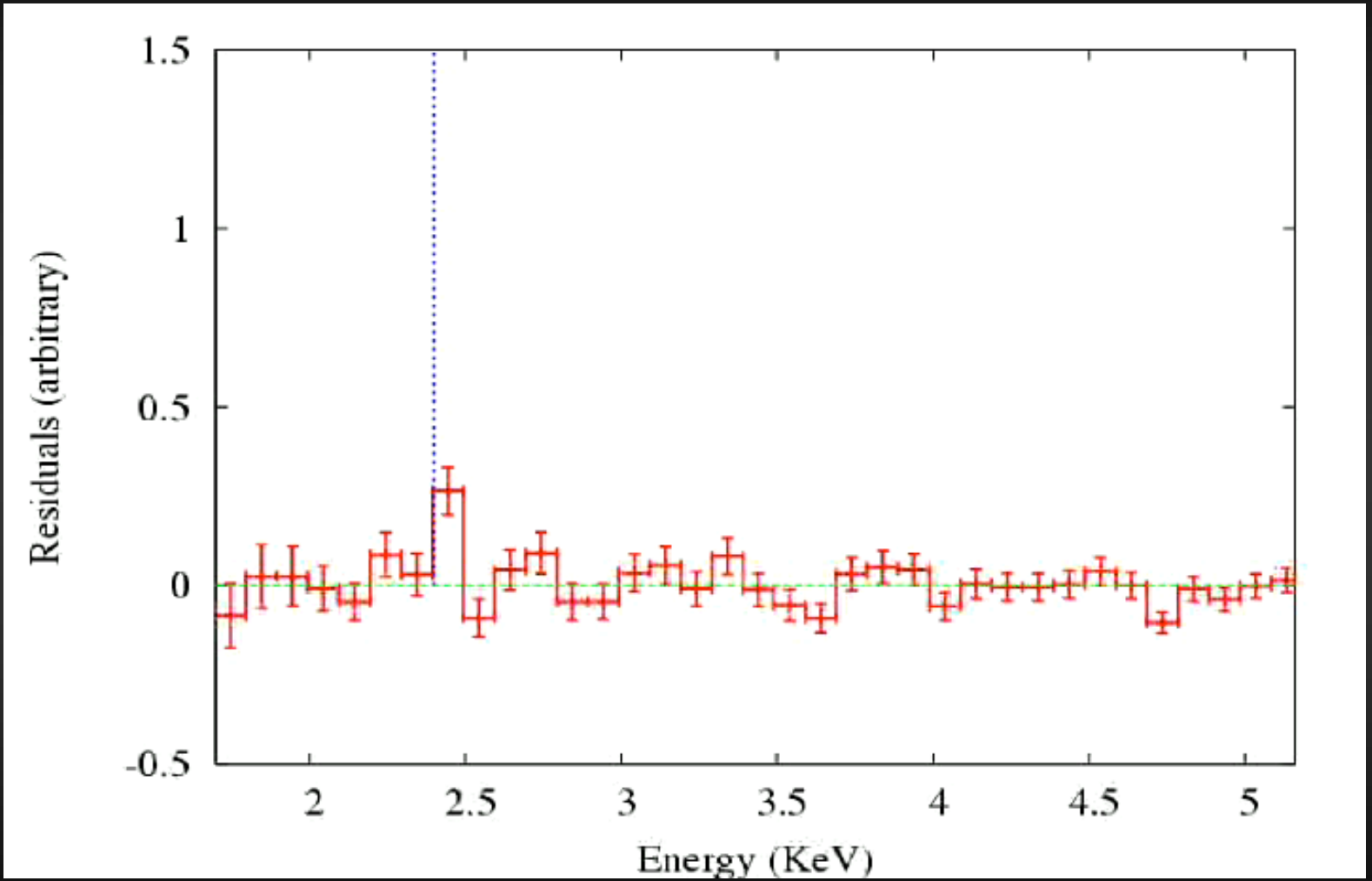


Future perspectives



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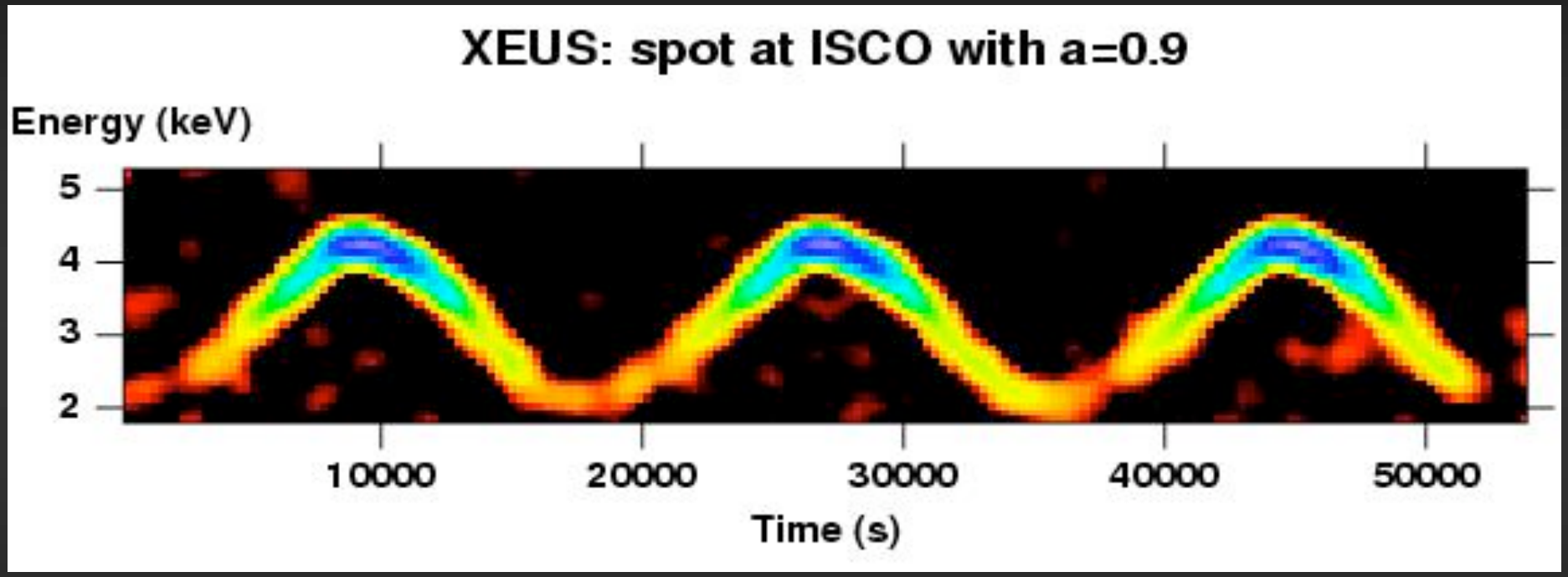

Request: we need 2 m^2 @ 6 keV !!!

Thanks !!