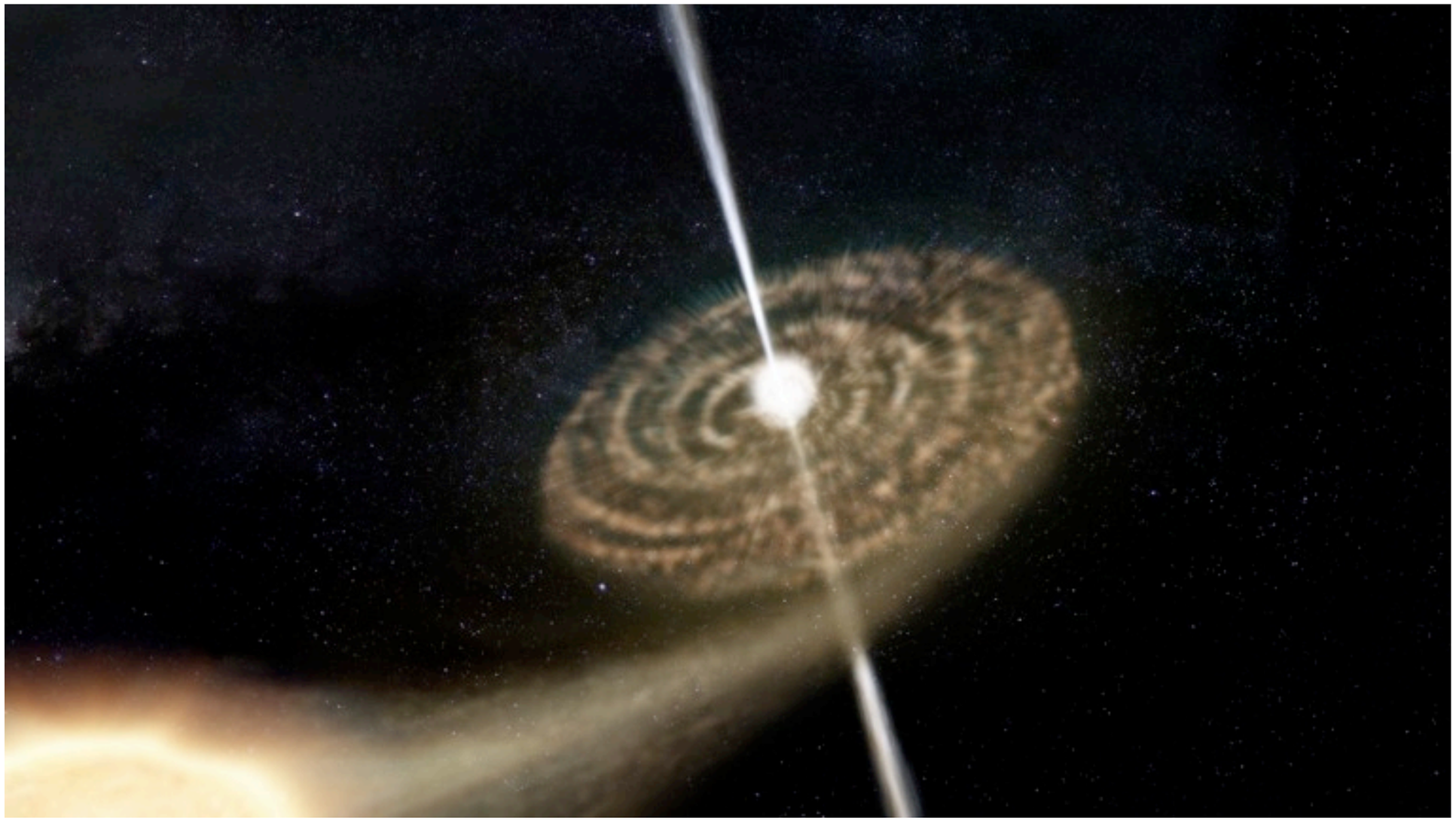
Reflection in Carbon-Oxygen Dominated Accretion Discs of Ultra-compact X-ray Binaries



Oliwia Madej

SRON, Radboud Universiteit Nijmegen

Peter Jonker, Randy Ross, Andy Fabian

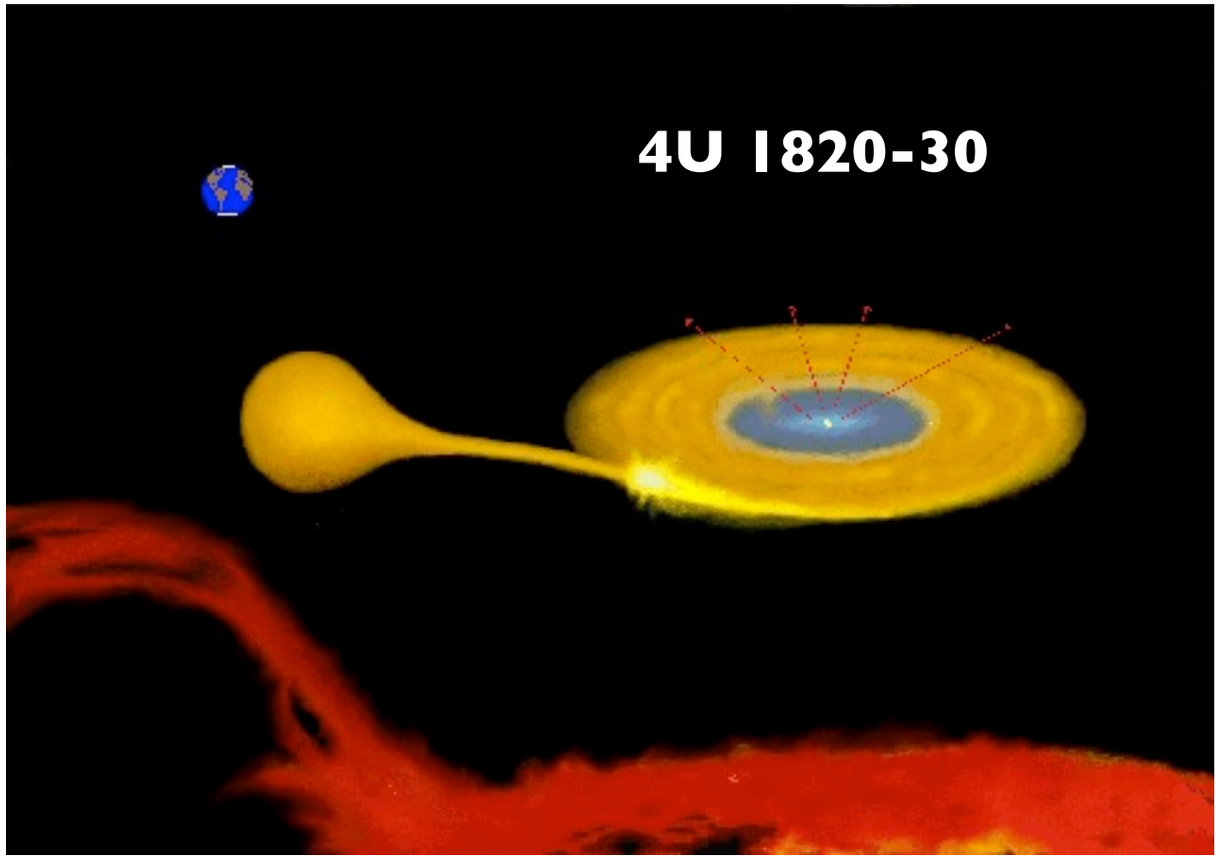
Boston, 11.07.2012

Ultra-compact X-ray binaries (UCXBs)

- subclass of Low-mass X-ray binaries
- BH/NS+He/CO WD
- orbital period < 80 min

  (4U1820-30, *P* ~11 min)
- ~10 known + 20 candidates

in't Zand et al. (2007)



Heasarc, Dany P. Page

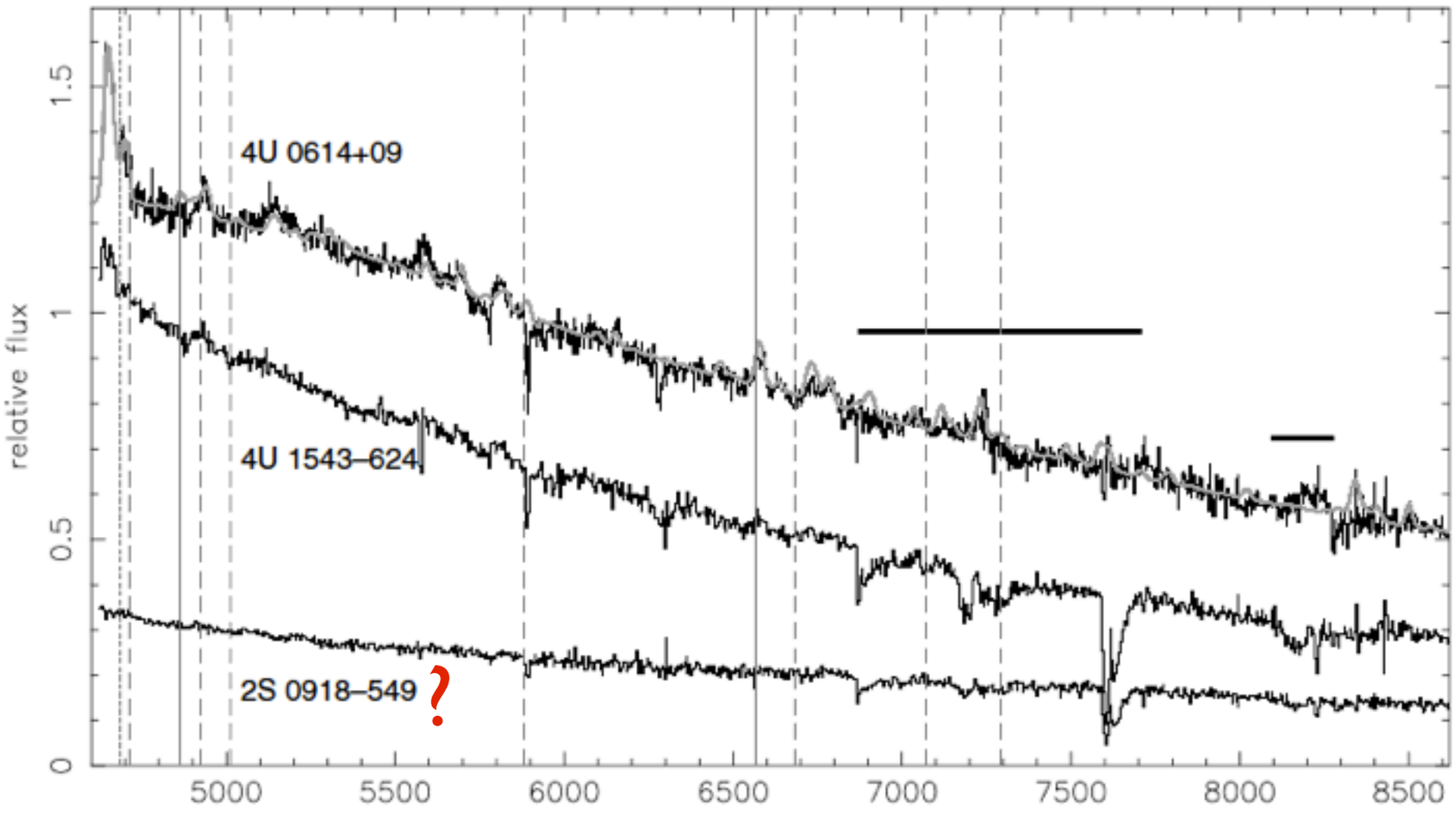
UCXBs with CO WD donor star

- candidate UCXBs: 4U 0614+091 (51.3 min) & 4U 1543-624 (18.2 min)

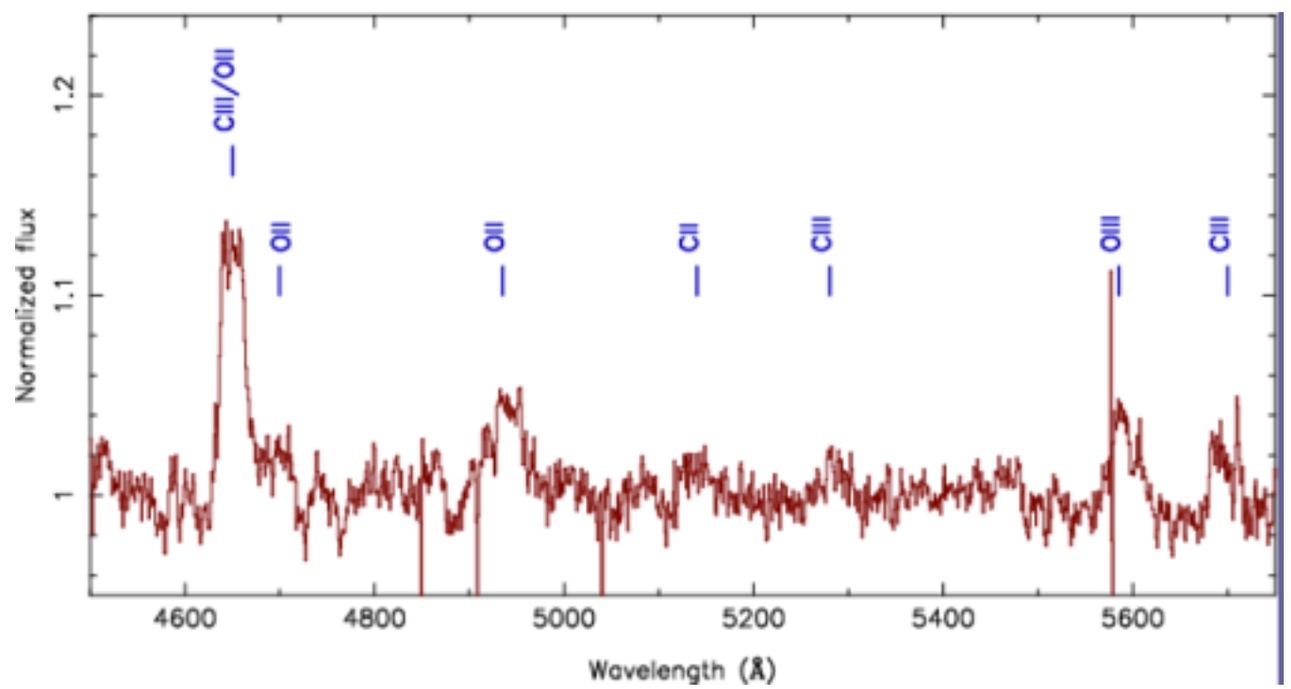
  Shahbaz et al. (2008) *Wang & Chakrabarty (2004)*
- H and He deficient, C and O emission lines in the optical spectra

Nelemans et al. (2004)

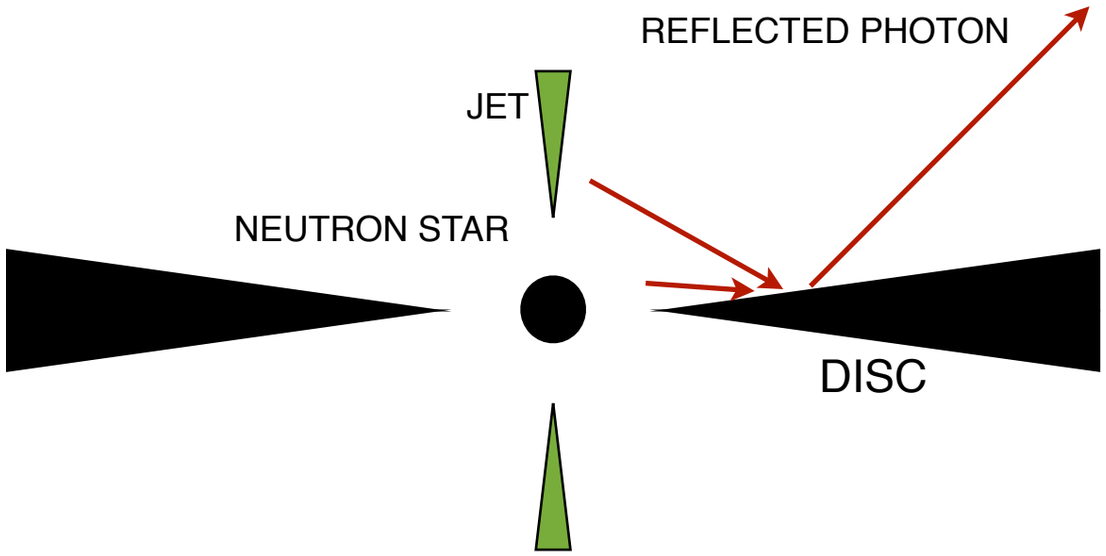
optical spectra

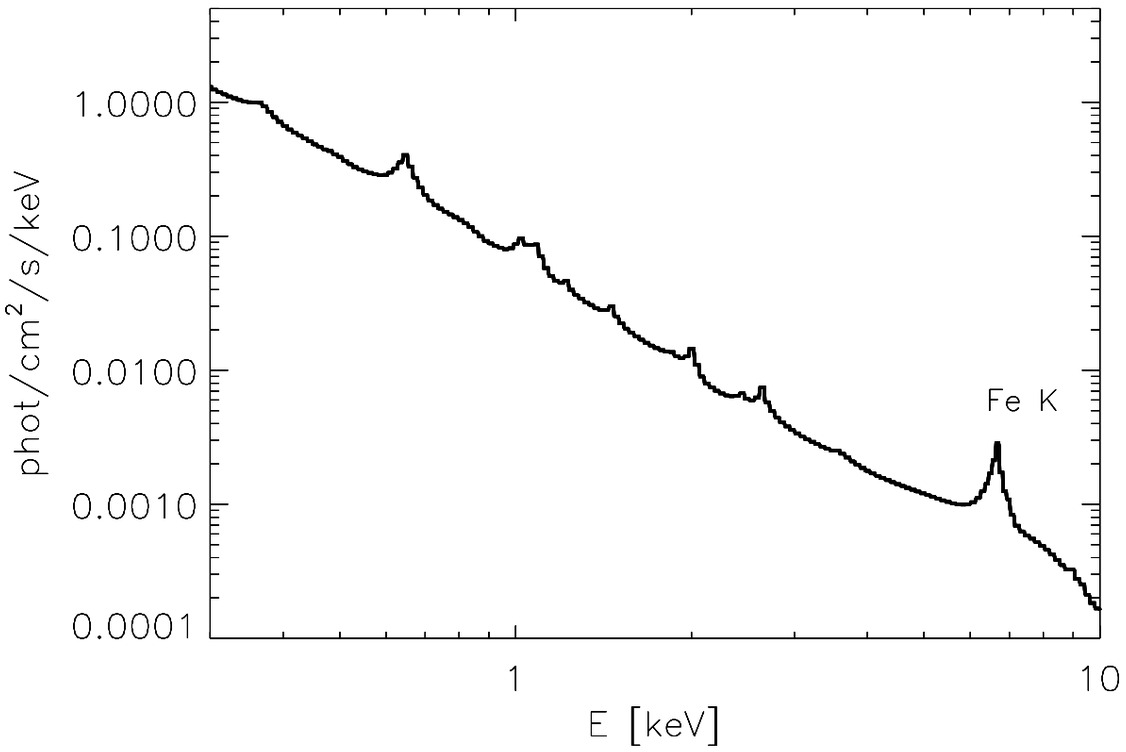


Nelemans et al. (2004)

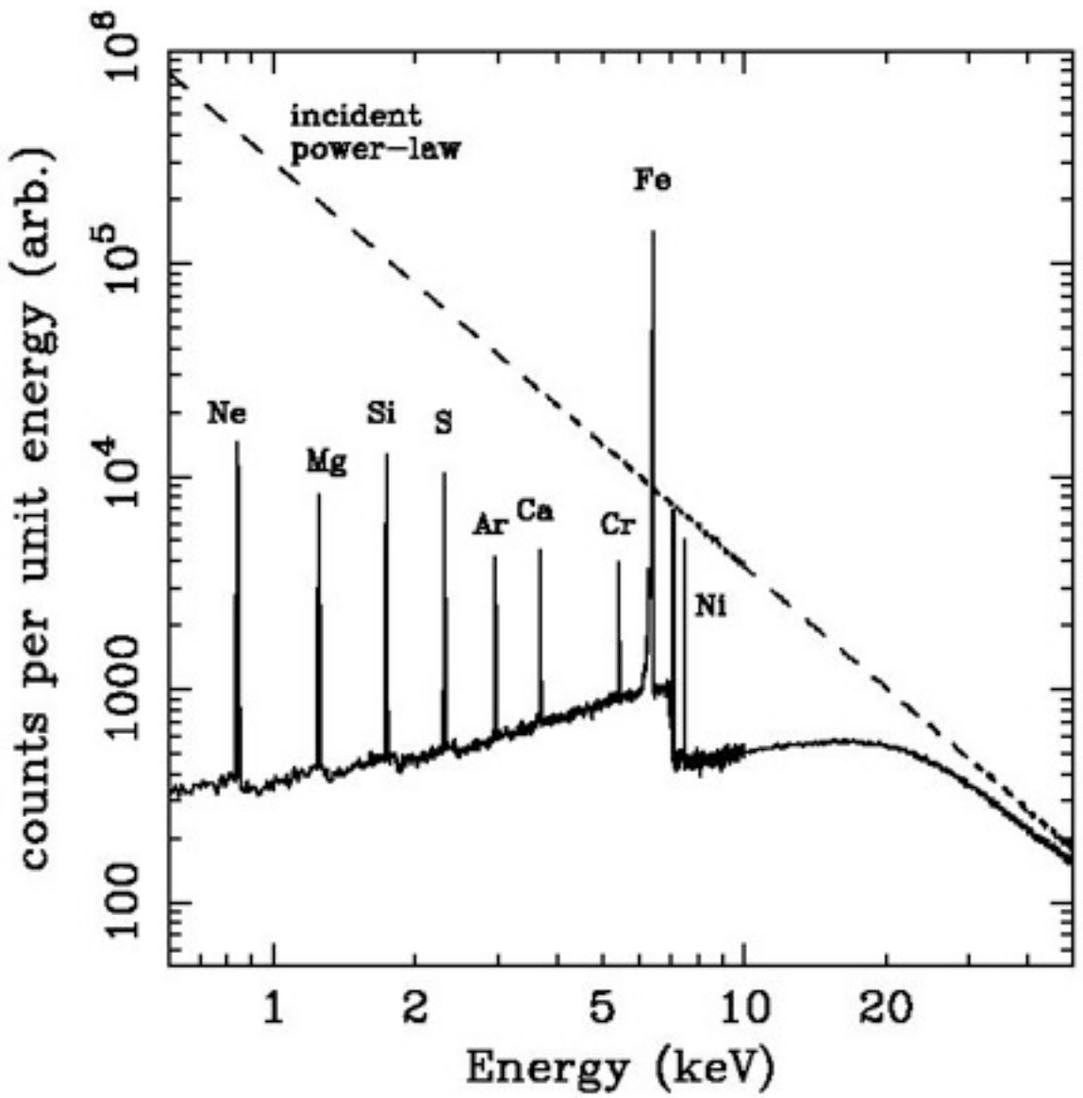


X-ray reflection



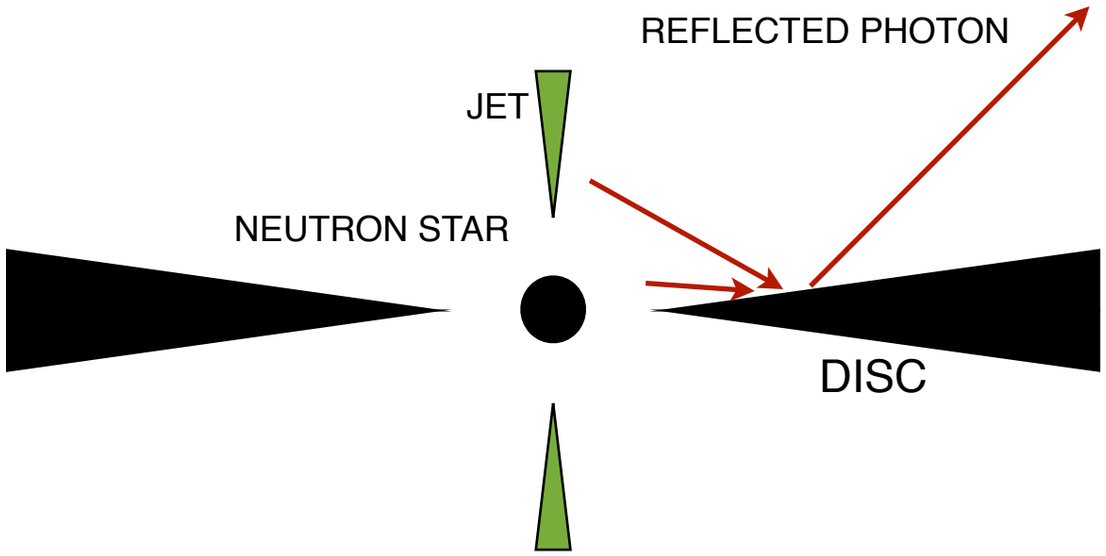


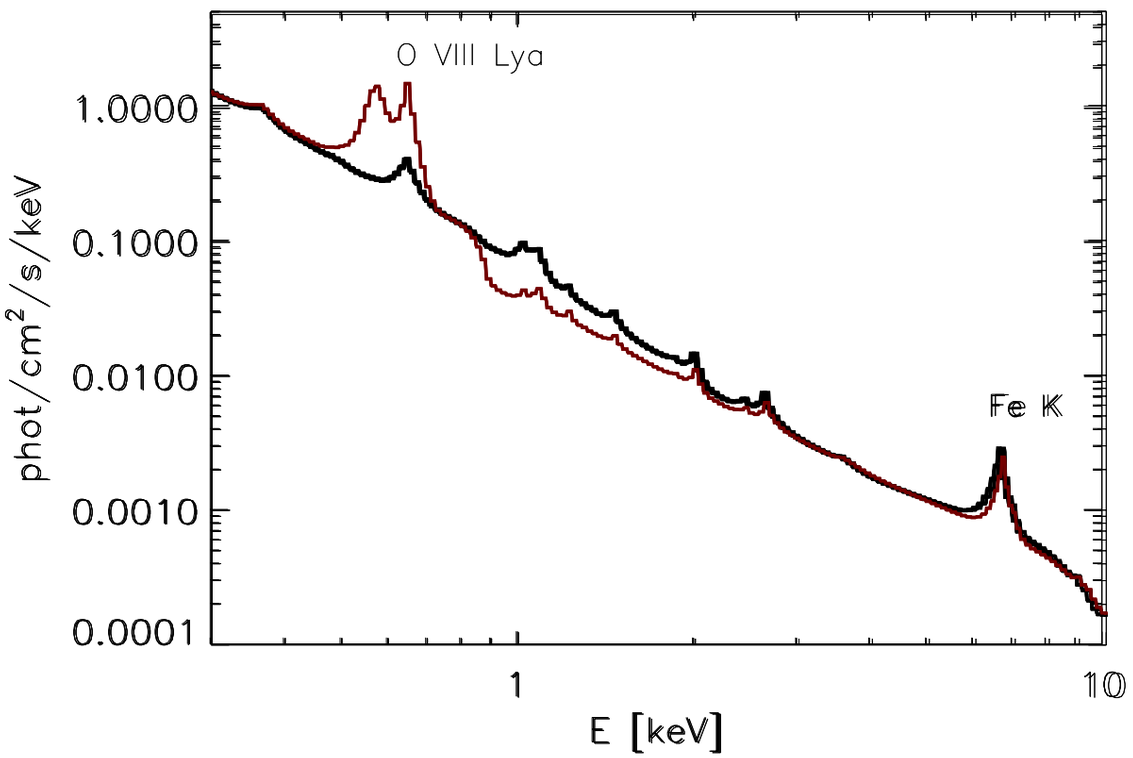
Ross & Fabian (2005)



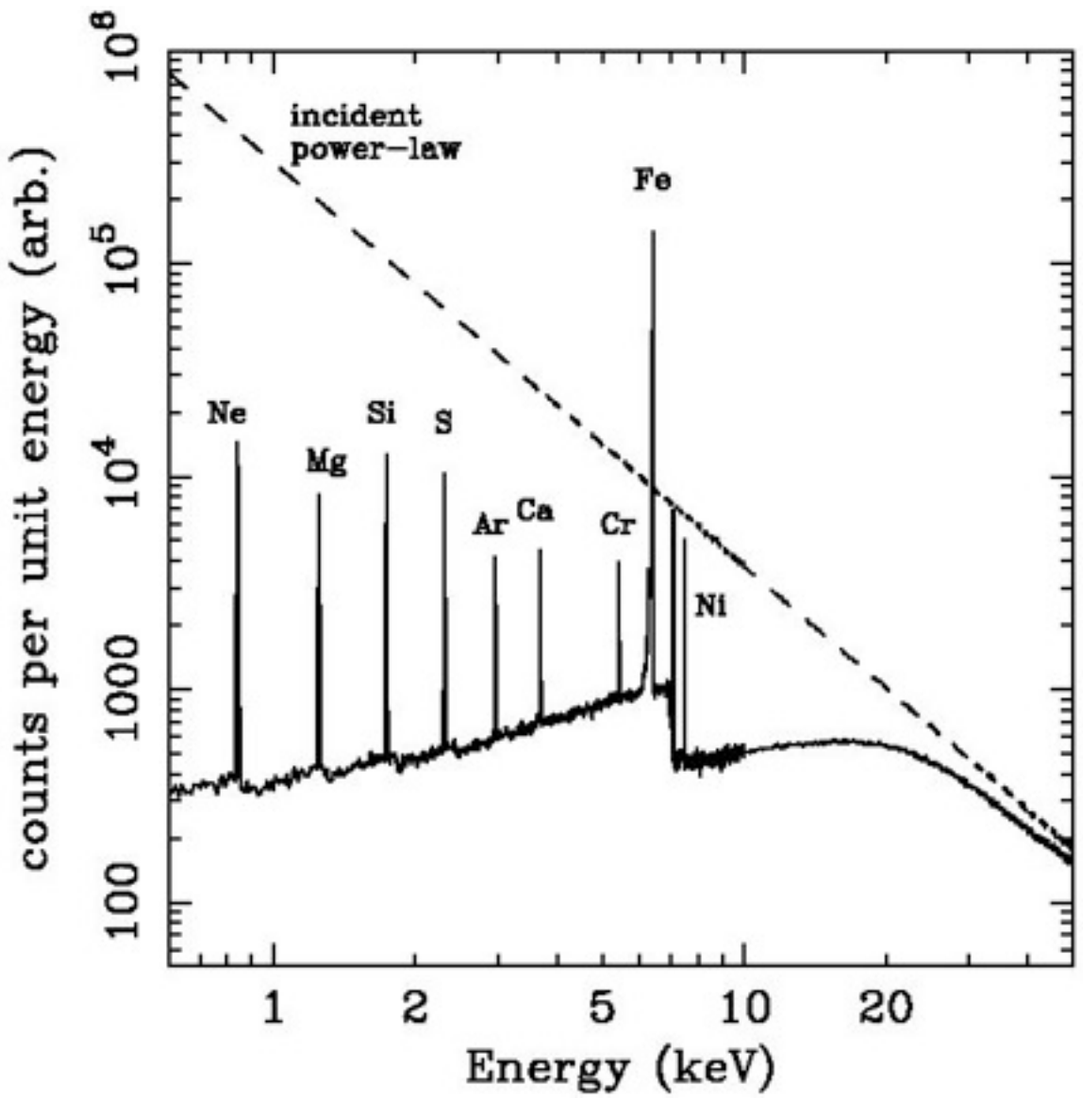
Reynolds et al. (2003)

X-ray reflection



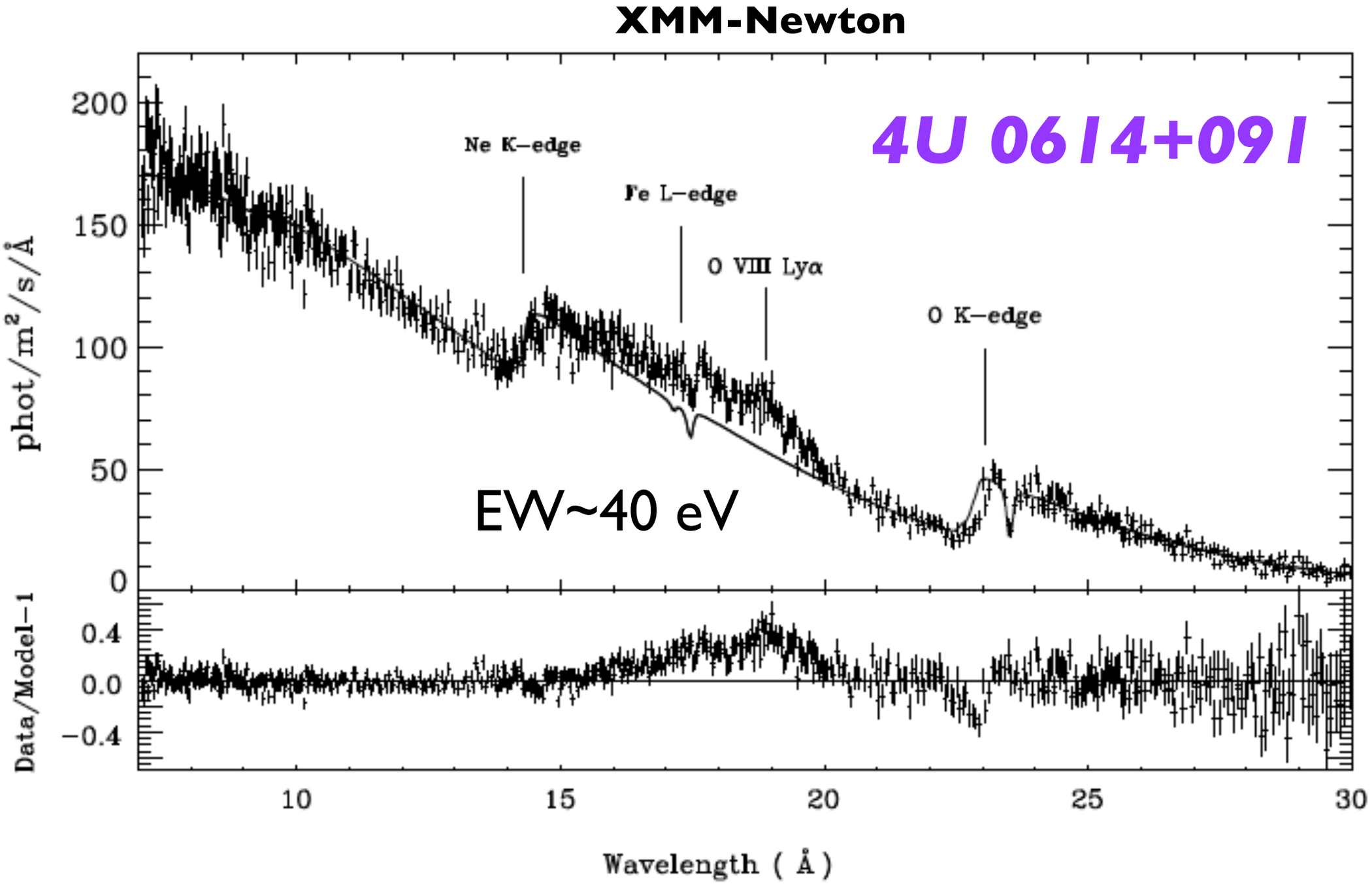


Ross & Fabian (2005)



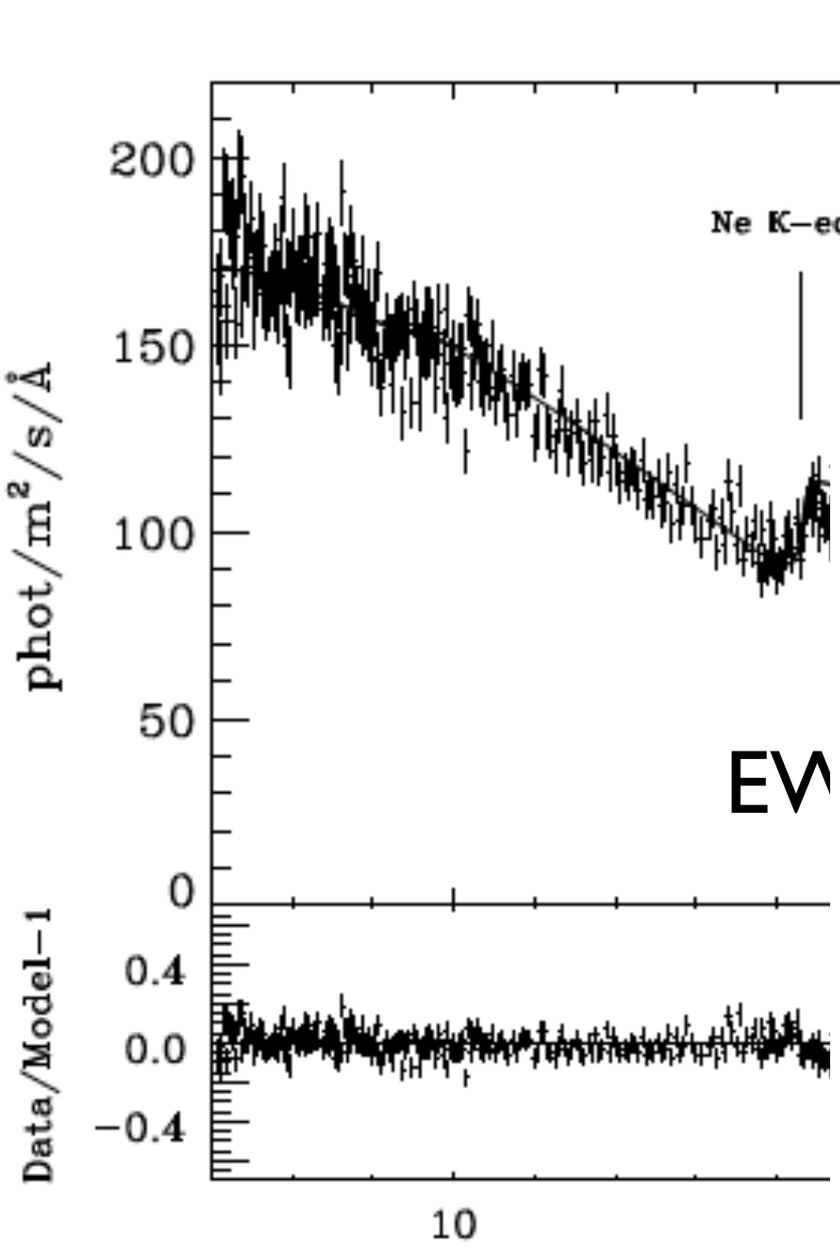
Reynolds et al. (2003)

X-ray spectra



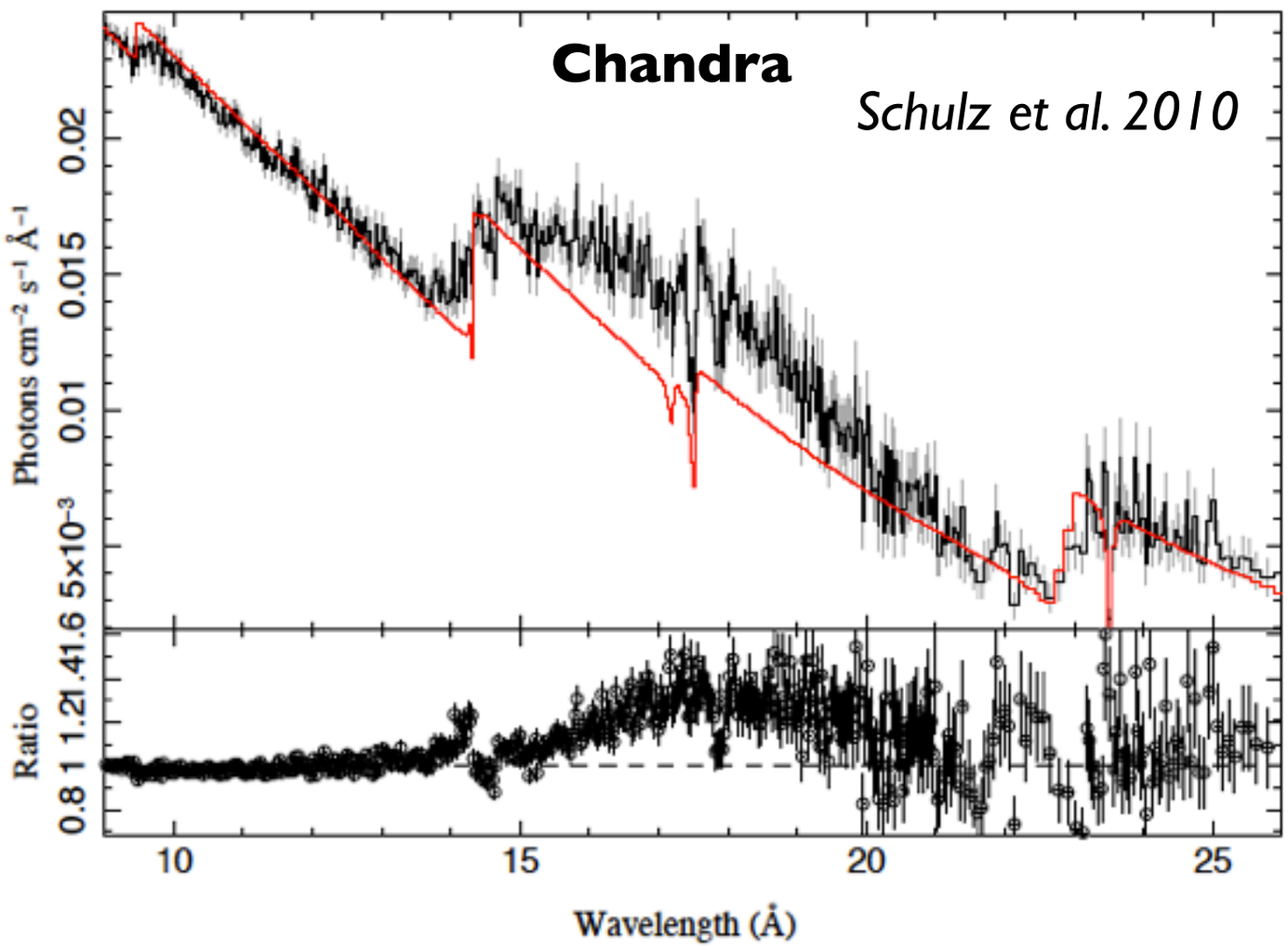
Madej et al. (2010, in press)

X-ray spectra



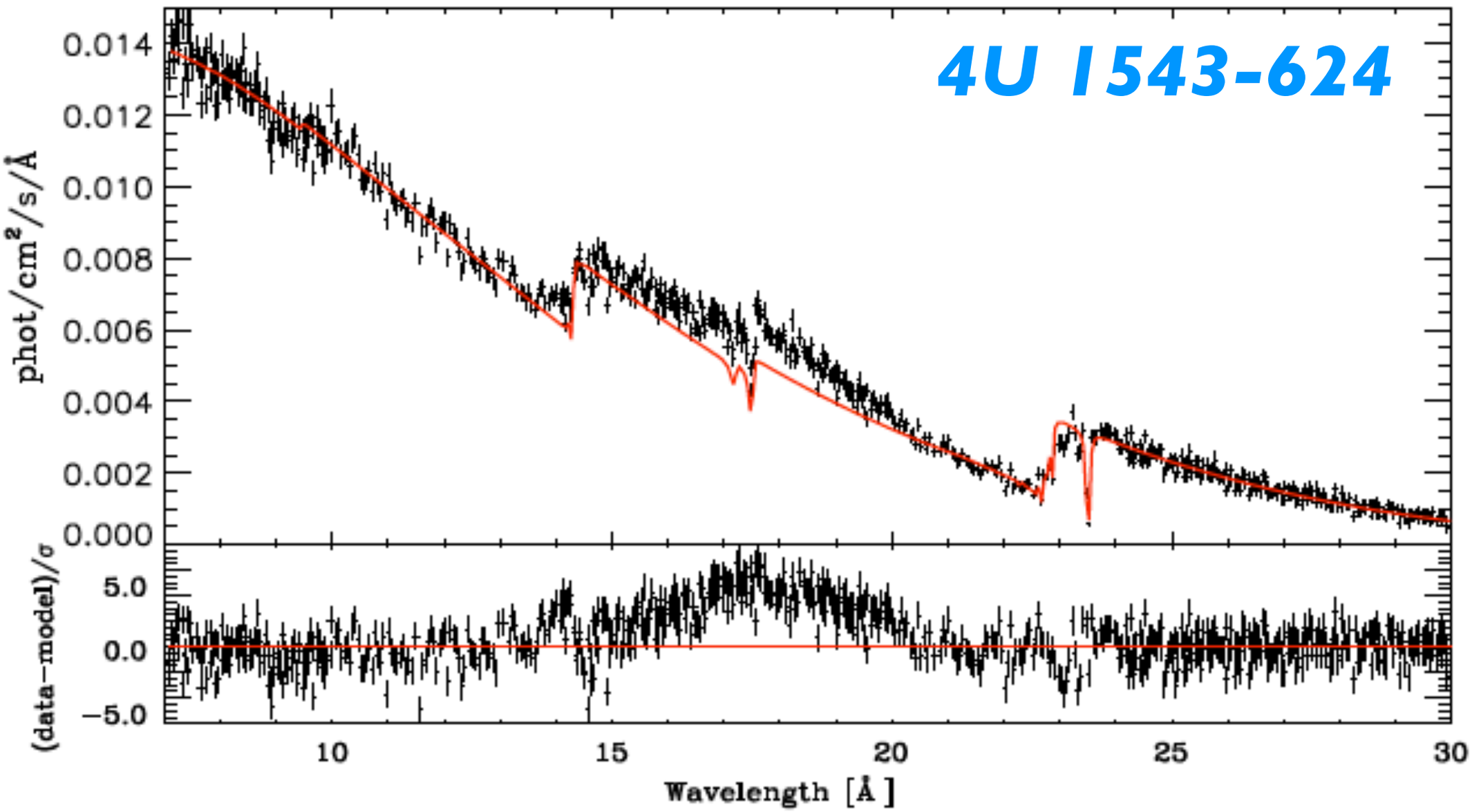
Madej et al. (2010, in press)

4U 0614+091



X-ray spectra

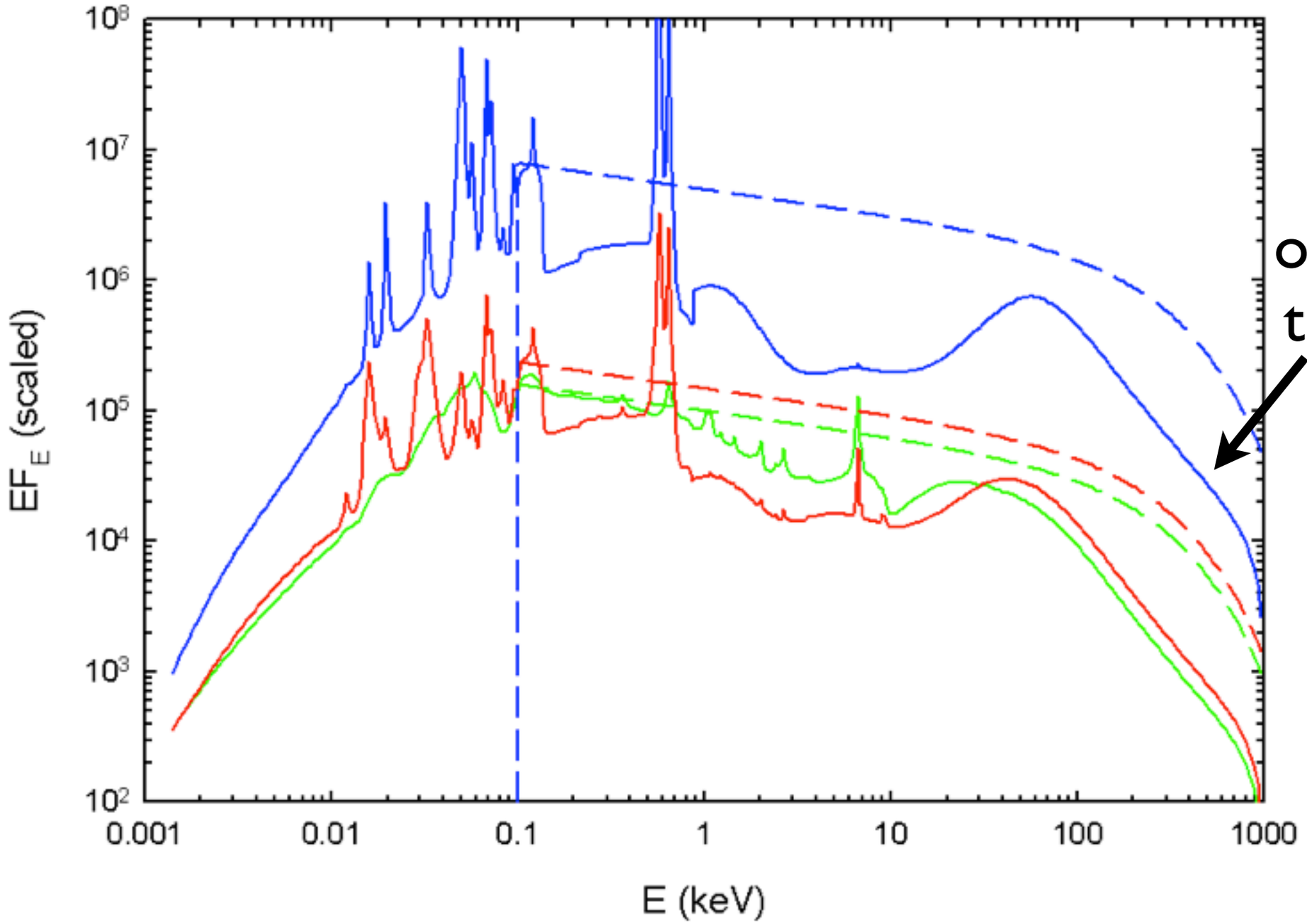
XMM-Newton



Madej et al. 2011

X-ray reflection-ionized disc

Illumination of oxygen-rich gas with $\xi = 1000$
for oxygen/solar = 1, 10^2 & 10^4



only top layer of the disc ionized

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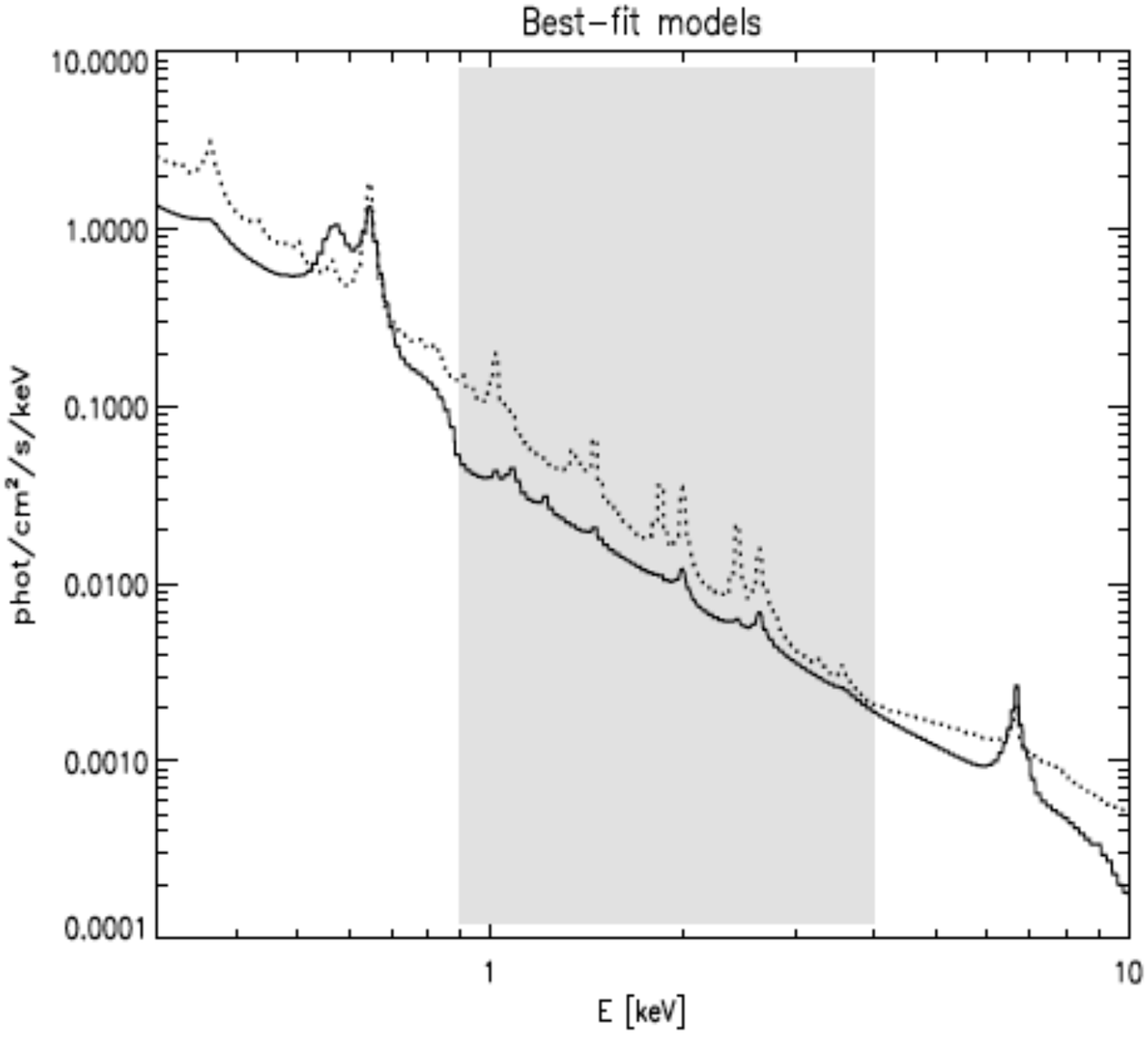
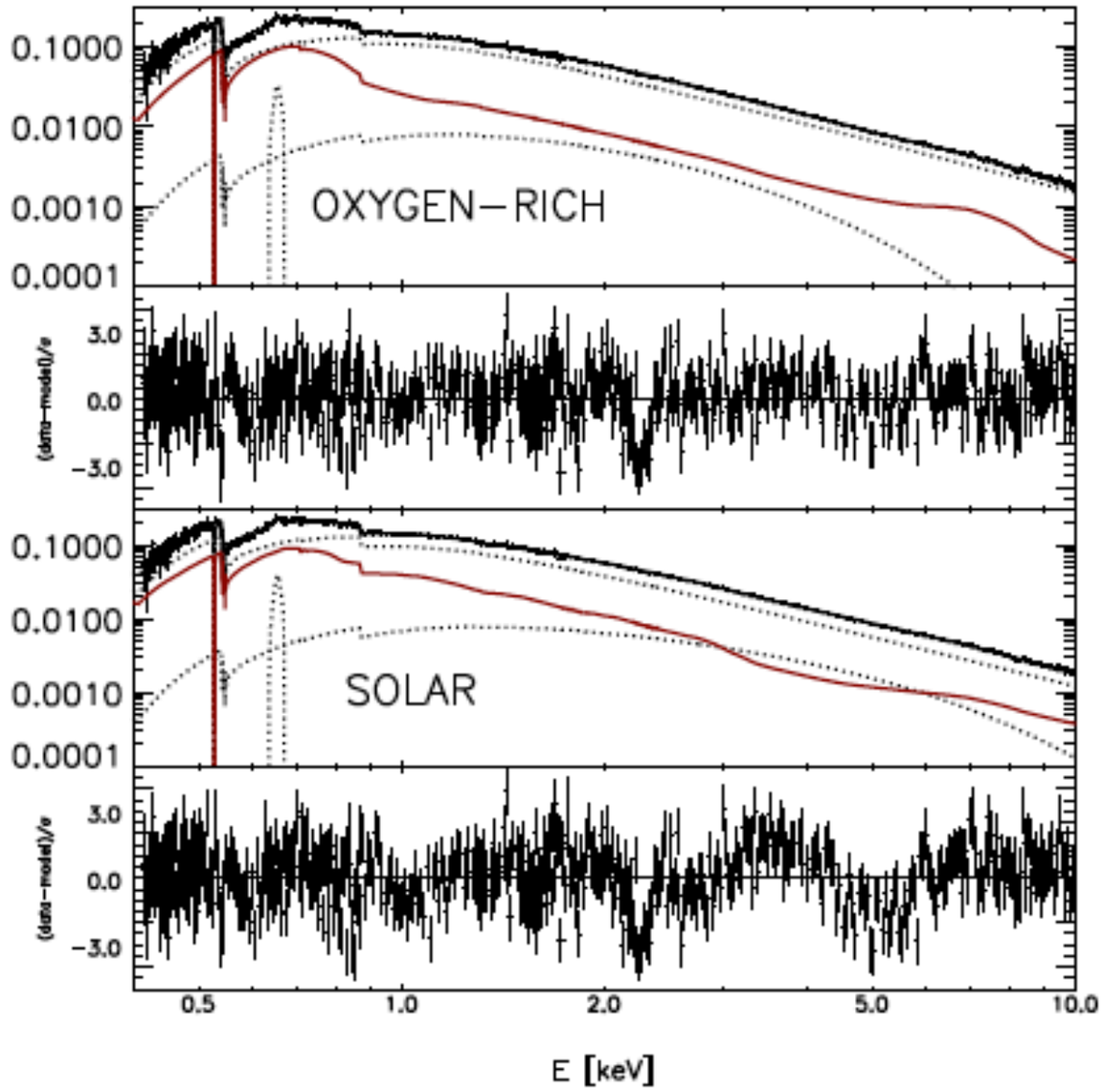
X-ray reflection-fitting data

4U 0614+091





Oxygen-rich reflection model fits better !

X-ray reflection-neutral material

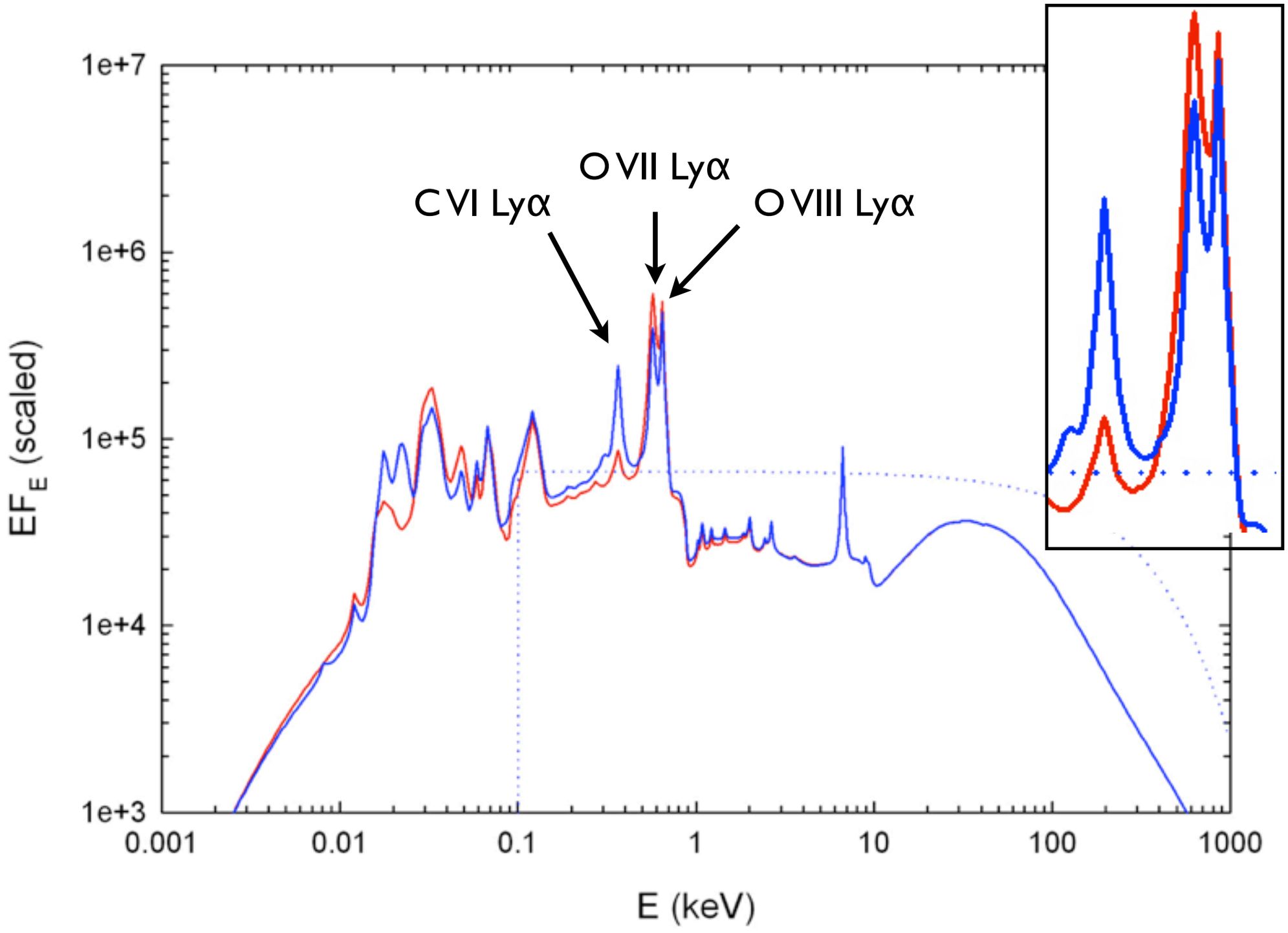
Equivalent widths [eV]

emission line	solar	C/O ratio 1:1	C solar overabundance of O
C (0.277 keV)	0.009	0.110	0.000153
O (0.5249 keV)	0.265	0.503	1.22
Fe (6.40384 keV)	86.5	0.684	0.431

Marat Gilfanov & Filippos Koliopanos

X-ray reflection-ionized disc

ξ = 1000 Γ = 2 with A_{Ox} = 10 and $A_{Ox} = A_C$ = 10



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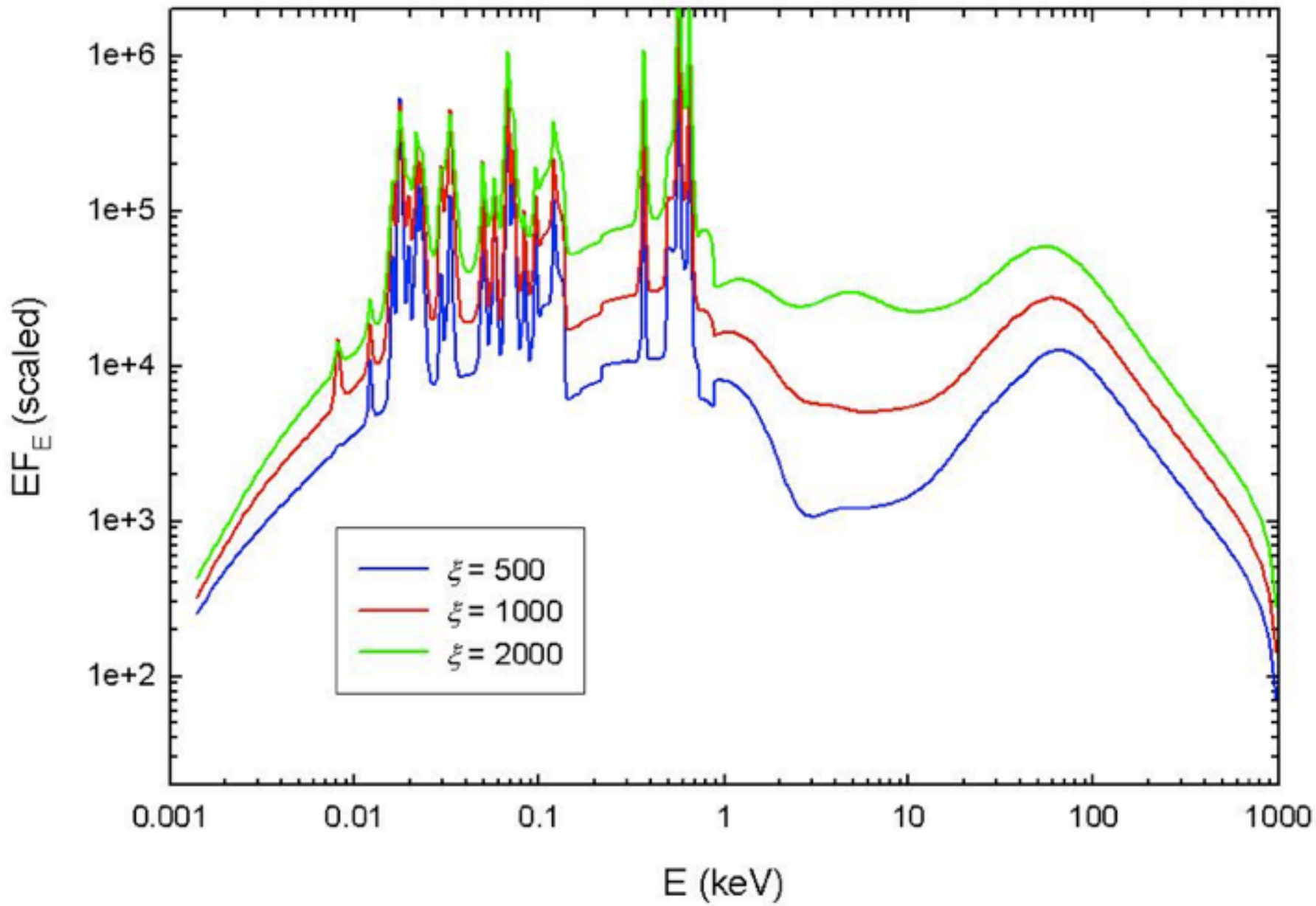
X-ray reflection-ionized disc2

C&O, C/O=1/2, H&He excluded

ξ = 500 , 1000 & 2000



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X-ray reflection-summary & outlook

model

- C & O overabundance in **reflionx** model *Ross & Fabian (2005)*
- (cold material in the disc)
- (power-law incident spectrum)

data

- OVIII Lyα reflection line in UCXB spectra
- 200 ksec Chandra obs. (4U 1543-624)
- 50 ksec Suzaku obs. (4U 1543-624)

We'd like to achieve:

- H & He excluded
- temperature of the disc $T \sim 0.1$ - 0.4 keV
- different incident spectrum (4U 1543-624)
- geometry of the accretion disc
- C & O abundance measurement