X-ray surveys of obscured AGN

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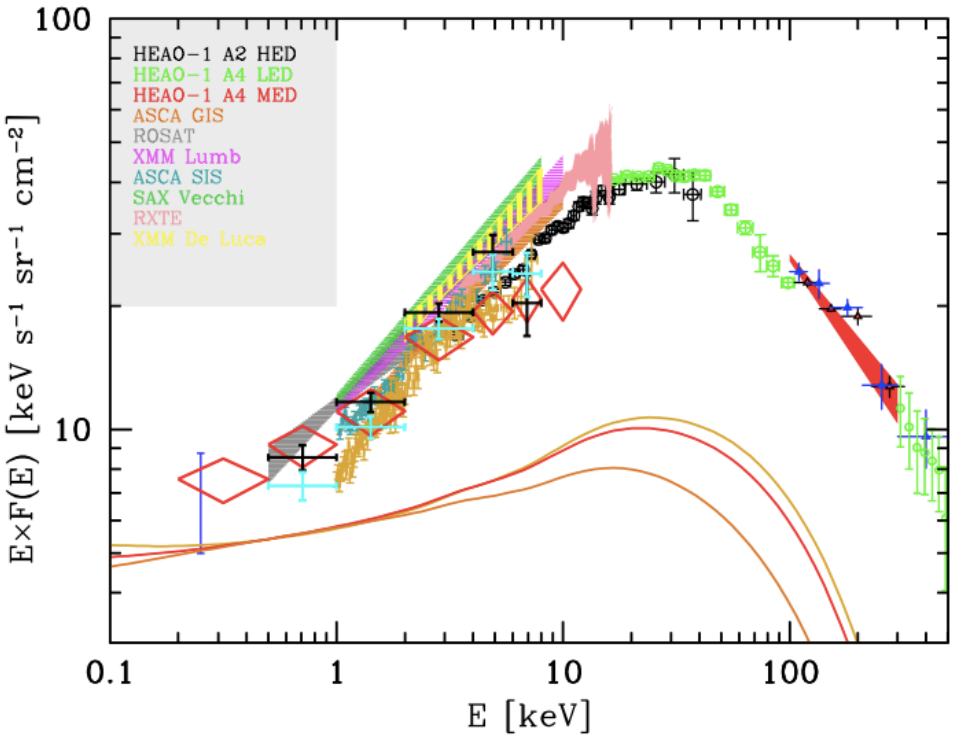
Obscured AGN probed by X-ray

- Nuclear geometry through Fe K lines
- Evolution of obscured AGN fraction
- Physical condition of nuclear gas
- High-z

Global view from X-ray background

Much (~85%) of accretion power in the Universe is absorbed



Gilli et al 07

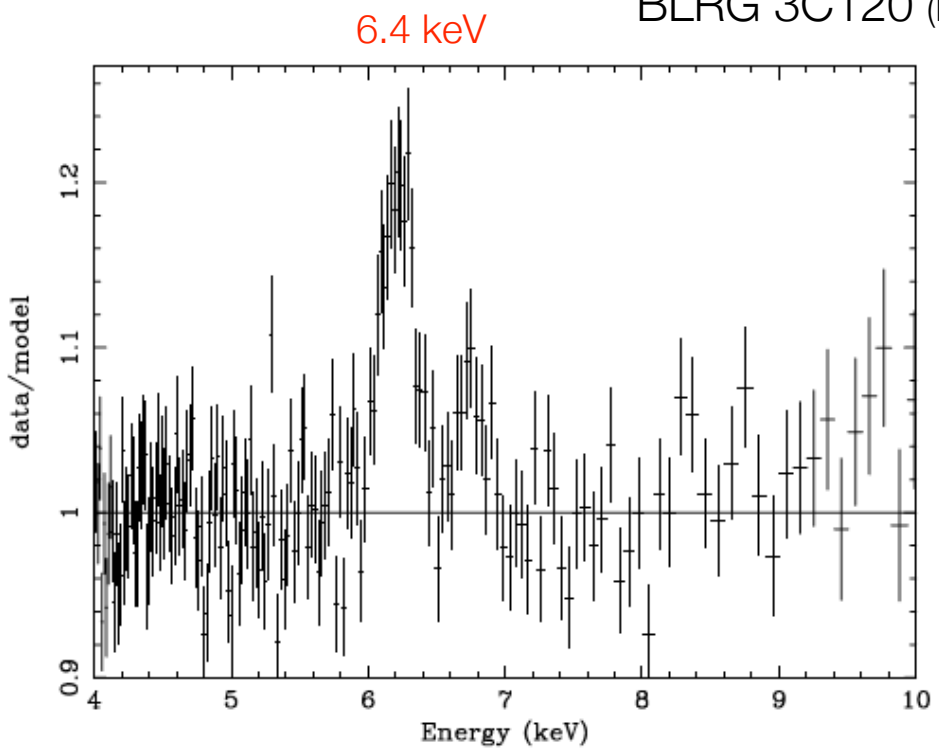
Geometry of nuclear obscuring material through Fe K line

XMM-COSMOS

Fe K line (6.4 keV) in AGN

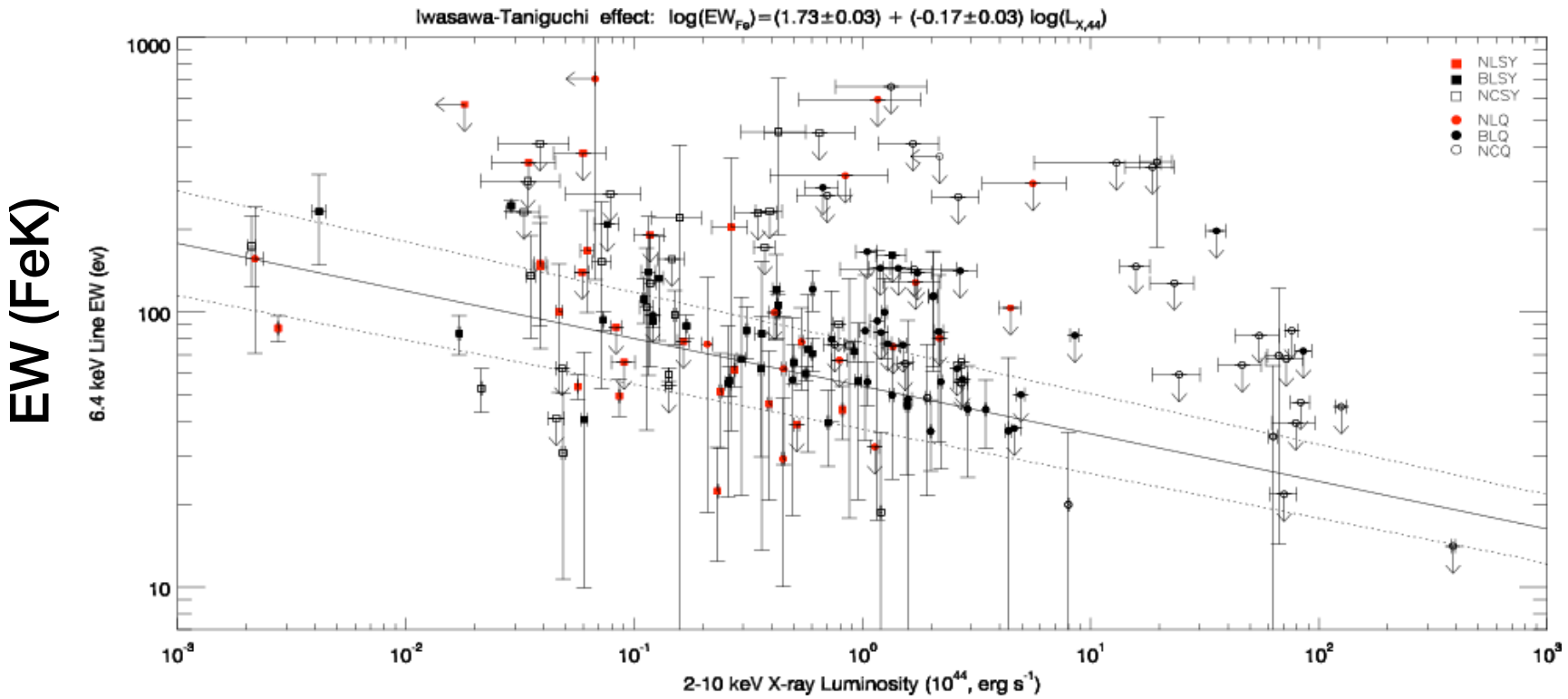
Reprocessing feature in **cold** gas

BLRG 3C120 (Ballantyne et al 2003)



EW(FeK) - L_X relation in Type I AGN

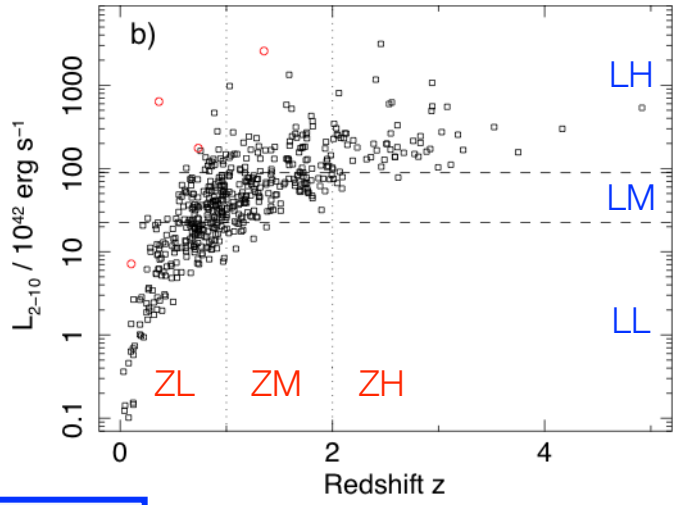
in nearby AGN

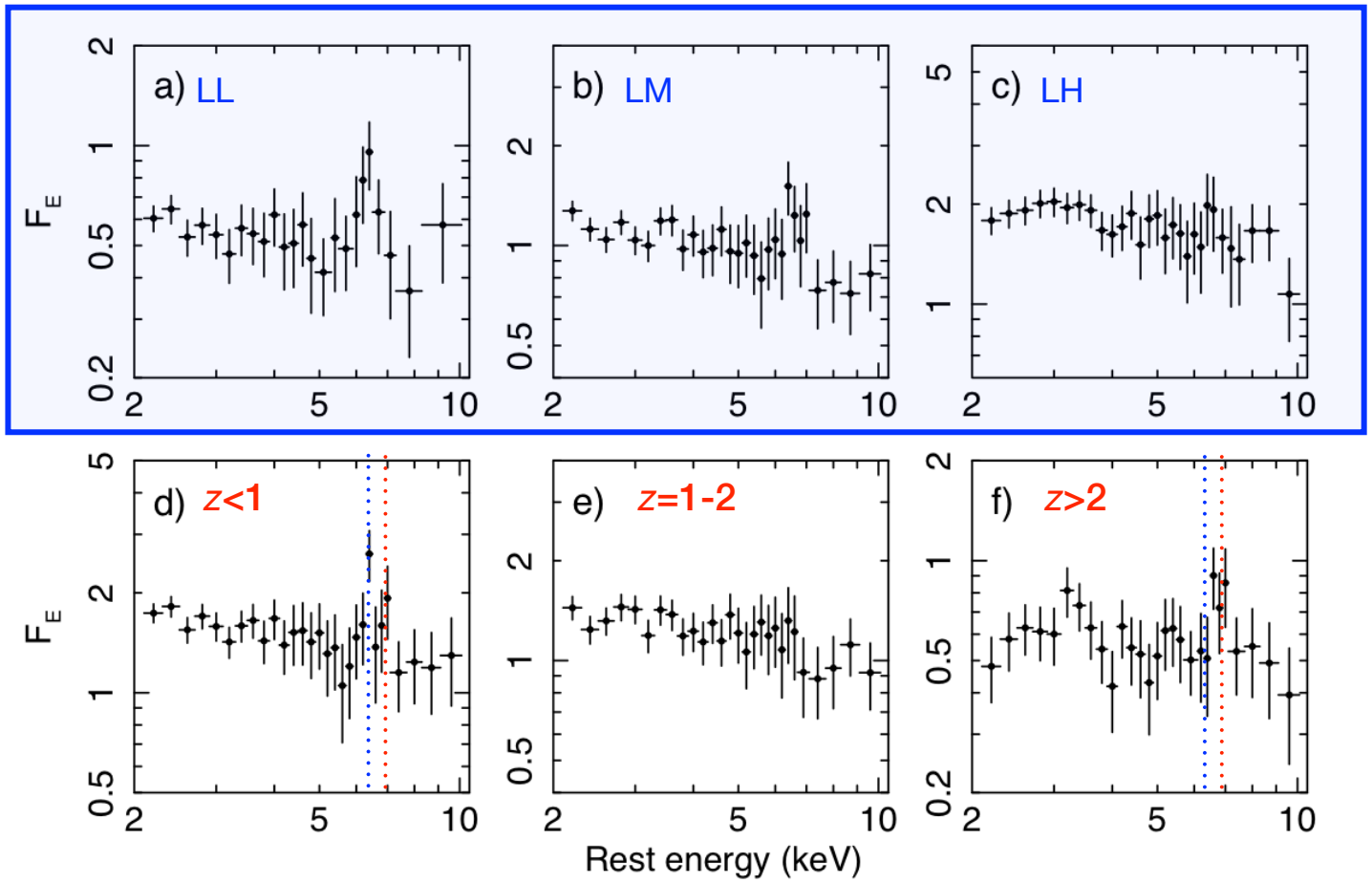


Bianchi et al 2007

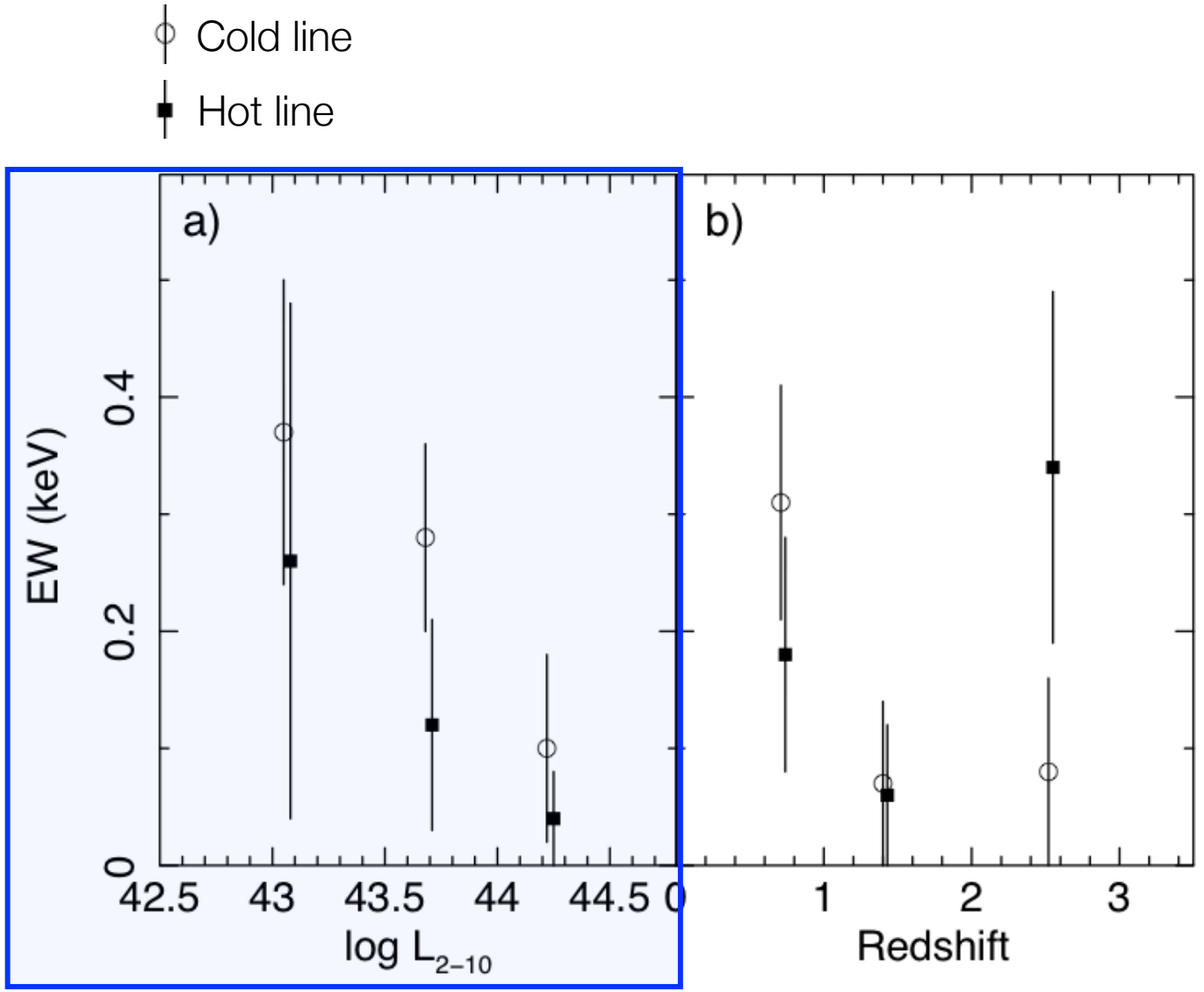
COSMOS Type II AGN

z~1

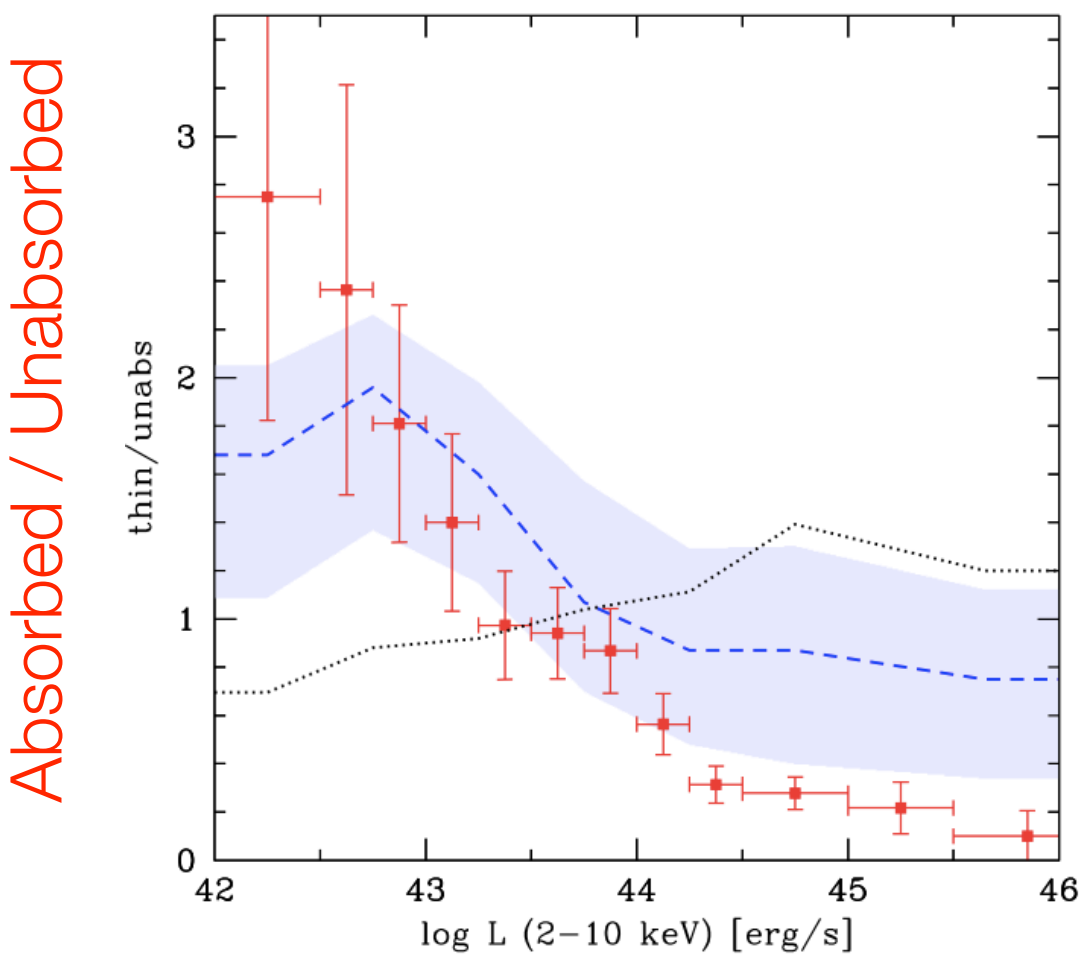




Luminosity dependence



Obscured AGN fraction vs. L_X



Hasinger 08

Luminosity dependent covering fraction of obscuring material

$z<2$

What about z = 2-3 ?

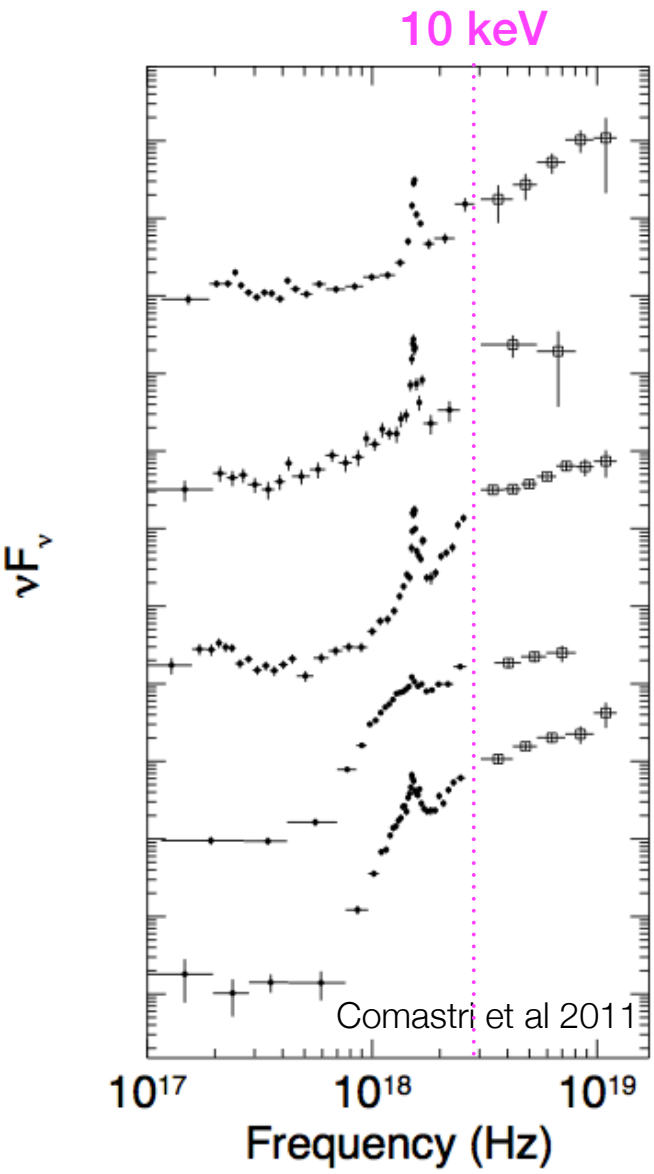
A hard X-ray (9-20 keV) selection of obscured AGN

at z~2.5

XMM-CDFS

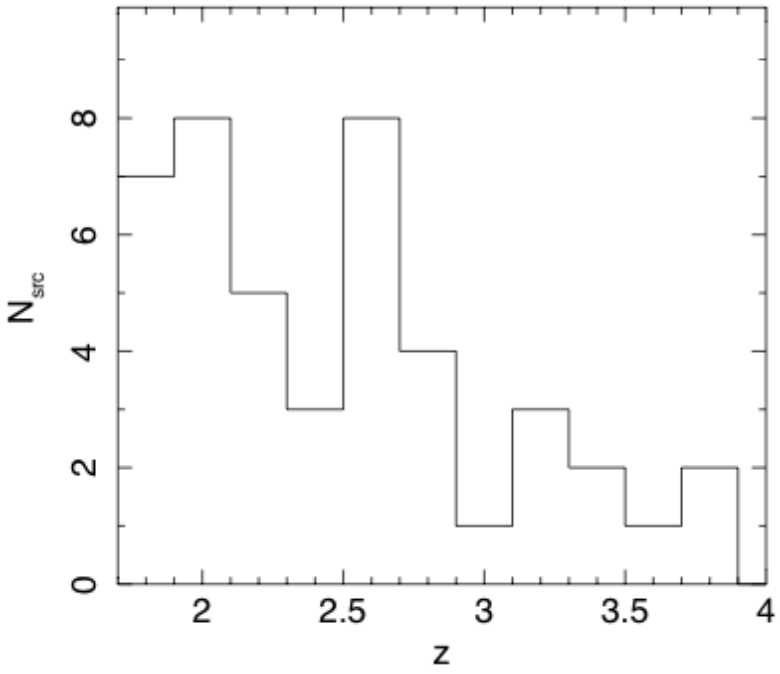
Motivations

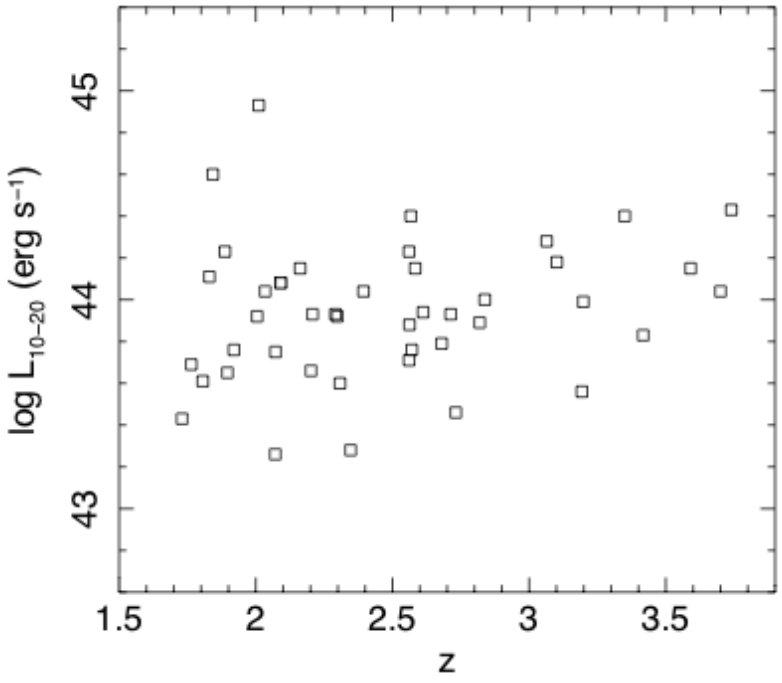
- Hard X-ray (>10 keV) selection is less biased against absorption
- Rest-frame 10-20 keV enters the XMM bandpass for $z>1.7$
- Negative K correction for absorbed spectra
- Significant depth of the XMM CDFS survey



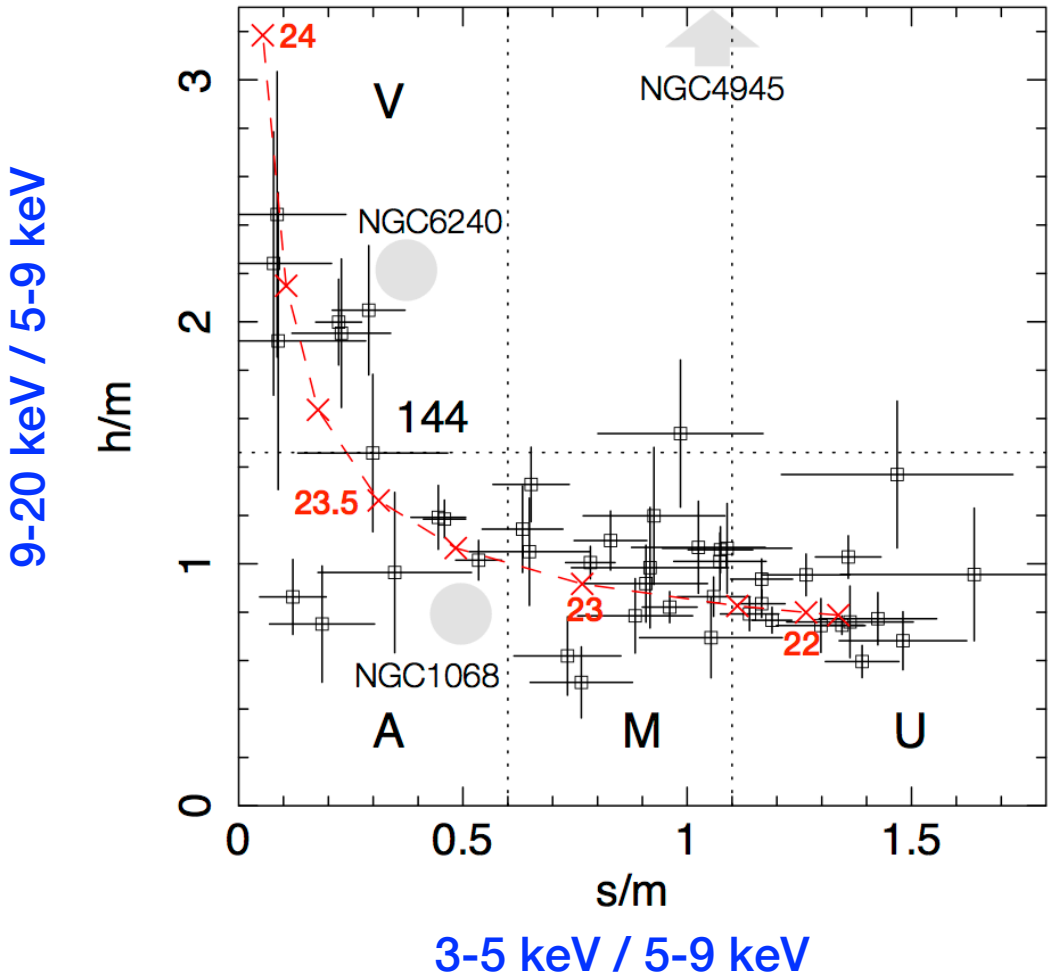
Sample

- Extracted from the first XMM-CDFS catalogue (176 sources)
- 46 objects at z>1.7

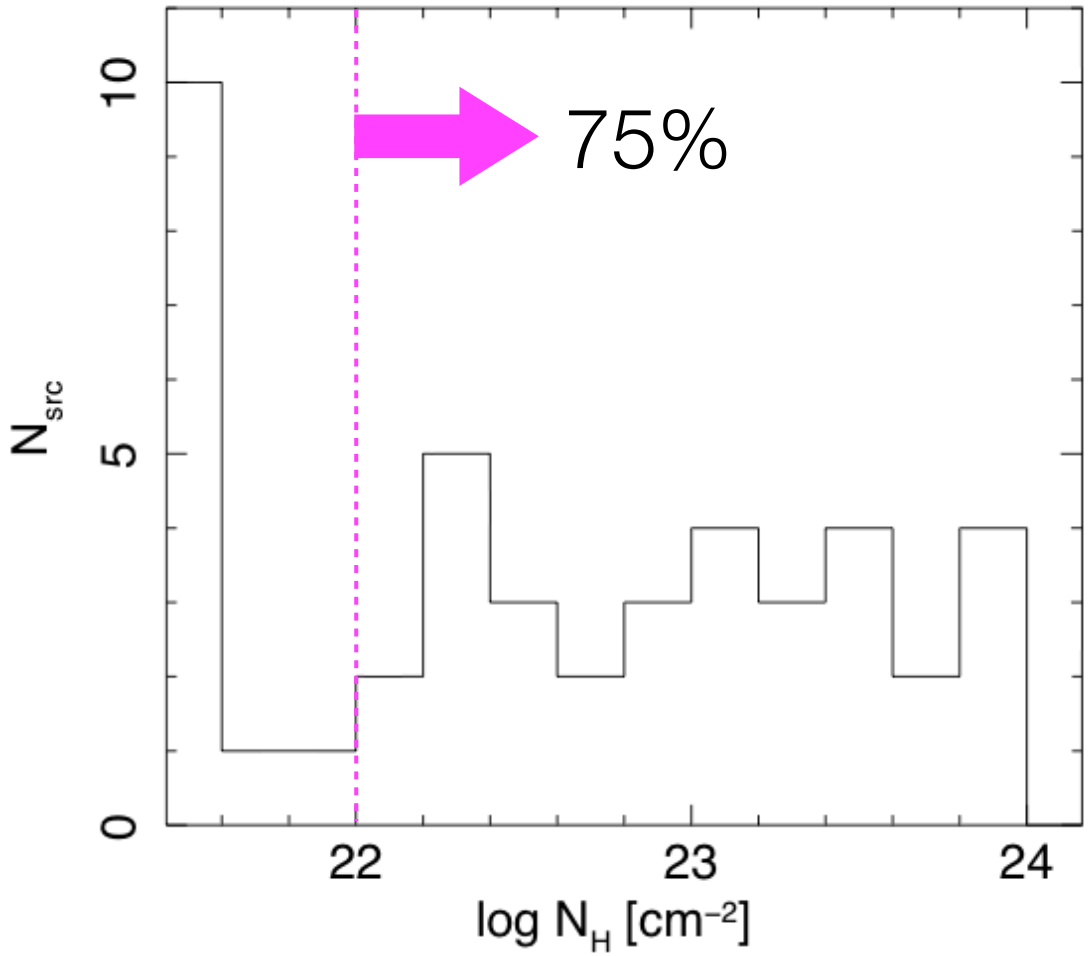




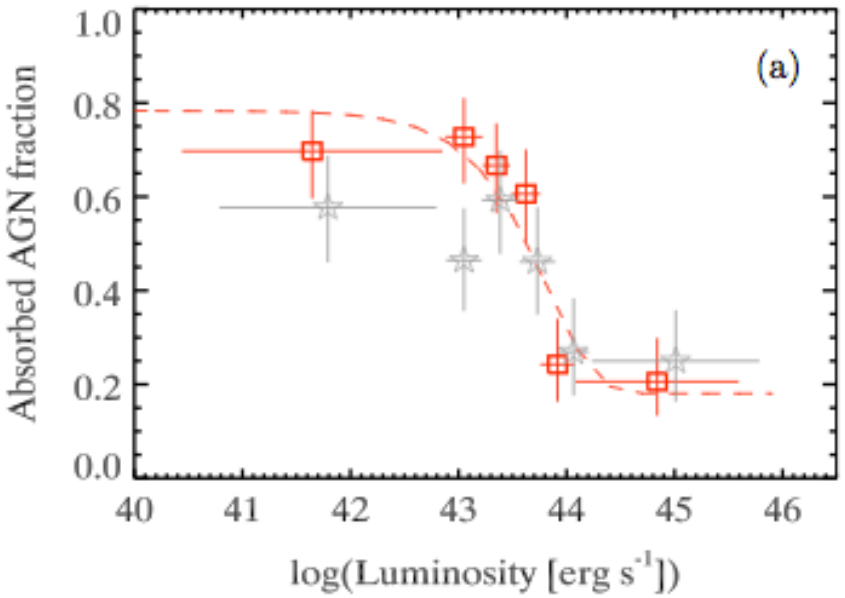
X-ray colour-colour diagram



N_H distribution, absorbed fraction



Fraction of absorbed AGN



Local Swift BAT sample

Burlon et al 2011

20% at z=0

75% at z=2.5

Corresponding Luminosity

Evolution of galaxy properties

★ Merger fraction $\propto (1+z)^2$

e.g., Xu et al 2012 for COSMOS

★ Gas fraction in galaxy $\propto (1+z)^{1.6}$

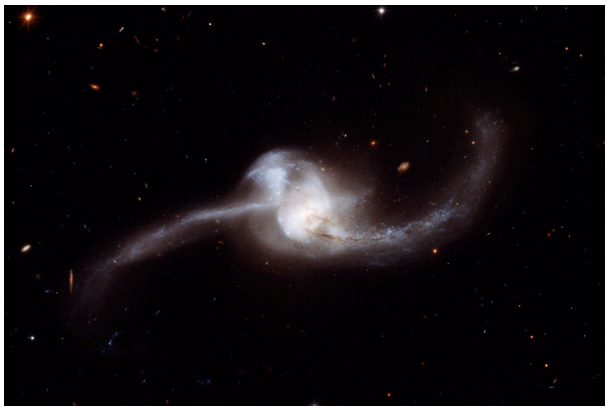
e.g., Carilli et al 2011

≤10% at z=0 ---> 57±6% at z=1.5

Classic merger → QSO scenario

e.g. Sanders et al 1988

Major merger



Starburst

Obscured AGN

Unobscured AGN = QSO

Obscured fraction

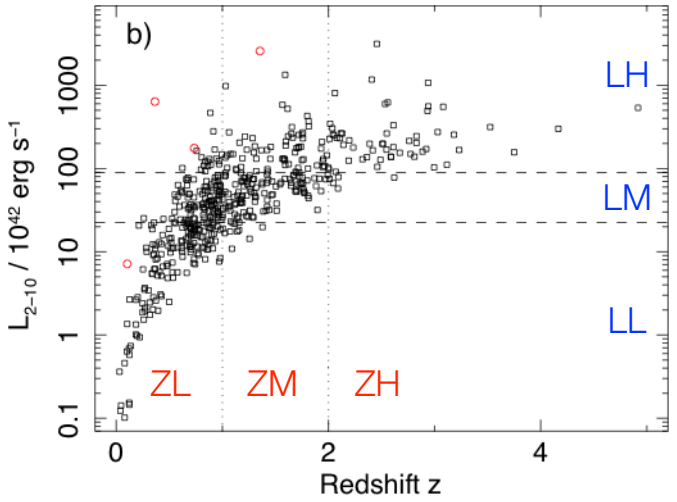
∝Duration of obscured phase

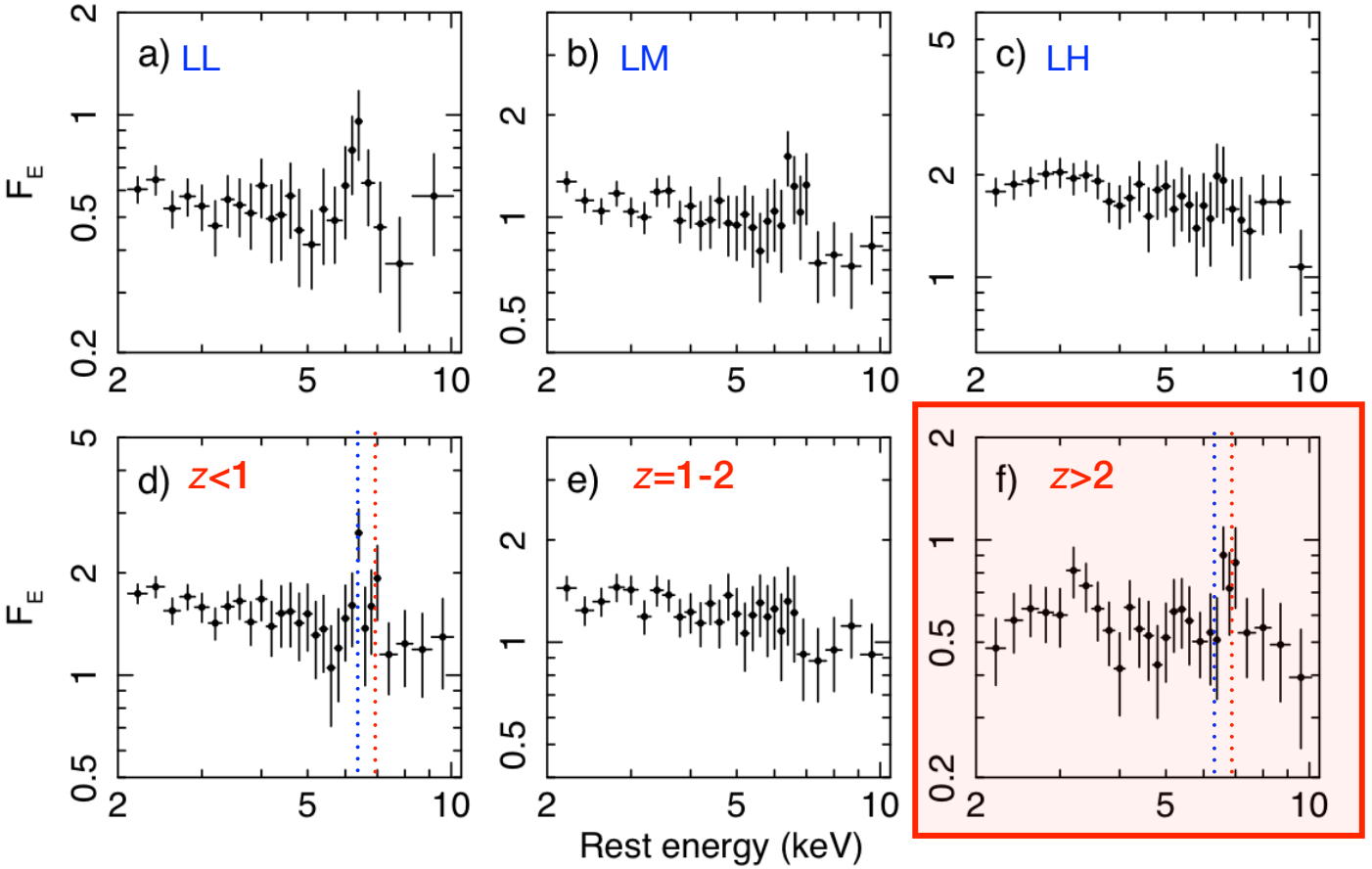
cf. QSO lifetime $<10^8$ yr

Physical condition of active nuclei in this epoch

XMM-COSMOS

COSMOS Type II AGN (z~1)

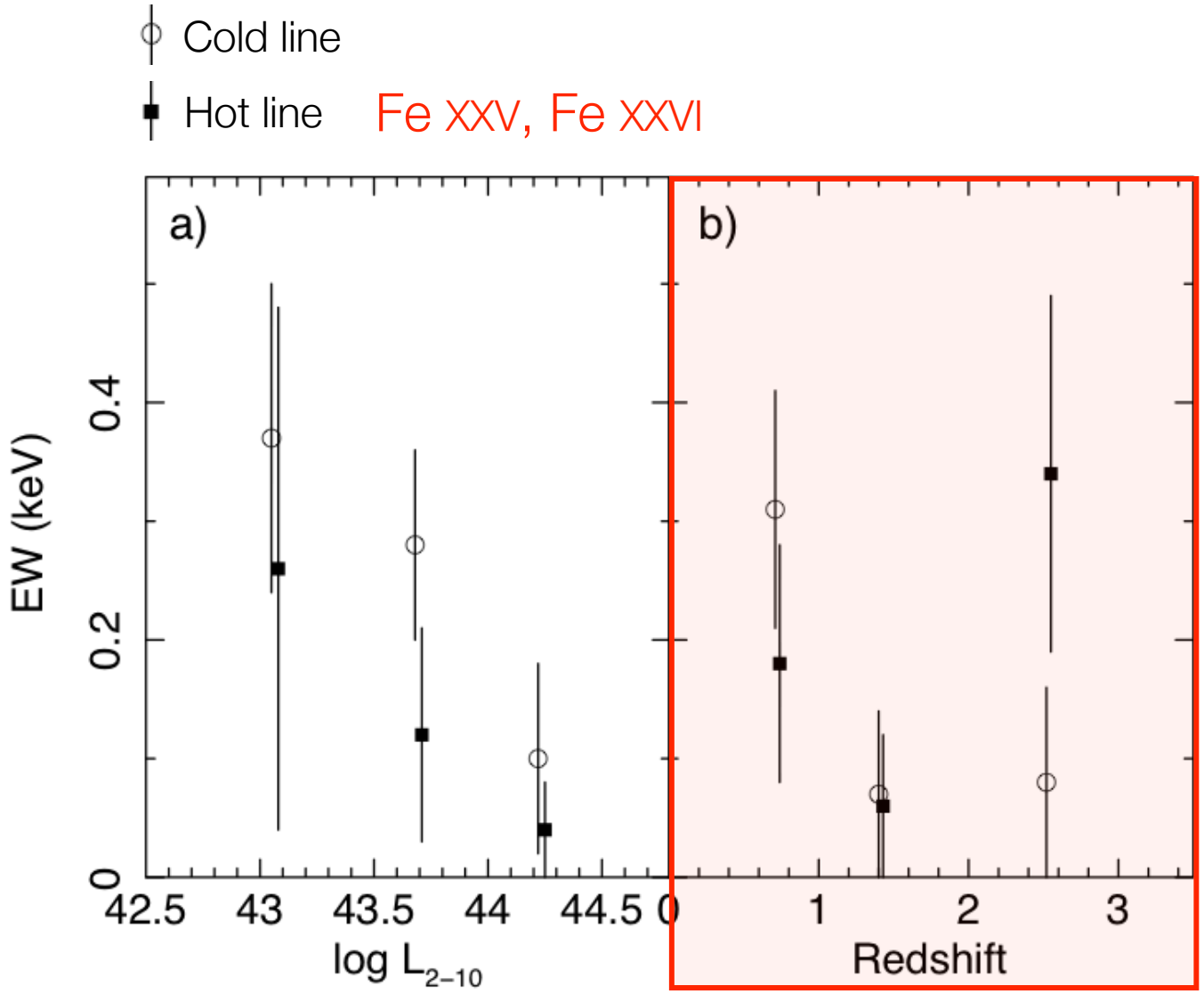




Lx

z

Fe line in Type II AGN

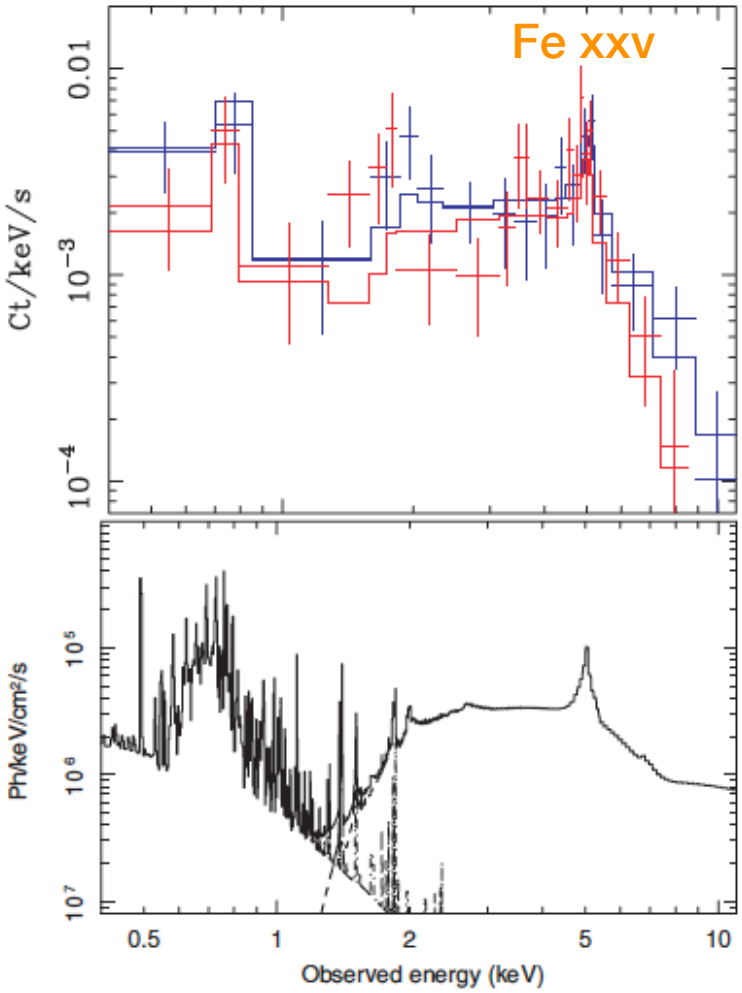


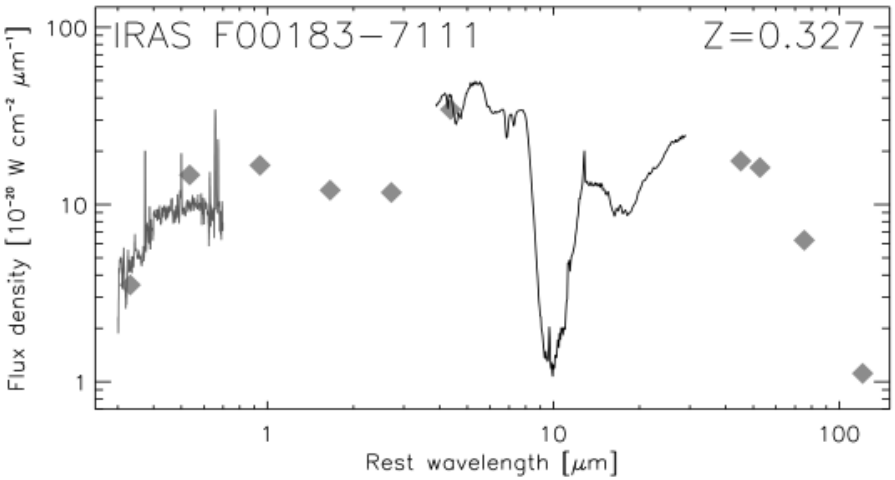
Hot Fe line in Type II AGN at z>2

- Comes from MIPS 24 um detected HLIRGs
- Hot dust (seen at rest-frame 7 um) heated by AGN
- Likely accreting at high Eddington-ratio
- Possibly associated with fast outflow

The local analogue: IRAS F00183-7111

IRAS F00183-7111: local analogue?

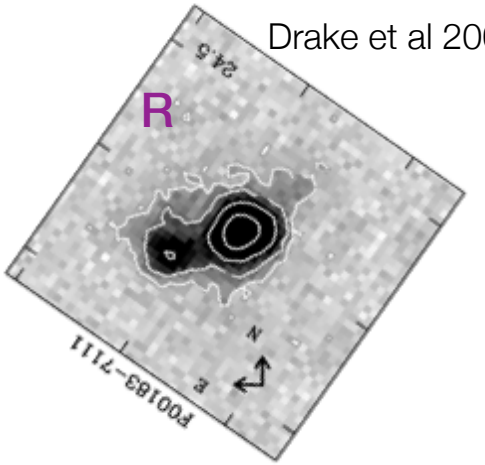


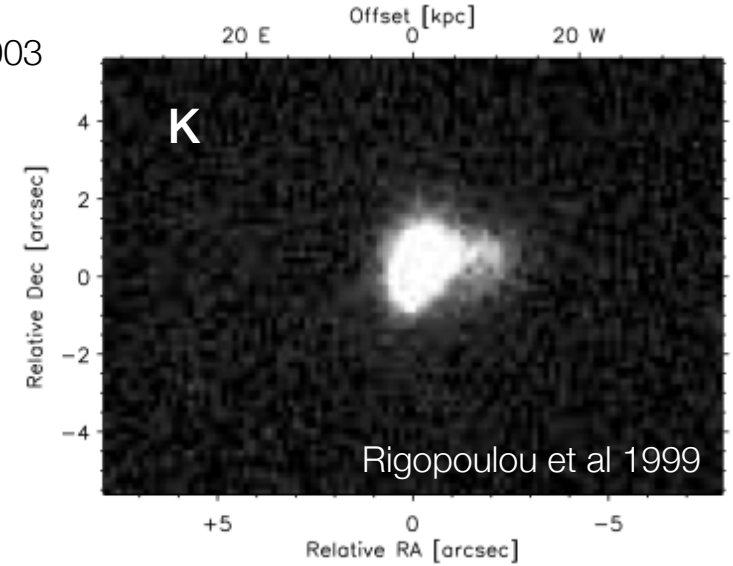


Heavily obscured HLIRG emitting hot Fe line

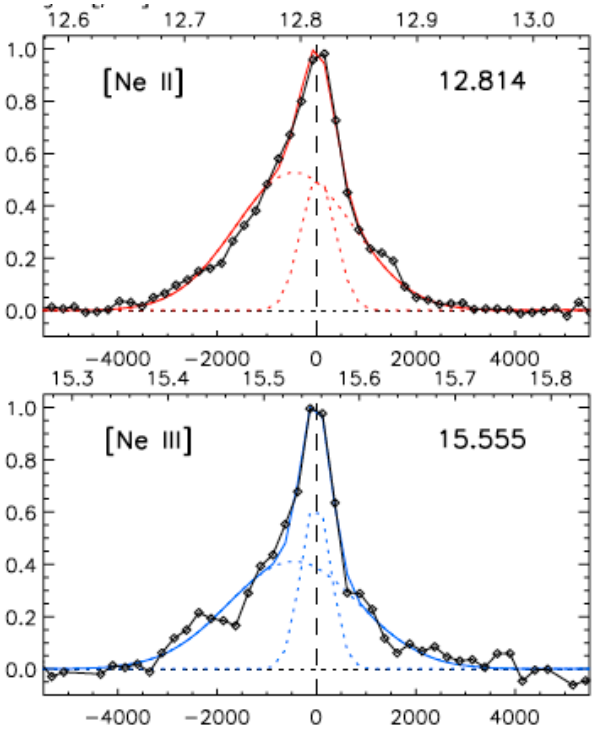
Fast outflow in F00183-7111

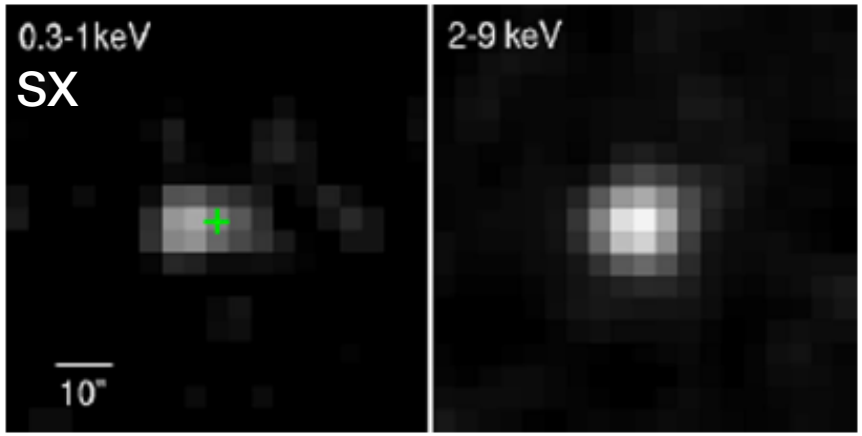
Drake et al 2003



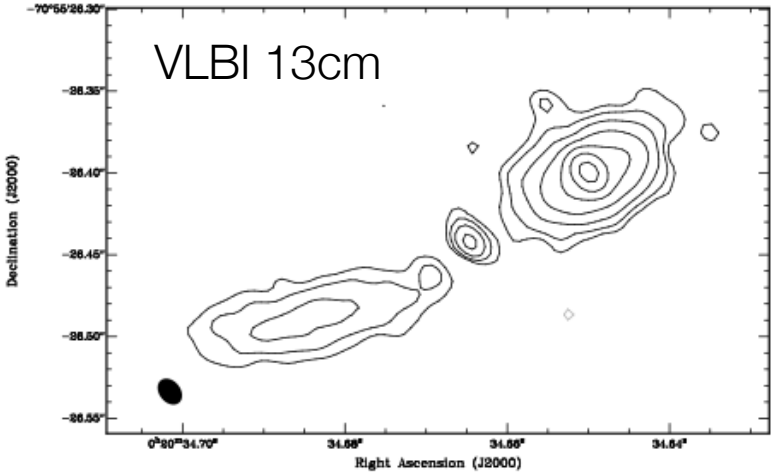


Spoon et al 2008





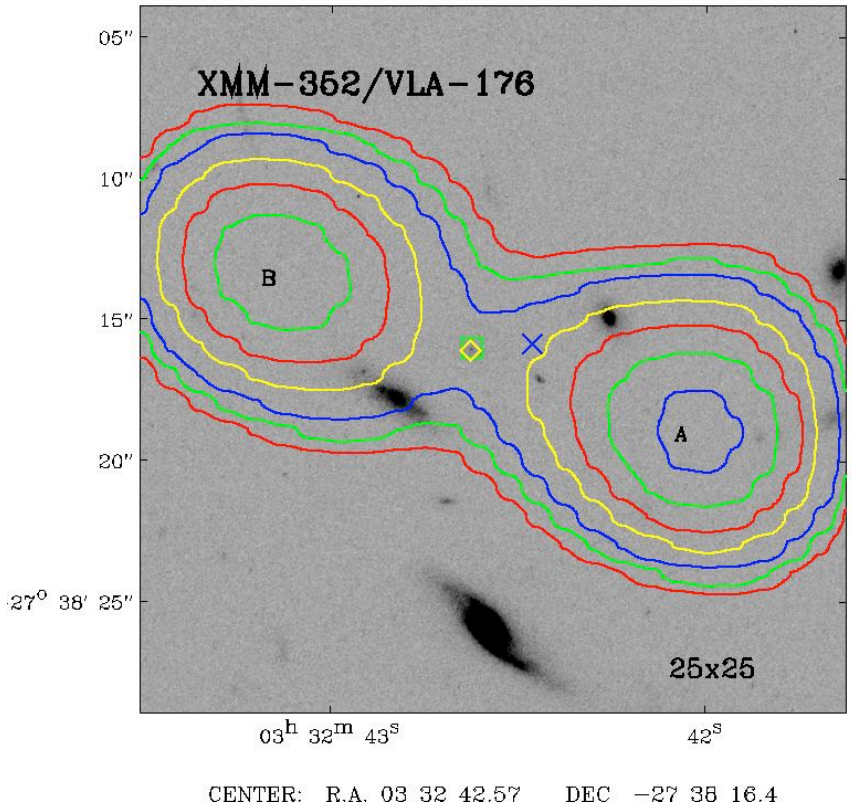
Nandra & Iwasawa 2007



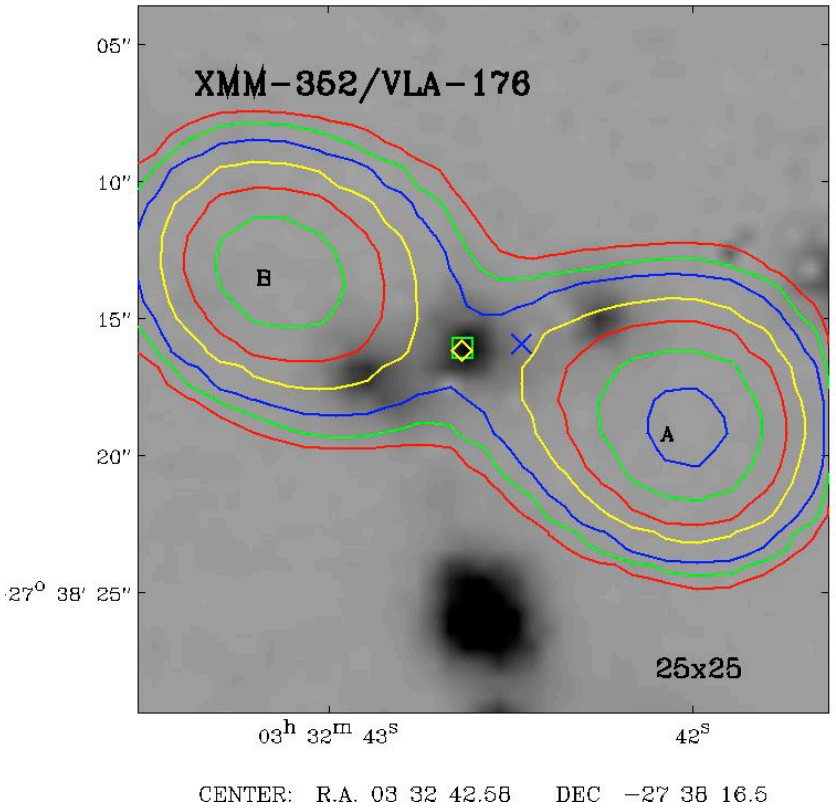
Norris et al 2011

Obscured QSO in CDFS

GEMS z



Spitzer IRAC 4.5 μm

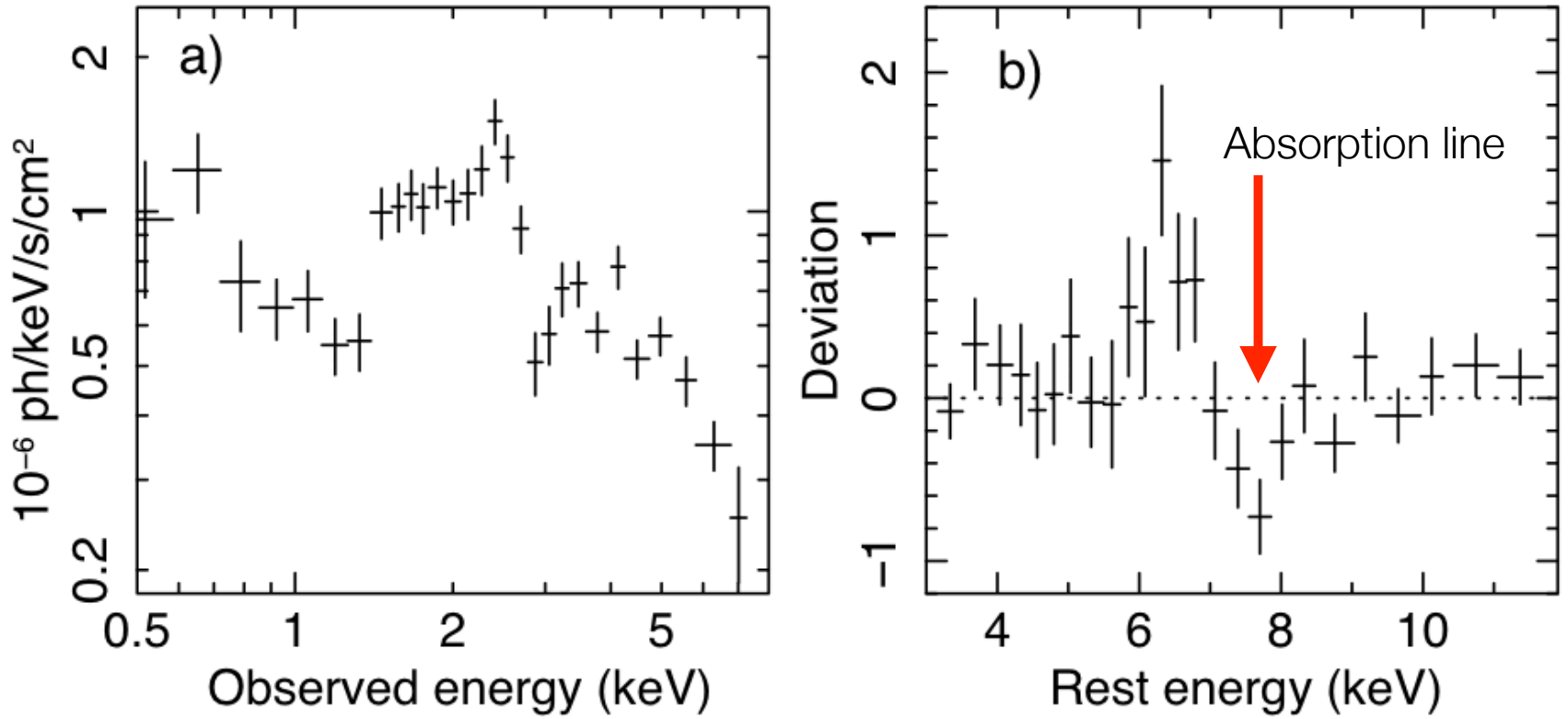


Courtesy of Vincenzo

Absorption, outflow...

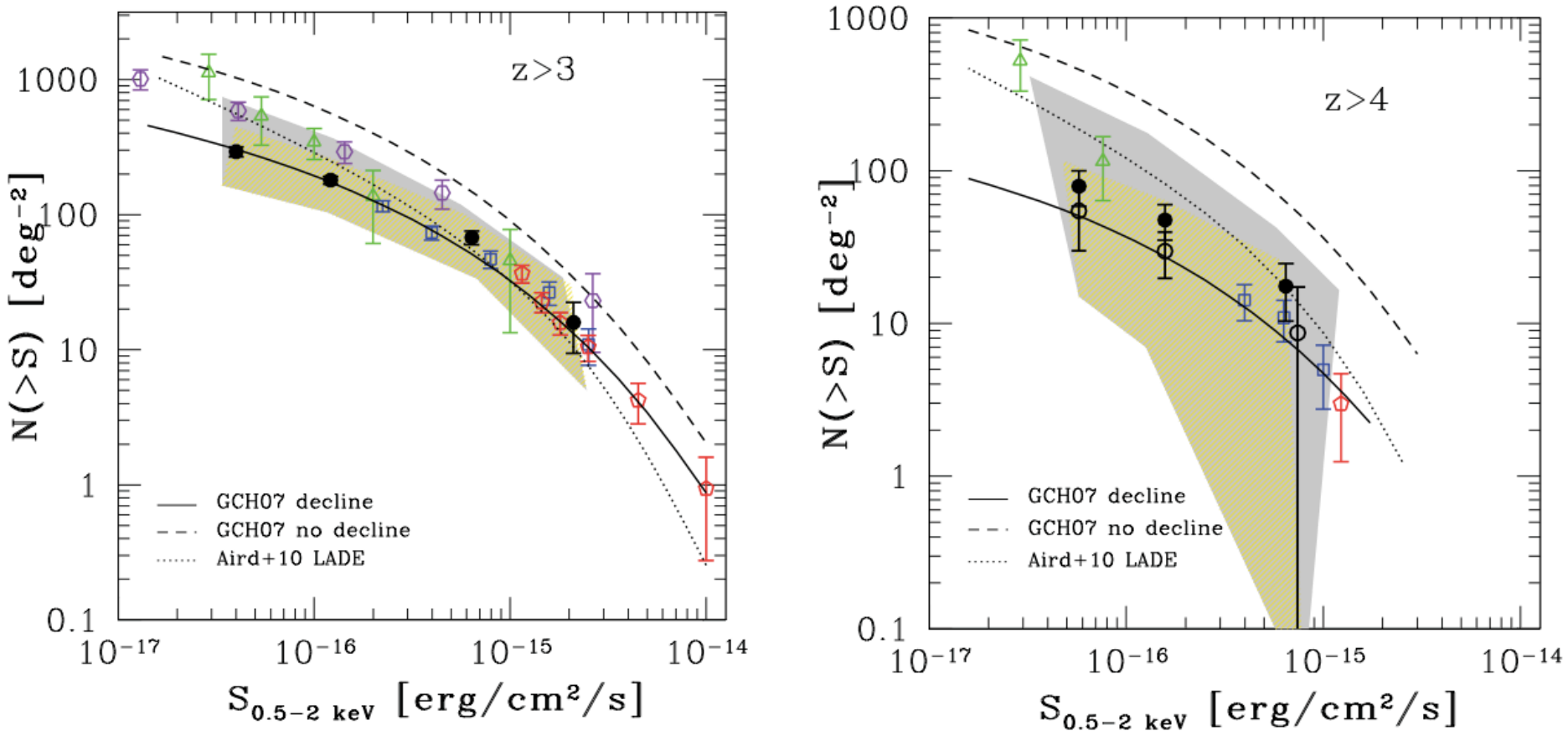
$N_H \sim 4 \times 10^{23} cm^{-2}$

Blueshift ~0.16*c*



High redshift

CDF-S Chandra 4 Ms survey



Vito et al 2013