X-ray spectroscopy of obscured (and unobscured) AGN

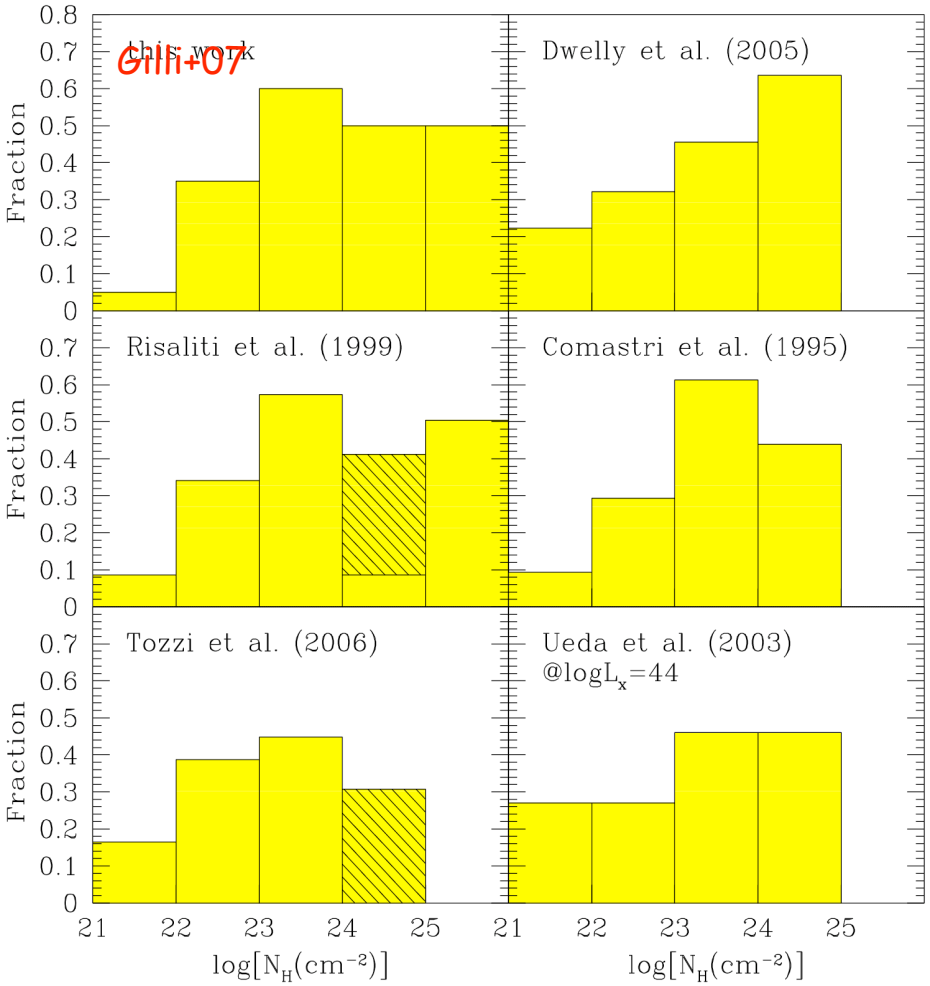
Andrea Comastri
INAF-Osservatorio Astronomico Bologna ITALY

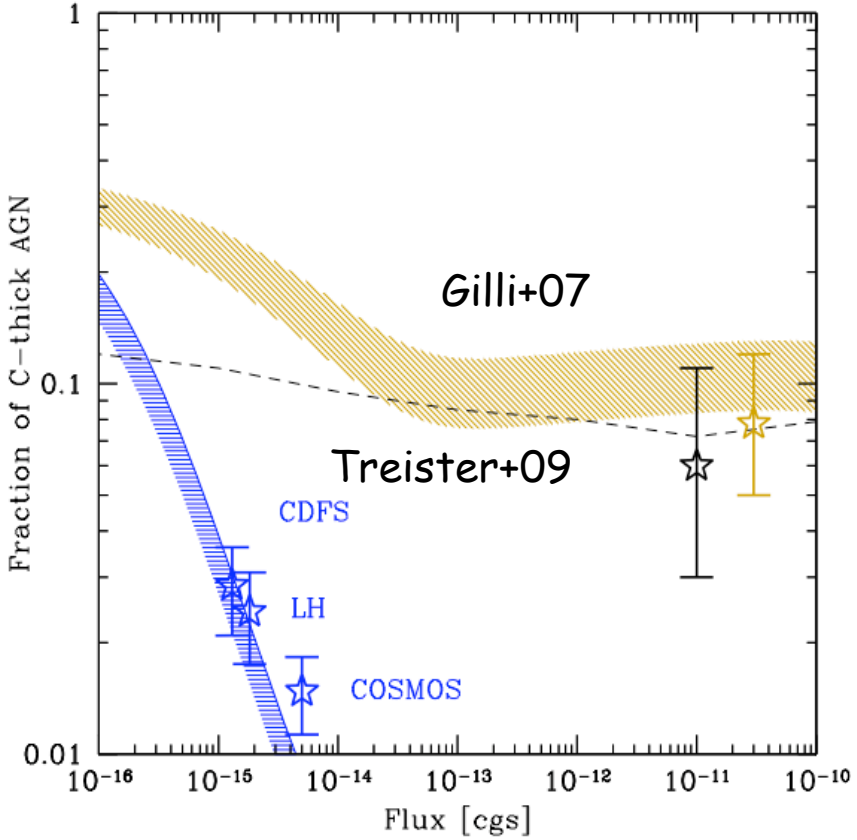
P. Ranalli (UniBO), R. Gilli (INAF-BO), C. Vignali (UniBO), K. Iwasawa (ICC-Barcelona), I. Georgantopoulos (INAF-BO), N. Cappelluti (INAF-BO), E. Rovilos (INAF-BO), X. Barcons (IFCA), F.J. Carrera (IFCA), S. Falocco (IFCA), M. Brusa (MPE), H. Brunner (MPE), I. Balestra (MPE), A. Merloni (MPE), A. Finoguenov (MPE), F. Civano (CfA), F. Fiore (INAF-Roma), F. Nicastro (INAF-Roma), S. Puccetti (ASI), V. Mainieri (ESO), P. Rosati (ESO), P. Tozzi (INAF-TS), N. Brandt (PSU), J. Silverman (IPMU)

Outline

- Search for and spectral characterization of the most obscured AGN beyond the local Universe
- Some recent results from the XMM deep field in the CDFS
- Average spectra (stacking)
- eROSITA perspectives

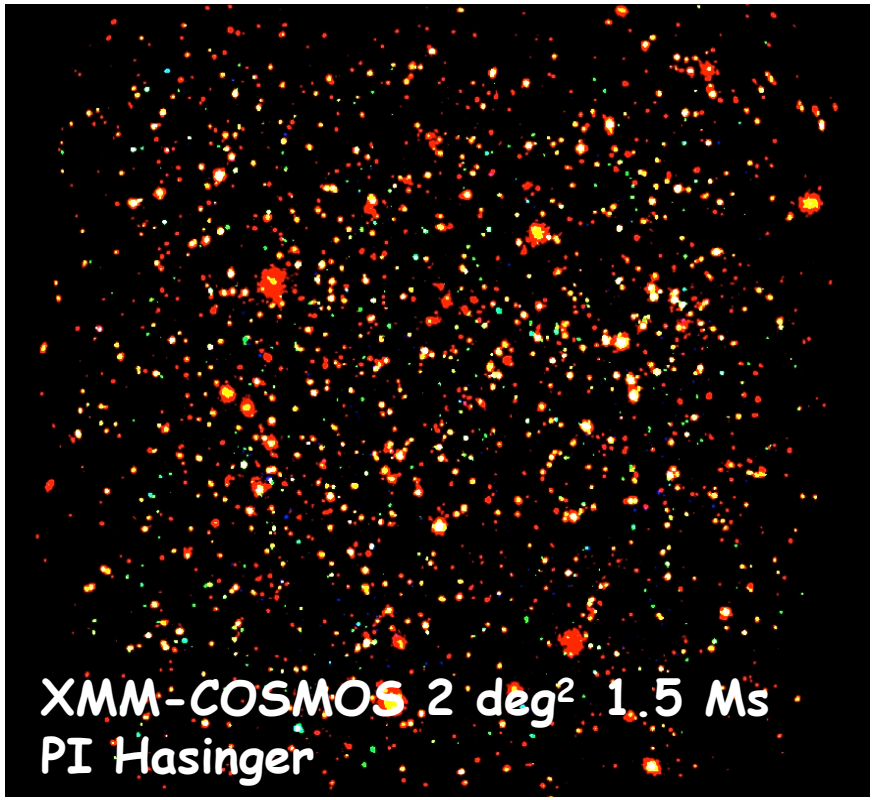
Obscured Accretion

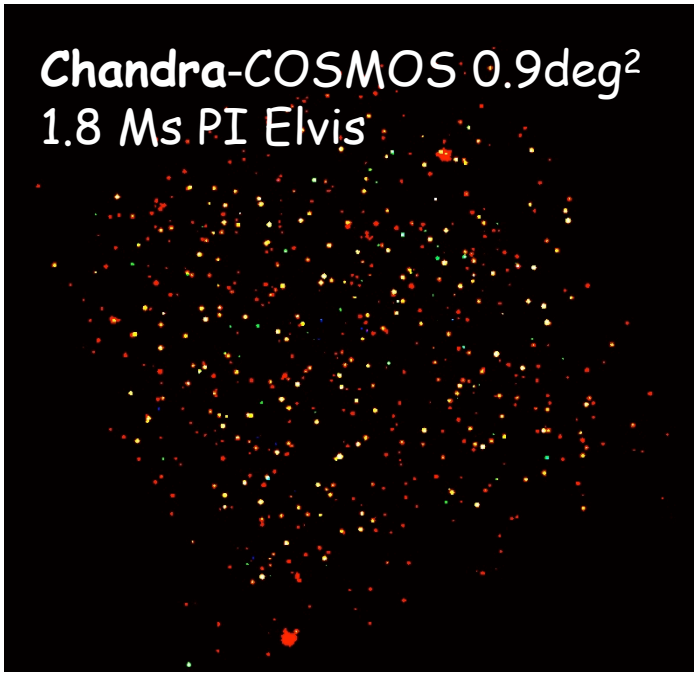


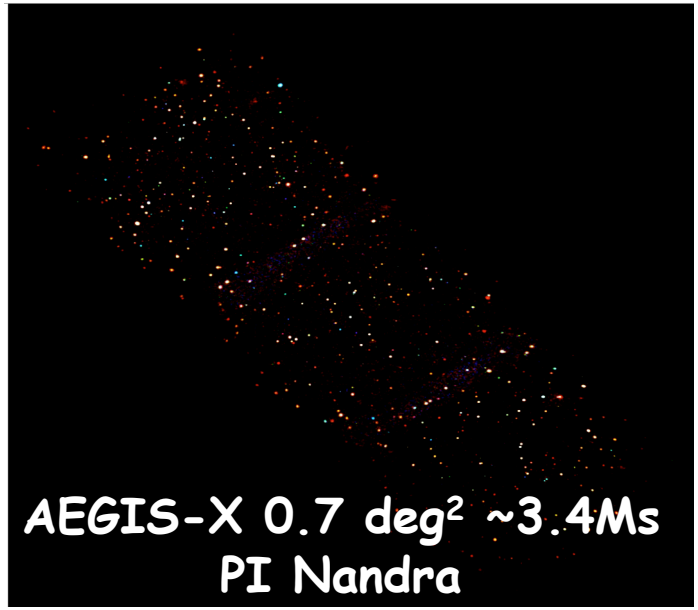


Heavily obscured and Compton thick are dominant but yet poorly constrained especially at high-z and high-L

"Large" area X-ray surveys



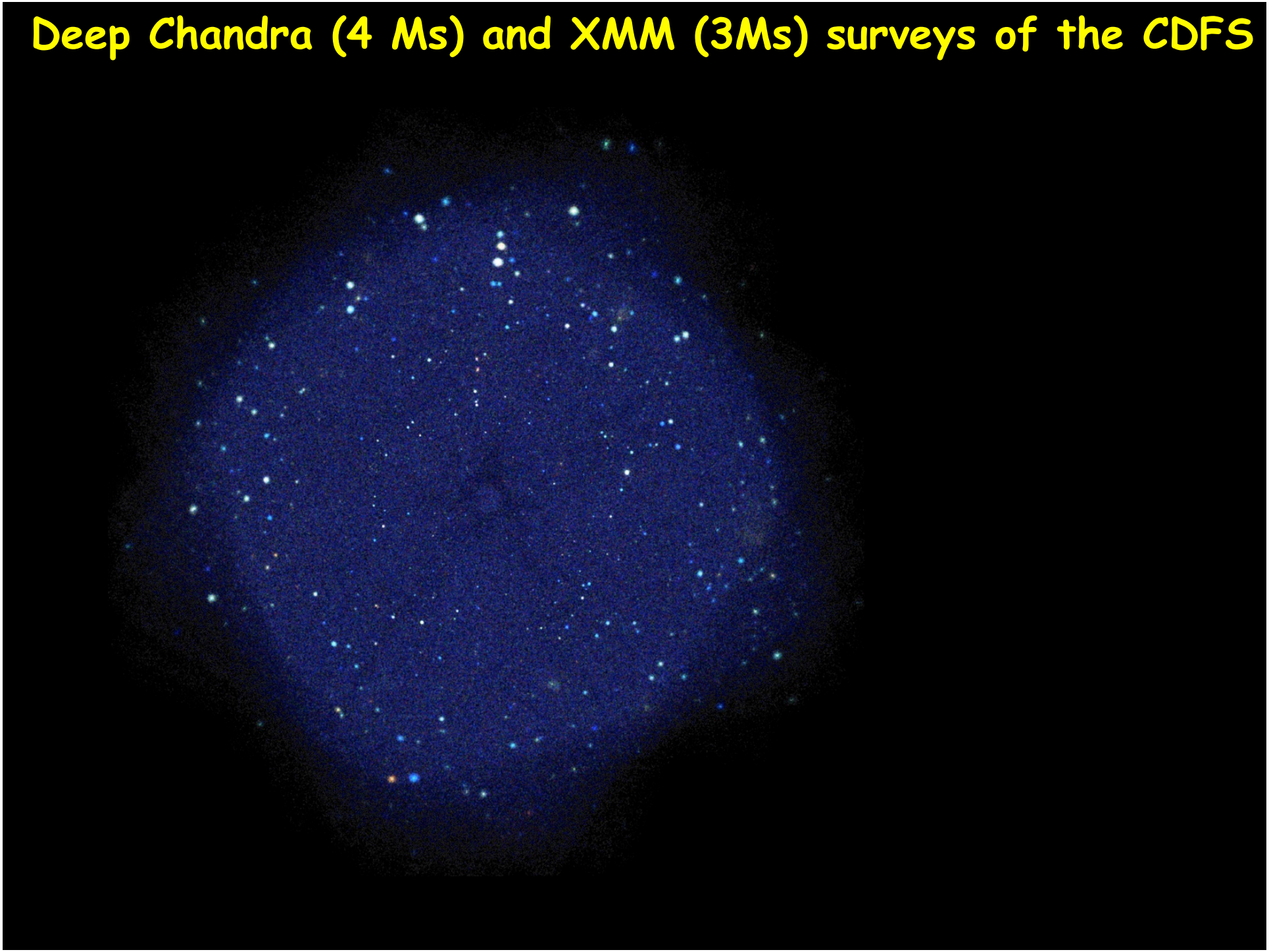




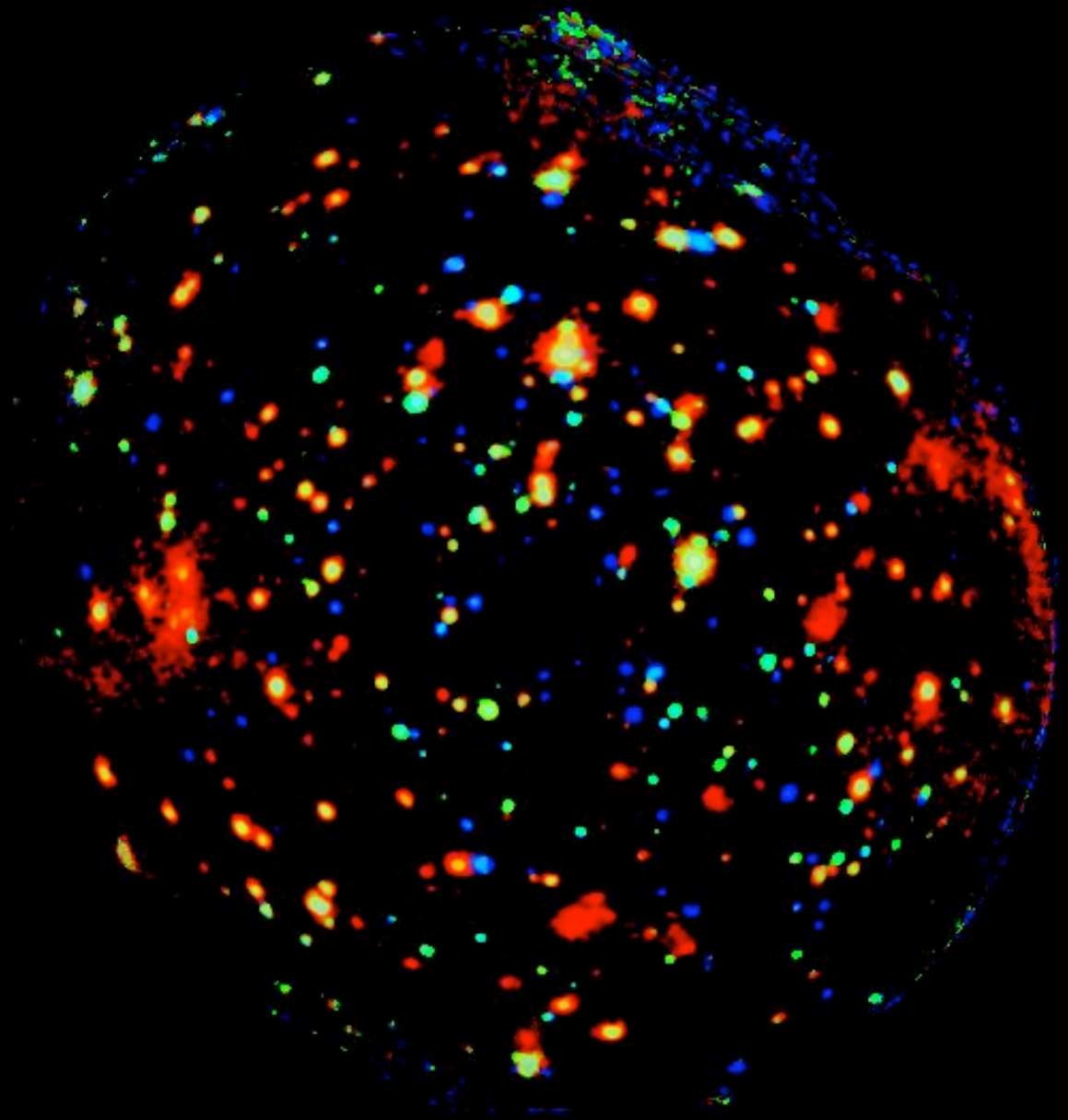
Very Large & Extra Large

XXL Pierre talk
XMM SS Watson talk

Deep Chandra (4 Ms) and XMM (3Ms) surveys of the CDFS



Deep Chandra (4 Ms) and XMM (3Ms) surveys of the CDFS



~0.3 deg^2

Goals:

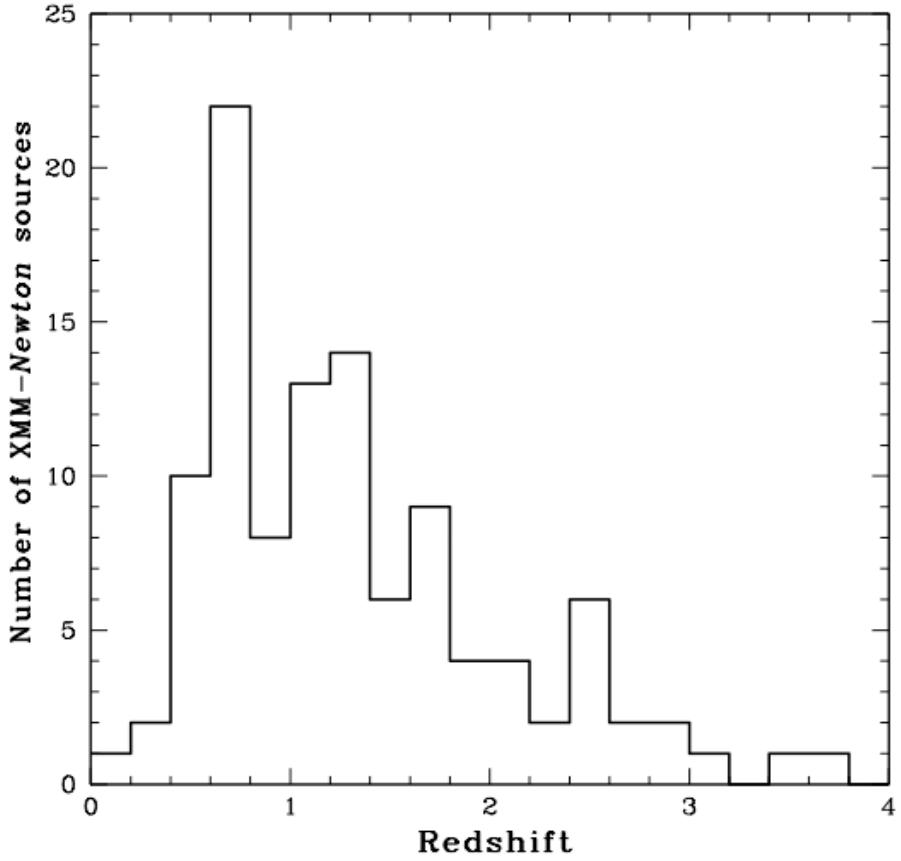
Resolve the XRB in the 5-10 keV band

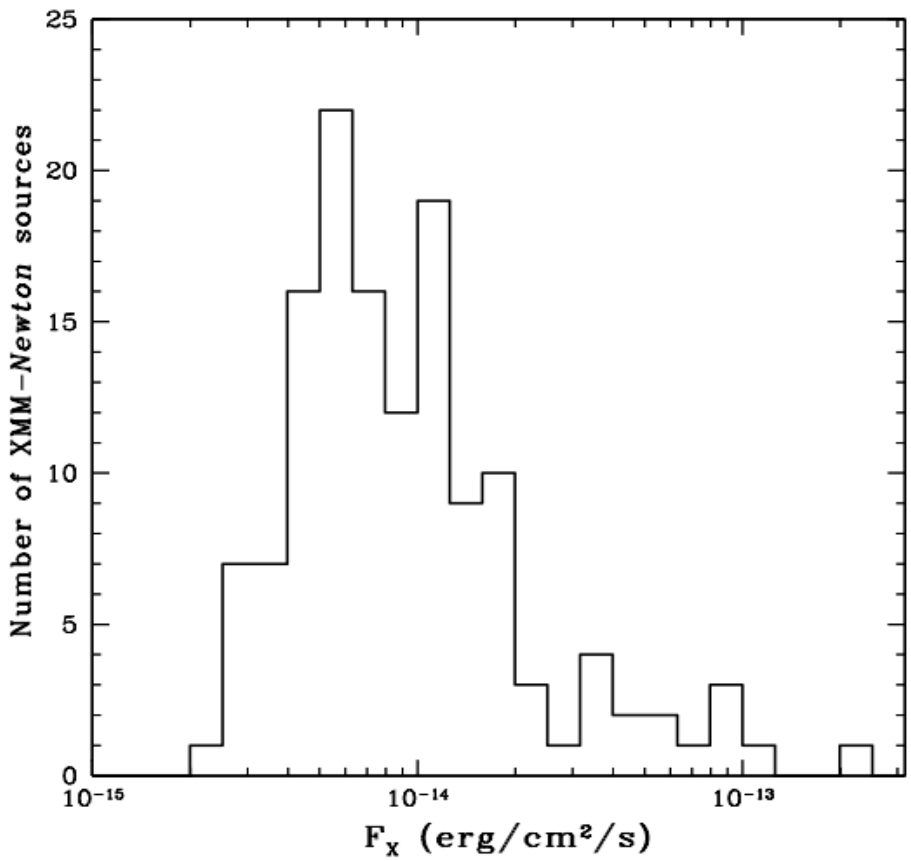
Fine spectroscopy of distant heavily obscured AGN

red = 0.4 -1 keV
green = 1 - 2 keV
blue = 2 -8 keV

Spectral Analysis

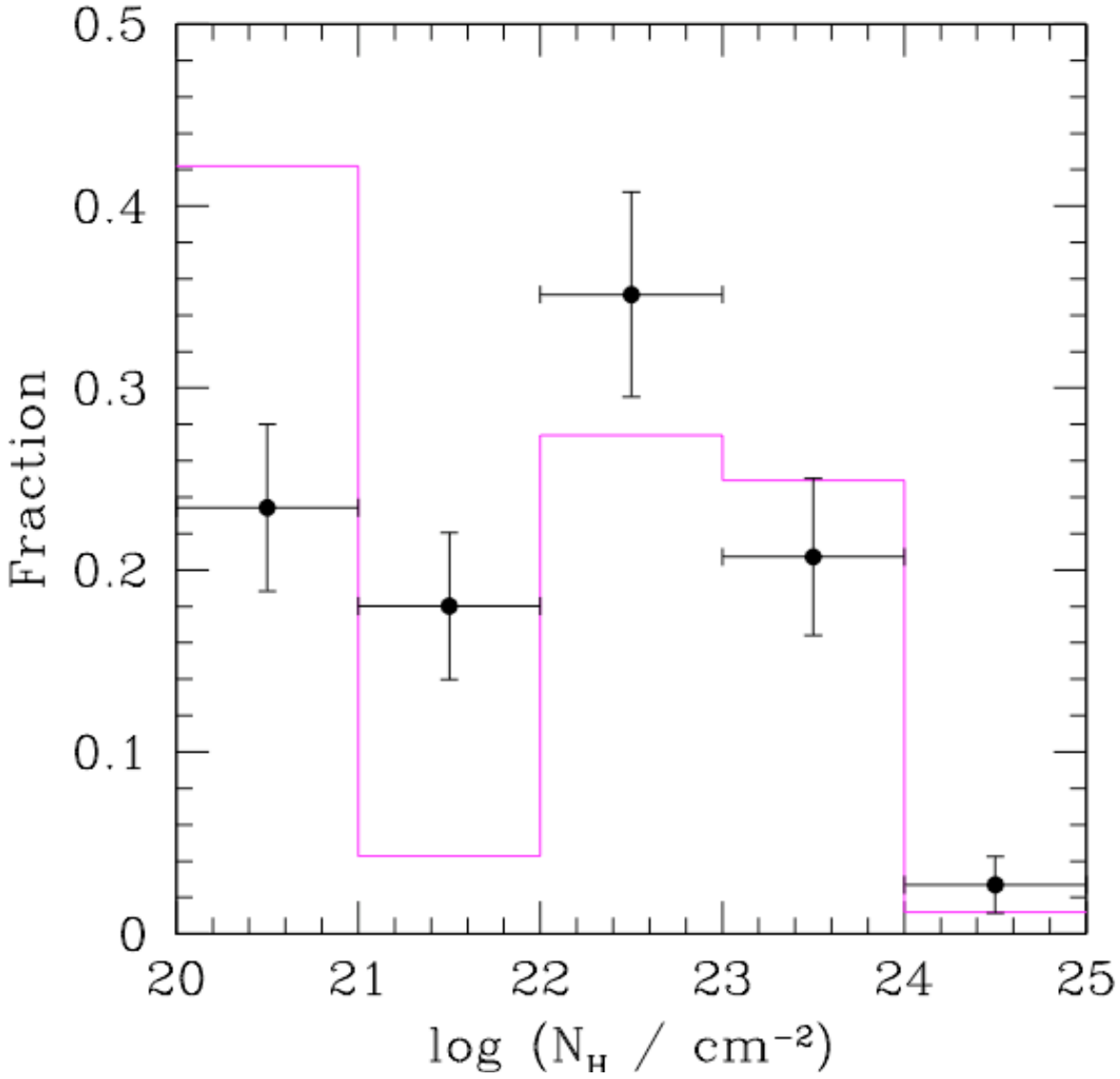
Bright sample -> 130 sources





2-10 keV, >10σ AND 1 Ms exposure

Absorption Distribution

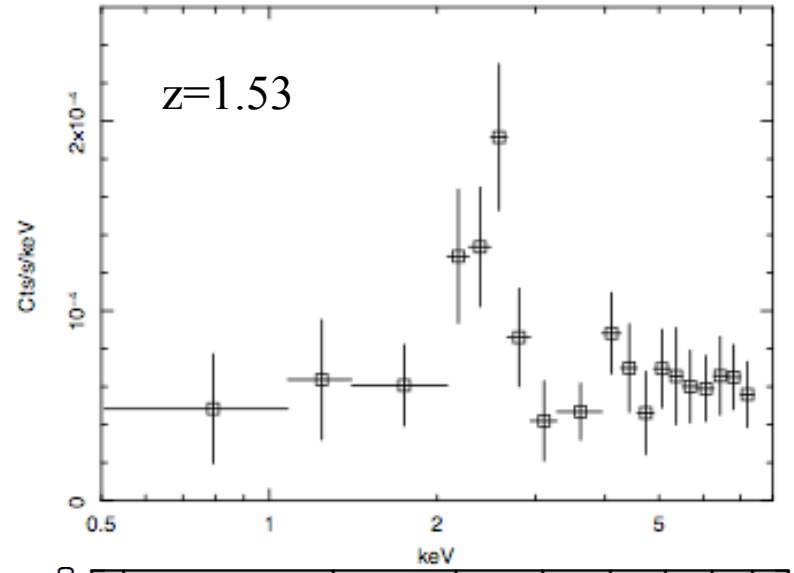


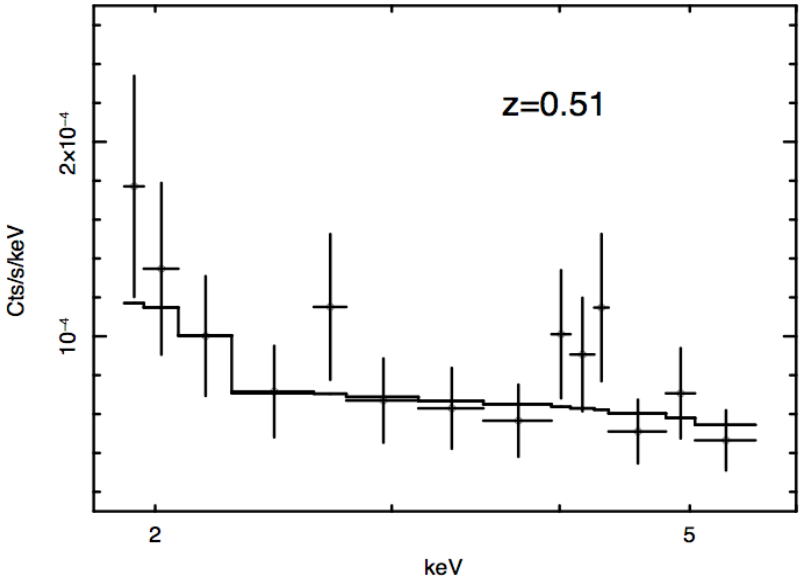
Observed
vs
Predicted (*GCH07*)
(folded with sky cov.)

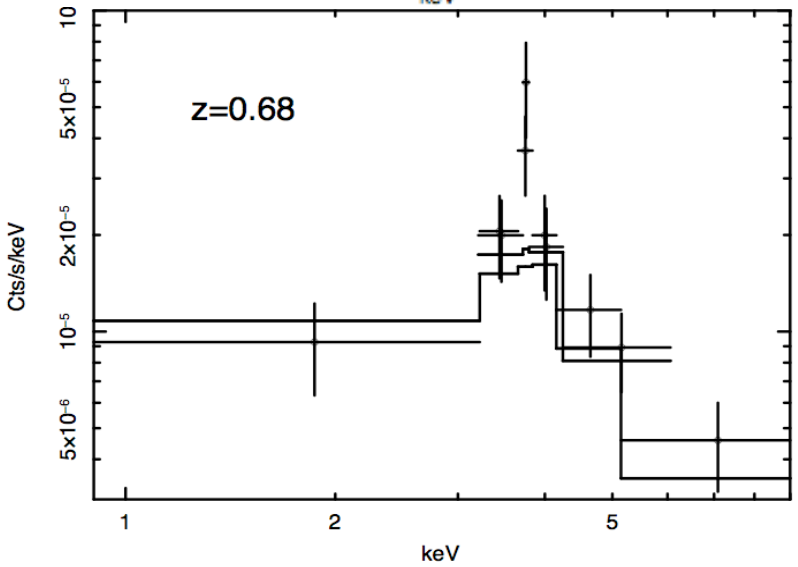
$\log N_H < 22$?

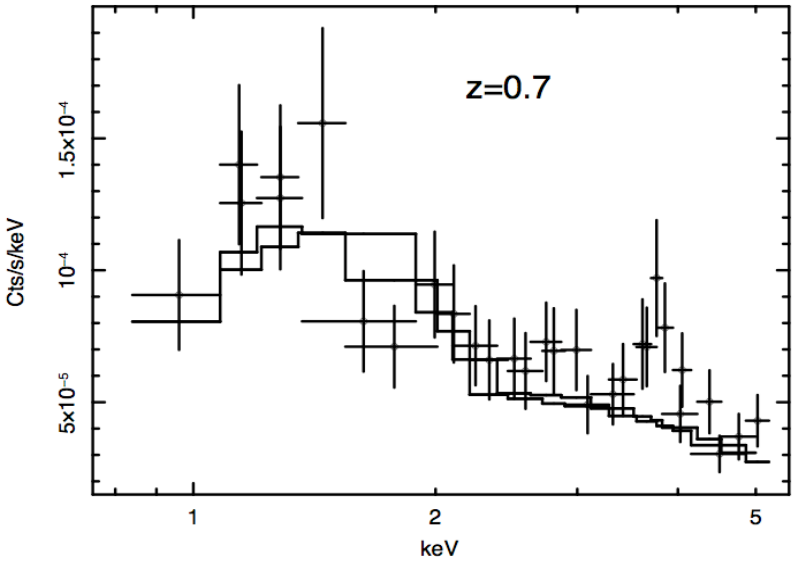
Uncertainties associated to N_H measurements at low column densities
Or
revise model parameters

Distant C-thick AGN in the XMM-CDFS



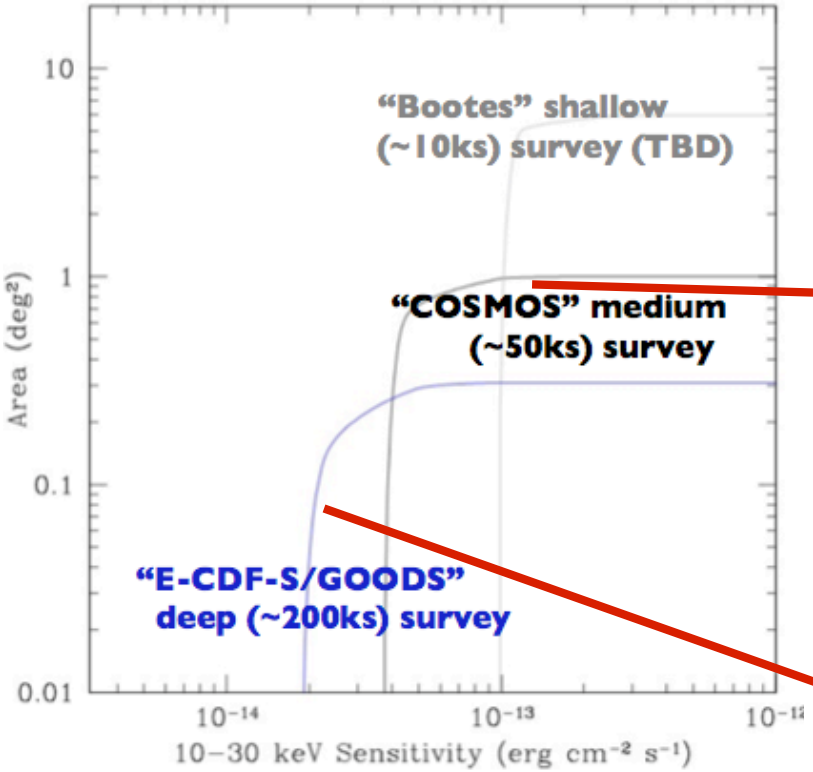


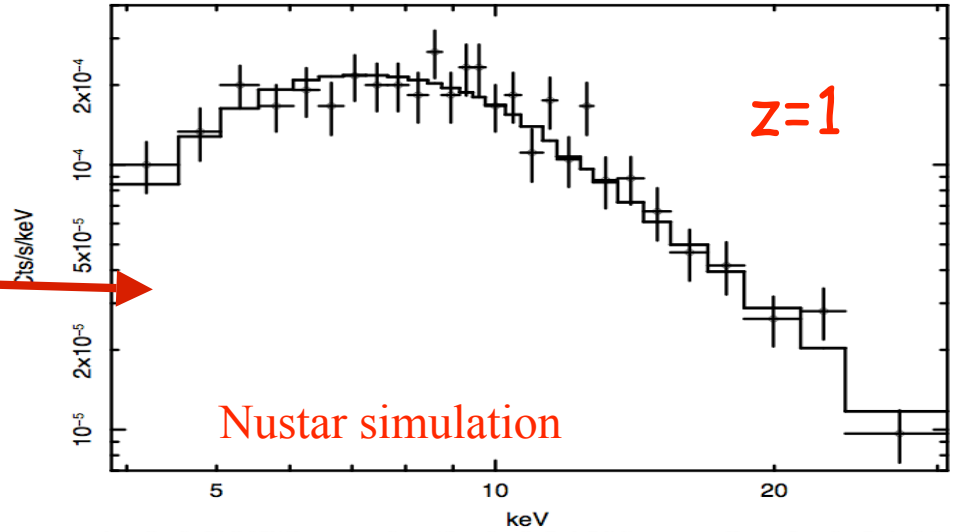


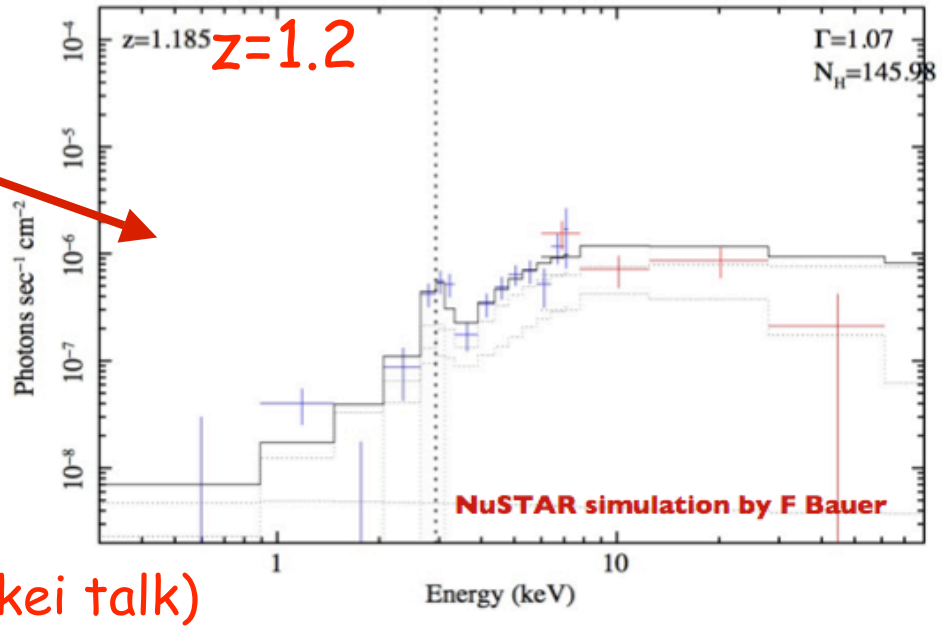


4 out of ~ 50 (Herschel sub-sample) reflection dominated !

Compton thick AGN (> 10 keV)



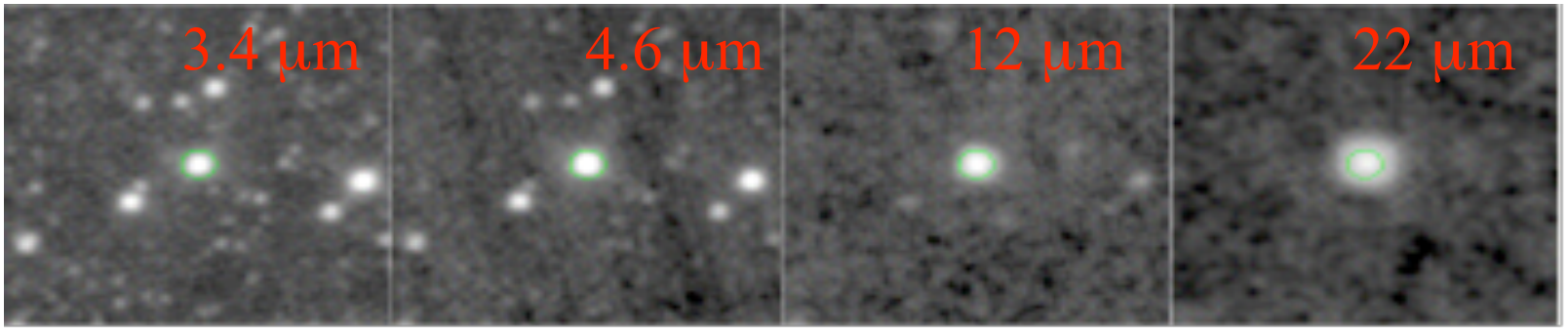




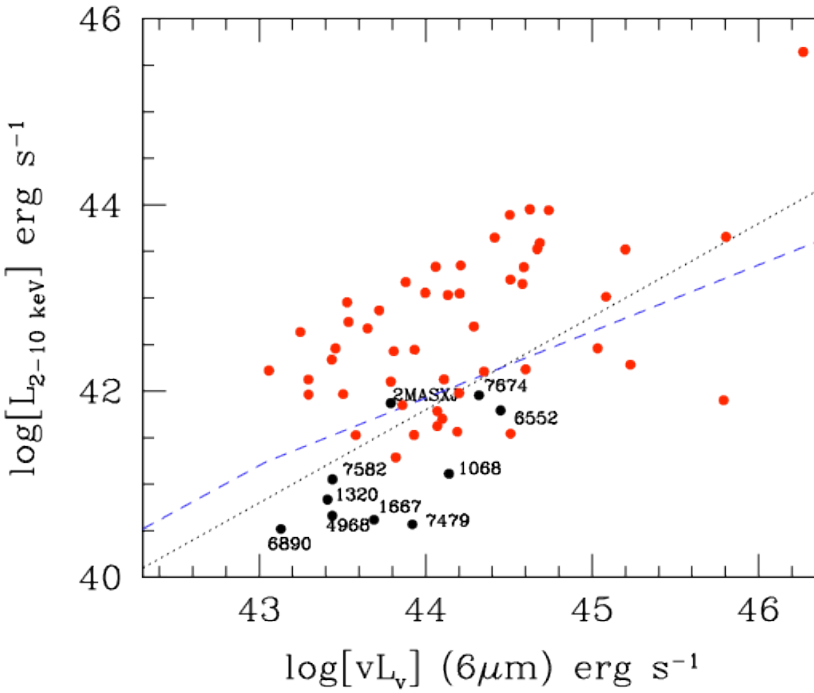
NuSTAR survey strategy
(Harrison talk)

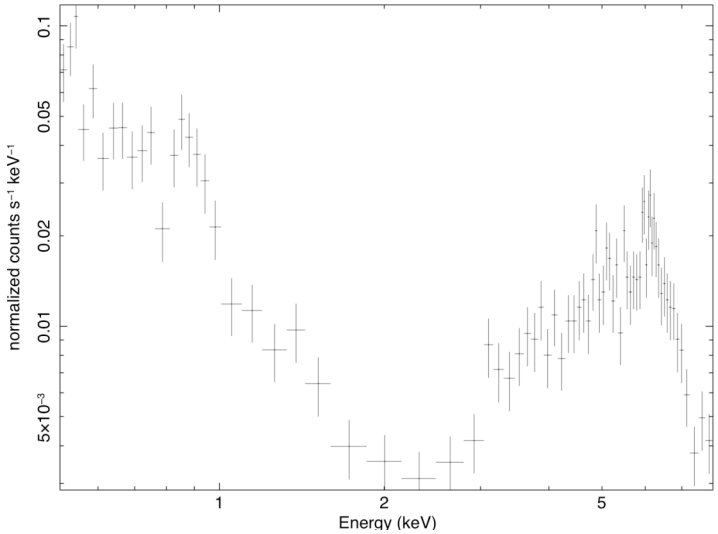
Bright tail (local Universe)
accessible by ART-XC
(Pavlinsky talk) and ASTRO-H (Takei talk)

Heavily Obscured AGN: IR selection



WISE Images

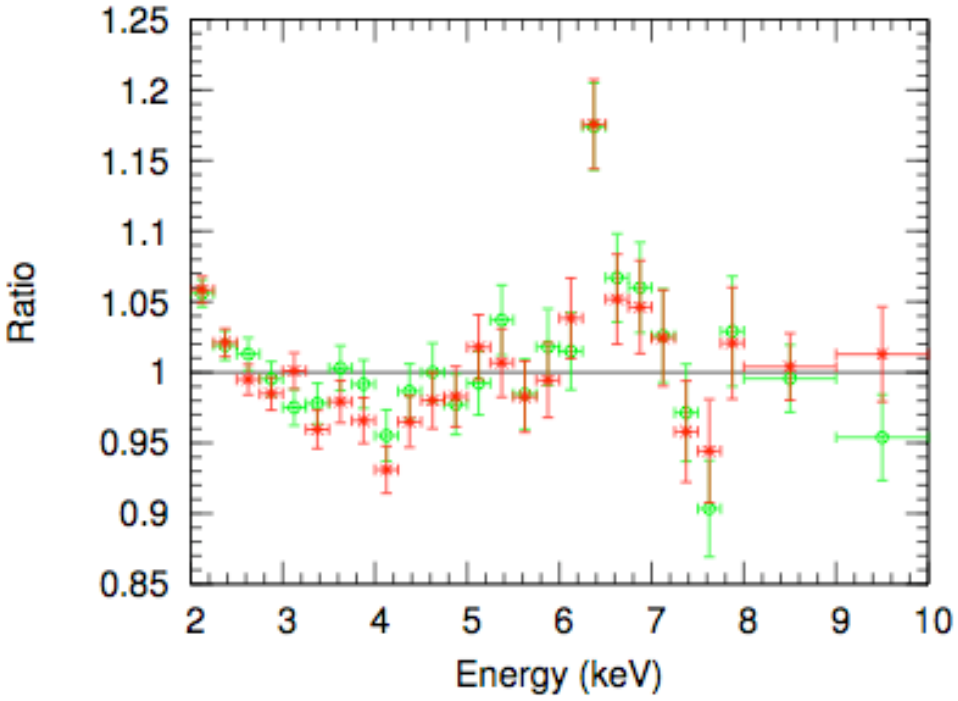


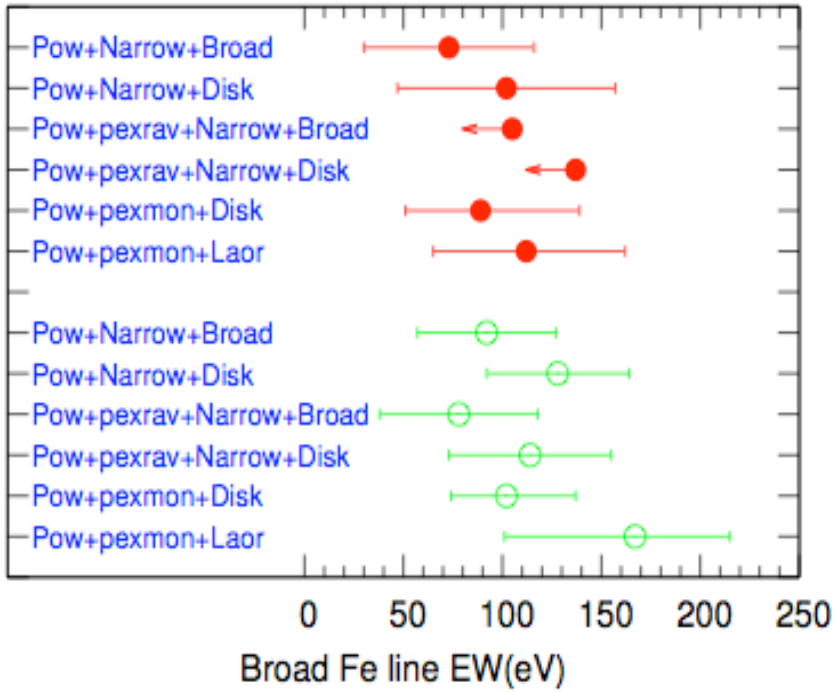


Black dots CT from Brightman & Nandra 11
Local Universe (z < 0.1)

Georgantopoulos+11 & poster

Stacking

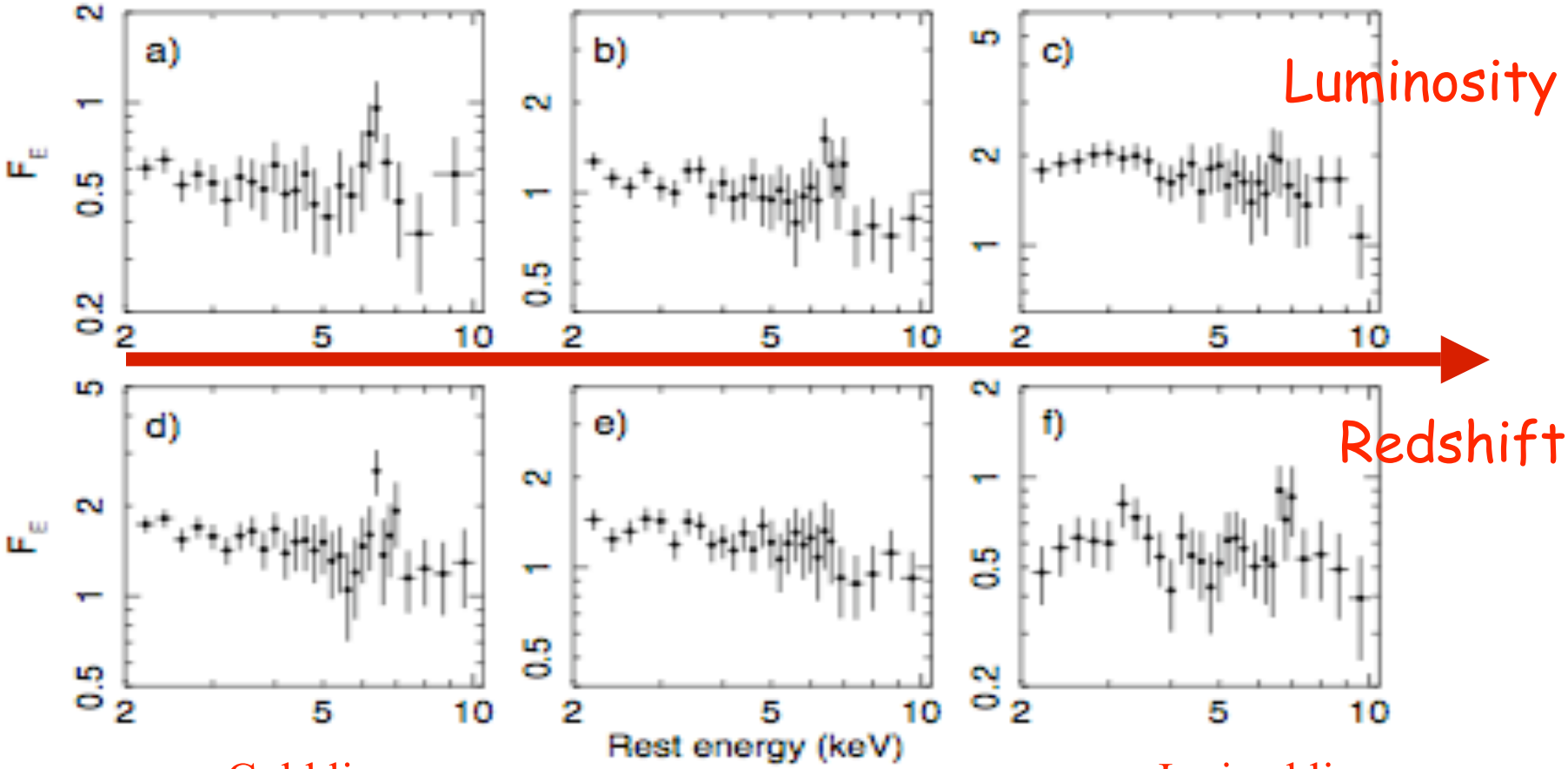




250 sources from 2XMM relatively low redshift
200,000 counts in the 2-10 keV (all sources)

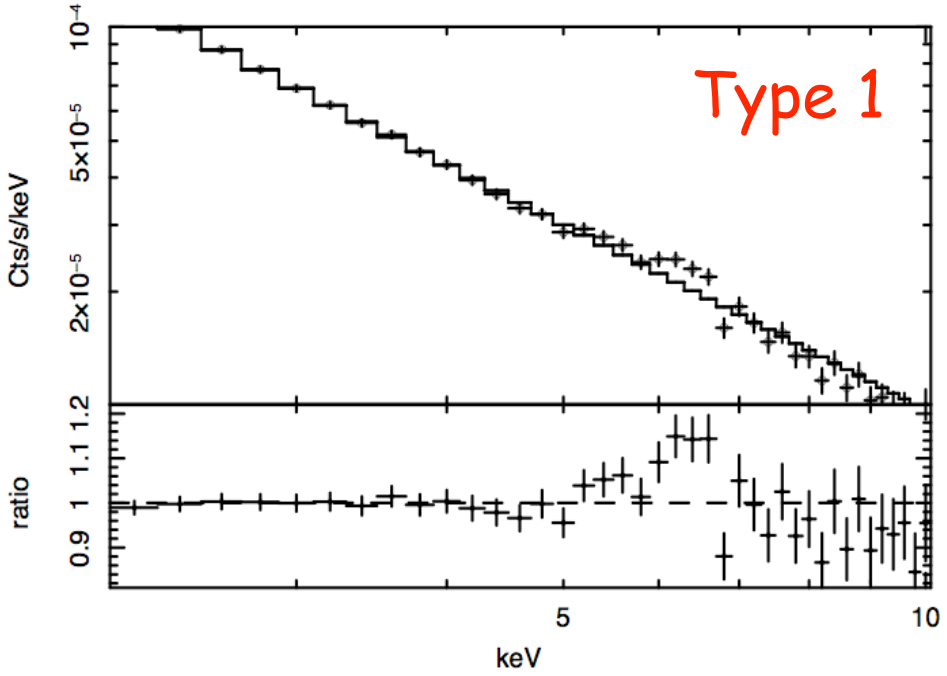
Chaudhary+11 arXiv yesterday

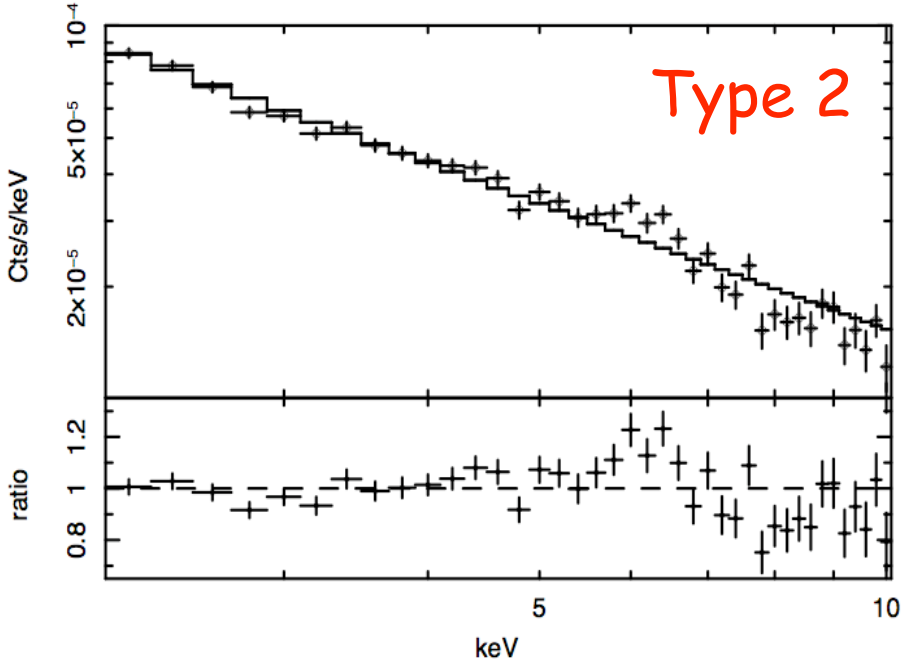
Stacking-XMM-COSMOS



Type 2 AGN Iwasawa+11 submitted
~29,000 counts
Iron intensity and energy (ionization) are L & z dependent

Stacking-XMM-CDFS



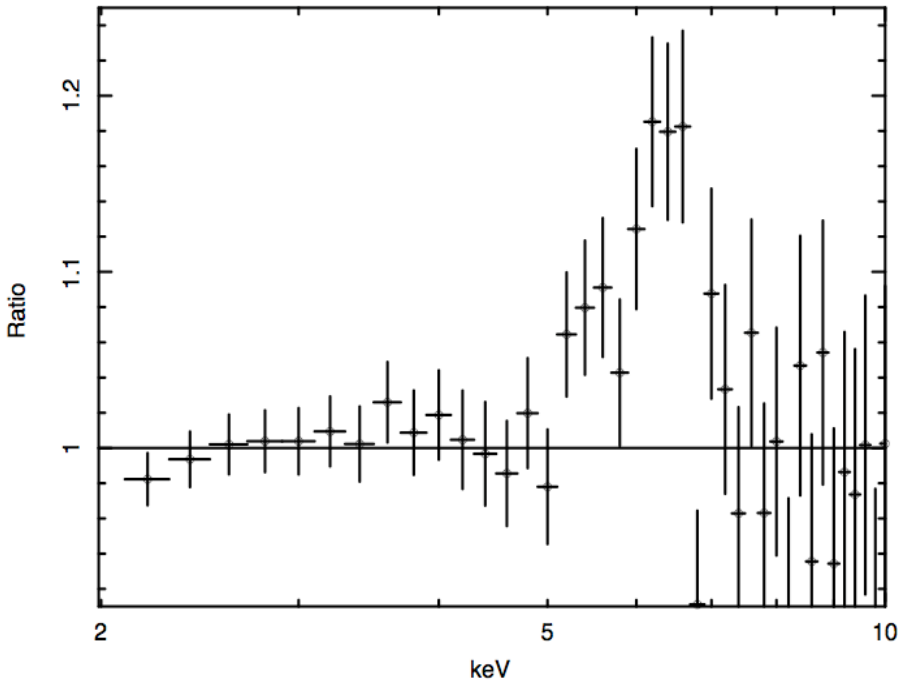


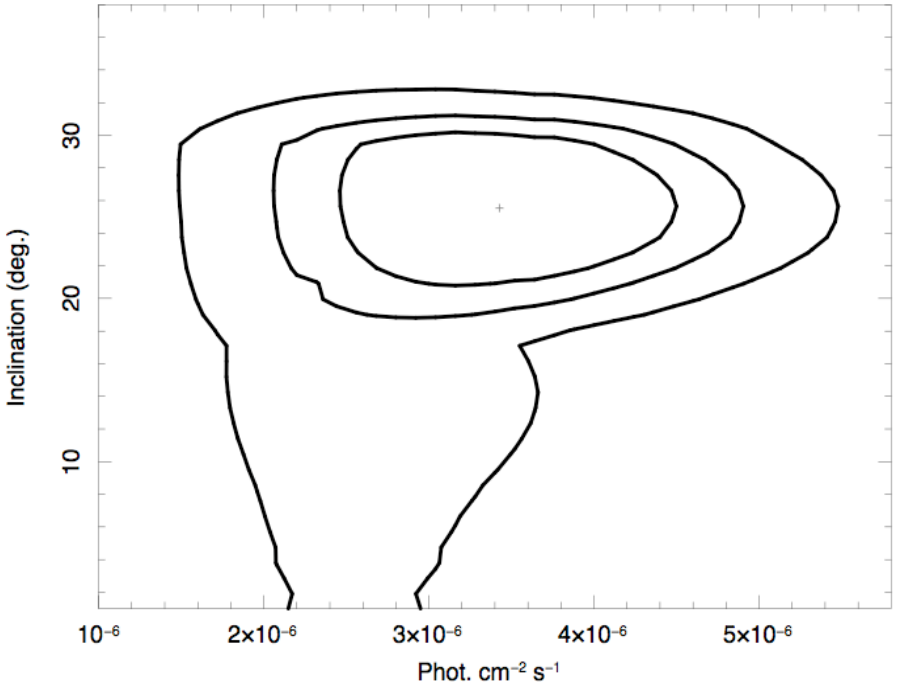
6.4 & 6 keV lines
Photo-z unc?

> 100,000 counts "Type1" un-obscured NOTBLAGN
>~ 60,000 counts "Type 2" obscured -NOT Type 1

Falocco & Iwasawa et al in preparation

Stacking-XMM-CDFS

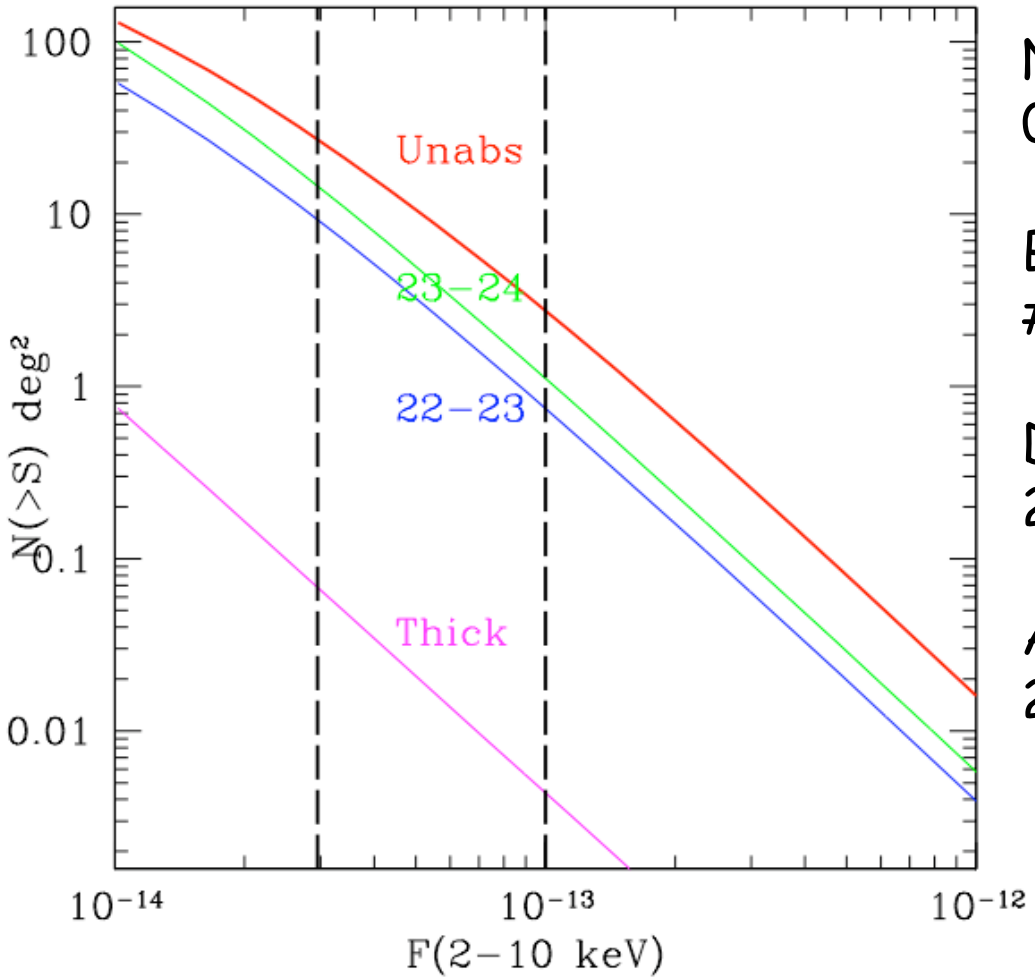




Residuals wrt Power law
fit $\Gamma \sim 1.7$
Line EQW ~ 170 eV

Power law plus R=1 reflection component plus disk line

eROSITA "grasp"



Number of sources per sq. deg
0.5 < z < 3

Back of the envelope
#Unobs ~ #Thin

Deep survey
200x30x30 ~ 90.000

All Sky
20000 x 3 x 30 ~ 900.000

Gilli, AC, Hasinger 2007

Summary

Spectral properties of obscured AGN are being studied by current satellites (XMM and Chandra)

Limited by the relatively low sample sizes

Well defined samples (i.e. Unobscured in XMM with spectro-z) may constrain iron line average properties

eROSITA (all-sky+ deep surveys)
Large samples -> populate L, z, N_H , … bins

Need: Large Redshifts Surveys &
Spectral Products