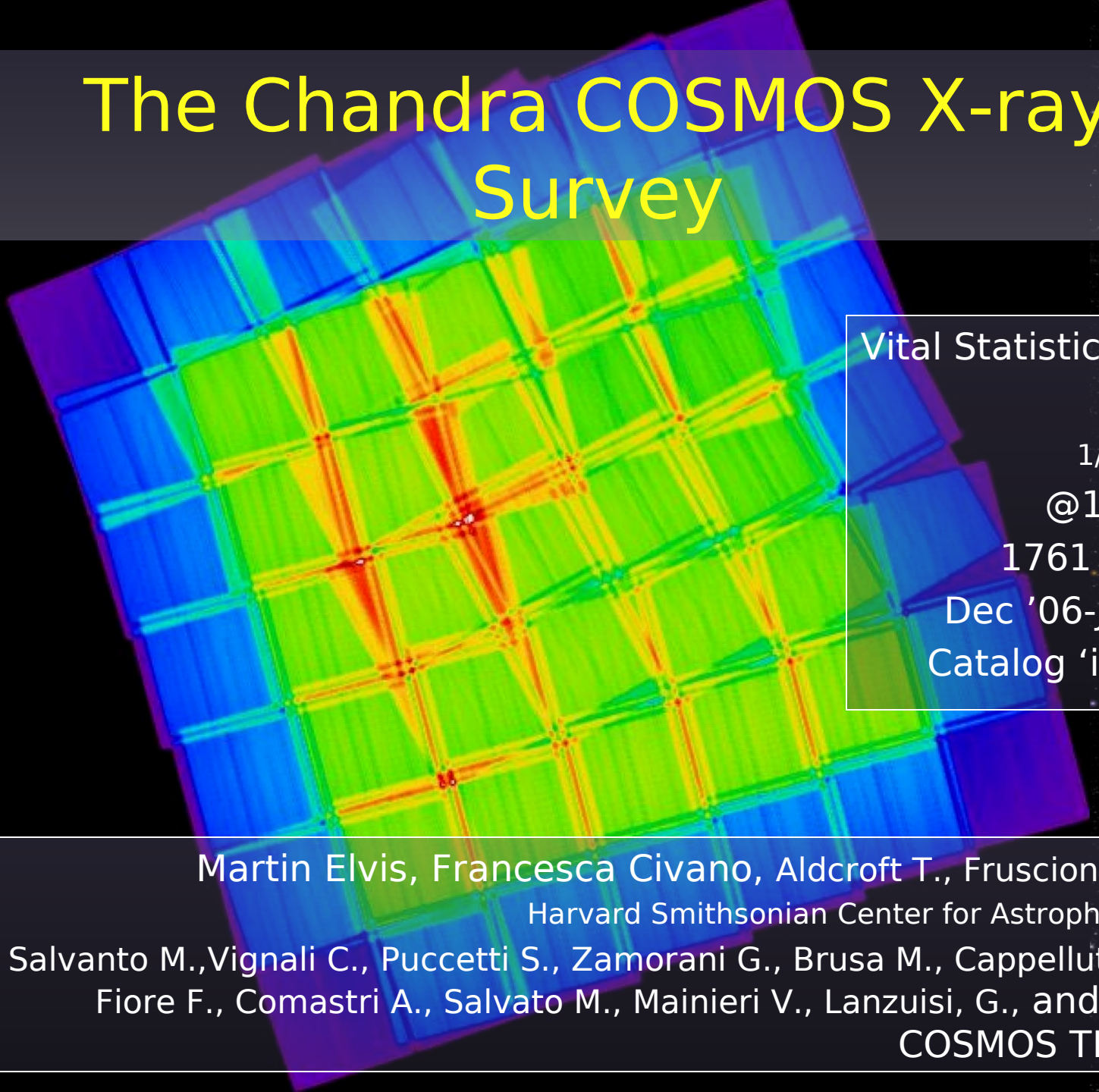
The Chandra COSMOS X-ray Survey

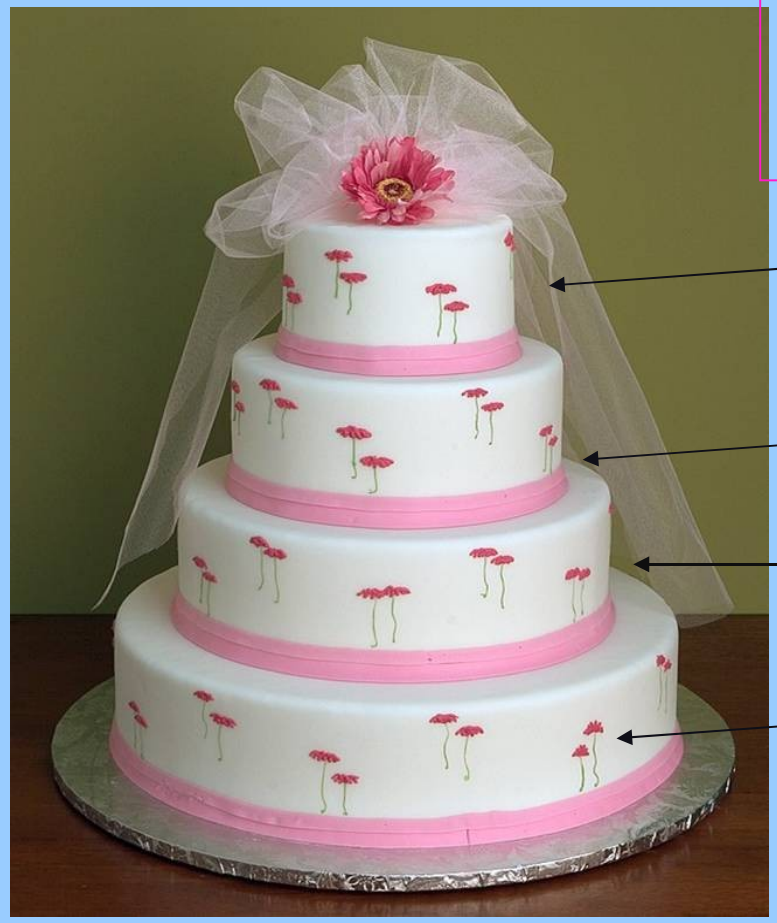


Vital Statistics:
1.8 Ms
1/2sq.deg
@160 ksec
1761 sources
Dec ’06-June ’07
Catalog ‘in press’ ApJS

Martin Elvis, Francesca Civano, Aldcroft T., Fruscione A.,
Harvard Smithsonian Center for Astrophysics
Salvanto M.,Vignali C., Puccetti S., Zamorani G., Brusa M., Cappelluti N., Fiore F., Comastri A., Salvato M., Mainieri V., Lanzuisi, G., and the COSMOS TEAM

Another X-ray Survey?

Chandra COSMOS hits a Sweet Spot, in 3 ways



Wedding cake Diagram

CDFs

COSMOS

Champ

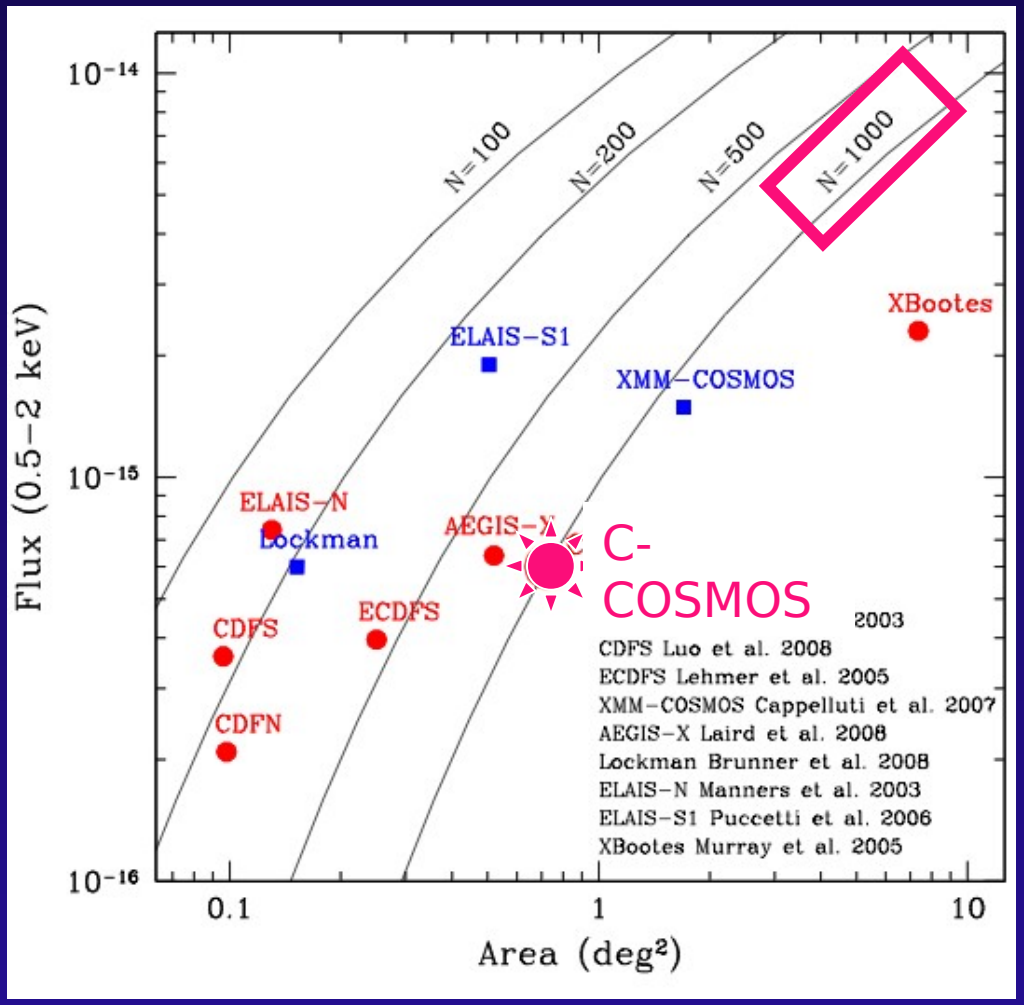
XBootes

Flux

AREA

Chandra COSMOS 1: Large Numbers

Statistics + Rare objects



1761 point sources

f_x > 2e-16cgs 0.5-2 keV

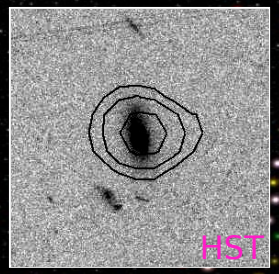
4 x fainter than XMM-COSMOS

Flux at 80% of the area

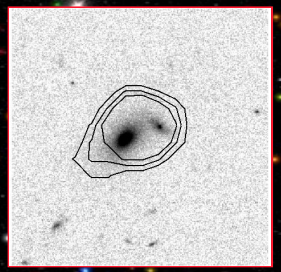
Chandra COSMOS: 2. *Matched* Opt/IR depth

>95% identified, 40+ photometric bands: *instant* SEDs, accurate phot-z

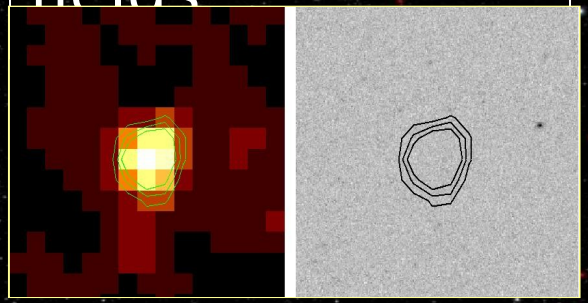
96% secure IDs

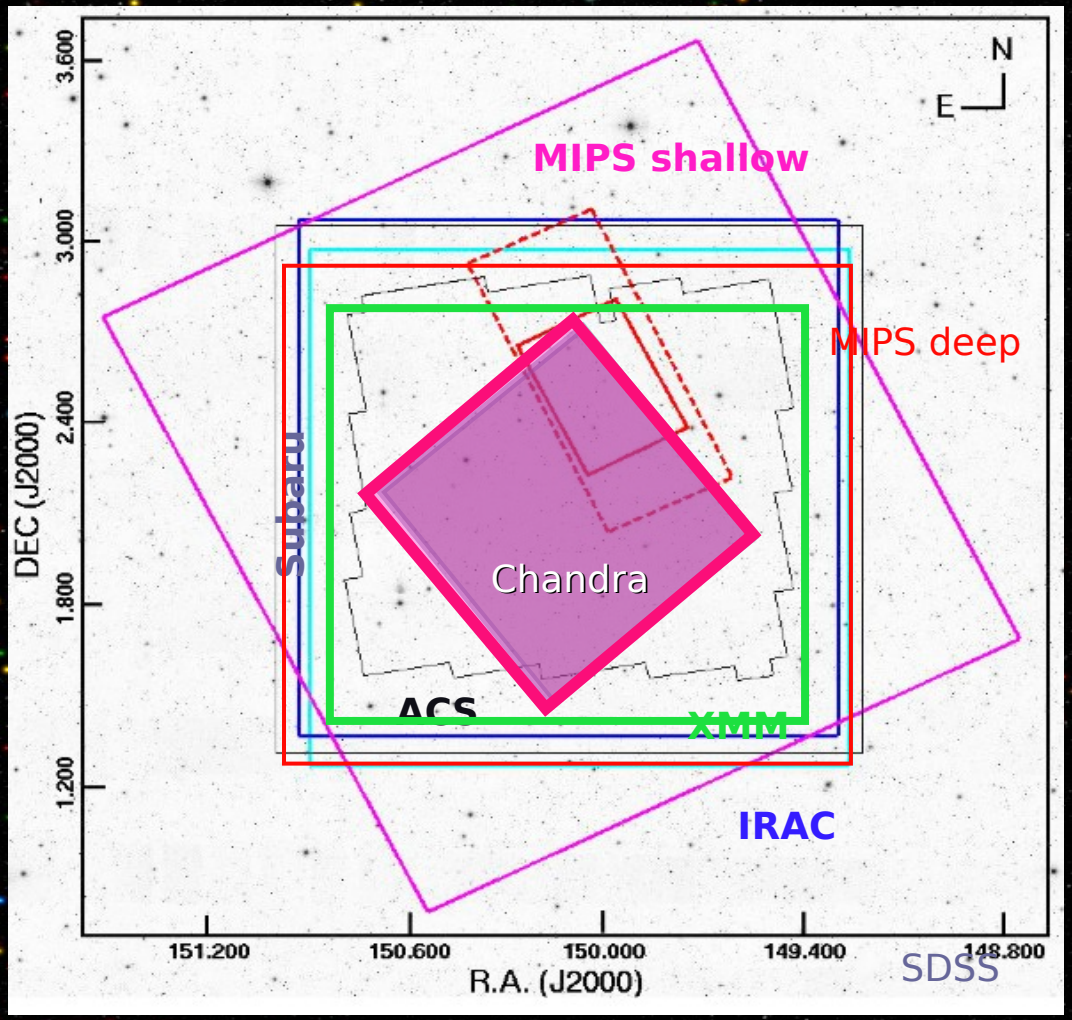


1.2% ambiguous IDs



0.3% blank fields





Chandra COSMOS: 2. *Matched* Opt/IR depth

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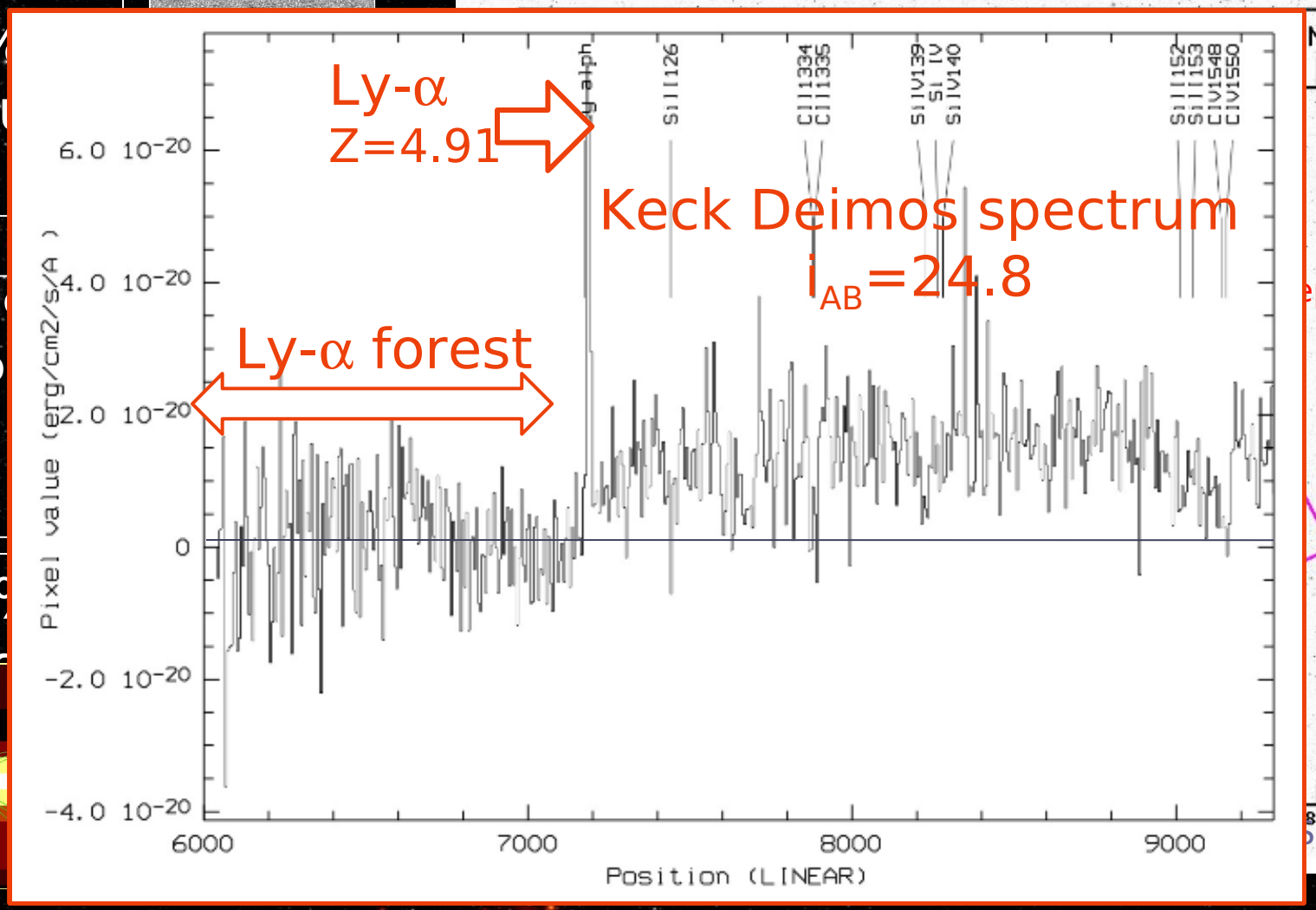
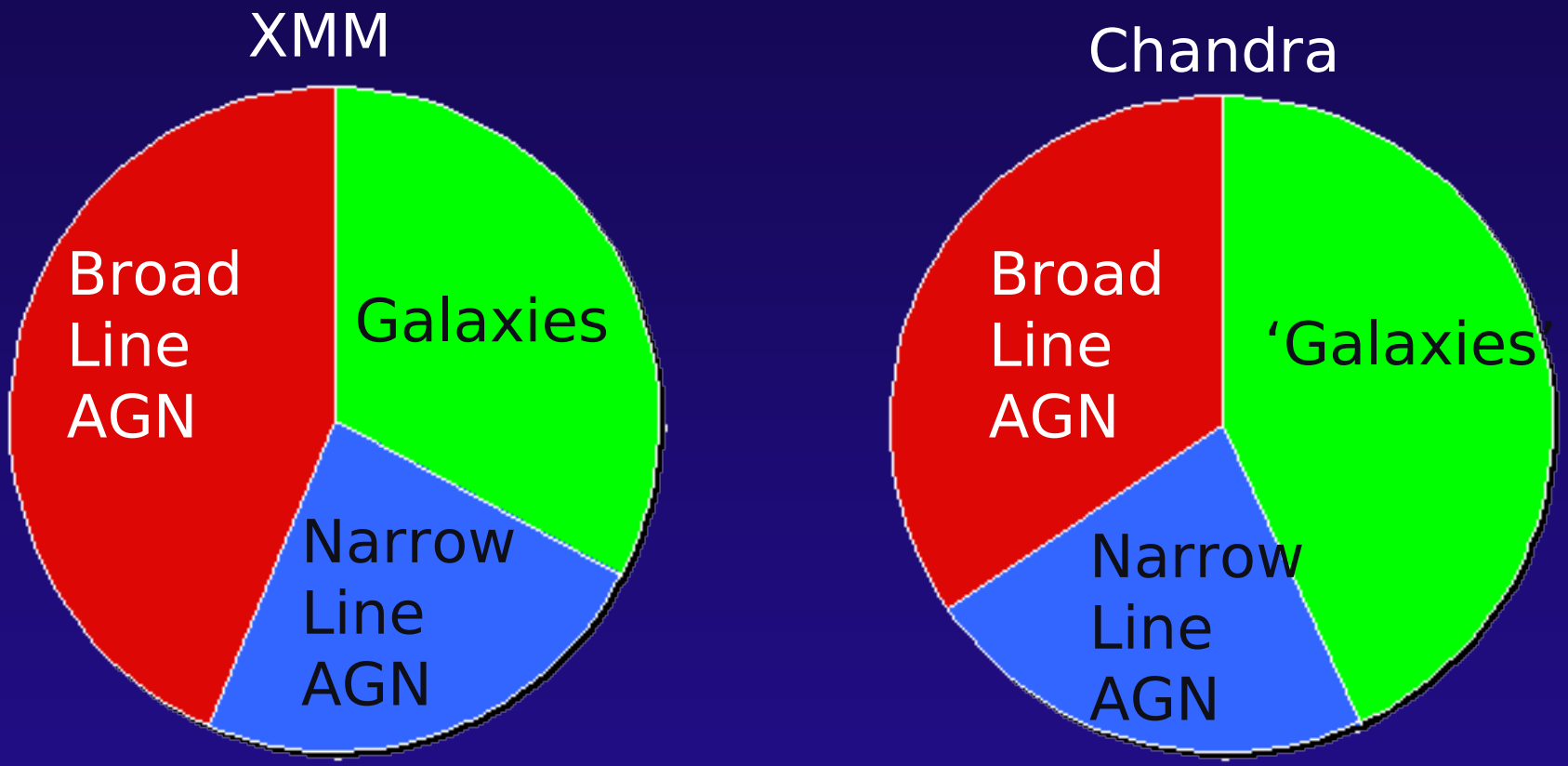


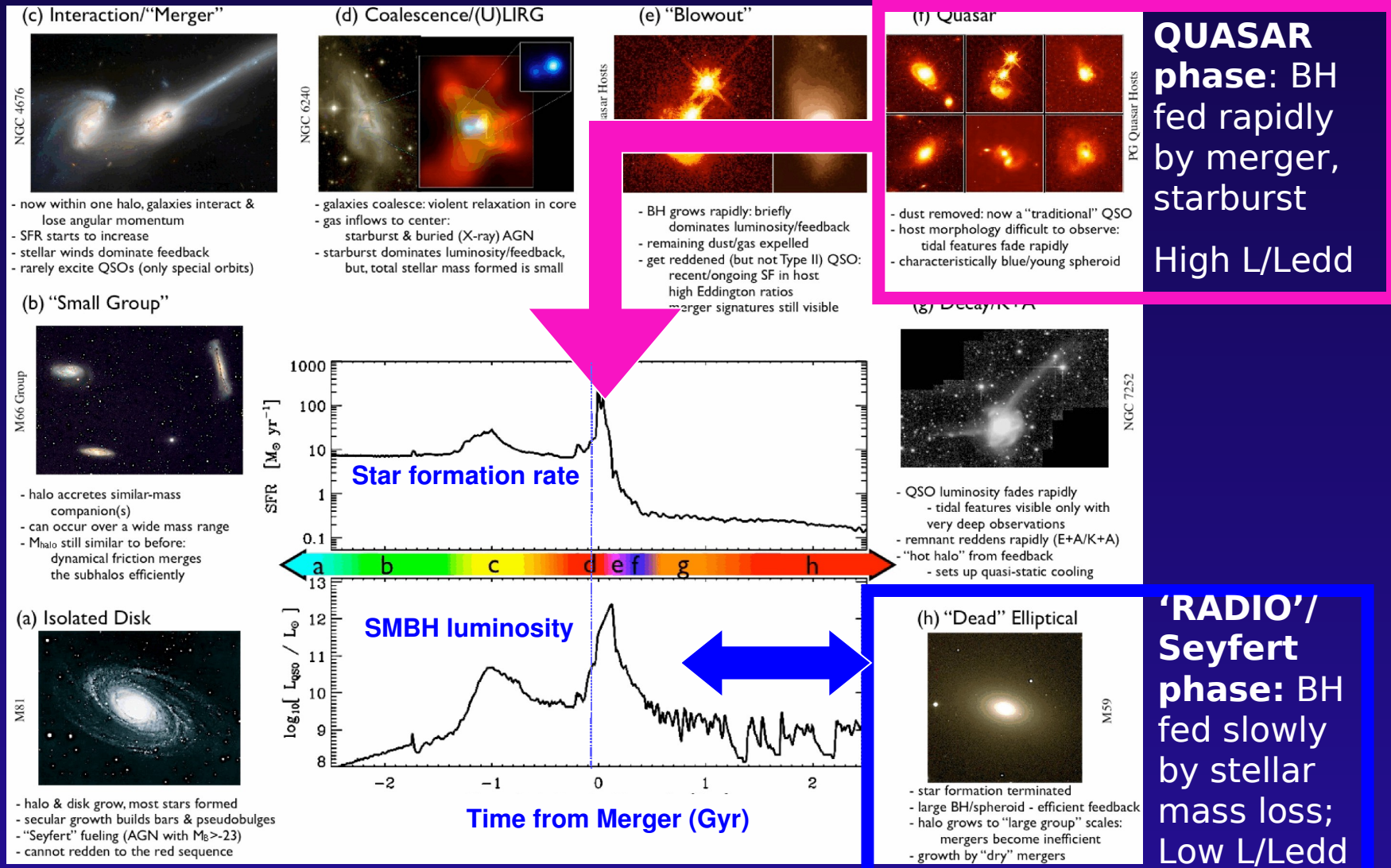
Chandra COSMOS 3: *Not Just More AGN*

Chandra-COSMOS reaches to a flux where galaxies outnumber type 1 AGN



SED FITTING TEMPLATE results
Salvato et al., 2009, Civano et al. 2009

Galaxy/SMBH co-evolution via Mergers



QUASAR phase: BH fed rapidly by merger, starburst

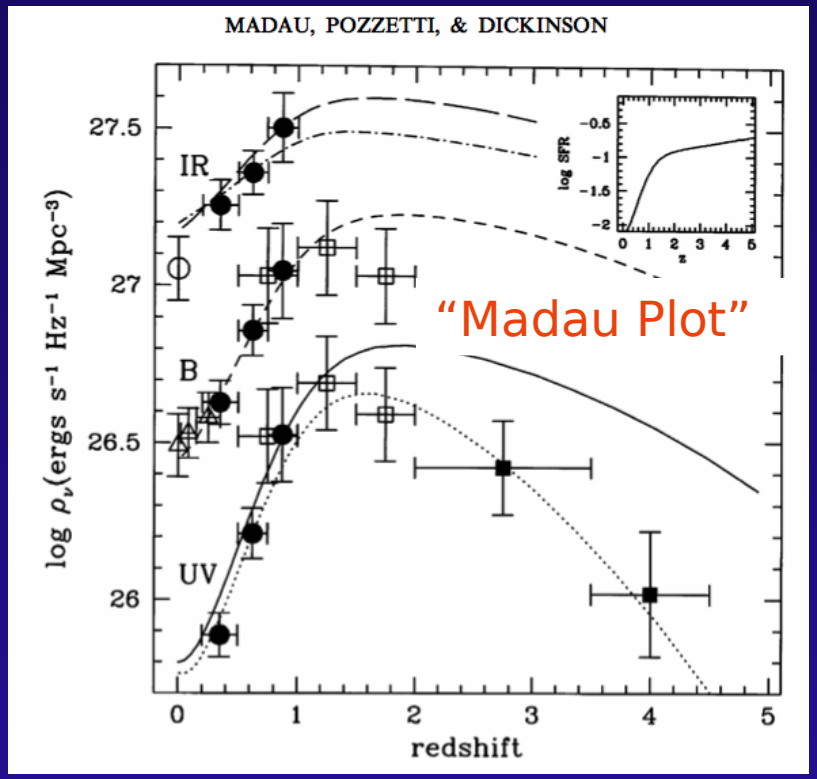
High L/Ledd

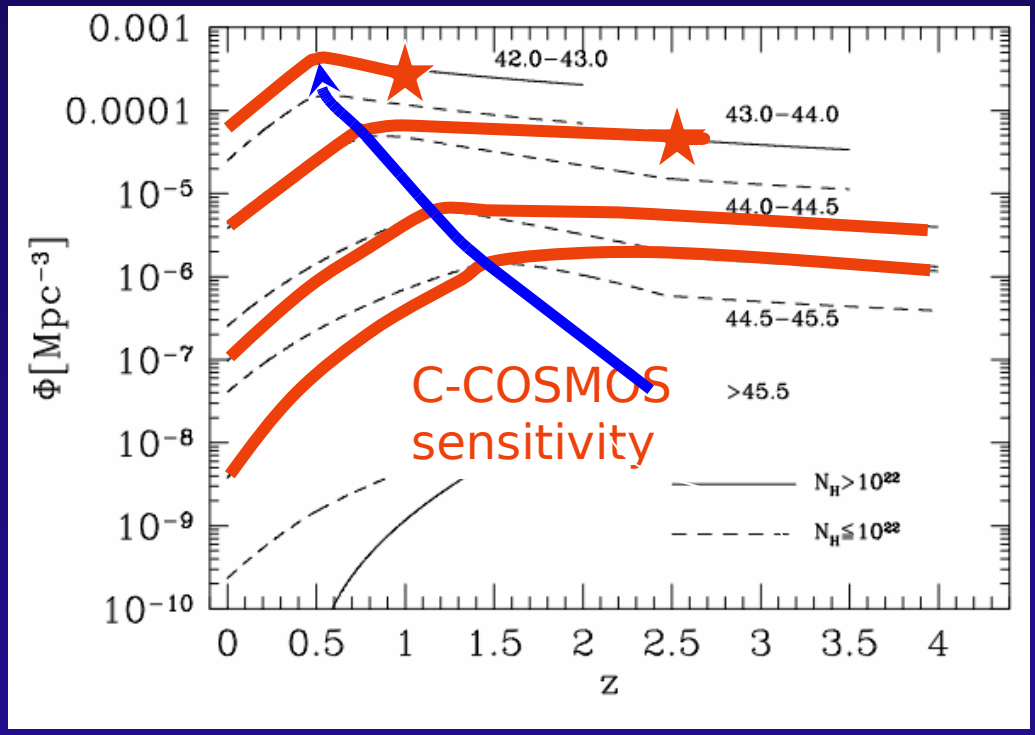
'RADIO'/ Seyfert phase: BH fed slowly by stellar mass loss; Low L/Ledd

Hopkins et al. 2008 ApJS, 175, 356

Downsizing in Star Formation and SMBH

- Star-formation and SMBH peak at z=1-2
- Co-evolution? onset of AGN feedback, assembly of spheroids, hosts to quasars and relic SMBH
- Central to design of COSMOS, C-COSMOS



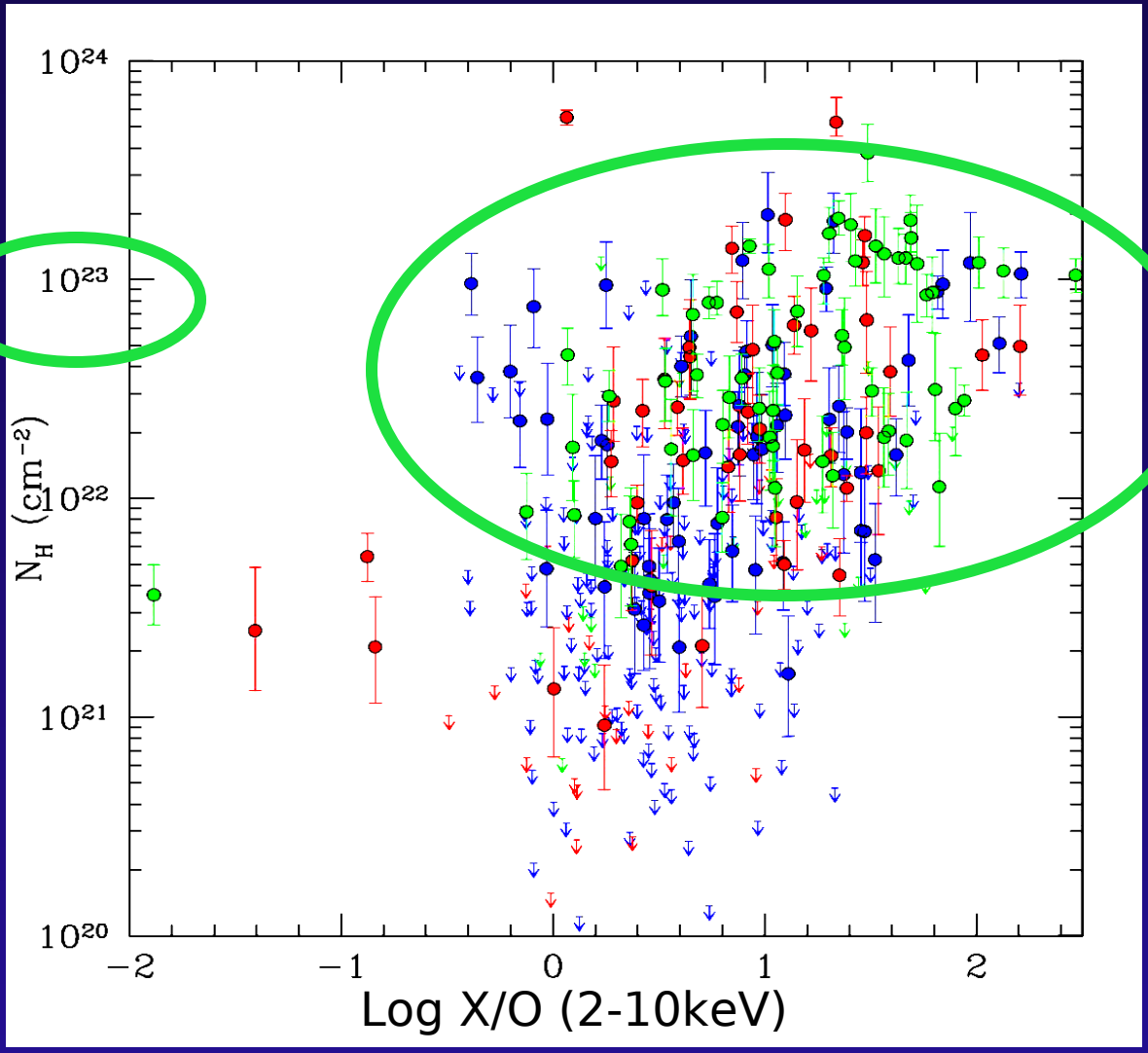


- DOGs" Massive, young, strongly star-forming at z=1-2

statistics

DOGs: AGNs or Starbursts?

Bright Chandra-COSMOS DOGs at z=1-2 are heavily obscured



$L_X > 10^{42}$ erg/s

⇨

AGN?

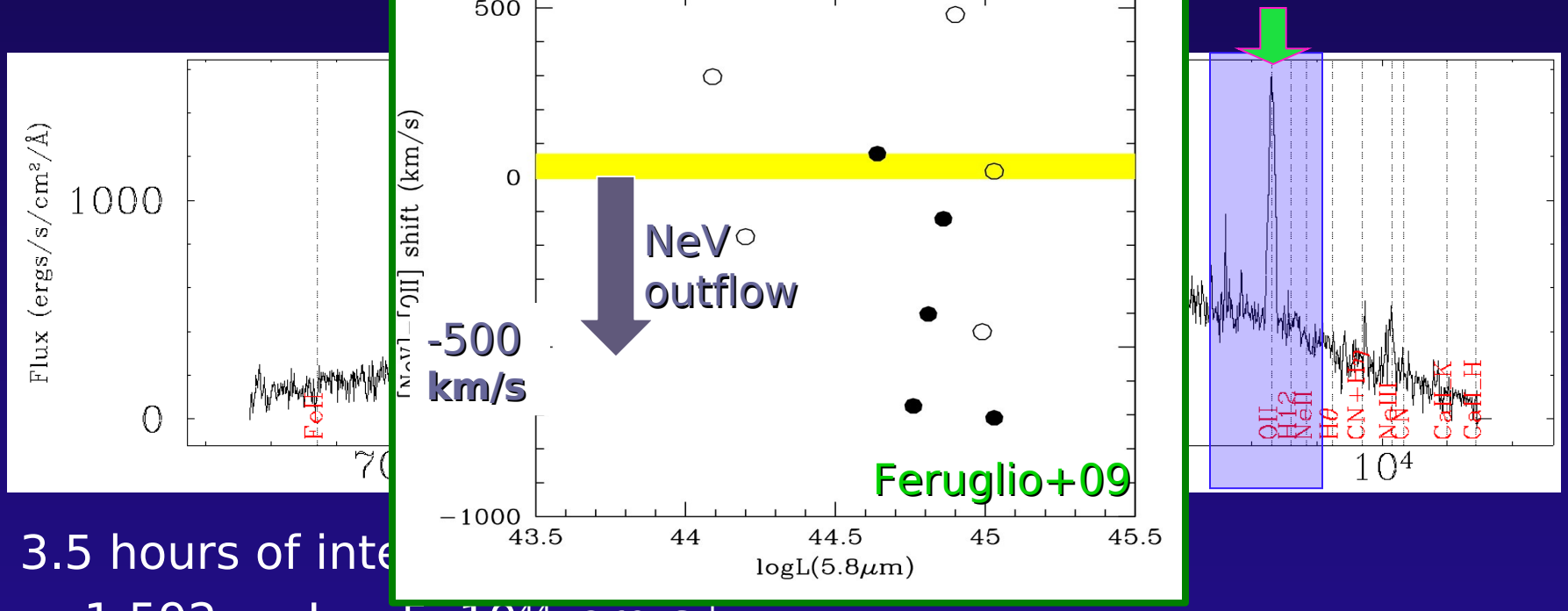
Lanzuisi et al., 2009, in preparation

statistics

Both!

Coeval growth of SMBH & Host at z~1-2

AG **Starburst**



3.5 hours of inte

z=1.592 Lx=5x10^{44} erg s^{-1}

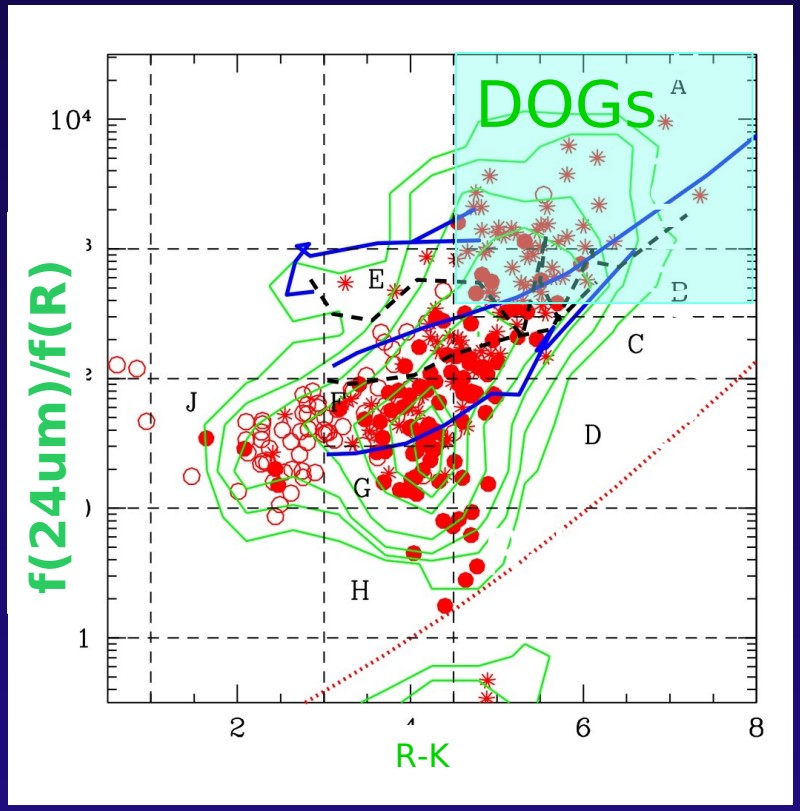
Update:~80 new redshifts from 150 C-COSMOS slits,
I_{AB}~23.5

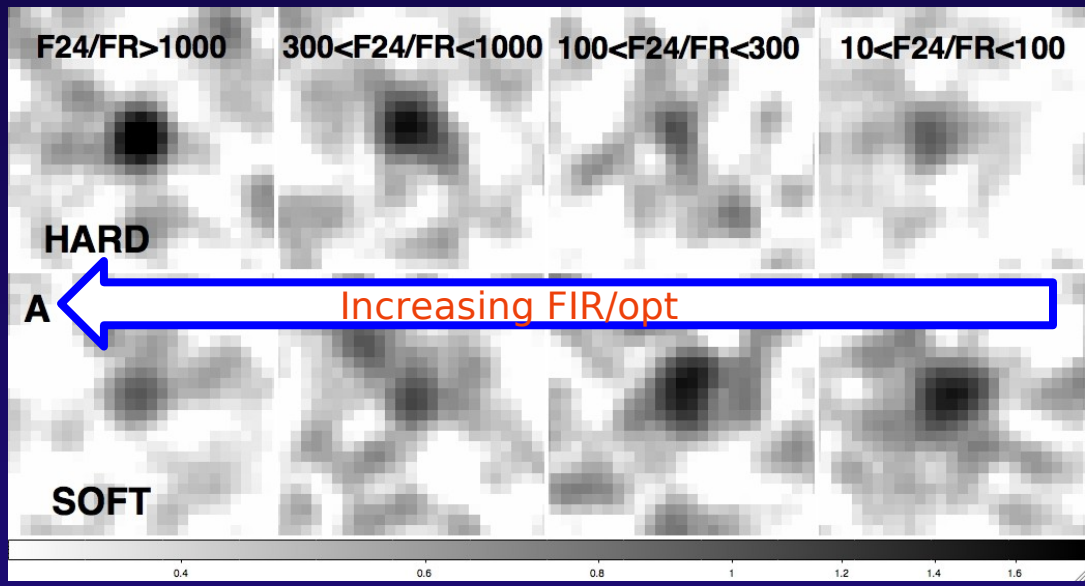
More nights in February 2010

Salvato et al., 2009, in preparation

COSMOS MIR DOGs

Fainter DOGs also obscured



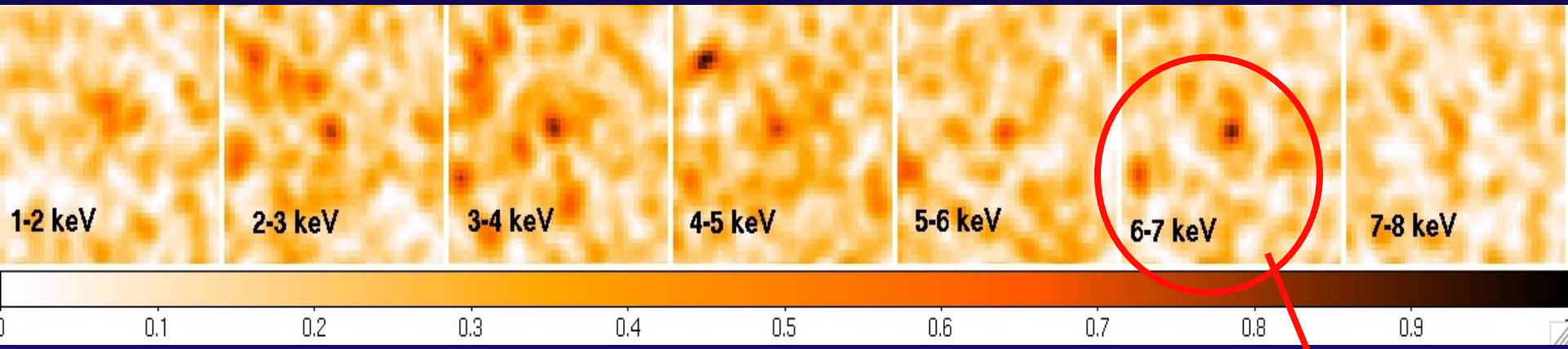


Stack of Chandra images of MIR sources not directly detected in C-COSMOS

Fiore et al., 2008

Chandra DOGs stacked in *Rest Frame*

Strong Fe-K Emission line: Compton Thick AGNs?



MIR Bright DOGs

99 sources with:

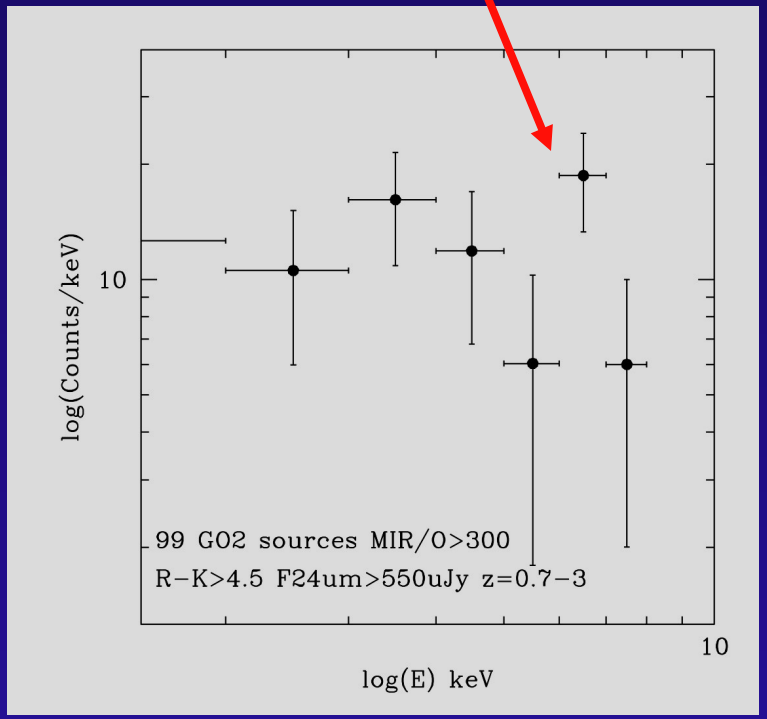
F24um>550uJy

MIR/O>300

R-K>4.5

All with redshifts

0.7<z<3



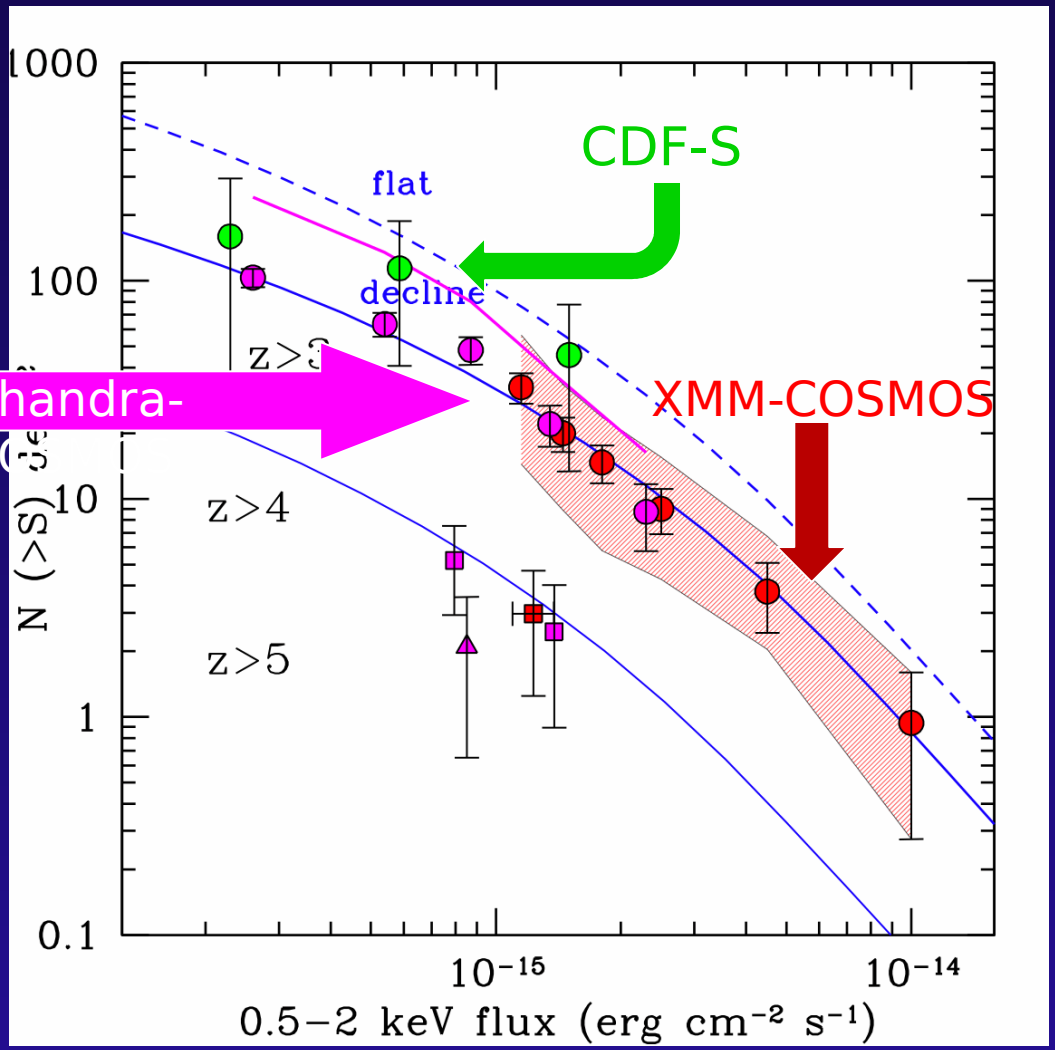
Fiore et al., 2009, in preparation

Z>3 Quasars

Good Statistics at last

54 z>3 quasars (phot-z)

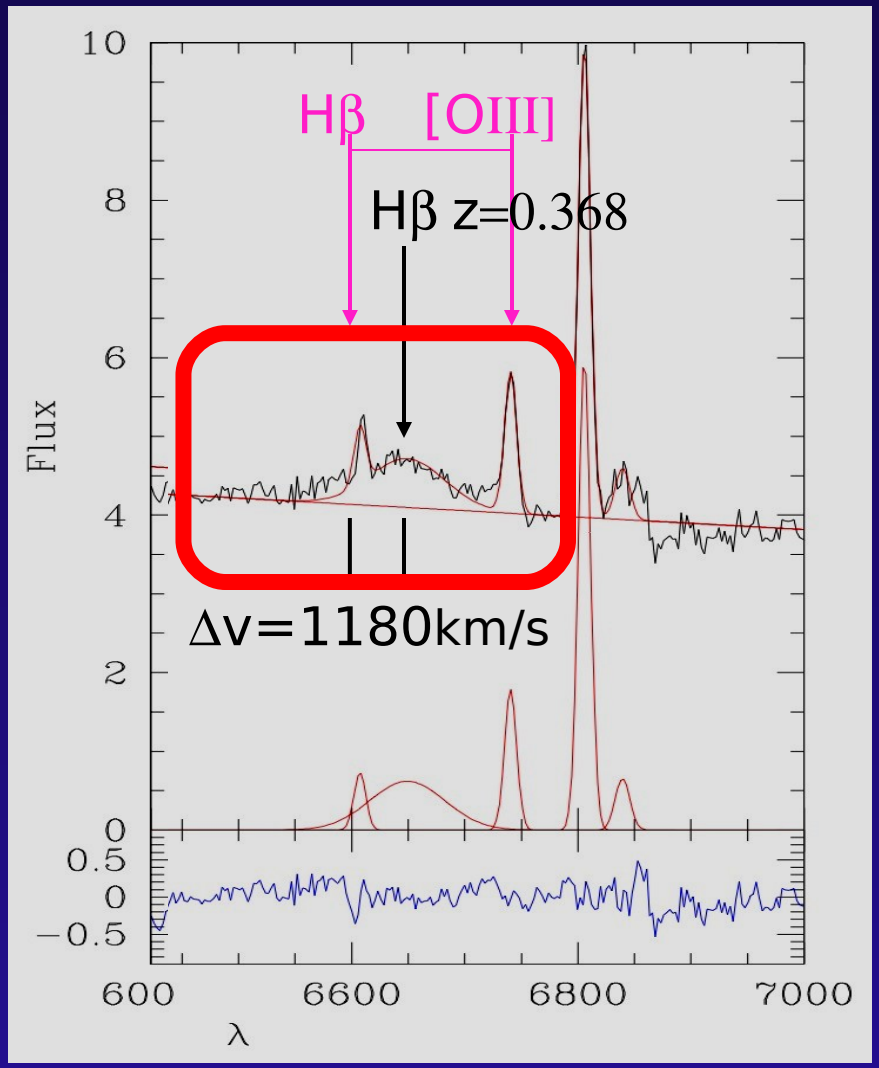
logN-logS has small errors
⇨ Discriminates models
⇨ Cut-off at z>2.7

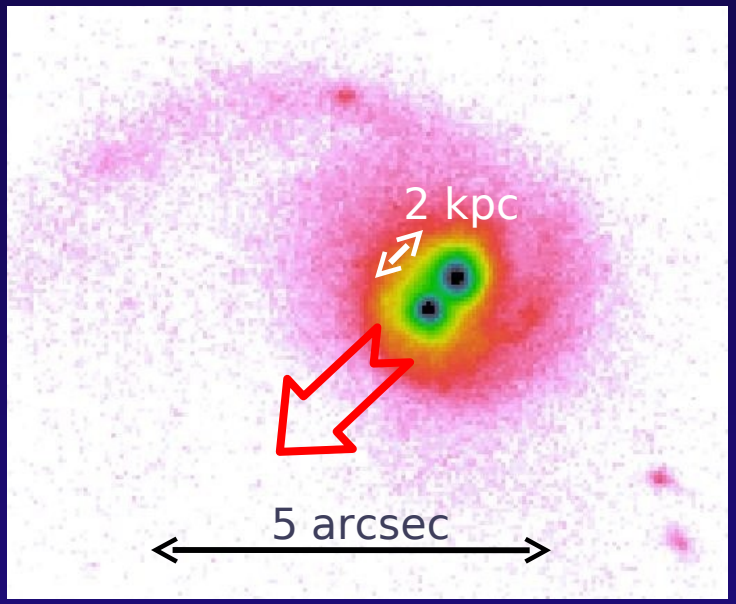


CDF-S: Fiore et al
XMM-COSMOS: Brusa et al. 2009
Chandra-COSMOS: Civano et al. 2009

Rare Objects: 1 Double Nucleus/1761 sources

Gravitational Wave Recoil ?





Just-merged SMBH get kick from Gravitational Waves

Ejected at up to 4000 km/s

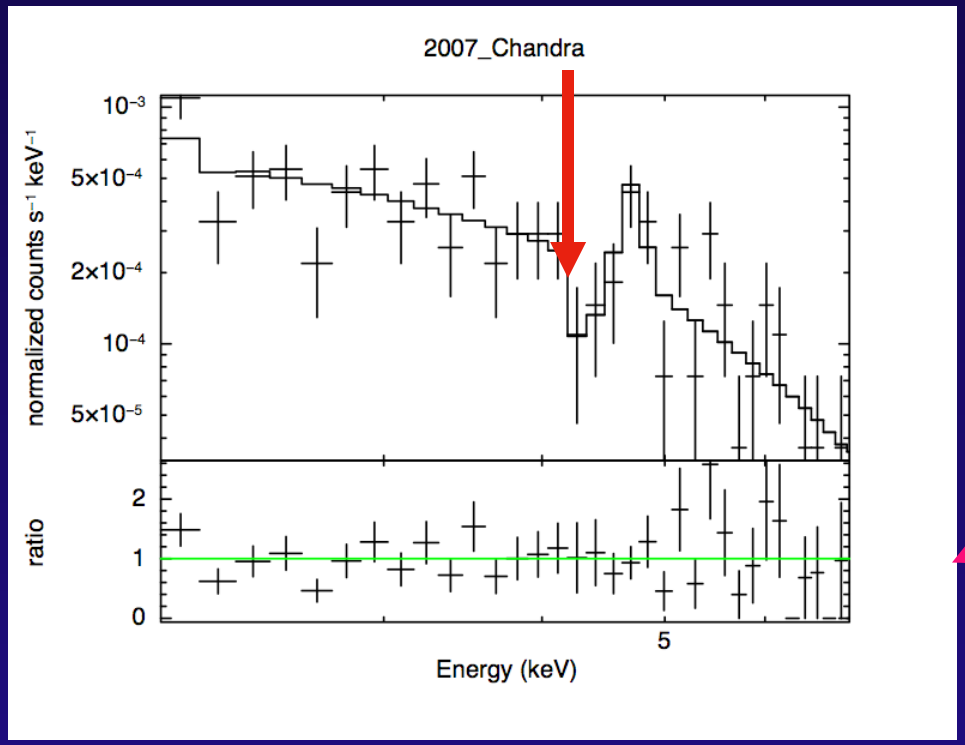
Accretion disk, BLR tightly bound

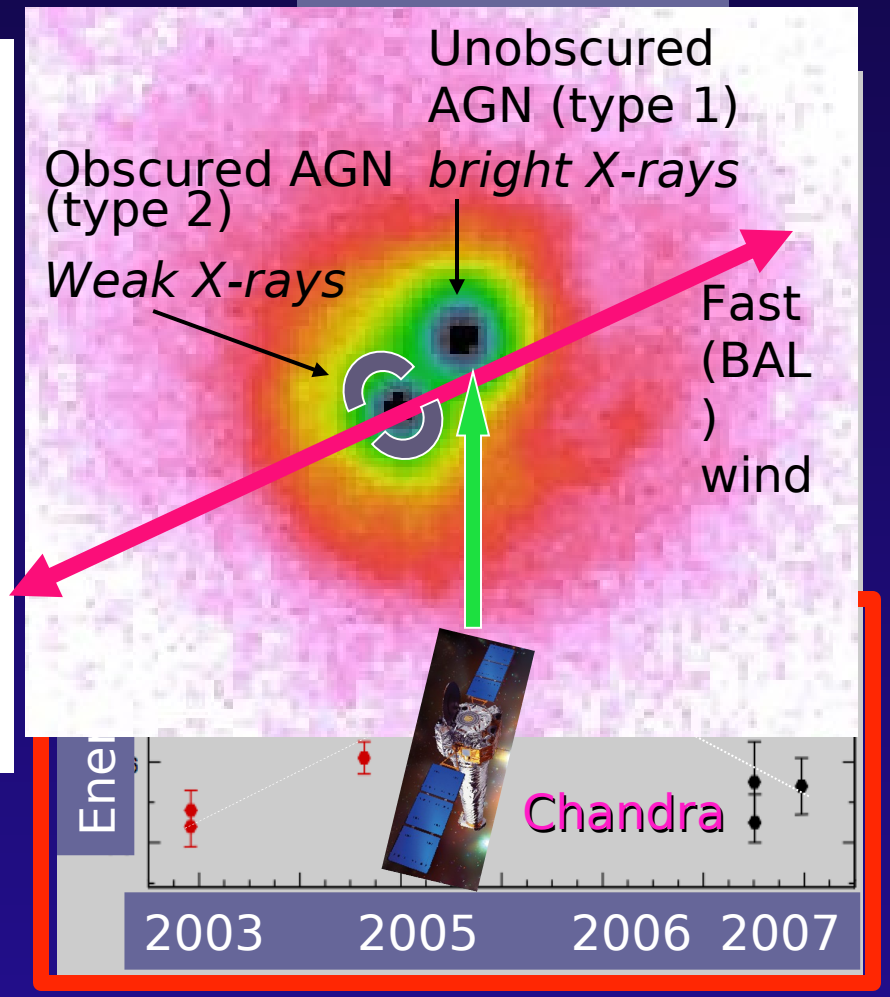
-> move with SMBH

Civano et al. 2009, submitted

Also Redshifted, Variable Energy Fe-K Absorption

Backlit BAL Wind?





$\forall \Delta E=500$ eV $=>10^4$ km/s/yr

0.02-0.07*c* FeI

0.09-0.14*c* FeXXVI

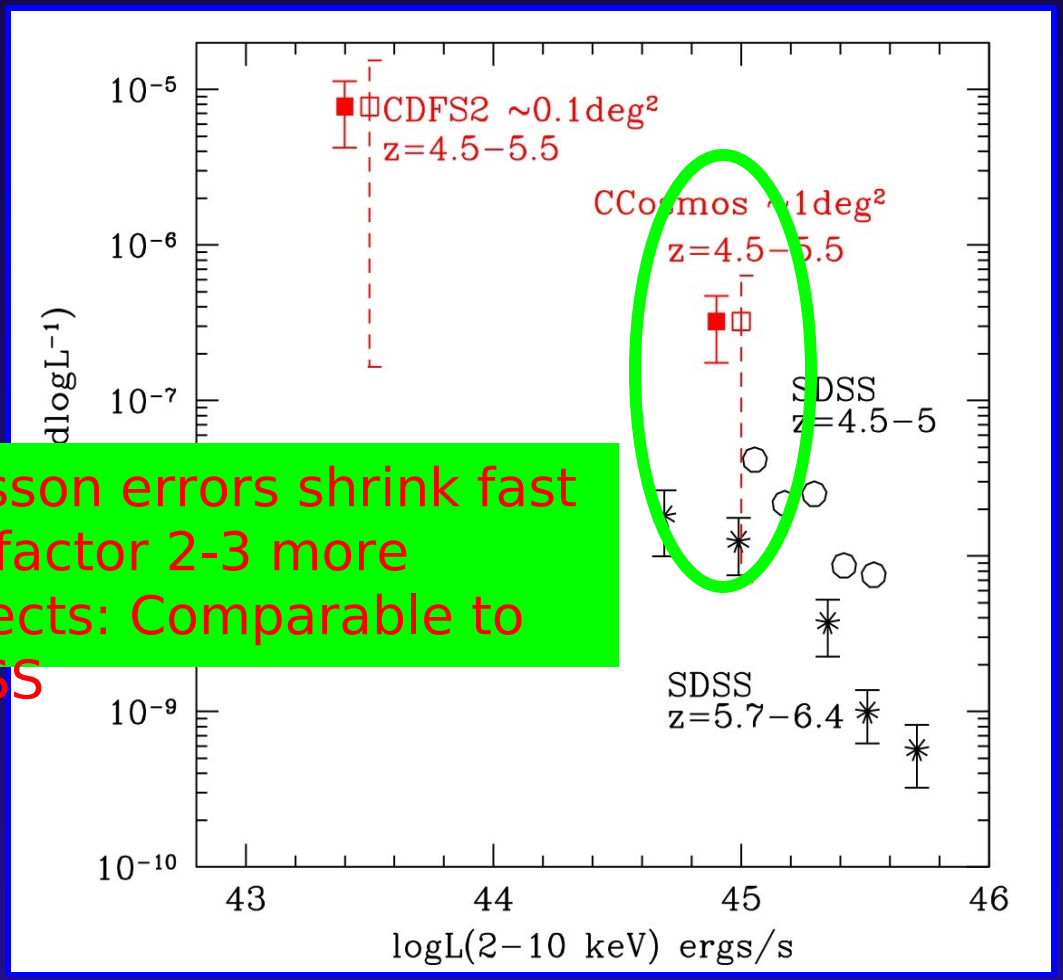
- BAL Wind in an Obscured AGN

Next : "The Complete Chandra COSMOS Survey"

CC-COSMOS: rare objects become common

2.45 Ms
1.7 sq.deg
@ 160 ksec
3600 pt. Sources

- AGN-Galaxy CCF to z=2
- AGN lensing by z, type
- Group lensing by type
- LIRG, AGN clustering @z>1
- AGN L/L_{Edd} in SB, passive hosts
- z>7 quasars (UltraVista)



Poisson errors shrink fast for factor 2-3 more objects: Comparable to SDSS

Also: SEDS, Herschel, AzTEC, Ultra-VISTA, Keck...

The Chandra COSMOS Survey: A high resolution X-ray legacy

C-COSMOS Vital Statistics:

1.8 Ms

1/2sq.deg

@160 ksec

1761 sources

Dec ’06-June ’07

Catalog :2009 ApJS,184, 158

Data products available at IRSA

Martin Elvis, Francesca Civano, Aldcroft T., Fruscione A.,
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statisti
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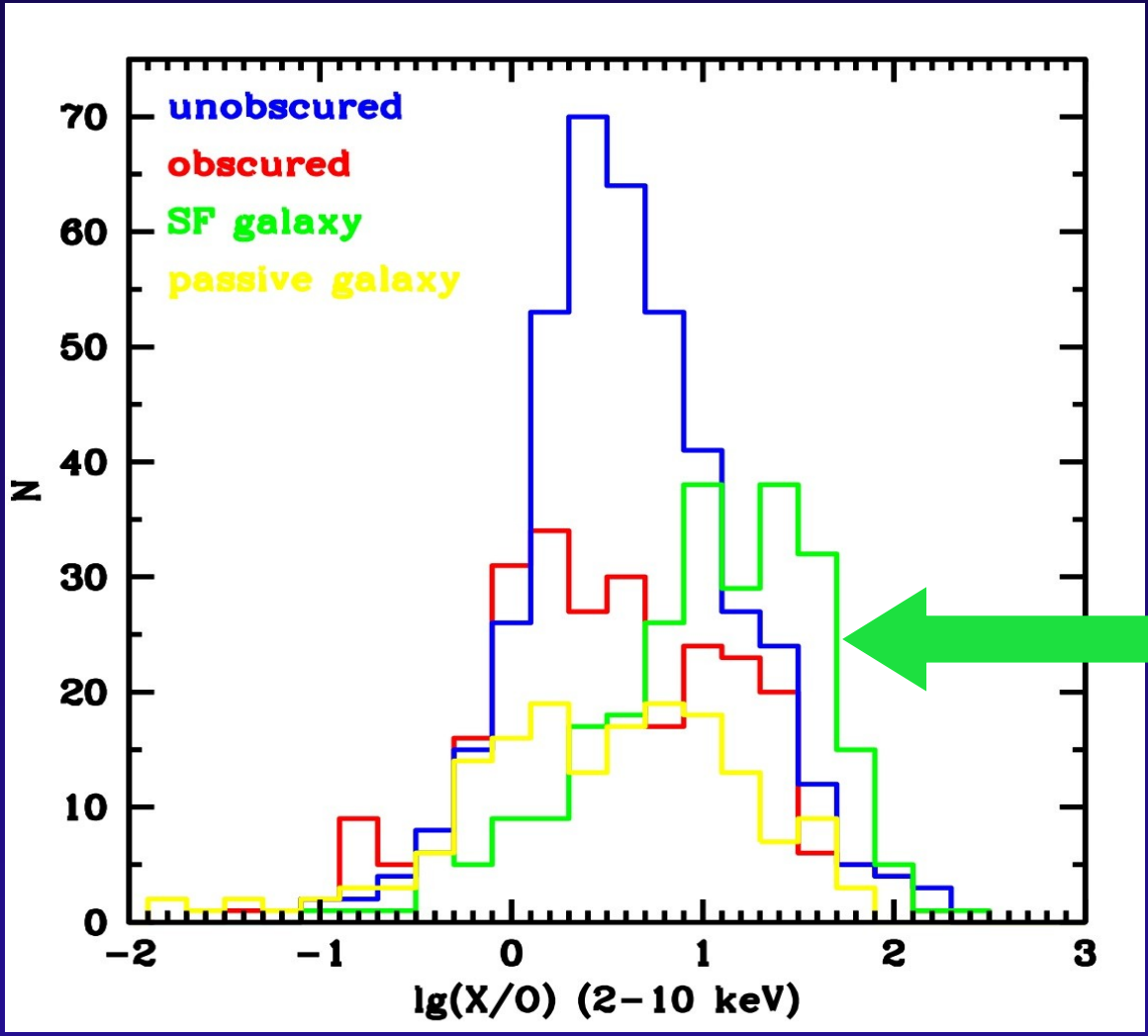
X-ray DOGs

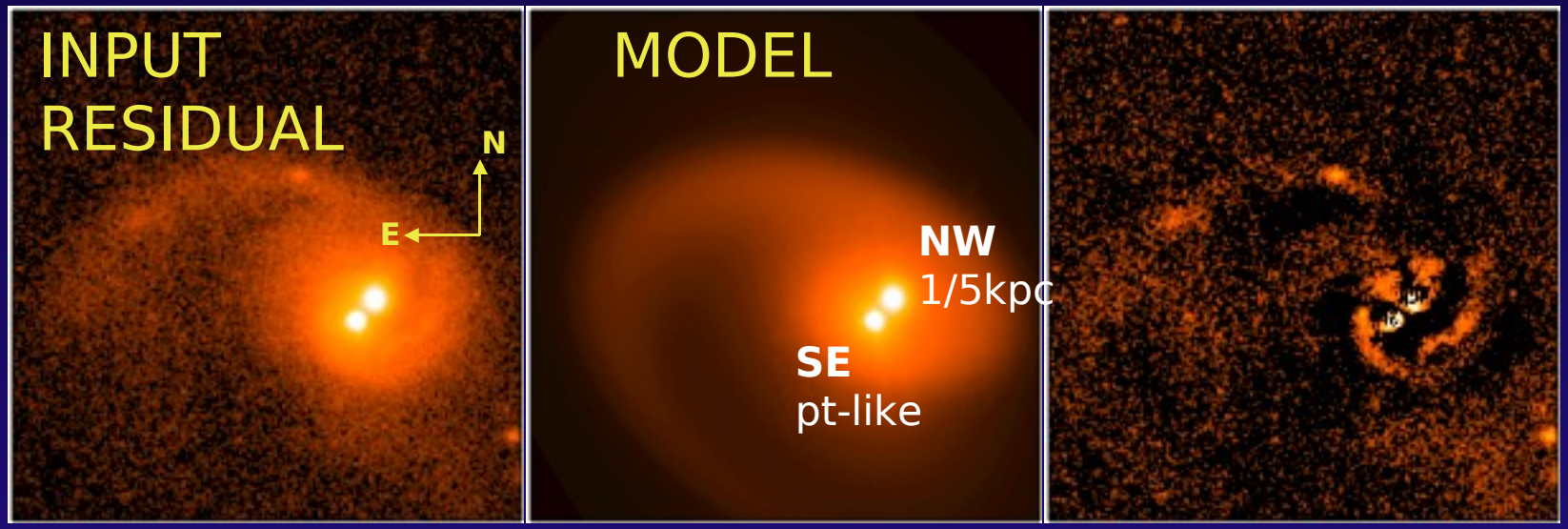
Chandra-COSMOS Galaxies have high X-ray/Optical ratios



DOGs

Civano et al., 2009, in preparation

Double Nucleus: 2kpc separation



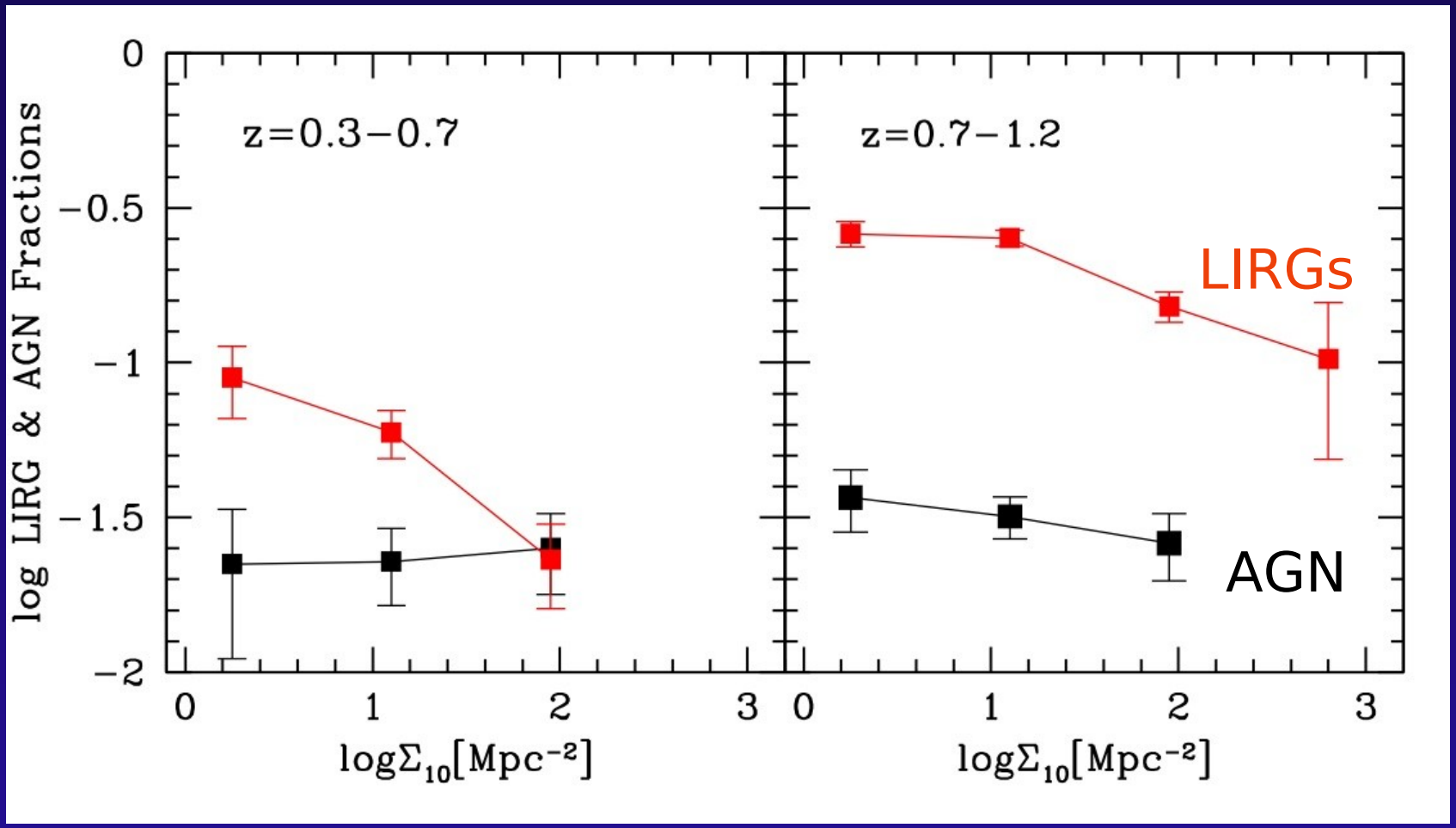
HST ACS F814W image

GALFIT 4 component MODEL:
1 PSF -->SE nucleus (20.51 mag) --> Type 1AGN
+ 1 compact --> NW nucleus (19.67 mag) -->Type 2 AGN
+ 1 extended --> galaxy (~15 kpc, 18.6 mag)
+ 1 asymmetric --> tail and overall light

statistics

AGN vs. Starburst Clustering

At z~1 Starbursts & AGN do not yet avoid high density regions



Feruglio et al. 2009 in prep.

statisti
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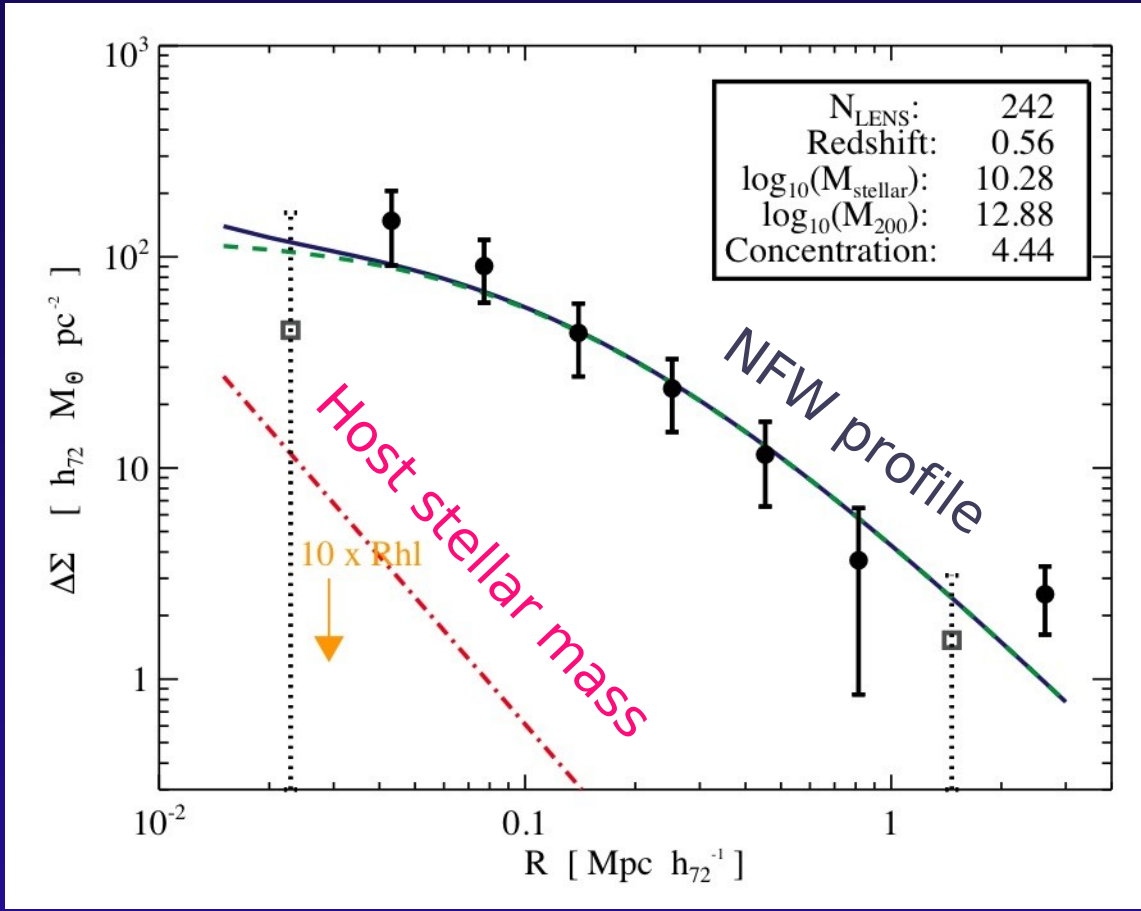
Weak Lensing around AGNs

Dark Matter halos around AGNS log<M>=12.9, same as groups

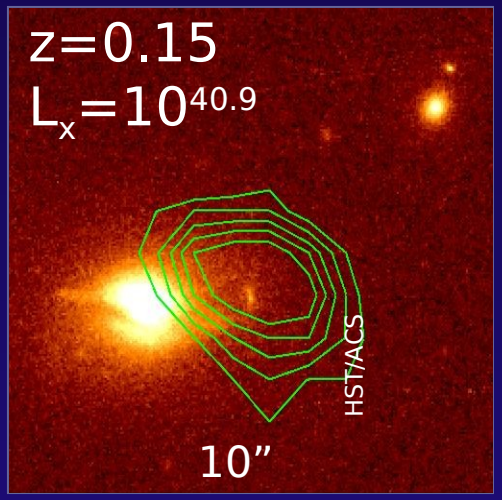


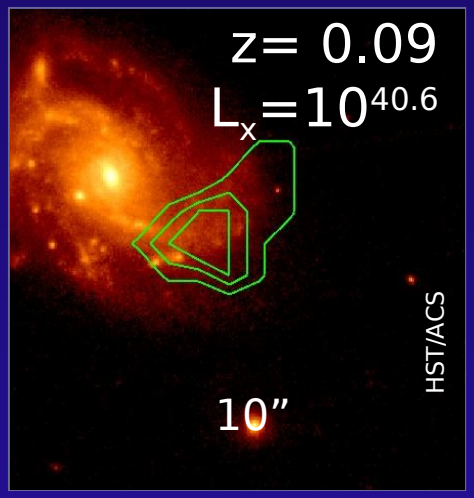
Leauthaud et al. 2009 in prep.

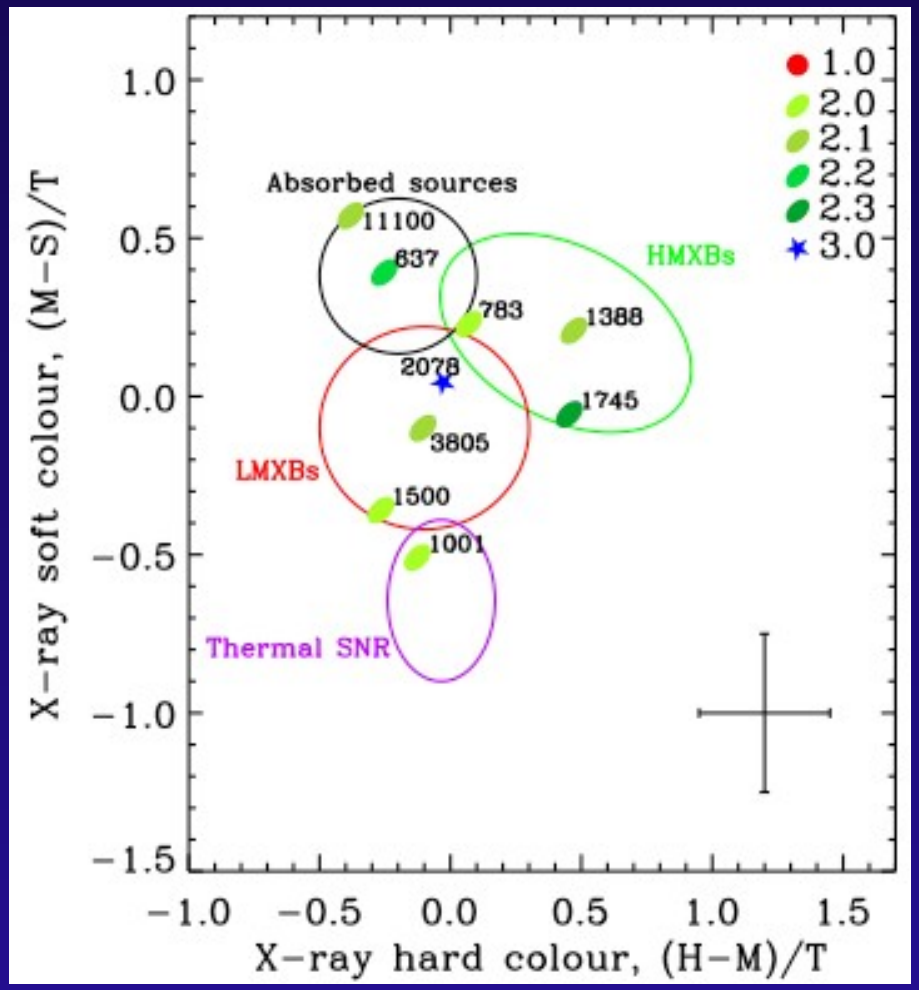
rare objects

Off-Nuclear objects

16 Ultra-Luminous X-ray Sources (ULXs) - intermediate mass back holes?





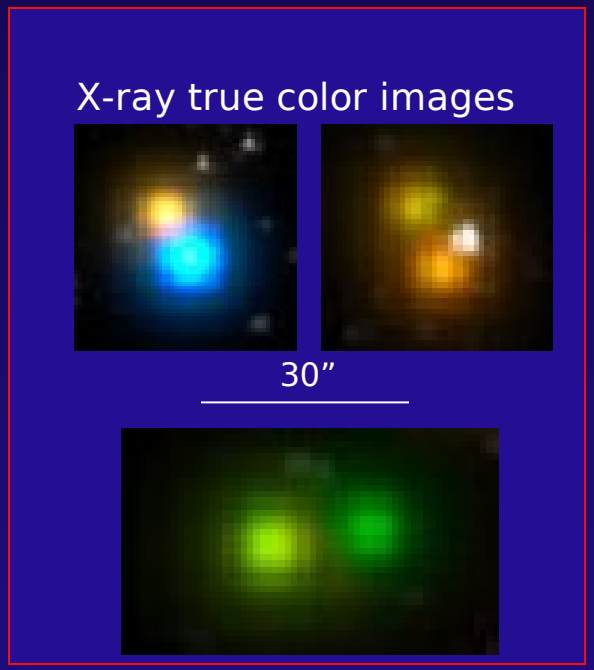


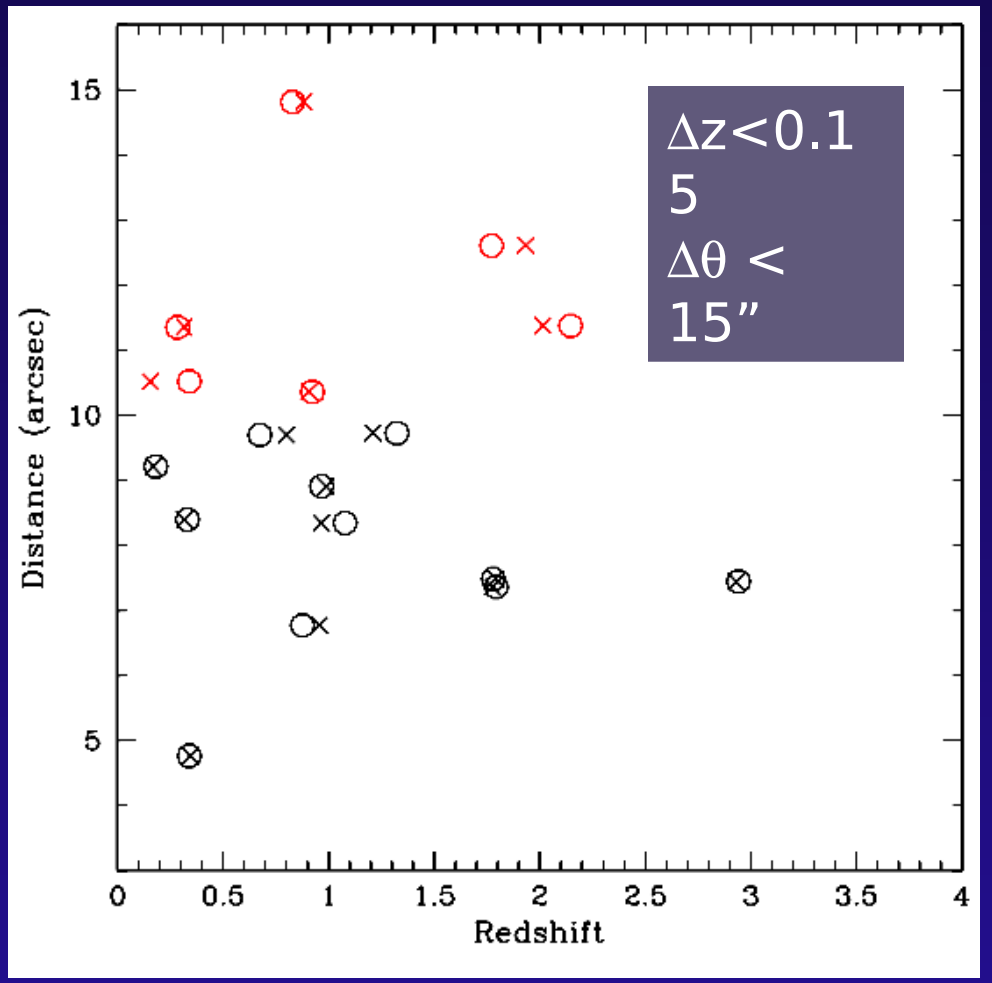
Mainieri et al. 2009, submitted

rare objects

Close AGN Pairs

19 Physical Black Hole Pairs at few kpc separation





Civano et al. 2009, in preparation

High-z AGN

Today constraints are too loose to constrain accretion physics and cosmology (handful of AGN at z>4.5 only). Both IXO and WFXT can provide breakthroughs in this field

!!!provided that a PSF with HPD<5" is

However, these programs will not

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