



Results from the AEGIS-X survey of the Extended Groth Strip

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AEGIS

All-wavelength Extended Groth strip International Survey



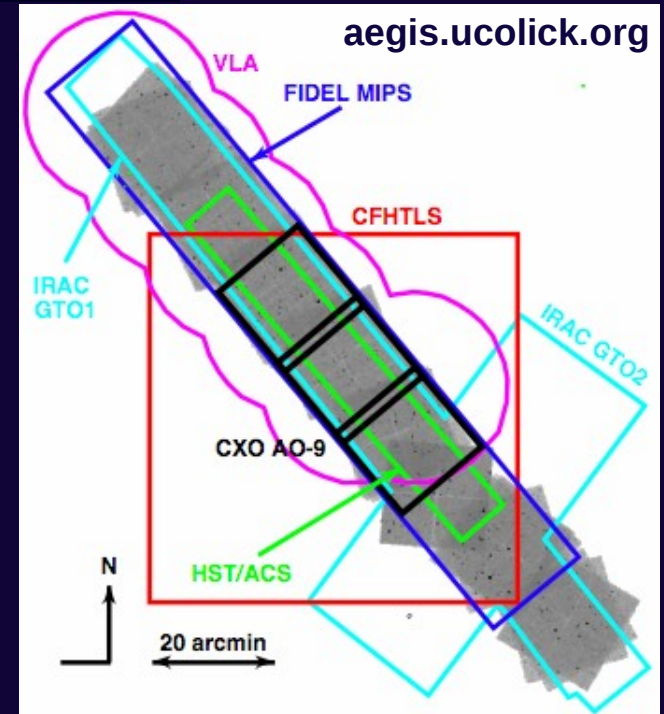
AEGIS

All-wavelength Extended Groth strip International Survey

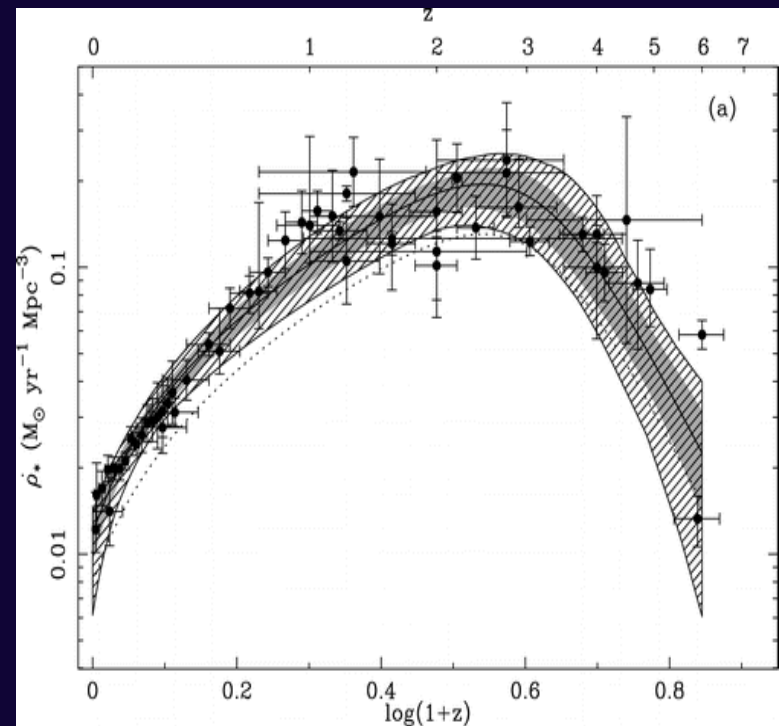
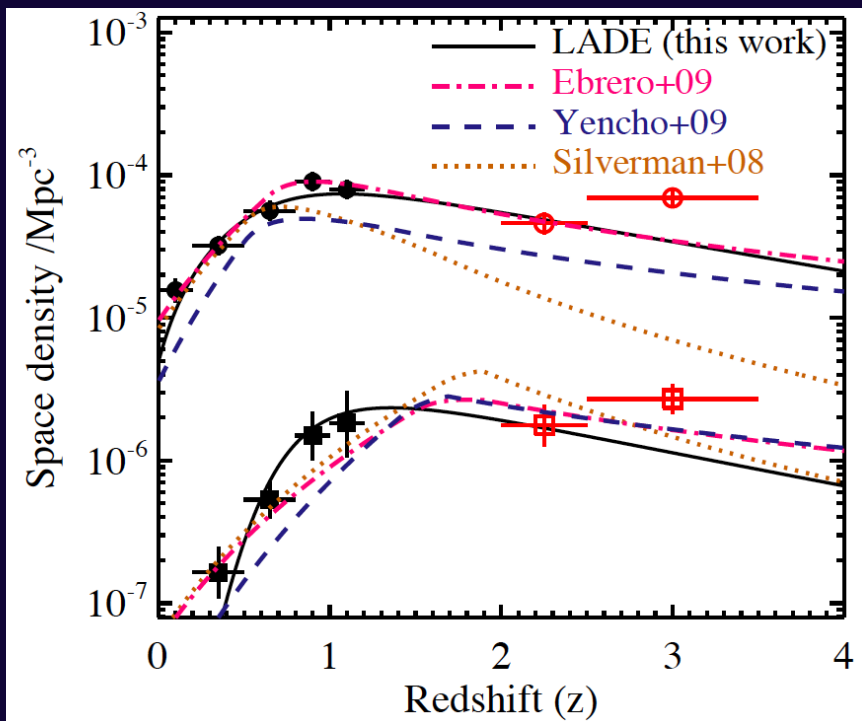
- AEGIS-X (*Chandra* AO-3 & AO-6): 1.6 Ms over 0.67 deg²

(Laird et al. 2009)

- Flux limits (on-axis, 1% complete):
 - SB (0.5-2 keV) 5.3×10^{-17} cgs
 - HB (2-10 keV) 3.8×10^{-16} cgs
- Deep multiwavelength data over wide area (~0.5 -1.0 deg²) **(Davis et al. 2007)**
- Keck/DEIMOS DEEP2 spectroscopy: >10,000 z's with $R < 24.1$, mainly at $0.6 < z < 1.4$
- Optical: 76%, complete to $R_{AB} = 24.1$
- IRAC 3.6 μ m: 94% (of sources with coverage) complete to $m_{AB} = 23.8$
- ~35% spectroscopic completeness \ (with DEEP3 \Rightarrow 65%)



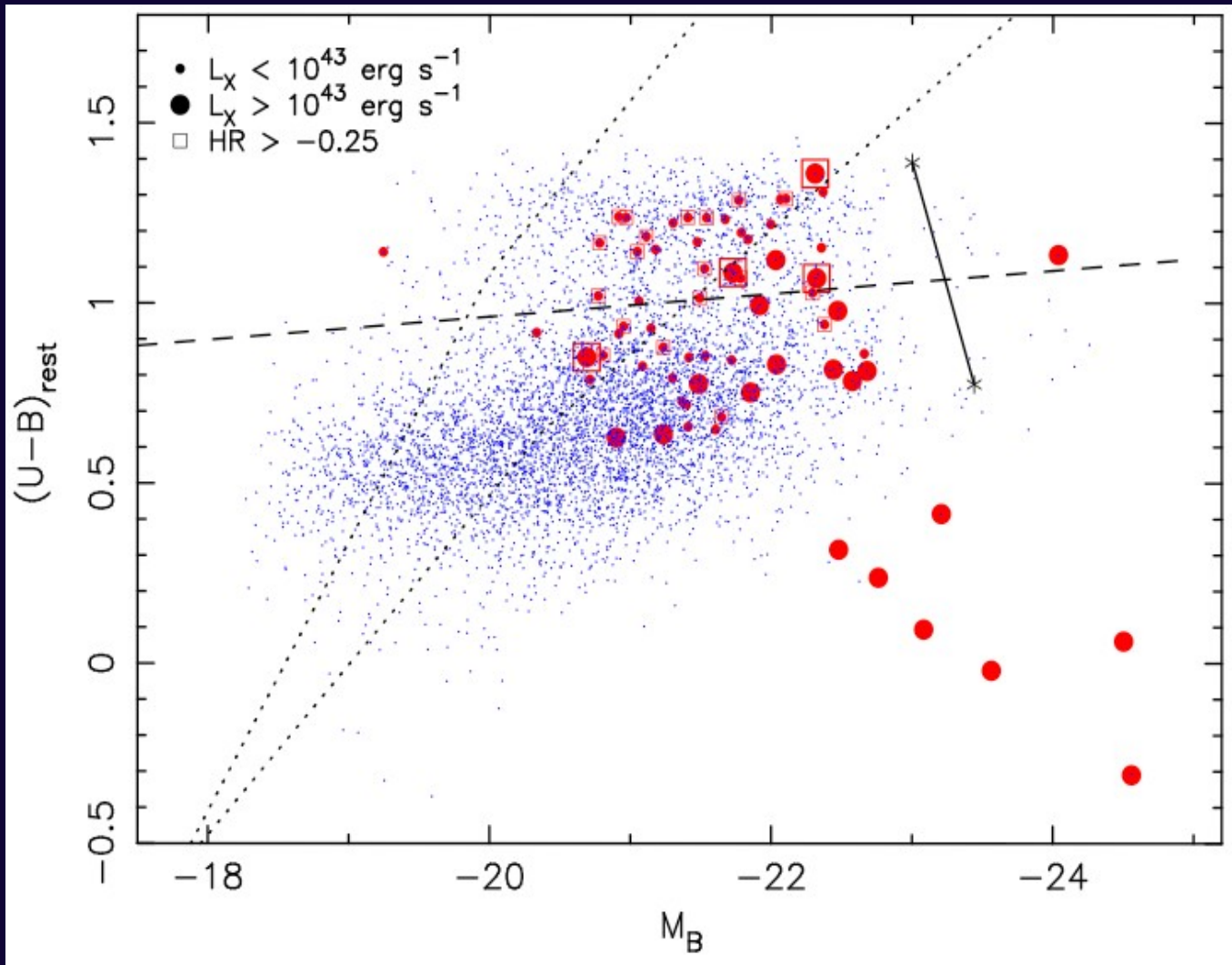
AGN and star formation rate evolution



AGN space density: **Aird et al.,**
submitted to MNRAS

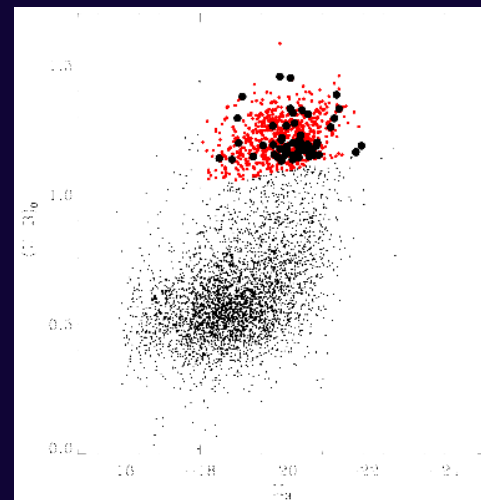
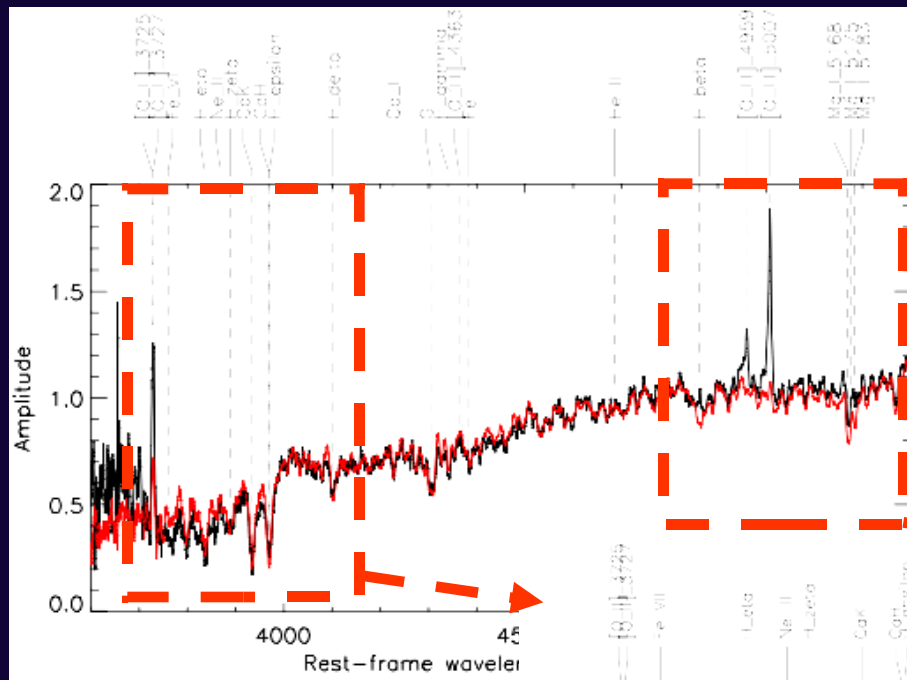
SFRD: Hopkins & Beacom (2006)

Color-magnitude relation for AGN



$z=0.6-1.4$; **Nandra et al. 2007**

Stacked optical spectra of AEGIS-X sources



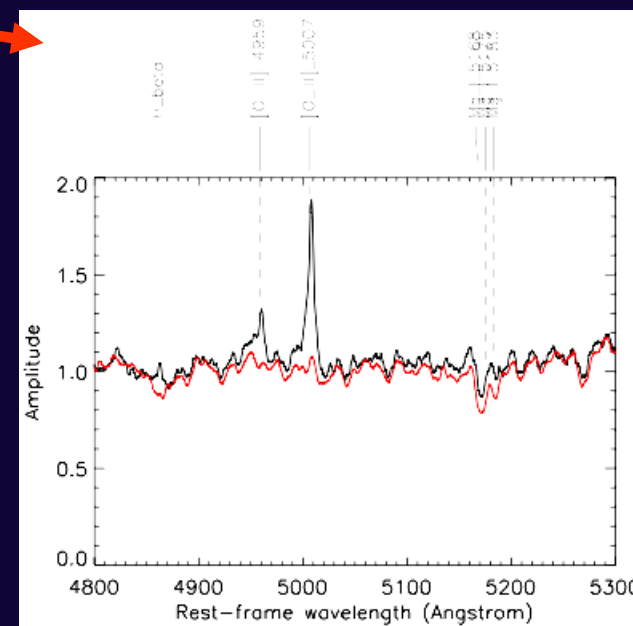
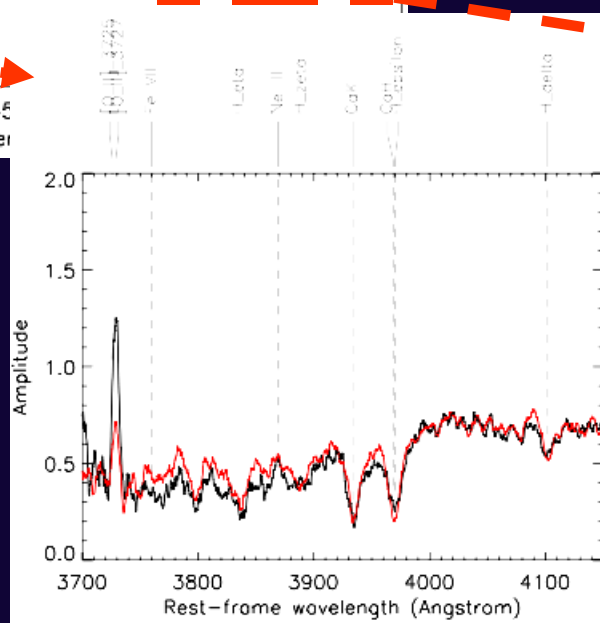
No. of galaxies

X-ray: 39

DEEP2: 123

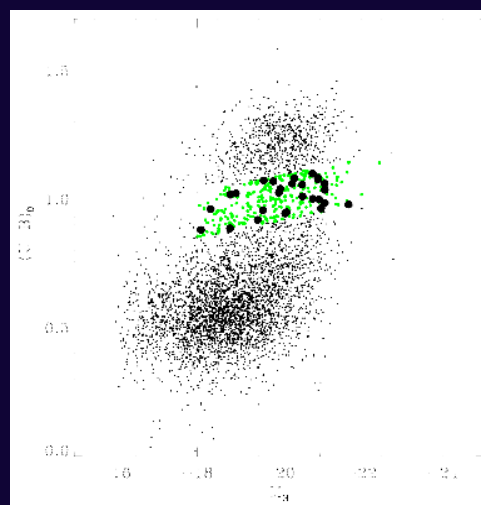
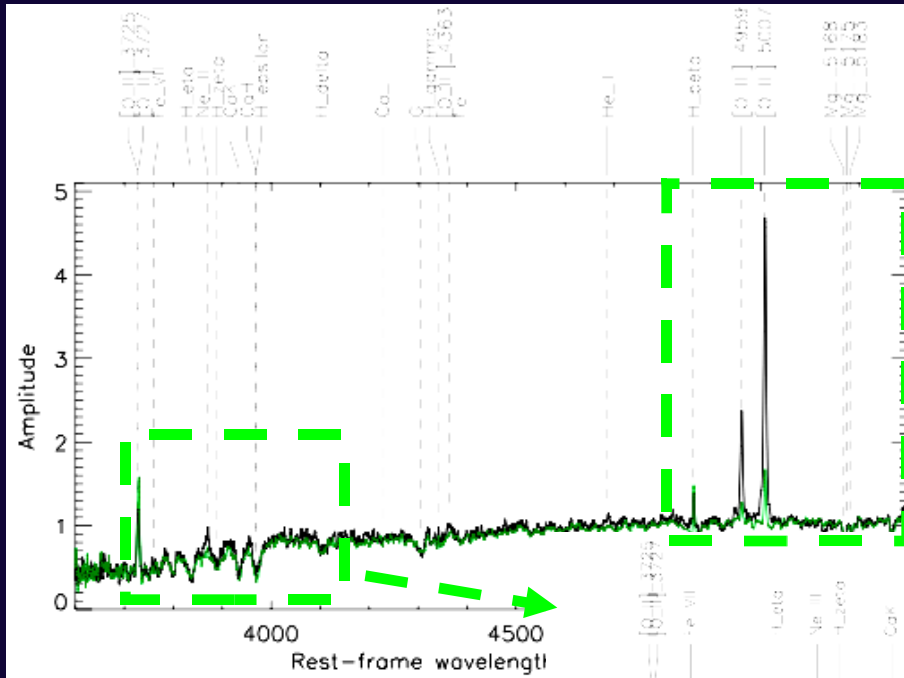
0.35 < z < 0.81

DEEP2 —
X-ray AGN —



Laird et al. in prep

Stacked optical spectra of AEGIS-X sources



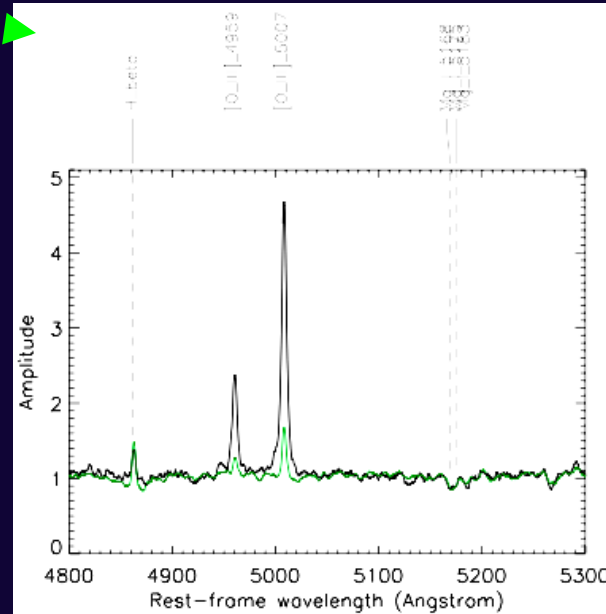
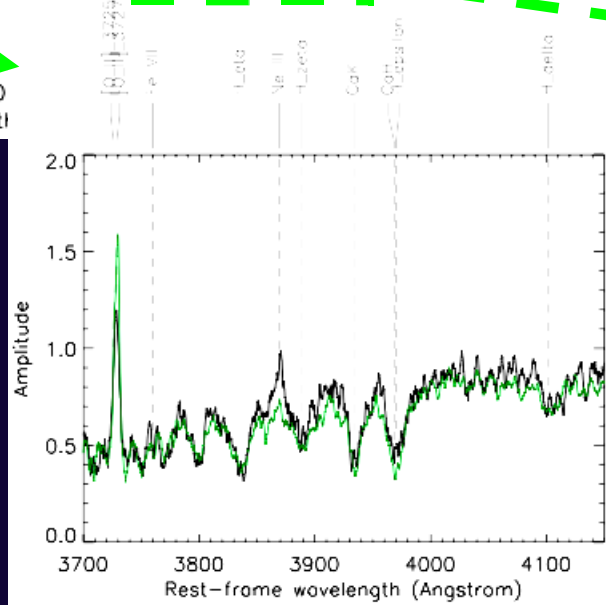
No. of galaxies

X-ray: 22

DEEP2: 128

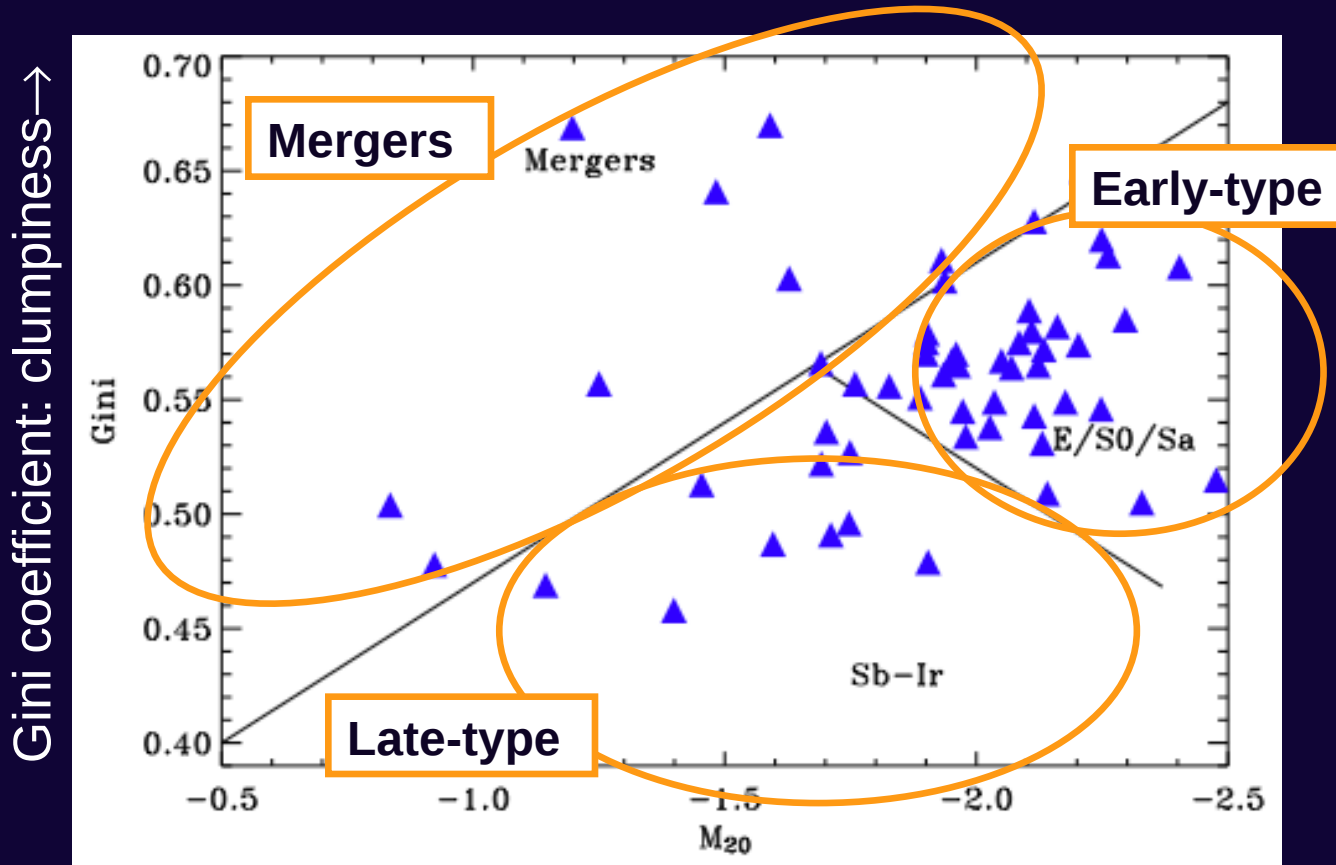
0.35 < z < 0.81

DEEP2 —
 X-ray AGN —



Laird et al. in prep

Host Galaxy Morphologies



- $0.2 < z < 1.4$
- $L_x > 10^{42} \text{ erg s}^{-2}$
- 65% X-ray AGN E/S0/Sa galaxies (compared to 18% of DEEP2 galaxies)

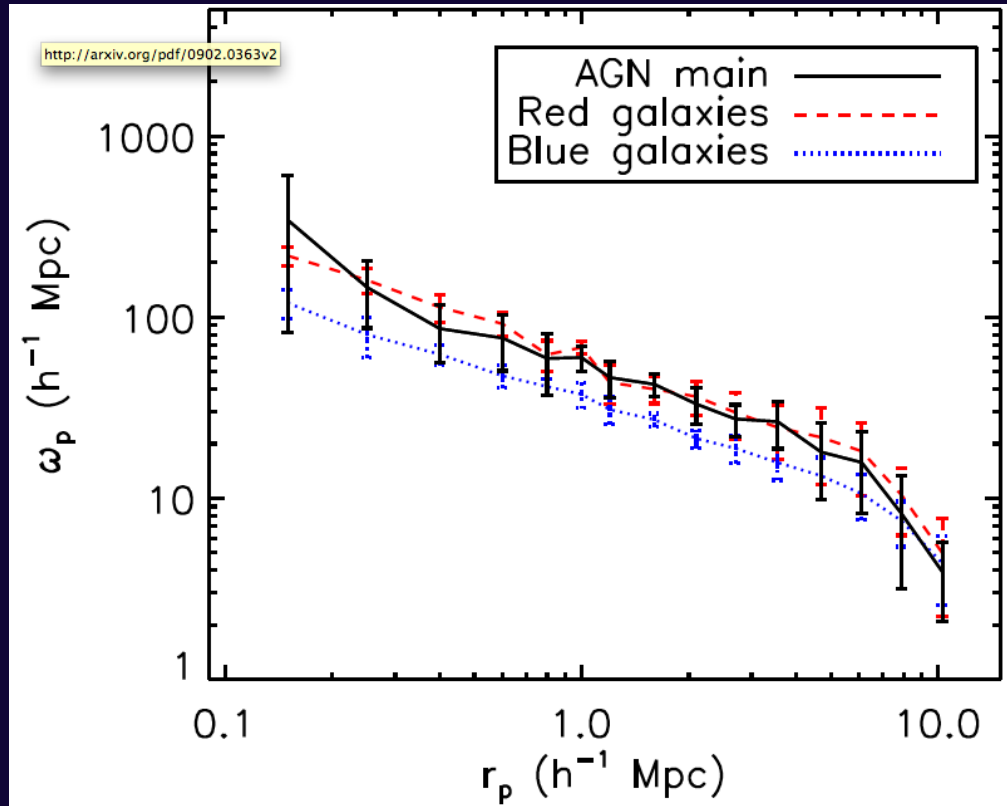
M_{20} : central concentration →

G- M_{20} : Abraham et al. 2003; Lotz et al. 2004

Pierce et al. 2007

AGN/Galaxy cross-correlation function

Measure the clustering of non-quasar AGN at $z=0.7-1.4$



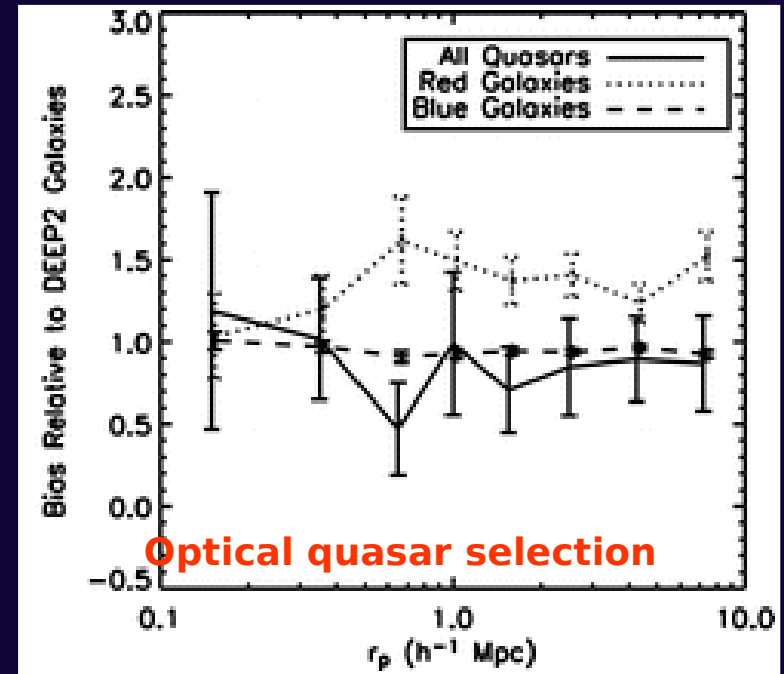
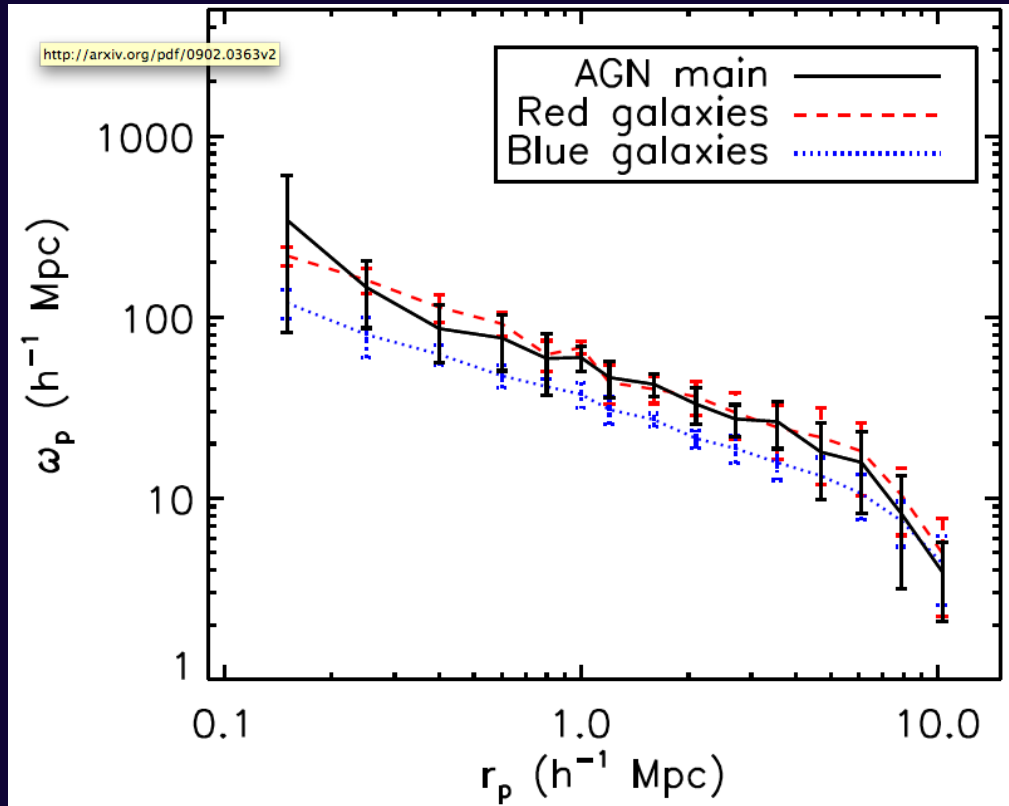
- AGN have ~same clustering amplitude as red, quiescent and green galaxies at $z \sim 1$
- Significantly more clustered than blue, star forming galaxies
- No dependence on L_x , M_B or HR
- Evidence for galaxies hosting AGN being *more* clustered than matched galaxy sample (2.8σ)
- ➔ X-ray AGN hosts more likely to reside in groups and massive DM halos, than similar galaxies without an AGN
- Also more clustered than optically selected quasars

Coil et al. 2009

Also Miyaji et al. for X-ray AGN in ECDF-S & COSMOS

AGN/Galaxy cross-correlation function

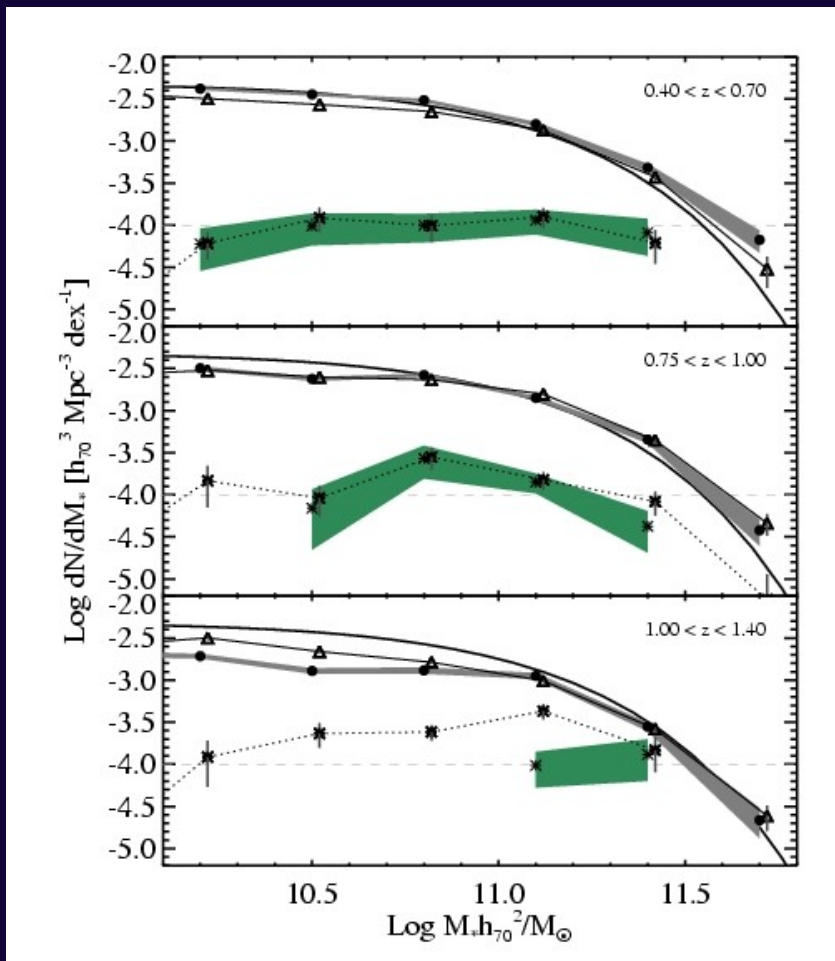
Measure the clustering of non-quasar AGN at $z=0.7-1.4$



Coil et al. 2007

If AGN/quasars are similar objects at different evolutionary stages, results consistent with quasar phase in blue cloud, then setting onto red sequence with lower luminosity X-ray AGN.

AGN stellar mass function



- Stellar mass function \sim flat over $0.4 < z < 1.4$
- AGN predominantly in massive hosts
- Luminosity function evolves rapidly over this redshift range but no evidence for AGN hosts “downsizing” in mass
 \Rightarrow **Accretion rate evolution?**

Also Babic et al. 2007 for $z < 1$ in CFD-S

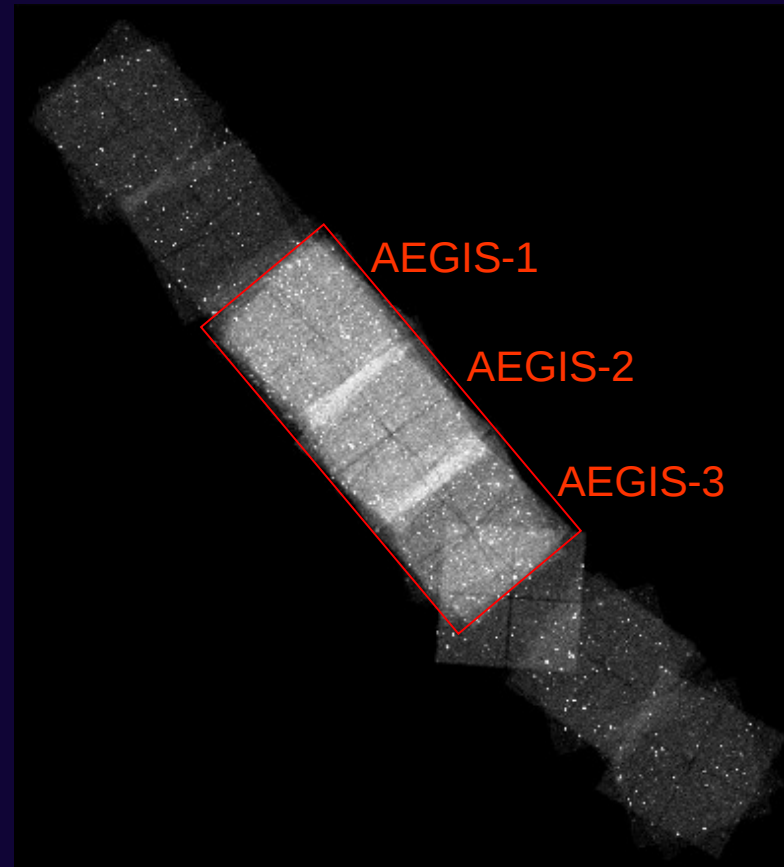
**Bundy et al.
2008**

Conclusions

- Typical AGN at $z \sim 1$ are in massive, red host galaxies
- Stacked optical spectra of X-ray AGN suggest
 - Red sequence AGN host galaxies very similar to DEEP2 red sequence galaxies, *but* may have elevated star formation compared to DEEP2 galaxies
 - Green valley and blue cloud AGN have reduced star formation compared to DEEP2 galaxies
- AGN hosts are bulge dominated
- AGN are in dense environments
 - cluster like red and green hosts
 - Evidence that are more clustered than matched sample
 - $\sim 42\%$ are in groups

New deep AEGIS-X *Chandra* data: AEGIS-X2

- A further 1.8 Ms observations complete as of end June 2009
- 3 x 600ks fields
- AO3+AO6+AO9 = largest *Chandra* survey program to date
- Complete data reduction underway. Each pointing composed of 17-29 (short) observations, with different roll angles
- Fields chosen to overlap with optimum part of AEGIS (ACS, CFHTLS, VLA, DEEP3 etc)
- Complete reduced dataset to be released early 2010



Nandra et al. in prep