AGN statistics with HETDEX

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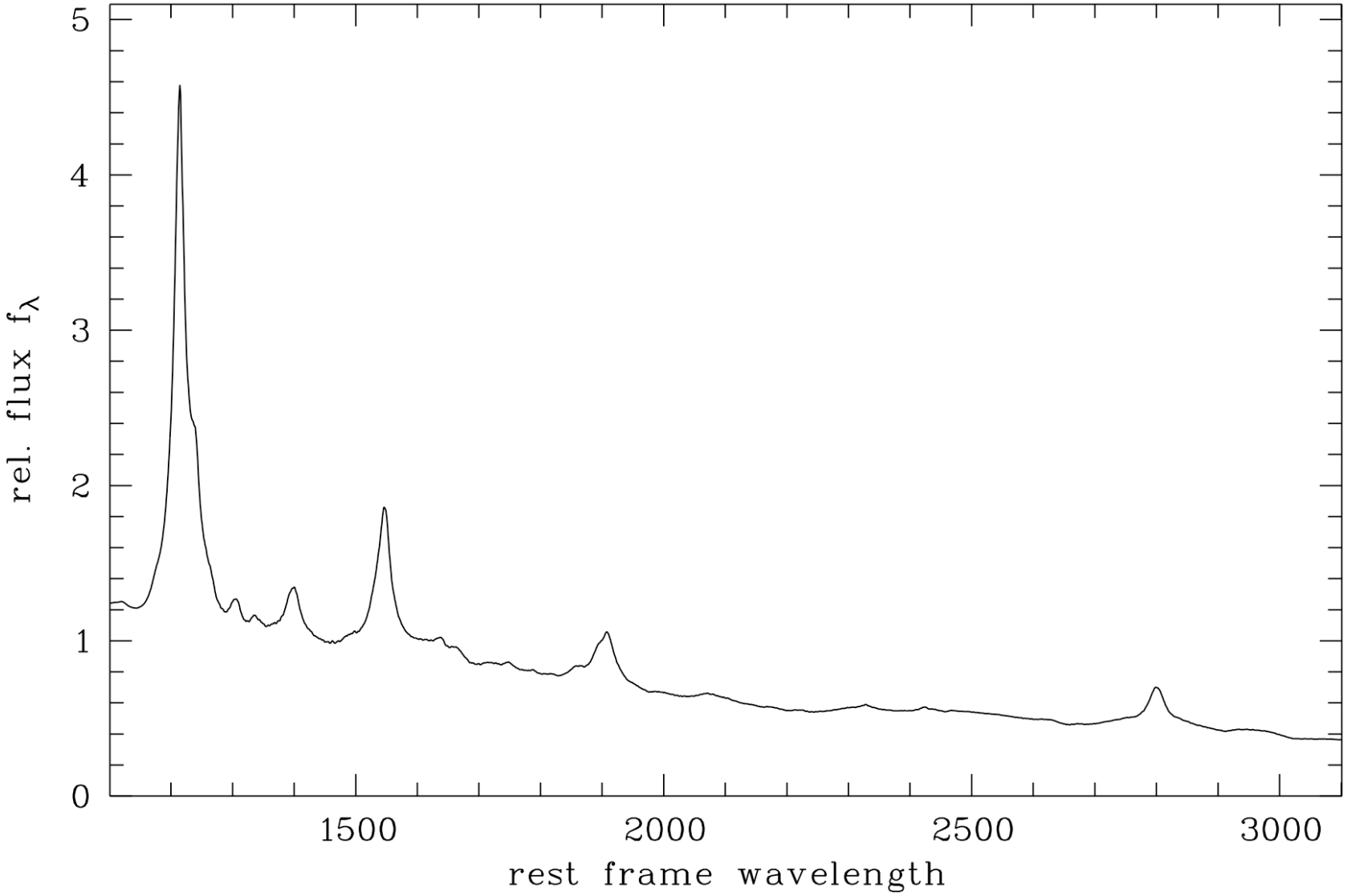
AGN statistics with HETDEX

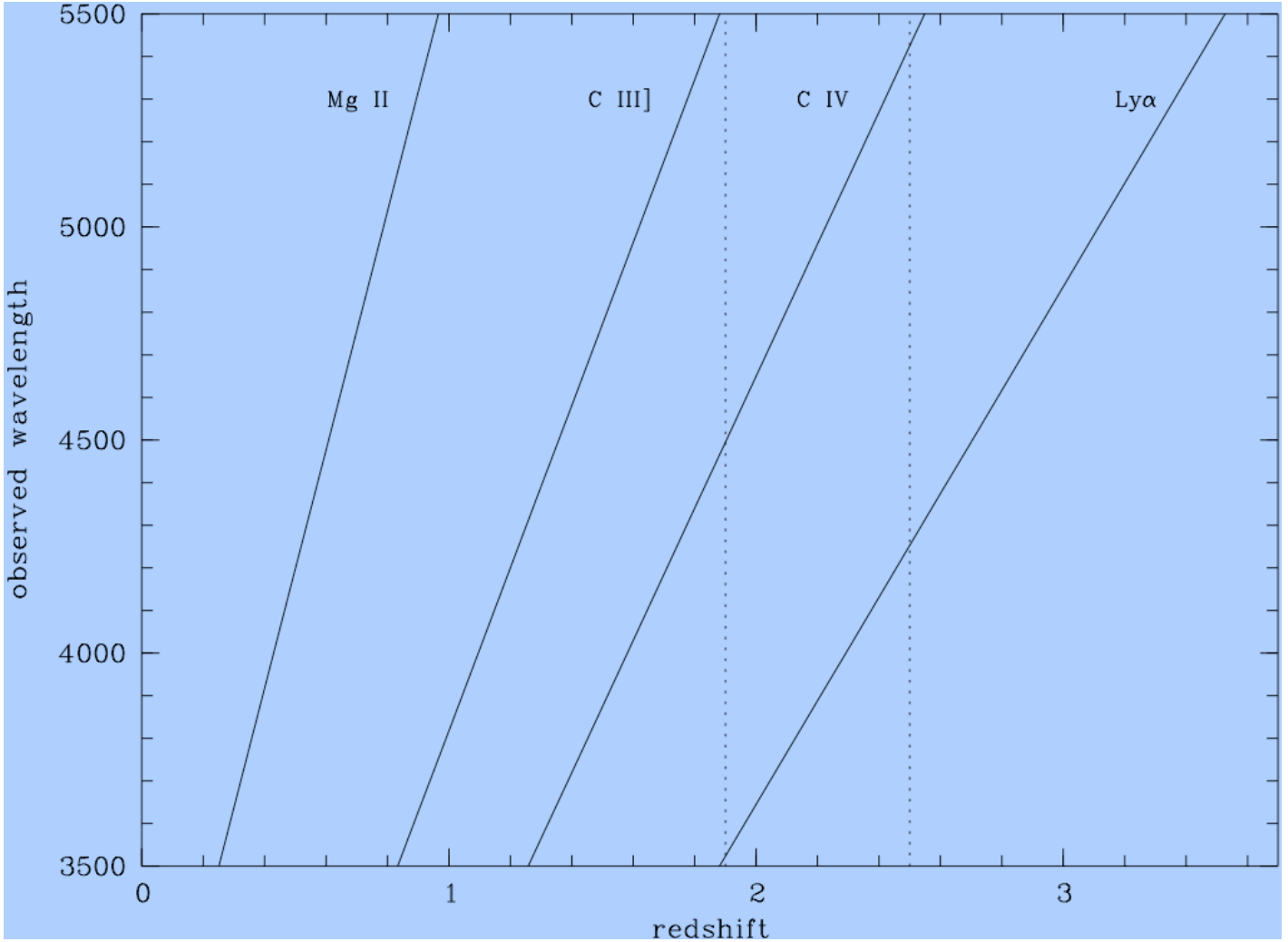
- Expected Yield: ~14000 BL-AGN
- The AGN Luminosity Density at the Epoch of He II Reionisation
- AGN – Galaxy Clustering: Probing
  - AGN lifetimes
  - the M_{Halo}-M_{BH} relation
  - AGN fuelling mechanisms

Broad-line AGN composite spectrum



AGN detectability in HETDEX

Visibility of emission lines:



Predicted AGN yield of HETDEX

Number densities:

- $1.9 < z < 3.5$, $g < 24$: 150 / deg^2
- $z < 1.9$, $g < 23.6$: 200 / deg^2

DEX survey: Nominal effective area = 56 deg^2

- ⇨ **~7000** AGN with $1.9 < z < 3.5$ and 5σ det. of Lyα
- ⇨ among these: ~1800 with $1.9 < z < 2.5$ and 8σ C IV
- ⇨ further ~7000 AGN with $z < 1.9$ and $g < 23.6$

Virial M_{BH} estimates from Mg II and C IV lines

Some other faint AGN surveys

COMBO-17 (17-band photometric redshifts)

- R < 24, 1 < z < 5: 0.75 deg^2 ⟶ 200 AGN

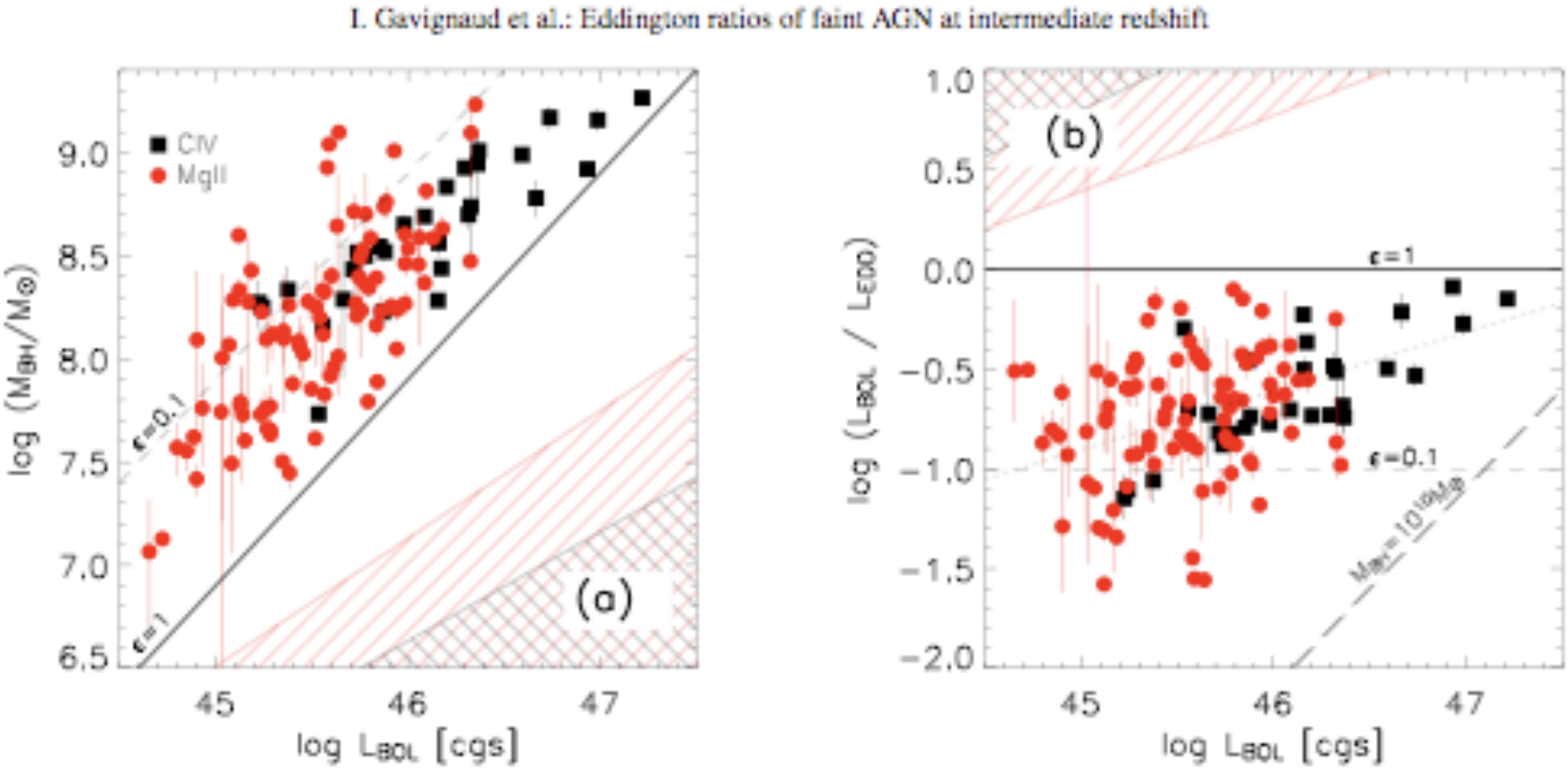
VLT-VIMOS Deep Survey (mask spectra)

- I < 22.5/24, 0 < z < 5: 6 deg^2 ⟶ 370 AGN

Deep X-ray surveys + optical follow-up

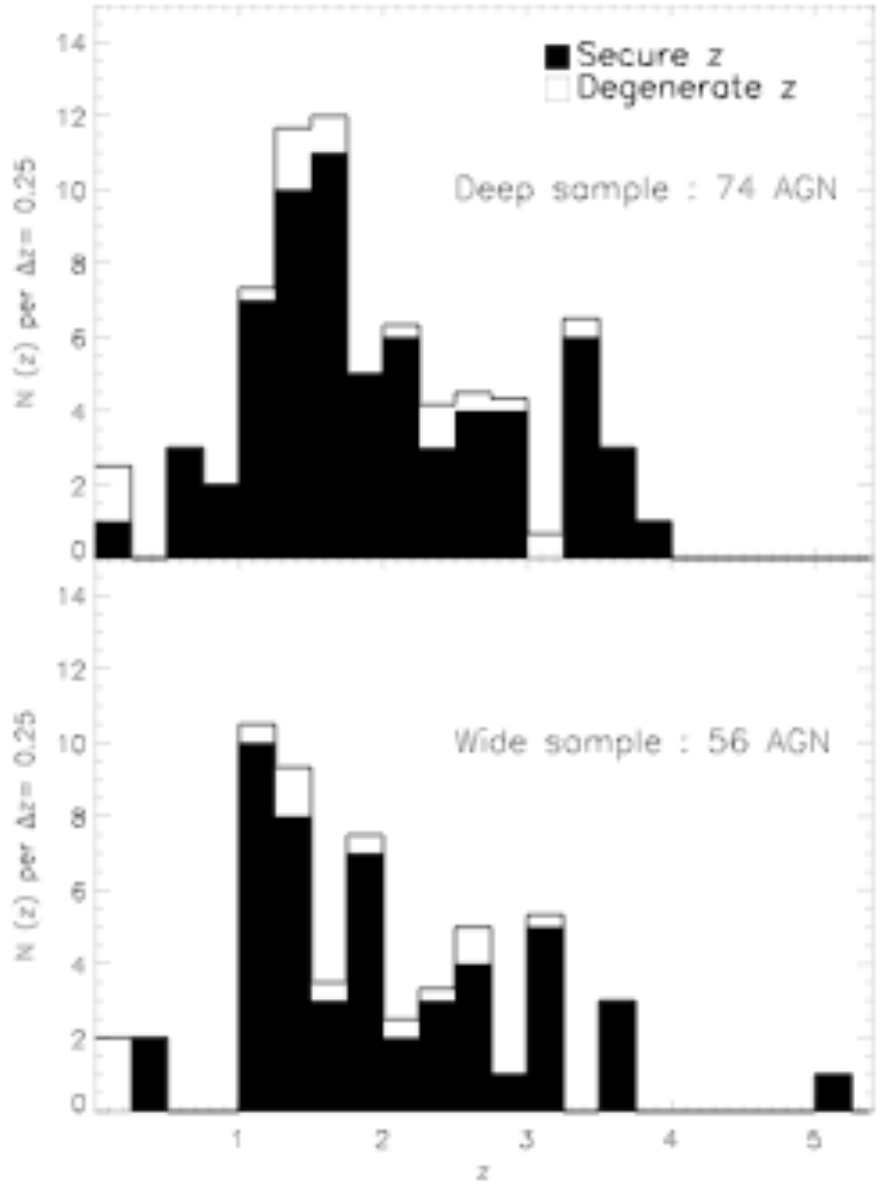
- R <~ 25, 0 < z < 5: few deg^2 ⟶ ~2000 sources
  (mostly very faint objects, many not even classical AGN)

Eddington ratios of faint AGN

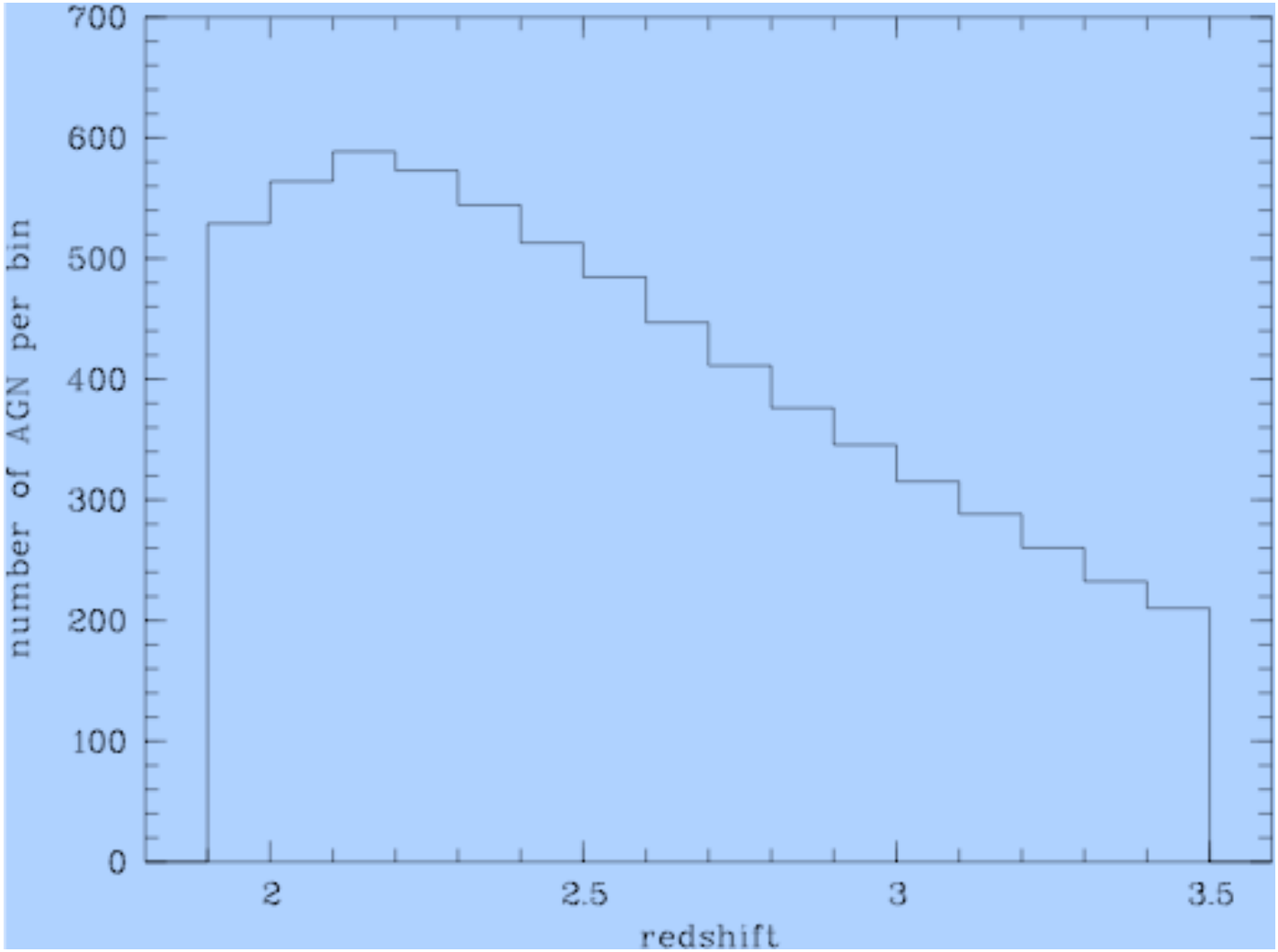


(Gavignaud et al 2008)

AGN redshift distribution in VVDS

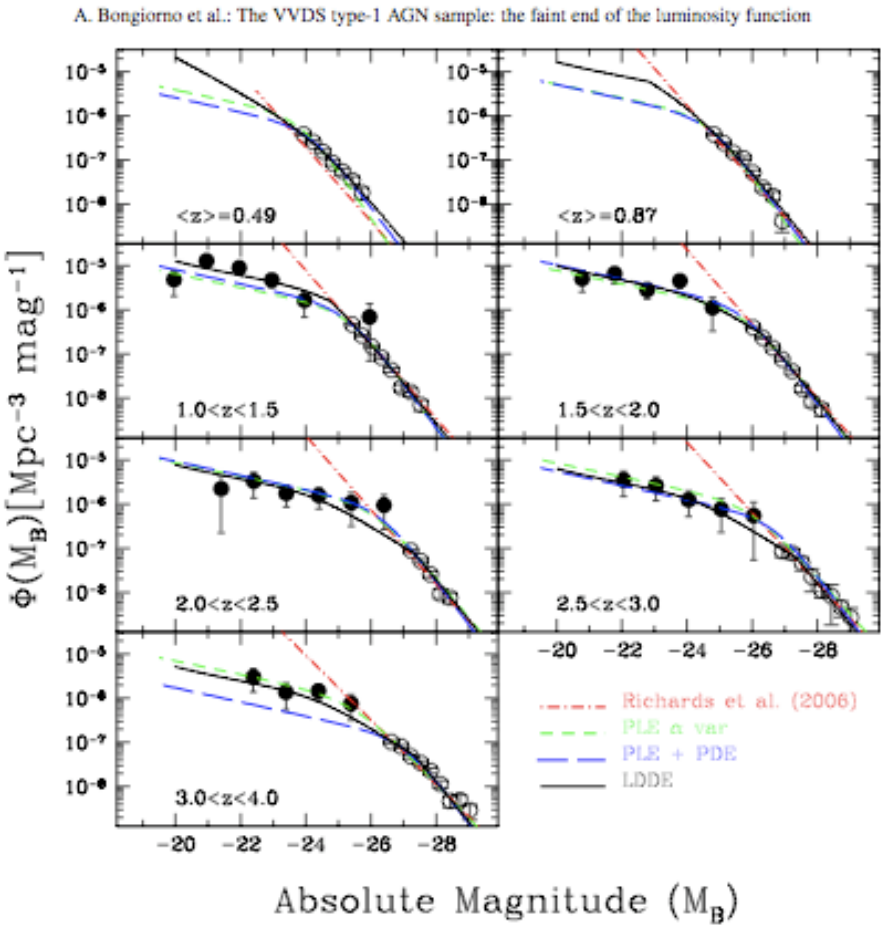


Predicted z distribution in HETDEX
(for 56 deg^2 baseline survey)



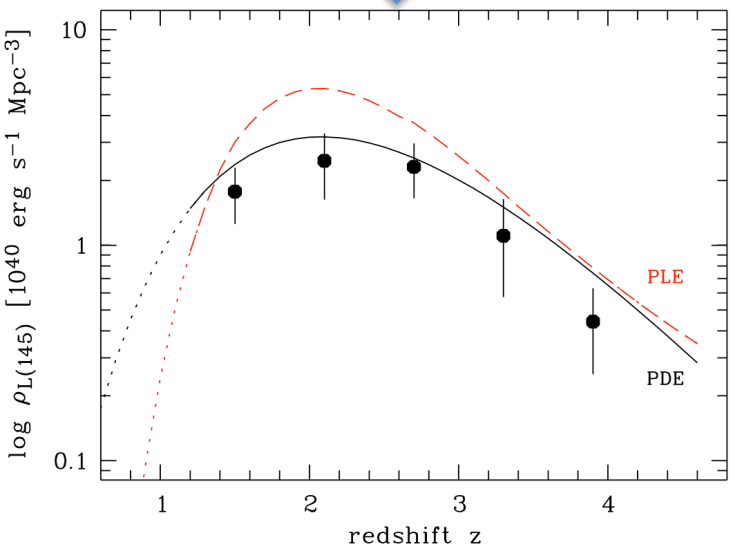
AGN luminosity density

Luminosity function



Luminosity density

$$\varepsilon_L = \int (L \cdot \phi)\, \mathrm{d}L$$



AGN luminosity density around z=3

- $z > 3.5$: Cosmic UV background dominated by stars: Intergalactic H = H^+ ; He = He^+
- $z < 2.5$: UV background has major AGN contribution: He = He^{++}
- Around $z \sim 3$: 2nd cosmic reionisation, $He^+ \longrightarrow He^{++}$
- Models need accurate redshift evolution of ultraviolet luminosity density of AGN, $\varepsilon_{UV}(z)$
- Large faint AGN sample with high completeness in $2.5 < z < 3.5$ ⟹ only HETDEX can deliver this!

AGN-Galaxy Correlation Function

Unique property of HETDEX:

- 10^4 AGN and 10^6 Galaxies in the same volume!

- Chance to measure AGN – galaxy spatial correlation properties with 100 x higher accuracy than presently possible

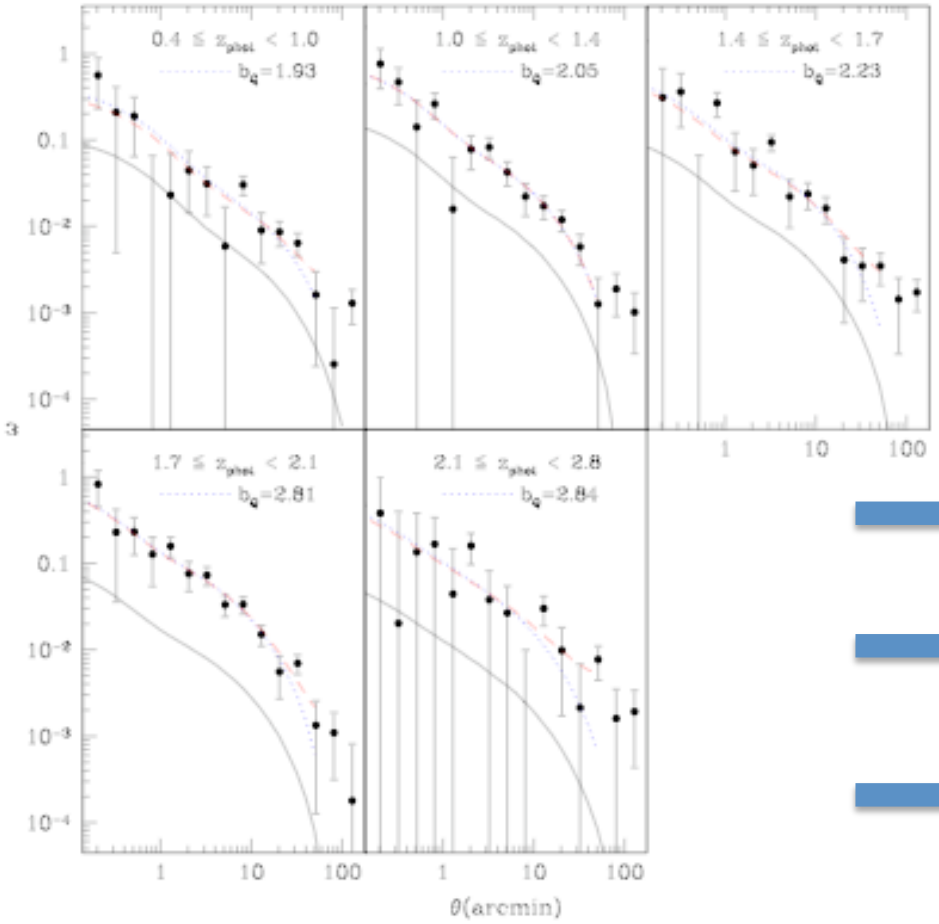
Clustering Properties of AGN I

Until recently: Only AGN-AGN clustering from large QSO surveys, because AGN and galaxy surveys cover disjoint volumes.

- Sparse sampling of large-scale structure, very poor S/N on scales below ~10 Mpc where most of the power is.

Example: SDSS QSO sample, 10^5 AGN but still only marginally sufficient to split by L or M

QSO-QSO Correlation at z < 2.8



→ AGN bias factor

→ DM halo masses

→ AGN duty cycle

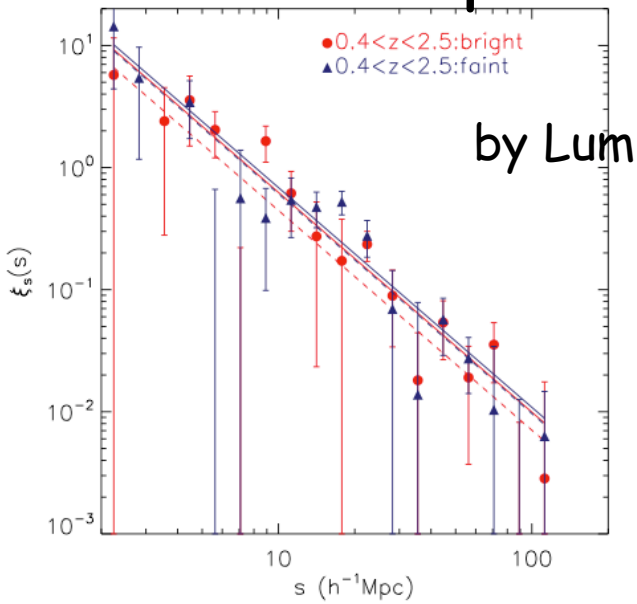
FIG. 3.— Quasar clustering evolution as a function of photometric redshift. There are ∼65,000 quasars in each bin except for the $2.1 \leq z_{phot} < 2.8$ bin, which contains ∼28,000 quasars. The solid line is the expected clustering of dark matter derived from Smi03. The

(SDSS QSO candidates with photo-z; Myers et al 2007)

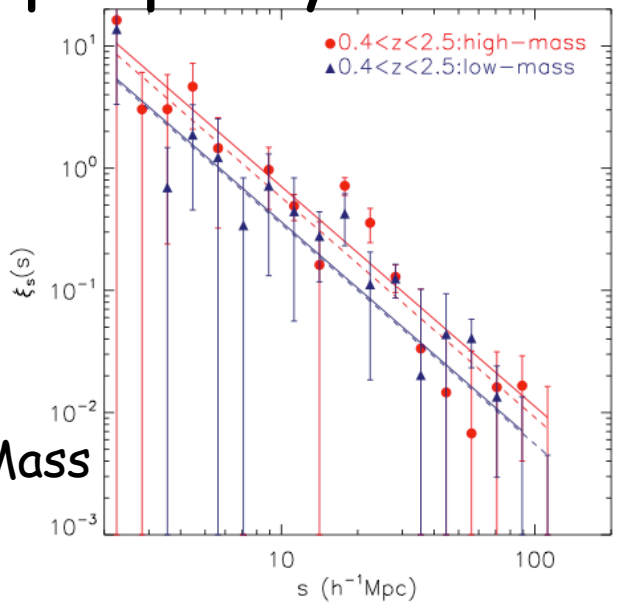
AGN-AGN Correlation at z < 2.5

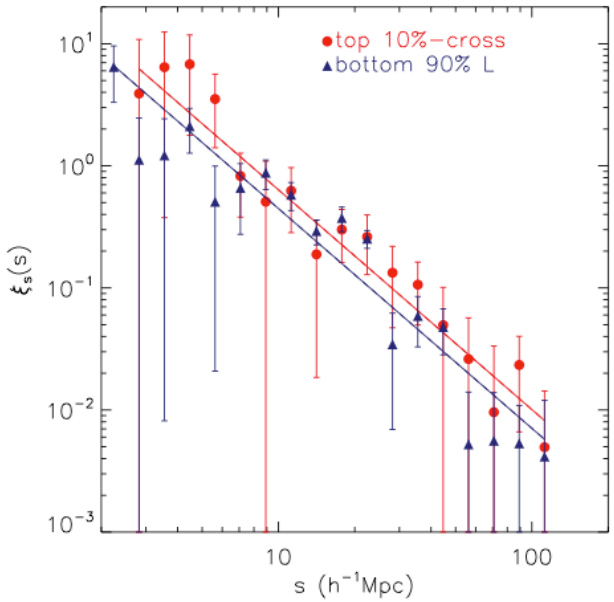
splitting it by AGN property

by Luminosity

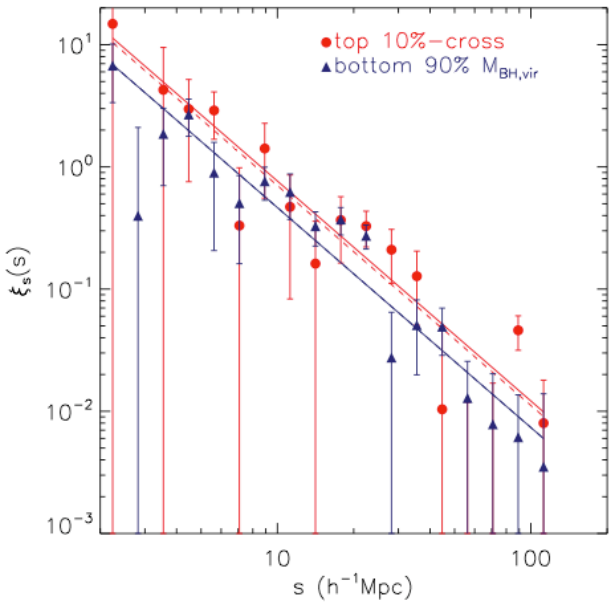


by BH Mass





(SDSS main QSO sample, Shen et al 2009)

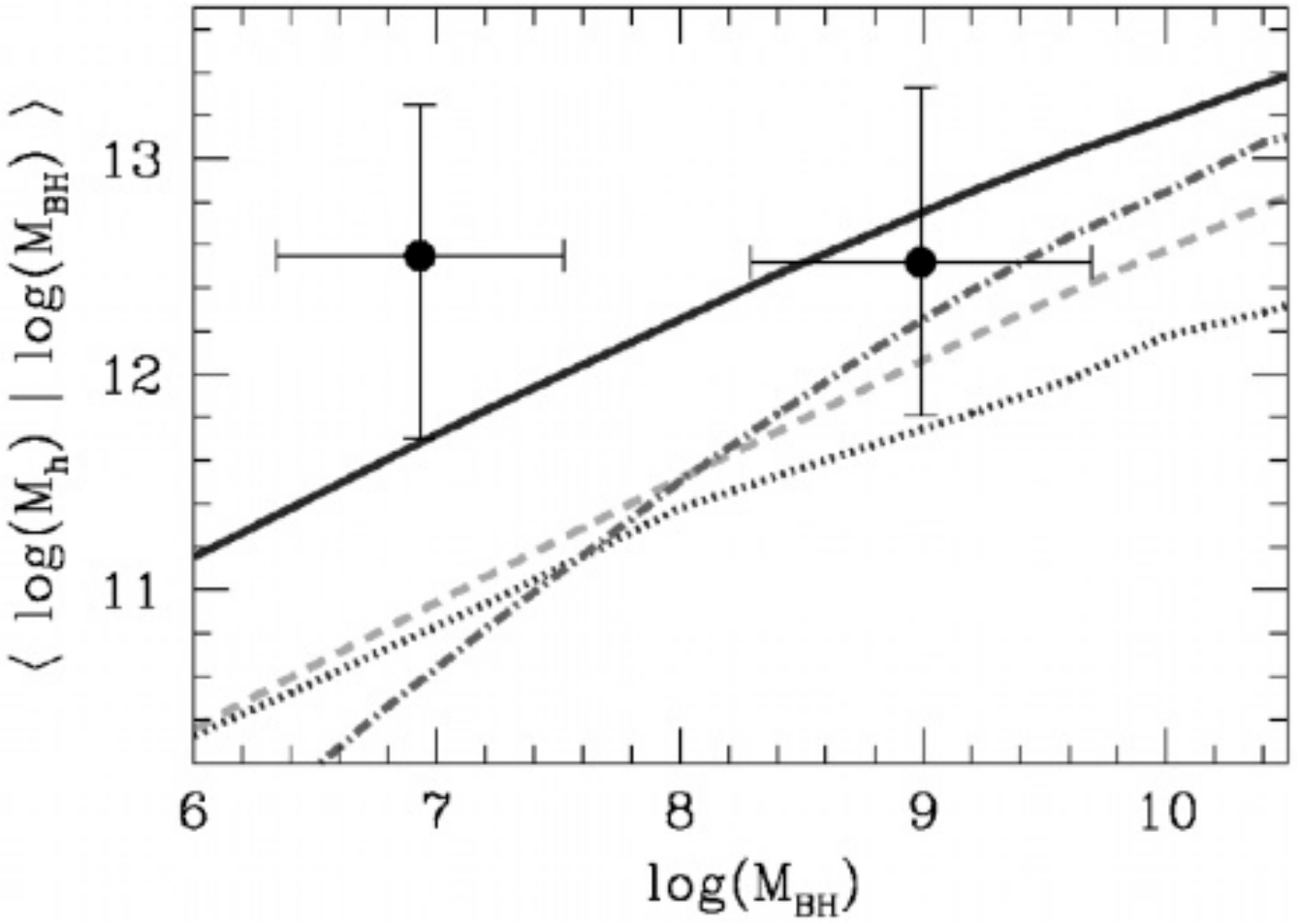


Clustering Properties of AGN II

Only recently: also AGN-Galaxy clustering.

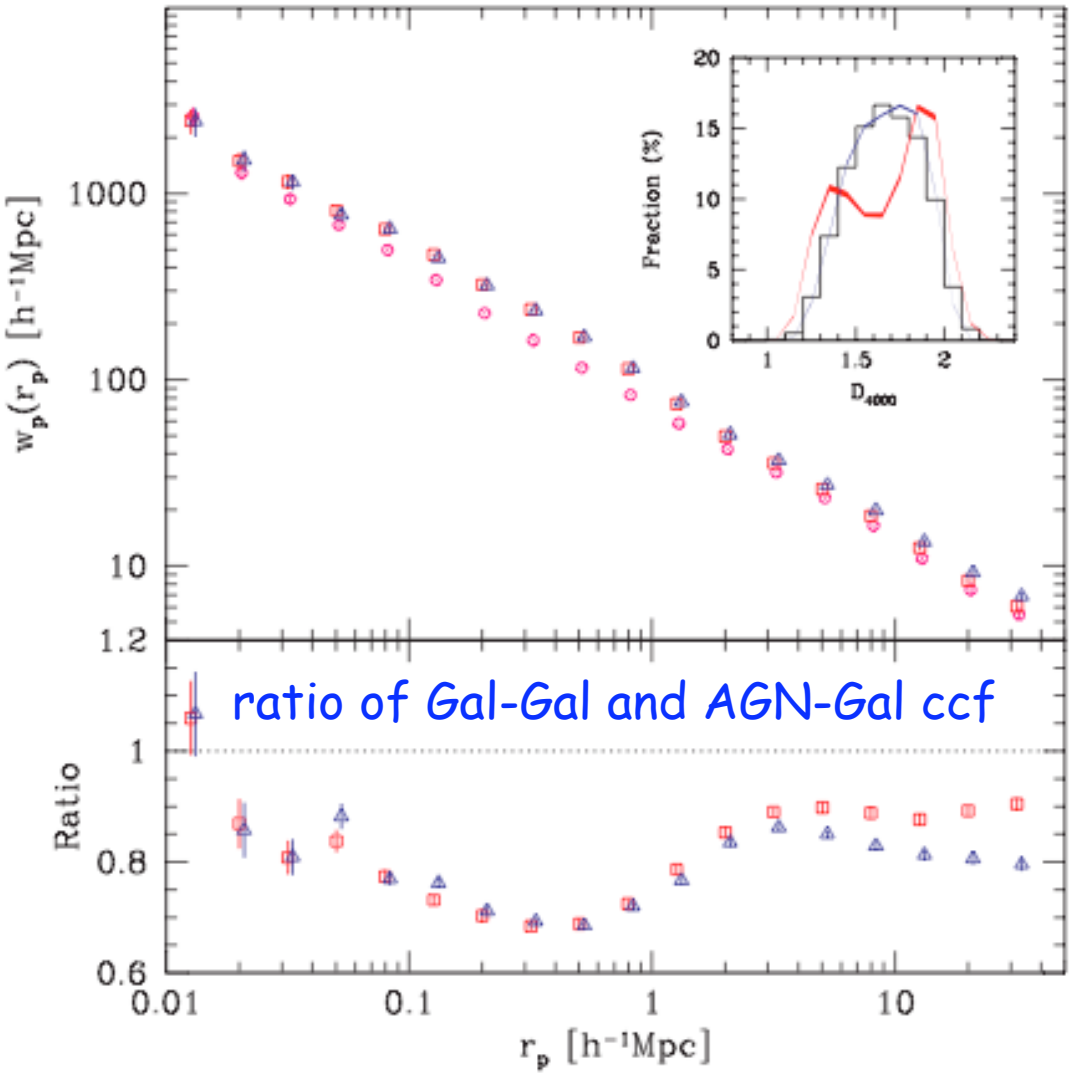
- AGN within SDSS galaxy sample ($z < 0.3$): 90000 (mostly weak) AGN vs. 300000 galaxies: very powerful diagnostic.
- at high-z: samples still very small, e.g.
  - DEEP2: 52 AGN + 5000 galaxies
  - MUSYC: 58 AGN + 1300 LBGs
  - Steidel survey: 79 AGN + 1600 SF galaxies

M_{Halo} - M_{BH} Relation at z~2.5



(Adelberger & Steidel 2005)

AGN-Galaxy Correlation at z < 0.3



(Li et al 2007)

Conclusions

HETDEX AGN sample will be highly competitive for luminosity function, distribution properties of M_{BH}, L/L_{EDD}, etc.

Completely unique and biggest impact: Correlation function at $1.9 < z < 3.5$

For $s > 1$ Mpc: Halo masses, bias, duty cycle

+ splitting sample by AGN properties

For separations < 1 Mpc: Constrain AGN fueling (strong test for merger hypothesis)