PFS - wide: a million galaxies over ten billion years

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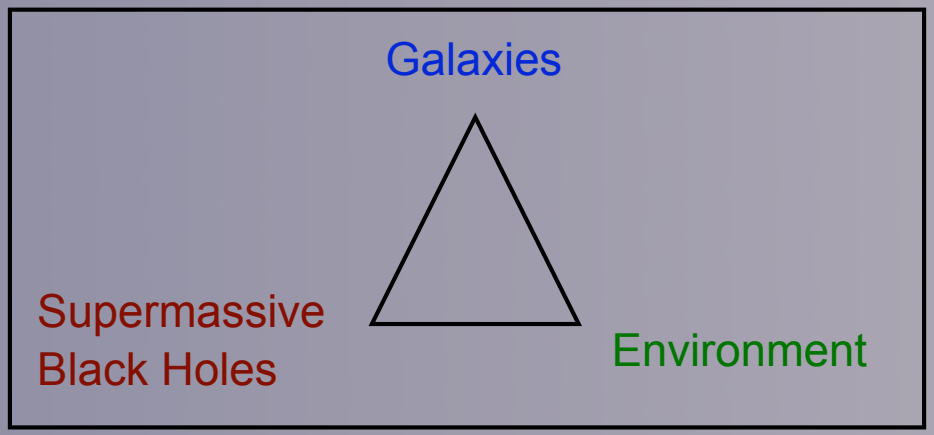
Outline

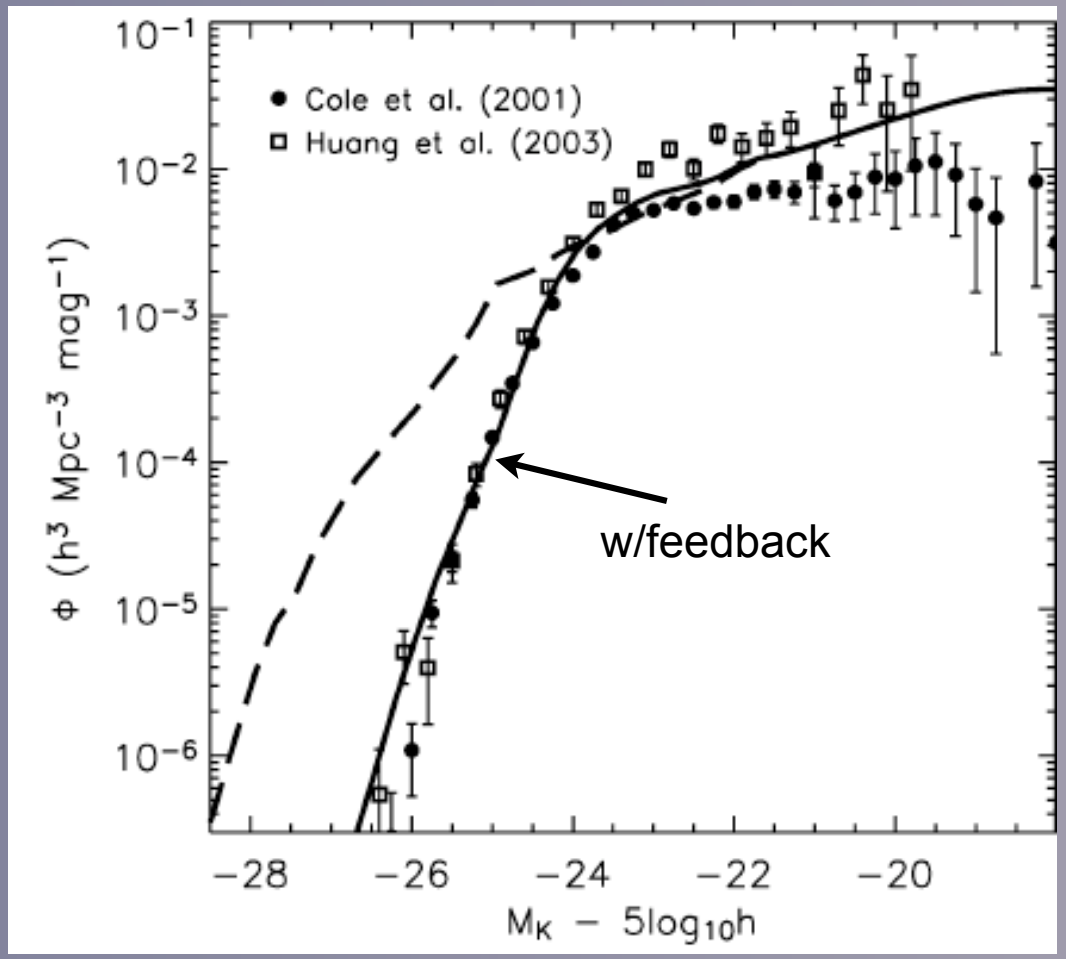
Motivation to push studies of the extragalactic Universe to z~2

Current, large (~10^4 spectra) spectroscopic surveys to z~1
Deficiencies of such narrow beam survey

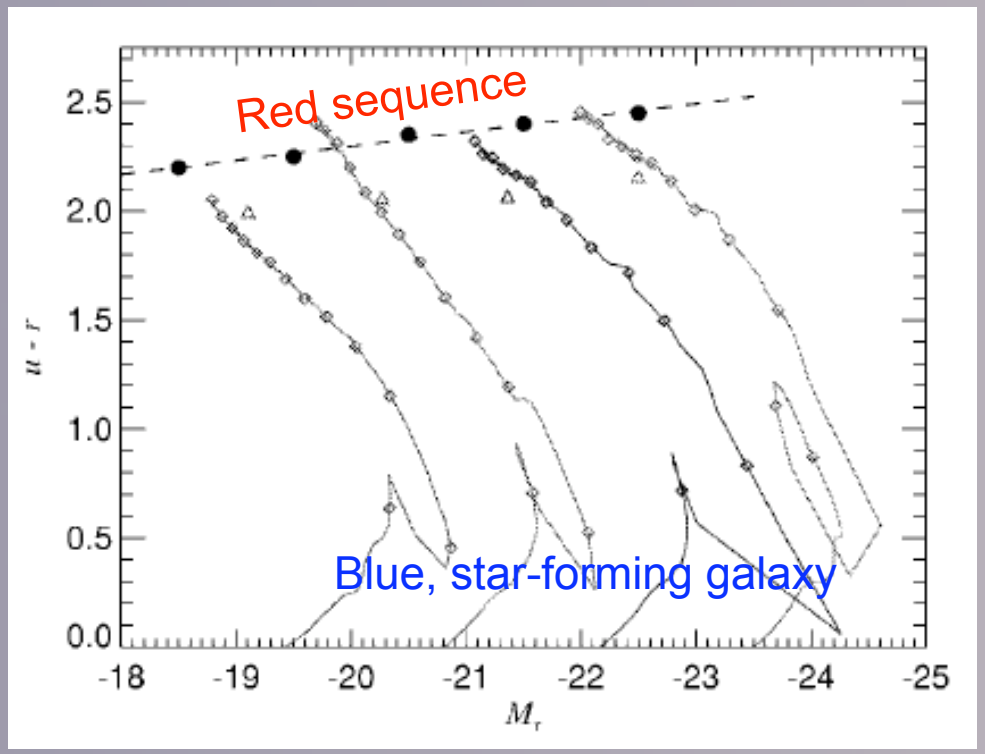
Defining a strategy for a PFS survey for galaxy and AGN evolution in an environmental context up to z ~ 2



Key problems in galaxy formation



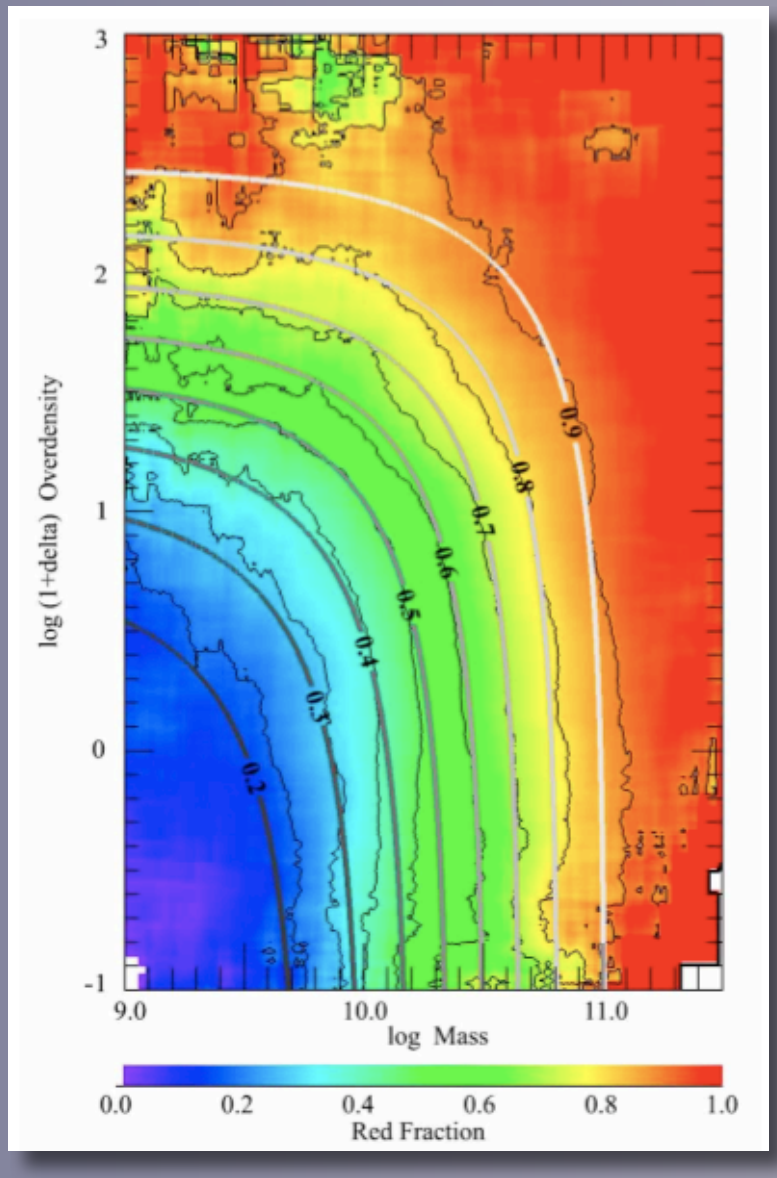
Croton et al. 2006



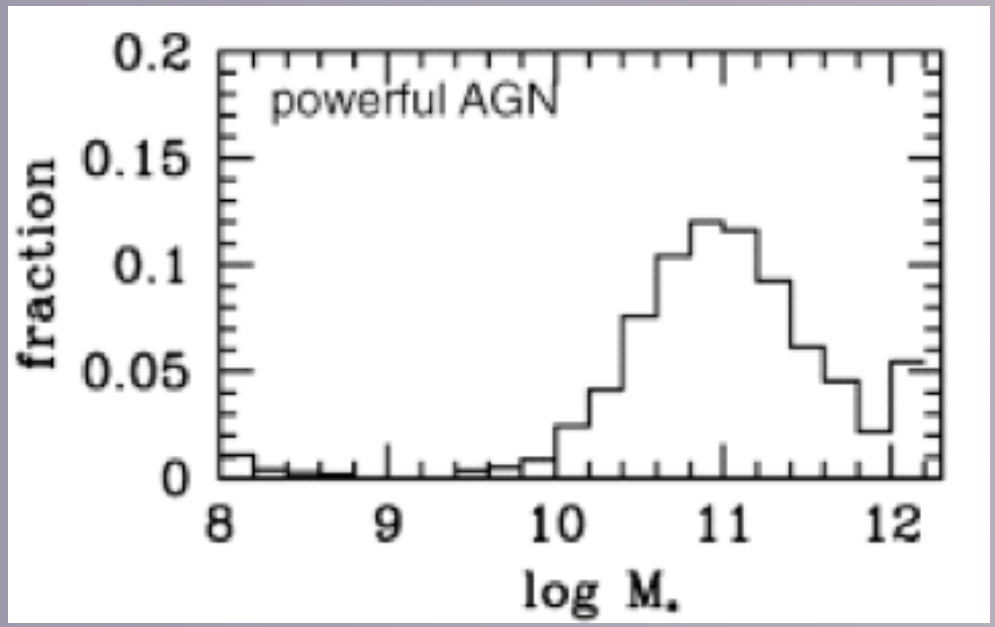
Springel et al. 2005

What physical mechanism(s) is halting the growth of massive galaxies?

SDSS: a (local) benchmark for galaxy and AGN surveys



Peng et al. 2010



Kauffmann et al. 2003

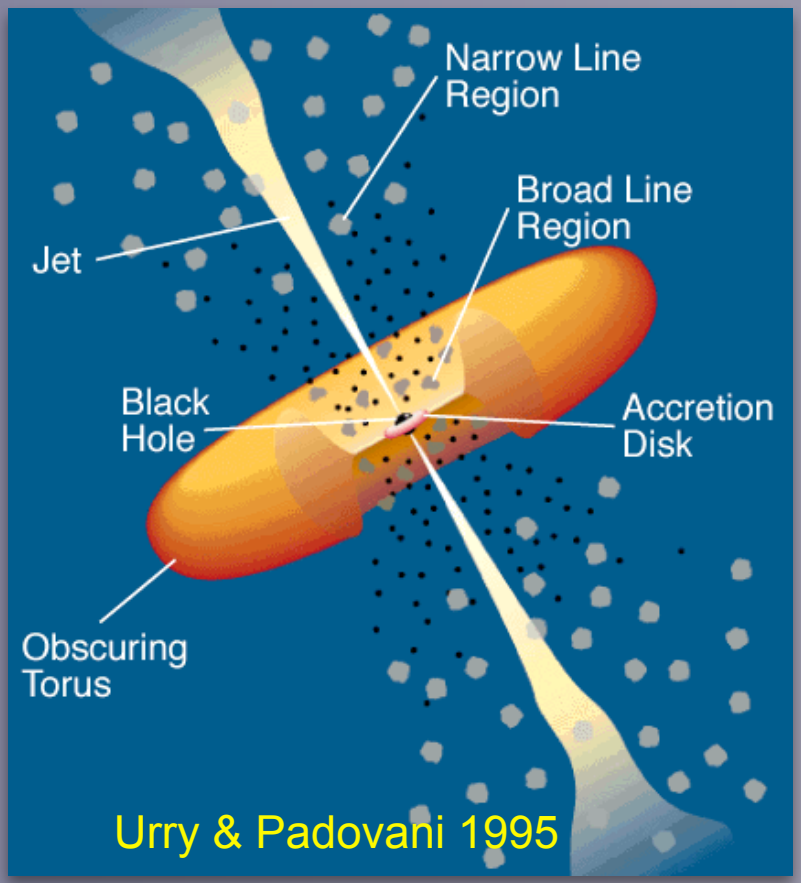
Mass and environment are fundamental parameters

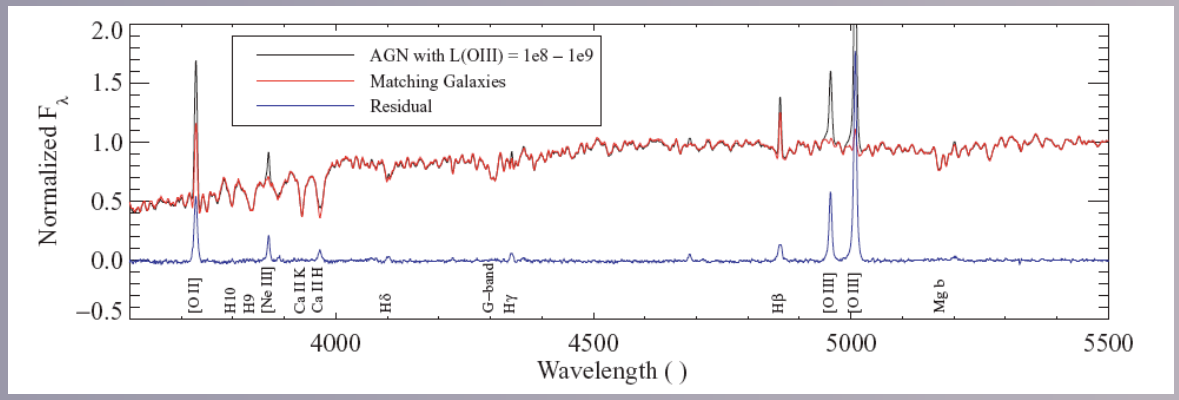
(e.g.,Baldry et al. 2004; Thomas et al. 2009; Peng et al. 2010)

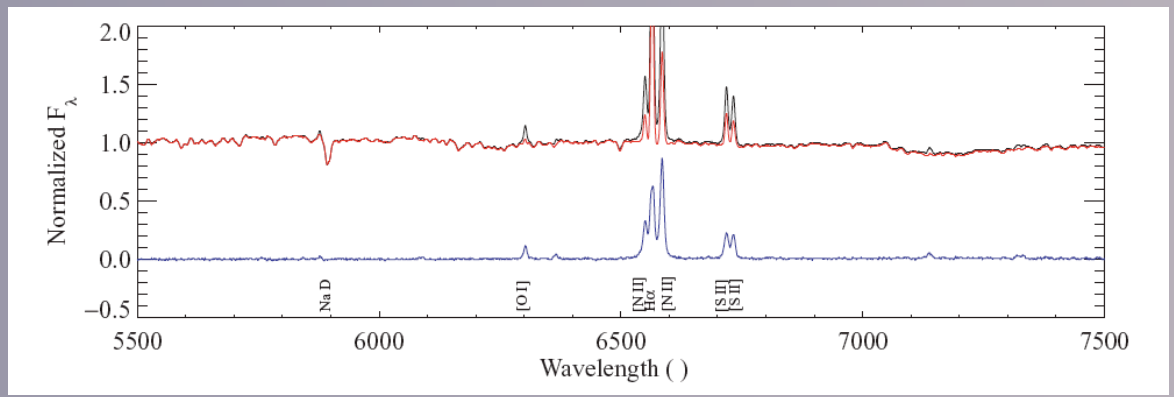
SDSS: a (local) benchmark for galaxy and AGN surveys

Type 2 AGNs: Nature's 'cosmic coronograph'

Selection based on emission-line ratios







Kauffmann et al. 2003

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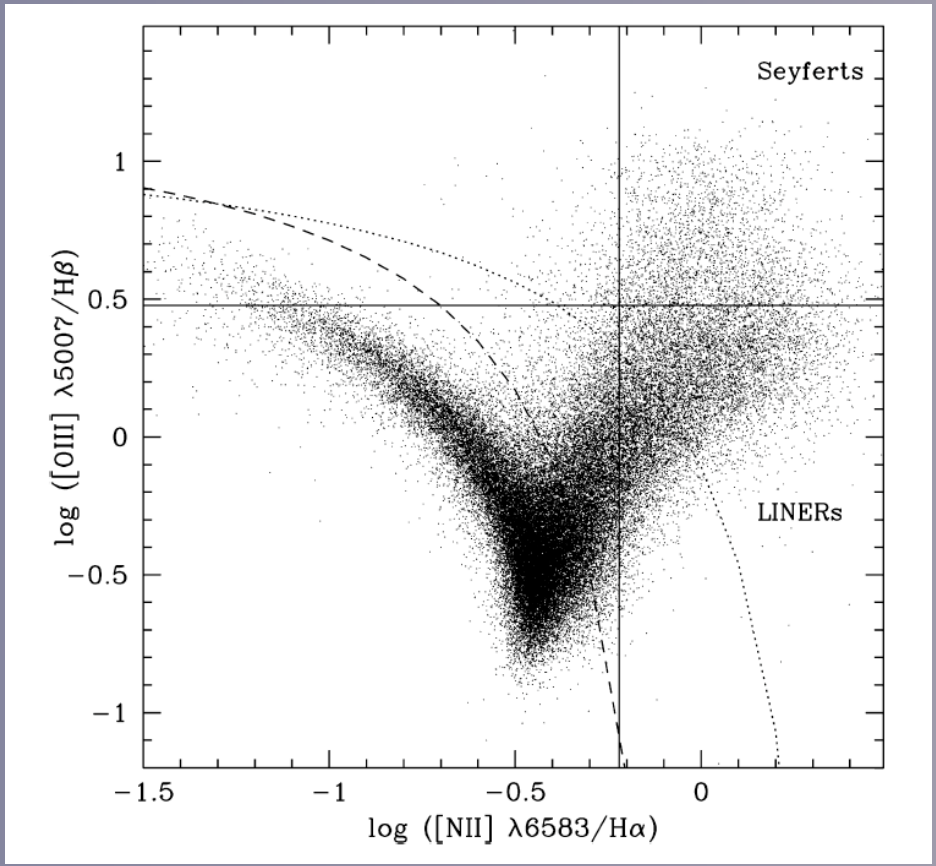
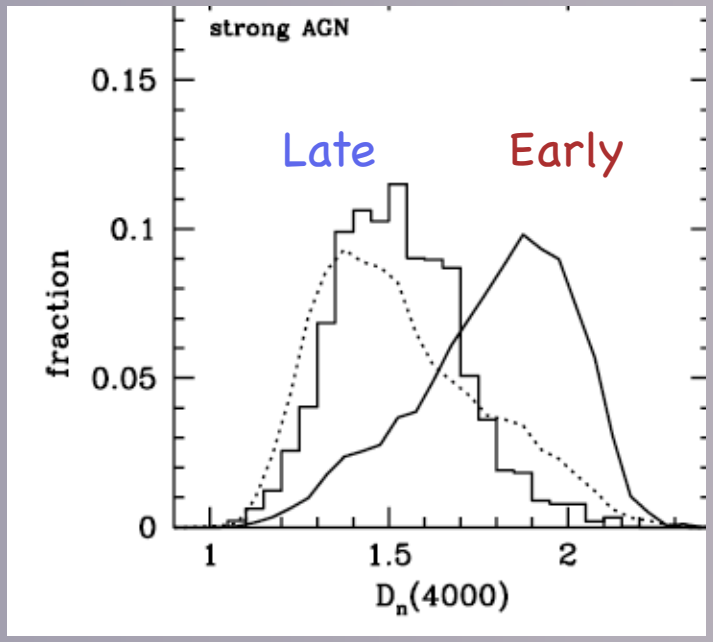
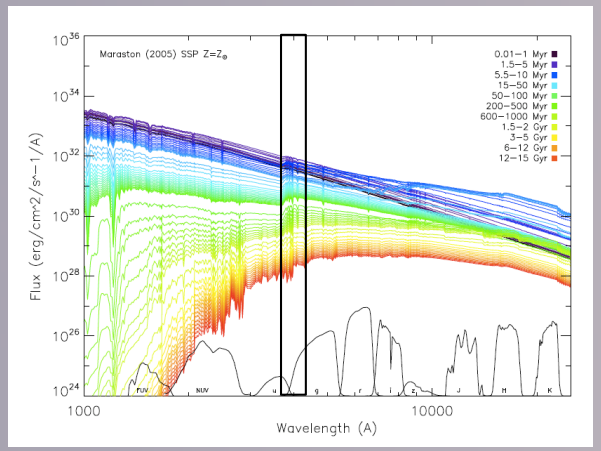


Kewley et al. 2006



Young stellar populations are associated with strongly accreting SMBHs

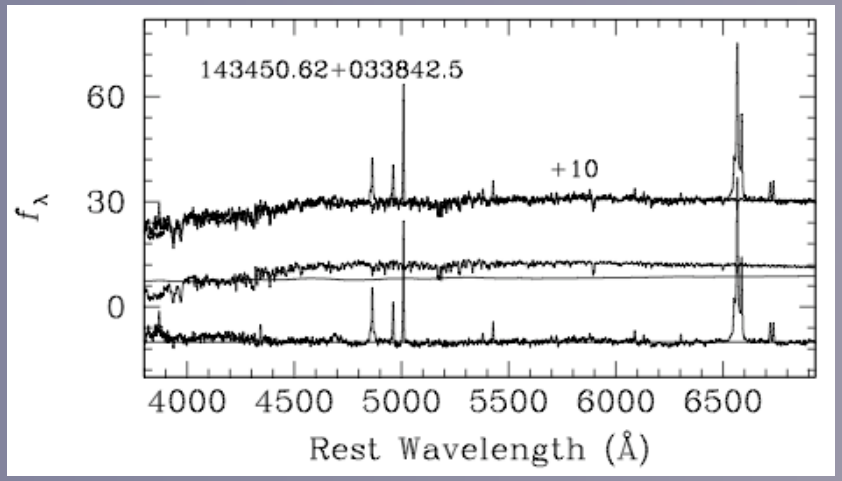
Kauffmann et al. 2003

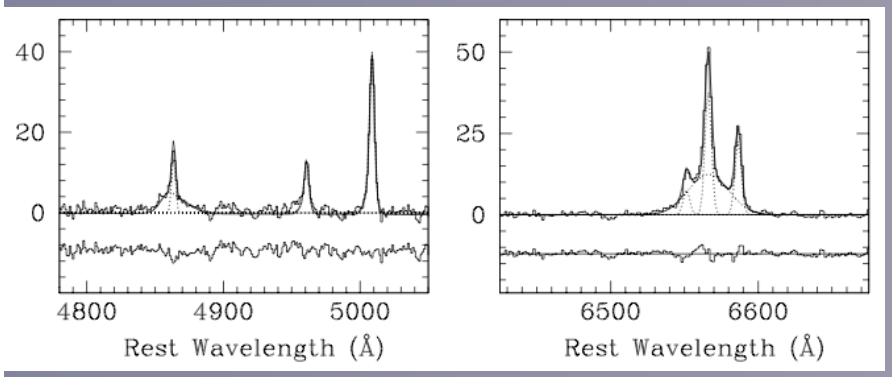


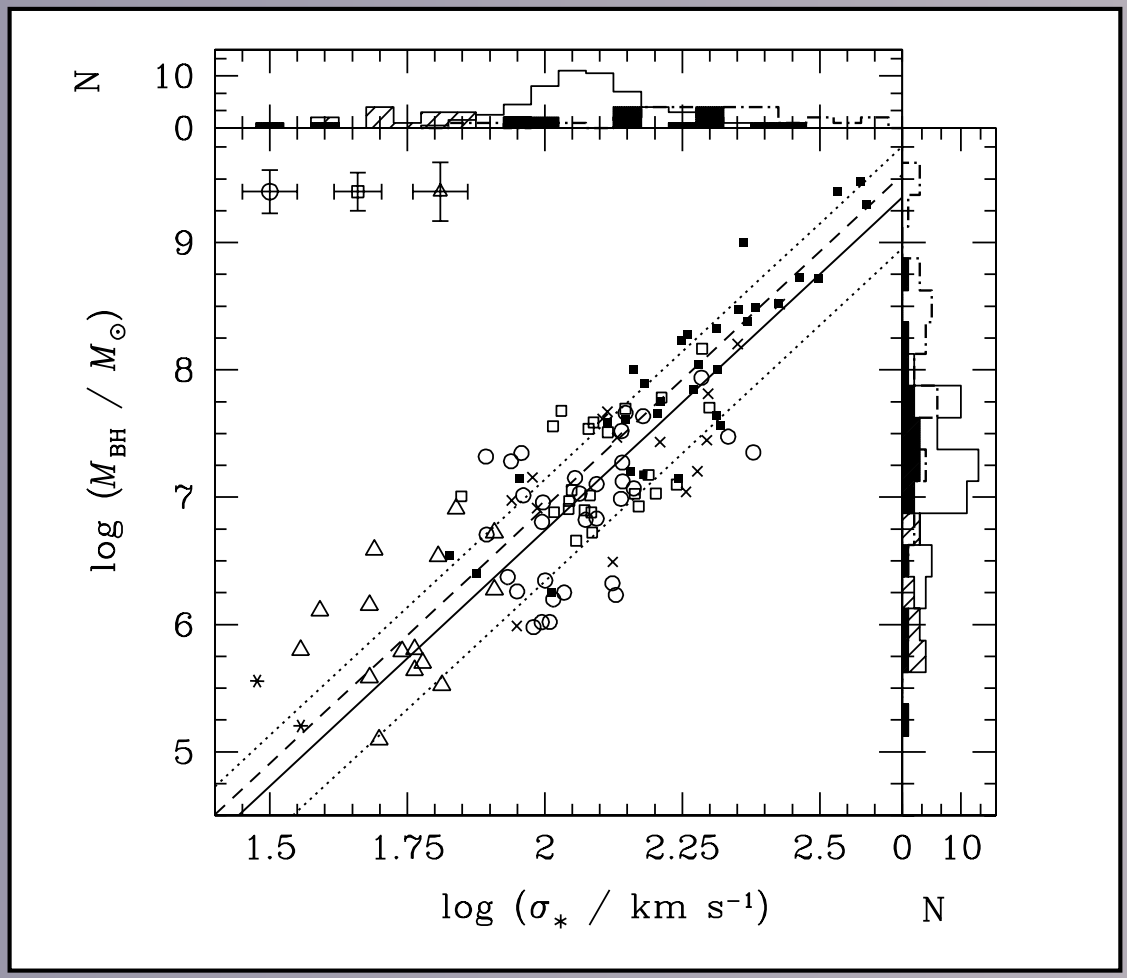
Schawinski et al. 2007

Do AGN impact the formation of stars?

SDSS: a (local) benchmark for galaxy and AGN surveys



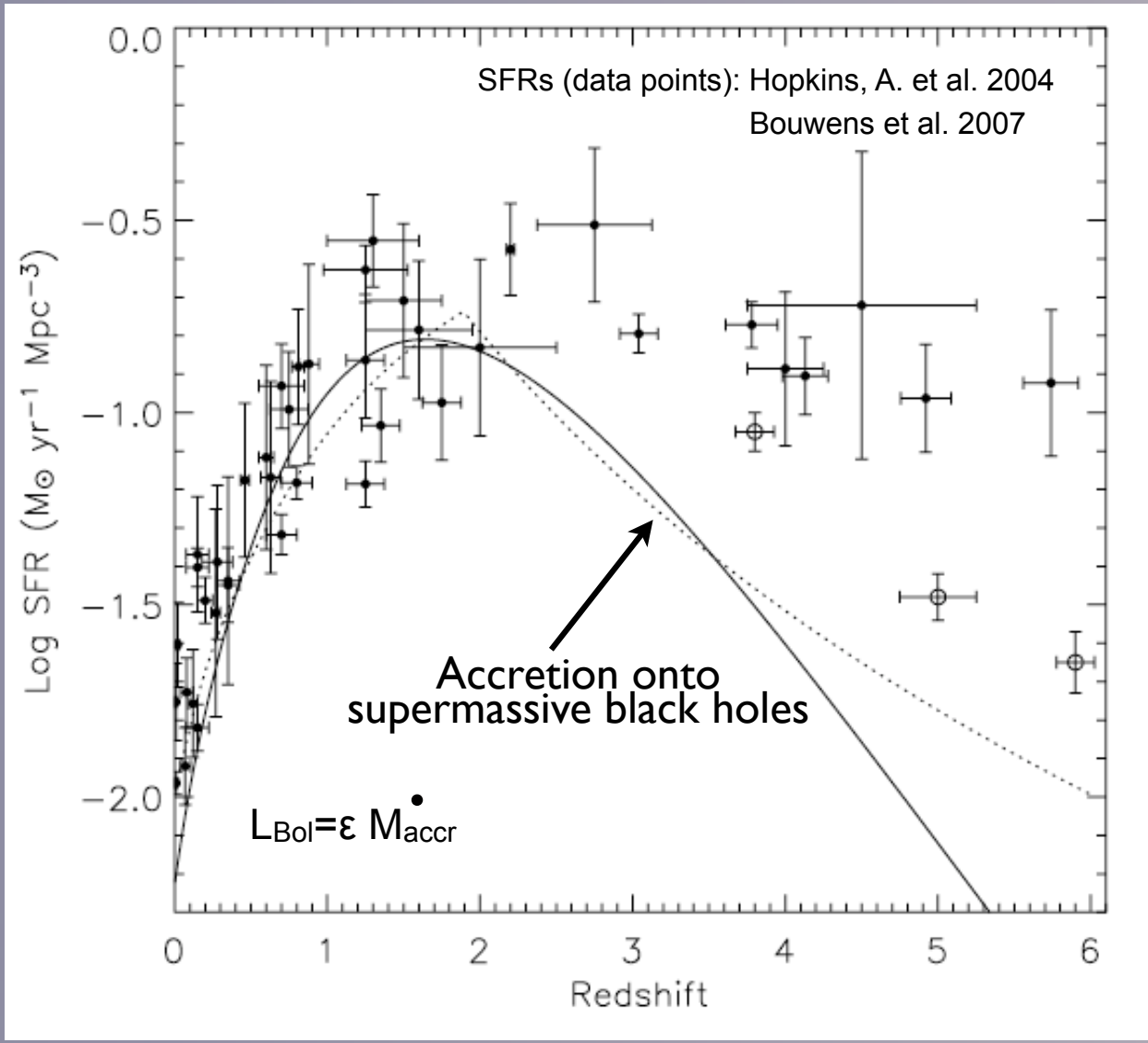




Greene et al. 2006

How do galaxies and their black holes migrate onto local mass relations?

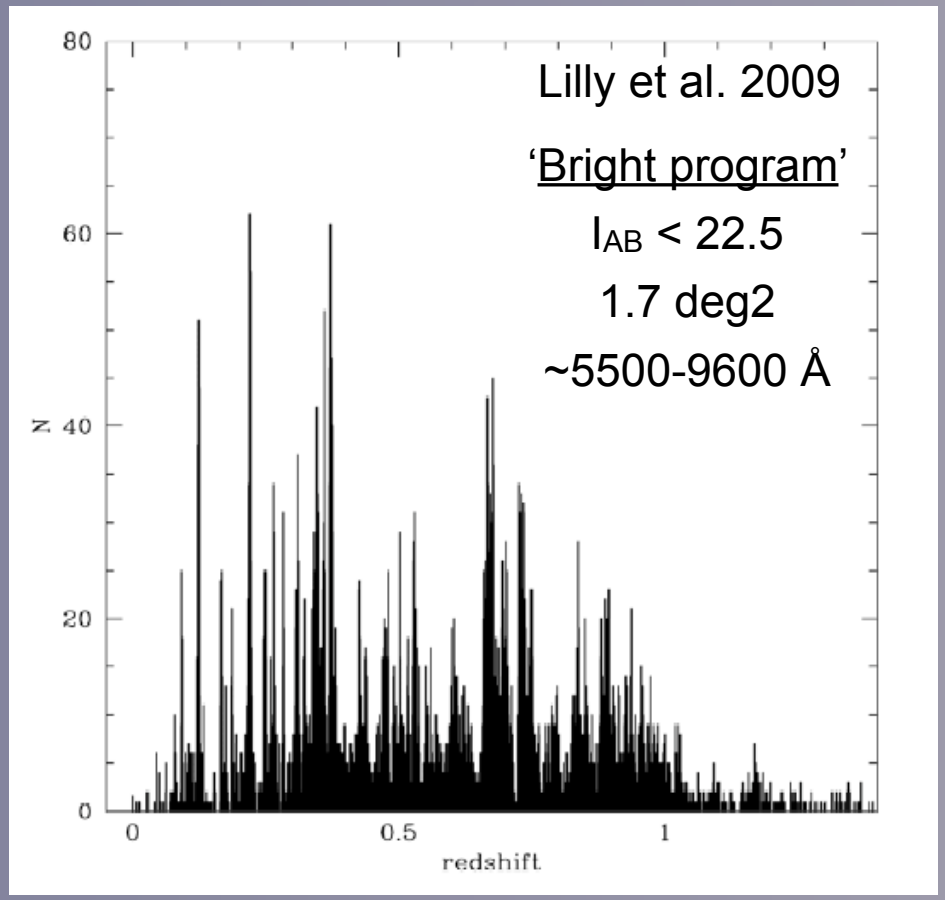
Need to push to higher redshift

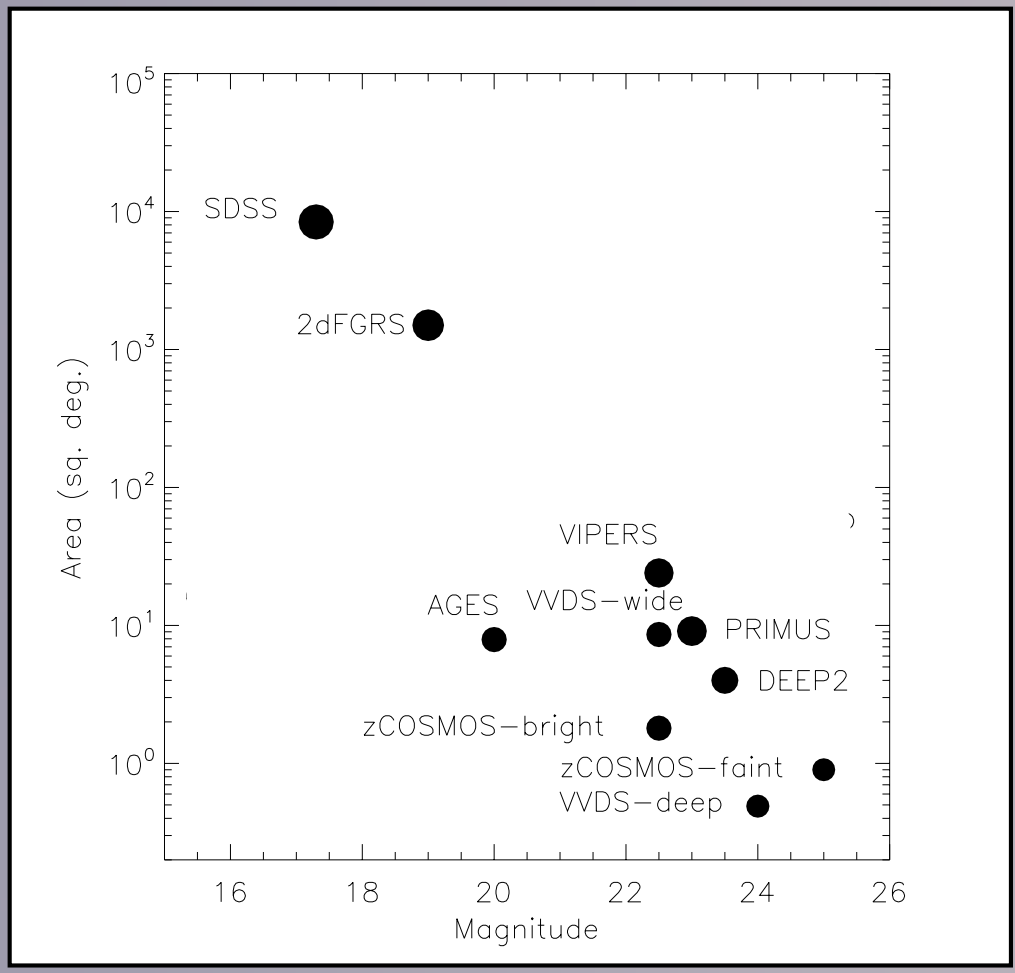


JDS et al. 2008

zCOSMOS and large spectroscopic surveys

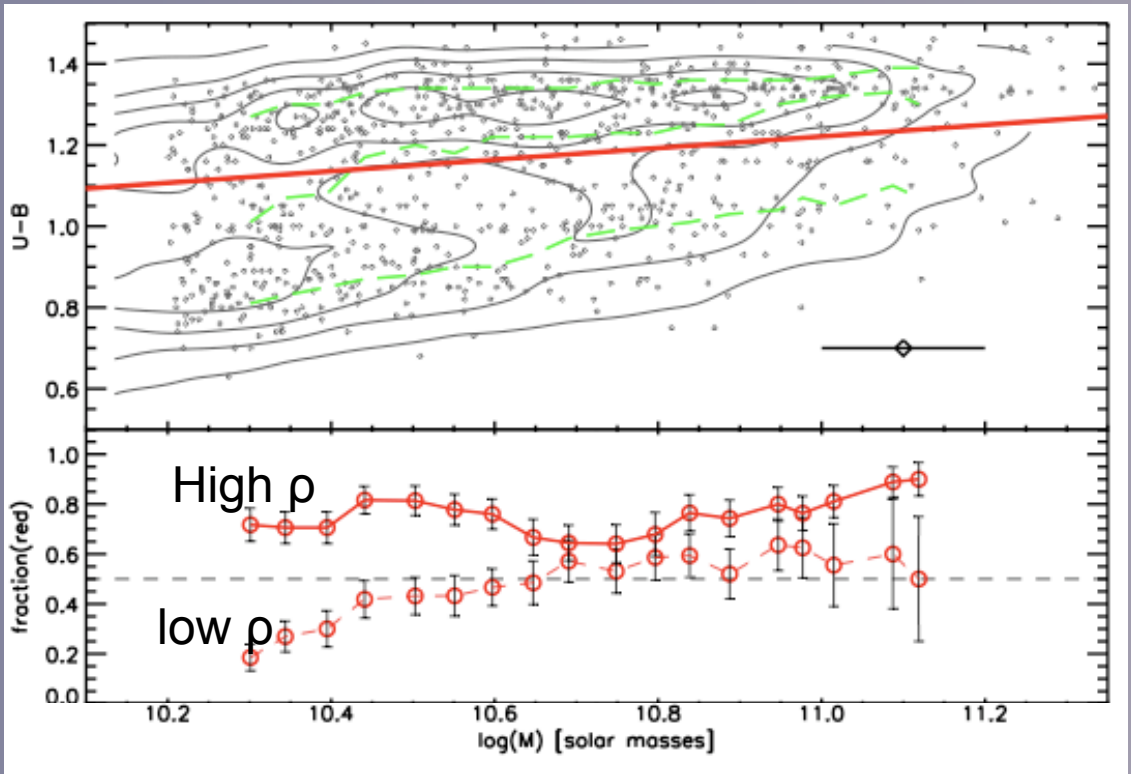
zCOSMOS
20k spectra





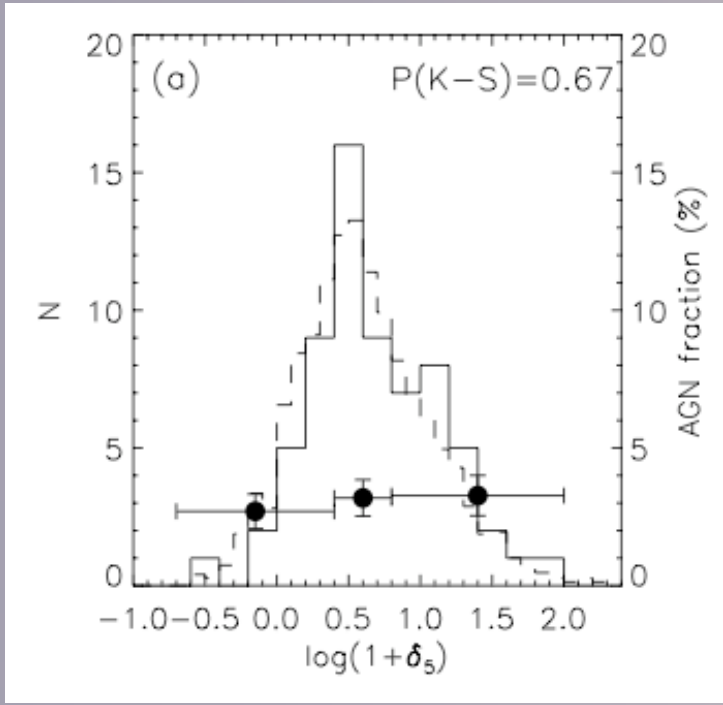
zCOSMOS and large spectroscopic surveys

Environmental studies of galaxies



Cucciatti et al. 2010

Environments of AGNs



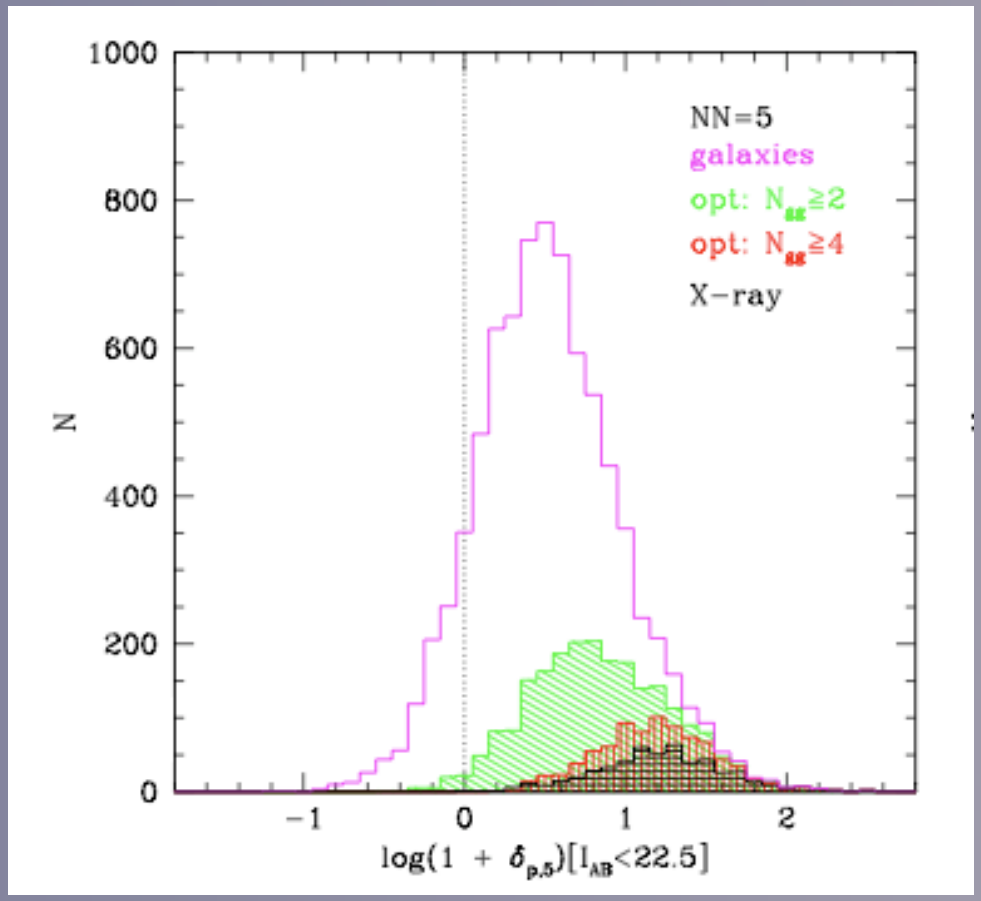
JDS et al. 2009

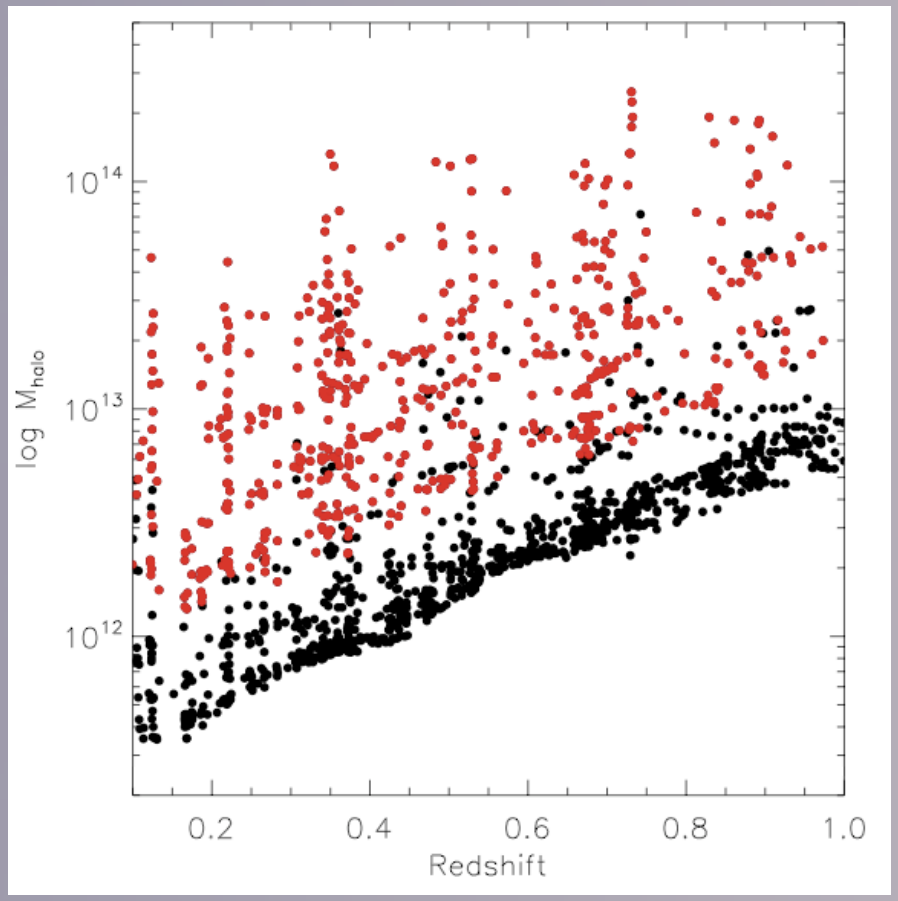
Environmental and mass dependence of galaxy properties up to z~1 (see Tanaka et al. 2010 for higher-z)

zCOSMOS and large spectroscopic surveys

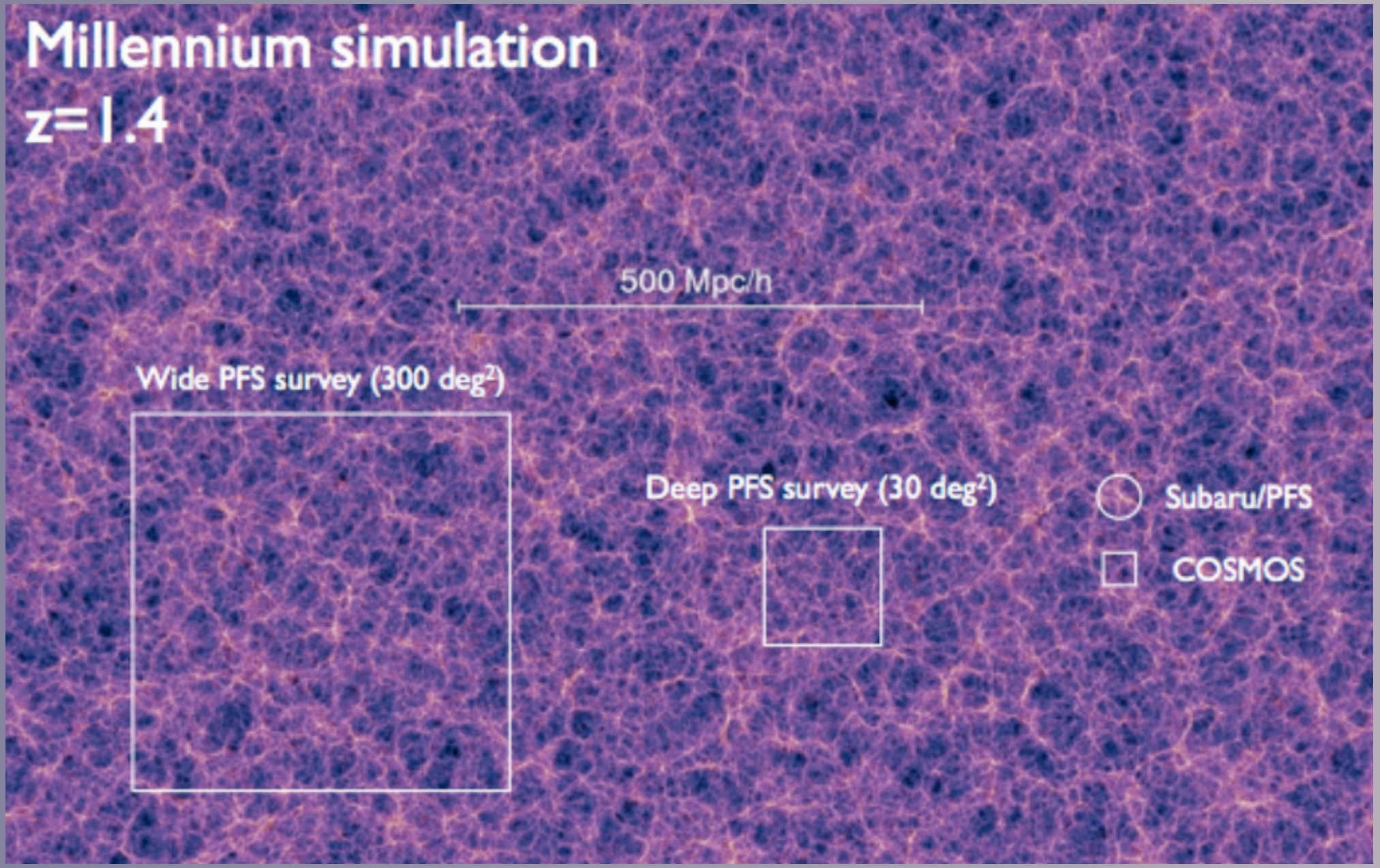
Galaxy group catalog (Knobel et al. 2009)

- 1681 groups in 20k (577 w/ 3 or more members)
- $10^{12} < M_{halo} < 10^{14}\ M_{\odot}$



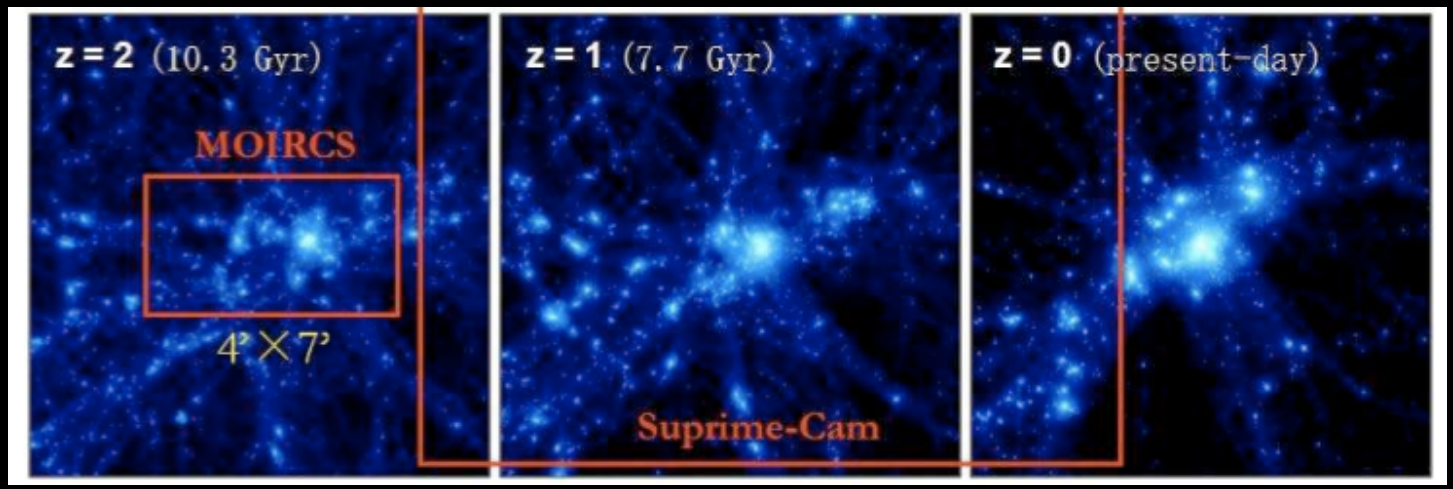


Practically no massive clusters!


Millennium simulation
z=1.4
500 Mpc/h
Wide PFS survey (300 deg²)
Deep PFS survey (30 deg²)
Subaru/PFS
COSMOS

Estimating cluster yields at 1 < z < 2

- given a fixed amount of observing time, there is a one-to-one correspondence between depth (z_{lim}) and area
- maximize the number of clusters (required to have >4 members)
- model the number of halos as a function of cluster mass after Tinker & Wetzel (2010), who used an HOD model to explain the clustering of galaxies at z=1-2 in UKIDSS UDS



Kodama et al. 2008; Nagashima et al. 2005

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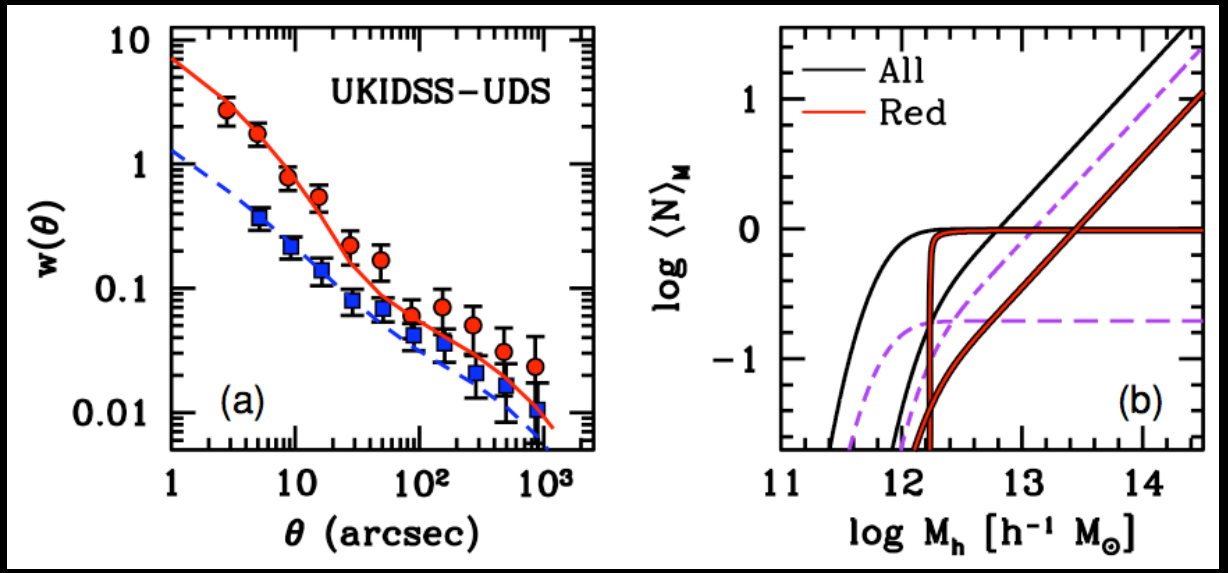
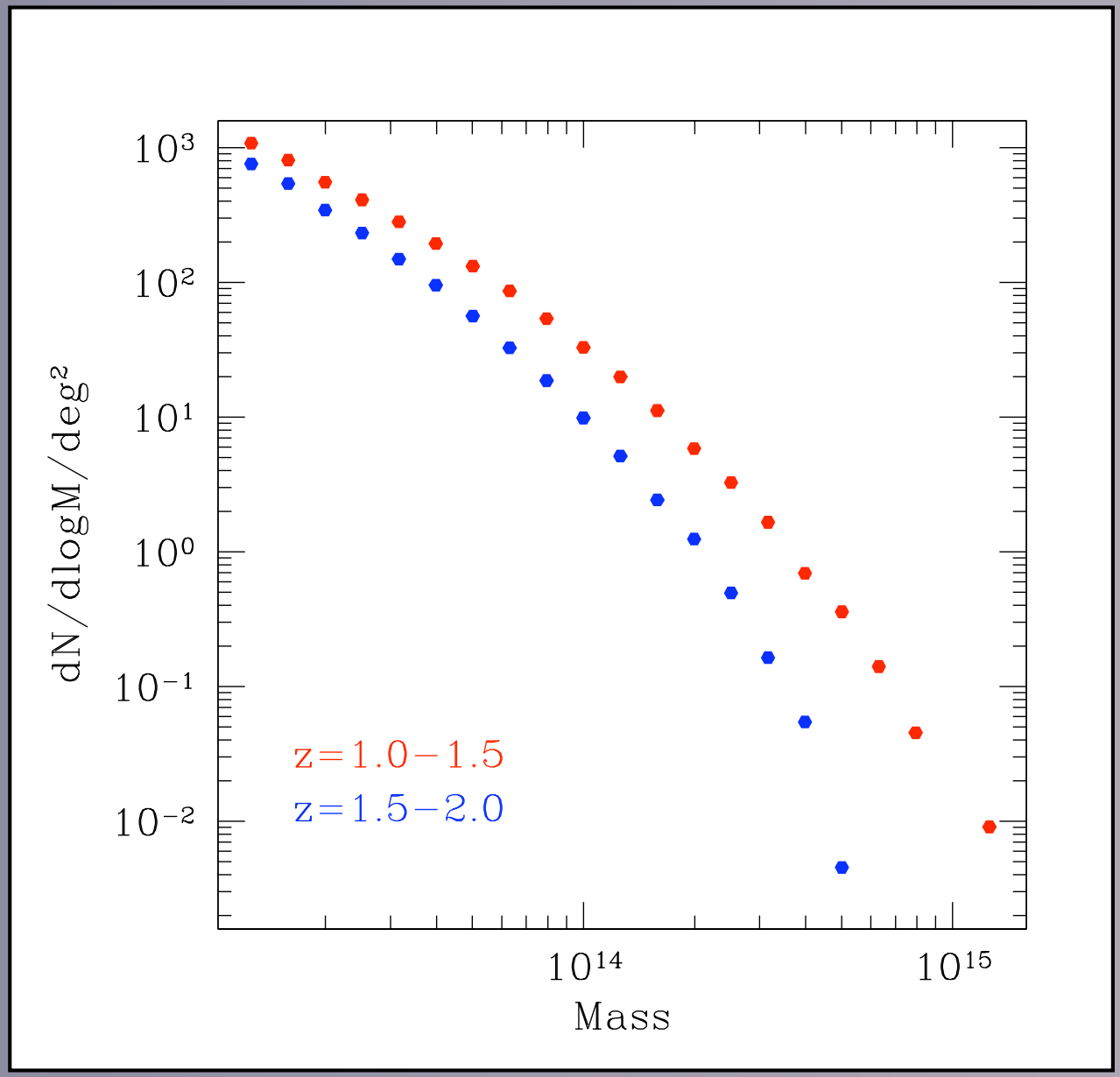


Estimating cluster yields at 1 < z < 2

- we populate the "lightcone" simulation by Paul Bode (see Sehgal et al '10) with Tinker's HOD model, using observed luminosity function at z~1.4 to scale the number of galaxies above the limiting mag
- given the depth (hence area), we select halos from the lightcone at z=1-2
- simulation covers an octant of the sky, resolves halos down to 6e12 Msun
- count the number of clusters with >4 members brighter than z_{limit}

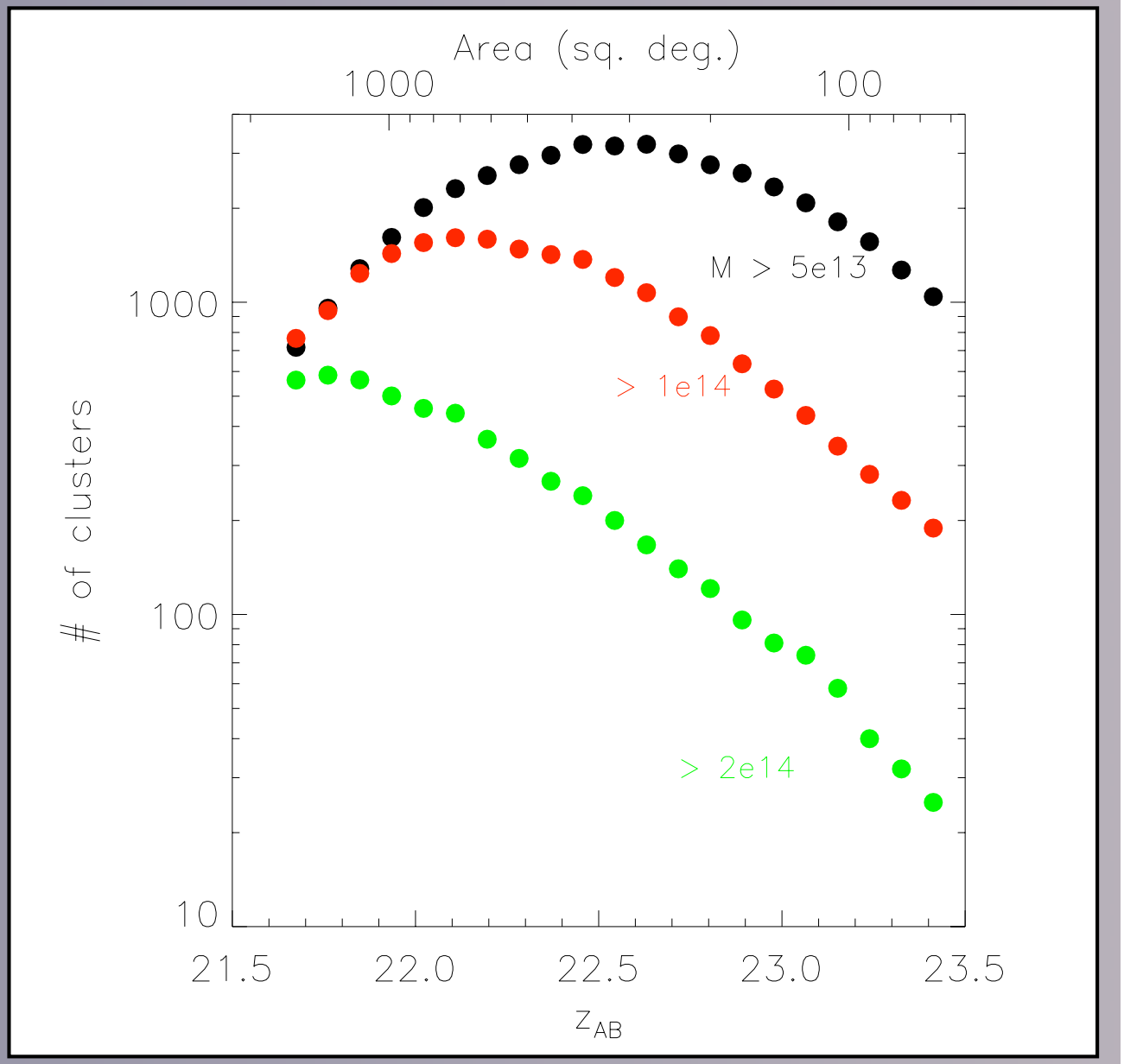
based on WMAP5 cosmology (sigma8=0.8).

Cluster mass function



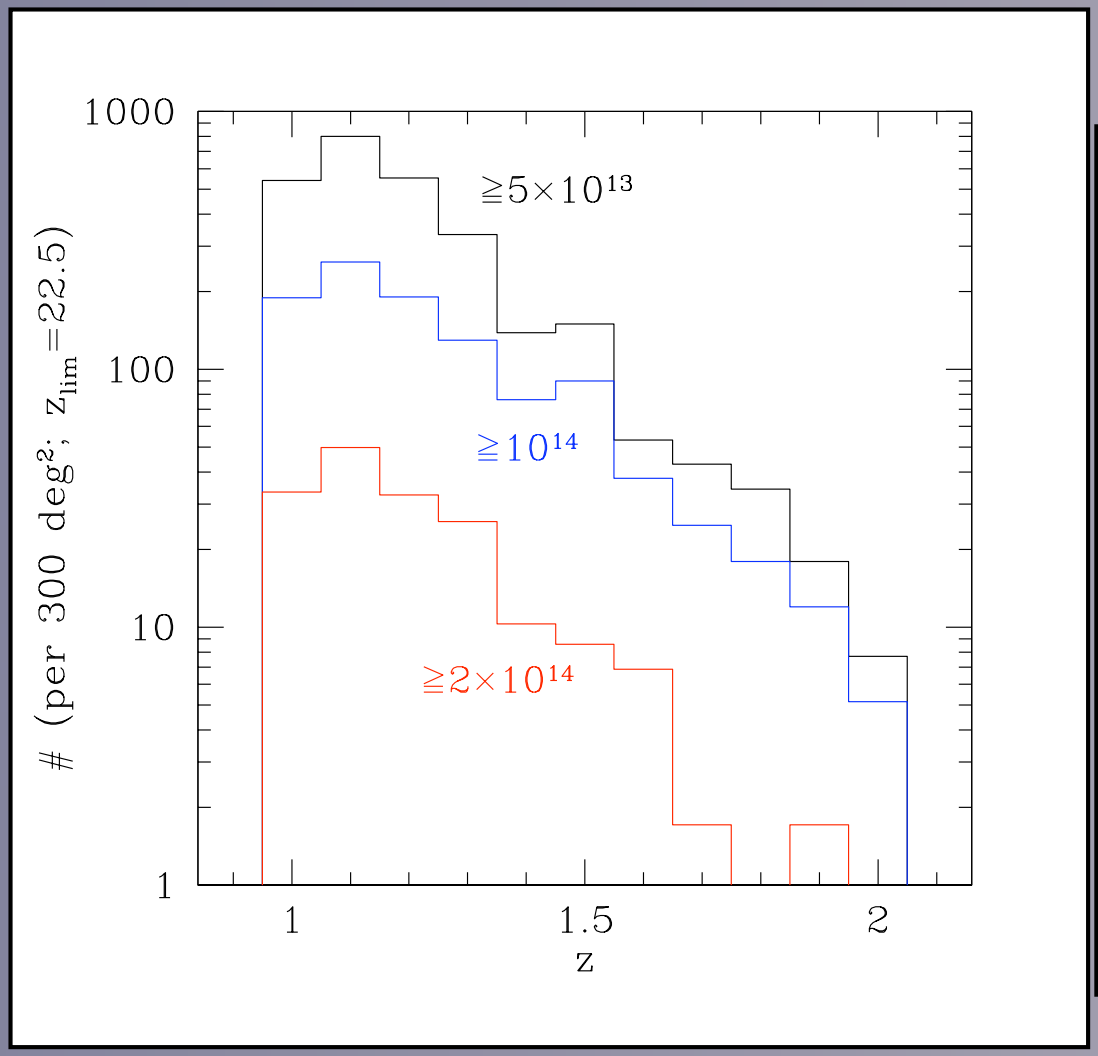
Expected cluster counts (1 < z < 2)

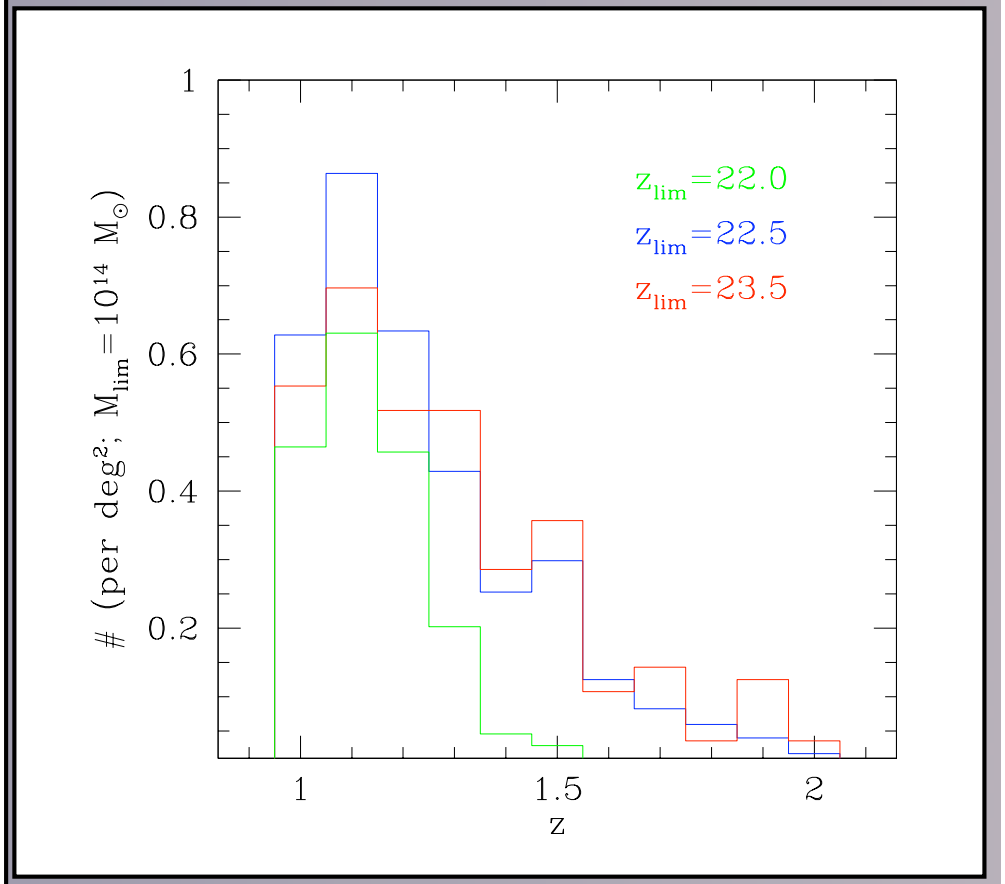
- 100 nights
- 6 hr science time per night
- >4 members per halo
- S/N ~3 per resolution element

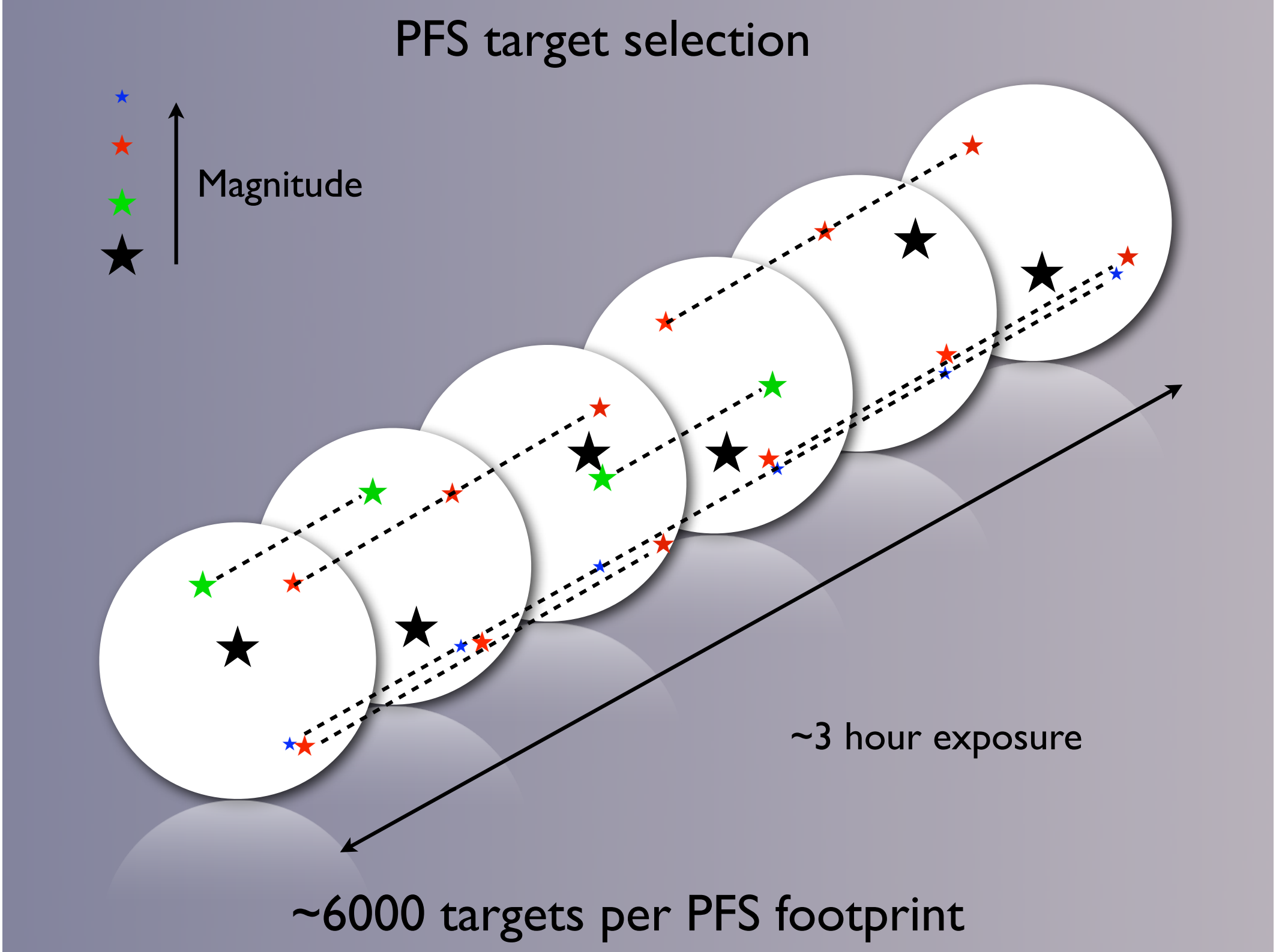


300 sq. degrees with tracer galaxies to z~22.5

Expected cluster counts (1 < z < 2)






PFS target selection
Magnitude
~3 hour exposure
~6000 targets per PFS footprint

PFS target selection

Random flux limited sample ($i<22.5$; $z<1.4$)	5000
field	
clusters	
Color-selected sample ($z<22.5$; $1<z<2$)	1000
cluster/group members (ACT, eROSITA)	~100
field sample	900
QSOs (see Imanishi's talk)	500
Other	~500
X-ray, radio, IR	

6000x(300 sq deg/PSF FOV)~10^6 galaxies

Comprehensive survey of the high-z Universe with PFS

10^6 galaxies up to z~2

- Galaxy evolution (mass buildup, star formation)

  SFRs up to z~2

- Growth of supermassive black holes (AGNs, QSOs)

  masses to z~1.6

- Cluster science

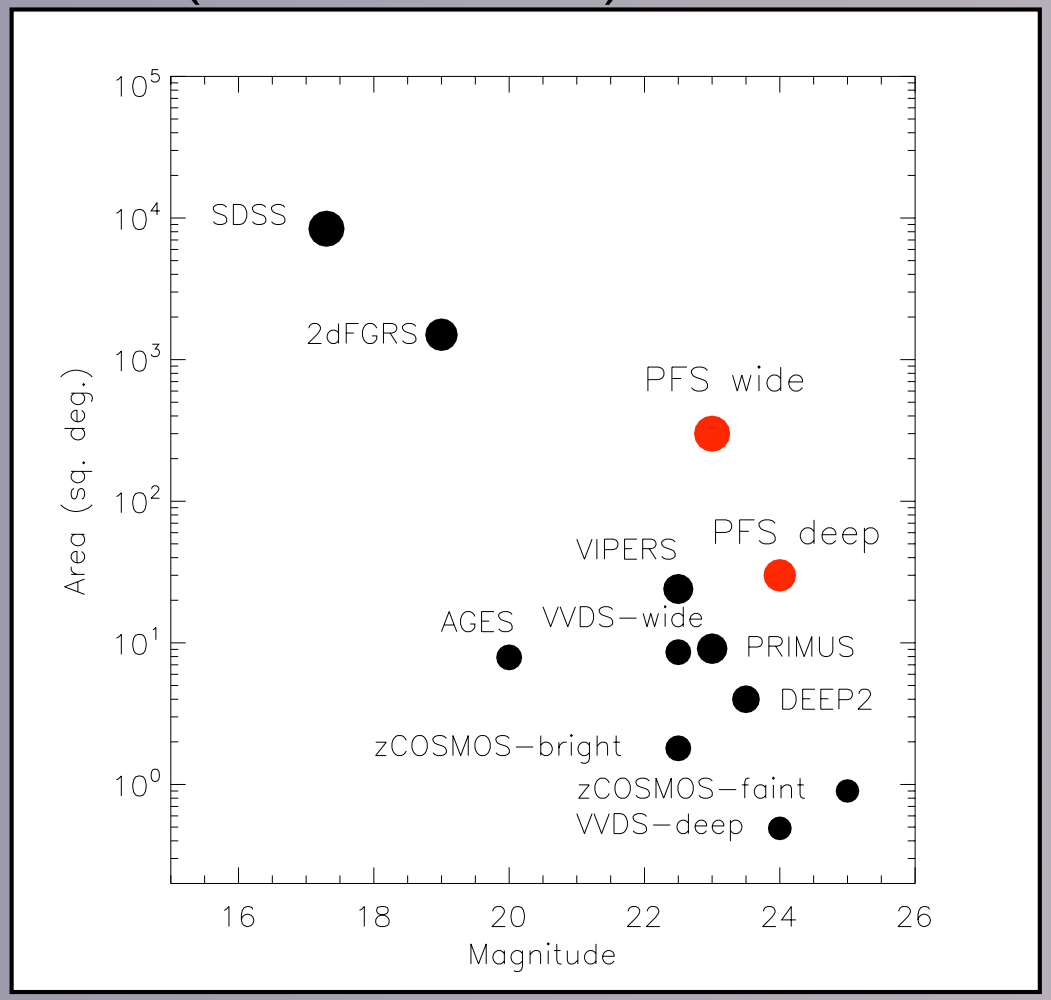
  Progenitors of today's massive halos

- Serendipitous discoveries

Synergy with PFS deep survey

Spectroscopic support for HSC surveys

Identify unique environmental laboratories for detail studies with TMT and ALMA



Provide a treasure-trove of data for a generation of students in Japan