Distant Clusters of Galaxies in a Deep XMM-Newton Observation

Targeting LBQS 2215-1759 in CFHT-LS D4

Arjen de Hoon

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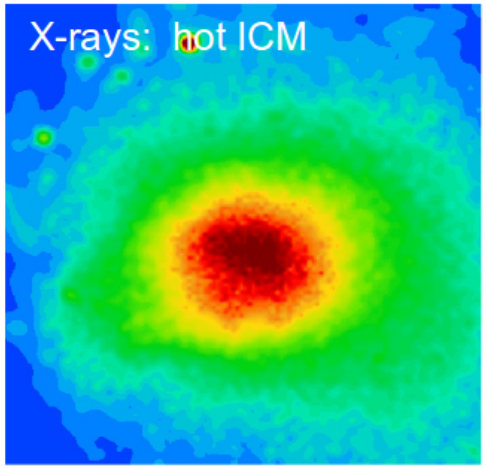
May 23, 2012

Distant Clusters of Galaxies

- CDM
- Cluster as giant laboratories
- Observation strategies



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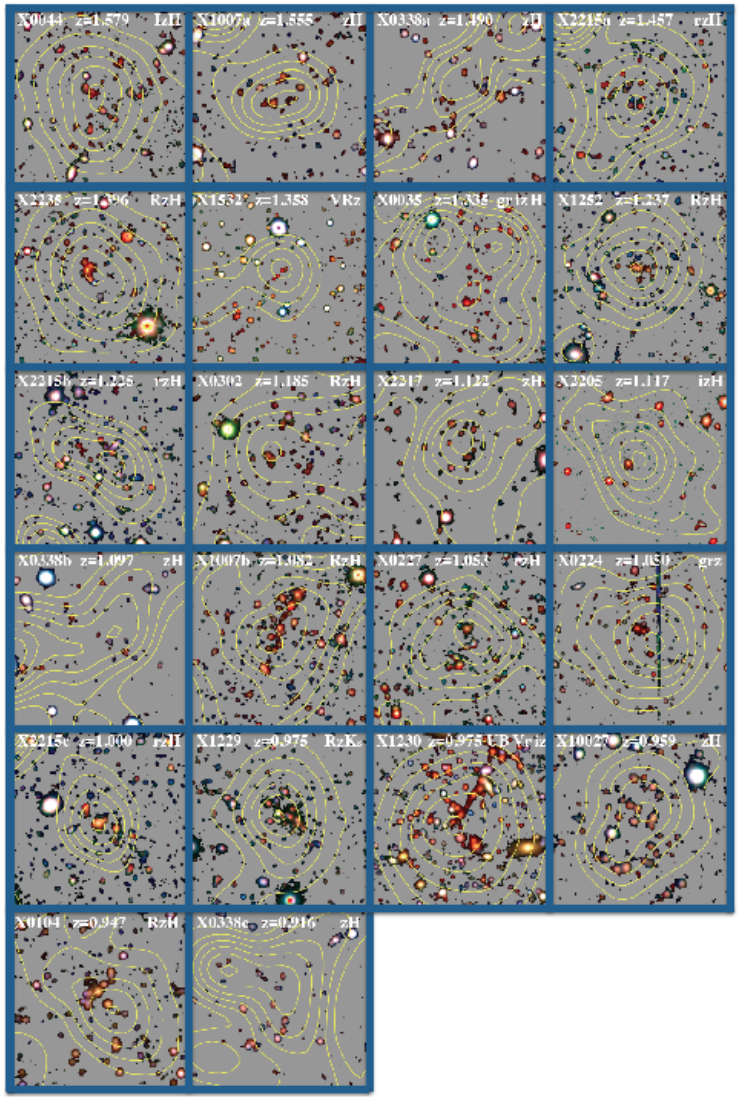
XMM-Newton Distant Cluster Project

Current status

Published sample of 22 X-ray clusters $0.9 < z < 1.6$.

- 17 clusters $z > 1.0$
- 7 clusters $z > 1.3$

Fassbender et al. (2011)



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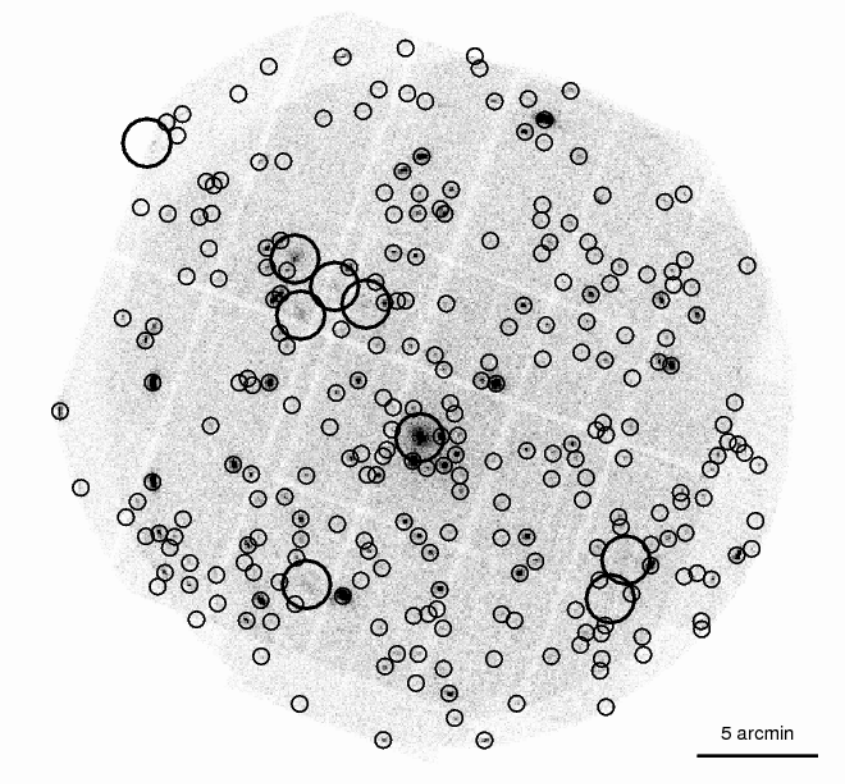
LBQS field



ObsID	good exposure time [ks]		
	MOS1	MOS2	PN
0106660101	57	57	55
0106660201	52	52	38
0106660401	33	34	-
0106660501	8	8	6
0106660601	100	101	84
total	**252**	**252**	**183**

Catalog

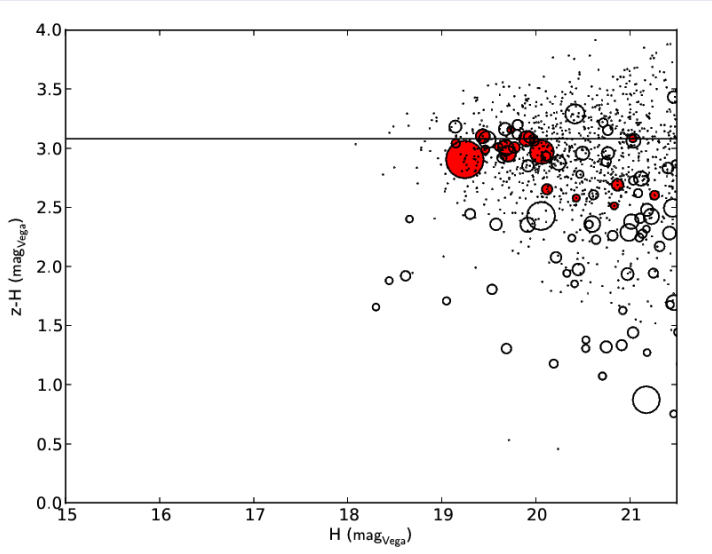
Full catalog available on-line.
255 point + 9 extended sources.

Follow-up strategy

Redshift (estimate) from:

- Photometric colour
- X-ray spectrum
- Spectroscopic confirmation

CMD



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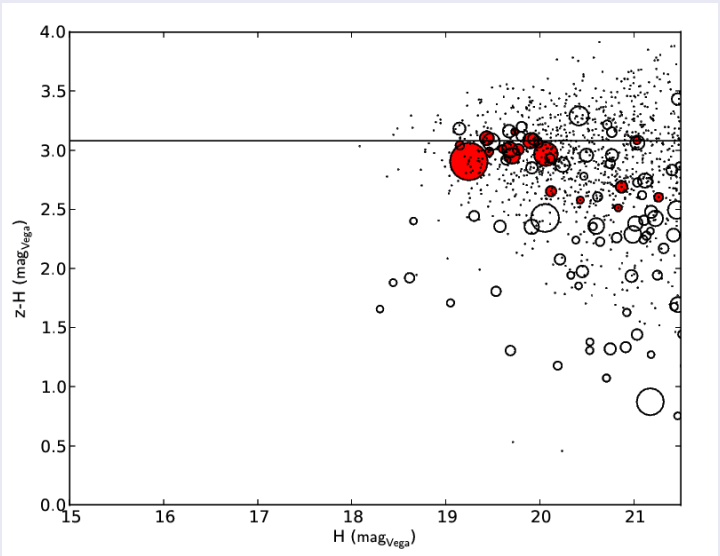
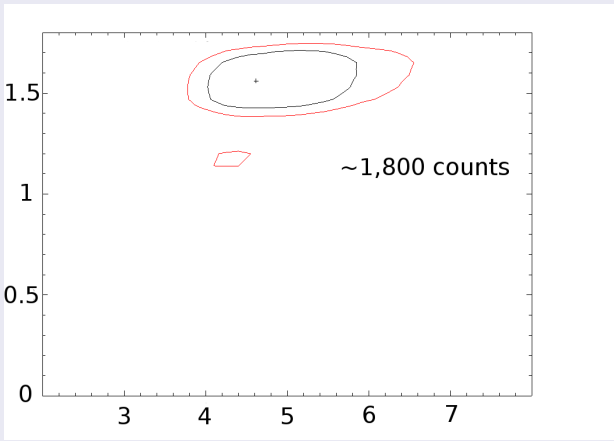


4 kT-z redshifts



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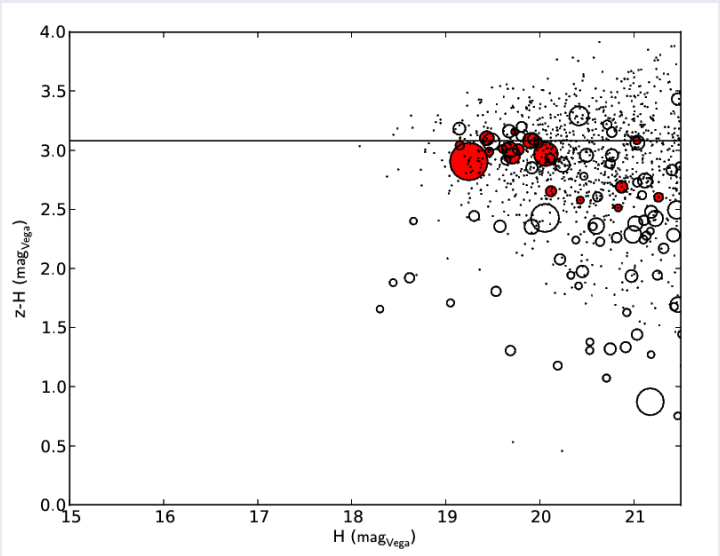

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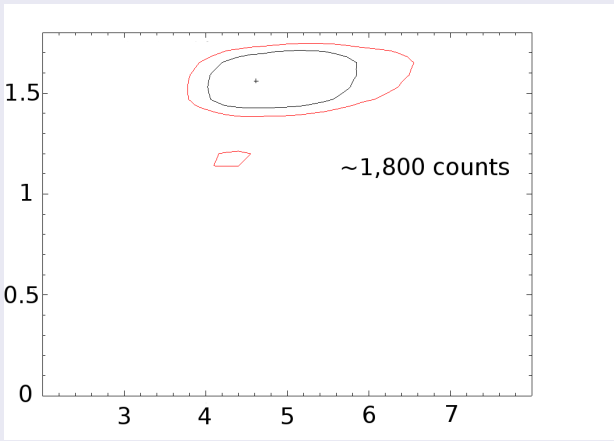
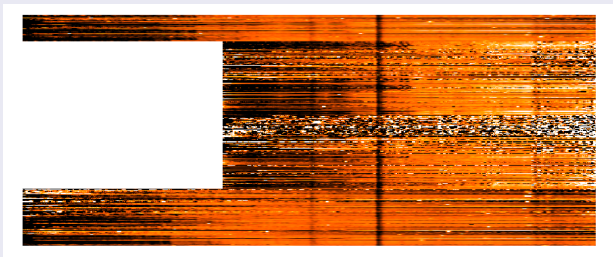


294 Spectra



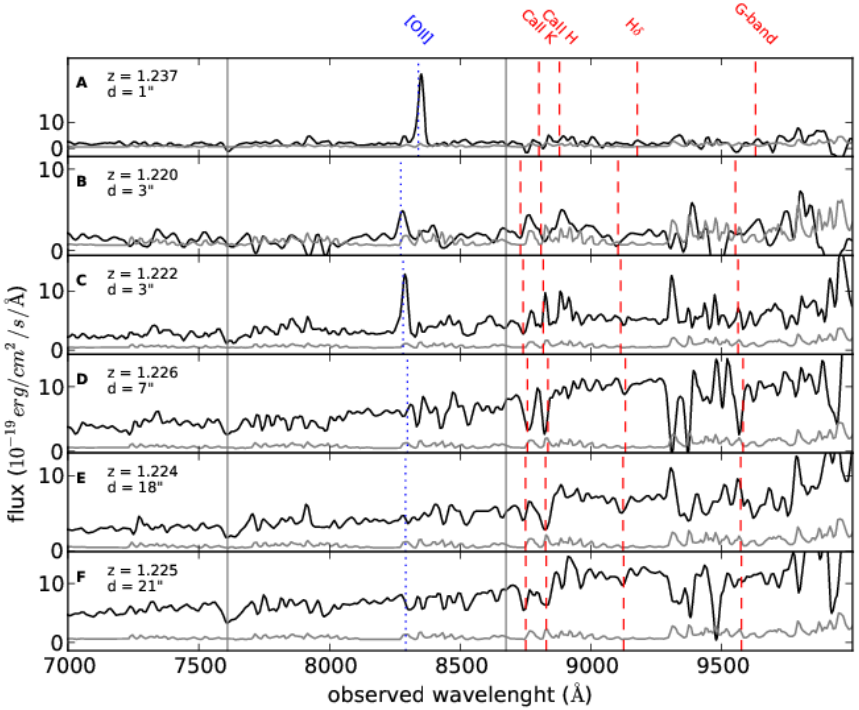
Cluster confirmation

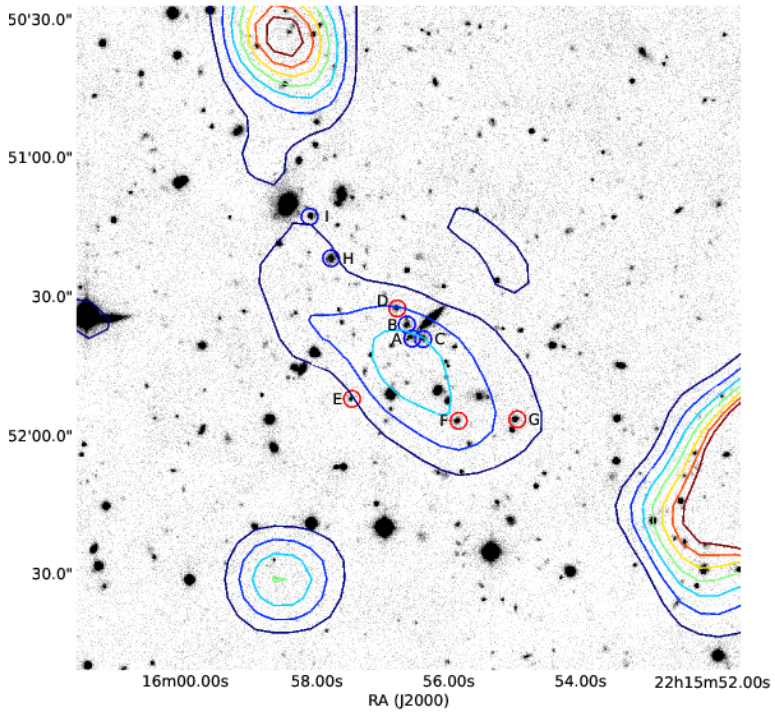
Confirmation of 6 clusters

3 clusters $z \geq 1.0$ (incl. Stanford et al. (2006))

3 clusters $0.3 < z < 0.4$

3 rejections



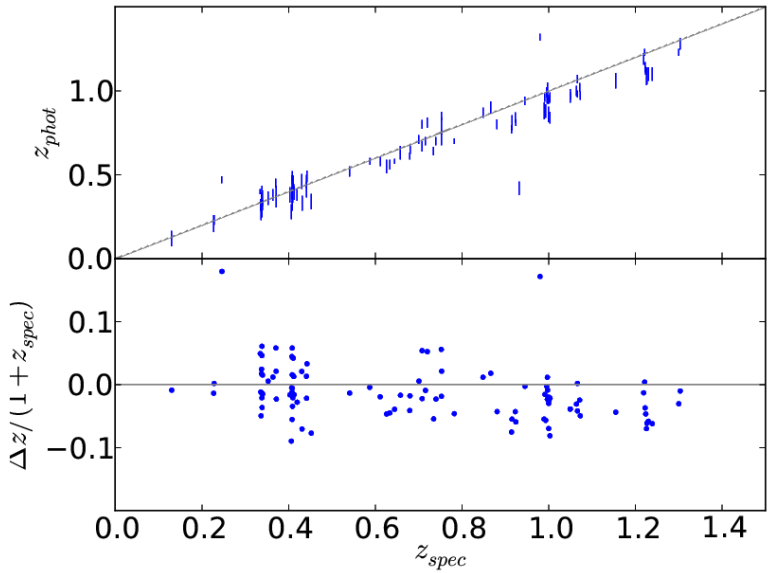


Overdensities of Galaxies

Search for *projected* galaxy overdensities in photometric *redshift slices*.

CFHT-LS D4

Data reduction and photo-z determination by Lerchster et al. (2011) for WL analysis.



$u^* g' r' i' z' JHKs$

8-band photometry

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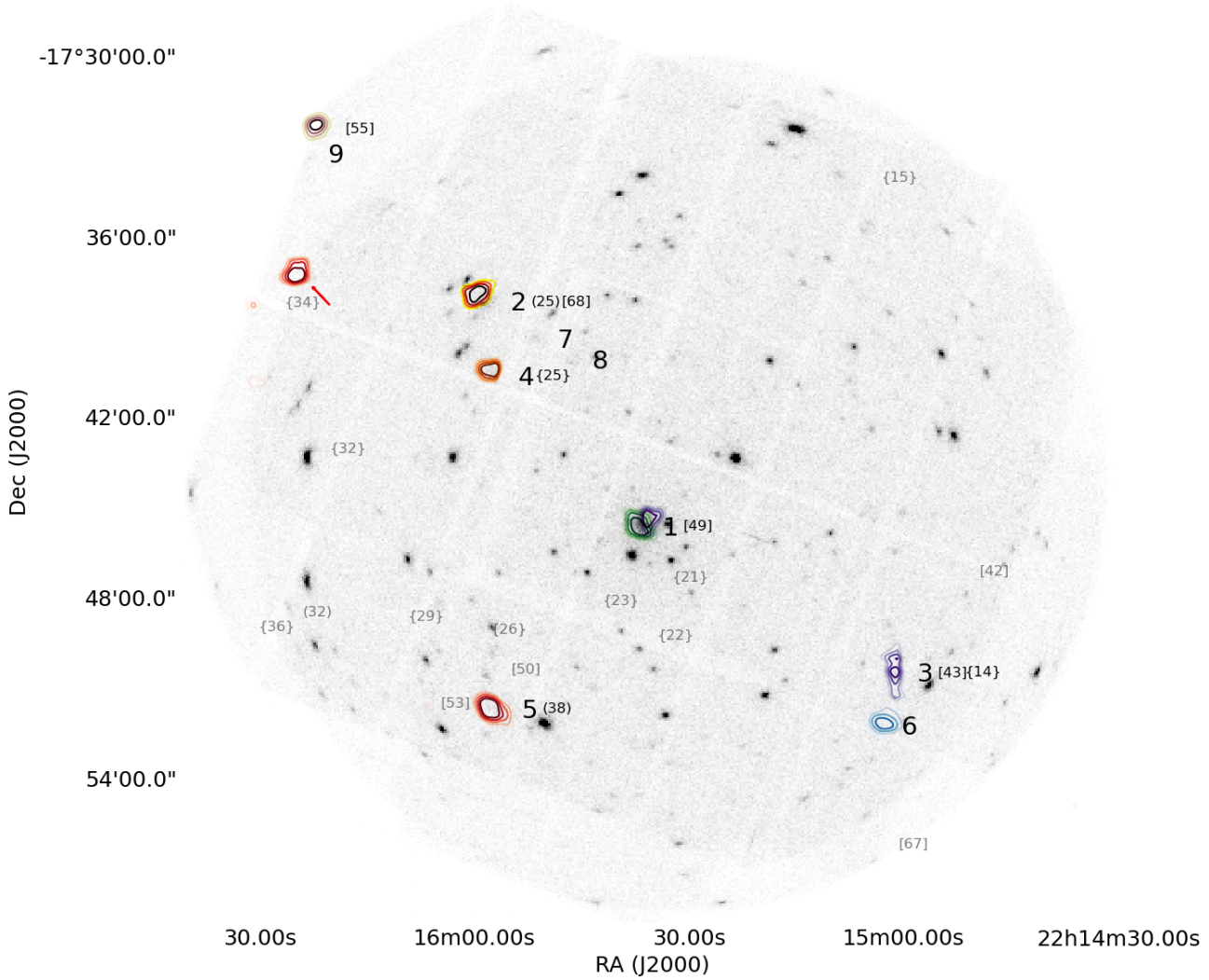
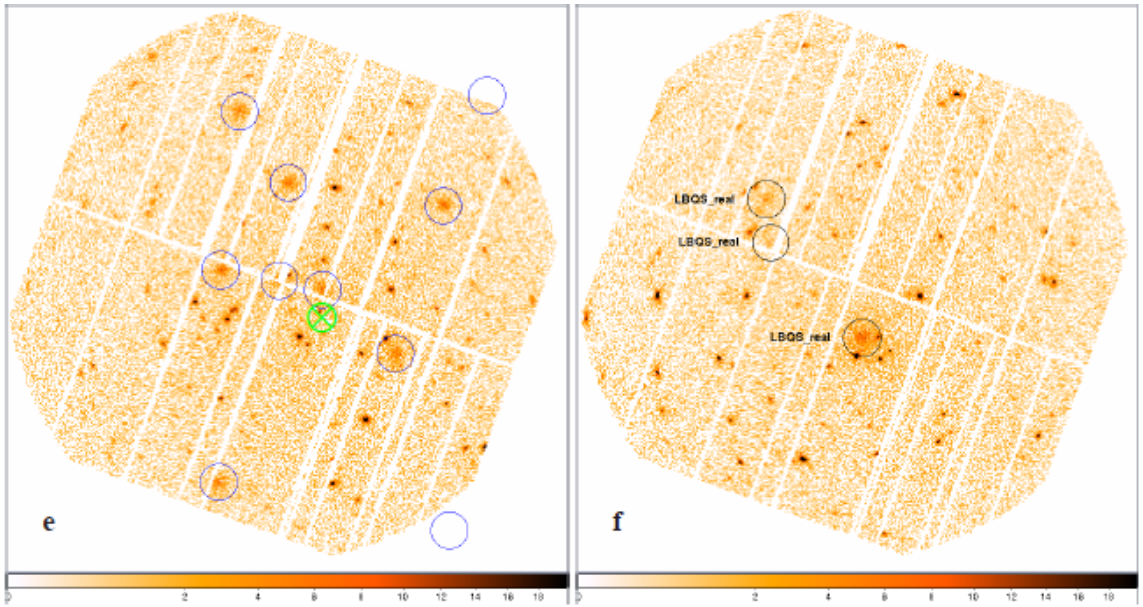


(Bielby et al. 2010; Adami et al. 2010; Olsen et al. 2007)

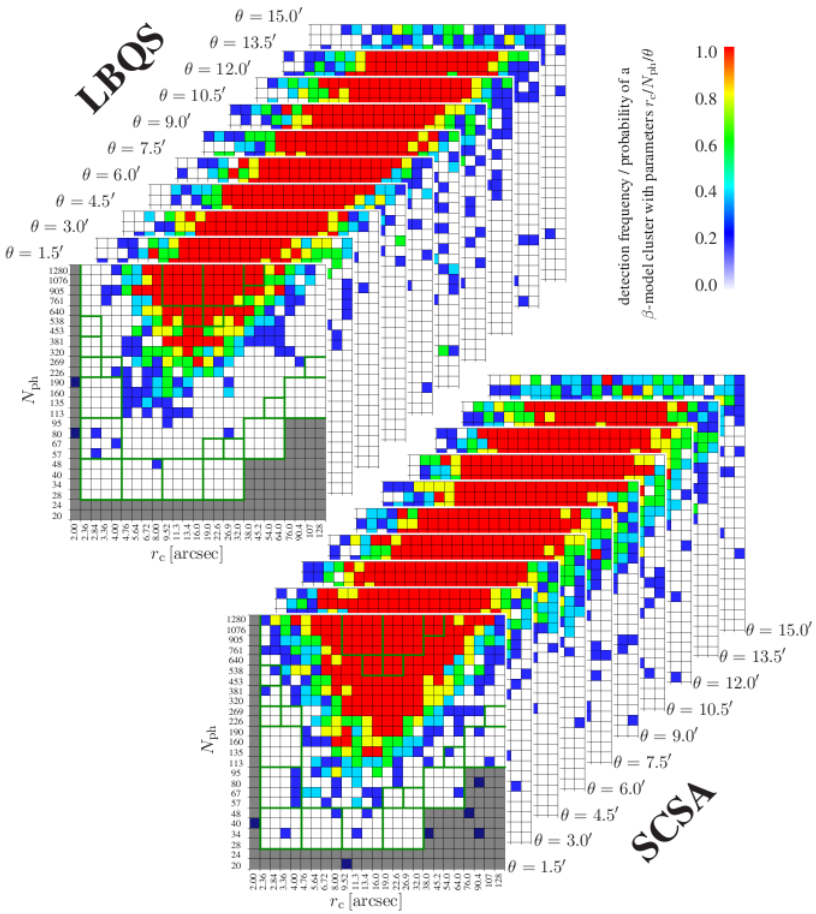
Cluster simulation

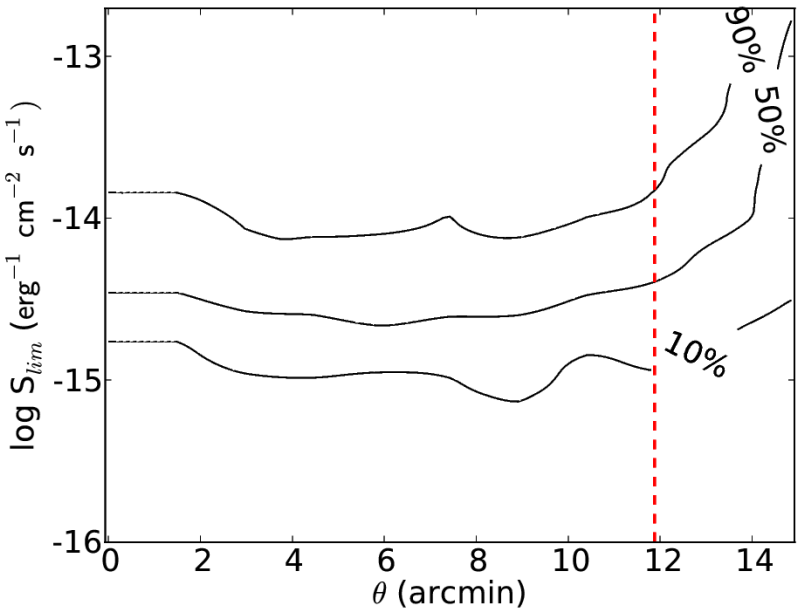


Simulation (Mühlegger 2010)

10 β-models
25 core radii
25 flux bins
amounts to 31 250 simulated clusters

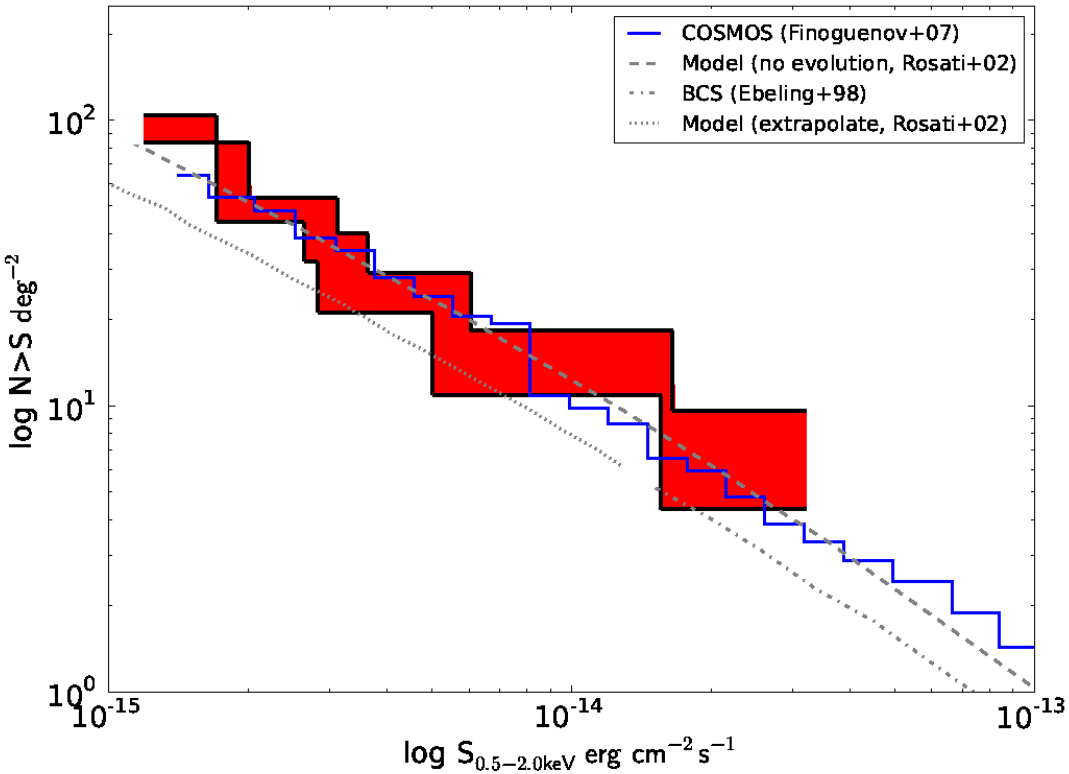
X-ray selection function





Small cosmological survey

- 50% complete $S > 2.5 \cdot 10^{-15}\ erg\ s^{-1}\ cm^{-2}$
- $\sim 0.2\ deg^2$



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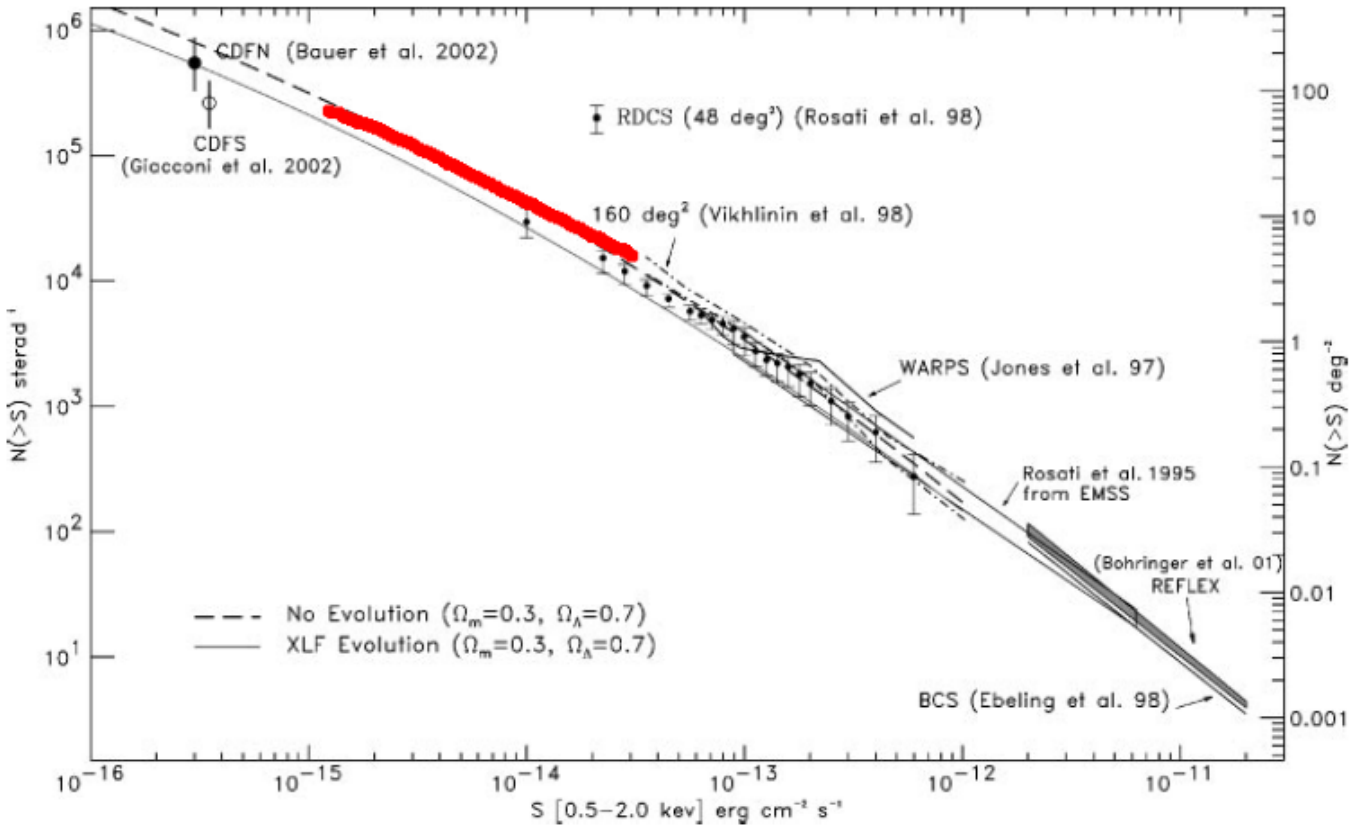

Conclusions

X-rays

Robust X-ray selected clusters sample

2 new $z \geq 1.0$ clusters

Completeness

Well-defined selection function

Photo-z maps

Flux-limited survey

50% complete at

$2.5 \cdot 10^{-15}\ erg\ s^{-1}\ cm^{-2}$

XDCP

$\sim 80\ deg^2$

Paper soon

de Hoon et al. (2012)

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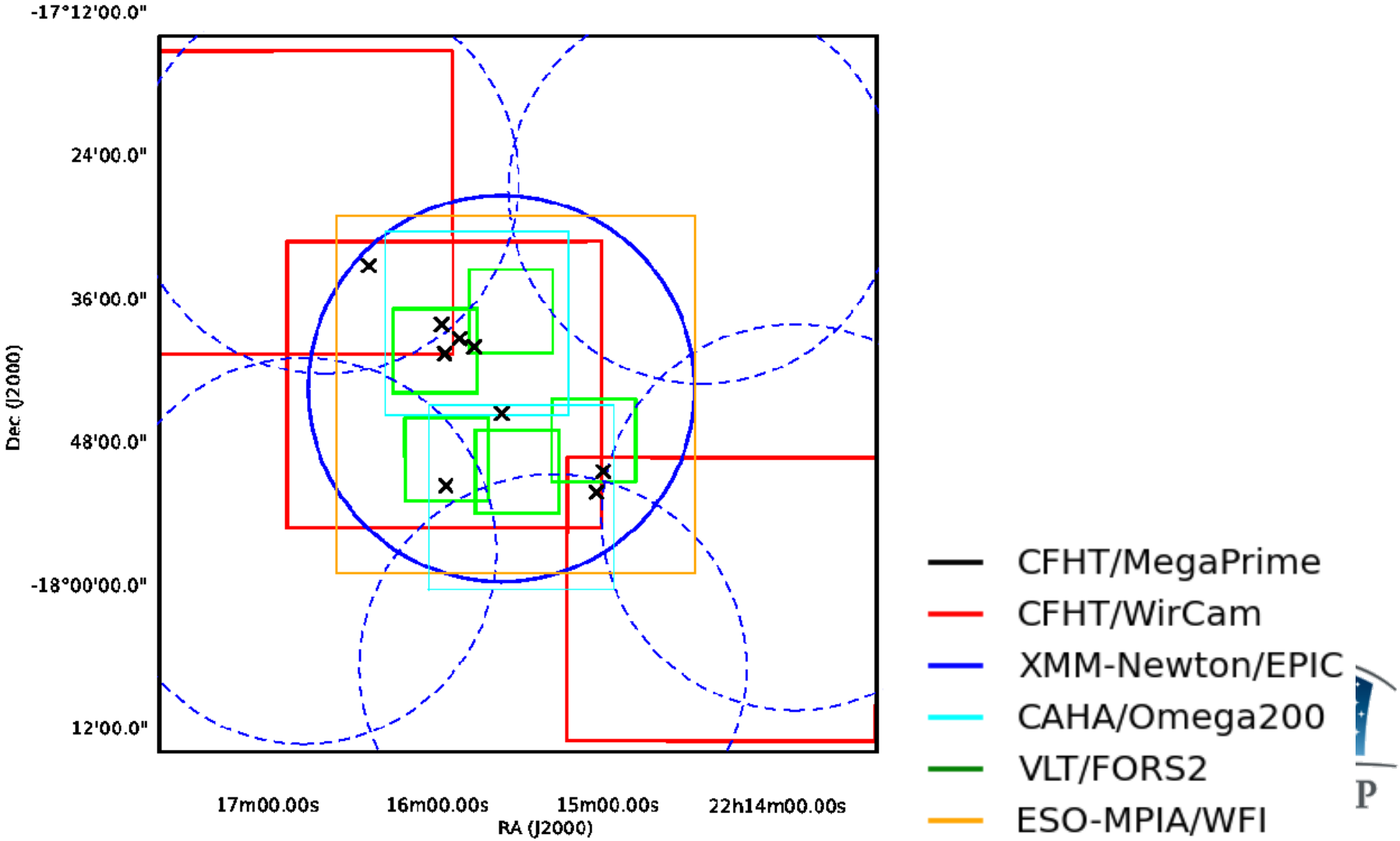
X-ray properties

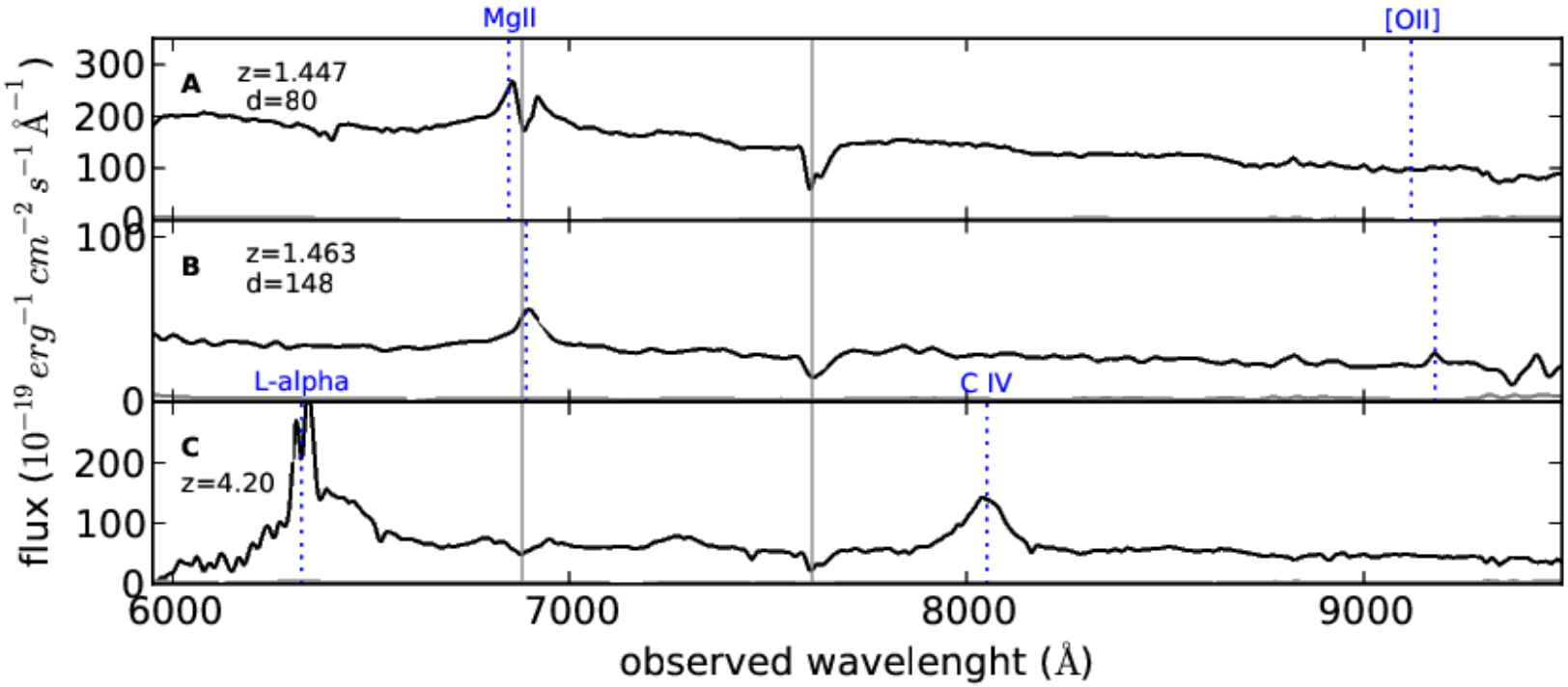
T keV	$r_{\rm spec}$ arcsec	R_{500} Mpc	L_{500} $10^{42}\,{\rm erg\,s^{-1}}$	$\rm M_{500}$ $10^{14}\,M_{\odot}$
2.14 ± 0.07	48	0.56	14.5 ± 0.3	0.79
4.40 ± 0.48	23	0.39	70.7 ± 5.3	1.07
1.42 ± 0.18	29	0.40	1.69 ± 0.09	0.17
2.06 ± 0.20	23	0.41	21.6 ± 4.0	0.57
2.00 ± 0.21	26	0.39	33.5 ± 7.9	0.71
1.84 ± 0.86^{a}	30	0.34	0.92 ± 0.2	0.12

Photometry

Field	Telescope	Instrument	Filter	m_{lim} [AB mag]
D4	CFHT	MegaPrime	u*	27.14
	CFHT	MegaPrime	g'	27.61
	CFHT	MegaPrime	r'	27.44
	CFHT	MegaPrime	i'	27.16
	CFHT	MegaPrime	z'	25.99
	CFHT	WirCam	J	25.10
	CFHT	WirCam	H	24.62
	CFHT	WirCam	Ks	24.62


-17°12'00.0"
24'00.0"
36'00.0"
48'00.0"
-18°00'00.0"
12'00.0"
Dec (J2000)
17m00.00s
16m00.00s
15m00.00s
22h14m00.00s
RA (J2000)
CFHT/MegaPrime
CFHT/WirCam
XMM-Newton/EPIC
CAHA/Omega200
VLT/FORS2
ESO-MPIA/WFI

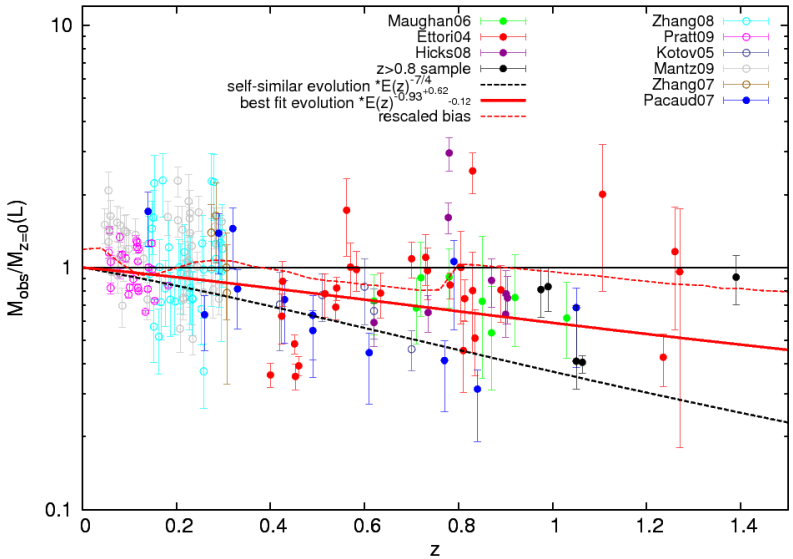
Quasars


MgII
[OII]
A
z=1.447
d=80
B
z=1.463
d=148
L-alpha
C IV
C
z=4.20
flux (10^{-19} erg^{-1} cm^{-2} s^{-1} Å^{-1})
300
200
100
0
100
0
200
100
0
6000
7000
8000
9000
observed wavelenght (Å)

Flux determination

Weak negative evolution

$M_{500} \propto L_{500}^{0.62} \cdot E(z)^{-1.15}$
(Vikhlinin et al. 2009)



Reichert et al. (2011)

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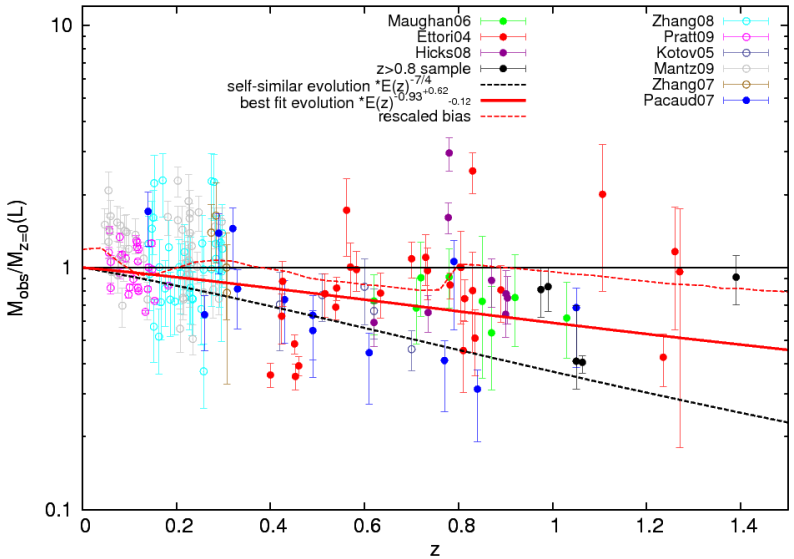


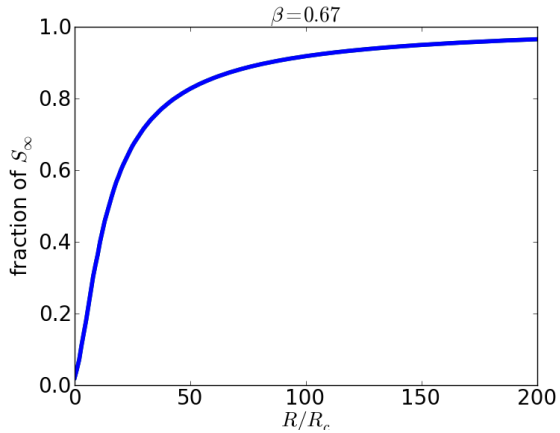
Reichert et al. (2011)

Iterate

$M_{500} \rightarrow R_{500} \rightarrow L_{500}$

(Böhringer)

$$S(R) = S_0 \left(1 + \left(\frac{R}{R_c}\right)^2\right)^{-\frac{3}{2}}$$



Takey et al. (2011); Šuhada et al. (2012)

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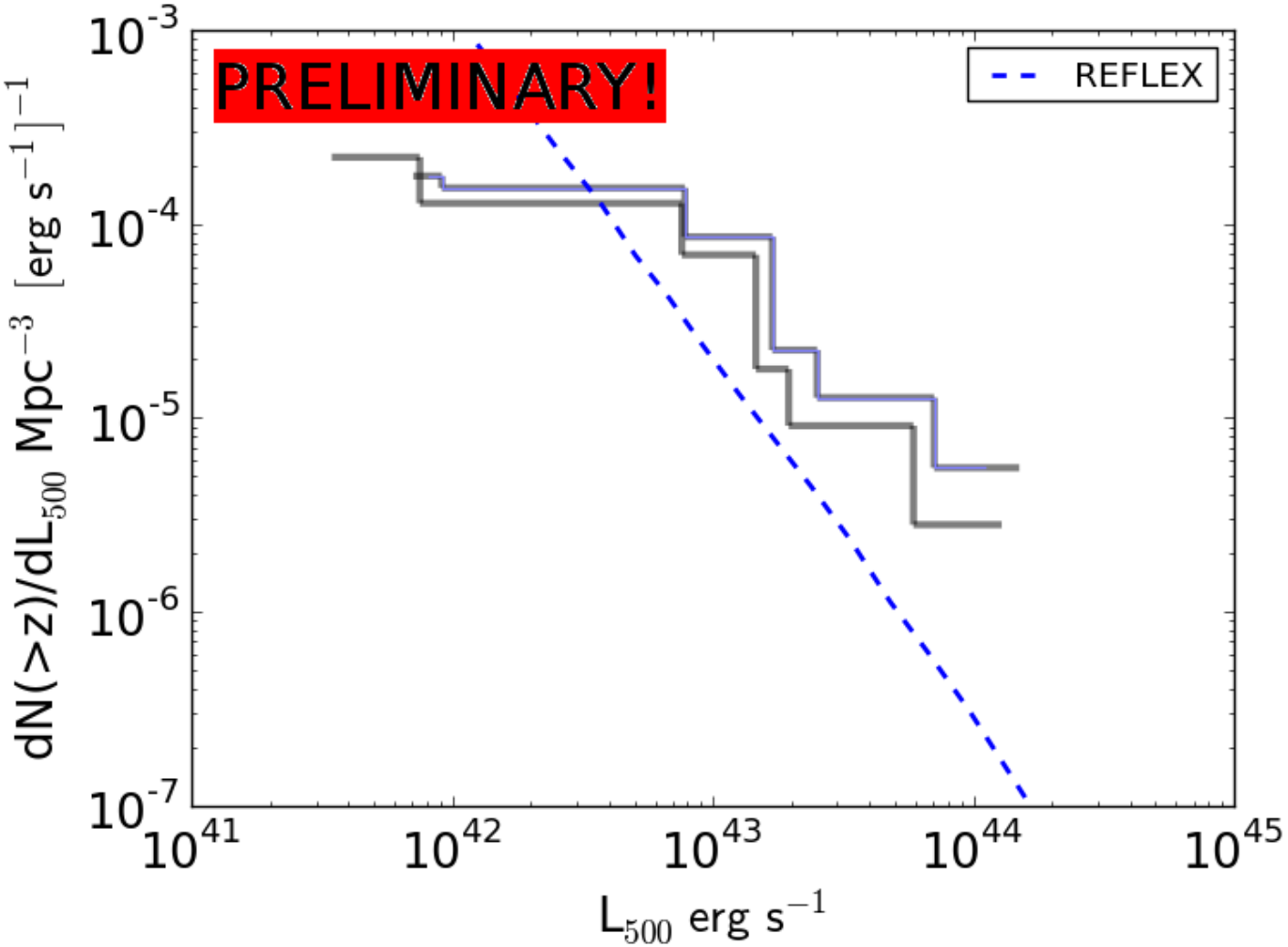
Luminosity function



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