Unveiling cold baryons in high-redshift clusters

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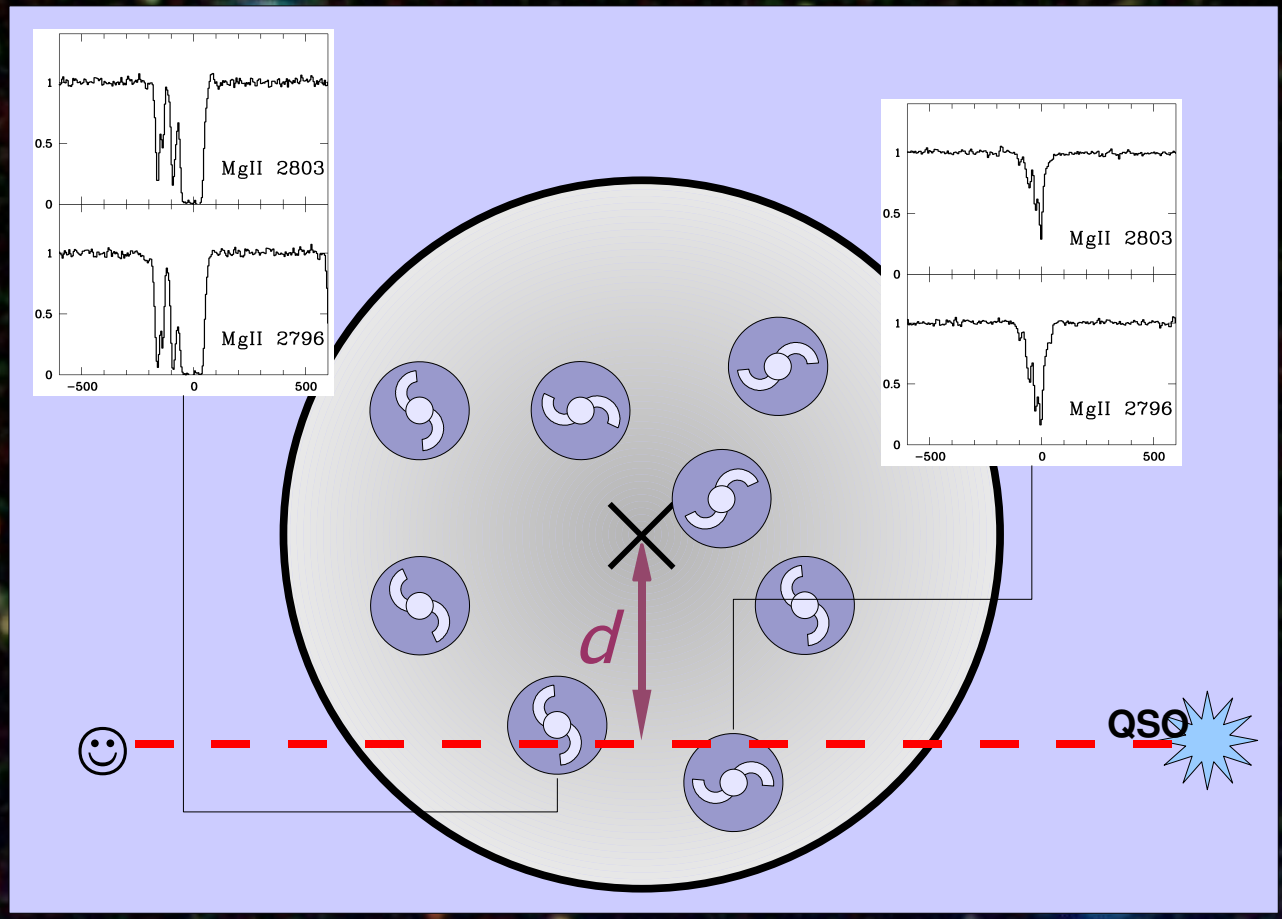
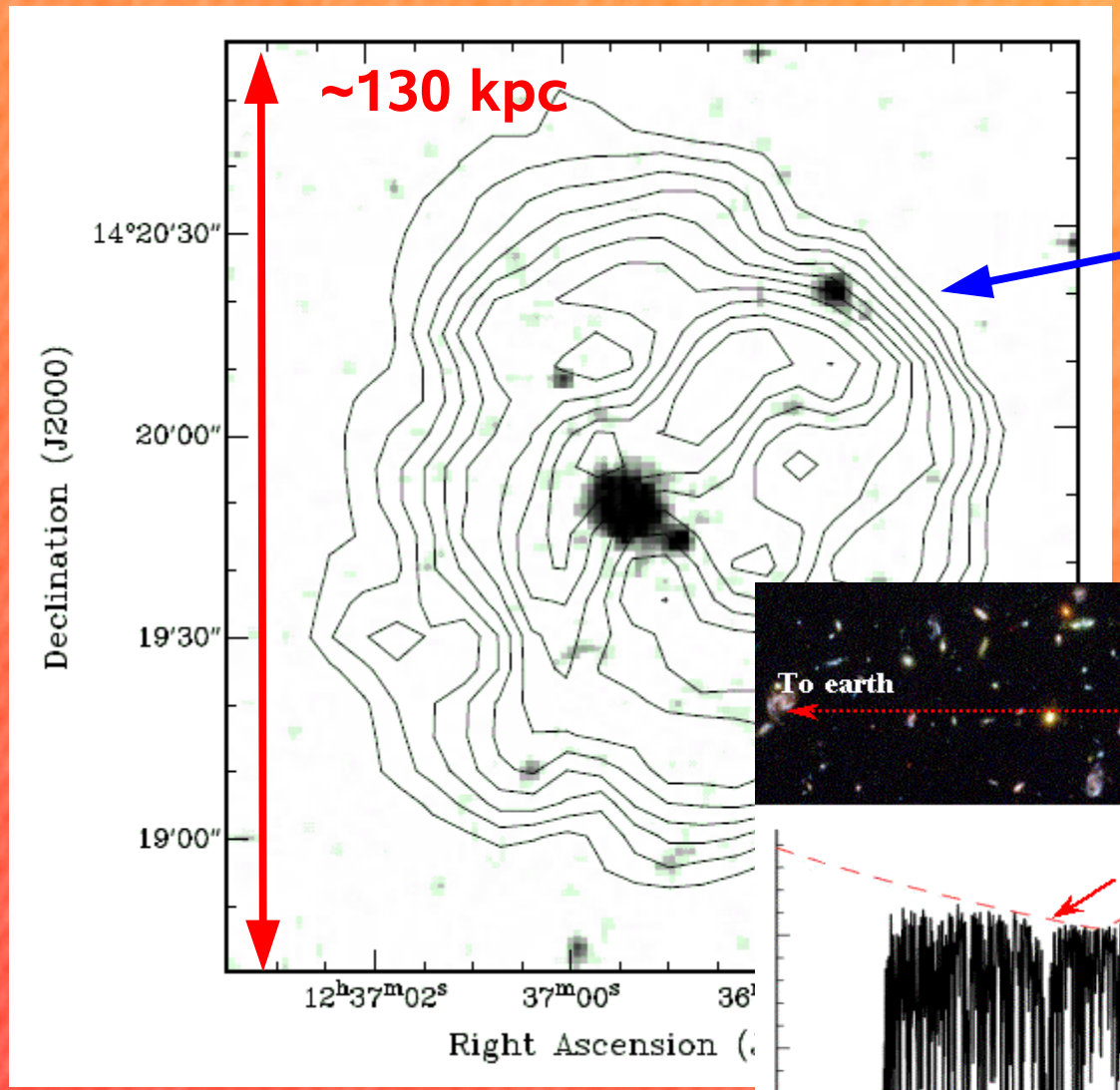
QbC: The Quasars behind Clusters Survey

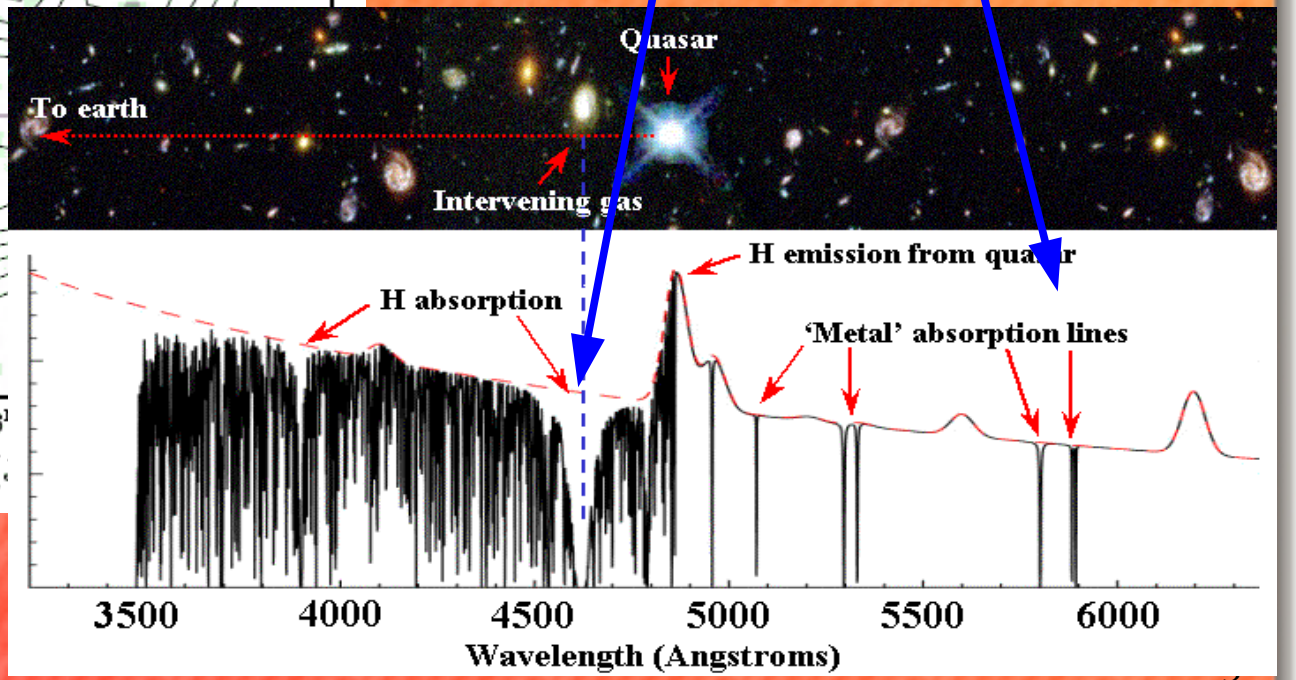


High redshift Universe: quasar absorption systems



$N(HI)=8\times10^{19}$ cm^{-2}

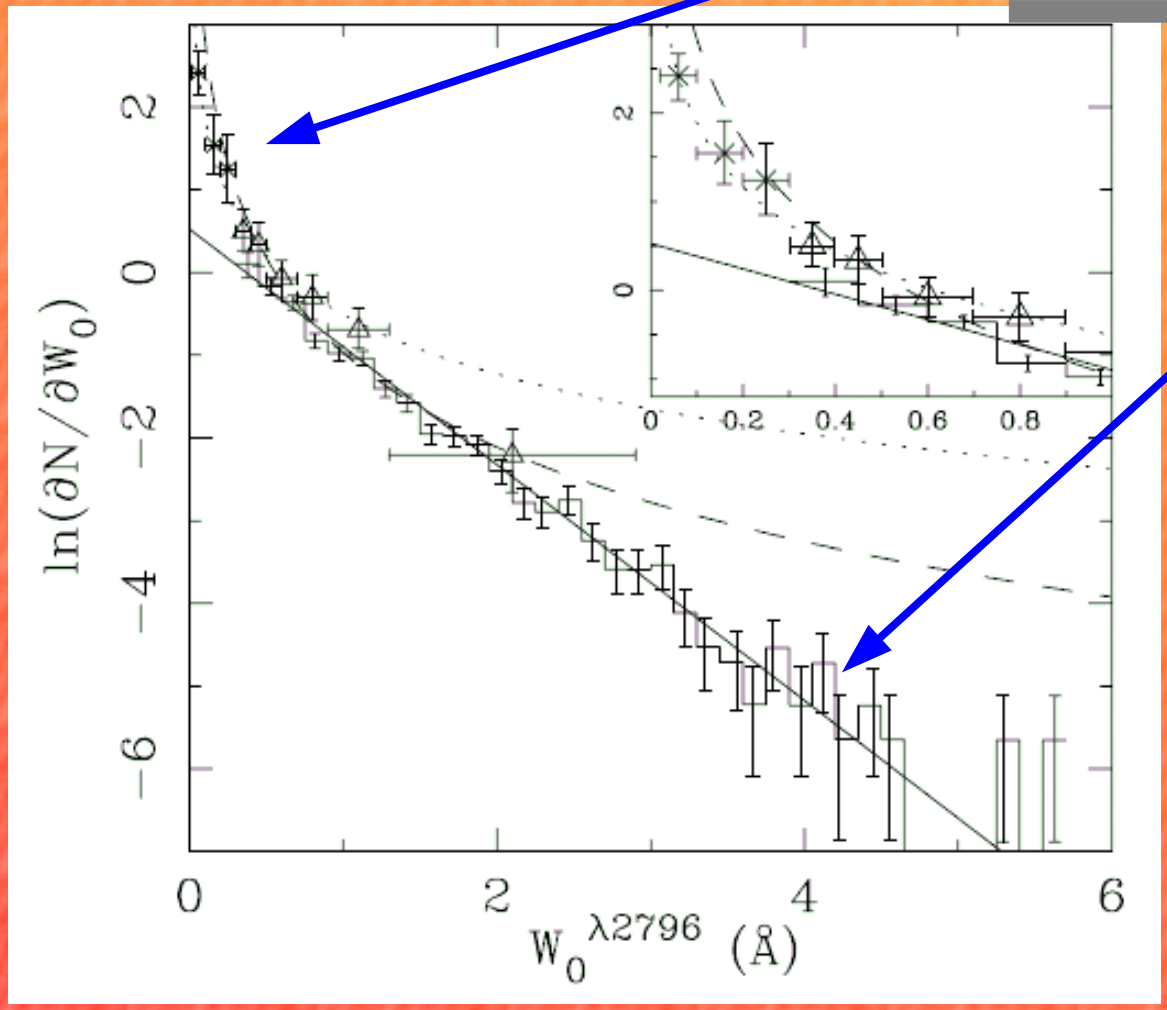
Redshifted Metal Lines



Weak and strong systems: two different MgII populations?

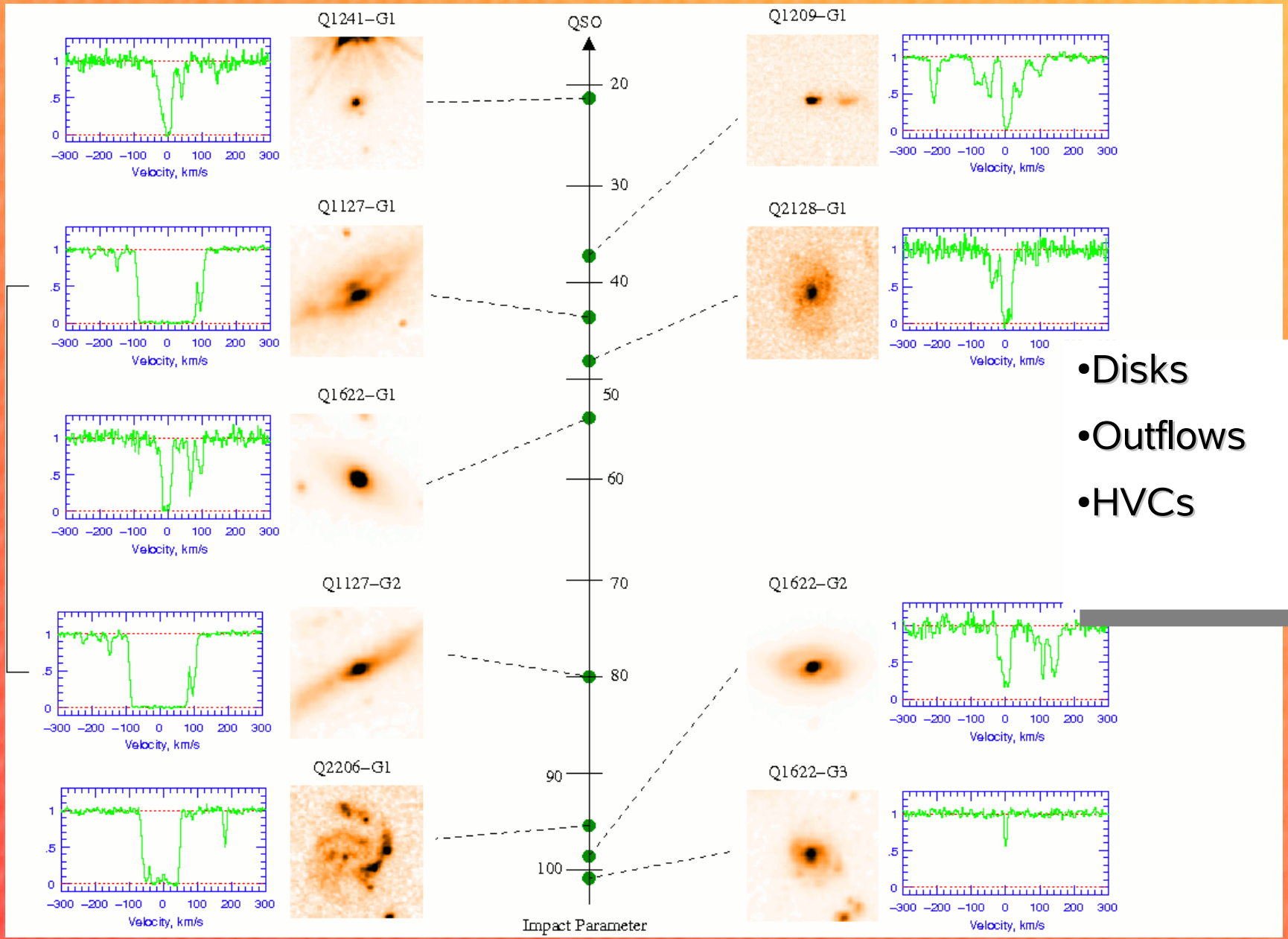
$W_0 < \approx 0.3$ Å, power-law

$W_0 > 0.3$ Å, exponential



Nestor et al. 2005

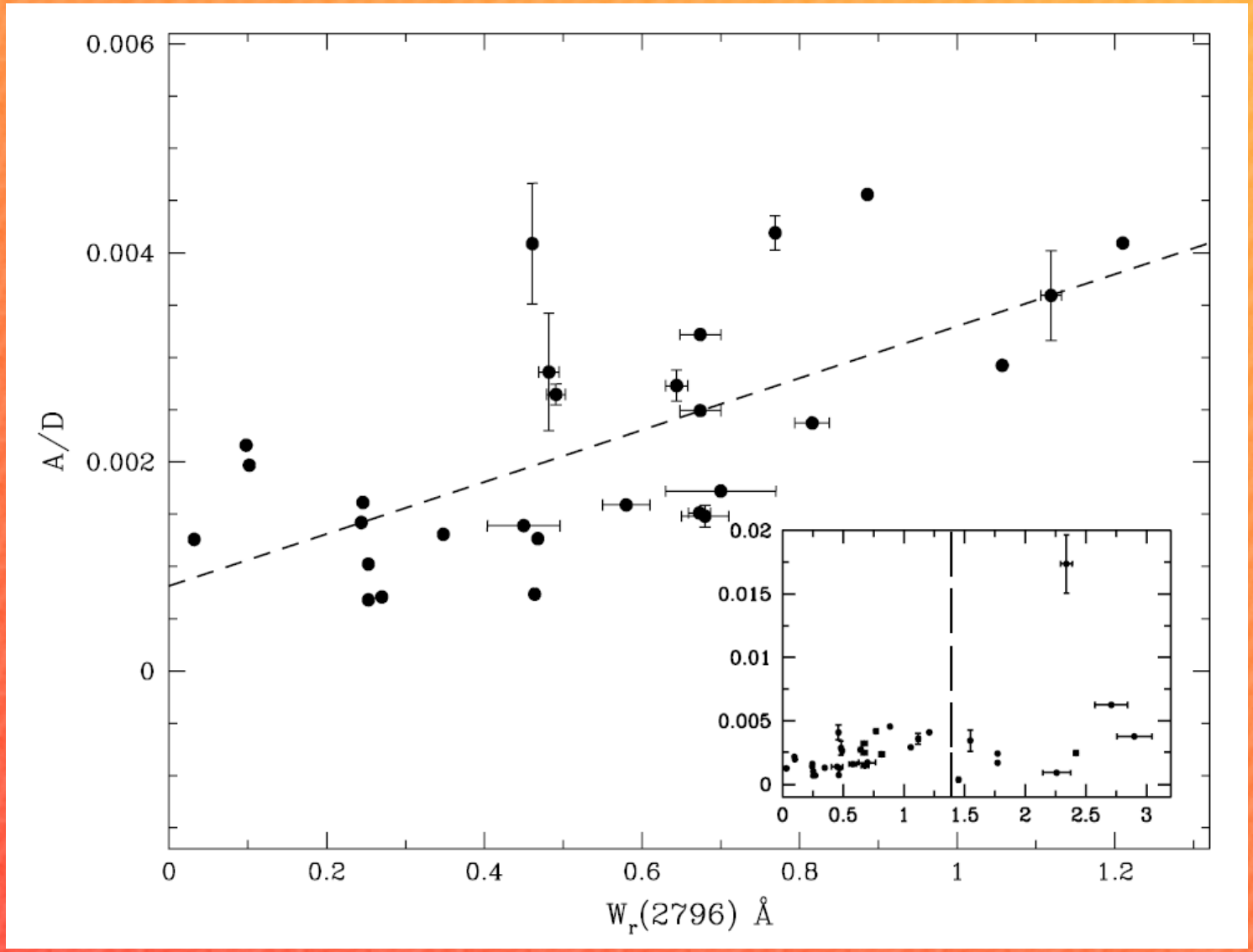
MgII traces galaxy halos at high-z



- Disks
- Outflows
- HVCs

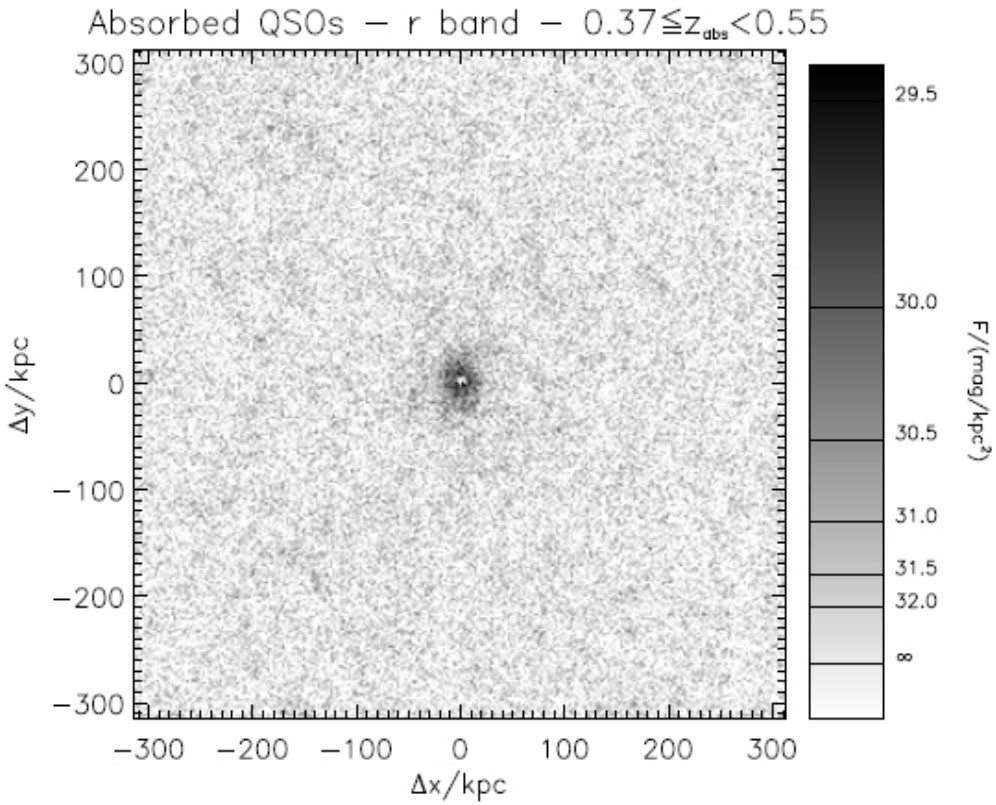
Churchill et al.

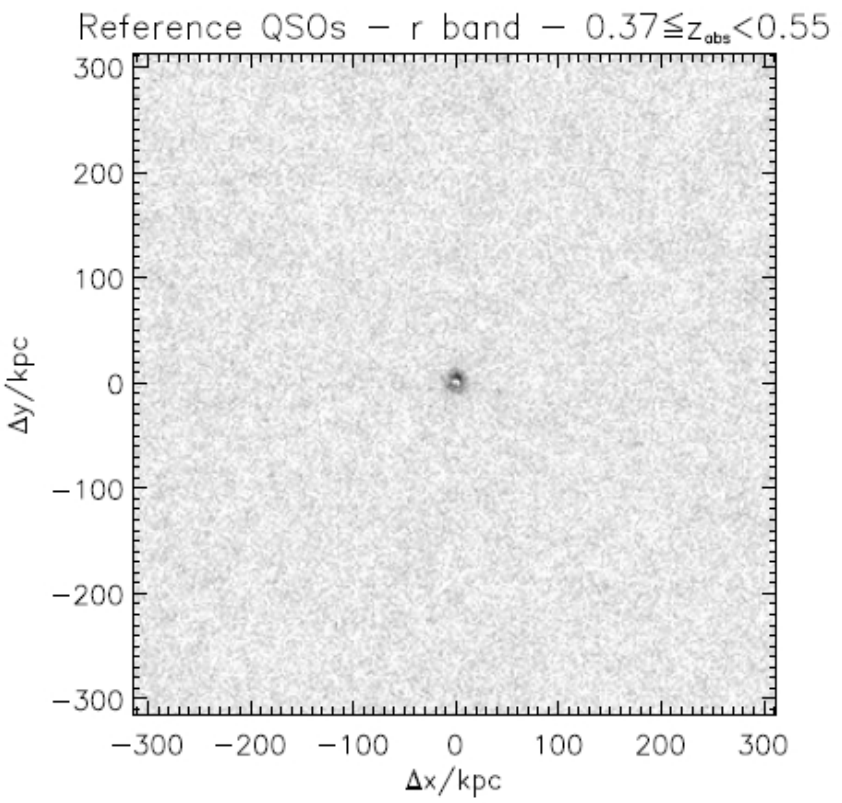
Morphological assymetries correlate with MgII line strength



Kacprzak et al. 2007

Stronger MgII systems select sub-luminous blue, star-forming galaxies





Stacking of SDSS QSO fields, Zibetti et al. 2006

What is the incidence *dN/dz* of MgII systems in high-*z* cluster galaxies?

What is the incidence *dN/dz* of MgII systems in high-*z* cluster galaxies?

This question important because clusters...

- have many galaxies at the same cosmic time
- induce galaxy transformations
- can be traced to high-z

...will tell us about the field MgII population

QbC: The Quasars behind Clusters Survey

Cluster Data

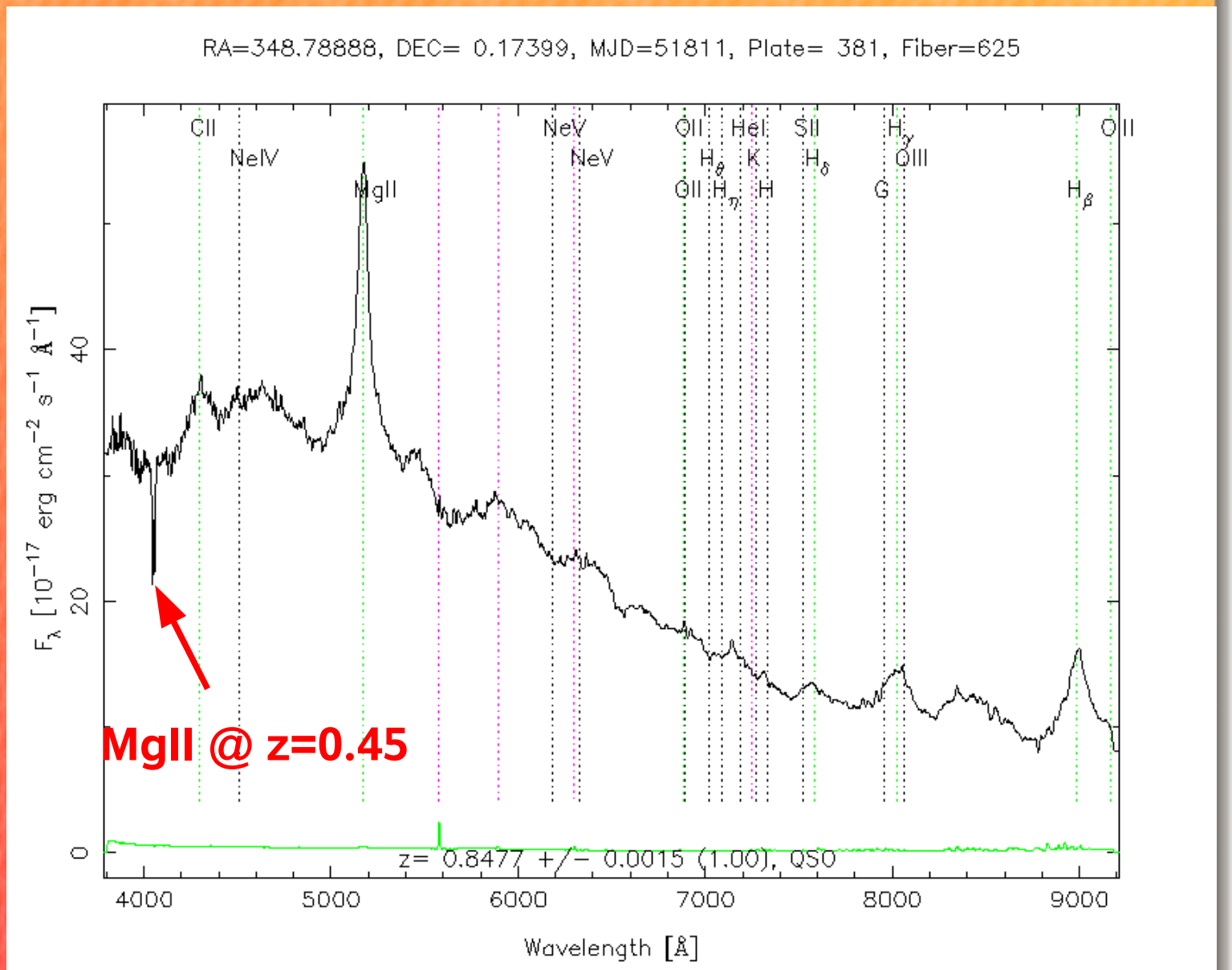
- Red-Sequence Cluster Survey (RCS-1)
- 100 sq deg
- *R*- and *z*-bands
- Galaxy Clusters up to z~1.4
- Photo-z accurate to Δz~0.1
- Contamination ~3%.

Gladders et al., Barrientos et al.

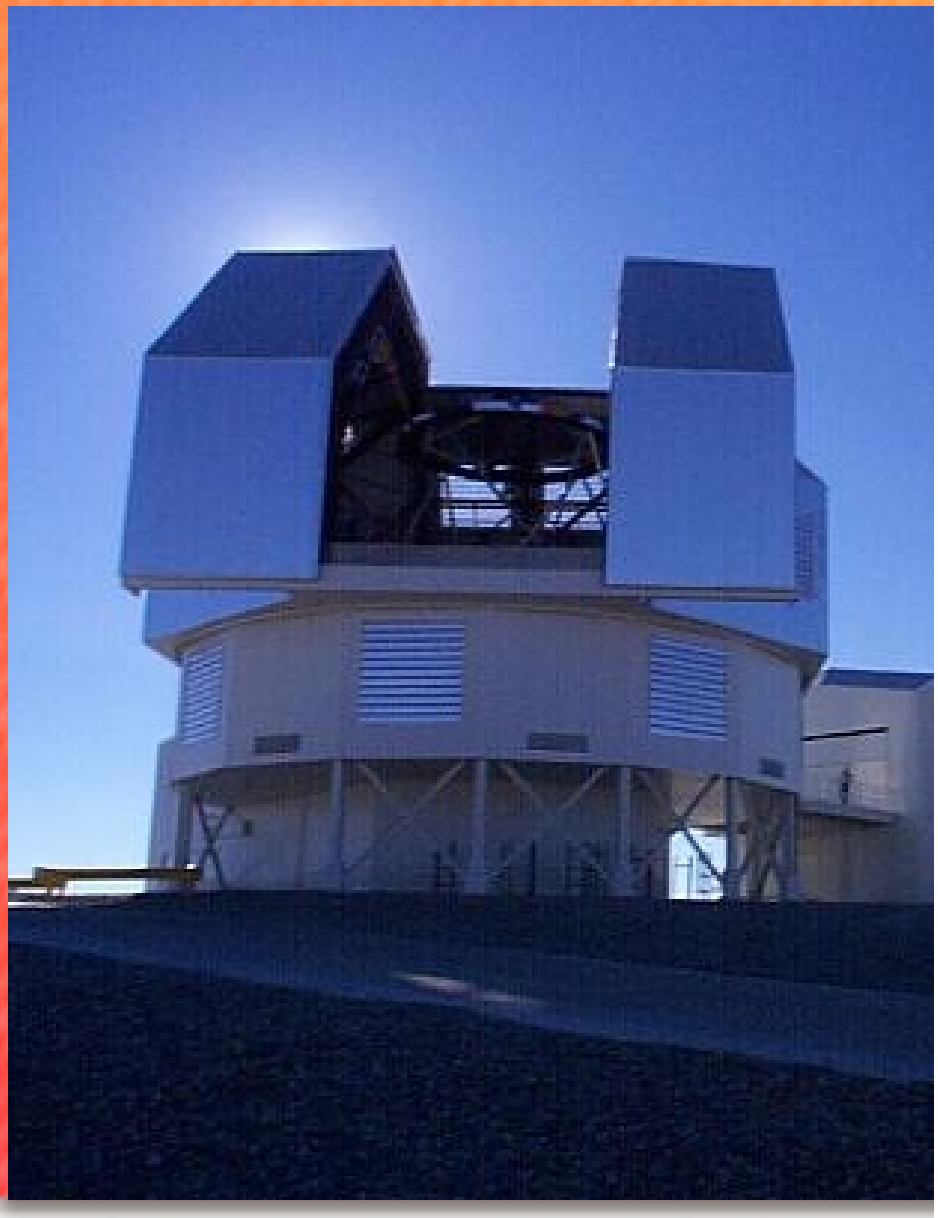
QbC: The Quasars behind Clusters Survey

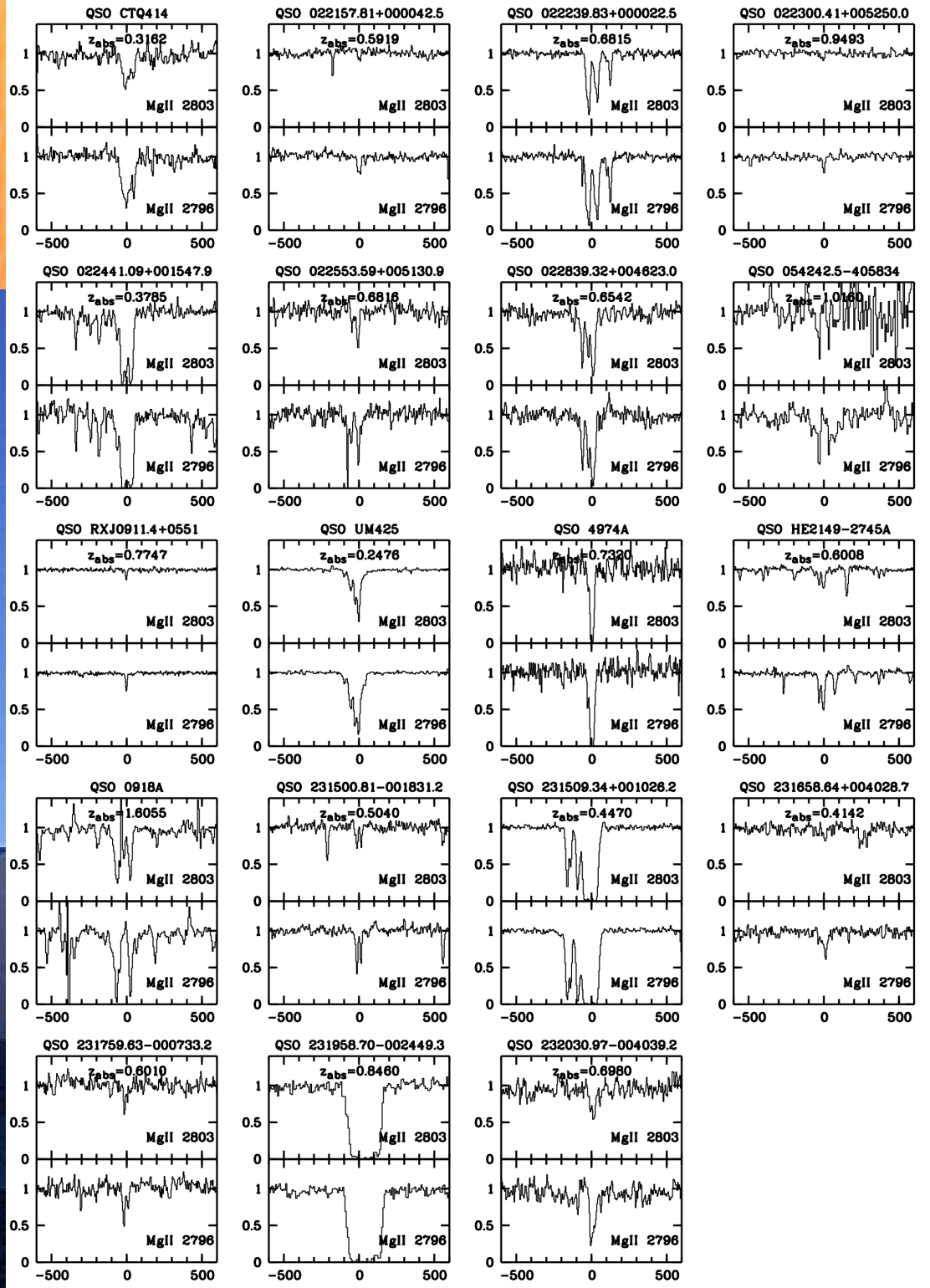
QSO Data

- SDSS
- DR3
- ~42000 QSOs.



Magellan/MIKE

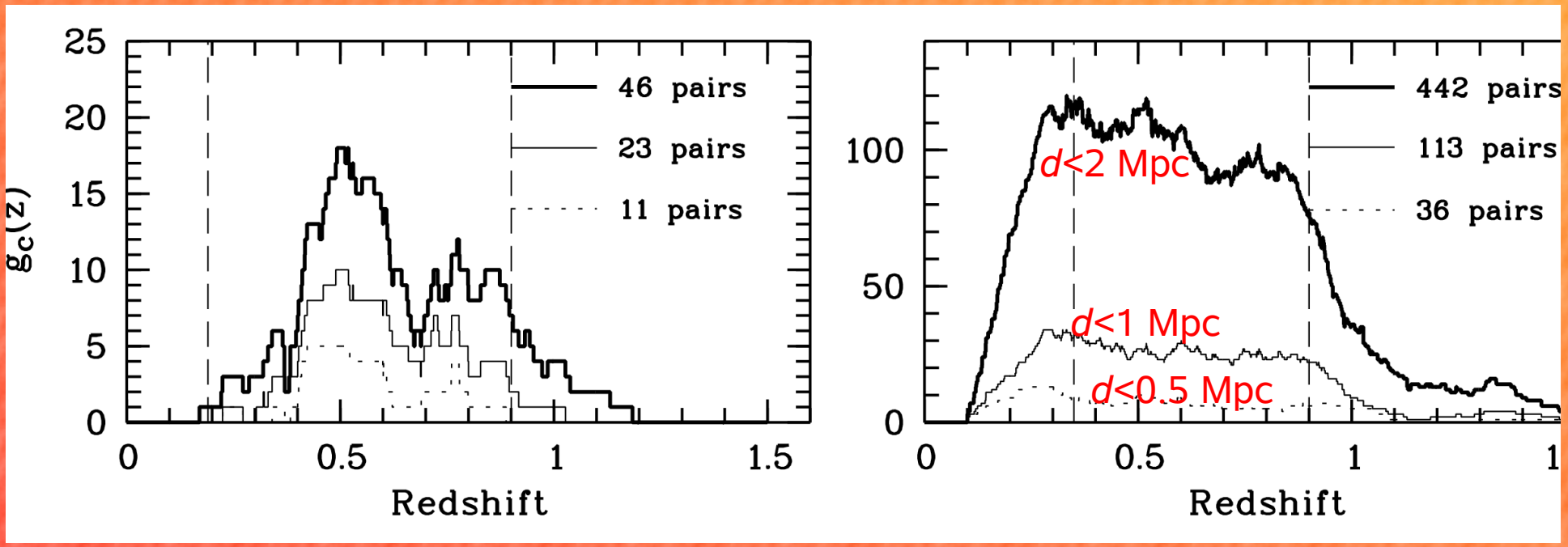




Survey Redshift Path Density

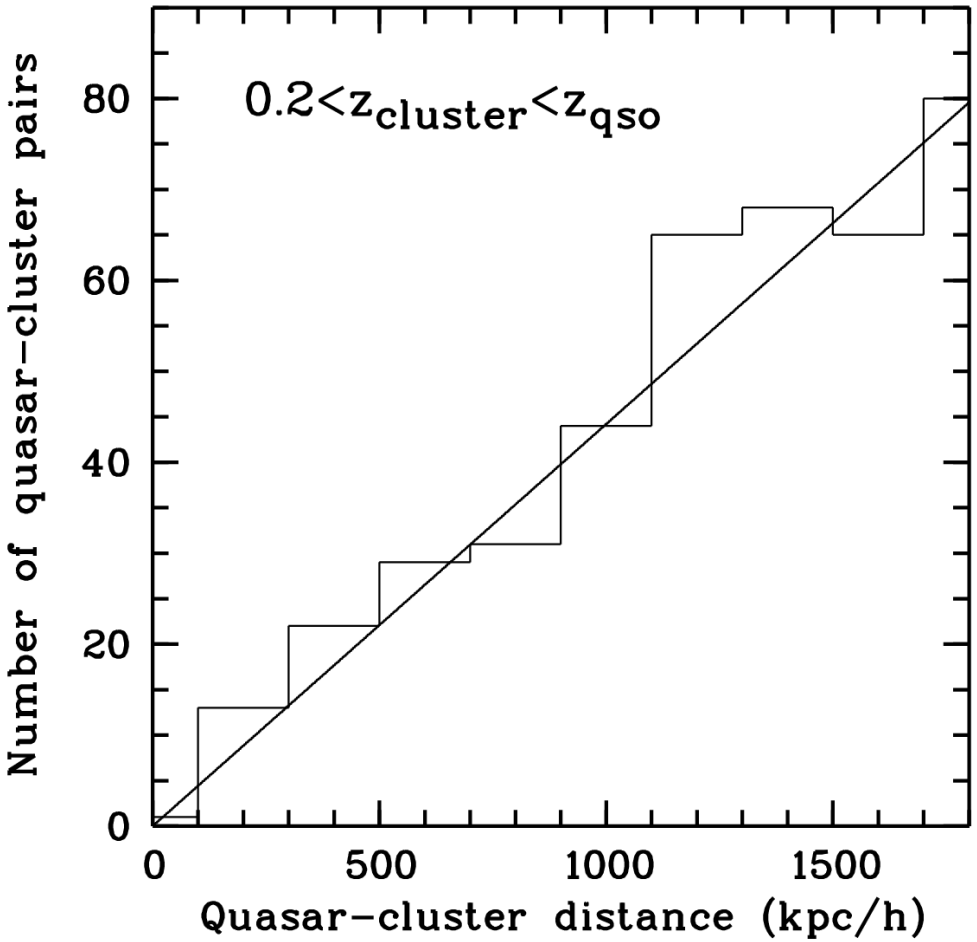
high-resolution sample

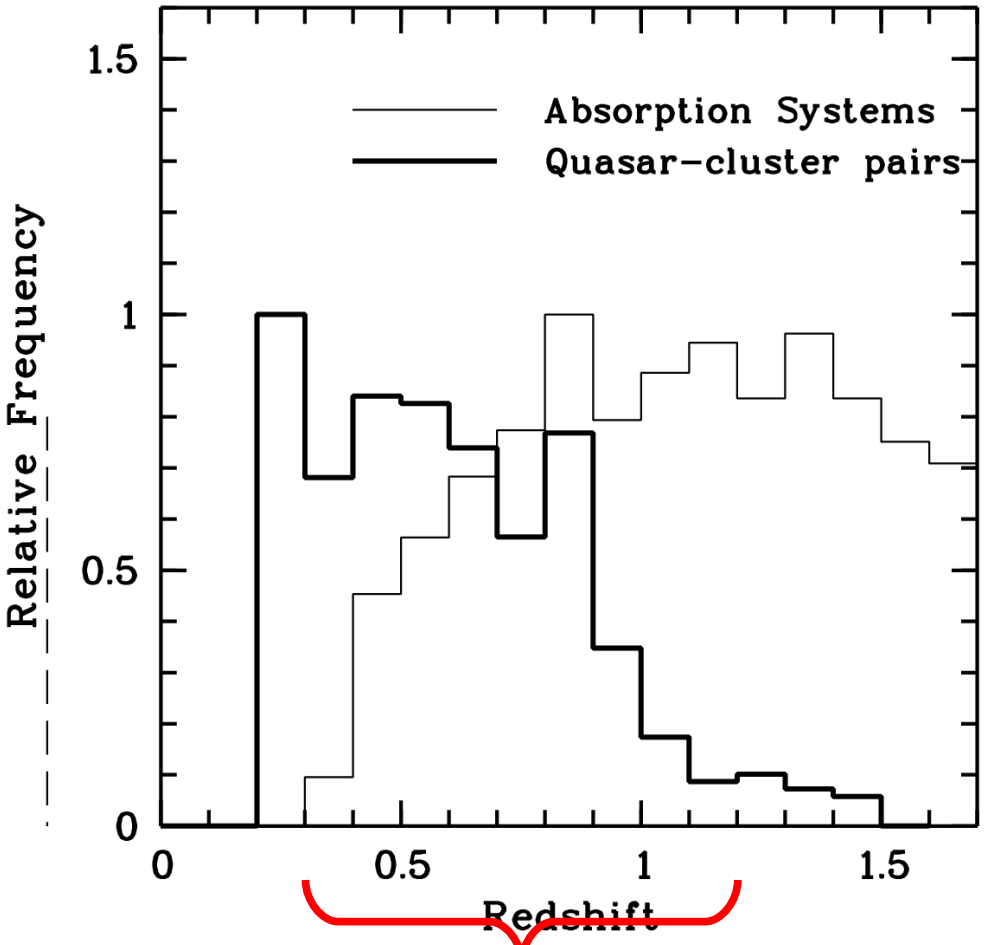
low-resolution sample



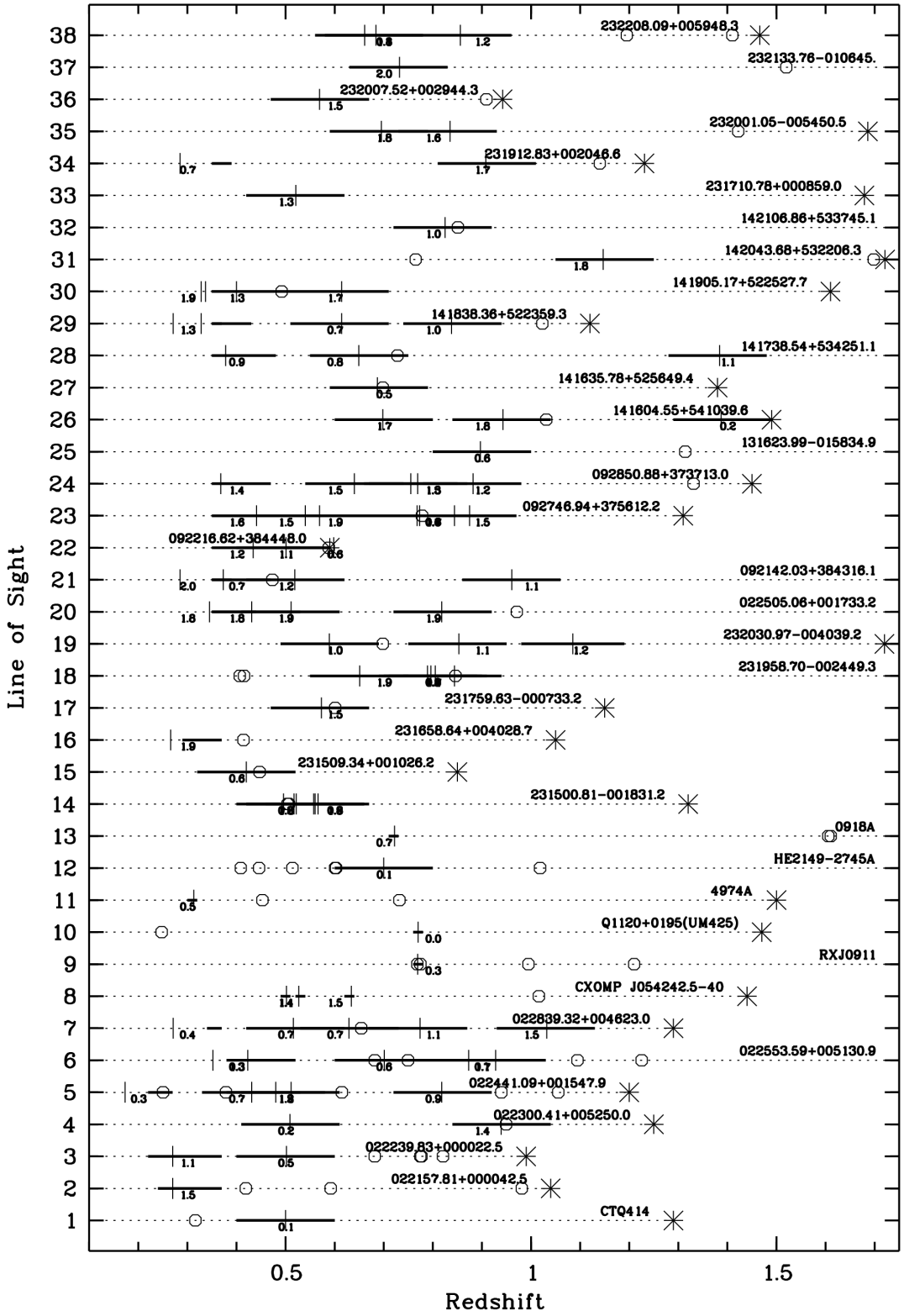
QbC: The Quasars behind Clusters Survey

RCS – SDSS correlation: complete and homogeneous





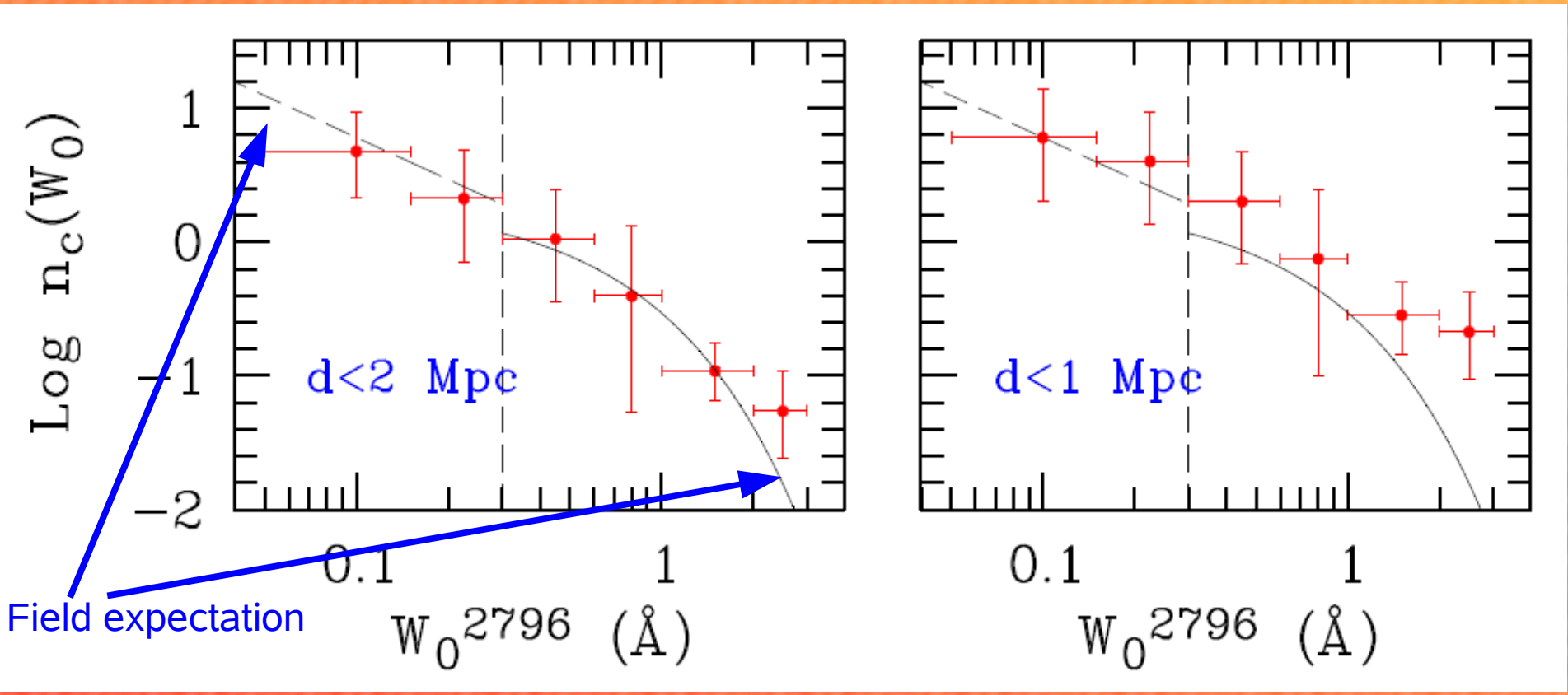
Good overlap thanks to RCS!



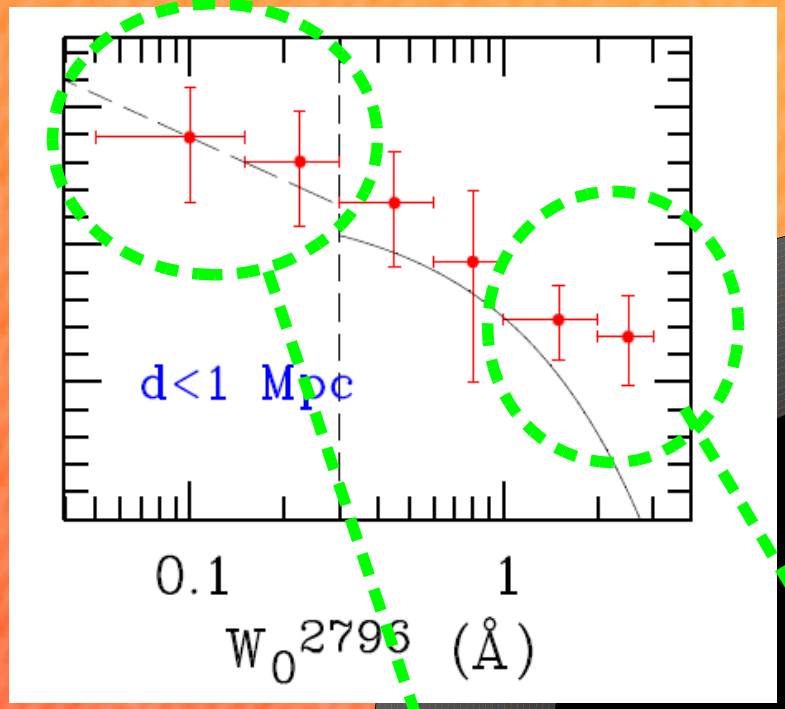
SDSS-DR3 + RCS-1 gives 442 QSO-cluster pairs with:

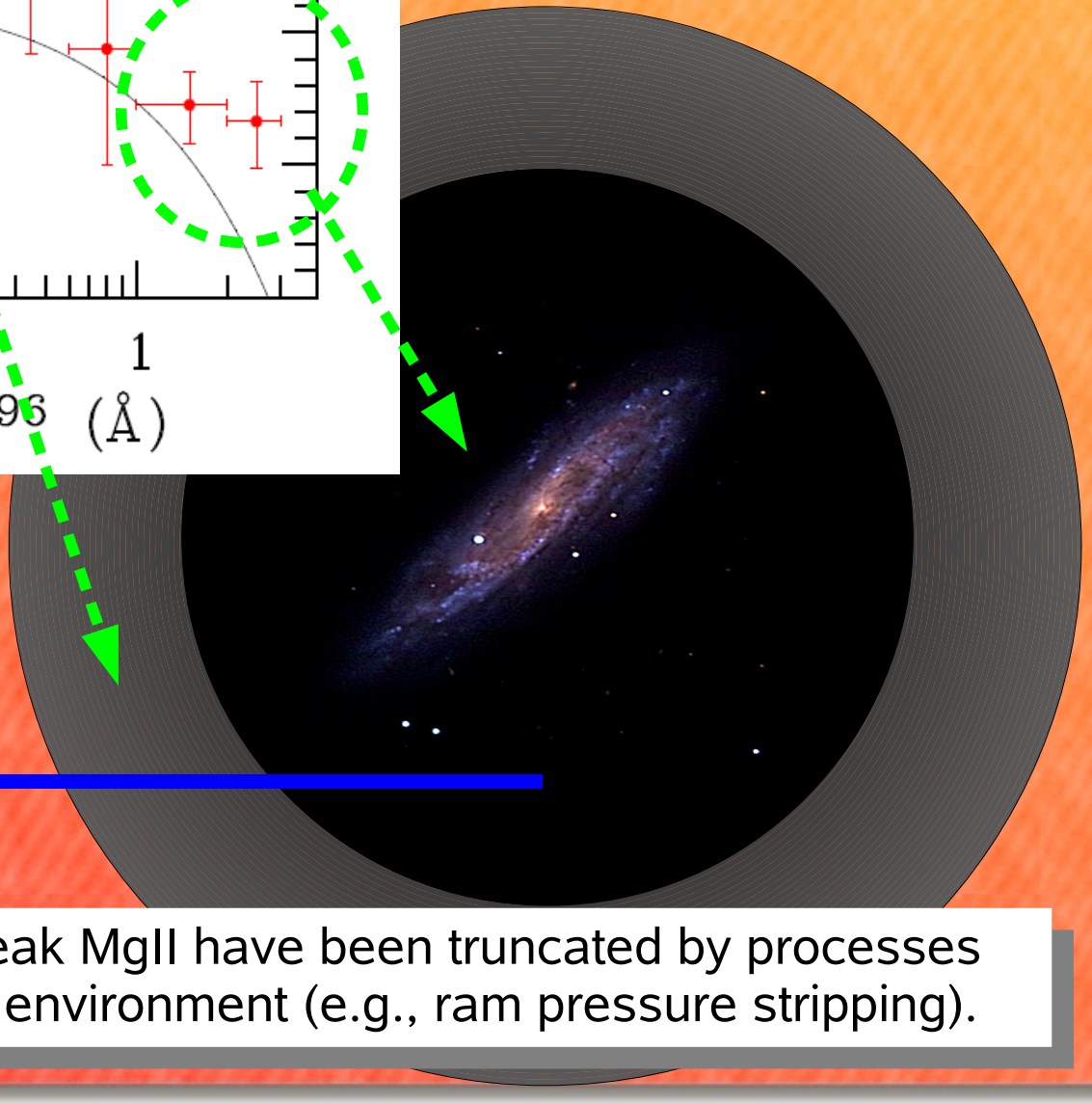
- $z_{QSO} > z_{cluster} > 0.2$
- Impact parameter $d < 2$ Mpc

Result: MgII Equivalent-Width distribution in Clusters



Interpretation

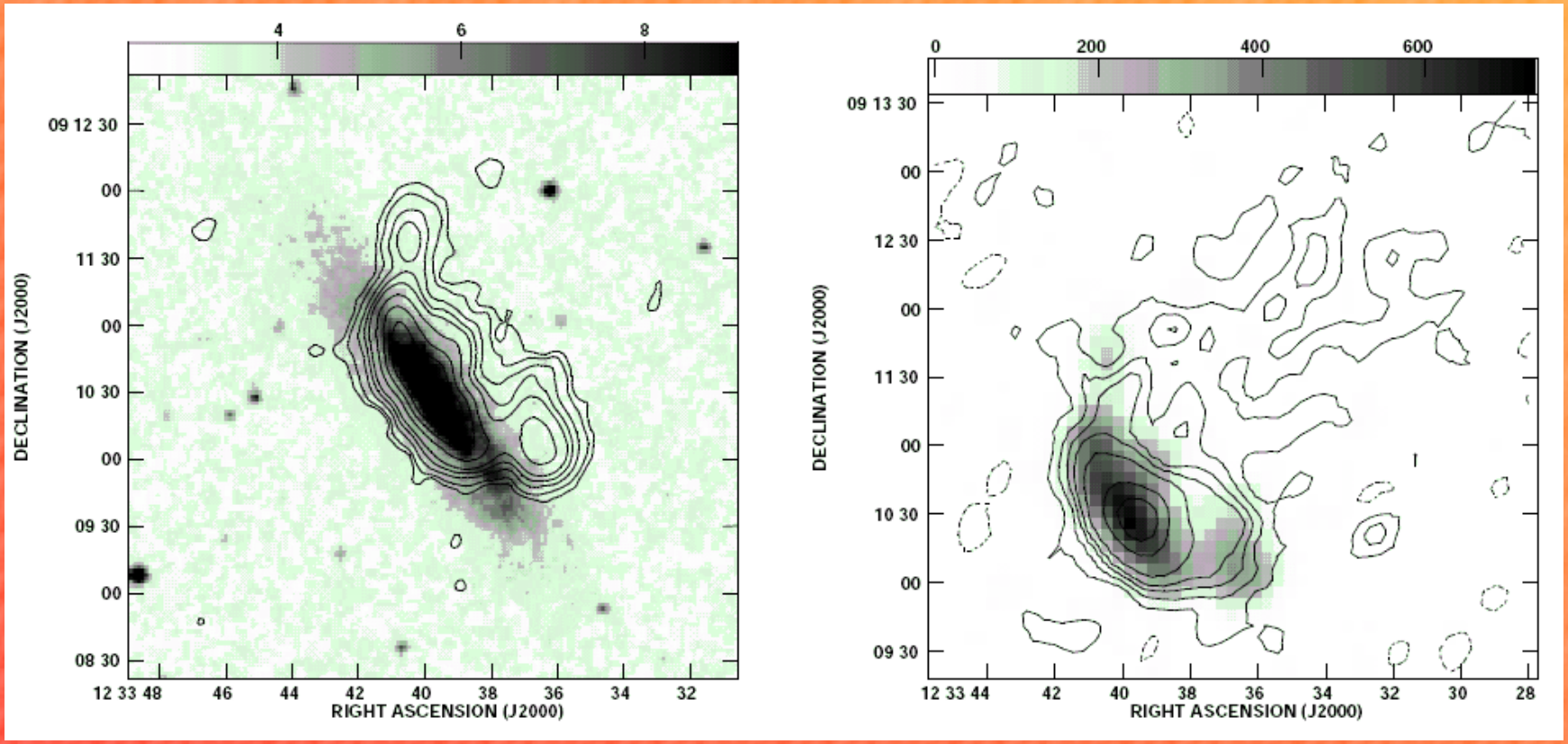




Distance *d* to cluster center

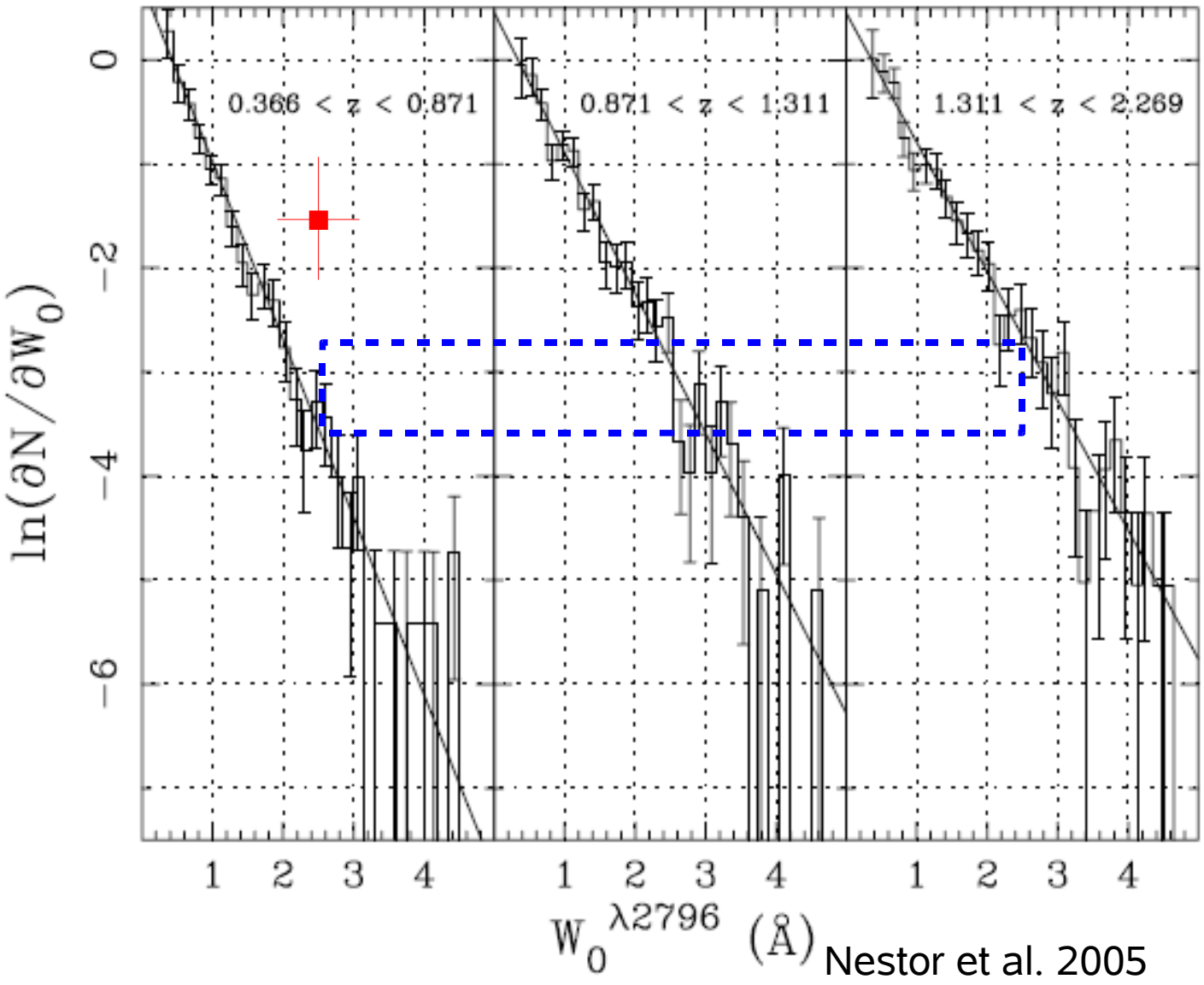
Halos giving rise to weak MgII have been truncated by processes inherent to the cluster environment (e.g., ram pressure stripping).

Virgo galaxies, 21cm



Kenney & Koopmann

Redshift evolution of $dN^2/dWdz$(MgII)



Nestor et al. 2005

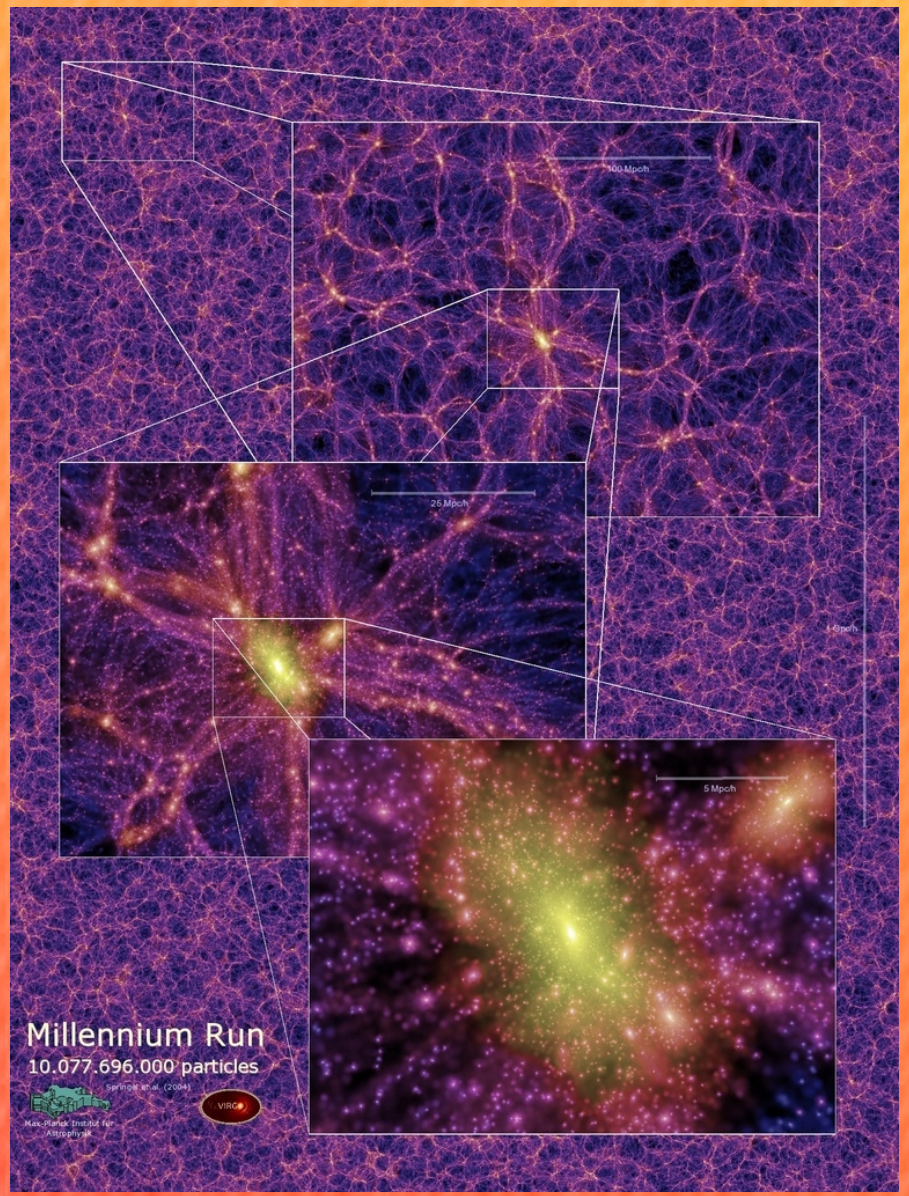
Expected (Later-type) Galaxy Overdensity ?

$$(dN/dz)_c \propto n_c(z)\ \sigma_c(z)$$

From simulations:

MgII halo sizes from semi-analytical galaxies

- Millennium Simulation
- 10^{10} collisionless dark-matter particles
- z=50 to z=0
- Use GALFORM
- Form composite cluster
- Cross LOSs



MgII halo sizes from semi-analytical galaxies

Possible trend with cluster impact parameter

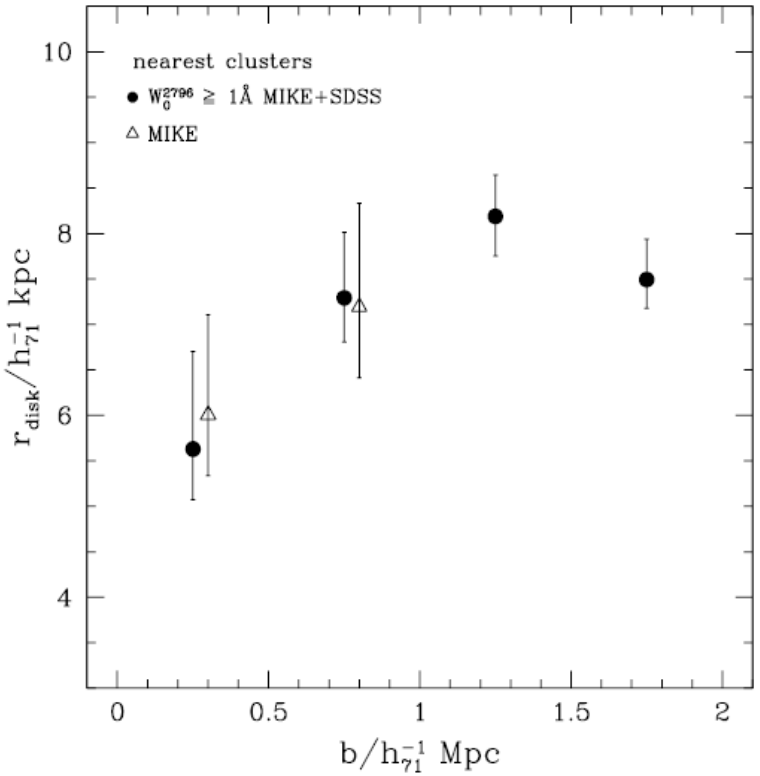


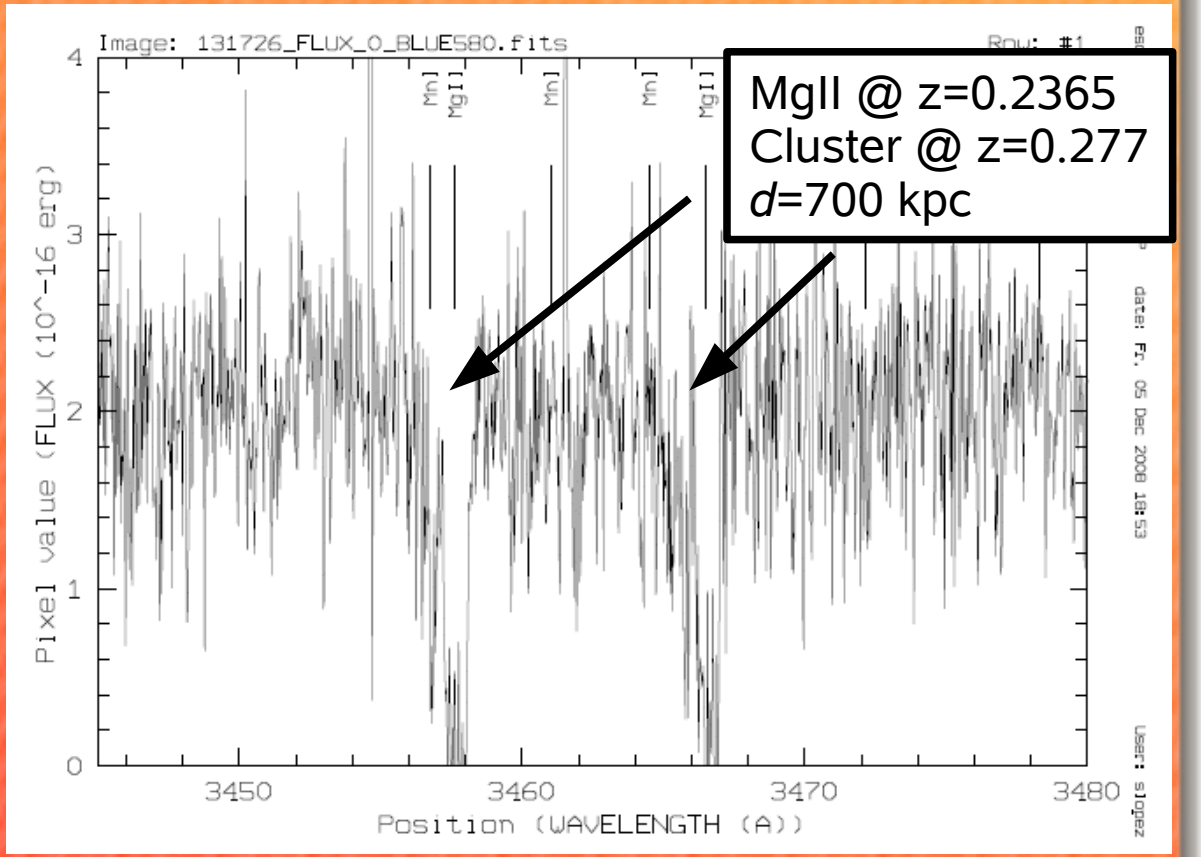
Figure 5. Semi-analytic model: Dependence on impact parameter to the cluster centre of the median disk scale-length in the semi-analytic model. The errorbars show the error of the median.

Padilla et al. 2009

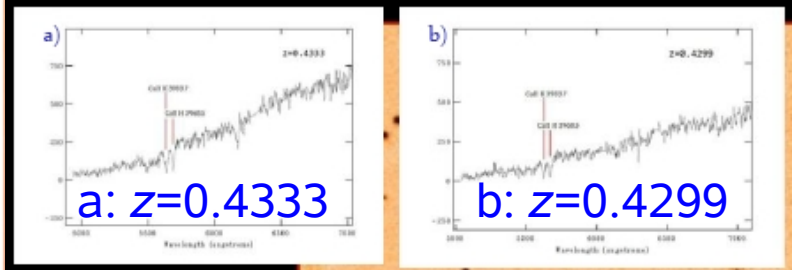
Ongoing...

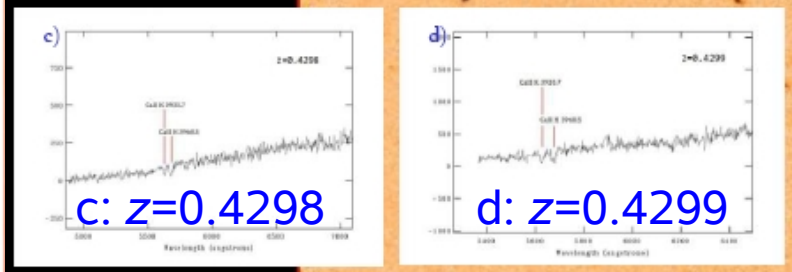
QbC: The Quasars behind Clusters Survey

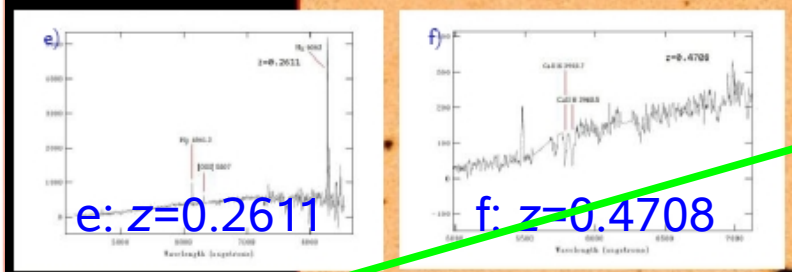
VLT-UVES QSO spectra (P81): abundances, ionization

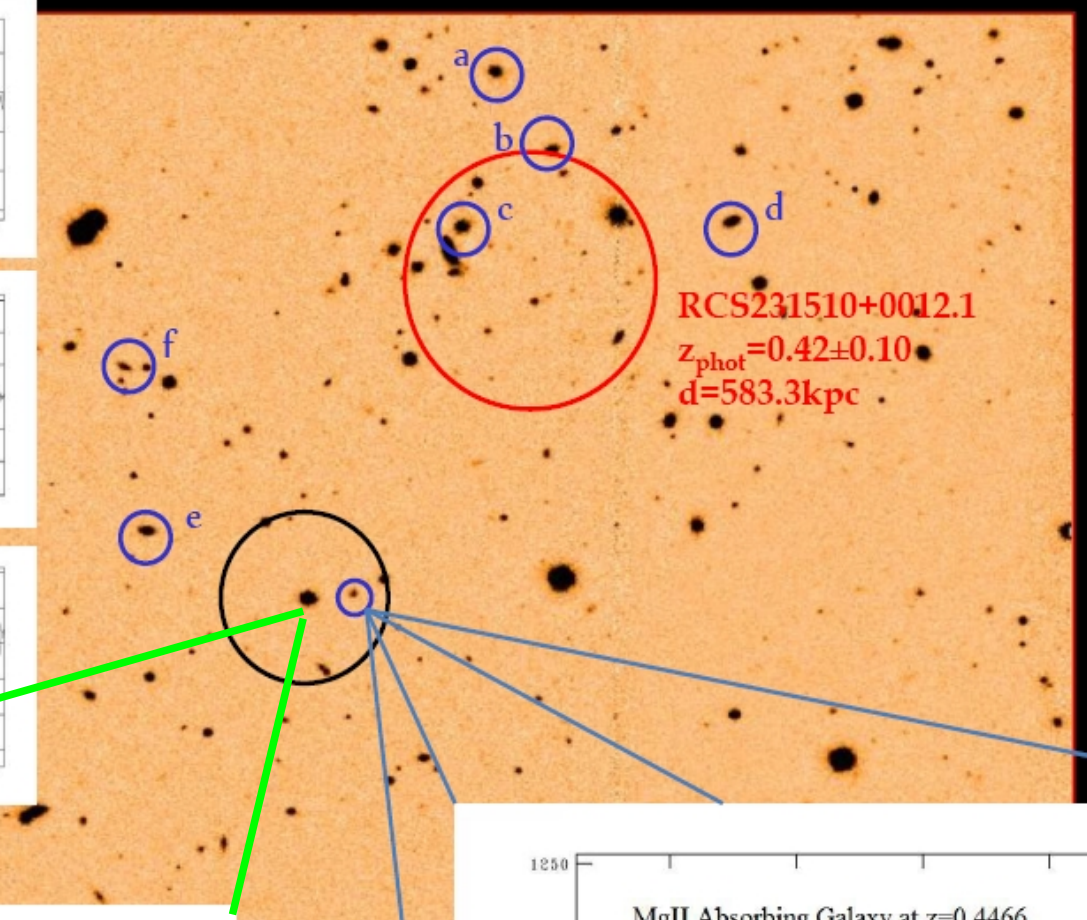


GMOS data on fields with “hits”: Poster by Heather Andrews

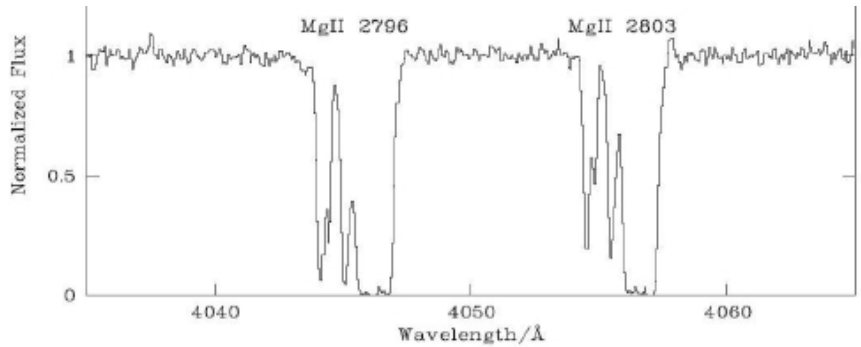


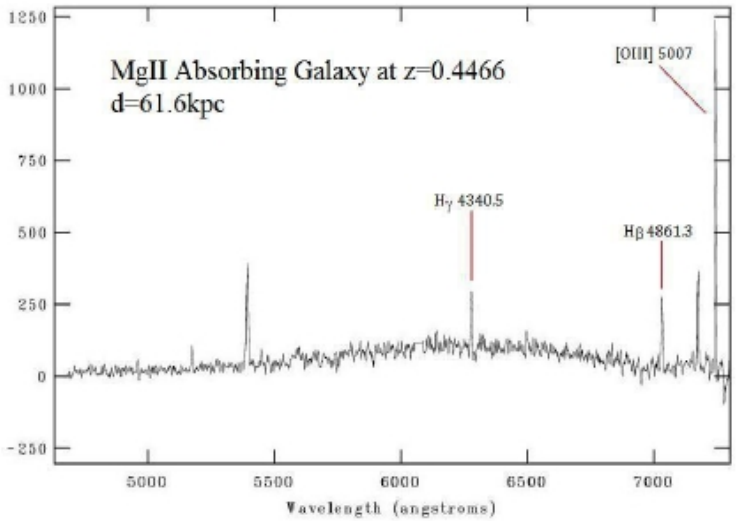




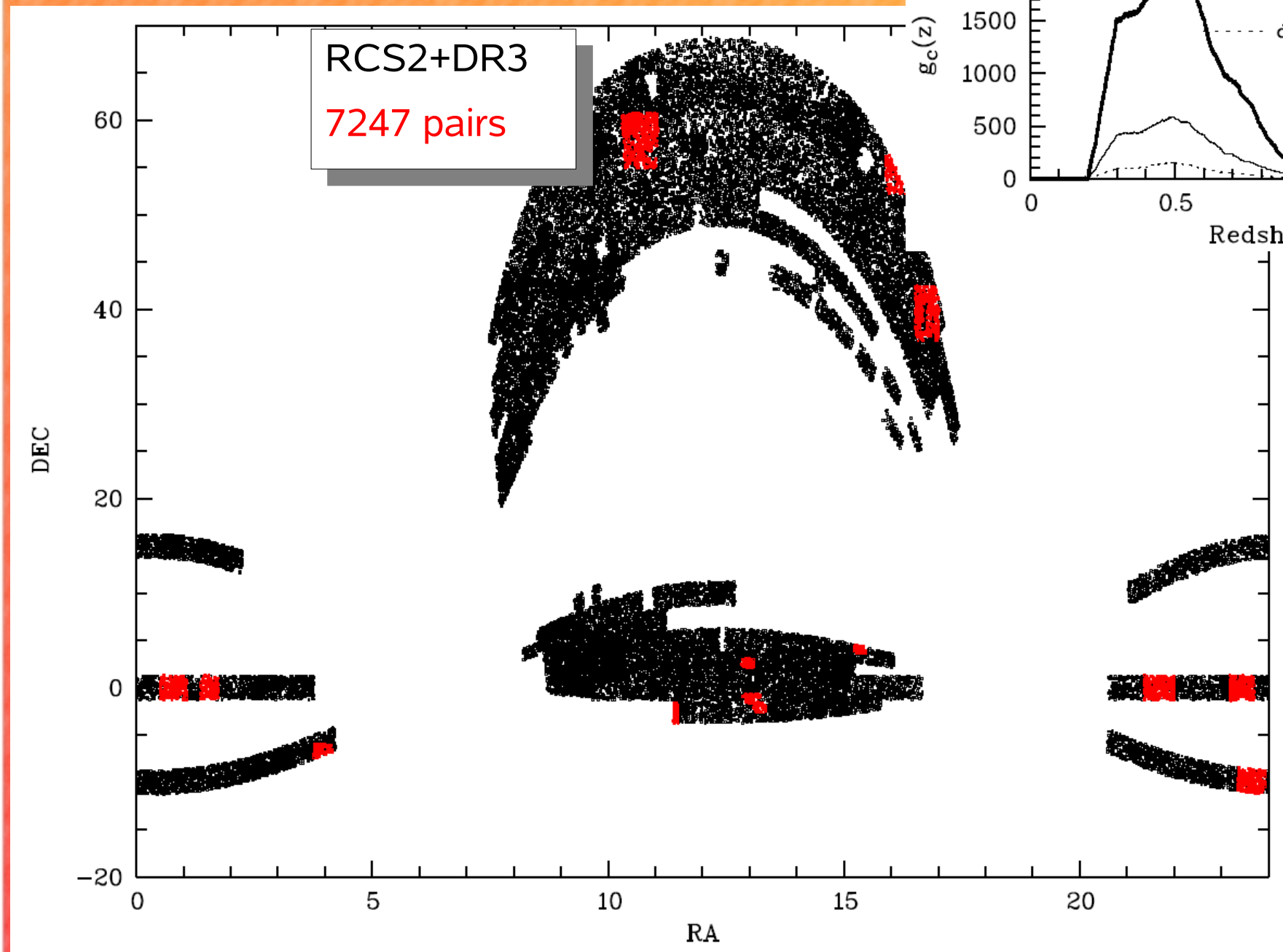


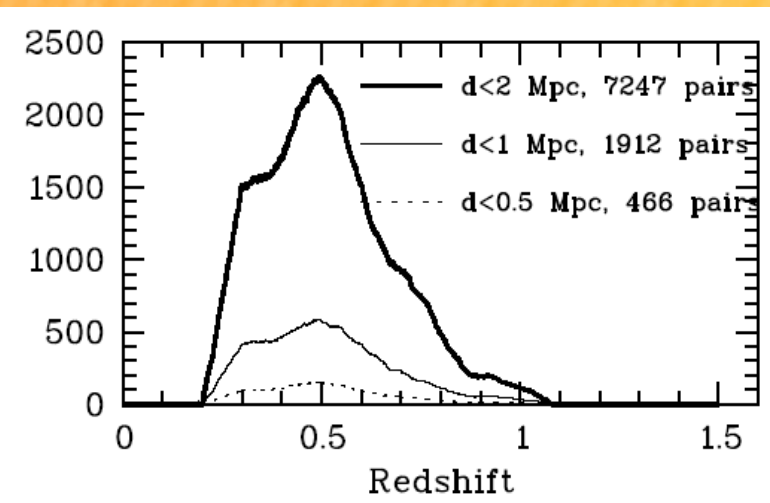
QSO 231509.34+001026.2, z_{abs}=0.4470

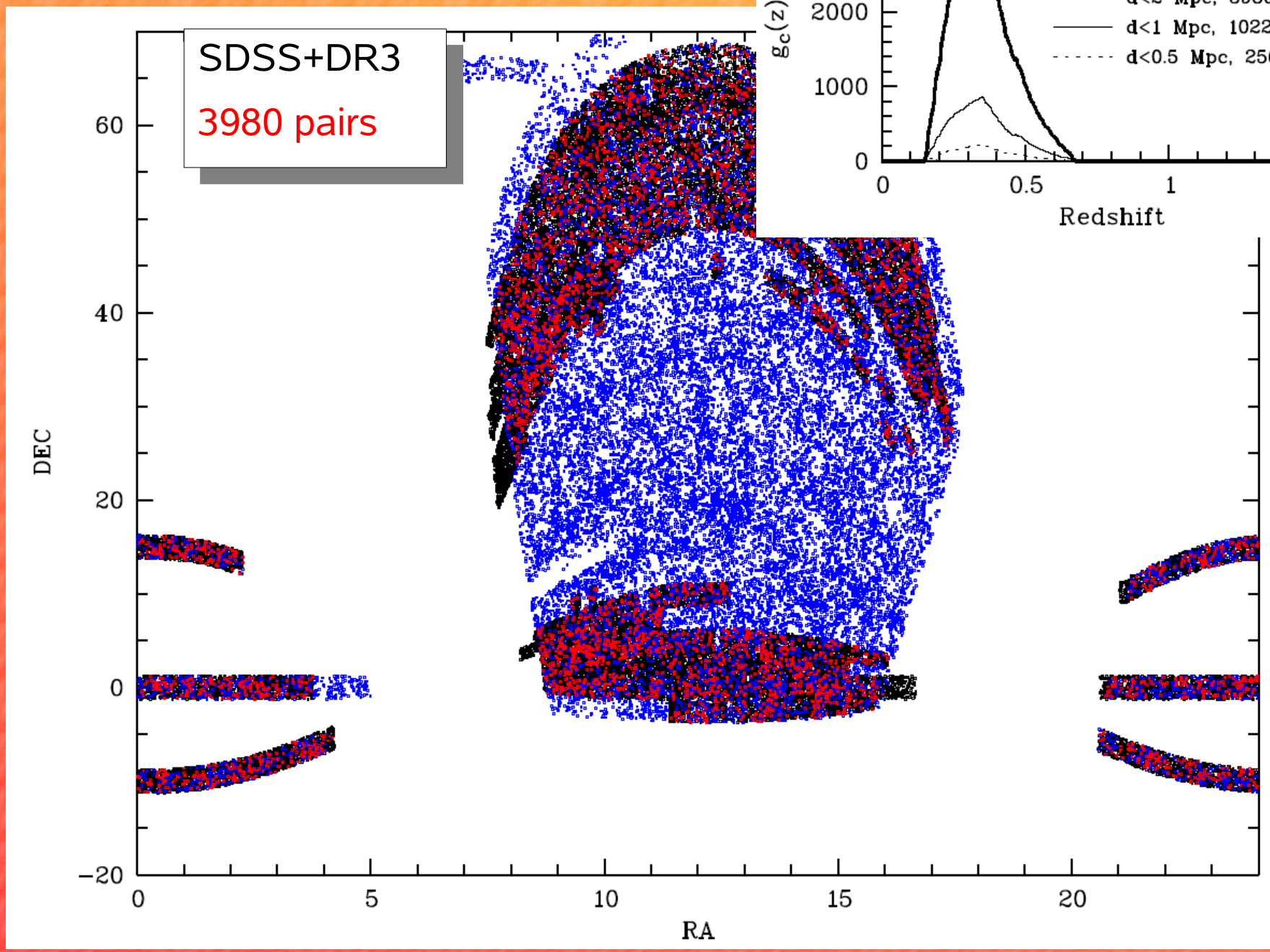




RCS-2 + SDSS DR7 = factor of 20 more pairs!






SDSS+DR3
3980 pairs
DEC
RA
60
40
20
0
−20
0
5
10
15
20
$g_c(z)$
Redshift
3000
2000
1000
0
0.5
1
1.5
d<2 Mpc, 3980 pairs
d<1 Mpc, 1022 pairs
d<0.5 Mpc, 256 pairs