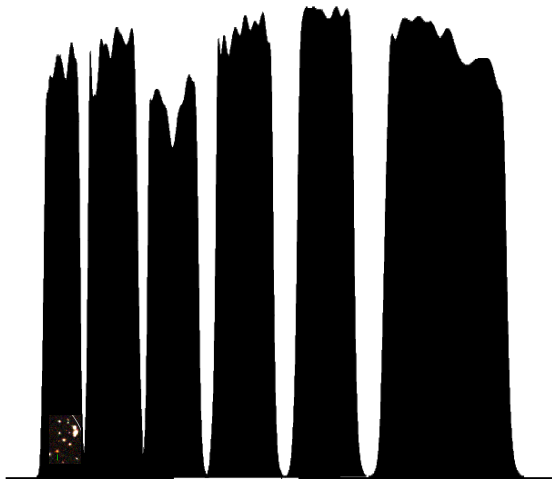
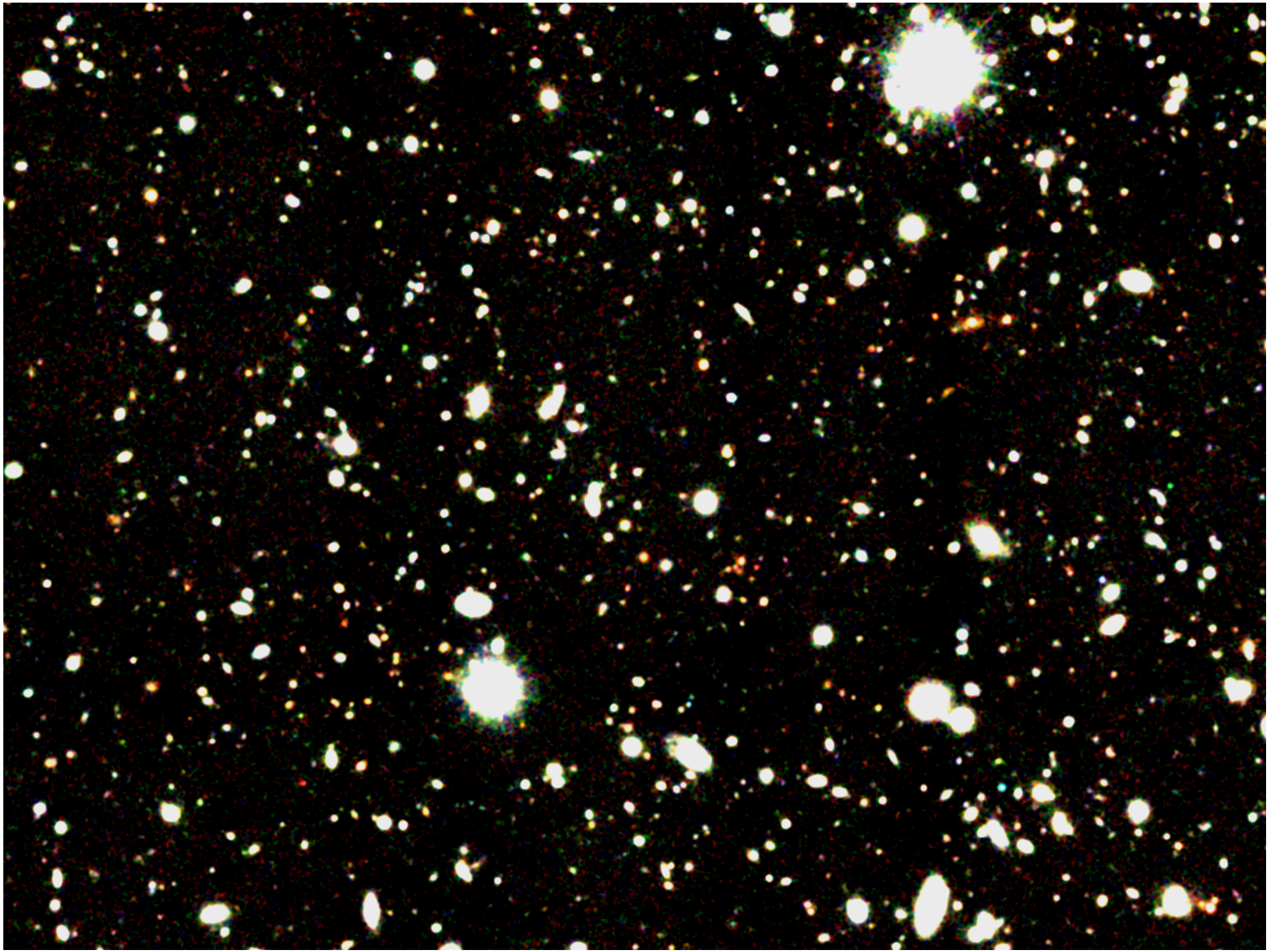
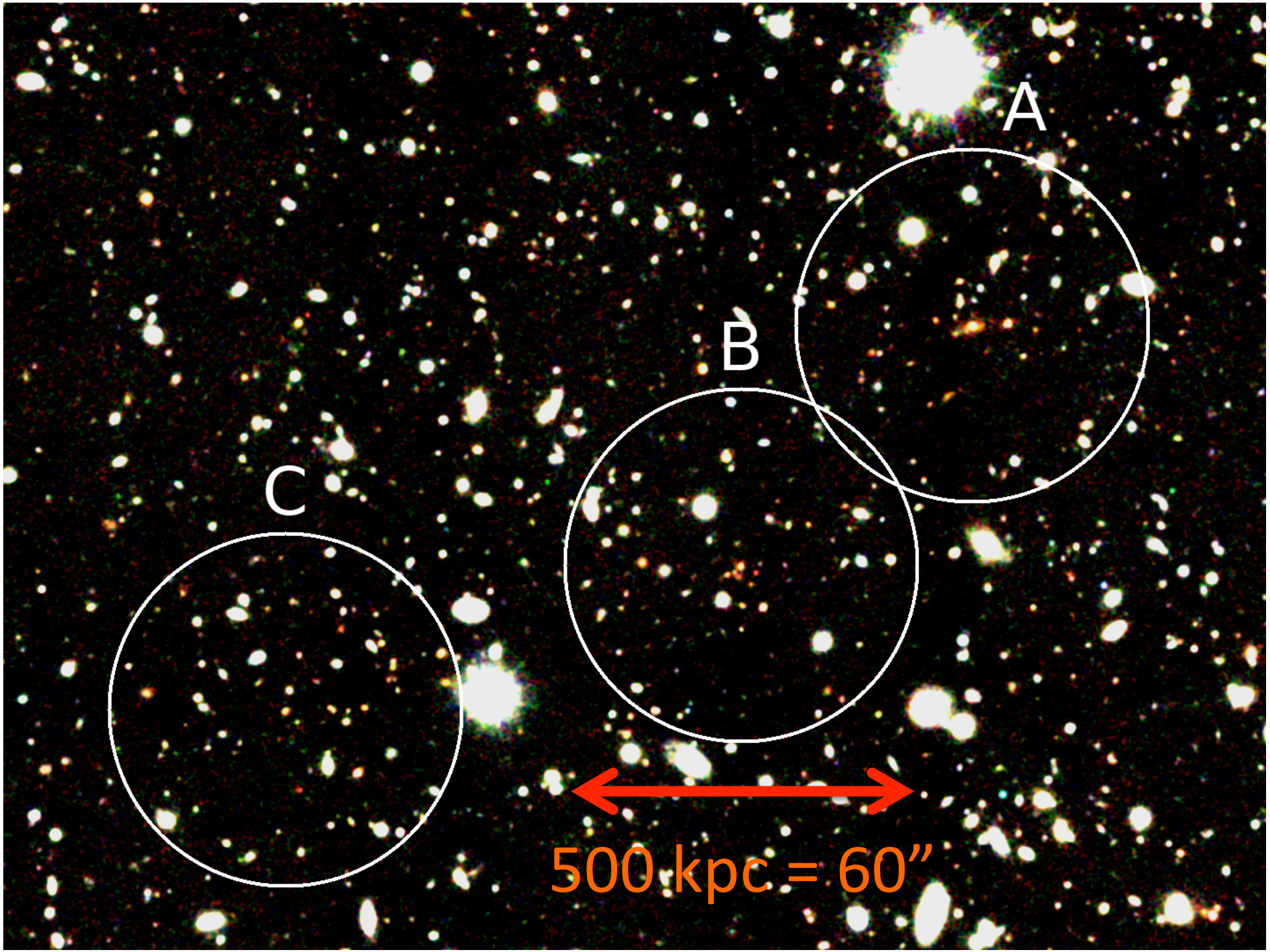
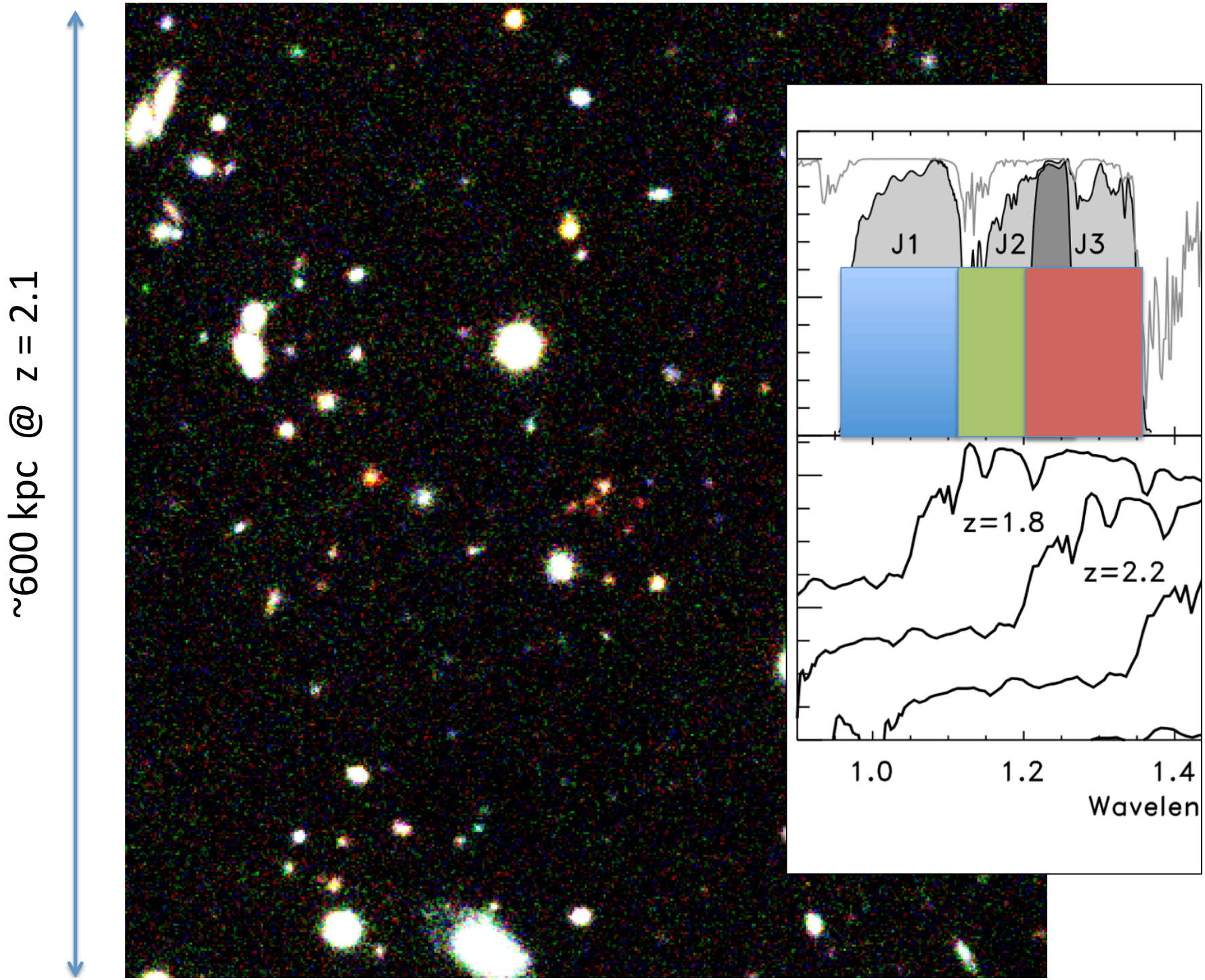
The discovery of a galaxy cluster with passive galaxies at redshift z=2.1



Lee Spitler
Macquarie University &
Australian Astronomical Observatory

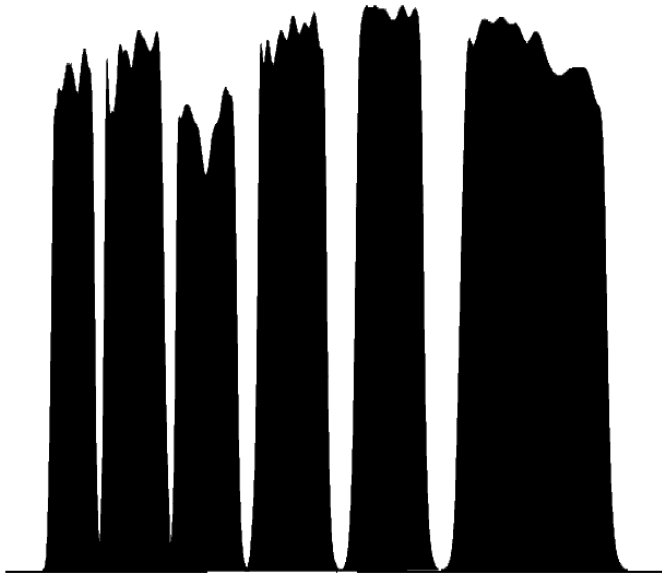



A
B
C
500 kpc = 60”


~600 kpc @ z = 2.1
J1
J2
J3
z=1.8
z=2.2
1.0
1.2
1.4
Wavelen

The Z-FOURGE Survey

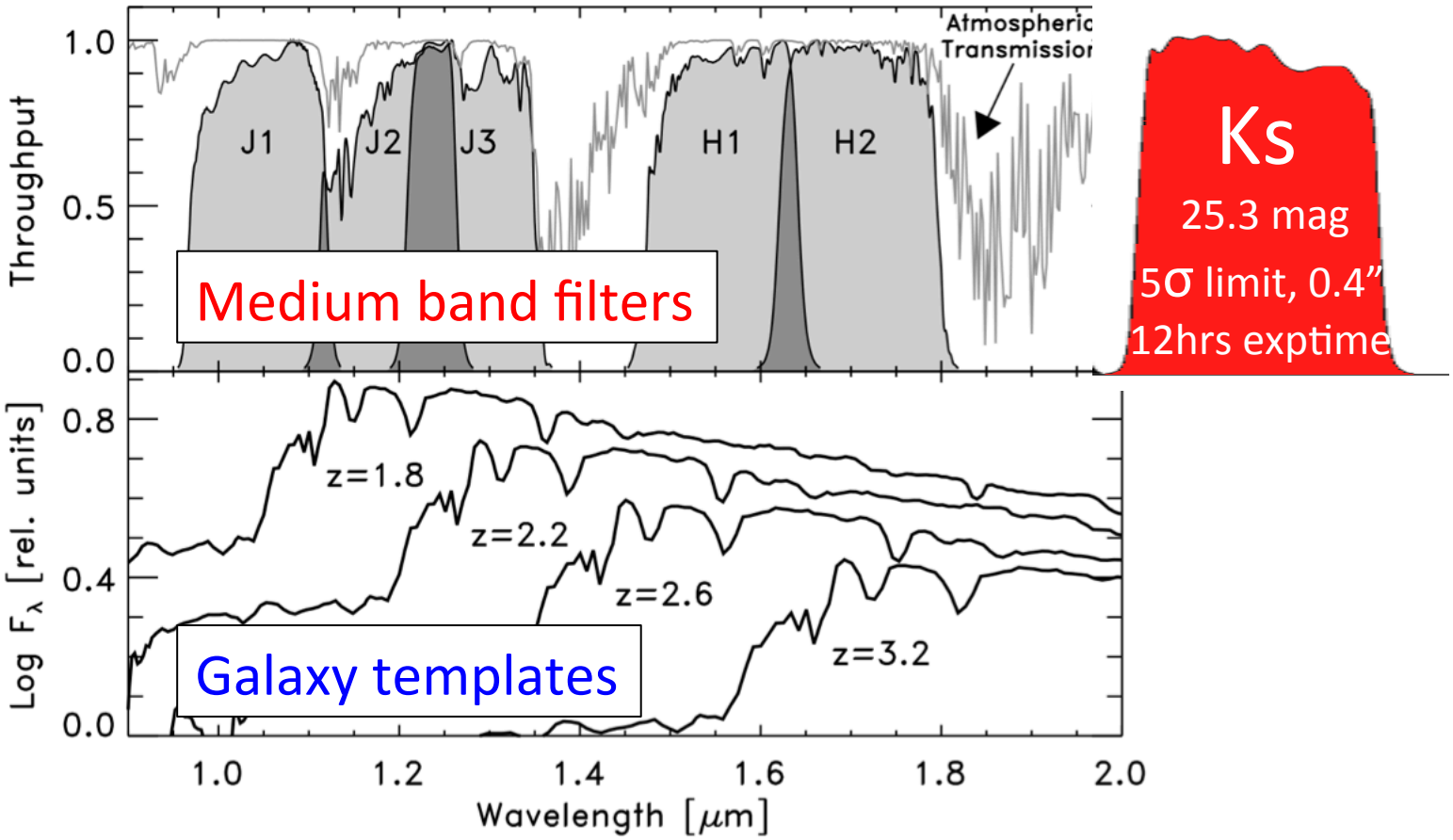
The
FourStar Galaxy Evolution
Survey



Glazebrook, Kacprzak, Labbé (PI),
Kelson, McCarthy, Monson, Murphy,
Papovich, Persson, Quadri, Spitler,
Straatman, Tilvi, Tran, van Dokkum

http://z-fourge.strw.leidenuniv.nl/

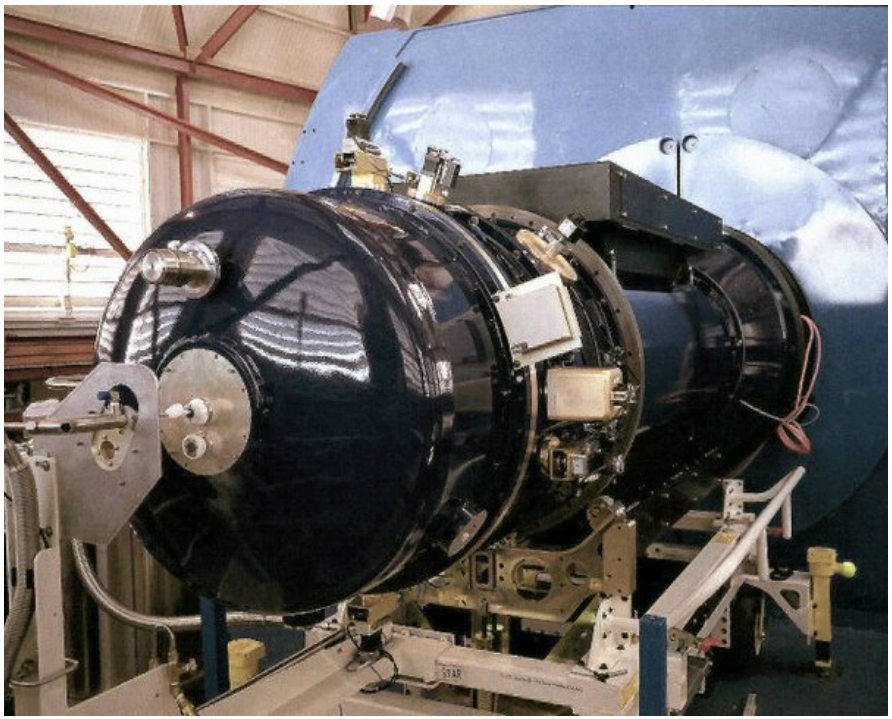
Main objective:
accurate photometric redshifts



1-2% redshifts uncertainties, σ/(z+1), at 2 < z < 3.5

The Z-FOURGE Survey

- ~50 nights with the new FourStar near-infrared camera at Magellan
- 3 fields each 11 x 11 arcmin^2
  - CDFS *complete*
  - COSMOS *complete*
  - UDS *scheduled for 2012B*

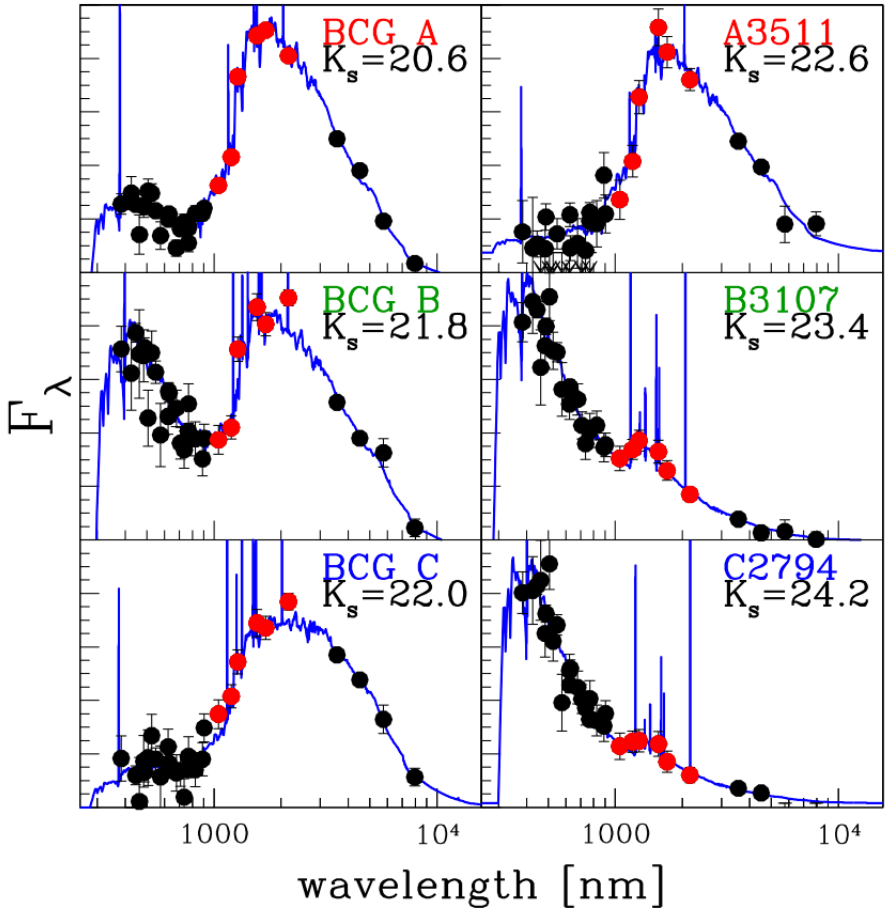


The FourStar camera
0.16" per pixel 11'x11' FOV
4x2048x2048 Hawaii-2RGs
PI: Eric Persson (Carnegie)

Properties of the z=2.1 overdensity

Contains young and old galaxies

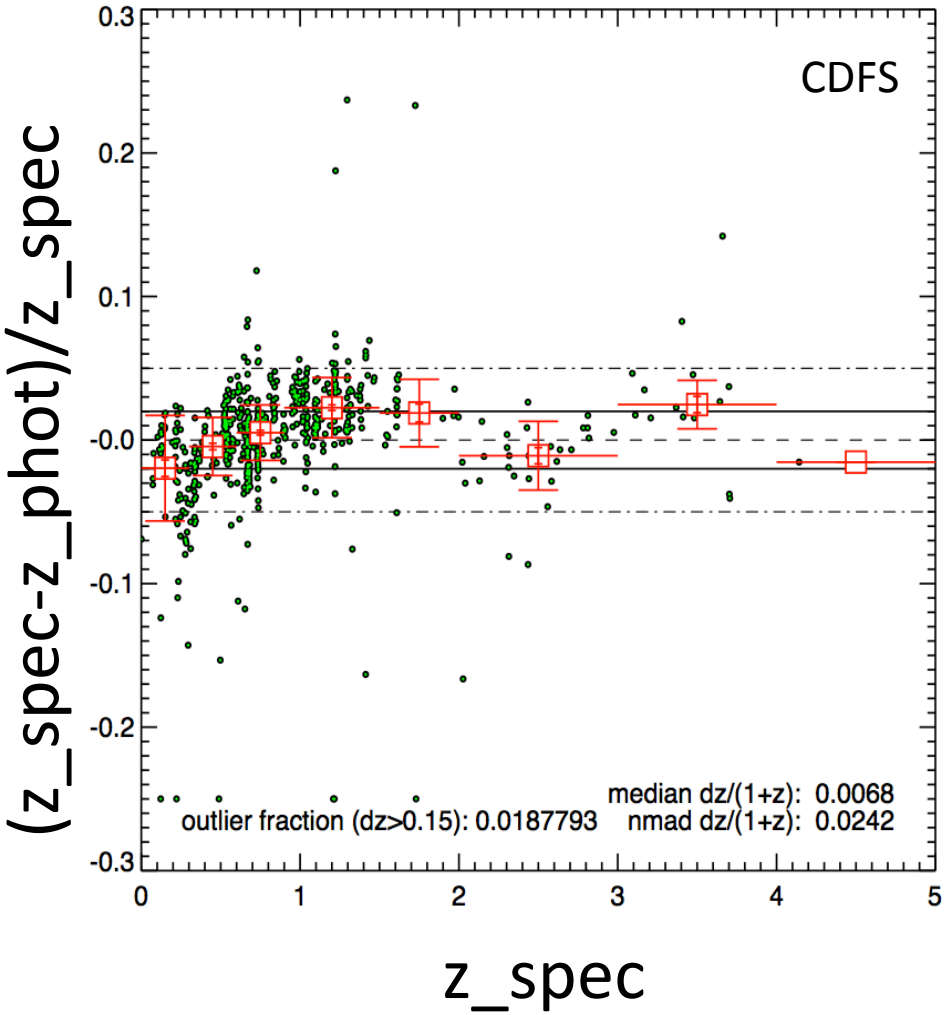
32 bands total



Z-FOURGE data **COSMOS legacy data** **EAZY galaxy templates**

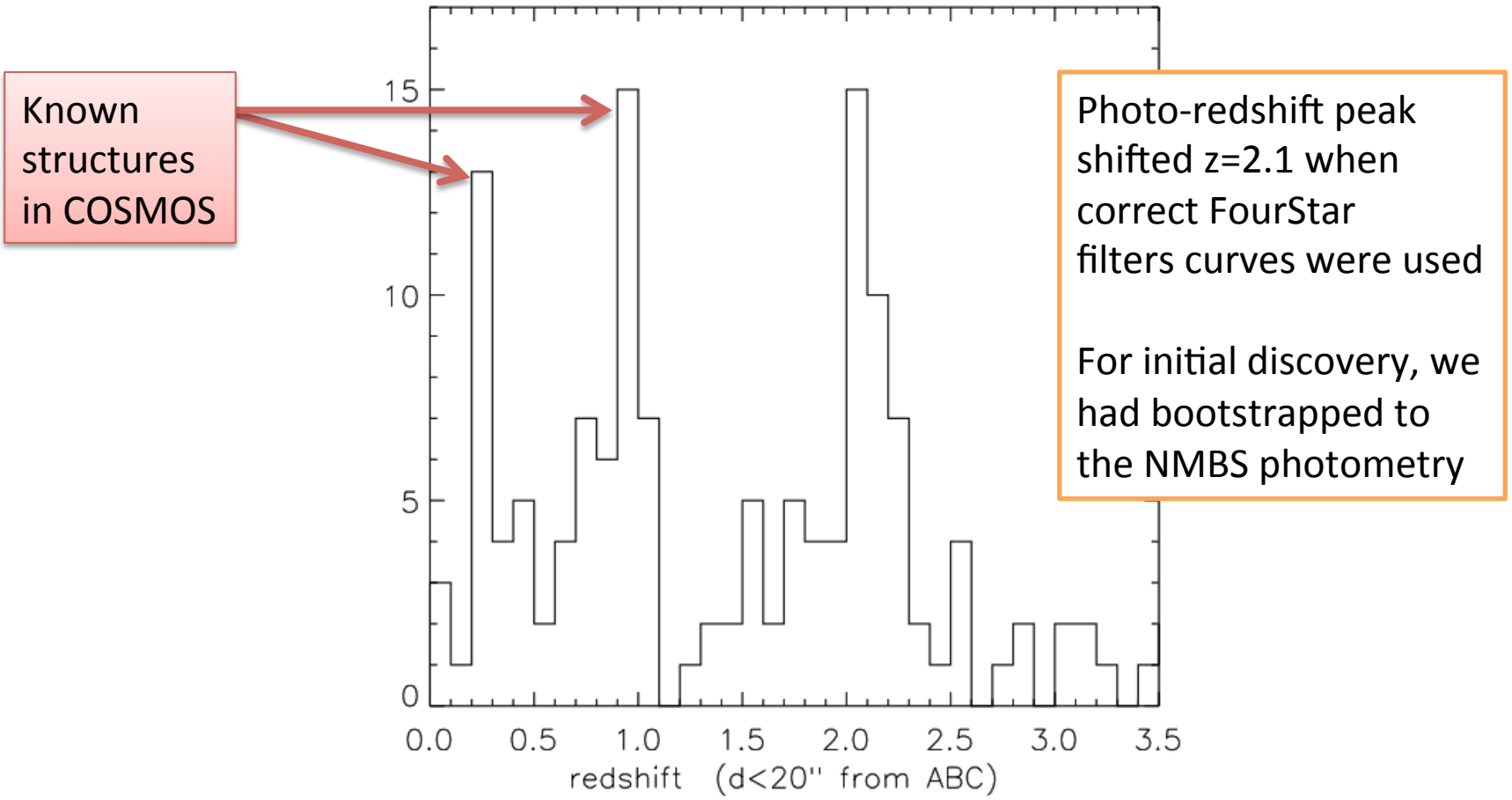
EAZY Brammer et al. 2008

Comparison to spectroscopic redshifts



C. Straatman et al. in prep.

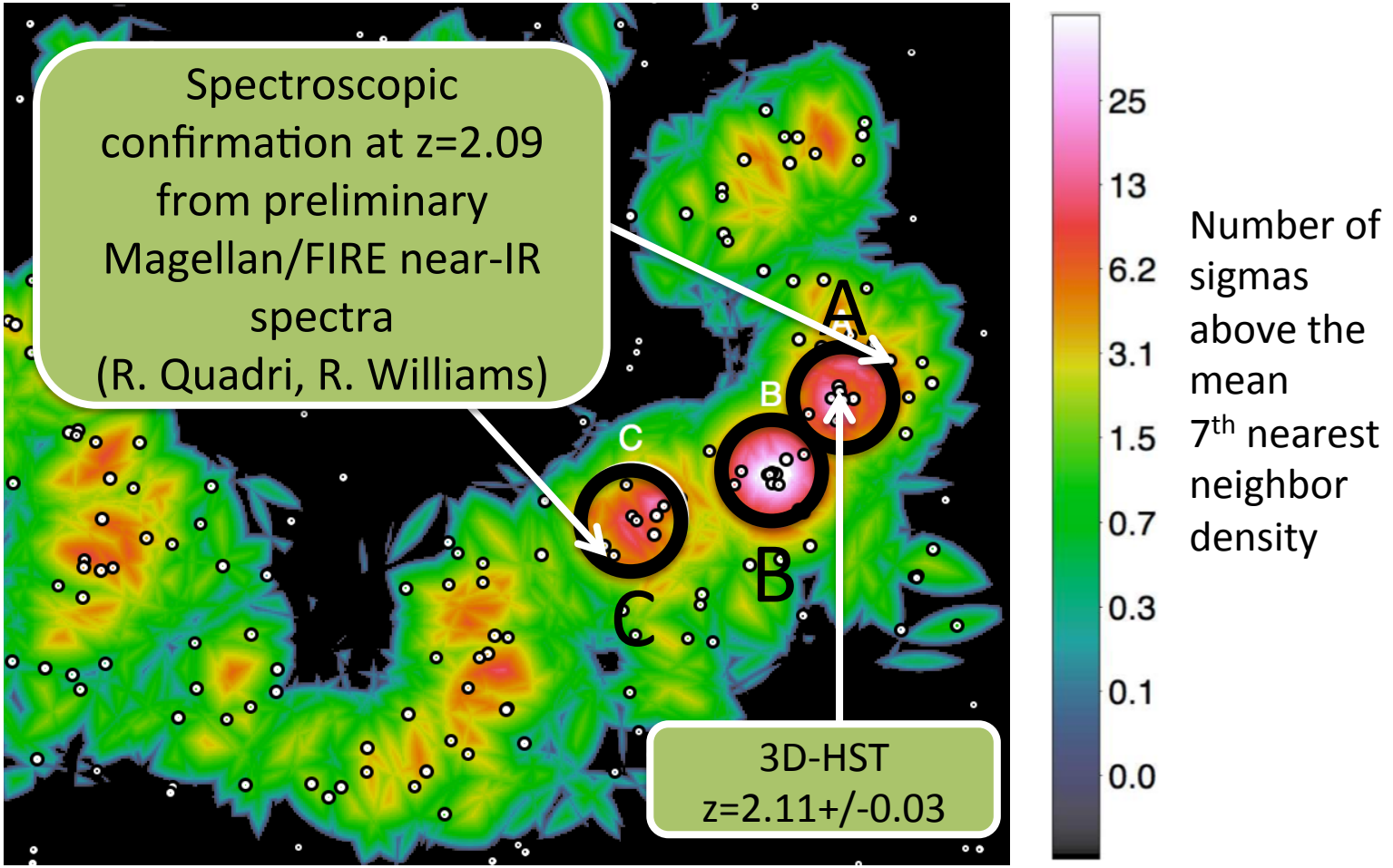
Photometric redshift histogram



Z-FOURGE redshifts

Number density map at z = 2.0-2.2

A & B unlikely to occur by chance

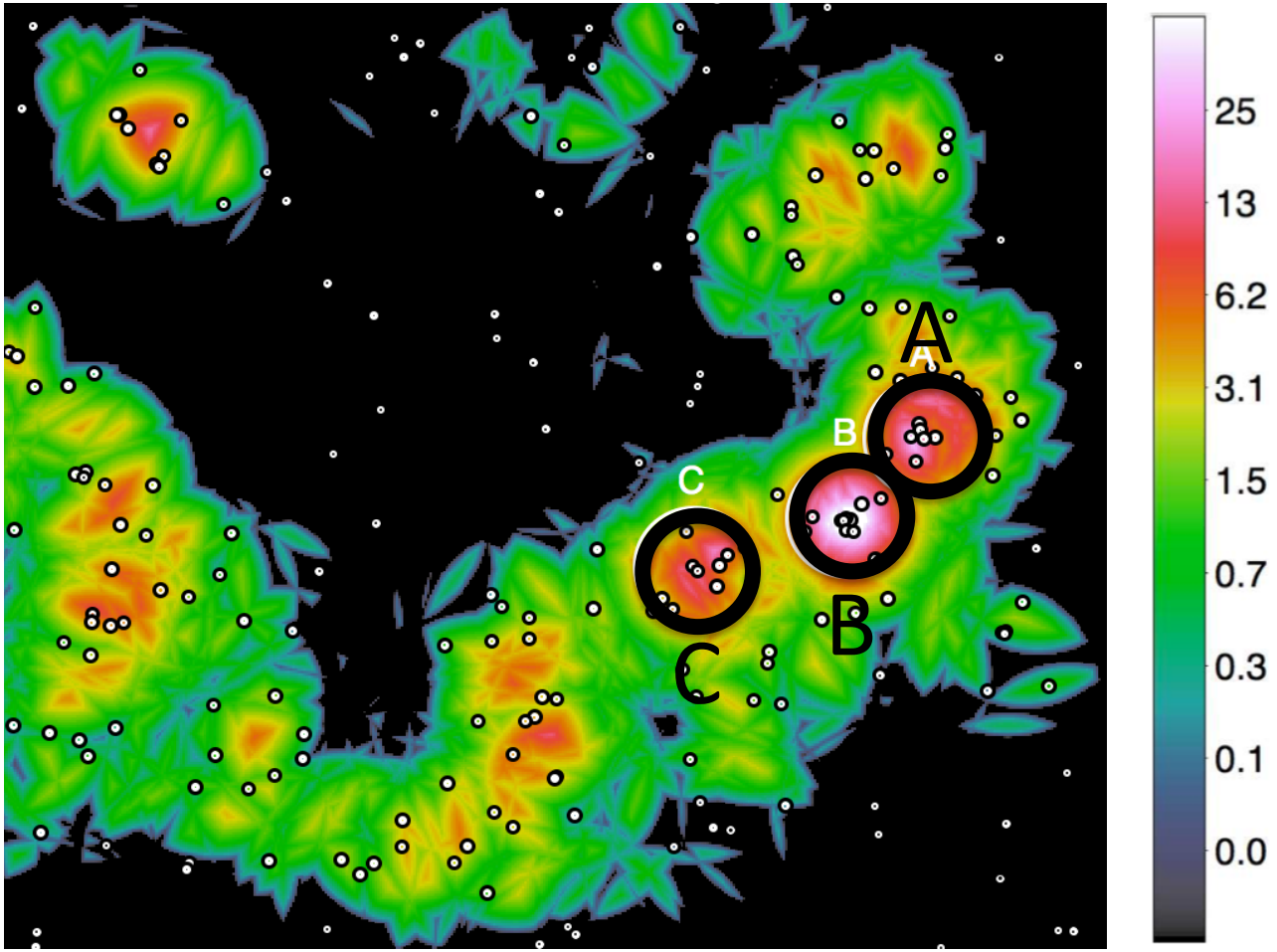


Number of sigmas above the mean 7th nearest neighbor density

Are the overdensities physically related to each other?

With only photo-redshifts cannot tell…

According to analysis of the GiggleZ simulation (G.Poole et al. in prep) 98% of halos with the same spatial and halo mass configuration will merge by z=0 into a cluster of mass M_{halo} ~ 10^14-15 M_{sun}



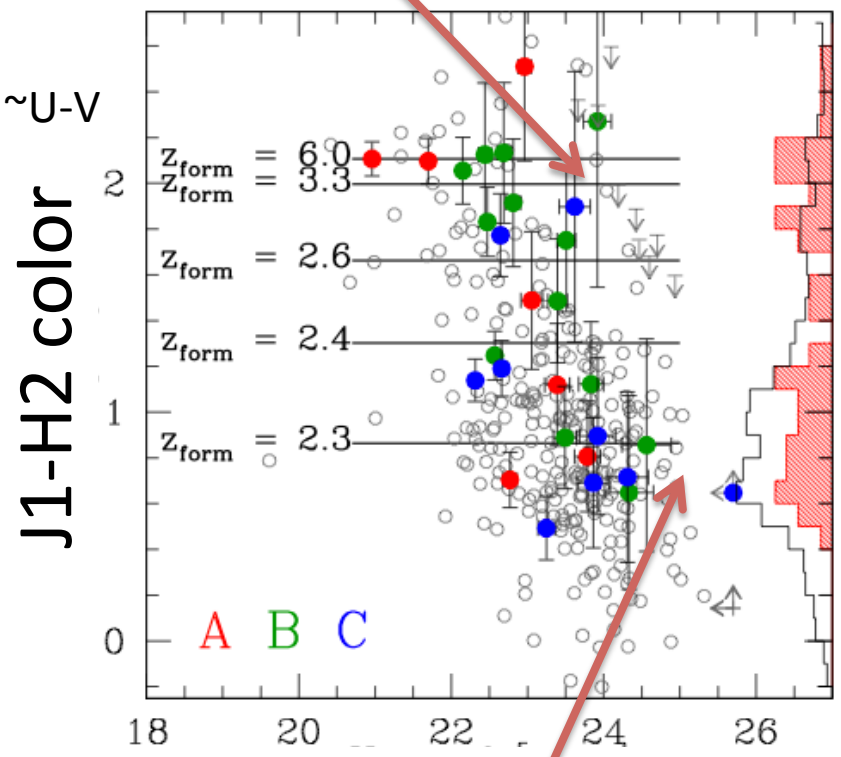
$M^{A}_{halo} \approx 6 \times 10^{13}$, $M^{B}_{halo} \approx 1 \times 10^{13}$, $M^{c}_{halo} \approx 1 \times 10^{13} M_{\odot}$

HOD
Moster et al. 2010

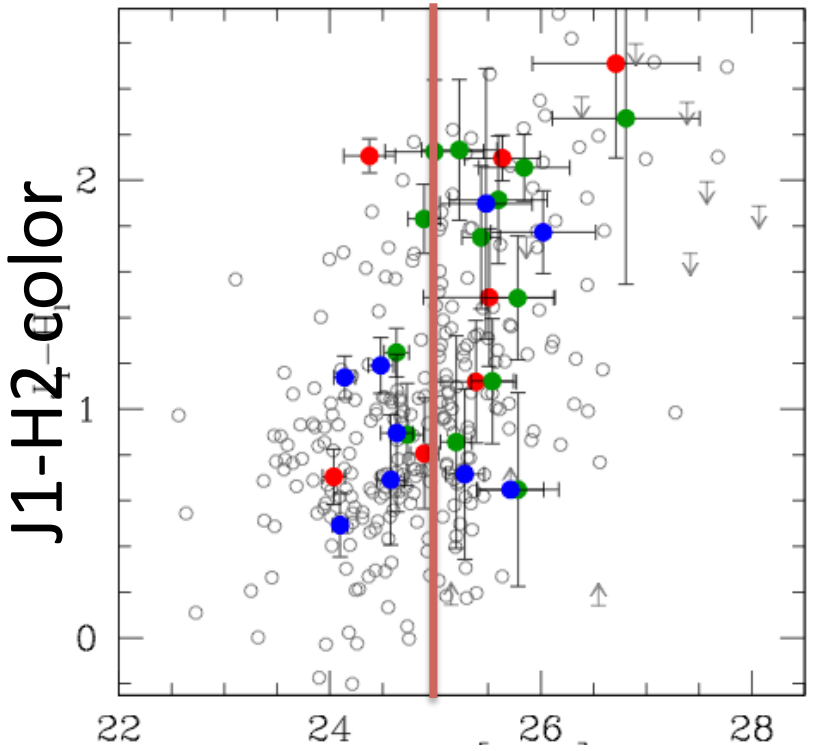
50±20% are red galaxies

$M_{stellar}$ ~ 10^10

.0-2.2 – field population has 20% f_red



Total H2-band mag.

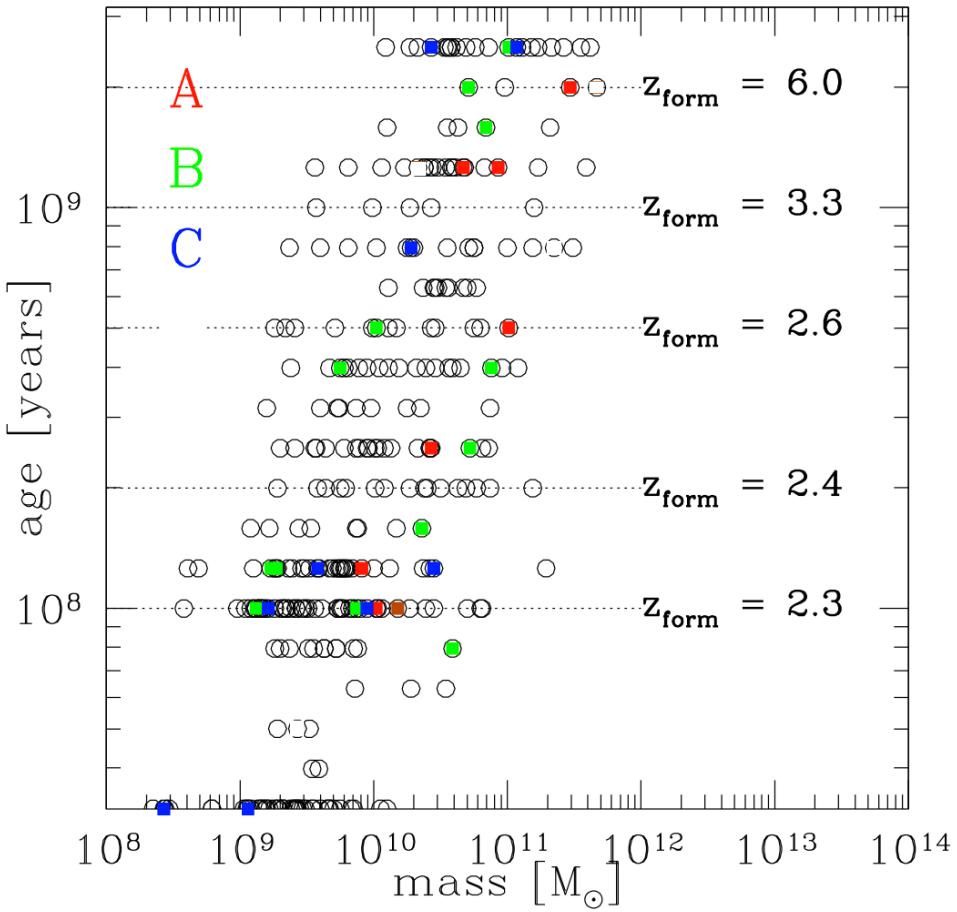


Total i-band mag.

$M_{stellar}$ ~ 10^9

Contains old & massive galaxies

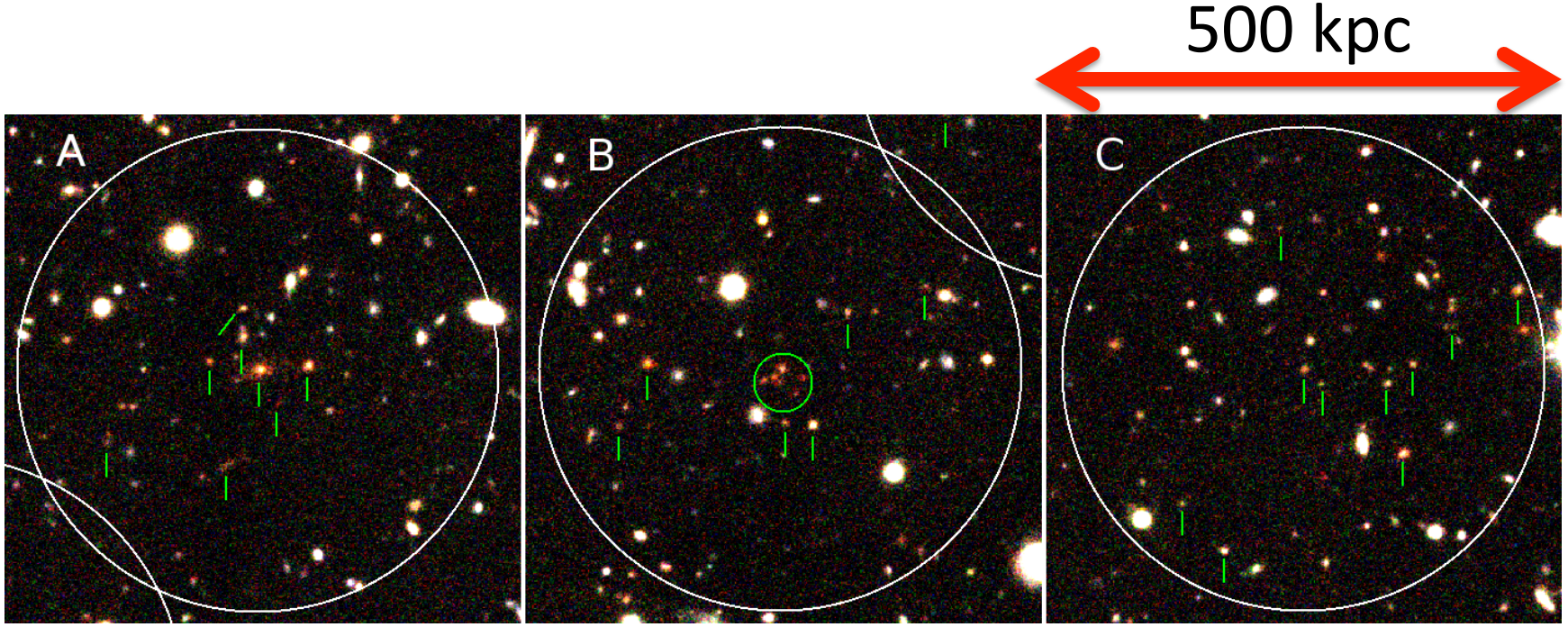
Age



Mass

BC03 fits with FAST
Kriek et al. 2009

Individual overdensity properties



Central galaxy

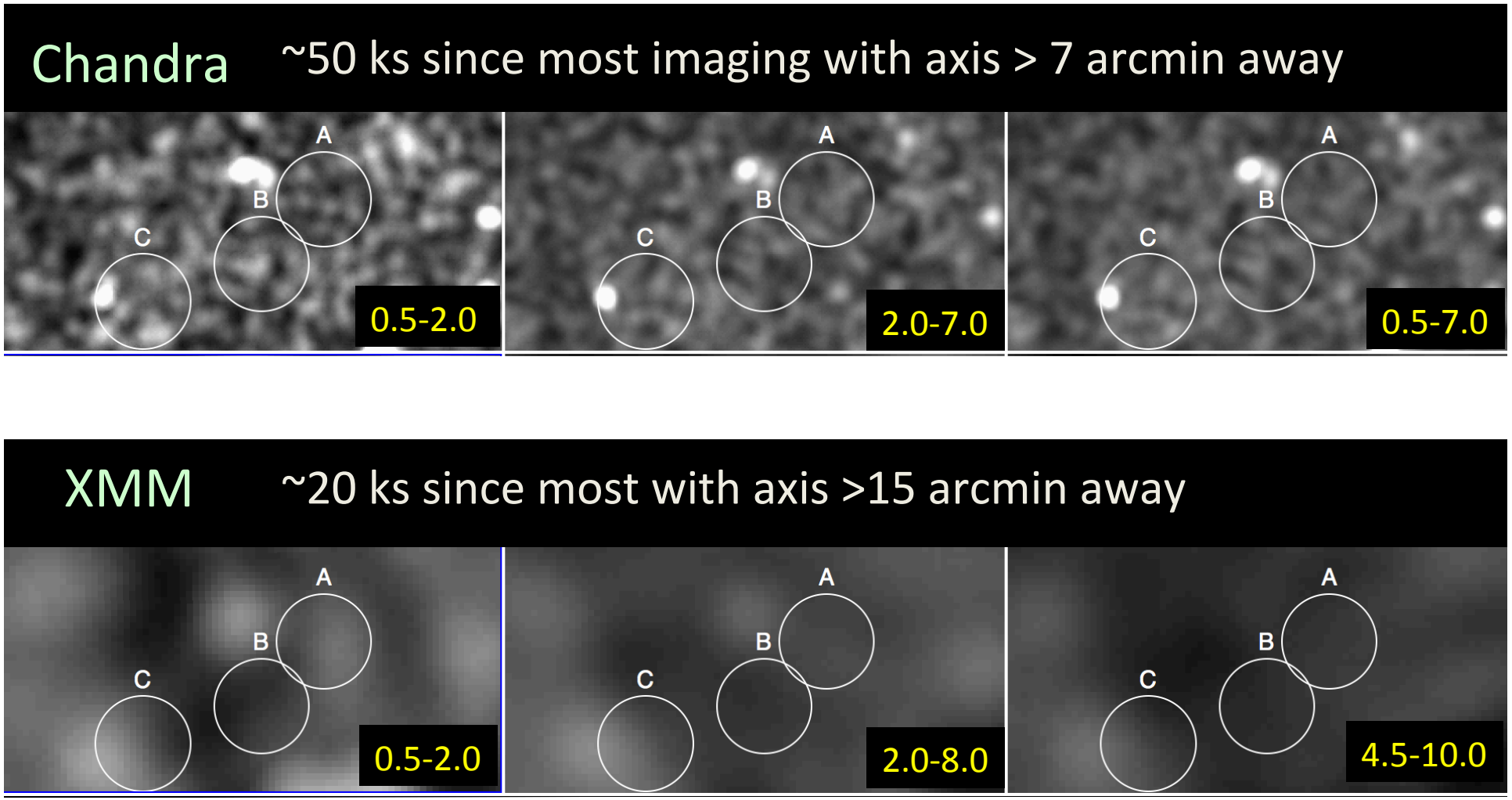
$M_{stellar}$ =3x10^11 =1x10^11 =1x10^11 M_{sun}

Old, extended stellar halo

Old + SF, compact satellites within 30 kpc

Young, star-forming members

X-rays – not enough exposure time

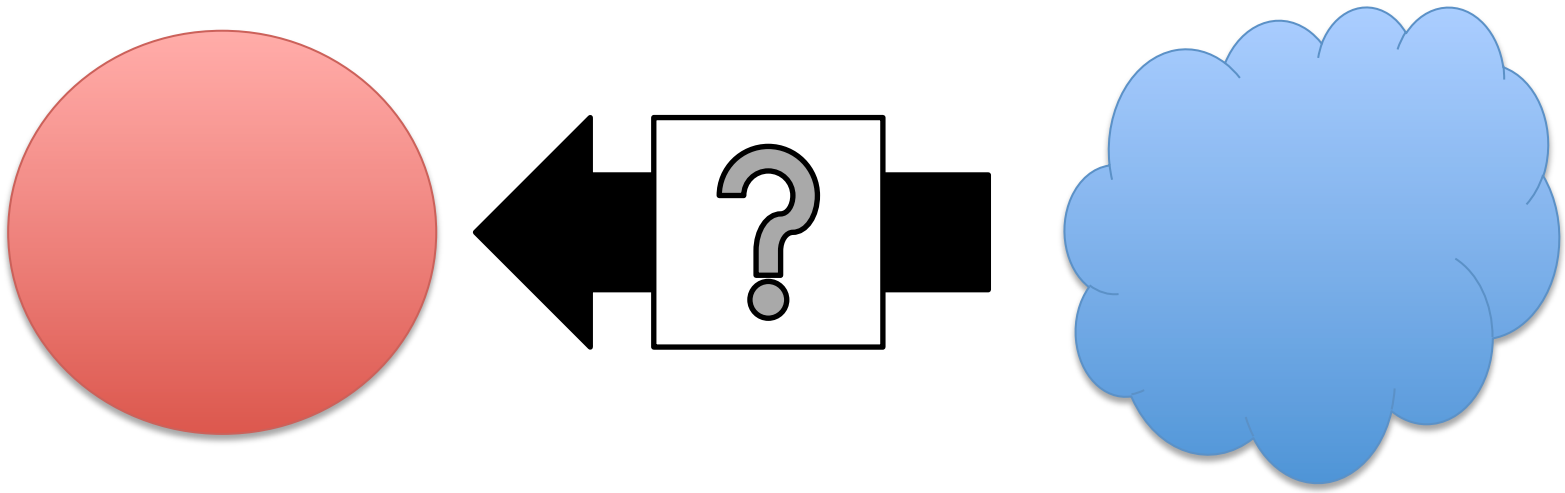


c.f. Gobat et al. 2011 z=2.09 cluster detection with 80 ks XMM & Chandra *on-axis observations*

Summary of properties

- Contains passive galaxies
- ~5 galaxies with M_stellar ~ 10^11
- Population different than the field
- No X-ray detection…
- No strong radio sources
- Spans 1.5 Mpc on the sky
- Multiple galaxy overdensities each ~500 kpc

What is this structure?



Summary

- Discovery of an interesting structure at z=2.1 ***in the middle*** of COSMOS legacy field
- Found with **Z-FOURGE** medium-band filters
- Half red galaxies – some dusty, most dominated by old stellar populations – also massive galaxies
- Few spectroscopic redshifts confirm z=2.1 – more needed
- Not enough X-ray data – more required
- May fall into the growing 'zoo' of structures between classical cluster & classical protoclusters

a transitional structure?

http://z-fourge.strw.leidenuniv.nl/