Star forming galaxies at high redshift

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Outline

- Introduction
- SMGs, LAEs and BzKs
- Correlation function
- Excess of galaxy count
- Conclusion

BUTTOM UP

Small galaxies

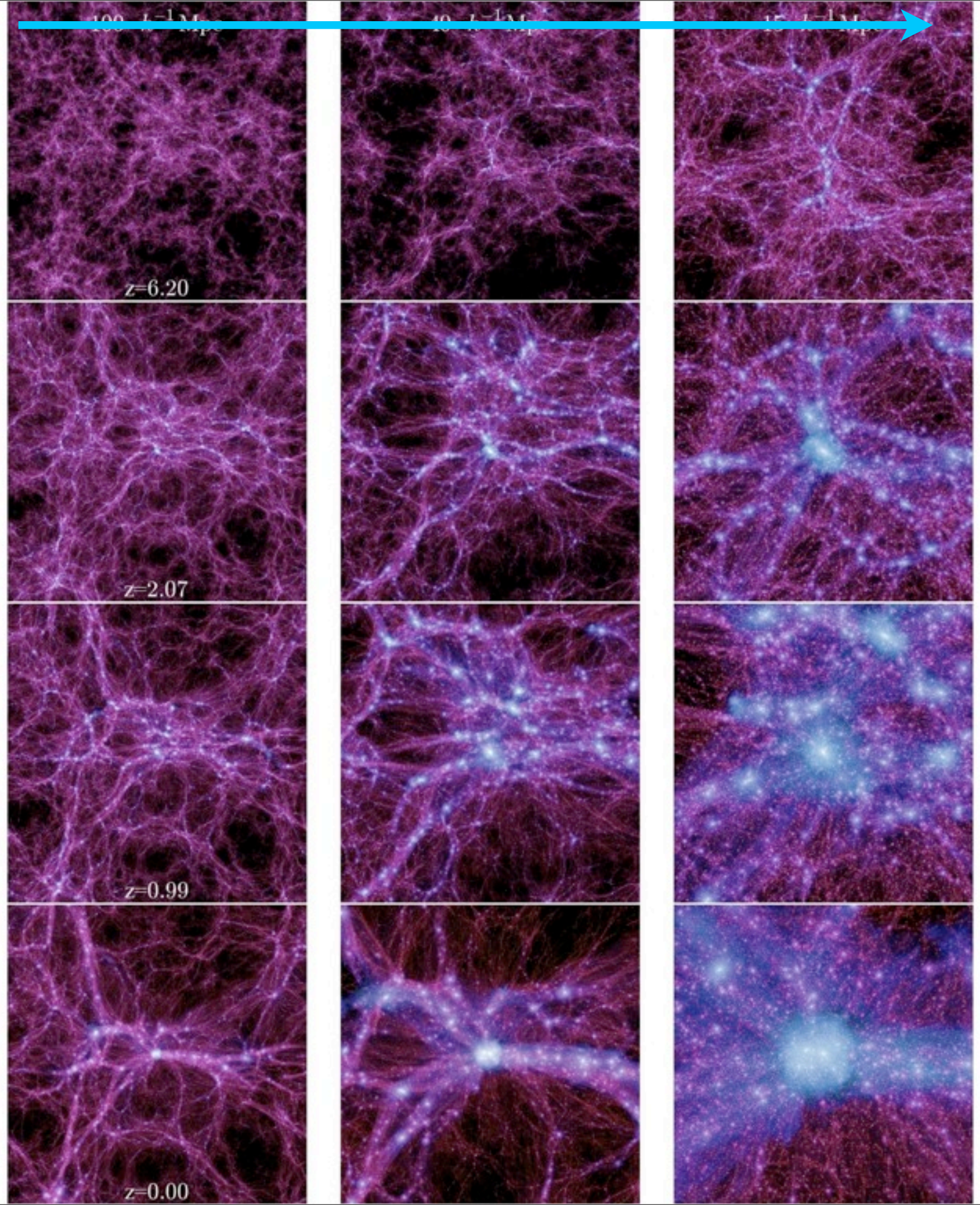
by merging

Big galaxy

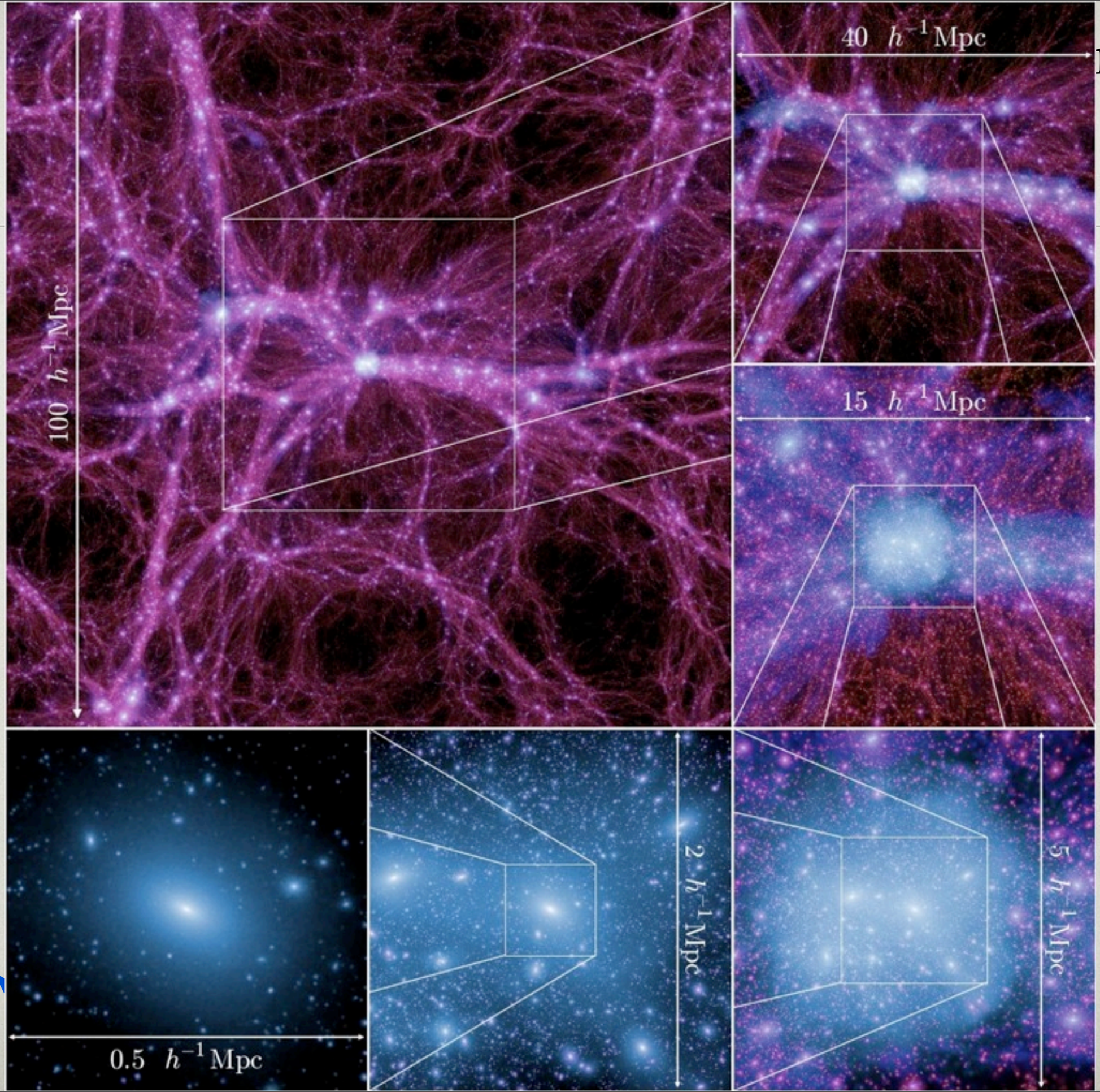
Hierarchical Universe

Zone in

Time



Time



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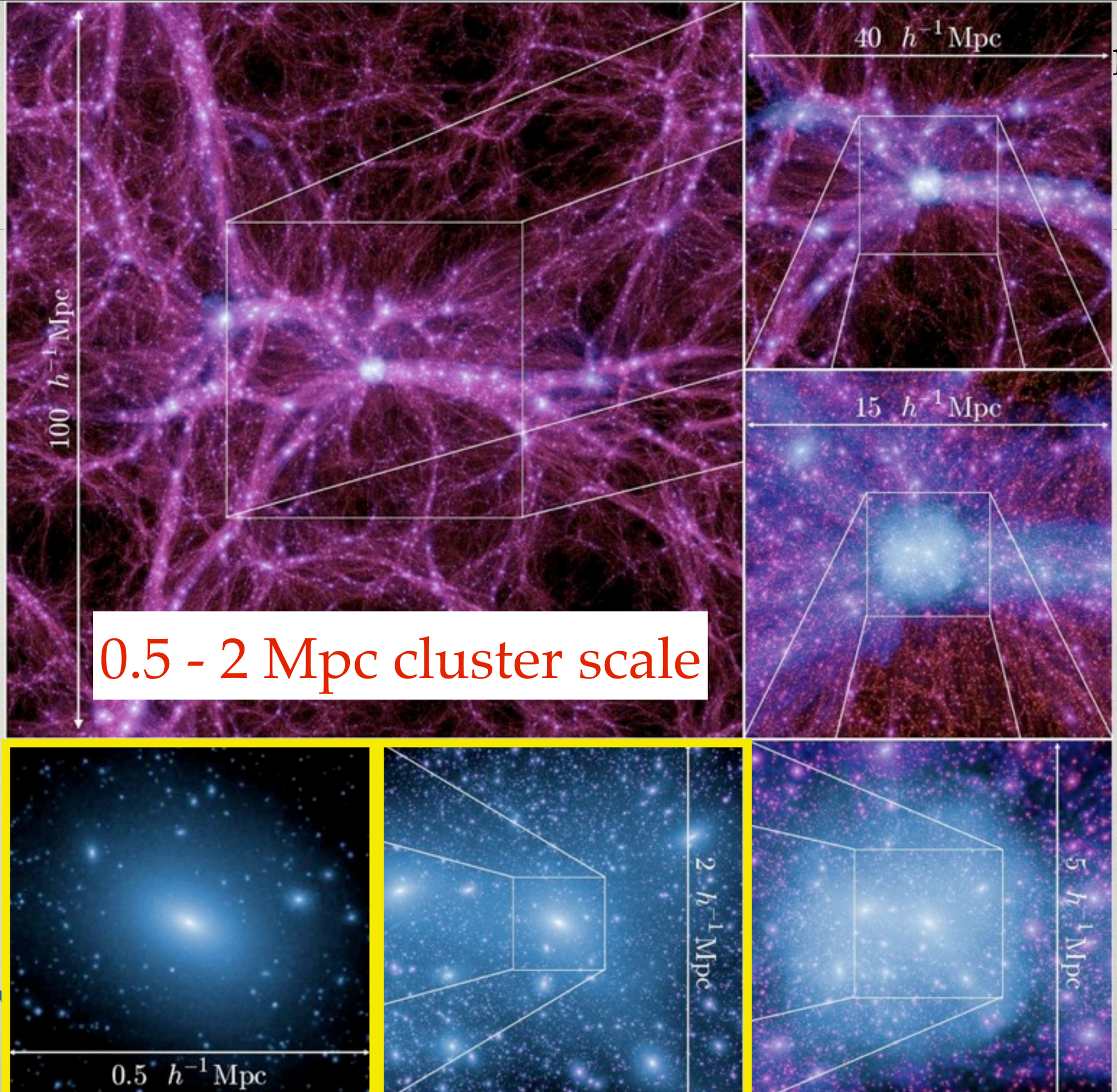
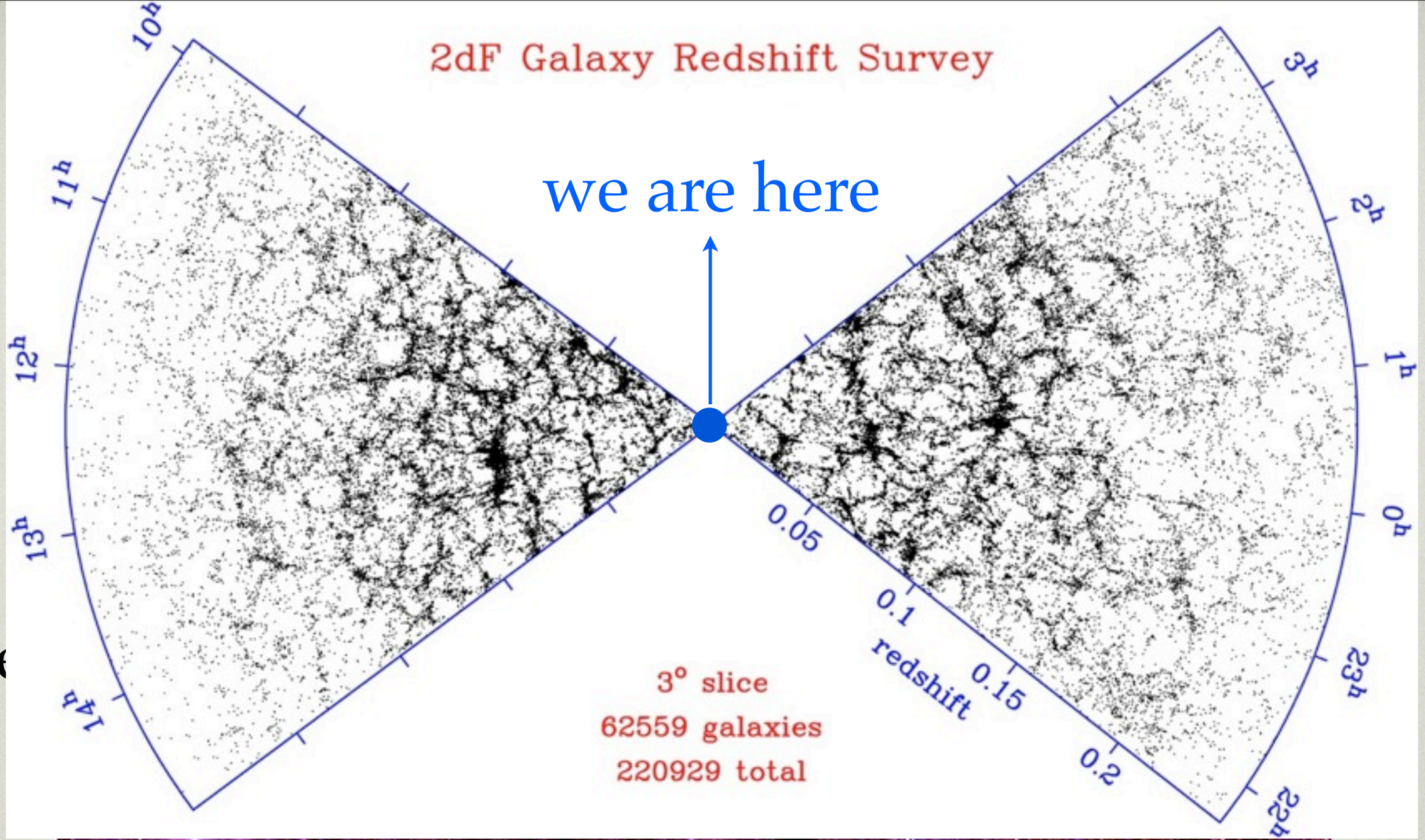
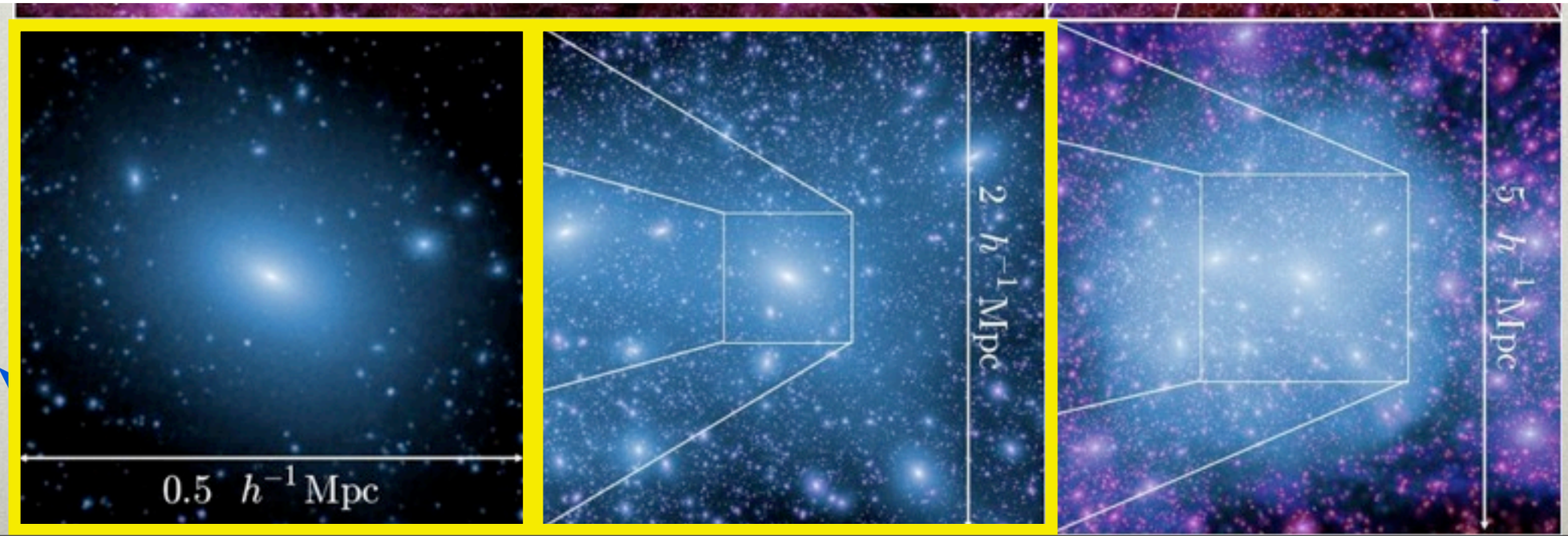
Time



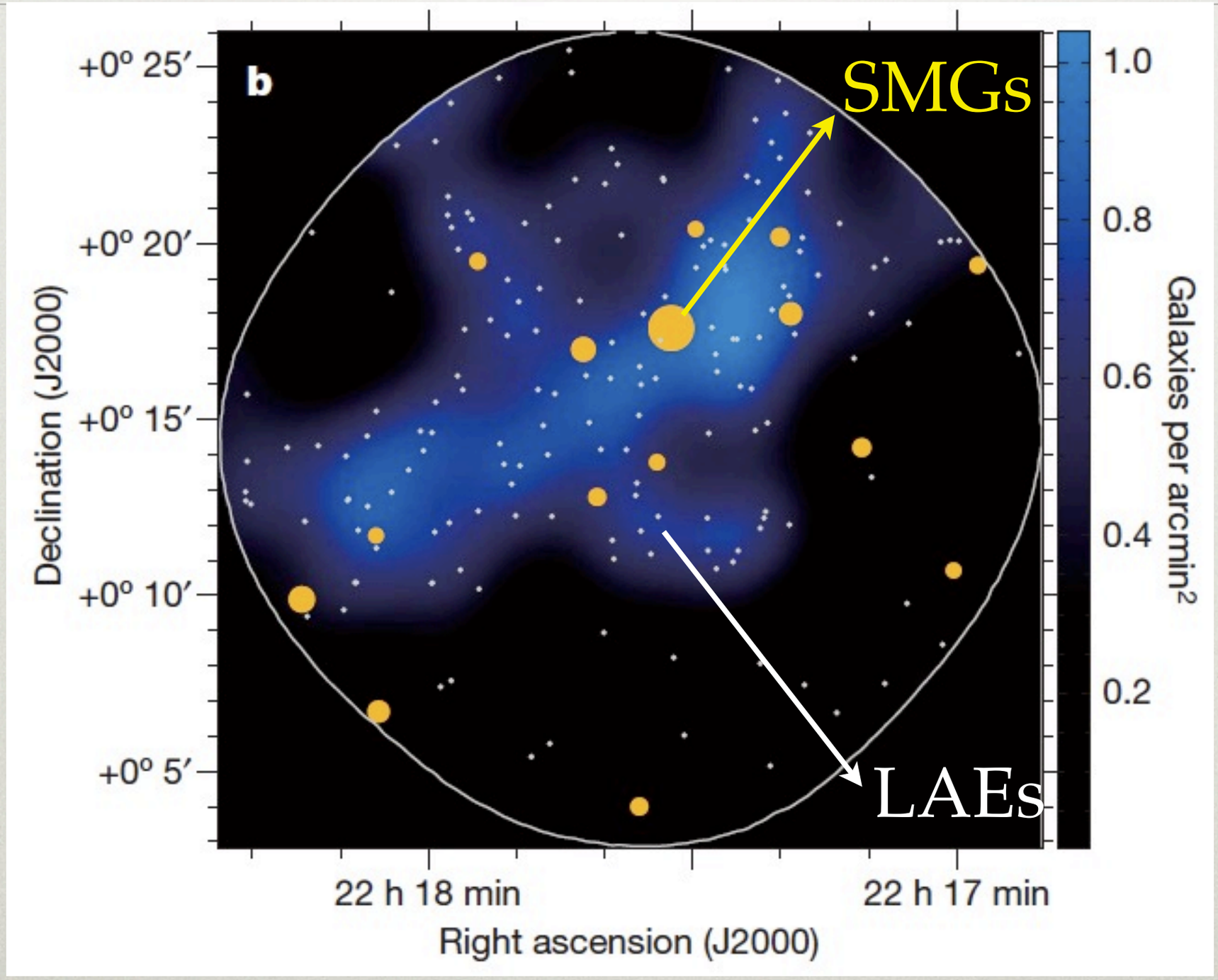
0.5 - 2 Mpc cluster scale

Time

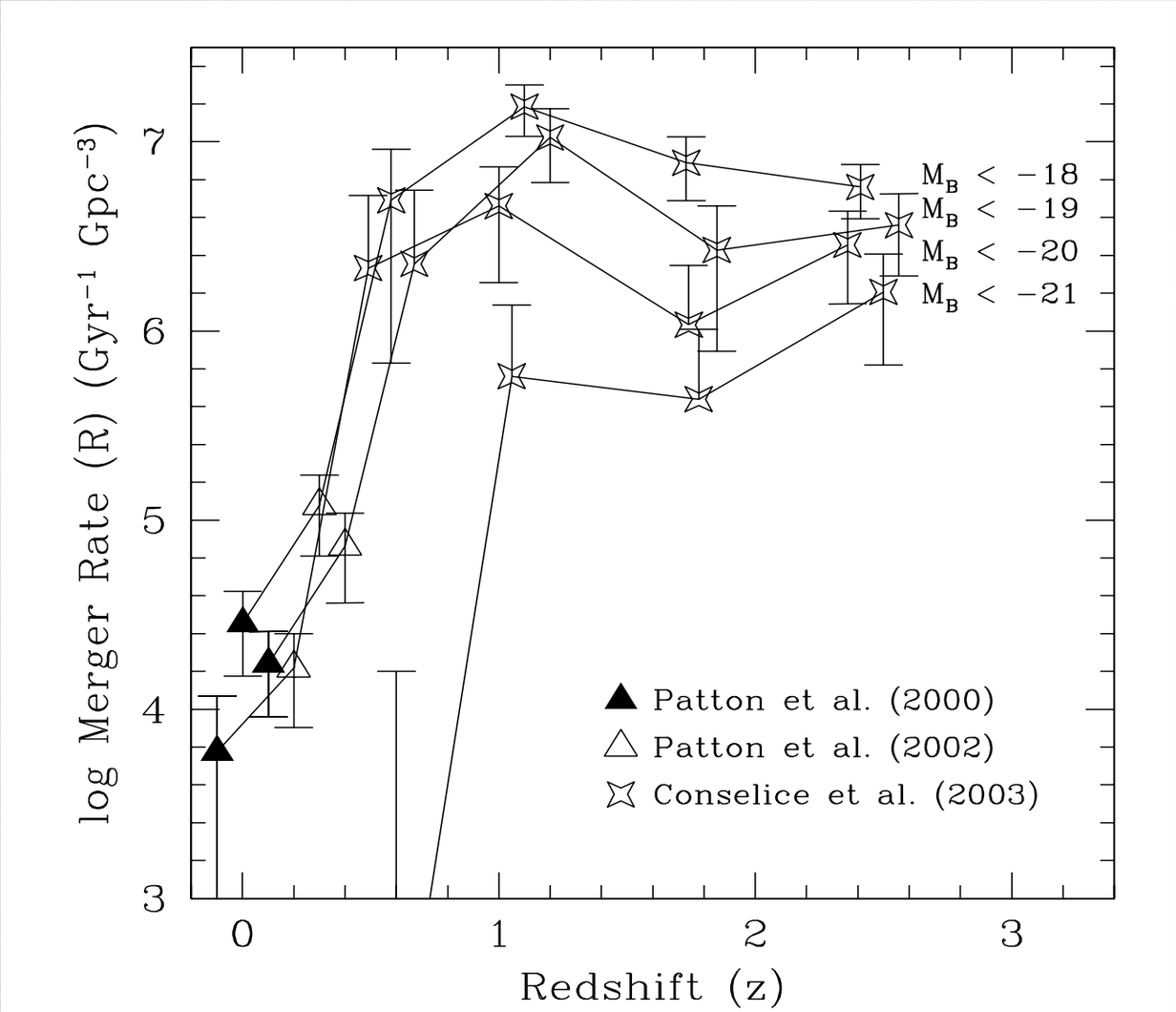

2dF Galaxy Redshift Survey
we are here
3° slice
62559 galaxies
220929 total
redshift
0.05
0.1
0.15
0.2
10h
11h
12h
13h
14h
3h
2h
1h
0h
23h
22h


0.5 h^{-1} Mpc
2 h^{-1} Mpc
5 h^{-1} Mpc

SSA22, a structure at high z



Tamura et al. 2009



Conselice 2006

- High merger rate at high-z
- Studying connection between different types of high-z galaxies.

DATA

- Combined SMGs and LAEs observations in two fields.
- Selected BzKs from optical galaxy survey catalogs.

	SMG[a]	LAE[b]	BzK[c]	
			Passive	Star forming
COSMOS[d]	189; AzTEC	187; $z \sim 2.3$	720	25942
ECDFS[d]	126; LABOCA	160; $z \sim 3.1$	112	776
GOODSS	47; AzTEC			

- a: AzTEC 1100 μm survey in COSMOS (Aretxaga et al. 2011) and GOODSS (Scott et al. 2010); LABOCA 870 μm survey in ECDFS (Weiß et al. 2009).
- b: $z \sim 2.3$ in COSMOS (Nilsson et al. 2009); $z \sim 2.3$ in ECDFS (Gronwall et al. 2007).
- c: this work (based on the criteria in Daddi et al. 2004)
- d: Galaxy catalogs of COSMOS (Ilbert et al. 2009) and MUSYC (Cardamone et al. 2010).

Galaxy classification

- brightness, mass, morphology, wavelength
- Selection methods → different properties
- Star forming galaxies
  - Submillimeter galaxies (SMGs)
  - Lyman alpha emitters (LAEs)
- BzKs
- Optical galaxies with rough redshift estimate.

SMGs

- Massive, intense dust-obscured.
- Large redshift uncertainty.
- SFR ≳ $10^{2\text{-}3}$ $M_\odot$ yr^{-1}

  (Blain et al 2002)

LAEs

- Young, less massive, dust free.
- Relatively precise redshift

  (Nilsson 2009)

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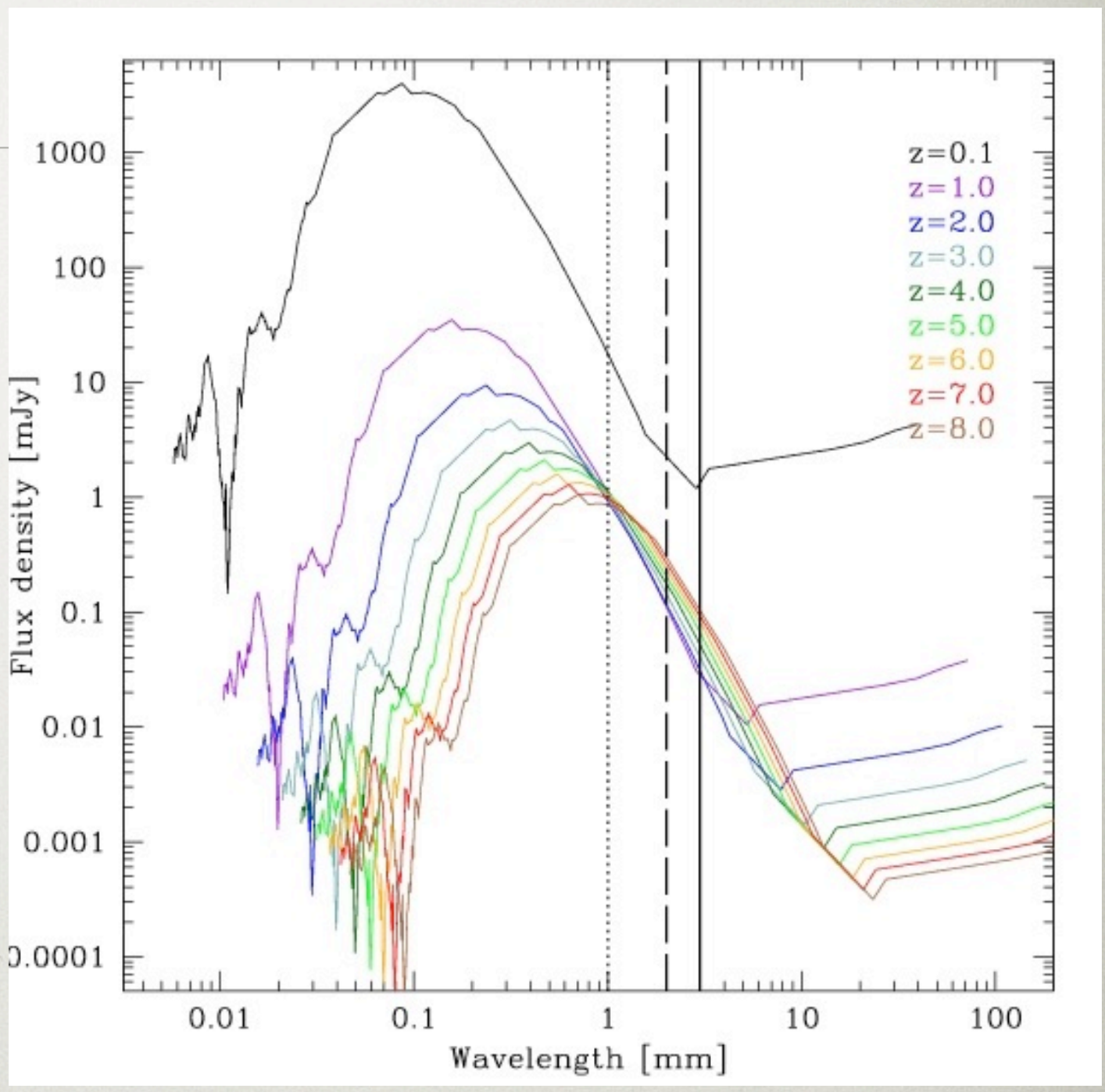

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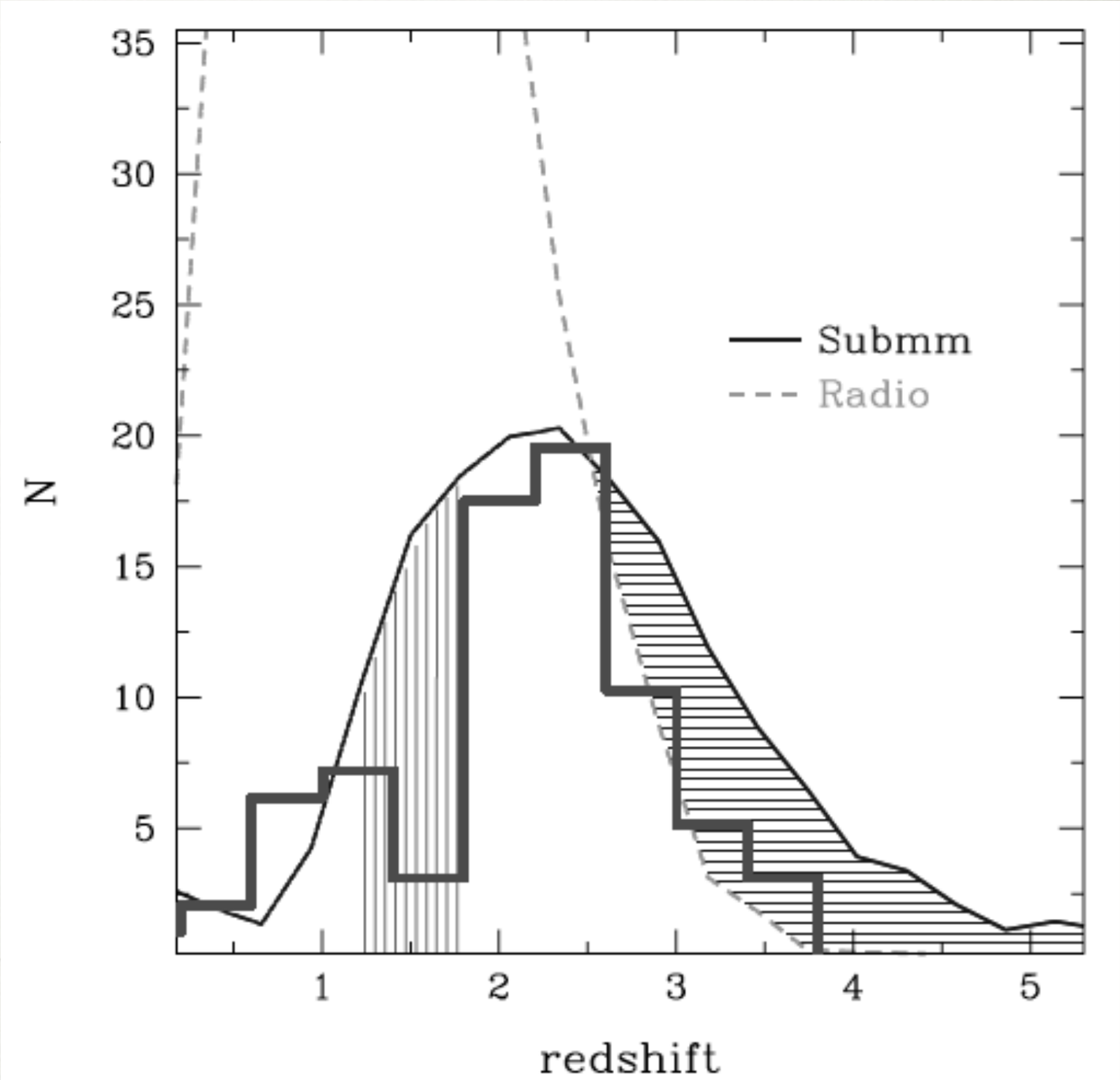
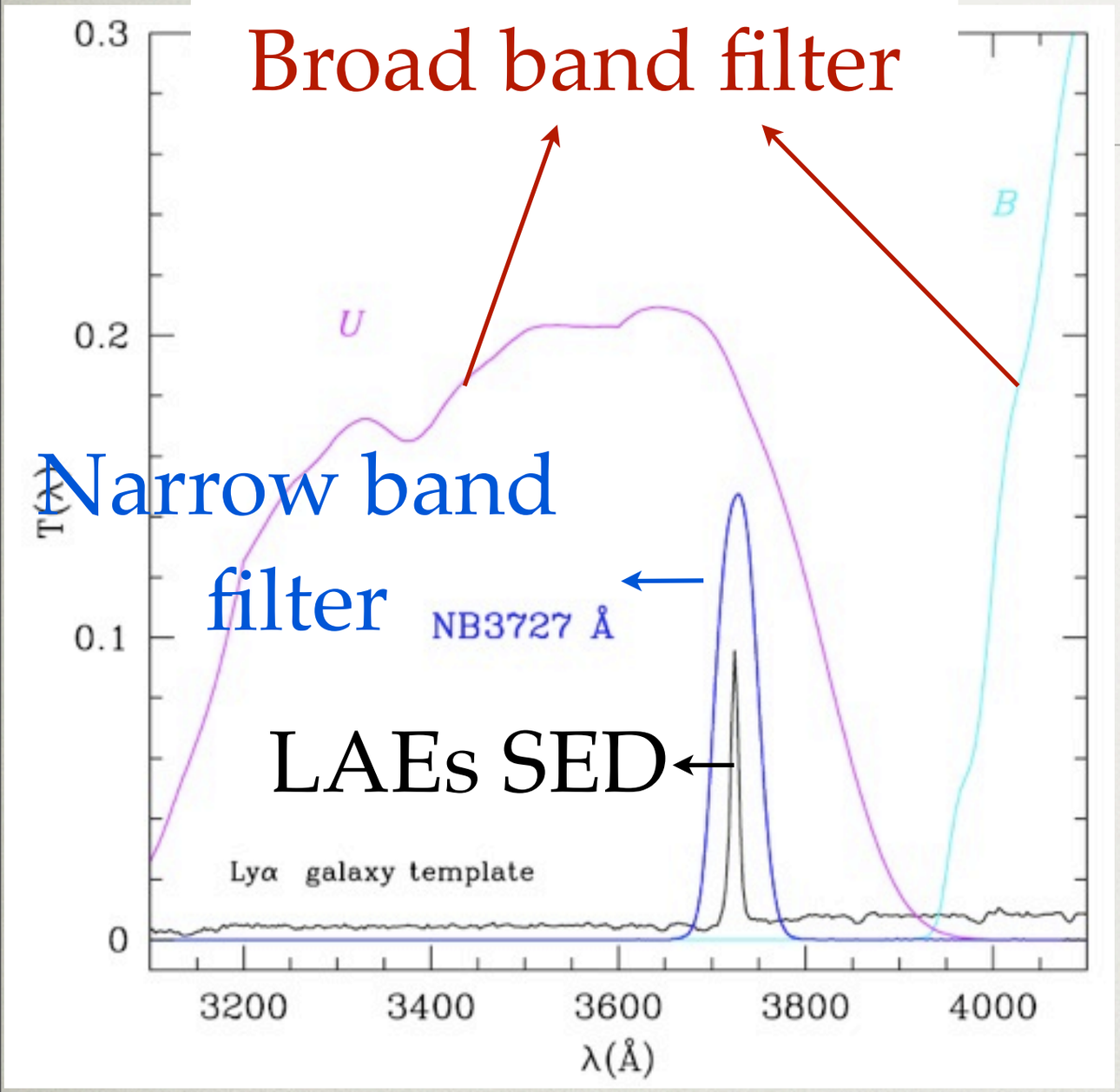


Chapman et al. 2005

LAEs



Guaita et al. 2010

- Young, less massive, dust free.
- Relatively precise redshift

(Nilsson 2009)

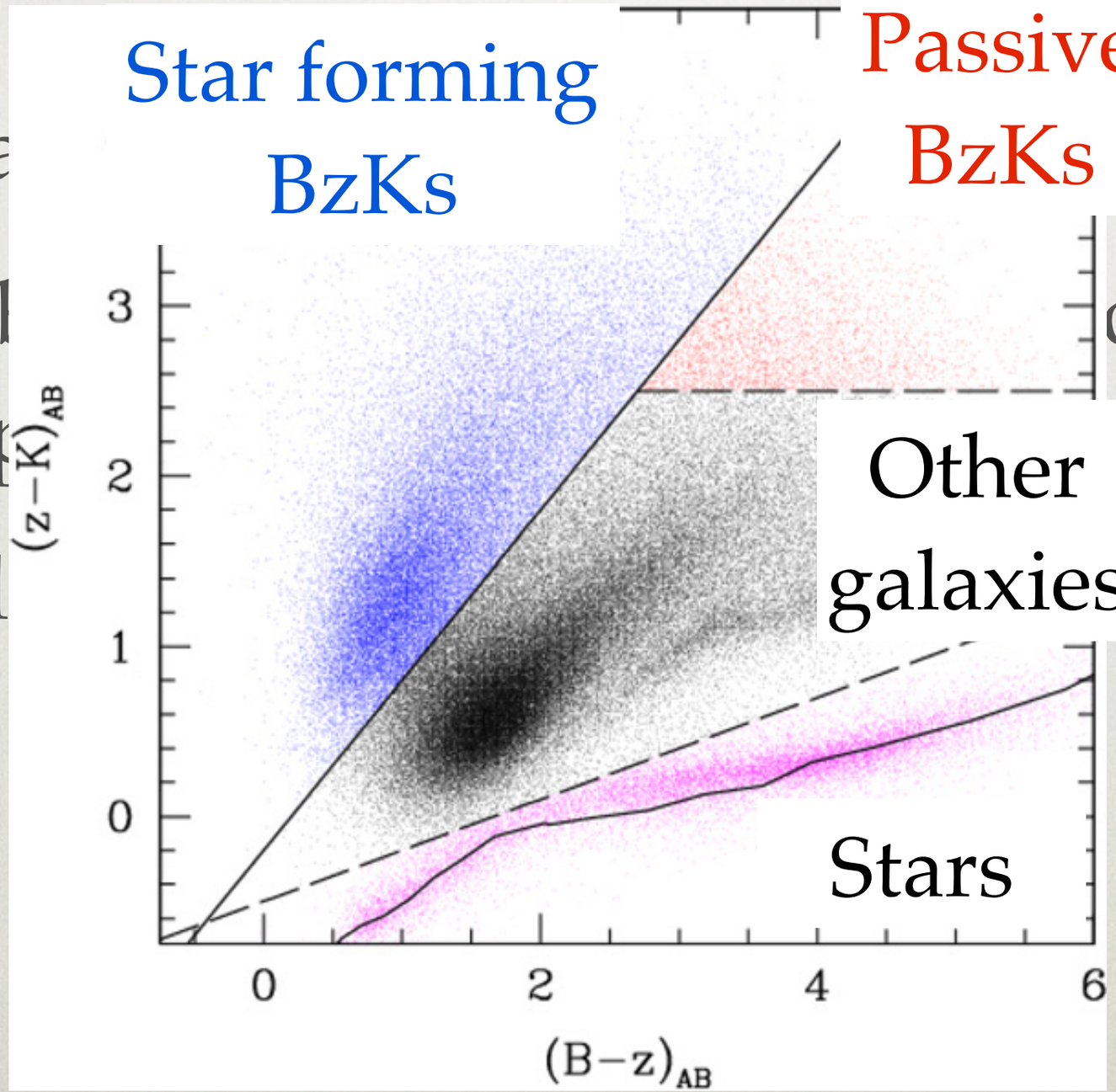
BzKs

- Stellar mass ~$10^{11}M_{\odot}$ at $1.4 \lesssim z \lesssim 2.5$
- Can be further classified as star-forming and passive galaxies

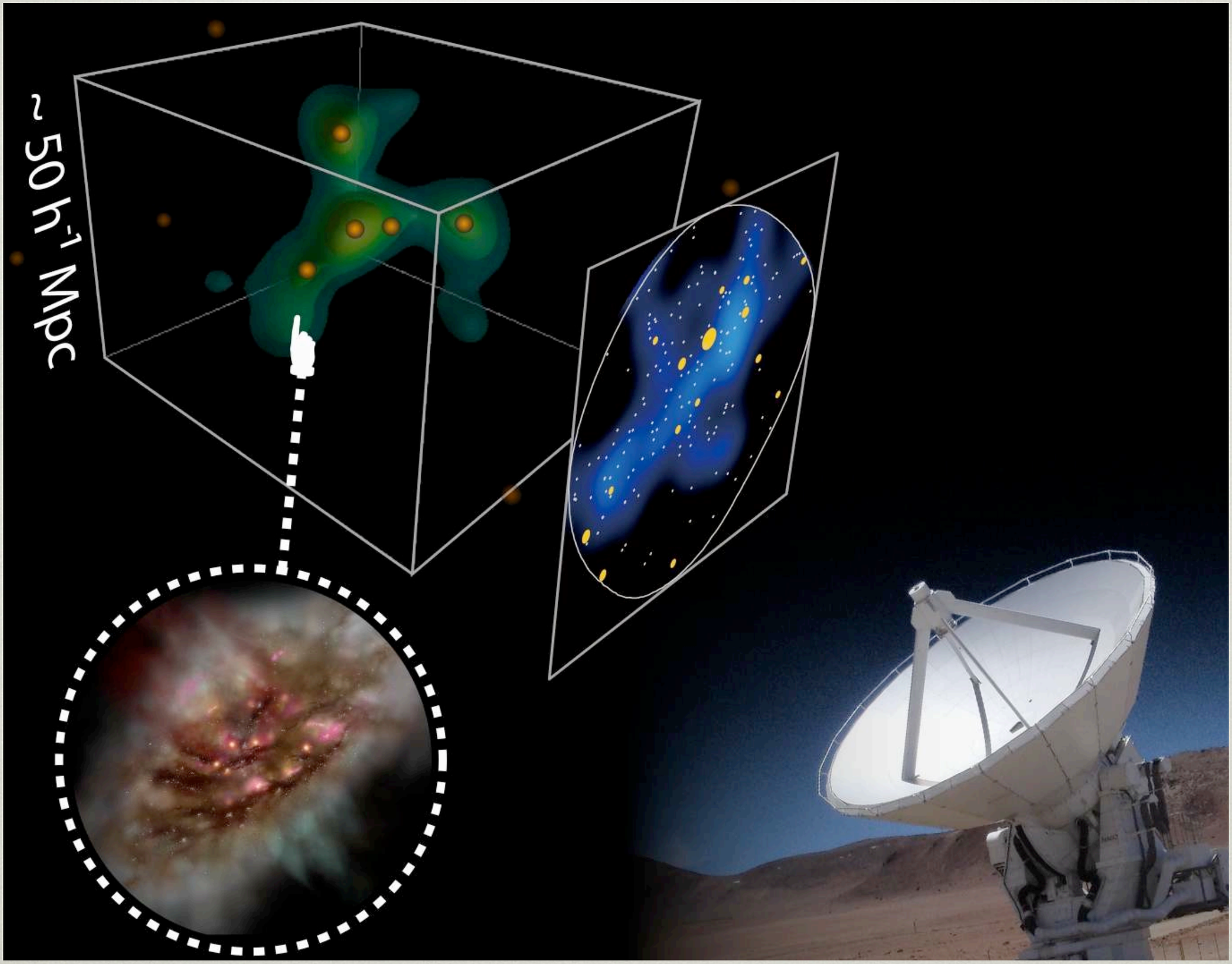
(Daddi et al. 2004).

BzKs

- Stella .5
- Can l orming and p
(Dad



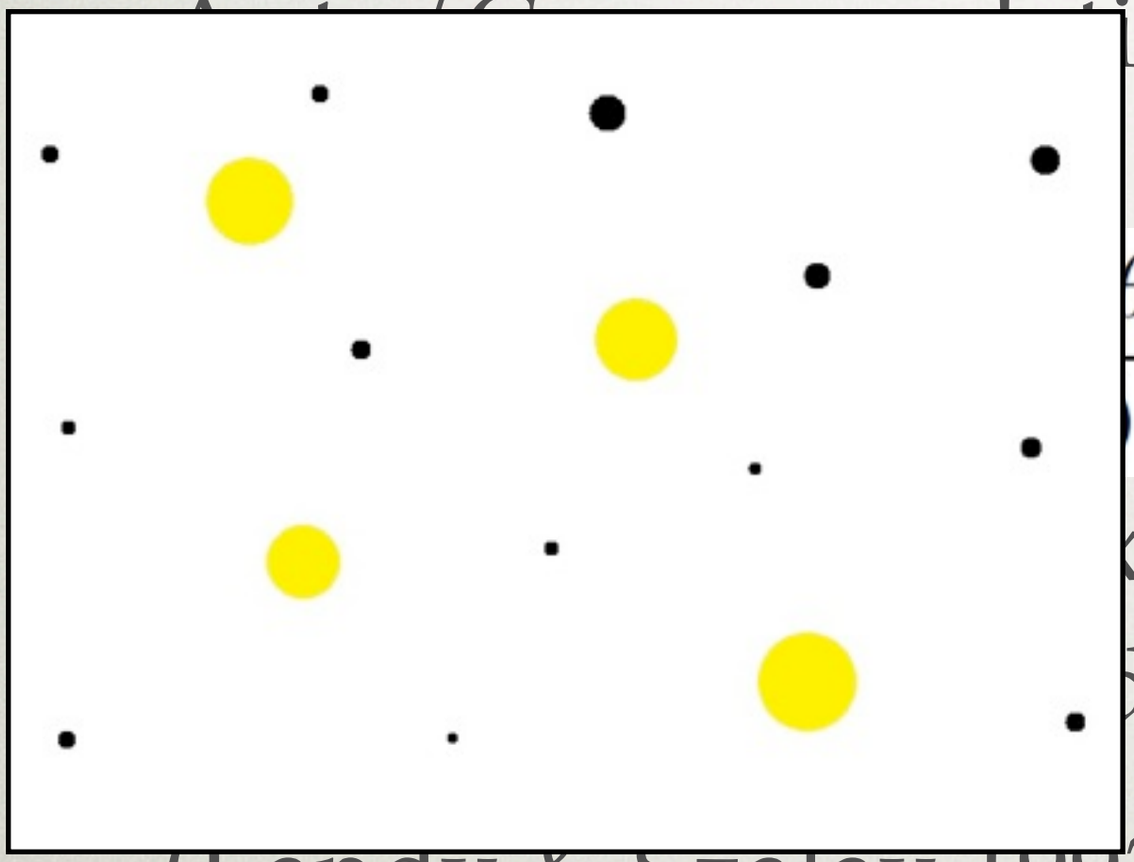
McCracken 2010

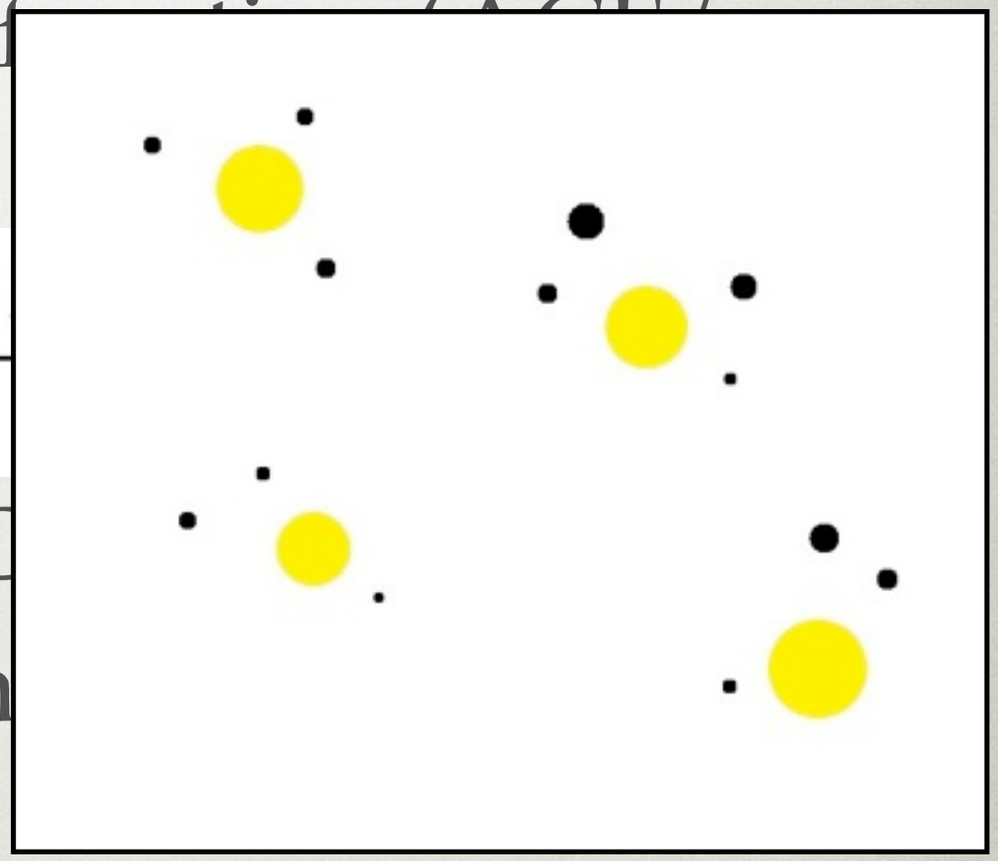


Tamura et al. 2009

Correlation function

Auto/Cross-correlation function (ACF/





(Landy & Szalay 1993)

Correlation function

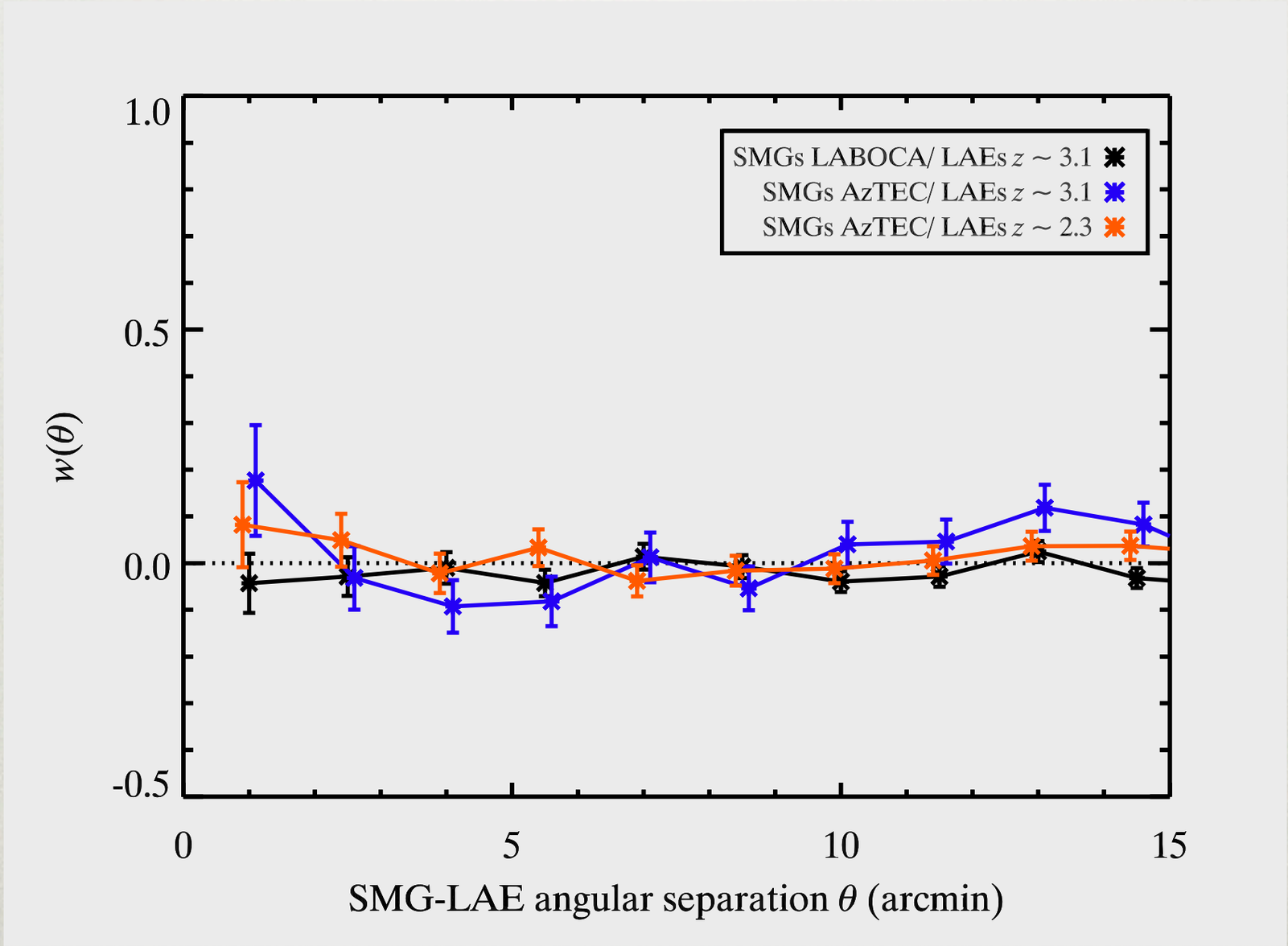
- Auto/Cross correlation function (ACF/CCF)

$$w(\theta) = \frac{DD(\theta) - 2\ DR(\theta) + RR(\theta)}{RR(\theta)}$$

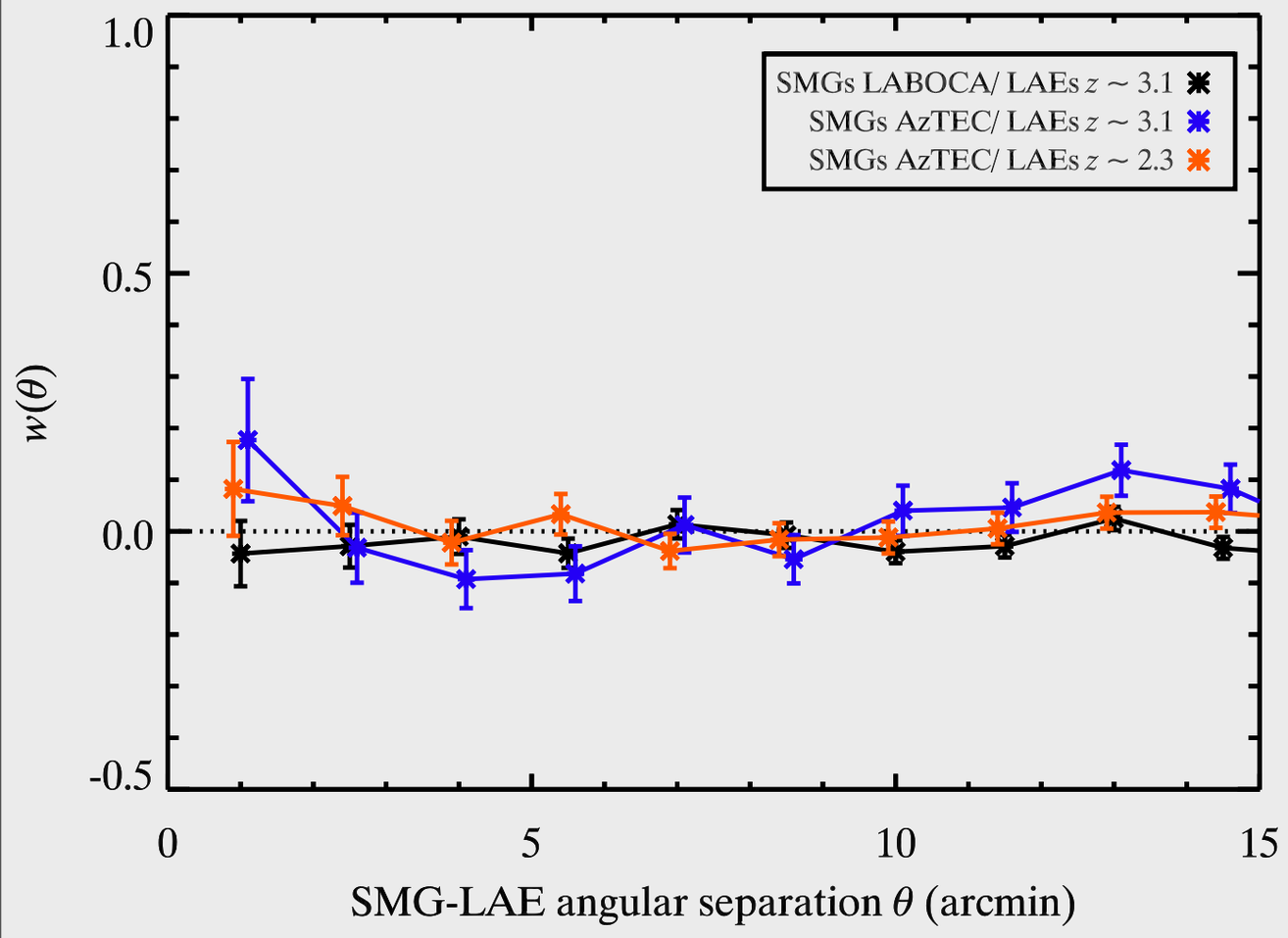
- DD(θ) : galaxy–galaxy; DR(θ) : galaxy–random; RR(θ) : random–random

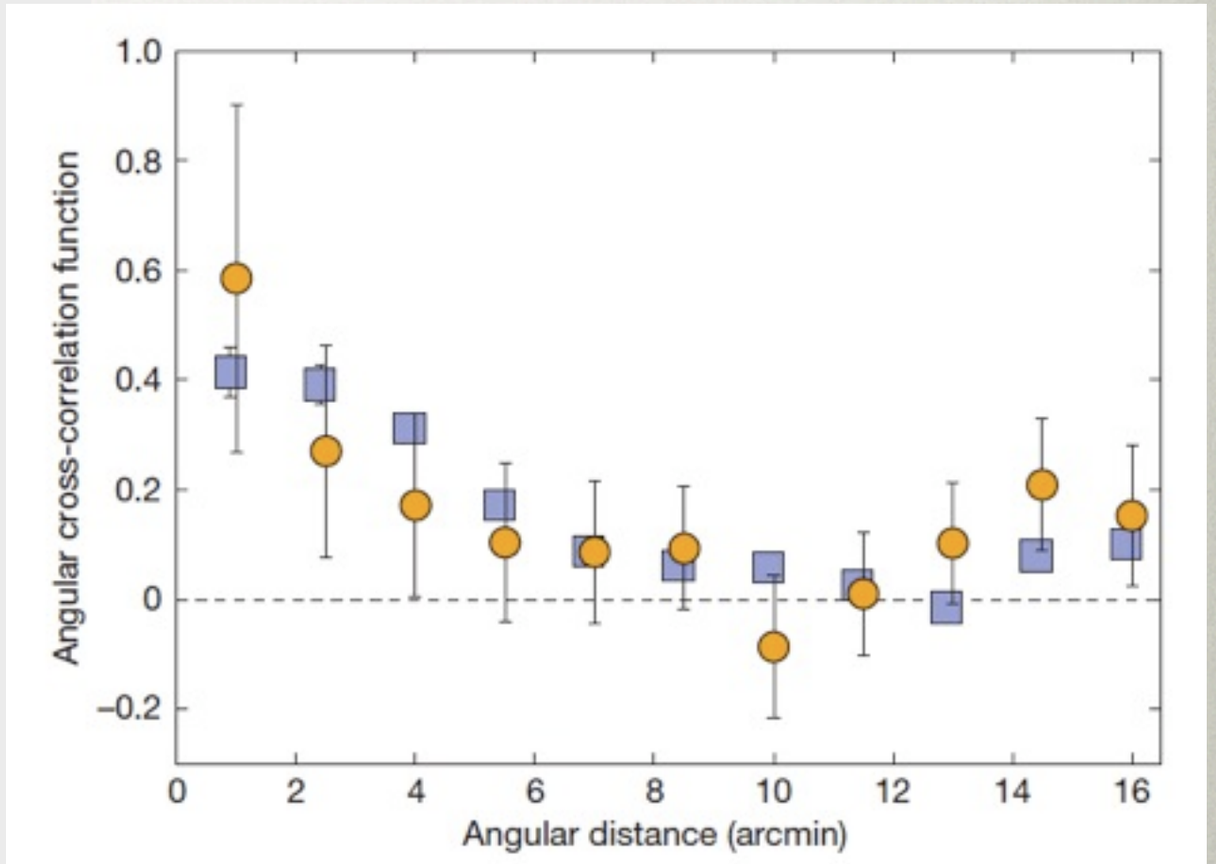
  (Landy & Szalay 1993)

- CCF between LAEs and SMGs



- SSA22 field





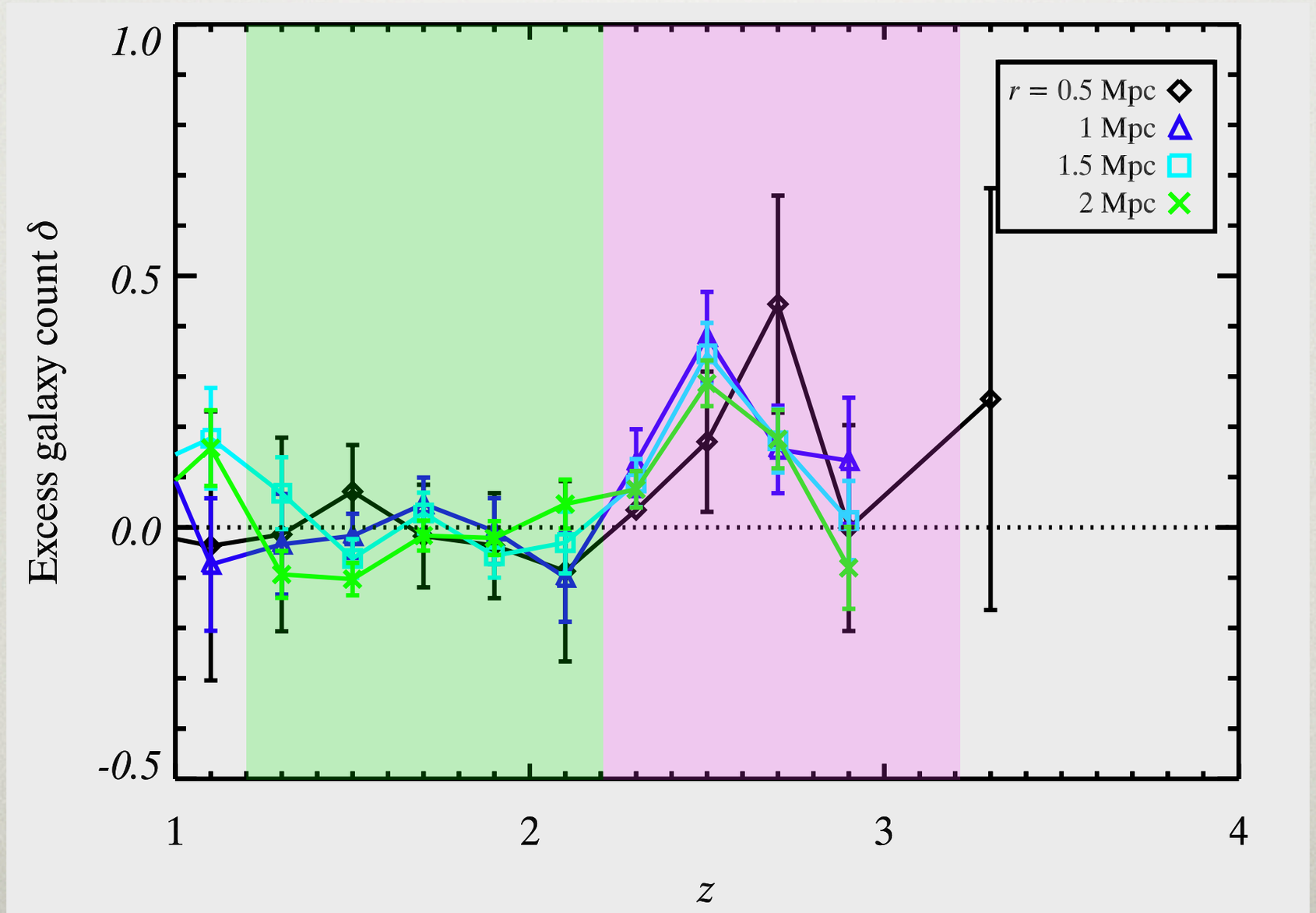
Tamura et al. 2009

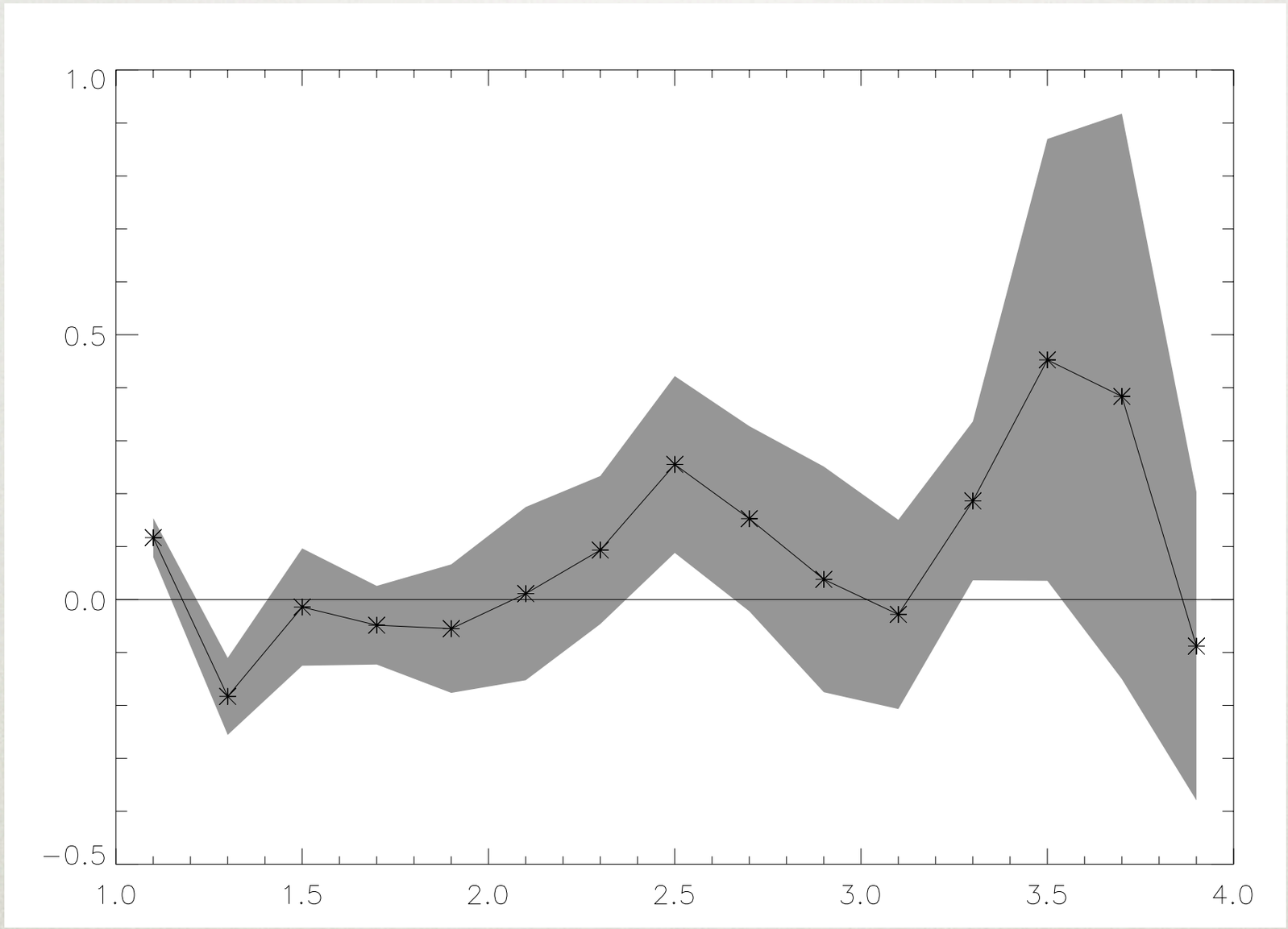
Excess of galaxy count

- $\delta n / n$
- Radii from 0.5 to 2 Mpc (assume SMGs $z = 2$)

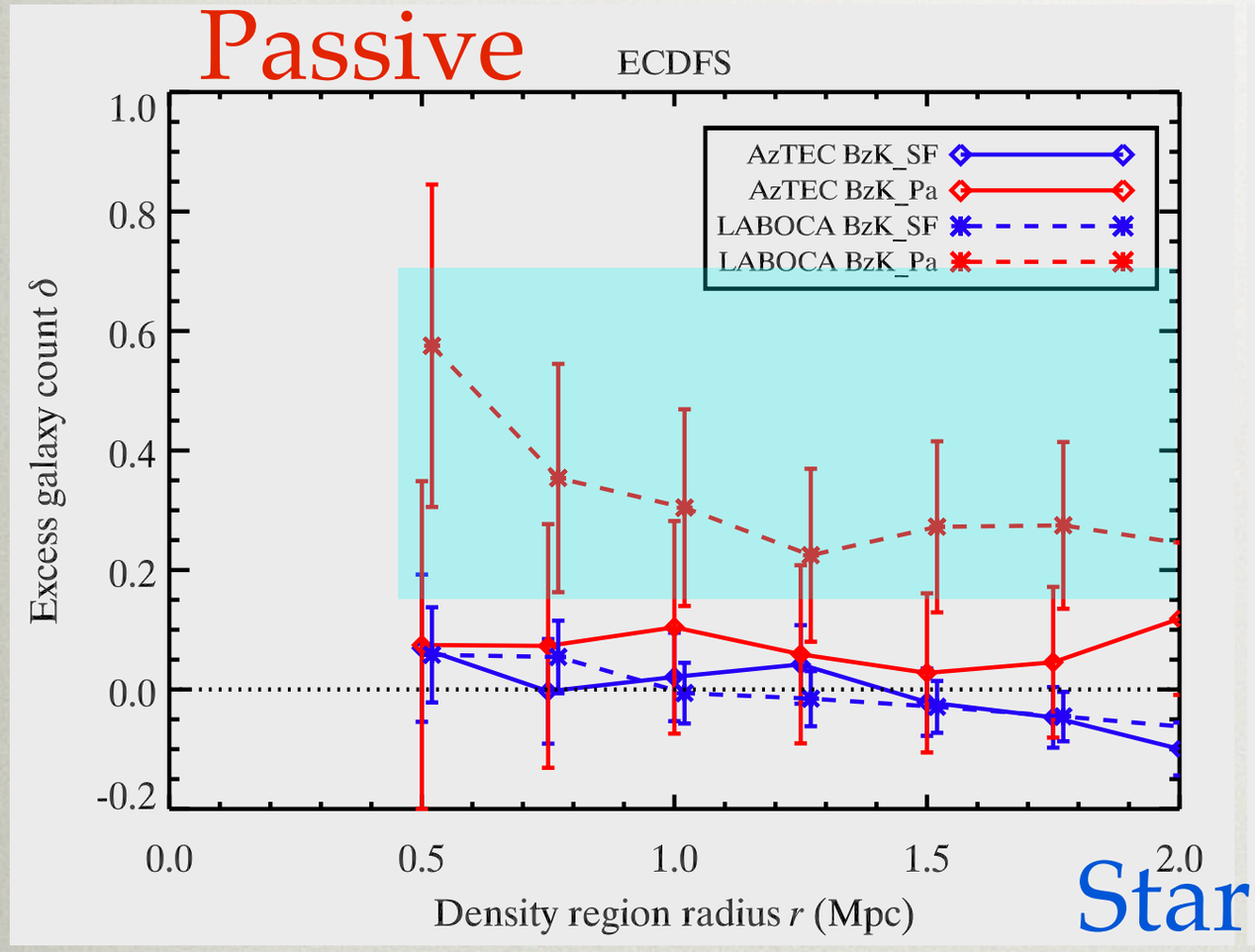
- SMGs with photo-z

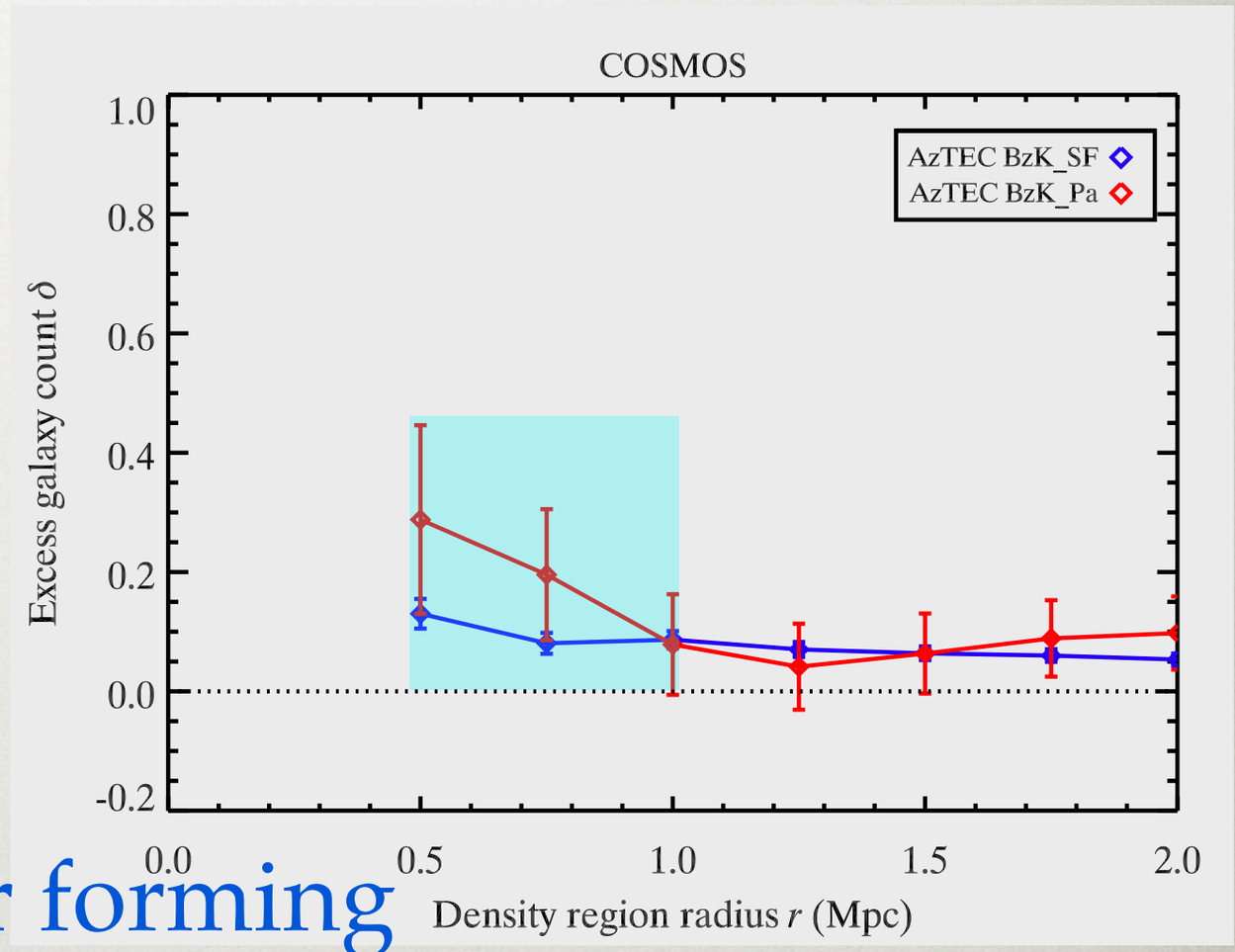
  Part of SMGs have photo-z estimate (Wardlow 2011) → eliminated foreground and background contamination.




1.0
0.5
0.0
−0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0

- Excess in BzKs count around SMGs





Star forming

Conclusion

- No detectable SMG-LAE cross-correlation signal in our selected fields.

  → more general SMG-LAE relation

  → signal is diluted by projected sources ?

- SMGs tend to be found in relatively dense regions at $z > 2$.

  → consistent with the expected merger scenario of SMG origins

- Passive galaxies may have higher probability around SMGs.

Thank you