

# How Isolated are Low Surface Brightness Galaxies? News From SDSS

---

Gaspar Galaz

Pontificia Universidad Católica de Chile

Rodrigo Herera (PUC)

Diego García Lambas (IATE)

Laura Ceccarelli (IATE)

Nelson Padilla (PUC)

# How Isolated are Low Surface Brightness Galaxies? News From SDSS

---

**Rodrigo Herrera Camus**

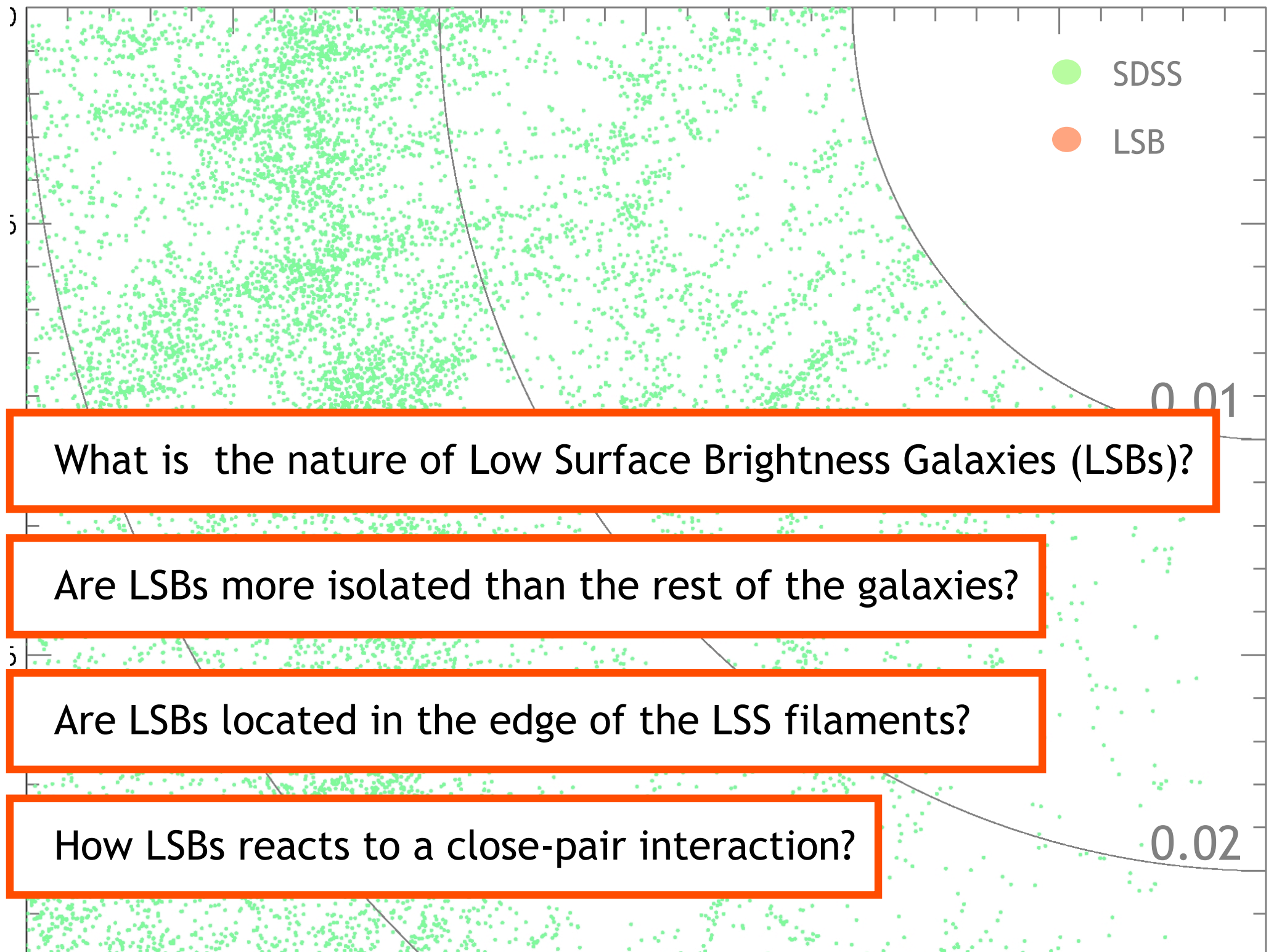
Pontificia Universidad Católica de Chile

Gapar Galaz (PUC)

Diego García Lambas (IATE)

Laura Ceccarelli (IATE)

Nelson Padilla (PUC)



# Low Surface Brightness Galaxies?

- LSBs are characterized by a central disk surface brightness (SB) in the blue band  $\mu_0(B) > 22.5 \text{ mag arcsec}^{-2}$ .
- Features of LSBs:
  - Low star formation rates (SFR) [de Blok et al. 1998]
  - Low metallicity. Typically subsolar [Galaz et al. 2002]
  - Higher gas fractions than HSBs [McGaugh et al. 1997, O'Neil et al. 2000, Galaz et al. 2002]
  - LSBs are some sort of unevolved systems as a result of a history traced by a lack of gravitational instabilities in their gas disks [van der Hulst et al. 1993]

# Low Surface Brightness Galaxies in SDSS

→ From the SDSS Main Galaxy Sample [Strauss et al. 2002]

$$\mu_0(m) = m + 2.5\log(2\pi a) + 2.5\log(b/a) - 10\log(1+z)$$

a: disk scale-length [arcsec]

b/a: axis ratio

m: g and r band + conversions [Smith et al. 2002] :  $\mu_0(B)$

→ Redshift range:  $0.01 < z < 0.1$

→  $\text{fracDev}_r < 0.9$ : Galaxies having an exponential light profile

→  $b/a > 0.4$ : Nearly face-on galaxies

→ Central disk surface brightness  $\mu_0(B) > 22.5 \text{ mag arcsec}^{-2}$

**10896 Low Surface Brightness Galaxies**

# Sample

— LSB

— HSB

10896 LSBs

$M_*$ , SFR

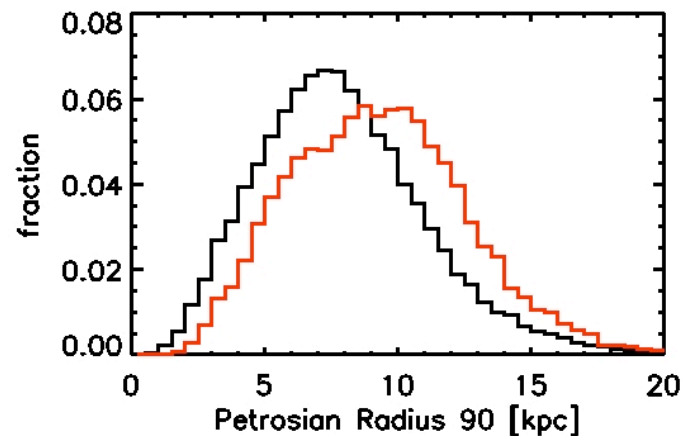
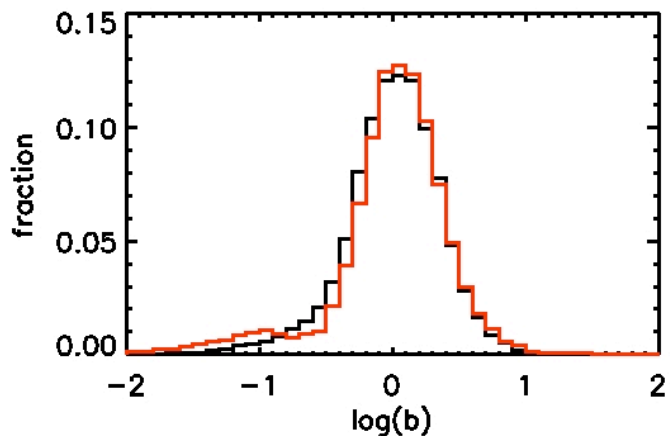
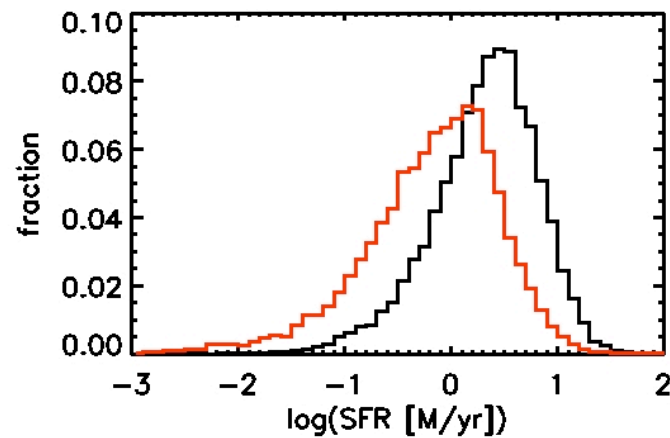
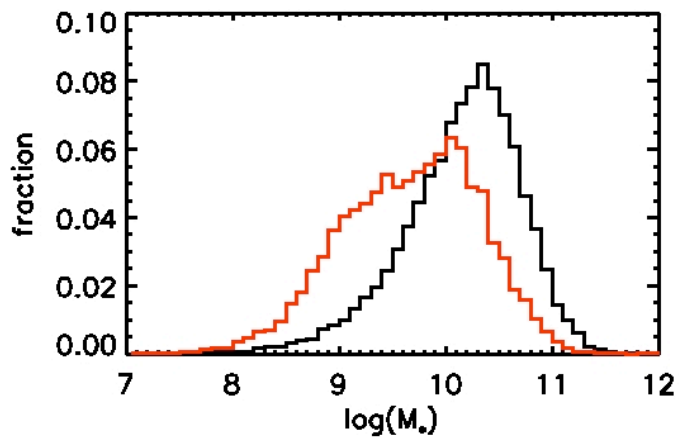
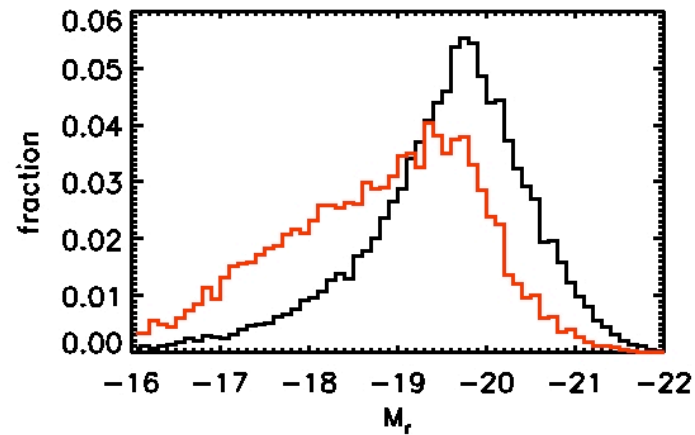
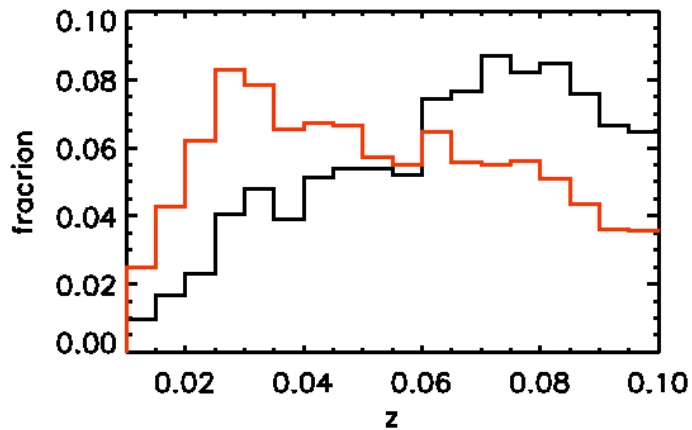
[Brinchmann et al.  
2004]

Birth rate  
parameter

$$b = 0.5t_H(\text{SFR}/M_*)$$

~8% of LSB host an  
AGN

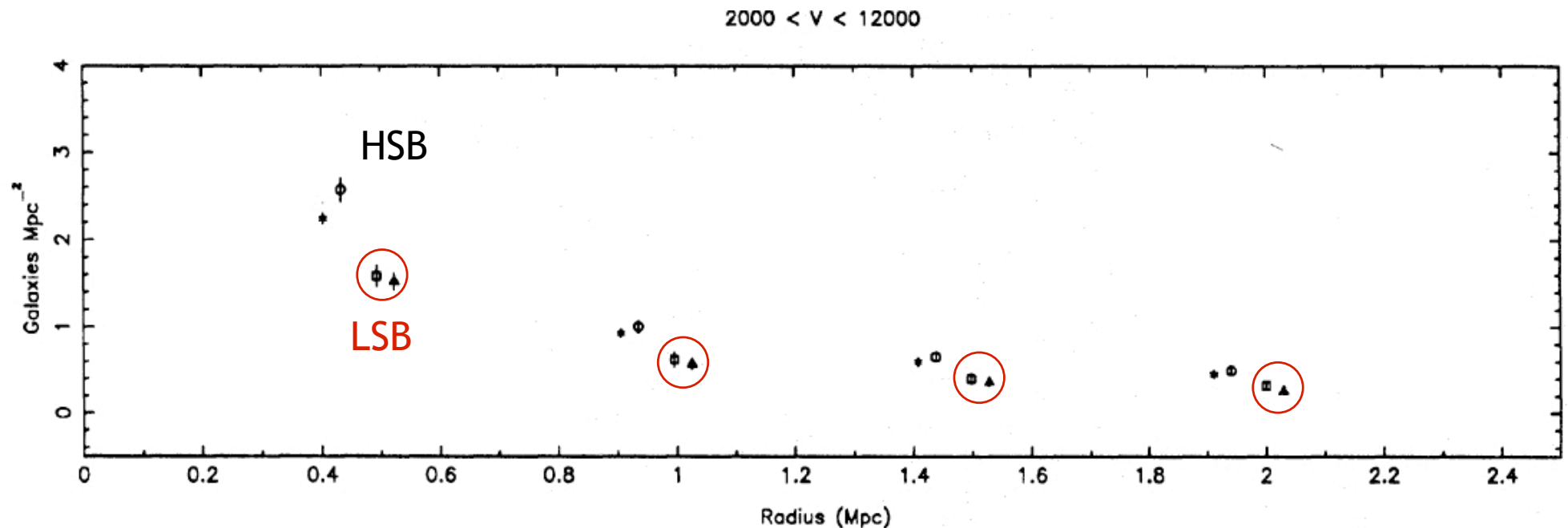
[Kauffmann et al.  
2003]



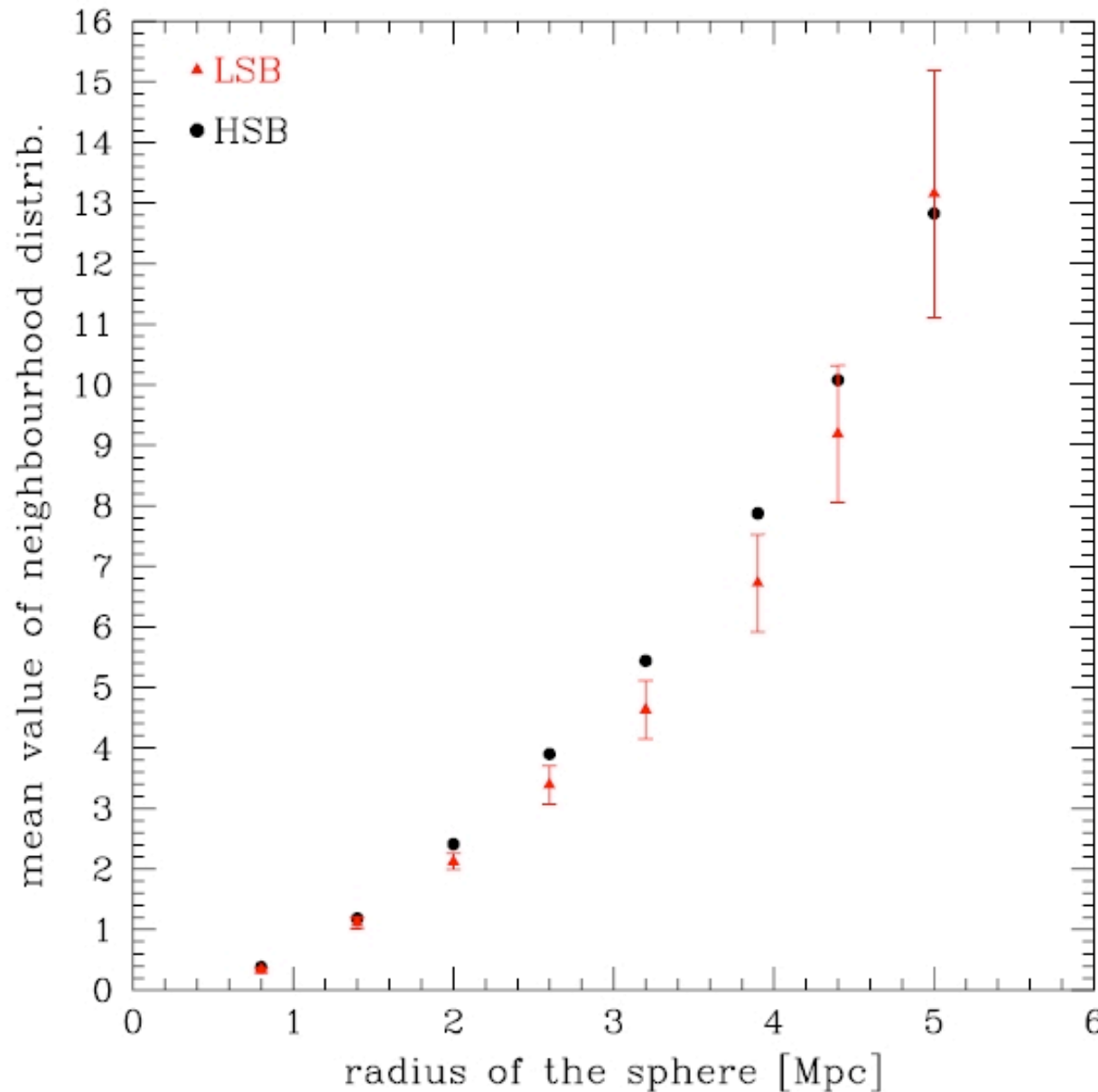
# The Environment

- Respect to the LSBs distribution on the large scale structure (LSS), [Bothun et al. 1993](#), provides the following insights:

On scales  $< 2.0$  Mpc, LSBs are significantly less clustered with respect HSB. In fact, there is a significant deficit of companions within projected distance of 0.5 Mpc, indicating that LSB disk are generally isolated.



# The Environment



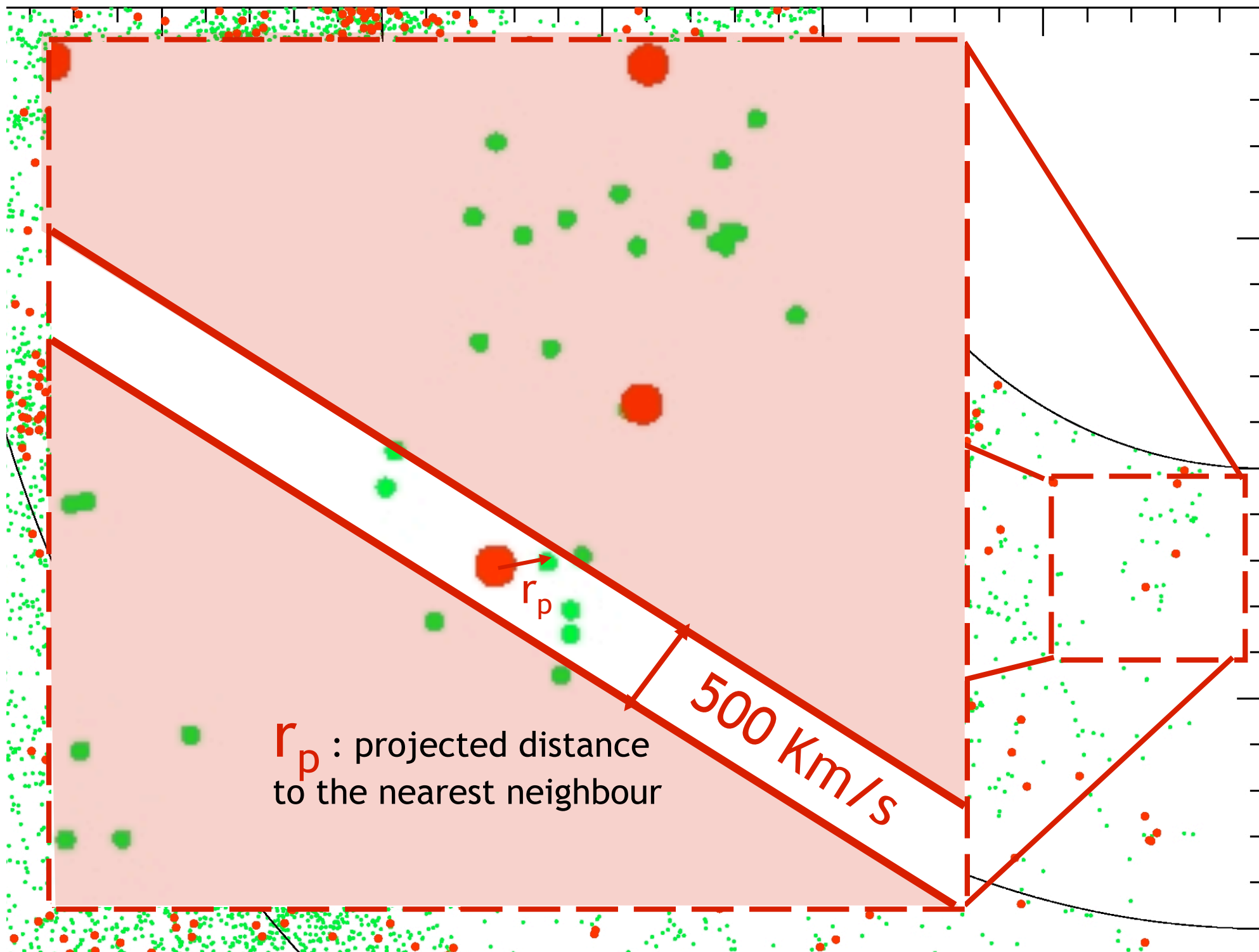
Rosenbaum et al. 2004

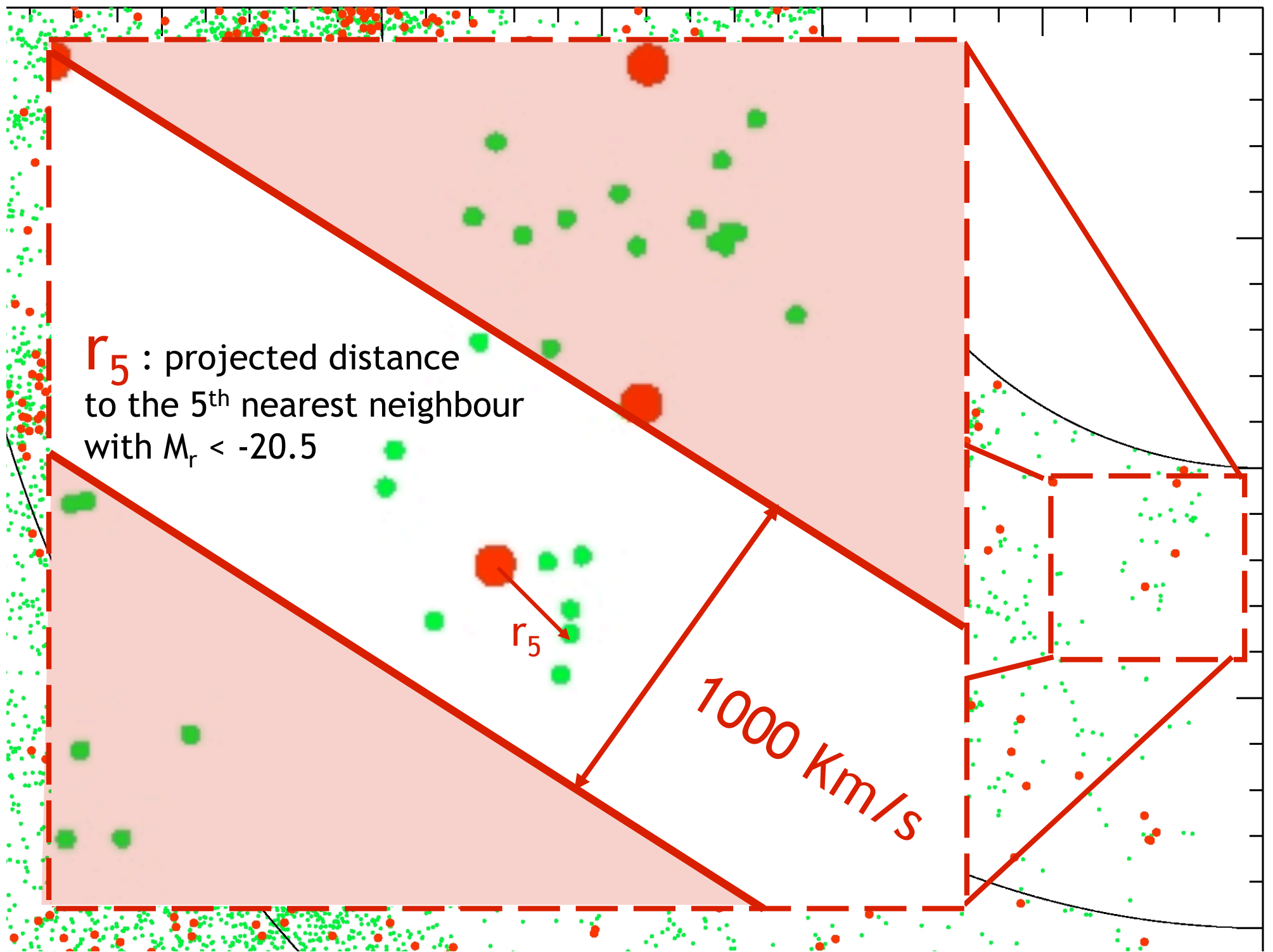
SDSS-EDR: **Central annulus** (0.23'') of the radial surface brightness profile.

The isolation of LSB galaxies takes place **on intermediate scales**

For smaller ( $r < 2$  Mpc) scales no significant differences in the statistical environments could be found in this study.







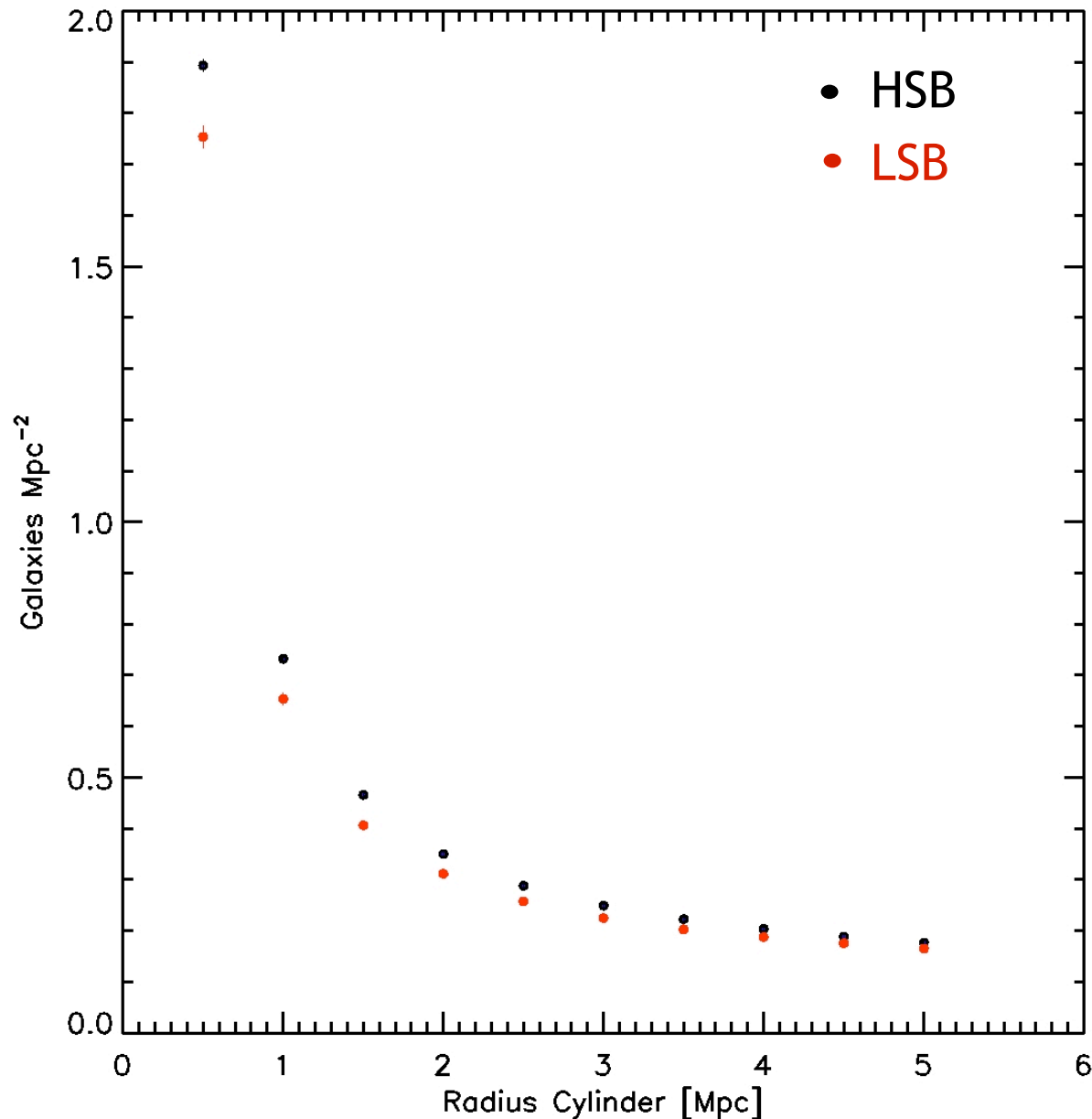
# The Environment

→ Distance to the **nearest** neighbour:  $r_p$

→ **Density** parameter:  $\Sigma_5 = 5 / (\pi r_5^2)$

→ **Cylinder Count**: From 0 to 5 Mpc in step of 0.5 Mpc and height of 1000 Km/s.

# The Environment



## Surface Density

Complete volume-limited sample:

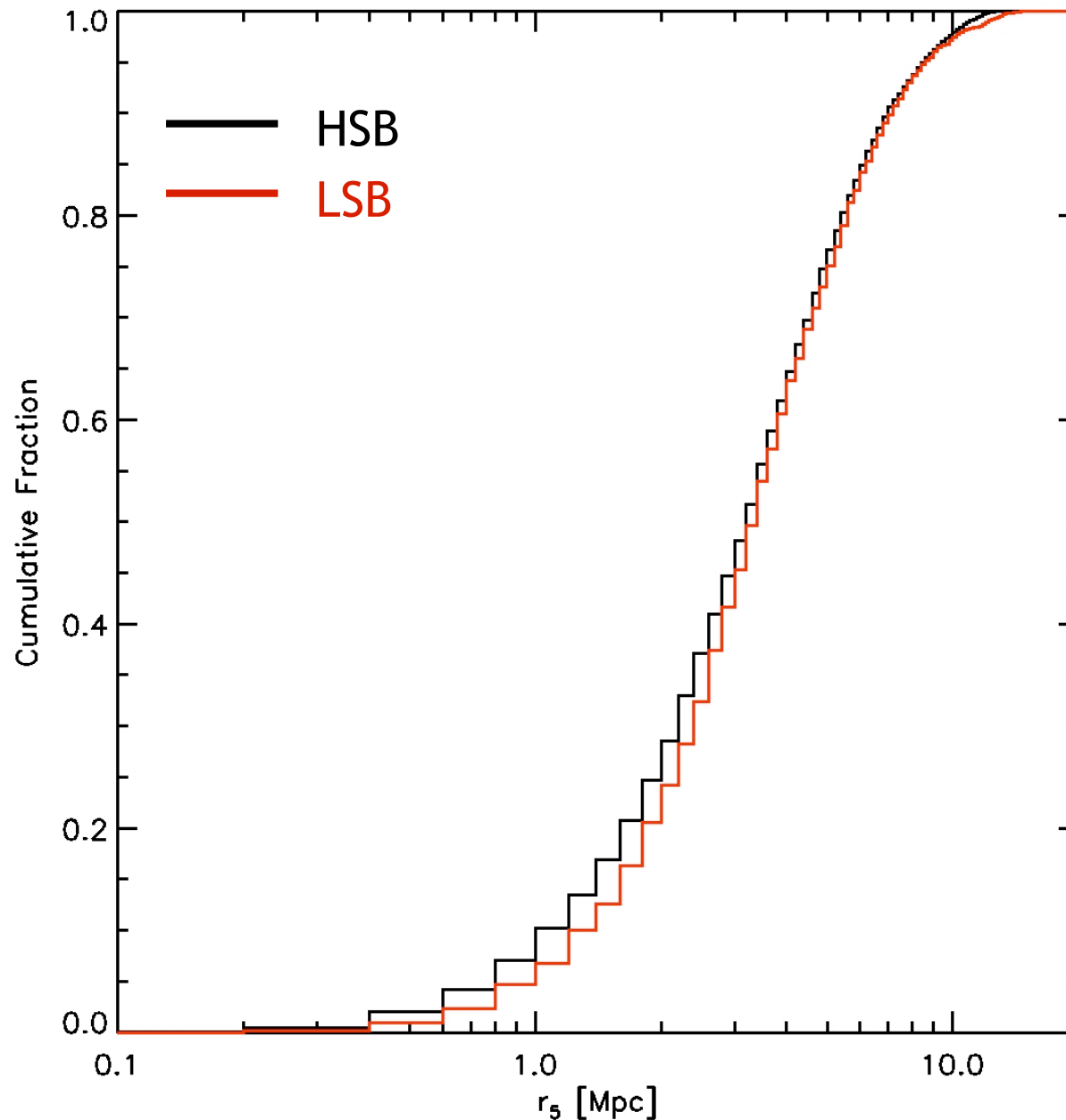
$$0.01 < z < 0.1$$

$$M_r < -19.8$$

**Small scales:** Significant deficit of neighbours around LSBs.

**Larger radii:** both distributions tend to merge.

# The Environment



Cumulative Fraction  $r_5$

Complete volume-limited sample:

$$0.01 < z < 0.1$$

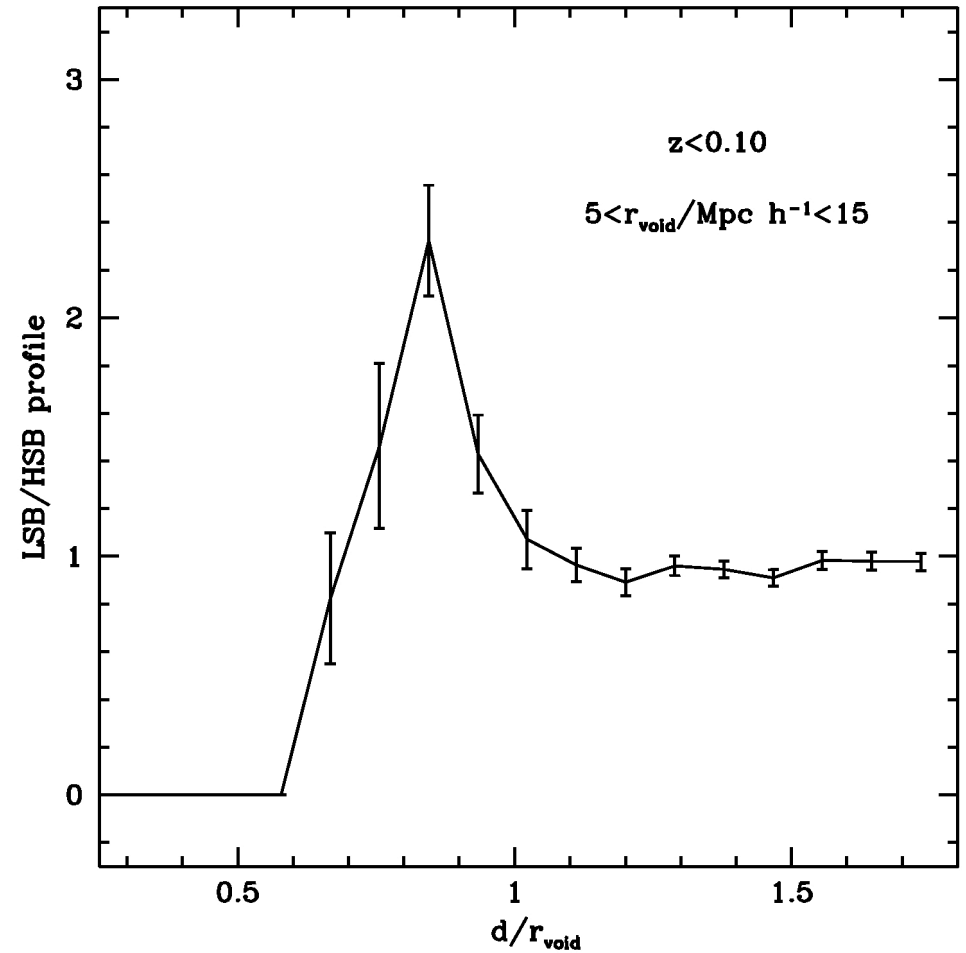
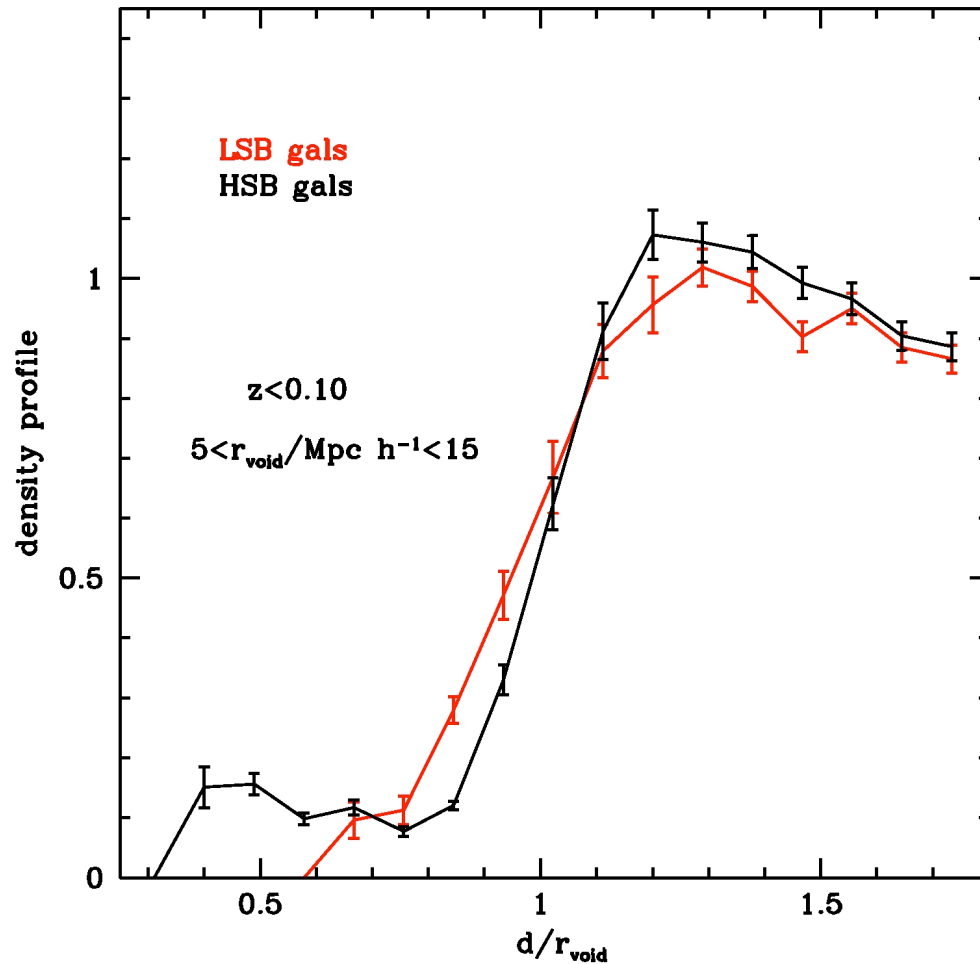
$$M_r < -19.8$$

Kolmogorov-Smirnov (KS) test **rejects**, with a confidence level greater than 99%, the hypothesis that the distribution of  $r_5$  is the same for LSB and HSBs.

# The Environment

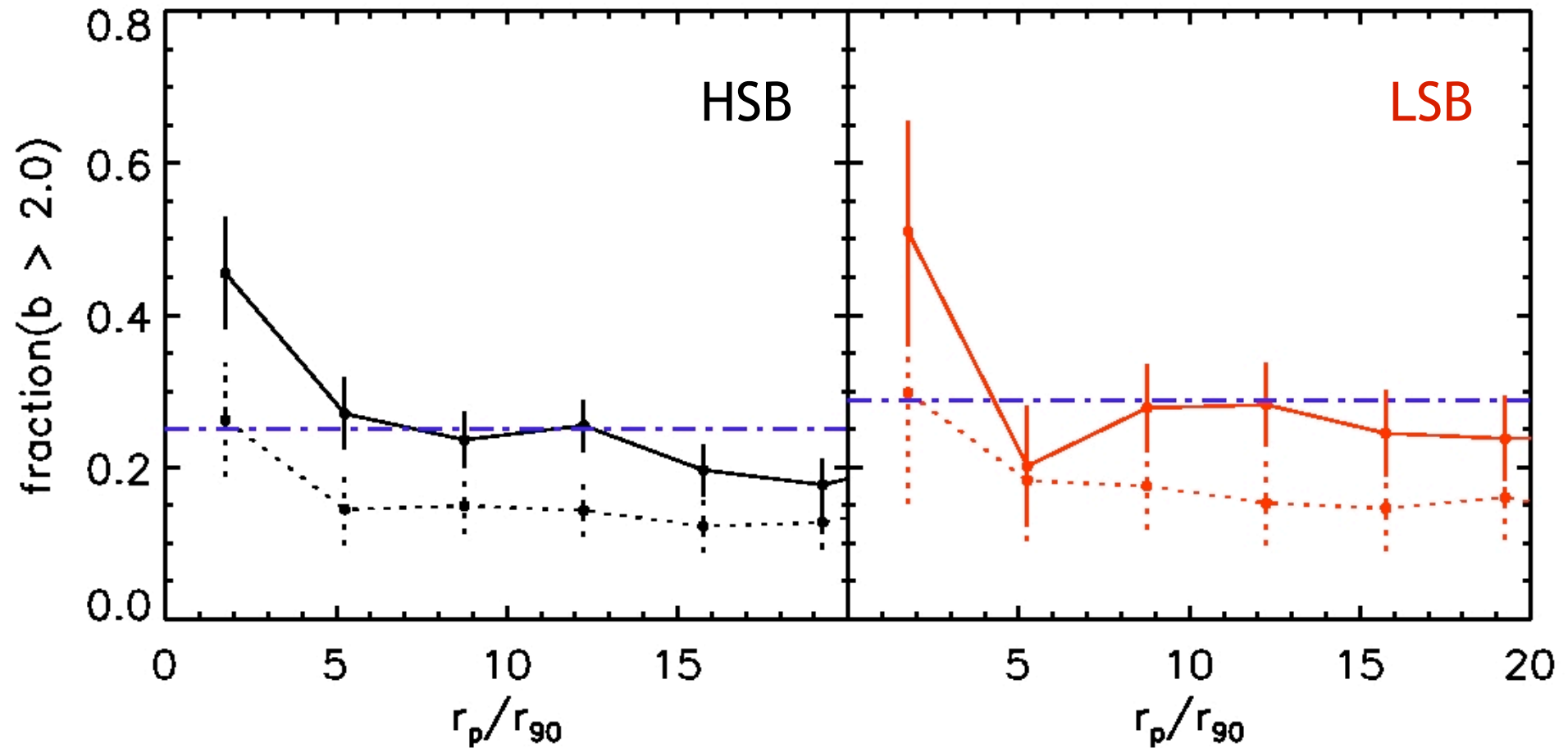
SDSS Void Catalog [Ceccarelli et al. 2006]

Voids radii in the range:  $5 < r_{\text{VOID}} < 15$  Mpc



LSBs tend to inhabit the walls of the voids  $0.8 < r/r_{\text{VOID}} < 1.15$

# Close Pair Interactions



Fraction ( $b > 2.0$ ):

Volume-limited sample:  $0.01 < z < 0.1$

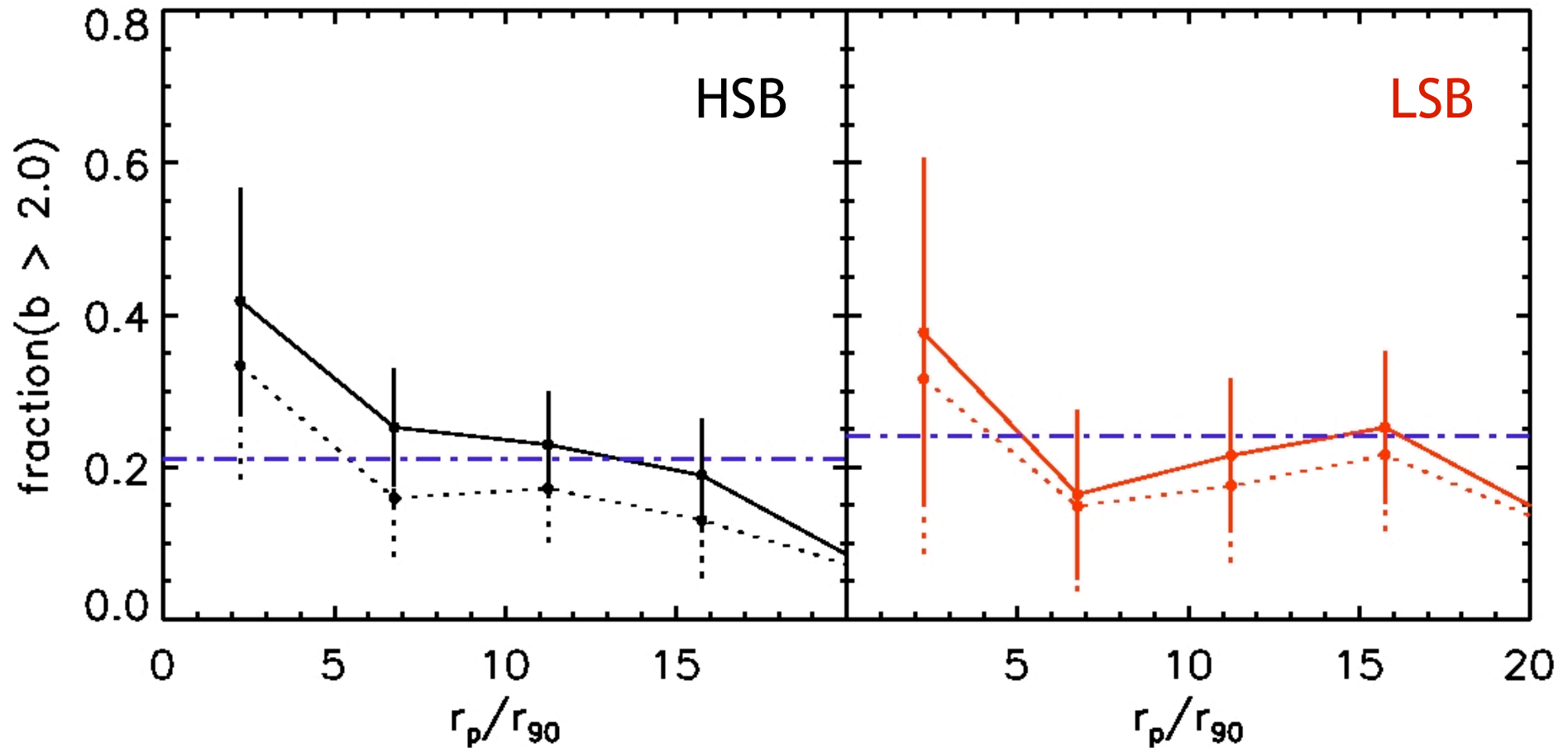
Weight =  $1/V_{\max}$

—  $1/V_{\max}$

- - - No Weight

- · - Control

# Close Pair Interactions



Fraction ( $b > 2.0$ ):

Complete Volume-limited sample:

$0.01 < z < 0.05$  &  $M_r < -18.2$

Weight =  $1/V_{\max}$

—  $1/V_{\max}$

- - - No Weight

- · - Control



# Summary and Conclusions

- There is a significant deficit of neighbours around LSBs at small scales compared to HSBs.
- LSBs tend to inhabit the walls of the voids, specially the regions just before the void radius.
- Close-pair interaction enhance the SFR of LSBs in a similar way than the previously observed enhance in HSBs [Lambas et al. 2002, Nikolic et al. 2003, Alonso et al. 2006].

# THANKS

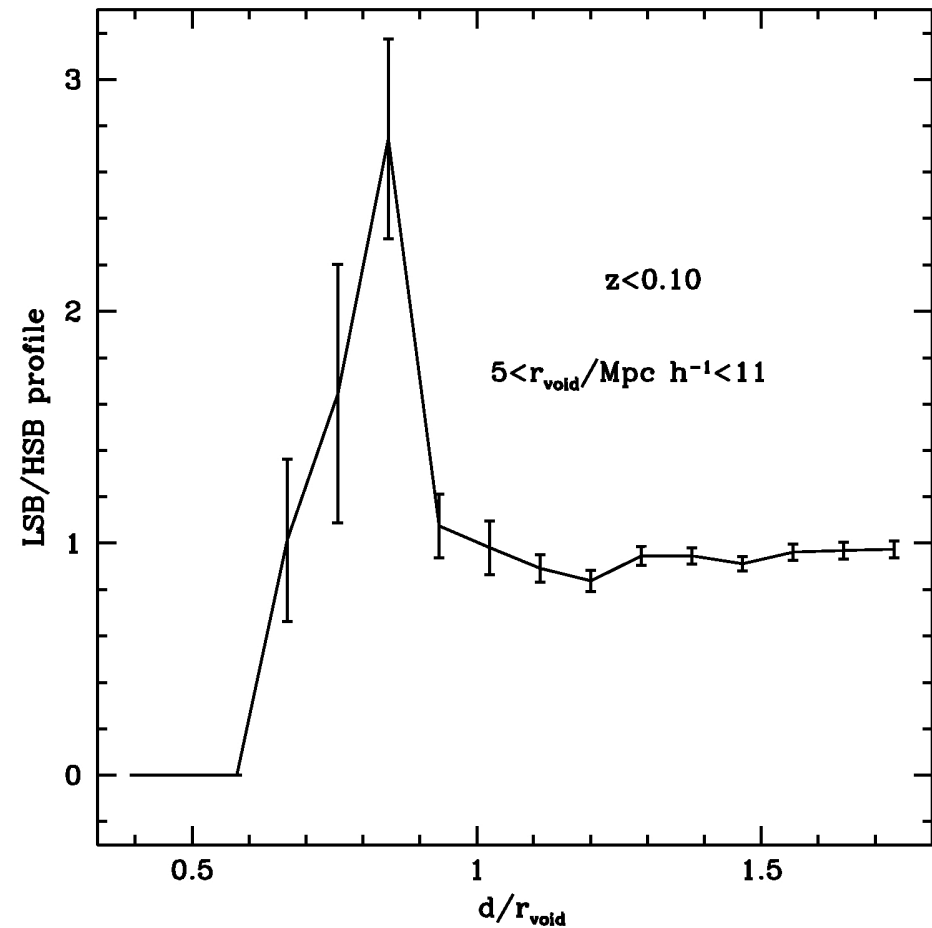
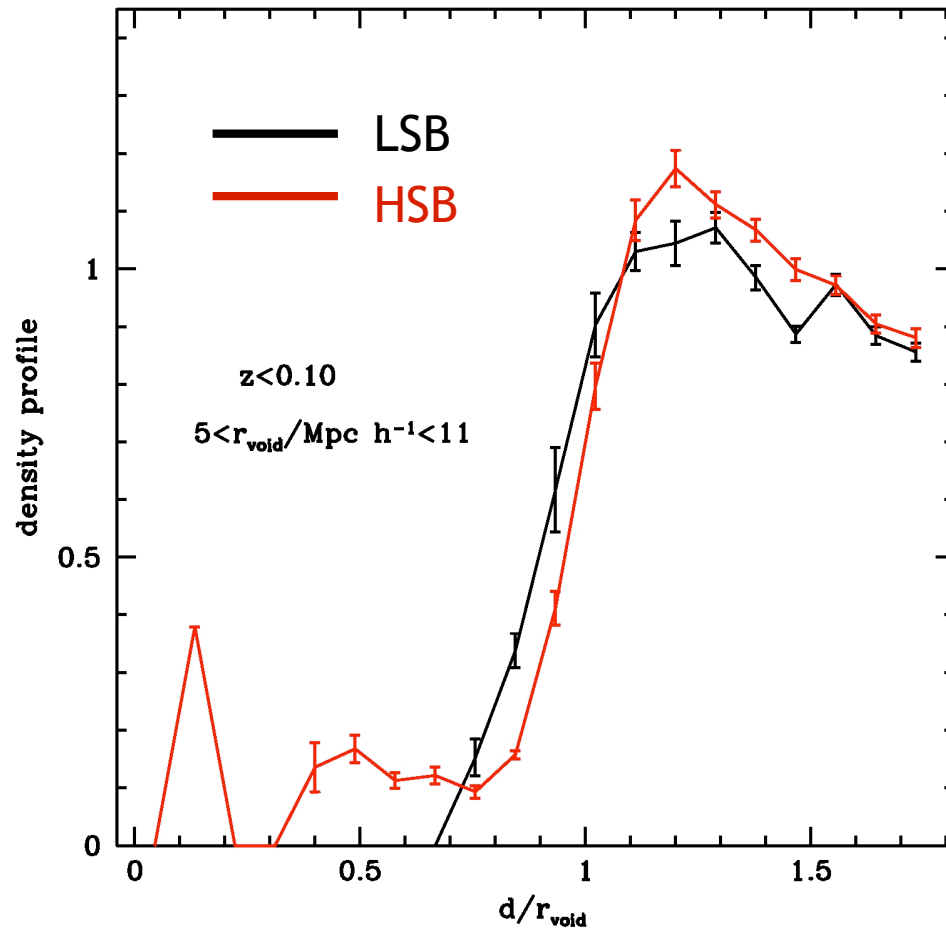
---

[rherrera@astro.puc.cl](mailto:rherrera@astro.puc.cl)

# The Environment

SDSS Void Catalog [Ceccarelli et al. 2006]

Voids radii in the range:  $5 < r_{\text{VOID}} < 10$  Mpc

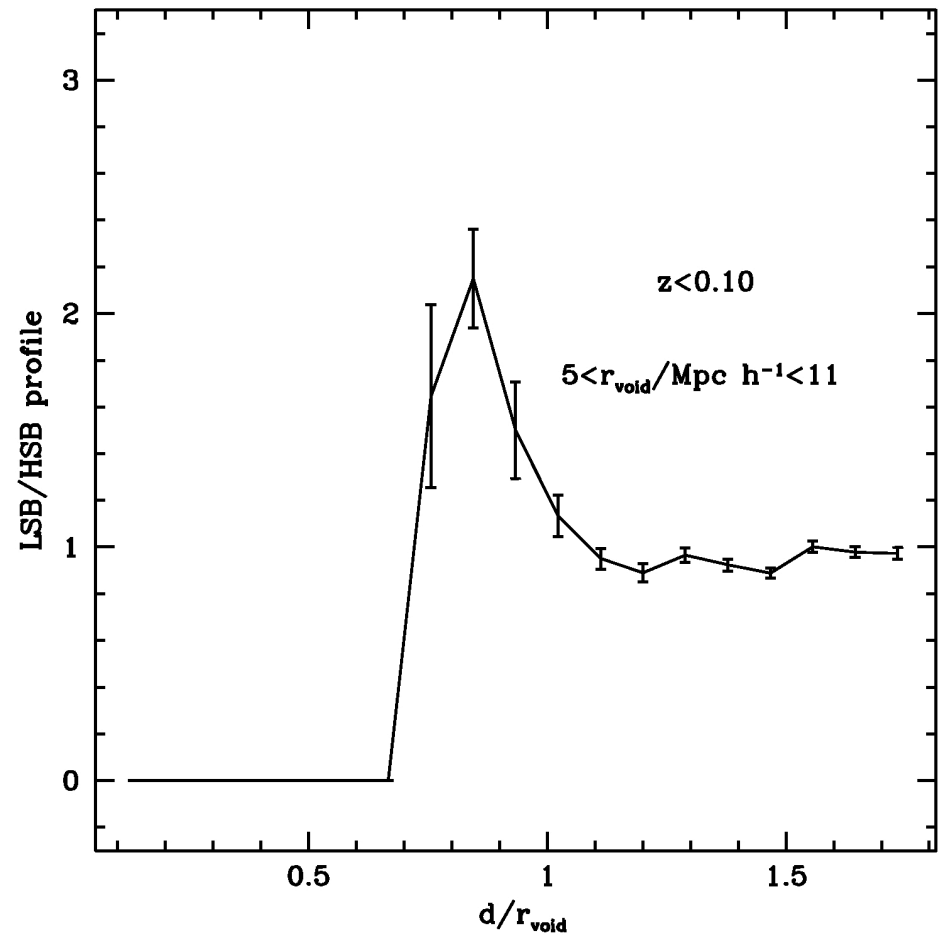
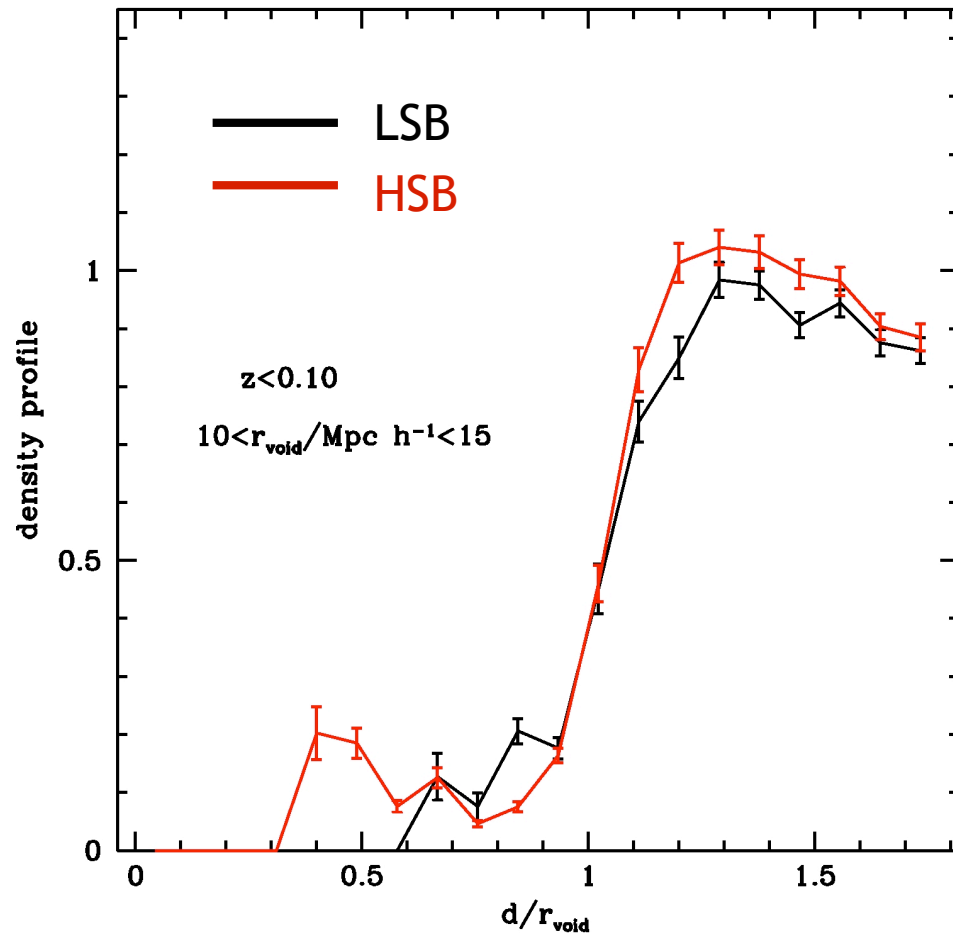


LSBs tend to inhabit the walls of the voids  $0.8 < r/r_{\text{VOID}} < 1.15$

# The Environment

SDSS Void Catalog [Ceccarelli et al. 2006]

Voids radii in the range:  $10 < r_{\text{Void}} < 15$  Mpc



- 
- In contrast / On the other hand -----> Opposite information follows
  - Nevertheless / Nonetheless -----> Unexpected information follows
  - HOwever -----> Opposite or unexpected information follows
  - Fortunately -----> Something lucky follows
  - Surprisingly / Interestingly -----> Something unexpected follows
  - Therefore / as a result / thus / consequently -----> Result follows
  - For example / for instance -----> Example follows
  - In summary / In conclusion -----> Conclusion follows
  - In fact / Indeed -----> Emphasis follows
  - In addition / MOreover / Furthermore -----> More information Follows
-