Most Massive Galaxies at $z > 6$: Interpreting Observations

Joseph A. Muñoz

XXIV IAP Colloquium

July 9, 2008

In collaboration with:
Avi Loeb

Questions

- How should we compare statistics measured from LBG surveys at high z to theory?

Quantify the Light-cone Effect

- What does the detection of a single object tell us?

Neighbors due to Clustering

Light-cone Effect:
Overview

We know that:

Each slice of a survey is seen at a different epoch.

But:

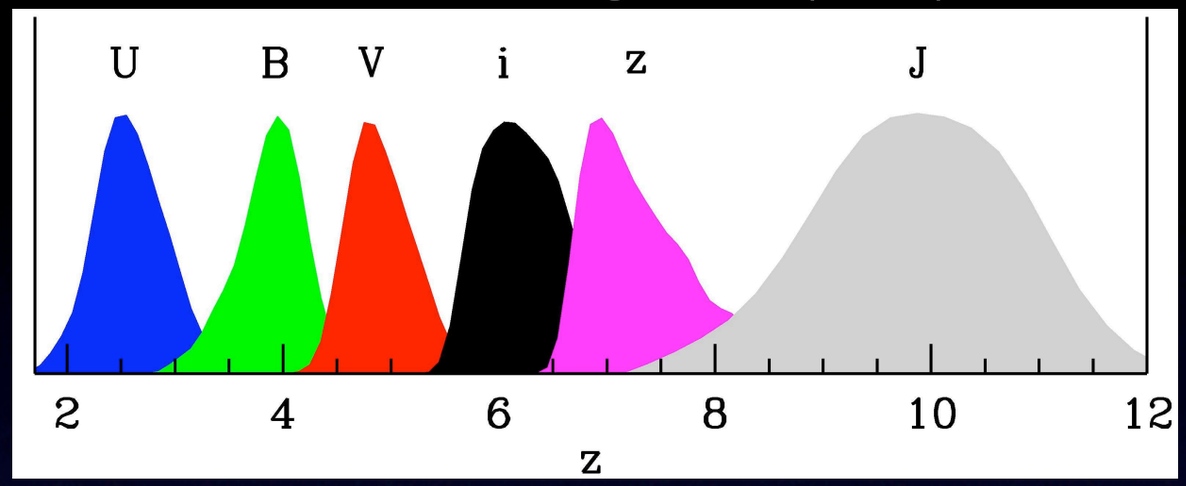
Abundance of halos that produce galaxies varies exponentially with redshift!

So the question is:

How much does the light-cone affect the statistics of galaxies measured from these surveys?

Light-cone: mental picture

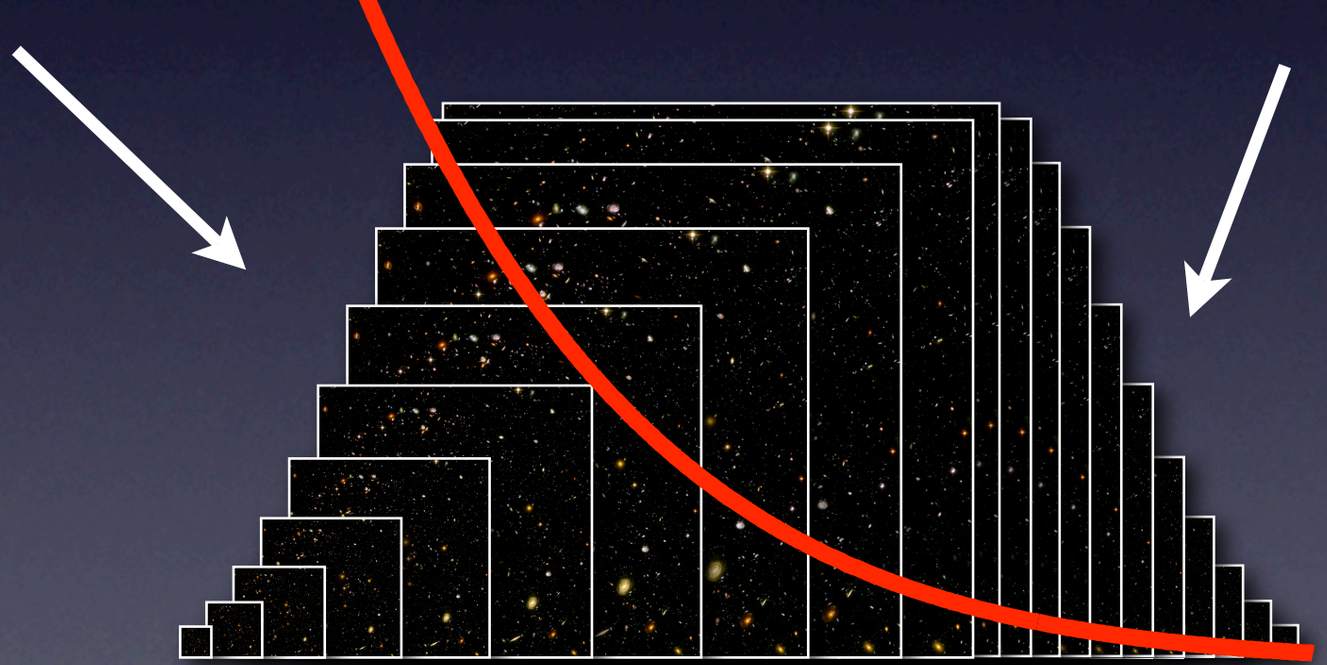
Bouwens & Illingworth (2006)



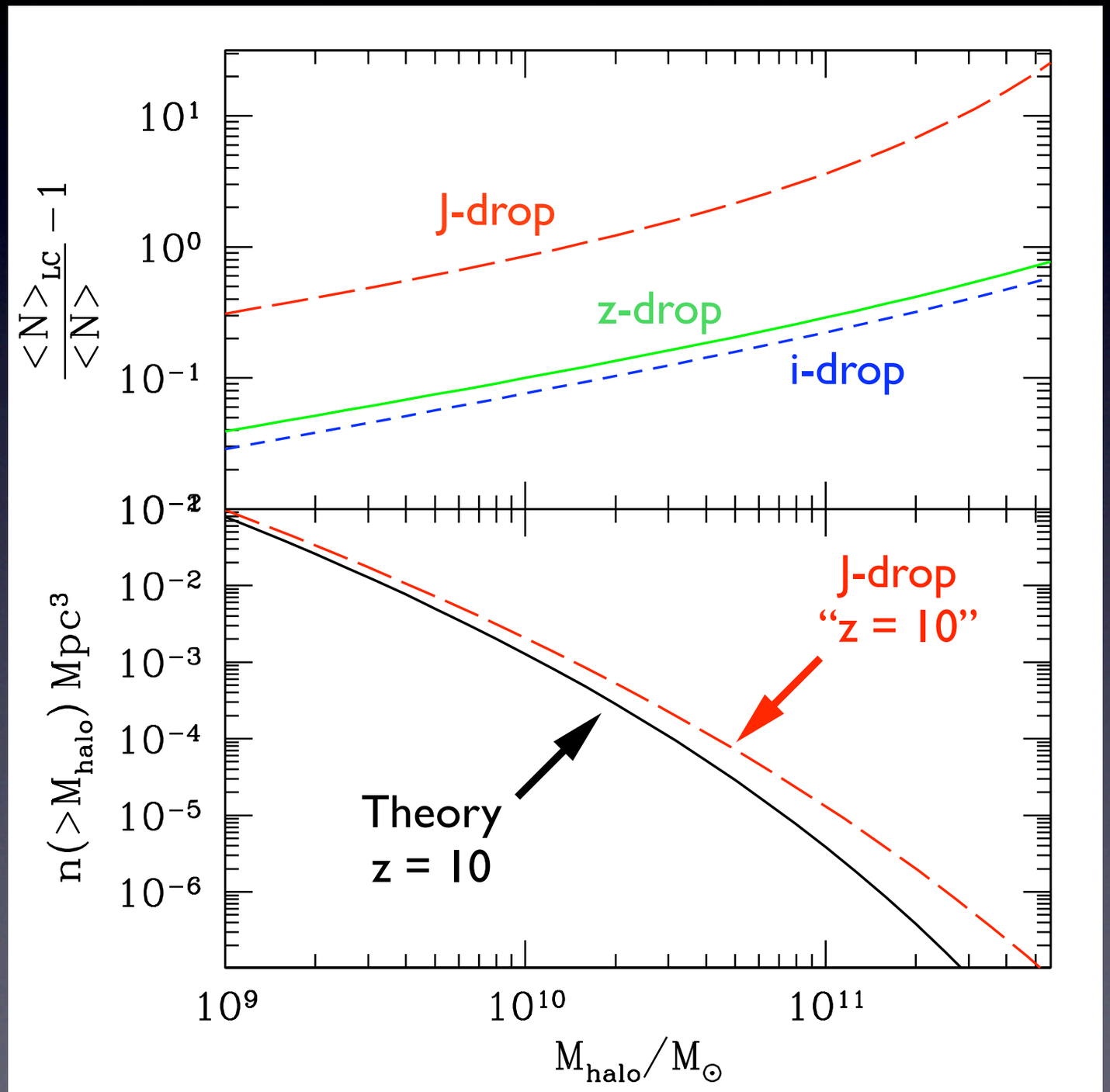
More Abundant

Less Abundant

Telescope



Light-cone Effect: mass function



- Galaxies are distributed to lower redshifts than expected
- Abundances are boosted since objects are actually at lower z
- Shift/fractional boost increases with M/L
- Result: mass function is flattened
- Beware fitting or evolving resulting luminosity function!

Muñoz & Loeb 2008b

Neighbors:
Overview

We know that:

MHRGs only exist in large over-dense regions.

That implies:

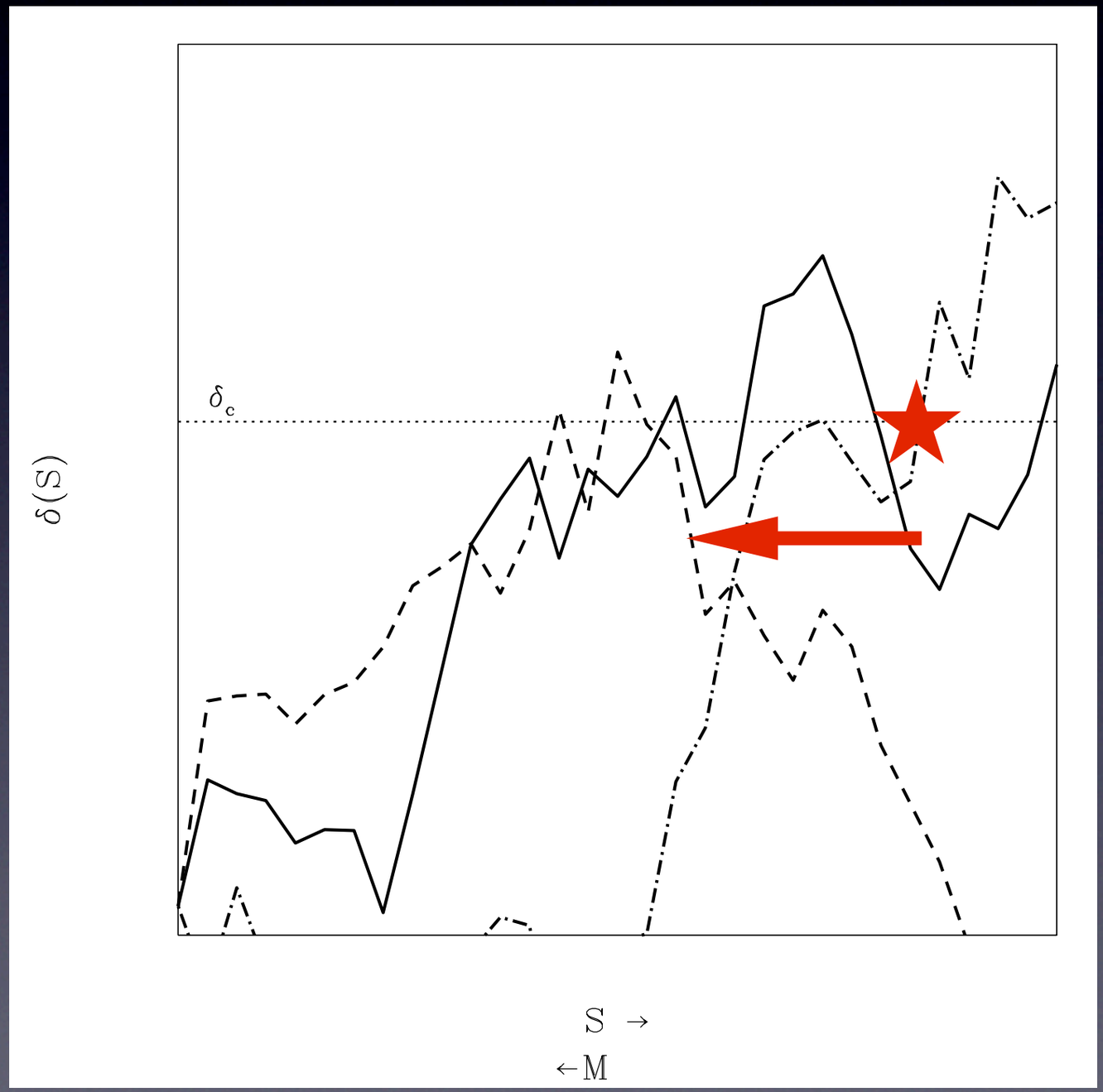
Other galaxies should form more easily nearby!

So the question is:

Can we look for these neighbors as a $z=6$ test?

Neighbors:
excursion-set formalism

- δ at a point is a random walk of contributions from Fourier modes on different scales
- Single observed galaxy pins down trajectory: $\delta(S(M)) = \delta_{crit}$
- Consider distribution of δ in larger region
- Calculate mass function in over-dense region (Barkana and Loeb 2004)



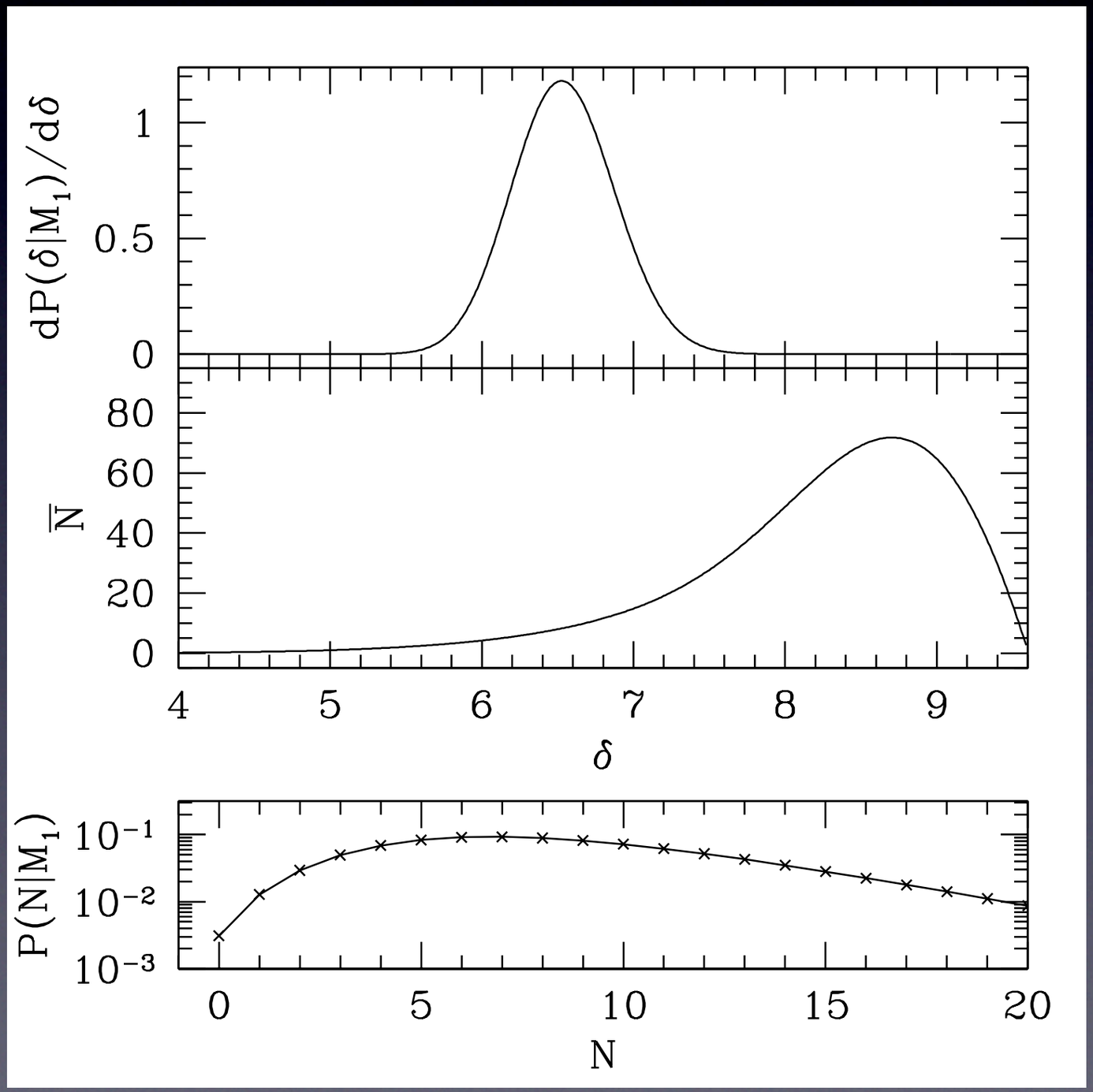
Neighbors:
HUDF-JD2 (Mobasher et al. 2005)

$$\langle N\left(z_{ab}<25\right)\rangle \sim 8$$

No such LBGs found in HUDF! (Bouwens et al. 2006)

$$P\left(N=0\right) \sim 0.003$$

Muñoz & Loeb 2008a



Summary

How should we compare LBG observations to theory?

- Statistics/mass function from large Δz surveys don't compare directly to theory
  - Galaxies distributed toward lower z
  - Mass function in flattened
  - More spectroscopic redshifts

What can a single massive galaxy imply?

- MHRGs are like cockroaches!
  - If you see one, there are probably more
  - Generic neighbors test

References

Barkana R., Loeb A., 2004, ApJ, 609, 474

Bouwens R., Illingworth G., 2006, New Astron. Rev., 50, 152

Bouwens R., Illingworth G., Blakeslee J., Franx M., 2006, ApJ, 653, 53

Muñoz J., Loeb A., 2008a, MNRAS, 385, 2175

Muñoz J., Loeb A., 2008b, MNRAS, 386, 2323