Massive Galaxy Formation:
What Can We Learn from the Most Luminous Lyman Break Galaxies at Redshift z=3

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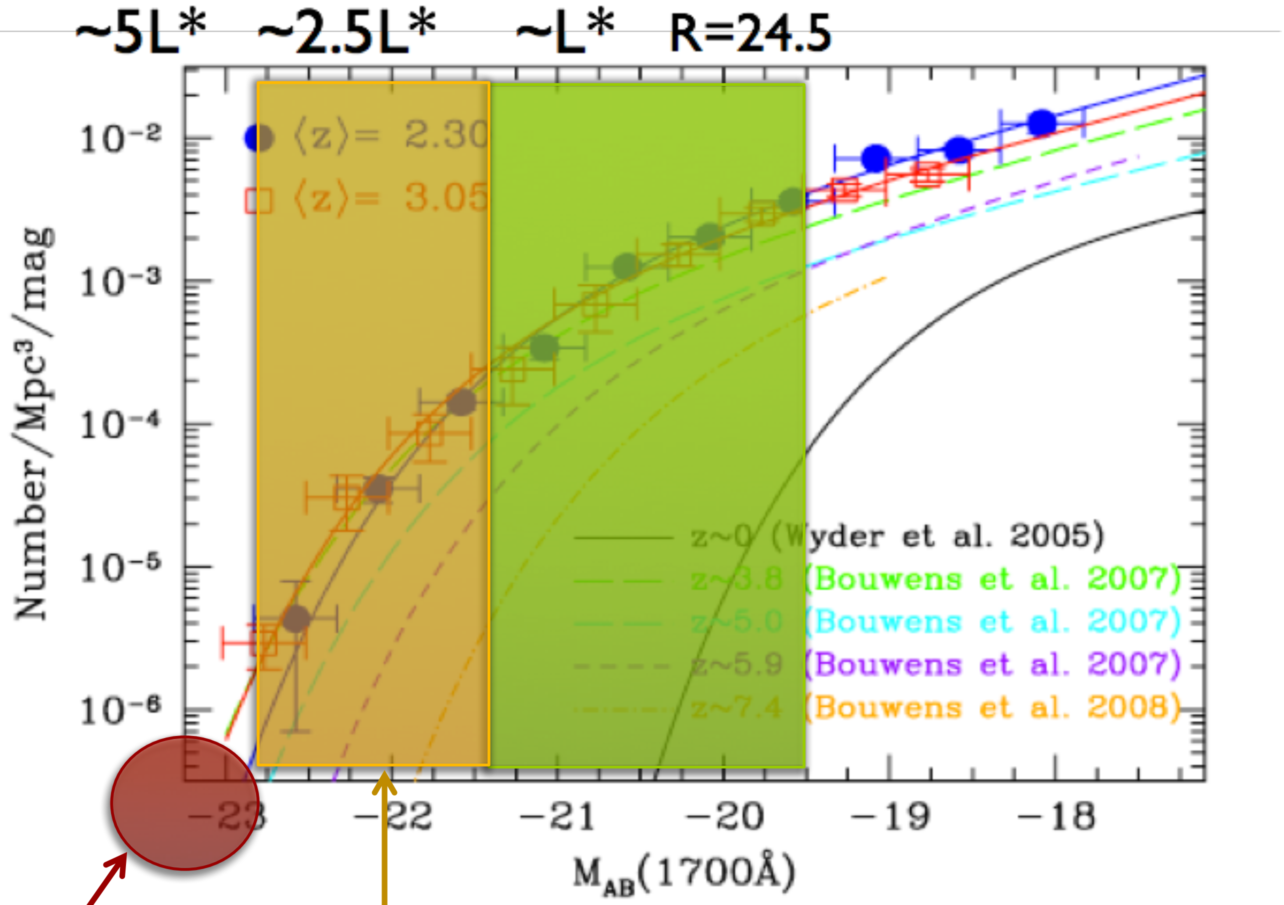
Luminous Lyman Break Galaxies at z~3



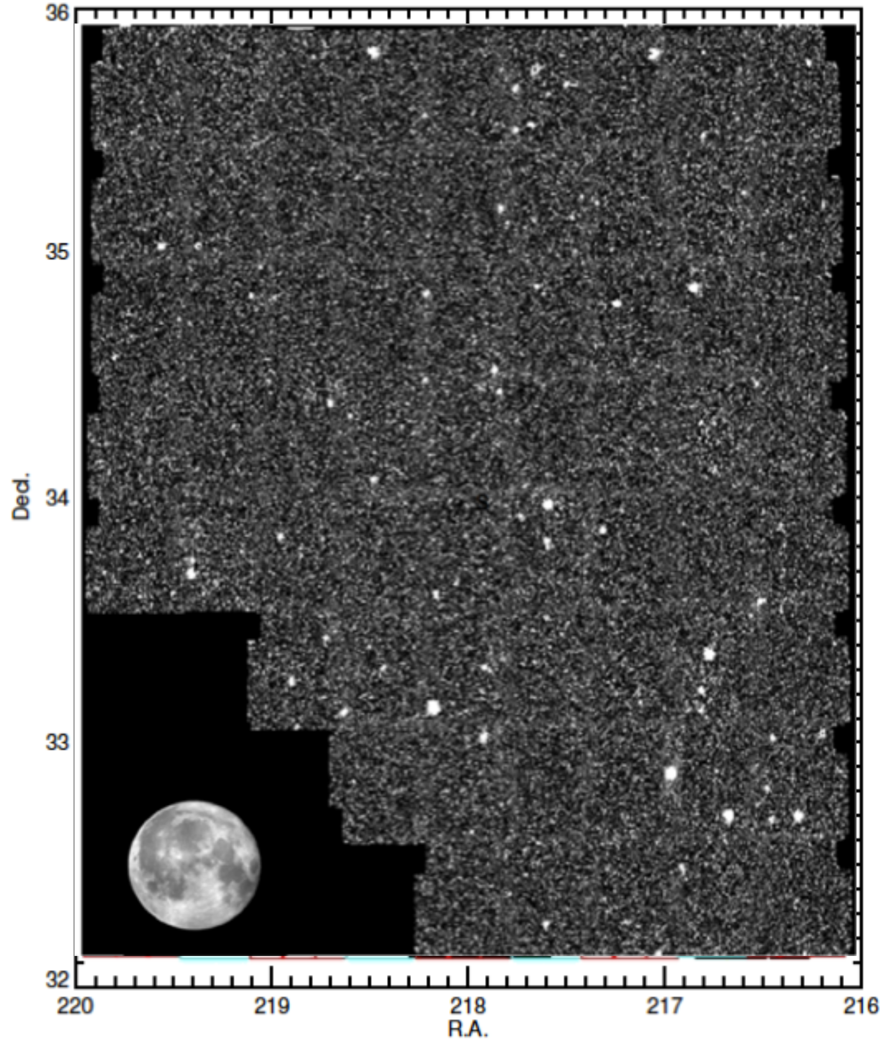
Reddy+2008

Require new measurements
Spectroscopically-confirmed LBGs
(e.g. Cooke+2008)

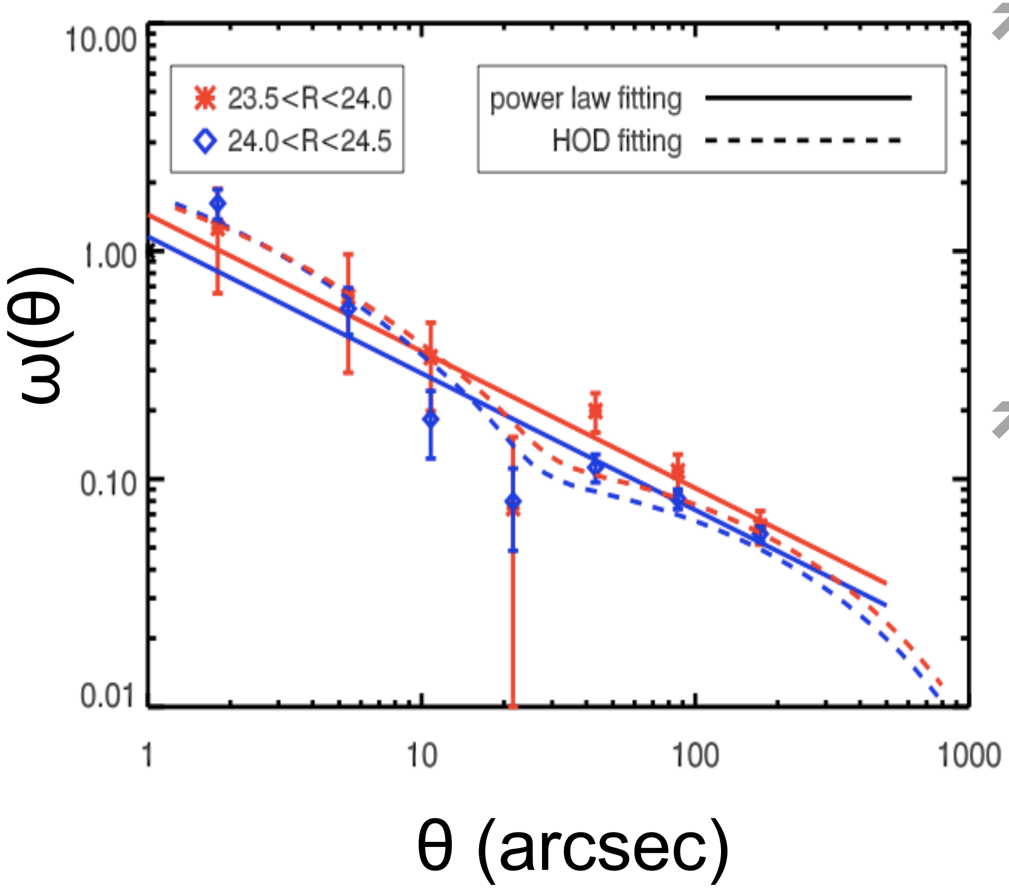
Require large sample and more accurate measurements (e.g., two point correlation function to study underlying dark matter halo masses)

NOAO Deep and Wide Field Survey

- NOAO Deep Wide-Field Survey (Jannuzi & Dey 1999) is a deep multicolor survey which covers two 9 deg^2 areas: Bootes Field and Centus field.
- The Bootes field is also covered by the new U- and Y-band data with the LBT/LBC (Bian+2013).
- Multi-wavelength coverage in the Bootes field from X-ray to radio.
- About 15,000 Lyman Break Galaxies (LBGs) at z~3 are selected in the Bootes field

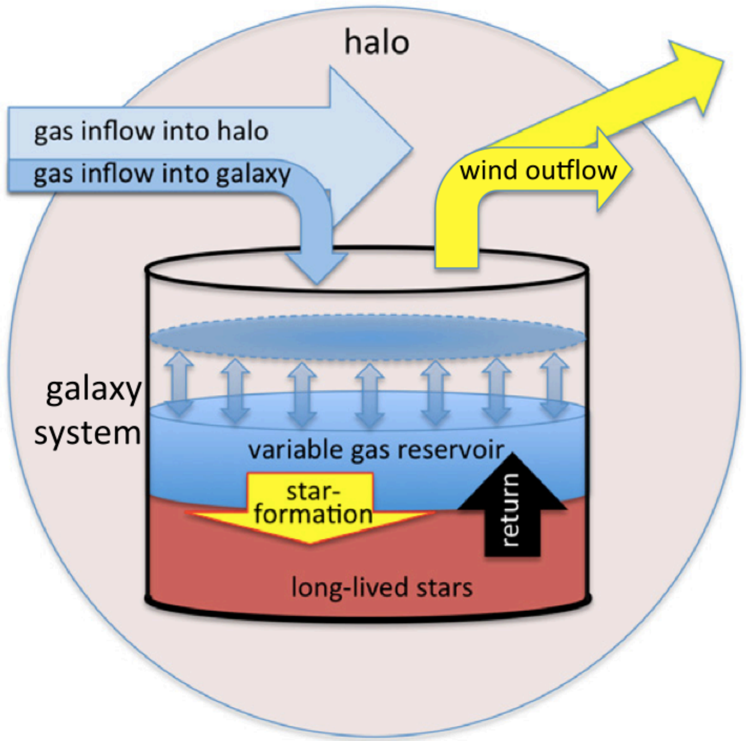


Clustering of Luminous LBGs



- 2D angular correlation function of two subsample of super L* LBGs (L*-1.5L* and 1.5L*-2.5L*).
- The average hosting dark matter halo masses are estimated from Halo Occupation Distribution models:
  $2.5 \pm 0.3 \times 10^{12} h^{-1} M_{\odot}$,(L*-1.5L*)
  $3.3 \pm 0.5 \times 10^{12} h^{-1} M_{\odot}$,(1.5L*-2.5L*)

Baryonic Gas Accretion on Galaxies



Lilly+2013

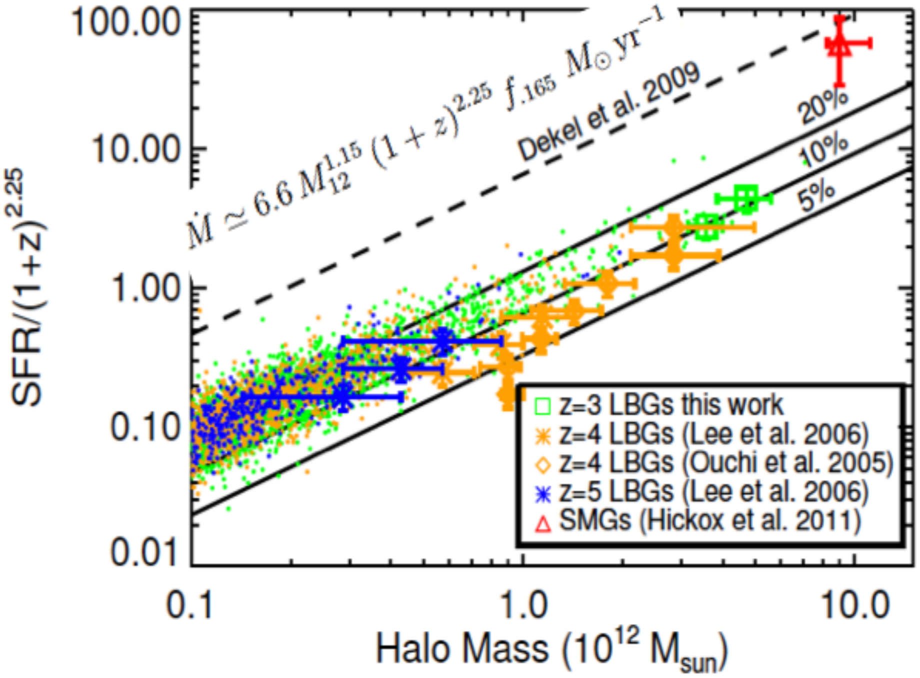
$$\dot{M} \simeq 6.6\, M_{12}^{1.15} (1+z)^{2.25} f_{.165}\; M_{\odot}\, \mathrm{yr}^{-1}$$

The baryonic gas accretion rate depends on redshift and halo mass (Dekel+2009)

Halo mass → $\dot{M}/(1+z)^{2.25}$

UV luminosity → $SFR/(1+z)^{2.25}$

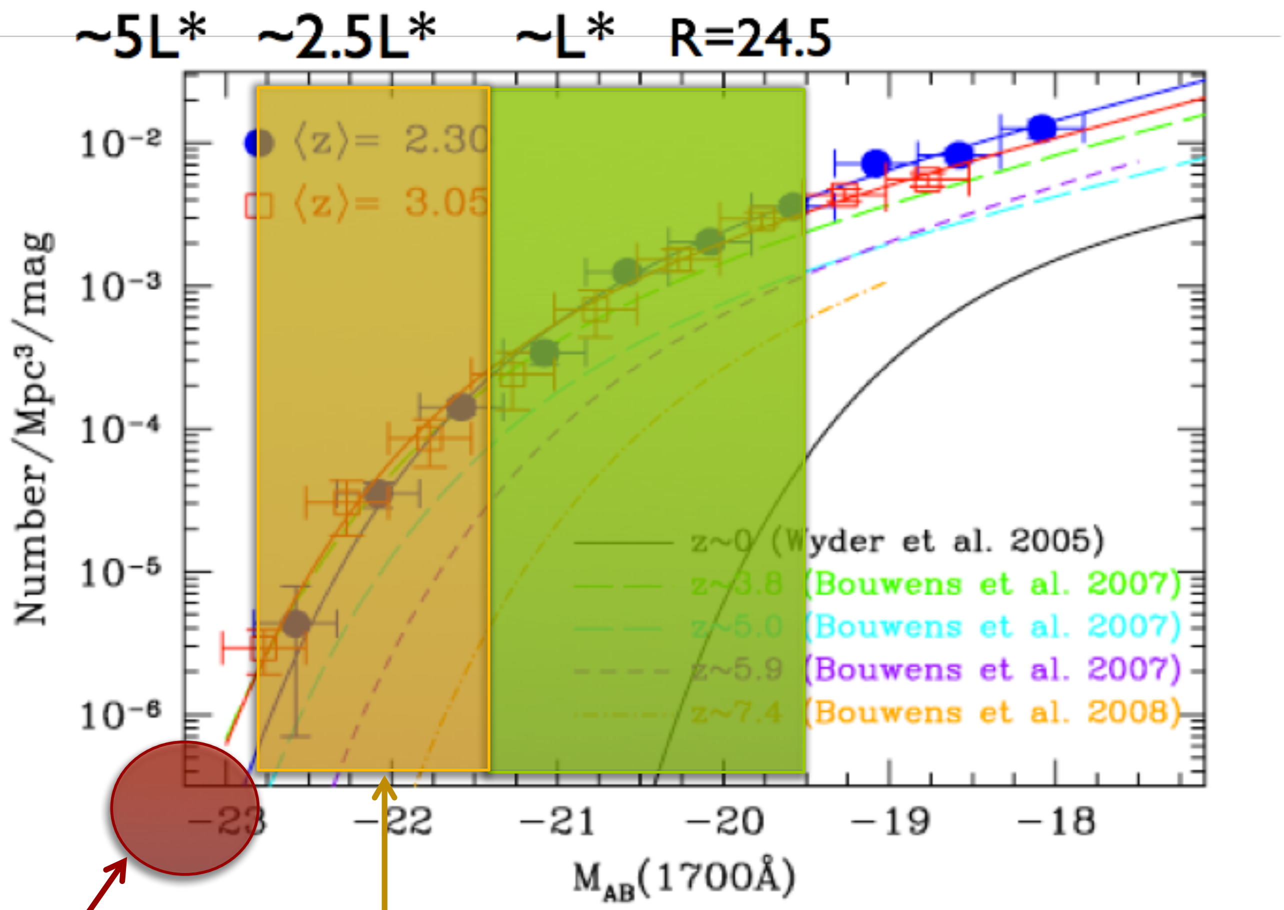
Galaxy formation efficiency in LBGs



- The galaxy formation efficiency is 5%-20%.
- This efficiency does not change significantly with redshift, galaxy luminosity, halo mass ($2x10^{11}$-$3x10^{12}$ $M_\odot$)
- The low cosmic star formation efficiency could due to feedbacks in high-z galaxies (e.g., Momentum-driven outflows).

Bian+2013

Luminous Lyman Break Galaxies at z~3

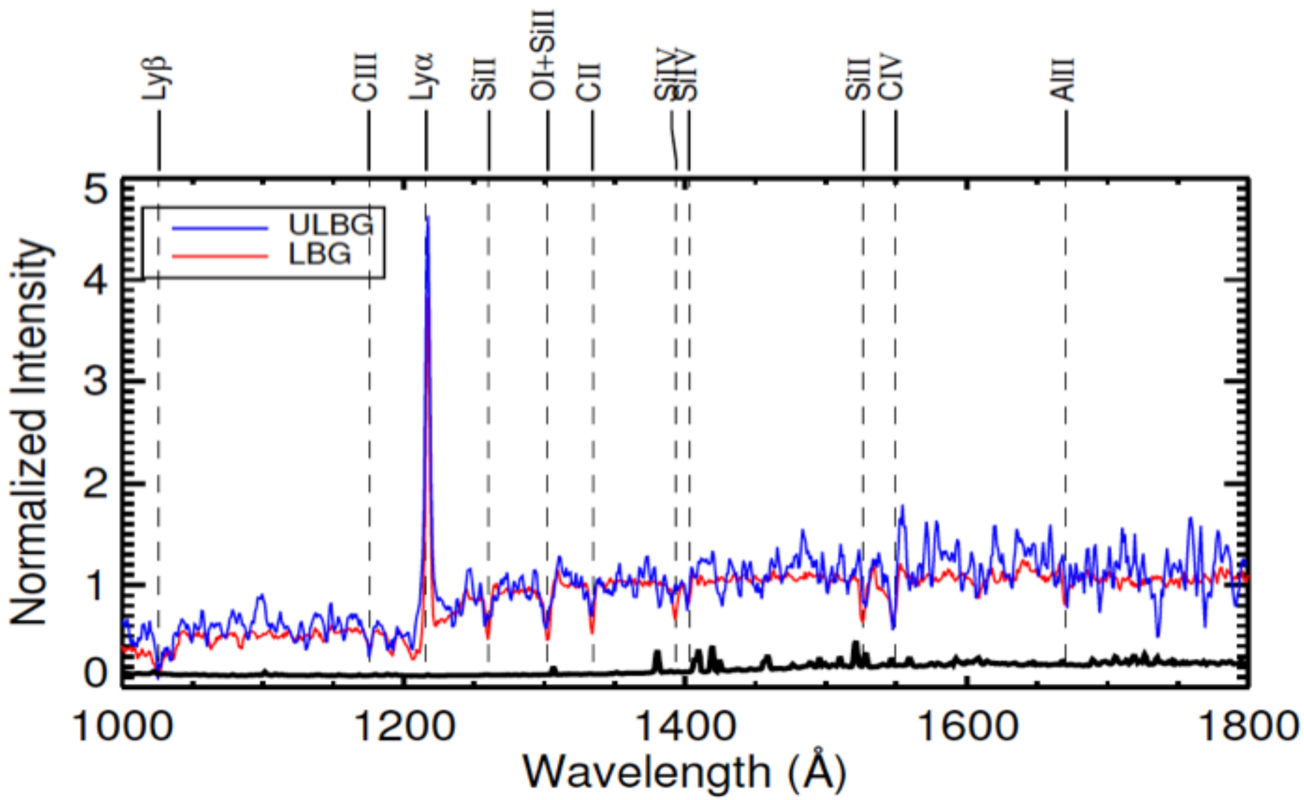


New measurements
Spectroscopically-confirmed LBGs
(e.g. Cooke+2008)

More accurate measurements
A large sample of photometrically-selected LBGs

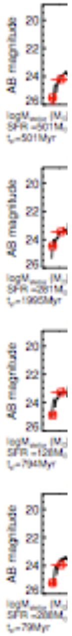
A Population of Ultra luminous LBGs at z~3

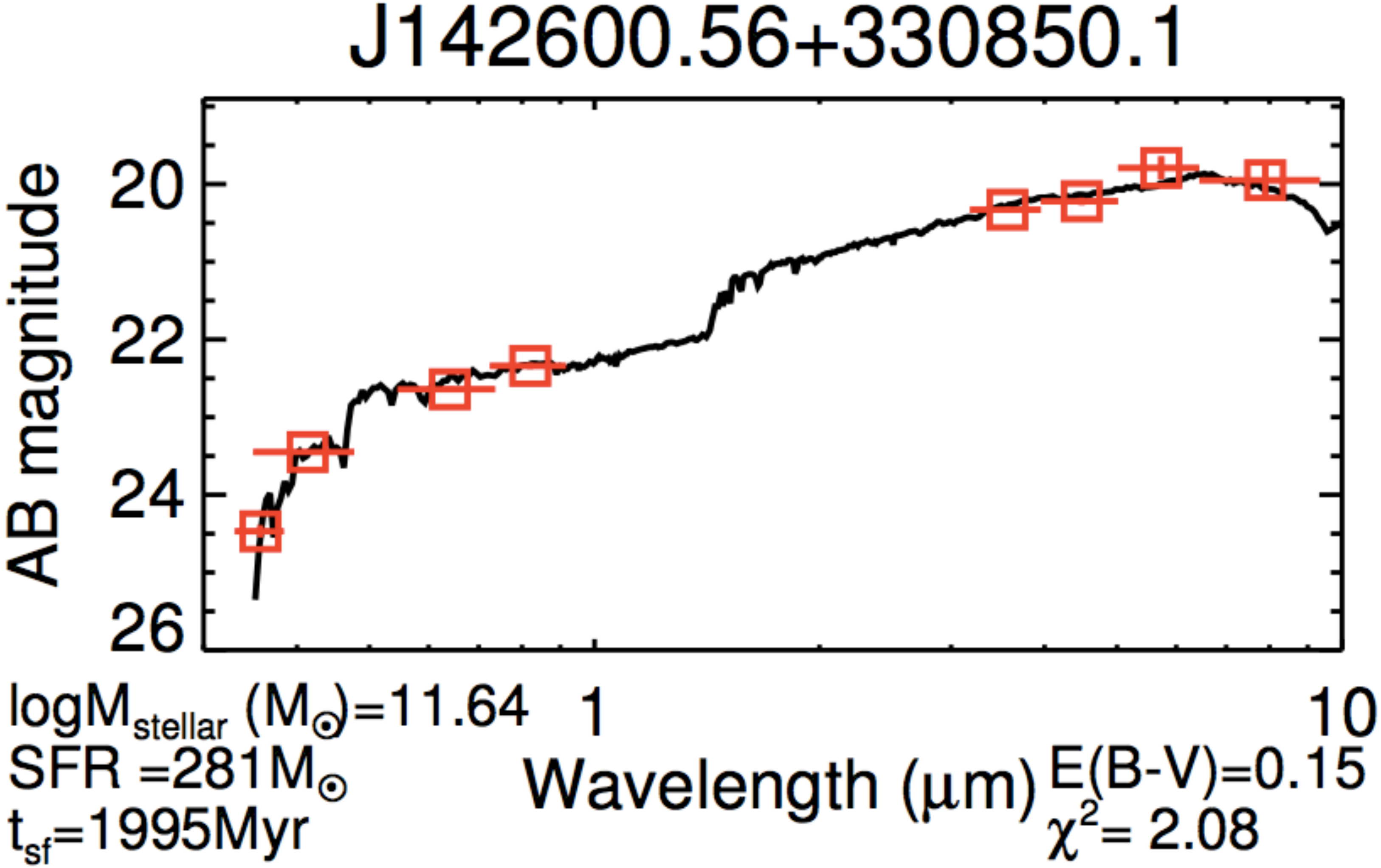
14 luminous star-forming galaxies (R<22.8, L>5L*) are discovered using MMT/BCS in the 9 square degree Bootes Field



Bian+2012, Bian in prep

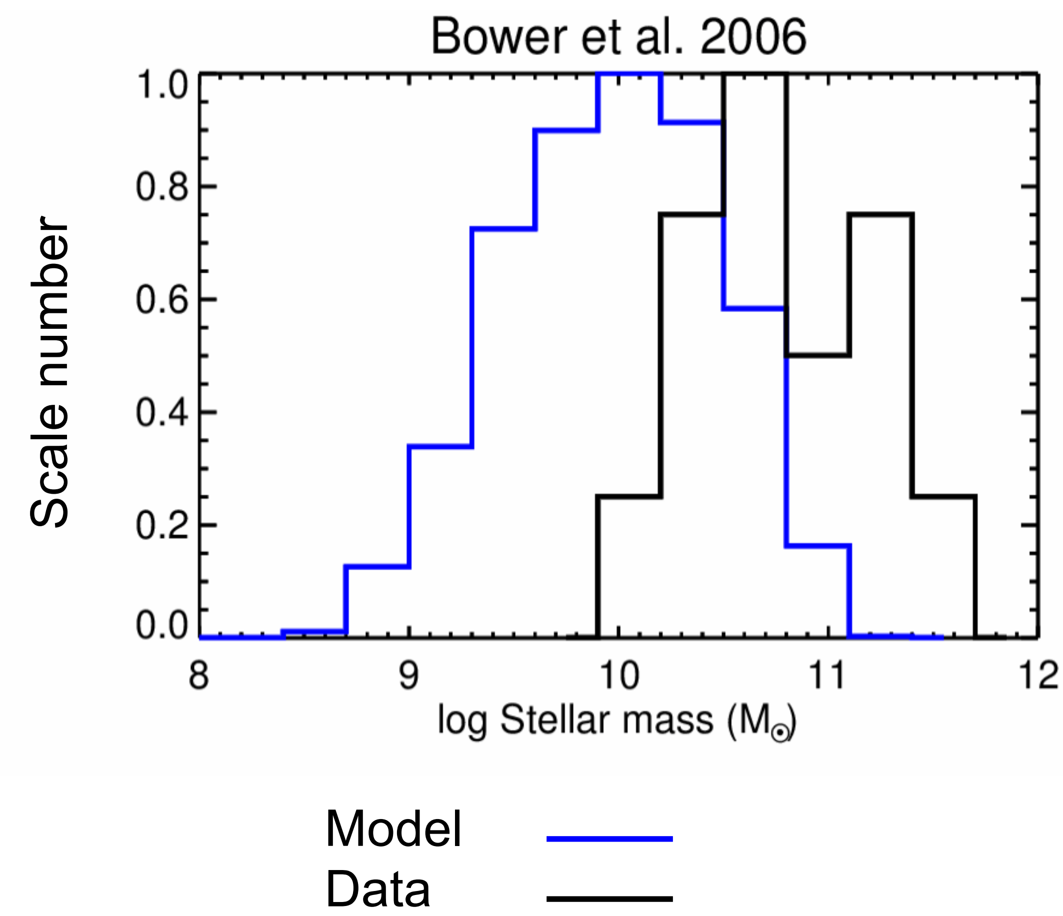
Physical Properties of Luminous LBGs





L* LBGs z~2-3 Shapley+2005

Comparison with Semi-Analytic Models



- Select galaxies in SAMs based on their colors and magnitude range.
- Predicted stellar mass distribution from SAMs is significantly smaller than observed.
- The latest SAMs make significant improvements.

Bian+ in prep

Conclusion

- A tight relation between the redshift-scaled SFR and hosting halo mass, which follows the slope from the baryonic flow accretion.
- The galaxy formation efficiency is 5%-20%, and does not change with redshift, galaxy luminosity and halo mass.
- A population of the ultra-luminous LBGs (ULBGs, L>5L*) are discovered with spectroscopic confirmation.
- These luminous LBGs have high stellar mass (~$10^{11}M_{\odot}$), high star-formation rate (~$500M_{\odot}$/yr).