The masses of sub-L* UV-selected galaxies at high redshift

Marcin Sawicki [1], Jonathan Savoy [1], David Thompson [2], & Taro Sato [1]

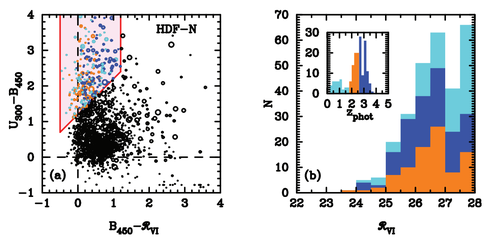
(1) Saint Mary's University (2) Large Binocular Telescope Observatory

We use multi-wavelength imaging to study the stellar and dark halo masses of UV-selected galaxies at high redshift.
We probe deep into the population, reaching ~3 mag below L* - i.e., to star formation rates of only a few solar masses per year.

Stellar masses

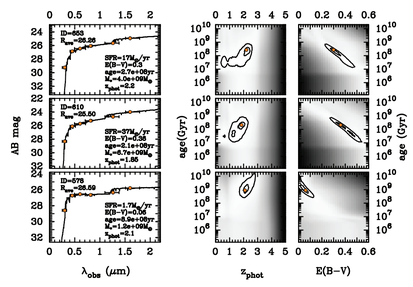
Sample:

Color-selected z~2 LBGs in the Hubble Deep Field:
91 objects down to R=28 (i.e., well below spectroscopic limit)



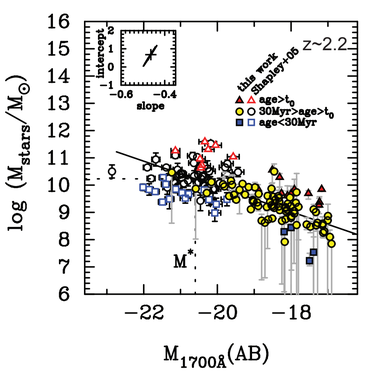
Method:

SED-fitting (Sawicki & Yee 1998) with Bruzual & Charlot (2003) models and Calzetti (1997) dust.



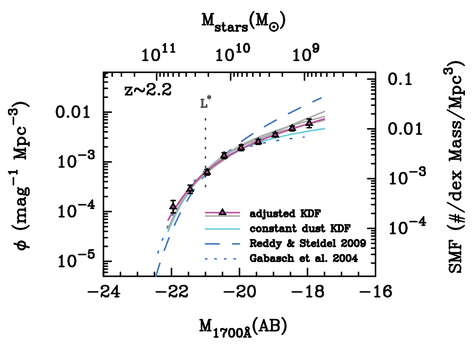
In this example: constant star formation rate fits to three of our 91 HDF objects. Error contours are at 1 and 2 sigma.

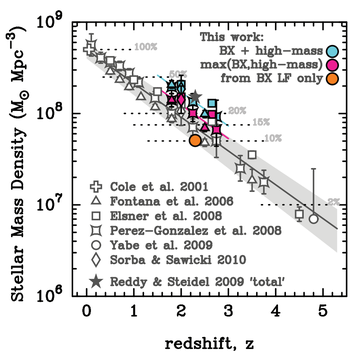
Results:



At z~2 there is a correlation between stellar mass and UV luminosity.

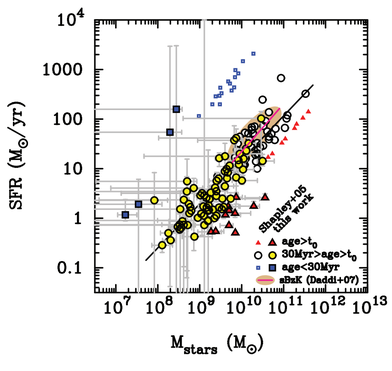
The above mass-luminosity relation allows the z~2 UV LF to be turned into a stellar mass function (right). This mass function reaches to very low masses.





These low-mass galaxies contain more stellar mass than shallower surveys suggest. Consequently, the universe appears to have made 1.5-2 times more stars by z~2 than was previously thought.

At z~2 there is also a correlation between stellar mass and SFR.This correlation can be explained by a simple model in which gas accretes along with DM onto a growing halo and turns into stars inefficiently (efficiency: ~1%).

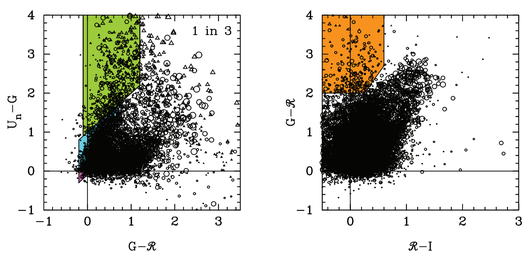


Sawicki 2011

Dark halo masses

Sample:

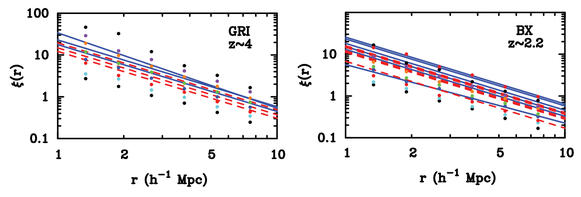
Keck Deep Fields images (Sawicki & Thompson 2005, 2006)
very deep UGRI imaging of 170 sq armin to R~27
LBG, BX, and BM selection a la Steidel et al (1999, 2003, 2004):



2000 z~1.7 galaxies
2400 z~2.2 galaxies
1500 z~3 galaxies
400 z~2 galaxies

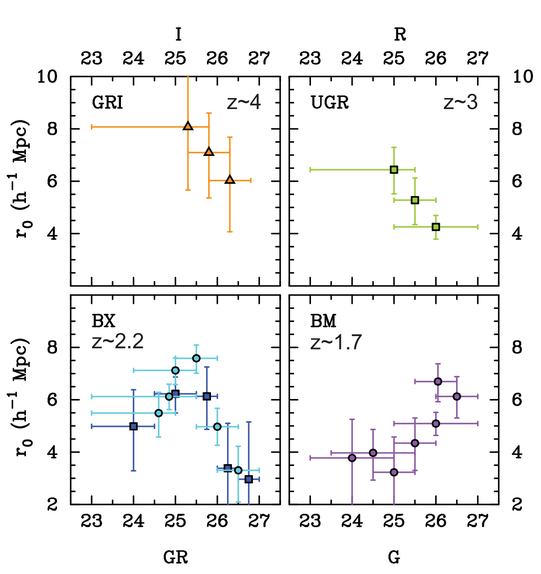
Method:

We measure 2D correlation functions, apply Limber inversion, and compare to clustering of halos in the Millennium simulation.



Points: Millennium simulation halo clustering for mass thresholds log(M/M_{sun}) = 11.0, ...,12.1.
Lines: fits to our clustering measurements.

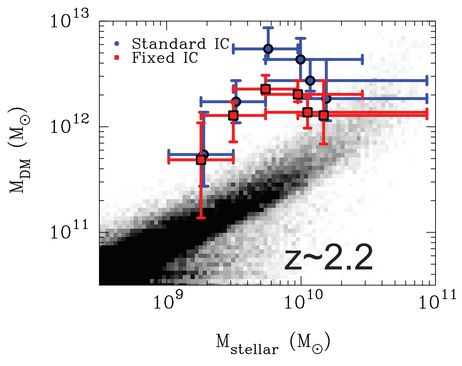
Results:



At z~3 and 4, more luminous LBGs reside in more massive halos (as was known from previous studies).

In contrast, at z~1.7 and 2.2 we see the most strongly clustered population move to lower luminosities.

We interpret this as evidence that star formation may be shutting down in the most massive halos.



Relating dark halo masses (from clustering) to stellar masses (from SED fitting) we get the DM-stellar mass diagram (left).

Observed stellar masses are lower than in semianalytic simulations (grayscale). This may indicate that our galaxies have significant hidden mass that is missed by the SED fitting, or may point to a deficiency in the models.

Savoy, Sawicki, Thompson, & Sato 2011