The Evolving Luminosity Function of Red Galaxies

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Massive Galaxies Over Cosmic Time 2
Red Galaxies

- Ideal for tests of simulations & models.
  - Contain the bulk of the stars at low redshift.
  - Include the most massive low redshift galaxies.
  - Little growth from recent star formation.

Image stolen from SDSS
Bootes Surveys

NOAO Deep Wide-field Survey
Spitzer IRAC Shallow Survey
AGES
Spitzer MIPS Bootes
XBootes
FLAMEX
GALEX

NDWFS I-band
IRAC 3.6\textmu m
Photometric Redshifts

Larger volumes than spec-z surveys.

Photo-zs accurate to +/-0.05 at $I<22$.

Luminosities & colours from SED model fits
Red Galaxy Selection

Selection criterion falls between CMR and blue cloud.

Similar selection used in the recent literature.
39599 red galaxies

astro-ph/0609584
The Luminosity Function

Red galaxies were brighter in the past.

Galaxies per unit volume

Luminosity Density

Stellar pop. model overestimates $j_B$ at $z \sim 1$

Stellar mass in red population increases.

Truncation of SF in blue galaxies.

The Luminosity Function

![Graph showing the luminosity function with different redshifts (z=0.3, z=0.5, z=0.7, z=0.9) and_bootes regions. The x-axis represents absolute magnitude (M_B - 5 log h), and the y-axis represents space density (h^3 Mpc^{-3} mag^{-1}). The graph illustrates the observed luminosity function across various redshifts.]
~4L* Red Galaxies

Steady evolution of luminosity with z

Differs slightly from stellar pop. model

Growth via mergers, but not rapid growth.

Summary

- Red galaxy assembly over the past 7 billion years:
  - Stellar mass within the red galaxy population doubles.
  - Star forming blue galaxies are being transformed.
  - The most luminous galaxies were assembled at z>1.
  - Some simulations overestimate z<1 galaxy assembly.

- Key Remaining questions.
  - What truncates star formation in galaxies?
  - When were massive red galaxies assembled?
  - What are the progenitors of today’s most massive galaxies?
The $z=0.5$ Luminosity Function
The z=0.9 Luminosity Function
Luminosities
Luminosity-Size

4" Flux divided by 6" Flux

0.42 Micron Luminosity ($L_{\text{Sun}}$)

$0.825 < z < 0.875$
Luminosity vs. Colour

(t-band absolute magnitude $M_t - 5 \log_{10} h$ (mag)

[SDSS, D. Hogg]
Observed Galaxy Mergers

Timescales? Significance?

Van Dokkum (2005)