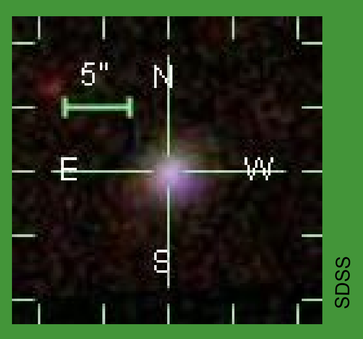
Finding Local Analogues to z~5 Lyman Break Galaxies



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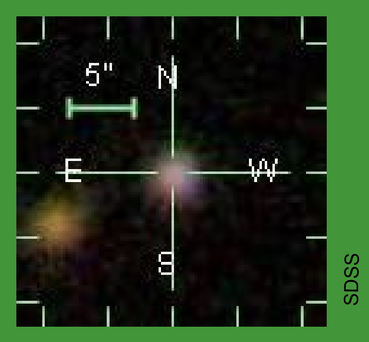


Introduction

Lyman break analogues (or LBAs) are compact, star-forming, and UV-luminous galaxies in the local universe. They are selected to match the characteristics of z~5 Lyman break galaxies (LBGs) in their luminosity, UV-spectral slope and physical compactness. The latter are thought to be the progenitors of today's ellipticals and spiral bulges, and are characterised by the Lyman break spectral feature, which shows a strongly reduced flux at the wavelengths corresponding to (rest-frame) 912Å and 1216Å. Having established a pilot sample of 22 nearby LBA candidates galaxies, we are currently working on refining the selection criteria, as well as investigating the properties of the sample.

Do some local galaxies with similar properties make good analogues to z~5 LBGs?

Candidate Selection

Using GALEX and SDSS data, a pilot sample of 22 good analogue candidates was found. This sample will be extended to include the full overlap region between GALEX and SDSS.

The selection criteria were chosen to mirror the properties of high-redshift LBGs:

- Flat UV spectral slope, such that -0.5<FUV-NUV<0.5 or -0.5<FUV-r<1.0 (in practice the latter did not, however, produce any additional satisfactory candidates),
- Blue: NUV-r<2,
- L_{UV}= 0.1 – 5 $L^*_{z=6}$ with M^*_{UV}= -20.24 at z=6 (Bouwens et al., 2007),
- Spectroscopic redshifts: 0.05<z<0.25.

SED Fitting

To deduce properties of the candidate galaxies, such as mass, age, star formation rate (SFR) and history (SFH), and dust, I developed an SED fitting program, which found the best-fitting model out of Maraston (Maraston, 2005) models with metallicities of 0.5 solar. This metallicity is thought to be a good match to z~5 objects, and is supported in the LBA sample by their SDSS spectra (see also Stanway & Davies, 2014).

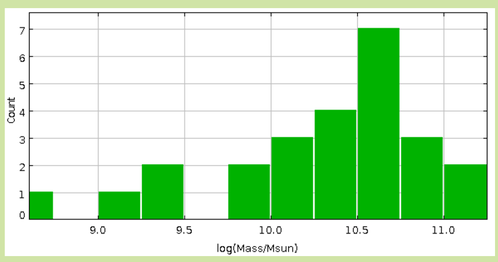
2MASS and WISE data was obtained to extend the available spectrum to the infrared.

Dust Absorption and Extinction

From high- and low-redshift observations, as well as from the line ratios found in the LBA sample, it is clear that they contain dust. In the UV and optical part of the SED fitting, the dust absorption was modelled according to the Calzetti et al. (2000) absorption law, while emission in the infrared part of the spectrum was calculated using the method from da Cunha et al. (2008) with PAH emission features modelled on Smith et al. (2007).

Mass

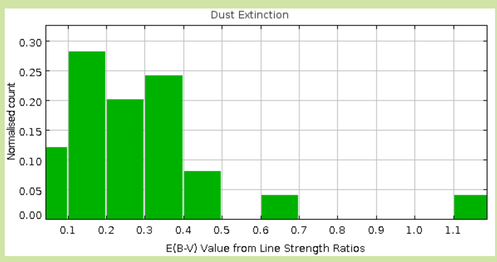
The masses of the galaxies were found to range between 8.6<log($M/M_\odot$)<11.2, with a mean mass of log($M/M_\odot$)=10.3.



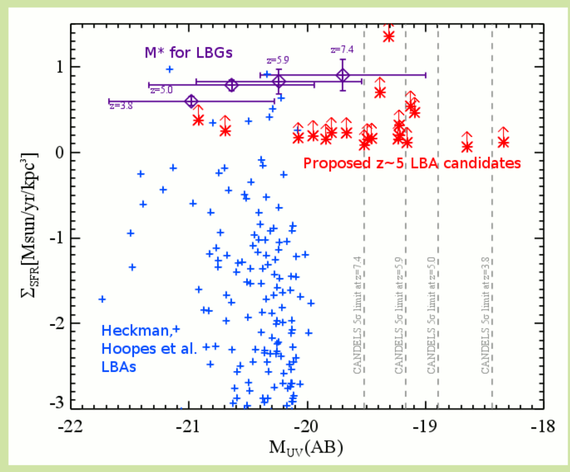
This is slightly higher than the masses suggested by Verma et al. (2007) of log($M/M_\odot$)~9 for z~5 LBGs, but comparable to those indicated by McLure et al. (2009) or Mosleh et al. (2012), which give log($M/M_\odot$)~10 for high-redshift LBGs.

Dust

Dust was found using both the SED fitting code and line strength ratios.
Both methods indicate that the galaxies have low dust extinction, with E(B-V) values between 0.0 and 0.6 from SED fitting, or 0.0 to 1.2 (mean:0.29) from line strength ratios.



Comparison with LBG population



A comparison of the here presented sample with the LBA sample of Hoopes et al. (2007, crosses) and high-redshift LBG samples (diamonds) shows that while our sample is fainter than the Hoopes et al. sample, the star formation density (derived via Madau et al. (1998) conversion factor) appears more in line with those of high-redshift LBGs.

Star Formation Rates

The candidates' lower star formation rate limits were determined using luminosity conversion factors in UV (Madau et al., 1998), and infrared (Lee et al., 2013) at wavelengths of 12 and 22μm based on WISE data. The mean SFR is 2.7 $M_\odot$/yr, with a range of possible SFRs between 0.2 and 10.3 $M_\odot$/yr.

Future Plans

As this is ongoing research, it will be valuable to attempt to answer the following questions:

- Investigate the **metallicities** of the candidate galaxies: how do their metallicities compare to other star-forming galaxies and LBGs? What is their mass-metallicity relationship?
- What is the **spatial abundance and distribution** of LBAs, how does it compare to other UV-luminous objects? By using the AAOmega spectrograph, for which we currently have a programme under way, we are seeking to obtain near-complete spectroscopy of a colour selected sample in a 2° field. This will enable us to determine the efficiency of colour selection, and hence derive an accurate space density, free from biases introduced by SDSS follow-up selection.
- By using **radio** observations of the galaxies, it can be determined whether their luminosity is indeed due to active star-formation, or due to other astrophysical processes. Some of the objects have already been followed up with ATCA and the VLT.

References

Bouwens et al., 2007, ApJ, 670, 928
Calzetti et al., 2000, ApJ, 533, 682
da Cunha et al., 2008, MNRAS, 388, 1595
Hoopes et al., 2007, ApJs, 173, 441
Lee et al. 2013, ApJ, 774, 10
Madau et al., 1998, ApJ, 498, 106
Maraston, 2005, MNRAS, 362, 799
McLure et al., 2009, MNRAS, 395, 2196
Mosleh et al., 2012, ApJ Lett, 756, L12
Stanway, Davies, 2014, MNRAS, 439, 2472
Smith et al., 2007, ApJ, 656, 770
Verma et al., 2007, MNRAS, 377, 1024

Also see: Stanway, Greis et al. (2014, submitted);
Greis et al. (2014, in prep).

For **further information**, please see:

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