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BUILDING THE BRIDGE BETWEEN DAMPED LYα ABSORBERS AND LYMAN-BREAK GALAXIES

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RESUMEN

El resumen será traducido al español por los editores. In 2000, we started the program "Building the Bridge between Damped Lyman-α Absorbers and Lyman-Break Galaxies: Lyα Selection of Galaxies" at the European Southern Observatory's Very Large Telescope (VLT). This project is an attempt to use the Lyα selection of high-redshift galaxies to bridge the gap between absorption- and emission-line selected galaxies by creating a large database of $z \approx 3$ galaxies belonging to the abundant population of faint (R $>$ 25.5) galaxies associated to Damped Lyα Absorbers (DLAs). Here we present the first part of our program, namely results from a deep Lyα study of the field of the $z = 2.85$ DLA toward the quasar Q 2138$-$4427.

ABSTRACT

In 2000, we started the program "Building the Bridge between Damped Lyman-α Absorbers and Lyman-Break Galaxies: Lyα Selection of Galaxies" at the European Southern Observatory's Very Large Telescope (VLT). This project is an attempt to use the Lyα selection of high-redshift galaxies to bridge the gap between absorption- and emission-line selected galaxies by creating a large database of $z \approx 3$ galaxies belonging to the abundant population of faint (R $>$ 25.5) galaxies associated to Damped Lyα Absorbers (DLAs). Here we present the first part of our program, namely results from a deep Lyα study of the field of the $z = 2.85$ DLA toward the quasar Q 2138$-$4427.

Key Words: **GALAXIES: HIGH-REDSHIFT**

1. INTRODUCTION

During the last decade, the observational study of high-redshift galaxies went through a revolution due to the advent of 8–10 m class telescopes and their instrumentations, allowing spectroscopic redshifts to be measured for galaxies as faint as R $\sim$ 25. Most of this progress, in terms of sample size, came from the study of Lyman-Break Galaxies (LBGs) selected by the sharp drop in the continuum of star-forming galaxies at the Lyman limit (Steidel et al. 1996; Fontana et al. 2000). In addition, the study of the dust and metal contents of high-redshift Damped Lyα Absorbers (DLAs) provides an independent look at the properties of high-redshift galaxies (see Pettini et al. 1997; Ledoux et al. 2002 and refs. therein). However, the number of galaxy counterparts of DLAs detected in emission has remained low, with only a handful of successes (see Møller et al. 2002 and refs. therein), implying that the bulk of the DLA galaxy population is significantly fainter than LBGs. This is because LBG samples are continuum-flux limited and the current spectroscopic limit of R = 25.5 in (ground-based) samples is not deep enough to reach the level of galaxies probed by DLAs (Fynbo et al. 1999).

2. THE "BUILDING THE BRIDGE" SURVEY

In 2000, we started the program "Building the Bridge between Damped Lyman-α Absorbers and Lyman-Break Galaxies: Lyα Selection of Galaxies" at the VLT (+FORS). This project is an attempt to use the Lyα selection to bridge the gap between absorption- and emission-line selected galaxies by creating a large database of $z \approx 3$ galaxies belonging to the abundant population of faint (R $>$ 25.5) galaxies associated to DLAs (Fynbo et al. 1999; Haehnelt et al. 2000). While targetting the fields of QSO metal-rich absorption line systems at $z \approx 3$, our main goal is not to detect the galaxy counterparts of the absorbers but to anchor our fields to previously known structures at the target redshift, therefore minimizing the risk of observing a void. We choose to use Lyα selection as it has been shown to be an efficient way to probe the faint end of the galaxy luminosity function of high-z galaxies (see Møller et al. 1993; Francis et al. 1995; Cowie & Hu 1998; Kudritzki et al. 2000; Pentericci et al. 2000, Fynbo et al. 2001 for examples of spectroscopically confirmed samples).

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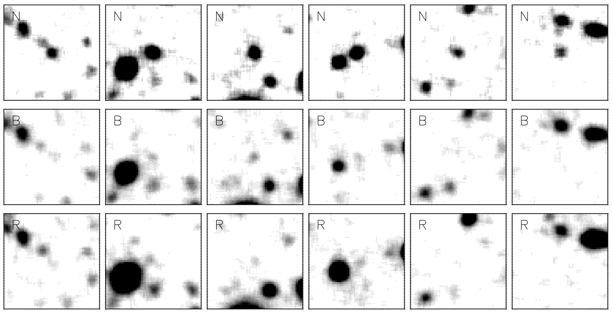

Fig. 1. Six examples of candidate $z = 2.85$ Lyα emitters in the field of Q 2138−4427. The size of each image is 12×12 arcsec^2. The upper rows are the narrow-band images of the candidates, the middle rows the B-band images and the bottom ones the R-band images. Several ($\sim$ 20%) of our candidates remain undetected in the broad bands despite 5σ detection limits of B(AB) = 27.0 and R(AB) = 26.4.

3. FIRST RESULTS

So far, the observations of the field of the $z = 2.85$ DLA towards the quasar Q 2138−4427 are complete. In this field, we detect 35 candidate Lyα emitters probing a redshift range $\Delta z = 0.053$. Six examples are shown in Fig. 1. The inferred density of candidates is about 15 arcmin^{-2} per unit redshift to a 5σ flux limit of 6×10^{-18} erg s^{-1} cm^{-2}, a surface density which is about 15 times larger than that for LBGs (Steidel et al. 1996). This is consistent with the fact that $\sim$ 90% of our candidates are fainter than the R = 25.5 spectroscopic limit for LBGs. Hence, we have already bridged at least some of the gap between LBGs and DLAs.

The glare of the quasar is reduced by 1.5 magnitudes in the narrow-band image due to the strong Damped Lyα Absorption line. This makes it much easier to detect the faint emission from a possible galaxy counterpart of the DLA close to the line of sight. After PSF subtraction, we detect an extended source at an impact parameter of only 1.4 arcsec from the QSO in the narrow-band image. This is a prime candidate for the DLA galaxy (see Fig. 2).

Spectroscopic follow-up of this first sample of candidate Lyα emitters is under way.

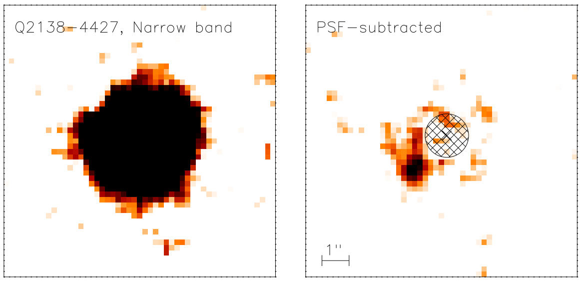

Fig. 2. *Left panel:* A 10×10 arcsec^2 narrow-band image centred on the quasar Q 2138−4427. *Right panel:* The same region after PSF subtraction of the QSO light showing excess emission 1.4 arcsec SE of the QSO position. The hashed area indicates the region where the residuals from the PSF subtraction are large. With upcoming spectroscopic observations with FORS at the VLT, we will be able to determine if this candidate is actually the DLA galaxy counterpart.

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