Lyα emitters in the field of GRB 000301C [1]

1. Observations and data reduction

Spectroscopic observations were obtained with the blue arm of LRIS (Oke et al. 1995) on Keck I during the night of 3 July 2002. A simple mask with straight slits was used with a slit position angle of 43° E of N. The observing conditions were extremely poor, observations were conducted through many magnitudes of extinction and were frequently interrupted due to loss of guide star. The relative throughput of the atmosphere was determined from the reference stars for each exposure, and optimal signal-to-noise weights were calculated. The effective seeing on the optimally combined (Møller & Warren 1993) image was 1.92 arcsec. Standard corrections for bias, flat fielding and sky subtraction were done using tasks within IRAF. For the wavelength calibration we used Hg and Cd lamp spectra.

2. Results

We targeted candidate Lyα emitters in the field of the Gamma Ray Burster GRB 000301C. The targets were selected from the candidate lists in Fynbo et al. (2002) and in what follows we shall follow Fynbo et al. and refer to the targets as candidate "LEGOs". In Fig. 1 we reproduce the field with the GRB galaxy marked by a cross and the candidate LEGOs marked with circles. The objects are clearly not randomly distributed across the field. Their tendency to populate the lower left part of the CCD image is reminiscent of the field of Q 1205–30 (Fynbo, Thomsen & Møller 2000) where an elongated 2D distribution of candidates later was shown (Møller and Fynbo 2001) to map out a narrow filament in 3D redshift space. Our aim with this spectroscopic study was to test if a similar filamentary structure has been found in the field of GRB 000301C. In Fig. 1 we have, for comparison, drawn two dotted lines separated by

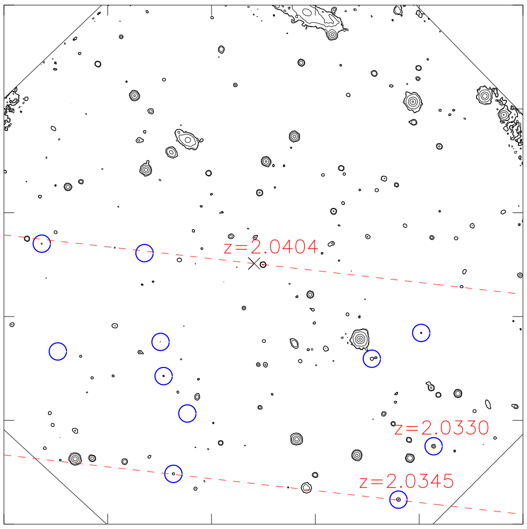

Fig. 1.— The 11 candidate LEGOs in the field of GRB 000301C are marked by circles, GRB 000301C itself is marked by a cross. The three objects with known redshifts are identified. In case this image intersects a filament at z≈ 2 (hypothetical filament outline marked by dotted lines) we would predict that redshifts of LEGOs in the Eastern part of the field should have redshifts larger than 2.04. N is up and E is to the left.

[1] Data presented herein were obtained at the W.M. Keck Observatory, which is operated as a scientific partnership among the California Institute of Technology, the University of California and the National Aeronautics and Space Administration. The Observatory was made possible by the generous financial support of the W.M. Keck Foundation.

1290 kpc ($\Omega = 0.3$, $\Omega_\Lambda = 0.7$, $H_o = 65$ km s^{-1} Mpc^{-1}). The two lines enclose all LEGO candidates in the field, and their separation is 1.6 times the width of the Q 1205–30 filament.

Despite the poor observing conditions we obtained enough signal to confirm the two brightest candidates in this field, candidates named S301_7 and S301_9 in the list of Fynbo et al. (2002). In Fig. 2 we show the two emission lines (dispersion direction up/down, spatial direction right/left) and in Table 1 we summarise their properties. The redshifts of the two LEGOs are 2.0330 ± 0.0005 (S301_7) and 2.0345 ± 0.0005 (S301_9). The absorption redshift of the GRB is 2.0404 ± 0.0008 (Jensen et al. 2001) and in Fig. 1 those three objects are also marked with their redshifts.

In Fig. 3 we plot the spatial profiles of the two Lyα lines and compare them to the profile of a reference star. Under such poor seeing conditions it is not possible to tell if the sources are extended. S301_9 fits the seeing profile very well but S301_7 appears to have a flat wide top (this is also apparent in Fig. 2). In the dispersion direction S301_9 is unresolved and could have intrinsic FWHM in the range 0-450 km s^{-1} (2σ). S301_7, on the other hand, is significantly wider than the resolution. This could be interpreted as either a single Lyα line with intrinsic velocity width 380 ± 140 km s^{-1}, or it could be due to the internal motion inside a resolved object. As pointed out above there is weak evidence suggesting that the objects is extended, an observation supported by inspection of the Lyα image. In fact it is often seen that high redshift Lyα emitters resolve into several subcomponents when imaged at HST resolution (the object S3 in Møller & Warren (1998), the host galaxy of GRB 000926 (Fynbo et al. 2002), and the DLA galaxies N-14-1C and N-16-1D (Møller et al. 2002)).

For future checks against consistent redshift determination, I also plot a comparison of the two Lyα lines against the underlying sky spectrum (Fig. 4).

3. Conclusion and Discussion

We targeted 11 candidate LEGOs. Due to poor weather conditions only the two brightest could be confirmed. The non-detections are fully compatible with the predicted S/N for the remainder of

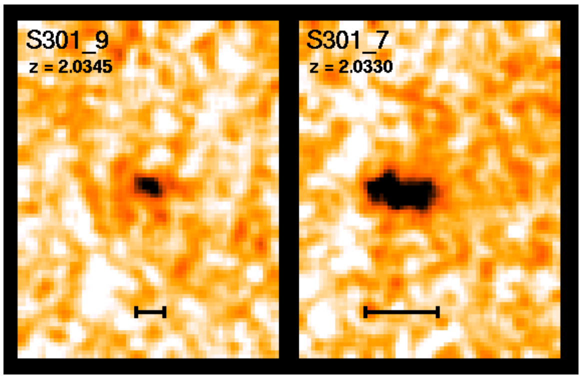

Fig. 2.— Lyα emission lines of the two confirmed LEGOs. Dispersion is up/down, slit direction is left/right. The two bars are of length 1.″1 and 2.″4 respectively.

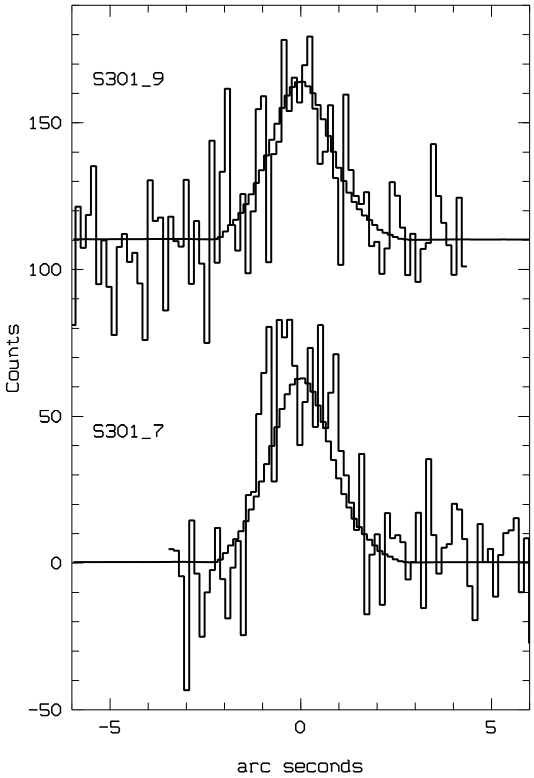

Fig. 3.— Spatial profiles of the two Lyα lines. The overlay profile is that of a reference star.

the candidates under such poor conditions, and the confirmation rate of the Fynbo et al. candidate list is therefore 100% (2 of 2 possible).

Our aim was to test the hypothesis that GRB 000301C and the 11 LEGO candidates in the surrounding field all sit in the same filament in 3D redshift space. Under this hypothesis there should be a simple correlation of redshifts across the field. The three redshifts we have so far obtained do not contradict this hypothesis. The two redshifts in the SW corner are almost identical and they are significantly lower that the redshift of the GRB. Therefore, under the above hypothesis, redshifts of the objects in the Eastern part of the field are predicted to be higher than 2.04.

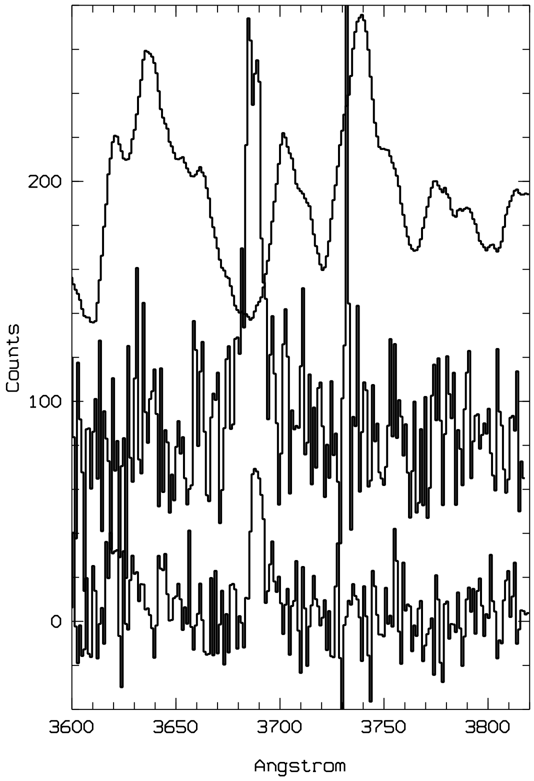

Fig. 4.— Lyα emission lines set against the underlying sky spectrum.

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This 2-column preprint was prepared with the AAS LaTeX macros v5.0.

Table 1

LEGO properties

Object ID	S301_7	S301_9
RA(2000)	$16^{\mathrm{h}}20^{\mathrm{m}}09\overset{\mathrm{s}}{.}526$	$16^{\mathrm{h}}20^{\mathrm{m}}11\overset{\mathrm{s}}{.}251$
dec(2000)	$29^\circ24'37\overset{''}{.}52$	$29^\circ24'02\overset{''}{.}54$
z	2.0330 ± 0.0005	2.0345 ± 0.0005
Lyα flux in 3″diameter aperture	17.7 ± 0.9^a	14.6 ± 0.9^a
Lyα EW(rest)	96^{+25}_{-18}	73^{+18}_{-14}
Lyα FWHM	380 ± 140 km s^{-1}	< 450 km s^{-1} (2σ) km s^{-1}
U(AB) in 3″diameter aperture	$24.83^{+0.12}_{-0.10}$	$24.90^{+0.12}_{-0.11}$
I(AB) in 3″diameter aperture	$25.92^{+3.90}_{-0.74}$	$24.64^{+0.39}_{-0.28}$

^{a}Lyα fluxes given in units of 10^{-17} erg s^{-1} cm^{-2}