FUNDAMENTAL PROPERTIES OF GRB-SELECTED GALAXIES: A SWIFT/VLT LEGACY SURVEY

PÁLL JAKOBSSON

Centre for Astrophysics Research, University of Hertfordshire, College Lane, Hatfield, Herts, AL10 9AB, UK

JENS HJORTH and JOHAN P. U. FYNBO

Dark Cosmology Centre, Niels Bohr Institute, University of Copenhagen, Juliane Maries Vej 30, 2100 Copenhagen, Denmark

JAVIER GOROSABEL

Instituto de Astrofísica de Andalucía (CSIC), Apartado de Correos 3004, 18080 Granada, Spain

ANDREAS O. JAUNSEN

Institute of Theoretical Astrophysics, PO Box 1029, 0315 Oslo, Norway

We present the motivation, aims and preliminary result from the *Swift*/VLT legacy survey on gamma-ray burst host galaxies. This survey will produce a homogeneous and well-understood host sample covering more than 95% of the lookback time to the Big Bang, and allow us to characterize their fundamental properties.

1. Introduction

With a very broad redshift distribution and a mean redshift of around $z = 2.8$,[1] gamma-ray bursts (GRBs) are becoming extremely useful tracers of star-forming galaxies. Long-duration GRBs are known to be associated with the deaths of short-lived massive stars[2] and thus have the essential advantage that their detection requires only a single stellar progenitor. Therefore, their detection is in principle independent of host galaxy luminosity.

The *Swift* satellite and a suite of ground-based observatories are detecting, localizing and studying a large homogeneous sample of GRBs. To take advantage of this unique sample, we have launched a dedicated programme aimed at building up a sample of host galaxies, based on *Swift* detections and VLT follow-up. This is a Large Programme to be executed over a period of two years. The resulting host sample will be largely unaffected by dust extinction and entirely independent of host galaxy luminosity. A more thorough description of the survey and preliminary results are presented in Hjorth et al. (in prep).

The details of the sample selection are relatively straight-forward, i.e. the GRBs

have to be well-placed for optical follow-up observations: (i) Detected by *Swift* after 1 March 2005 when it was fully operational and automatically slewing. (ii) An X-ray position is available, obtained by the *Swift* XRT detector. (iii) The Galactic extinction is less than $A_V < 0.5\,\mathrm{mag}$. (iv) Declination favorable for VLT and not at a polar declination, i.e. $-70^\circ < \mathrm{dec} < 25^\circ$.

2. Aims

The concrete goals of the programme are to: (i) Identify the GRB hosts, reaching a limit of around $R = 27.0$ and $K = 21.5$, which will allow us to detect extremely red objects. For non-detections of hosts we will spend additional time to reach a limit of around $R = 28.0$. While hosts have been detected for nearly all pre-*Swift* localized GRBs, almost none have been detected in the *Swift* era. (ii) Measure redshifts for GRBs without absorption redshifts. (iii) Search for the Lyα emission line when possible, i.e. for bursts with a known redshift $z \gtrsim 2$. (iv) Study the effects of dust reddening within hosts. (v) Determine the host luminosity function. Finally, we will perform detailed studies of particularly interesting targets, e.g. short-duration GRB hosts and very bright hosts. Specifically, we will carry out emission line diagnostics, e.g. metallicity estimates via the R_{23} method.[3]

3. Results

The final host sample is expected to consist of approximately 70 galaxies of which a major fraction will have redshifts. The programme so far has consisted mostly of target build-up, observational preparation, data taking and preliminary analysis. To date, only six months after the start of the programme, we have completed roughly half of item (i) above; R- and K-band imaging of three of the hosts is displayed in Fig. 1 as an example. The current average and median R-band magnitude of the sample is fainter than 25.5.

With this programme, we hope to detect a number of faint galaxies (such as the GRB 030323 host[4]) that possibly dominate[5] the total star-formation density at $z \gtrsim 2$, but are impossible to find and study by other methods than GRB selection. But most importantly, we will produce a coherent sample of GRB host galaxies for future follow-up with the *HST*, *Spitzer*, VLT, and later with ALMA and *JWST*.

References

1. P. Jakobsson, et al. *A&A*, **447**, 897 (2006).
2. J. Hjorth, et al. *Nature*, **423**. 847 (2003).
3. J. Gorosabel, et al. *A&A*, **444**, 711 (2005).
4. P. Vreeswijk, et al. *A&A*. **419**, 927 (2004).
5. P. Jakobsson, et al. *MNRAS*, **362**, 245 (2005).
6. N. R. Butler, *AJ*, submitted, astro-ph/0611031.

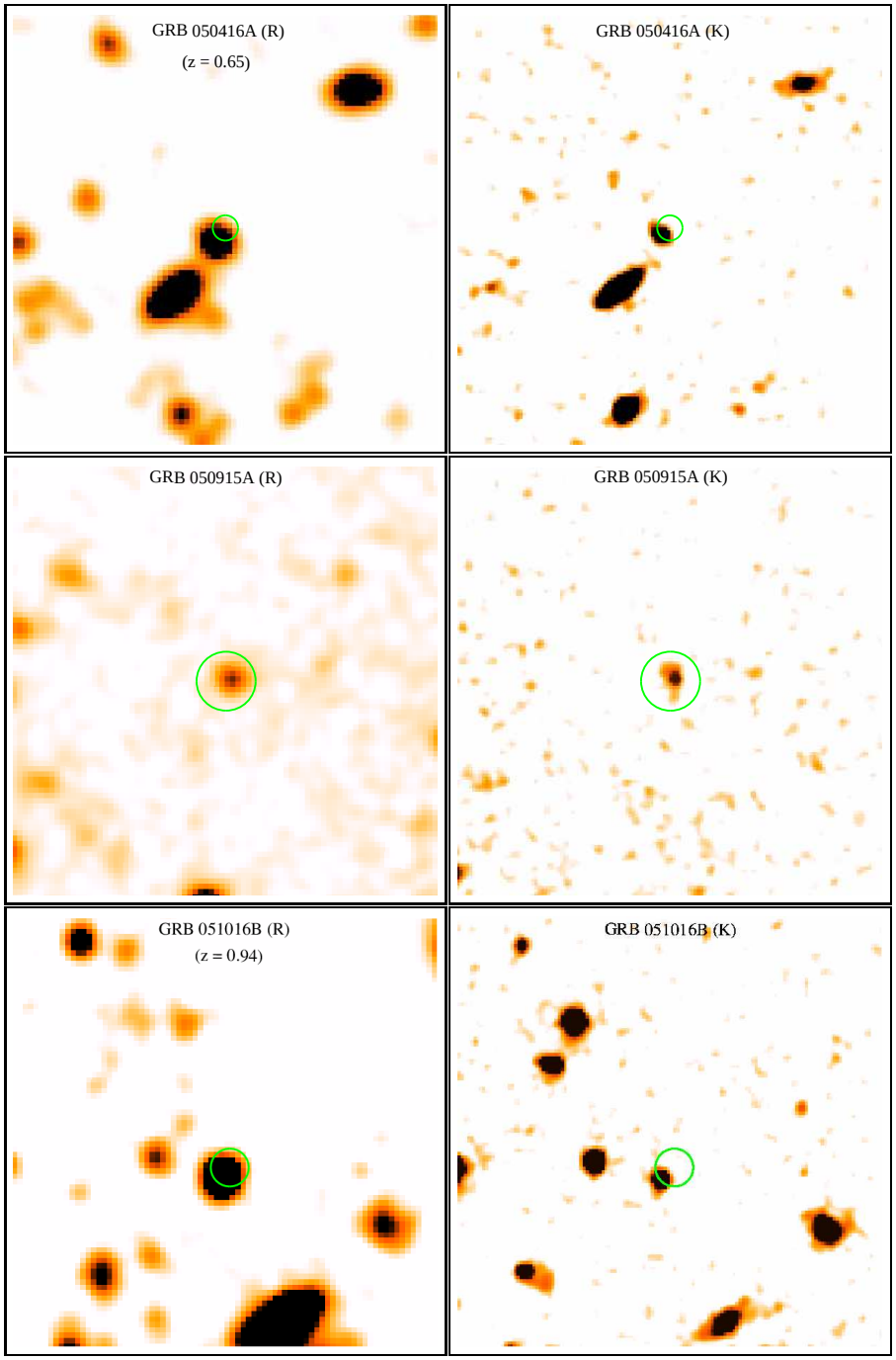

Fig. 1. A mosaic of three of the targets; left column displays the R-band while the K-band is in the right column. The host galaxy is detected in both bands for all targets, and is located inside the revised[6] XRT error circle in each case (solid circle). Each host galaxy also coincides with the corresponding optical afterglow. The GRB 050915A host and all the K-band host detections have not been reported before. North is up and east left in each panel which is $20''$ on a side.