

## 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  $z = 2.8$ ,<sup>1</sup> 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<sup>2</sup> 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

2 *P. Jakobsson*

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  $A_V < 0.5$  mag. (iv) Declination favorable for VLT and not at a polar declination, i.e.  $-70^\circ < \text{dec} < 25^\circ$ .

## 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 Ly $\alpha$  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.<sup>3</sup>

## 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<sup>4</sup>) that possibly dominate<sup>5</sup> 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.

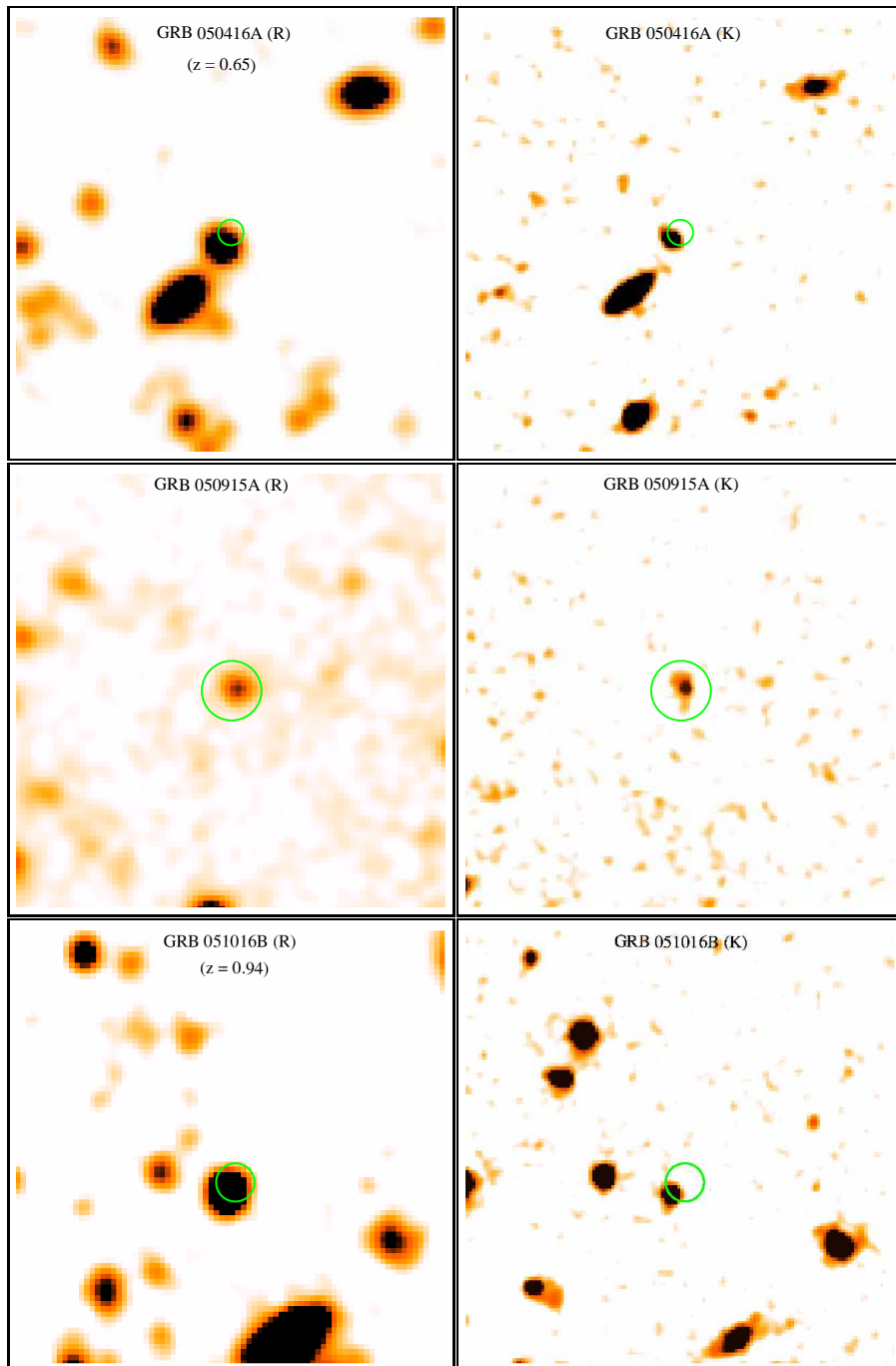


Fig. 1. A mosaic of three of the targets; left column displays the *R*-band while the *K*-band is in the right column. The host galaxy is detected in both bands for all targets, and is located inside the revised<sup>6</sup> XRT error circle in each case (solid circle). Each host galaxy also coincides 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.