New insights on GRB host galaxies from XSHOOTER observations

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On behalf of the French-Italian X-shooter collaboration for the study of GRB host galaxies

Special guests: S. Savaglio, P. Petitjean and J. Fynbo
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**XSHOOTER: 2nd Generation instrument @ VLT**

- 3 echelle spectrographs
- Full range 3000 – 24000 Å in a single shot
- Resolution 5000 – 10000
- Slit length 11”
- Integral field unit 1.8” x 4”
- \( m(AB) \sim 21 \) (1h, SNR=10; \( K(AB) \sim 19 \))

**P.I. Board:** Sandro D'Odorico (Chair), Francois Hammer, Lex Kaper, Per Kjaergaard Rasmussen, Sofia Randich

**Project Manager:** Hans Dekker

**Instrument Scientists:** Joël Venet (Garching), Elena Mason (Paranal)

- Copenhagen University Observatory, Niels Bohr Institute (DK)
- Institute for Physics and Astronomy in Aarhus (DK)
- Astronomical Institute 'Anton Pannekoek' from the University of Amsterdam (NL)
- Department of Astrophysics from the University of Nijmegen (NL)
- Netherlands Foundation of Research in Astronomy (ASTRON, NL)
- Osservatorio Astronomico di Brera (INAF, IT)
- Osservatorio Astronomico di Trieste (INAF, IT)
- Osservatorio Astronomico di Palermo (INAF, IT)
- Osservatorio Astrofisico di Catania (INAF, IT)
- GEPI, Paris Observatory (FR)
- AstroParticule et Cosmologie institute (Universite Paris 7, CNRS and CEA, FR)
- European Southern Observatory (ESO)

April 19-23, 2010, Kyoto, Japan
Open to the community from October 2009
Consortium GTO time: partly dedicated to GRB science

**French-Italian GTO to study GRB host galaxies:** about 160 hours over 3 years
PIs: Silvia Piranomonte (INAF-Rome) / Hector Flores (GEPI-Paris)

- Slit spectroscopy: \( z \geq 1 \) host galaxies
- IFU observations: \( z<1 \) host galaxies
  - Velocity field and a velocity dispersion map for each detected emission line.
  - Electron density, metallicity, extinction and star formation measures.
Open to the community from October 2009
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Slit spectroscopy: \( z \geq 1 \) host galaxies

- Extend emission lines spectroscopic host galaxy studies to high redshift: SFR, extinction, metallicity... (e.g. Savaglio et al. for \( z<1 \))
- Comparison with GRB-DLAs
- Comparison with surveys of galaxies
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New instrument: first selection based on galaxies with one or more emission lines already detected in the optical

GRB 021004 $z \approx 2.3$
GRB 000210 $z \approx 0.8$
GRB 000911 $z \approx 1.1$

-November 2009-

GRB 990506 $z \approx 1.3$
GRB 011211 $z \approx 2.1$

-March 2010-

GRB 000418 $z \approx 1.1$
GRB 060801 $z \approx 1.3$
GRB 030328 $z \approx 1.5$
GRB 080520 $z \approx 1.5$

-Now-

**GRB 000210**: [OII], [OIII], H-gamma, H-beta, H-alpha
Piranomonte et al. in preparation
GRB 021004

One of the best studied GRB

Afterglow light curve sampled from X to radio
VLT/UVES afterglow spectrum (and many other)
Lyman-alpha emission in the afterglow spectrum

HST host galaxy observations UVB to NIR (Fynbo et al. 2005):
m_r = 24.4
Blue starburst galaxy

Tentative [OIII] and H-alpha VLT/ISAAC detections
(Castro-Tirado et al. 2010)

SCUBA observations (Tanvir et al. 2004):
no detection
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Absorbers at $z=2.3289$

Emission of Lyman-alpha $z=2.33167$
$\Delta v = 250 \text{km/s}$

Absorption up to $3000 \text{km/s}$:

- WR wind? (Fiore et al. 2005; ...)
- Close-by galaxy? (Chen et al. 2007; ...)

UVES afterglow spectrum
2 strong MgII intervening systems (Vergani et al. 2009;...)

MgII doublet

GRB 021004 \( z = 1.3800 \)

GRB 021004 \( z = 1.6026 \)

\[ \text{[OIII]} \text{ emitter at 16'' } \sim 100 \text{ kpc} \]

Vreeswijk et al. 2003

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X-shooter observations (nodding)

Slit position 1
Slit  UVB 1.0''  R=5100  t_exp=4800
     VIS 0.9''  R=8800  t_exp=4800
     NIR 0.9''  R=5100  t_exp=5200

Slit position 2
Slit  UVB 1.0''  R=5100  t_exp=3600
     VIS 0.9''  R=8800  t_exp=3600
     NIR 0.9''  R=5100  t_exp=5200

Slit position 3
Slit  UVB 1.6''  R=3300  t_exp=4800
     VIS 1.5''  R=5400  t_exp=4800
     NIR 1.5''  R=3300  t_exp=5200
**Preliminary results** (Vergani et al. in preparation)

Detection of $\text{[OIII]}5700\text{Å}$ doublet, H-alpha, Ly-alpha, H-beta on a sky line

Tentative NII Limit for $\text{[OII]}$; $\text{[OIII]}/\text{[OII]} > 4$

Integrated continuum only detection

2D NIR spectrum (slit position 1) $\text{[OIII]}$; $z = 2.33102$
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2D UVB spectrum

$z = 2.33177$

Spatially more extended than [OIII]

Asymmetric profile typical of LAE

Shift of about 70 km/s
Lyman-alpha absorption difference of 1/10 only (a few $10^{17}$ ergs/s/cm$^2$)
Properties and distribution of the neutral gas

Verhamme et al. 2006

NHI, Vexp, b
Extended Lyman-alpha emission

Jakobsson et al. 2005

ACS image / Narrow-band contours

Ly alpha excess (position 1)

Ly alpha excess (position 2)

about 1/7 of the total flux

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Interactions between the host and ‘A’?

High velocity absorbers: outflowing gas?

IFU observations

No detections of intervening absorbers counterparts
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GRB100418A UVB XSHOOTER

FeII, FeII*, CrII, ZnII, MgII and MgI absorption lines

$z=0.6235$  GCN 10620

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![Graph showing spectral lines](Image)

- [OII] 4959
- H-δ
- H-γ
- H-β
- [OIII] 4959
- [OIII] 5007

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GRB100418A NIR XSHOOTER

H-α

Arbitrary Units

10400  10500  10600  10700  10800  10900  11000

Angstrom

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