

X-Shooter GRB Host Galaxies French-Italian GTO

H. Flores/ S. Vergani
On behalf of a larger collaboration

X-Shooter

2nd generation instrument @ ESO/VLT echelle spectrographs

Full range 3000–24000 Å in a single shot

Resolution 5000 – 10000

Slit 11''

Integral field unit 1.8'' x 4''

P84 --> P90 : GTO to the consortium (Denmark, Italy, Netherlands, France)

Consortium GTO program: GRB afterglow spectra

PIs : J. Fynbo (DARK)

Italian-French GTO program to study GRB host galaxies

PIs : S. Piranomonte (INAF-Rome) / H. Flores (GEPI-Paris)

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The study of the chemical composition of long GRB host galaxies, from $z \sim 0.1$ up to 3.5.

1) Host galaxies with $z < 1$: IFU Mode observations. (France)

- Velocity field and a velocity dispersion map for each detected emission line.
- Maps electron density, metallicity, extinction and star formation.

2) GRBs host galaxies with $0.5 < z < 3.5$ (Italy)

- measure their star formation activity and metallicity,
- estimate their dust content
- in general to understand the galaxy evolution at different redshifts

Status

- 30 hosts observed in long slit

- complementary to Danish GTO
- 15 with $0.8 < z < 1.5$ (Piranomonte+ in prep.)
- 15 $z > 1.5$, 10 $z > 2$ (Vergani+ in prep.)

~ no systematic spectroscopic studies at $z > 1$ before

~ 14 hosts observed in IFU

$z < 0.5-1$ (Flores+ in prep.)

1st IFU survey of GRB hosts

Italian-French GTO program to study GRB host galaxies

GRB 070306 @ $z=1.5$ (Vergani+ in prep.)

DARK GRB : A_v (afterglow) = 5.5 (Jaunsen+08; Krühler+11)

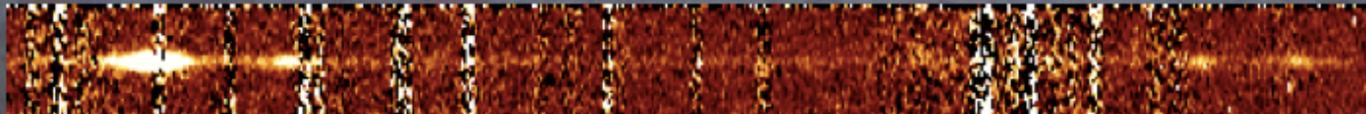
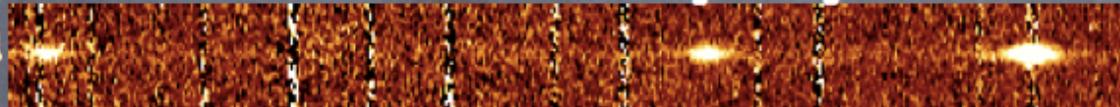
Luminous blue galaxy

$\log(M_{\text{star}}) = 10.4 M_{\text{sun}}$

X-shooter NIR arm

[OIII] doublet

H-beta



H-alpha [NII]

[SII] doublet

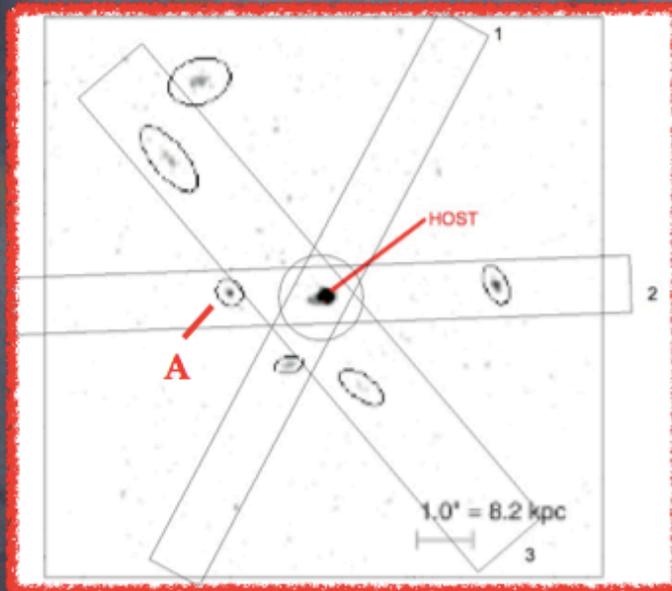
SFR $\sim 100 M_{\text{sun}}$

$12 + \log(\text{O}/\text{H}) \sim 8.4$

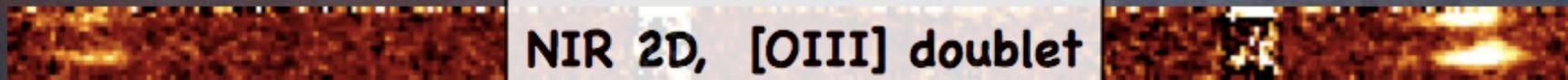
$A_v \sim 1.3 \neq 0.1-0.5$ (Jaunsen+08)

Italian-French GTO program to study GRB host galaxies

Interactions



NIR 2D, [OIII]5007



and other cases @ $z > 1$

SN/LGRB connection with X-shooter

GRB091127/SN2009nz **z=0.490**
(Cobb+10; Berger+11; Vergani+11)

GRB100316D/SN2010bh **z=0.0591**
(Starling+10; Bufano+12; Chornock+10; Cano+11)

GRB101219B/SN2010ma **z=0.552**
(Sparre+11)

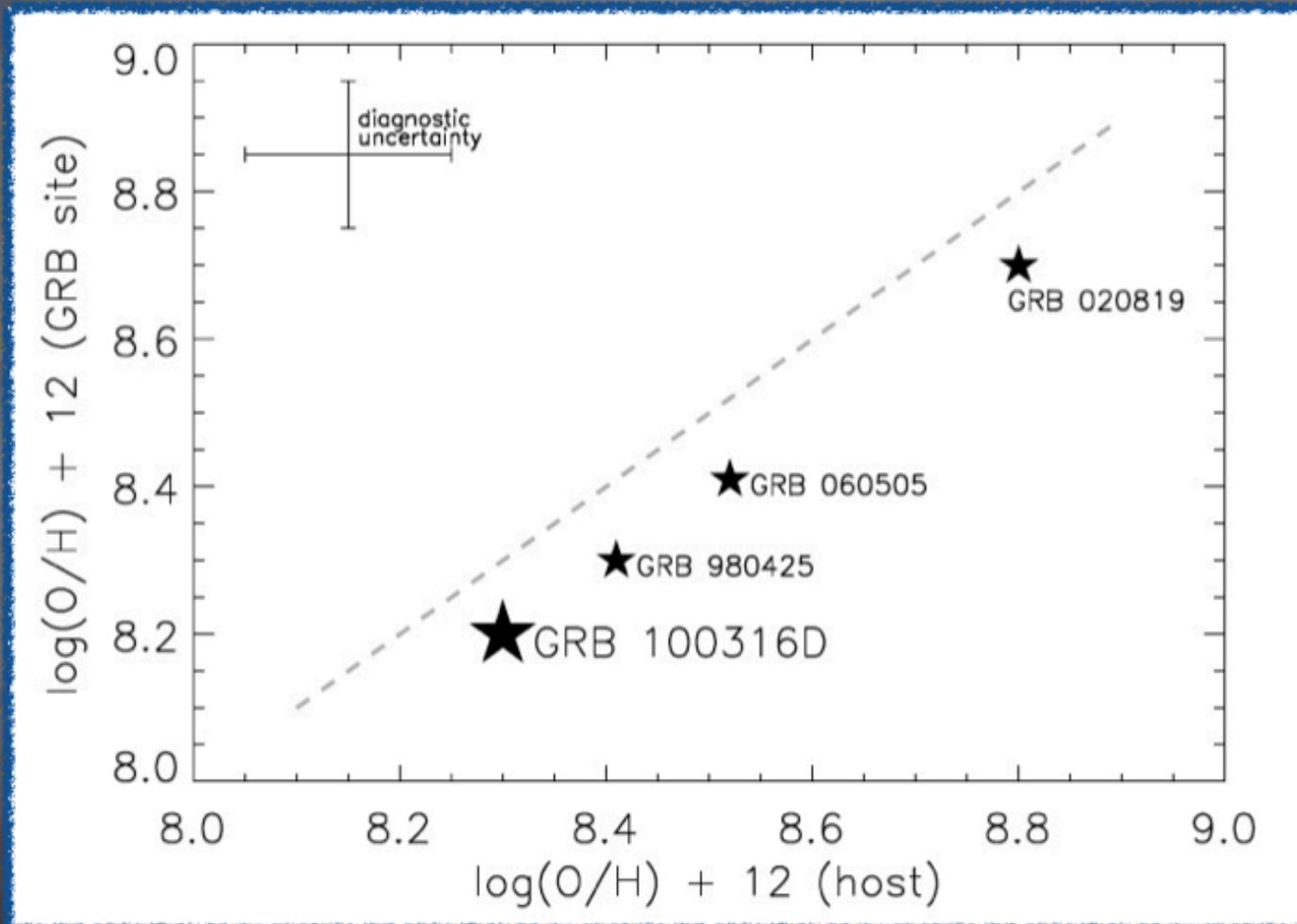
Consortium GTO program: GRB afterglow spectra

PIs : J. Fynbo (DARK)

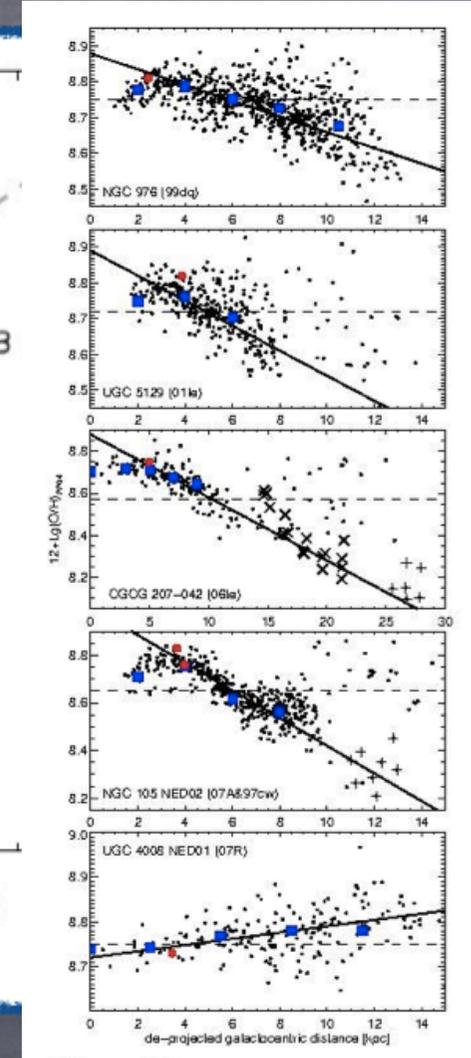
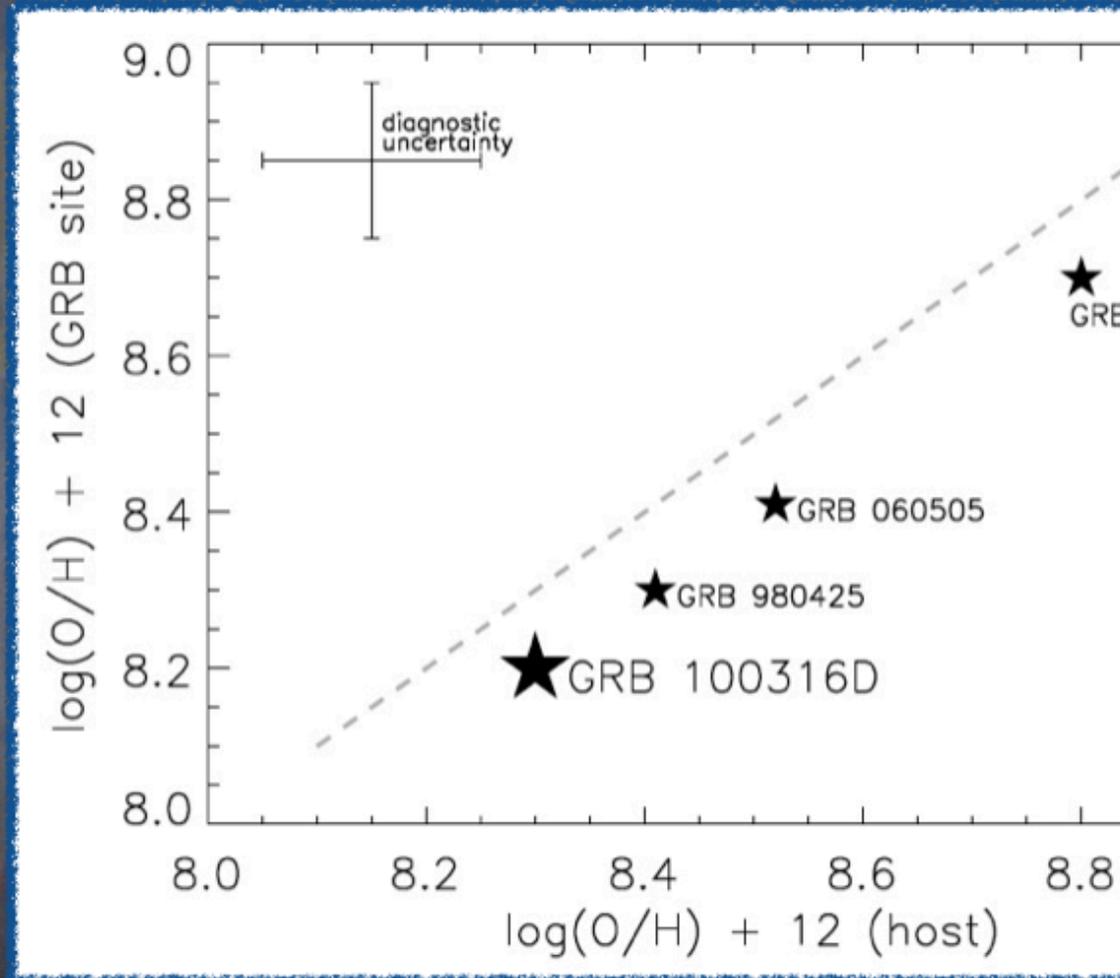
Italian-French GTO program to study GRB host galaxies

PIs : S. Piranomonte (INAF-Rome) / H. Flores (GEPI-Paris)

Levesque+11



Levesque+11



Stanishev et al, submitted

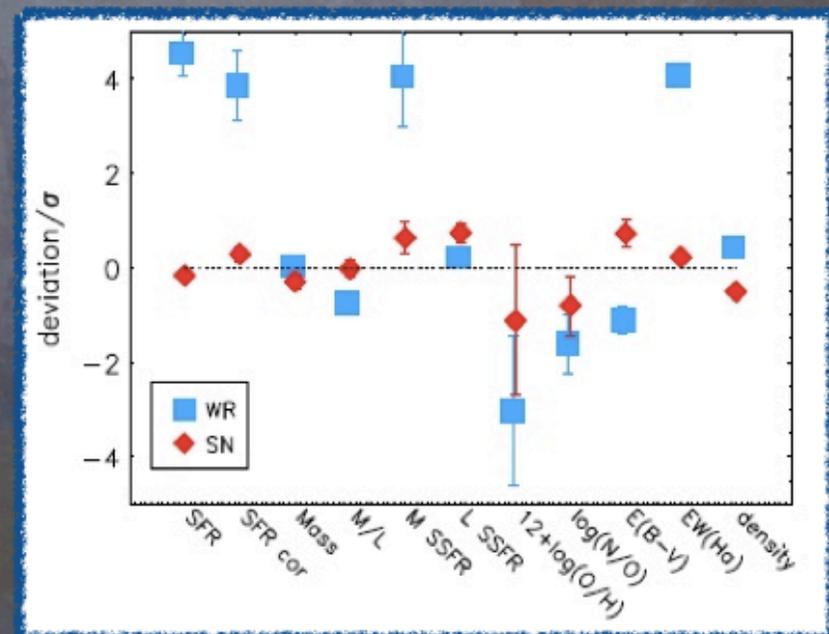
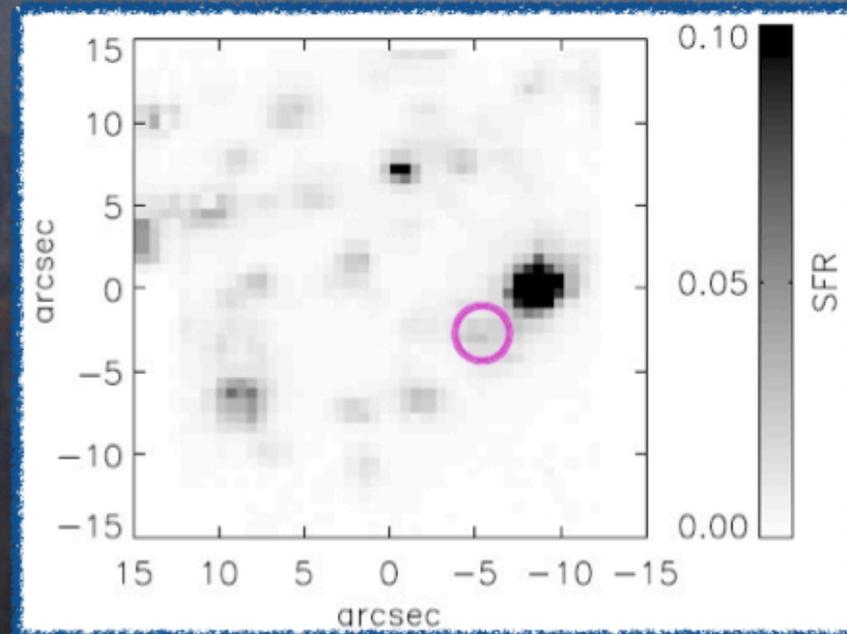
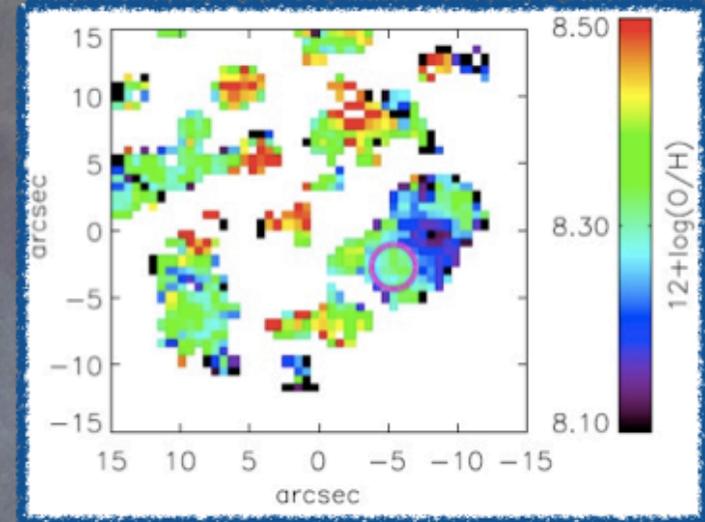
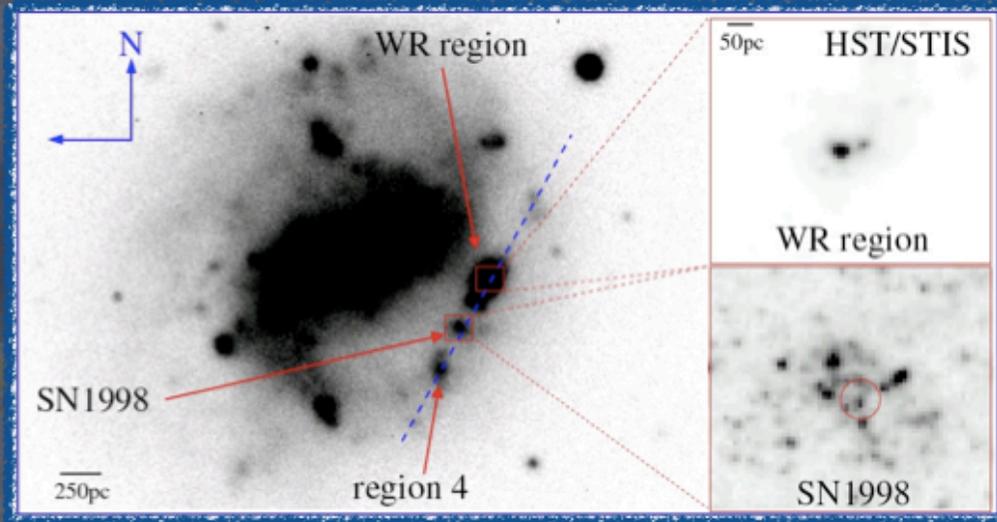
Local SN and Sp shows the same behavior: Lower metallicity in the external regions

IFU studies

Hammer+06

GRB980425 $z=0.0085$

Christensen+08



ARGUS observations of the GRB

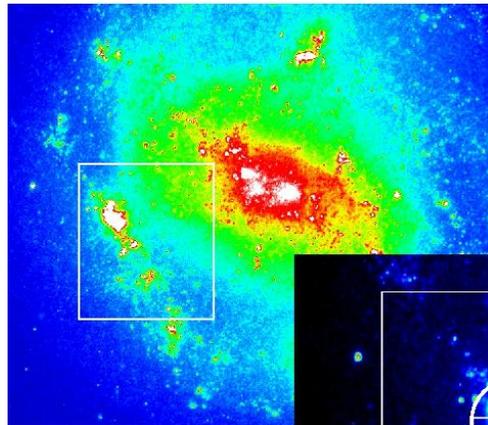
Argus Observations R ~ 27000

GRB950425

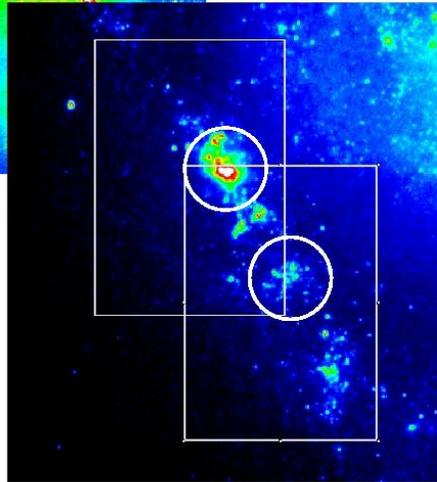
Ha Flux

VF

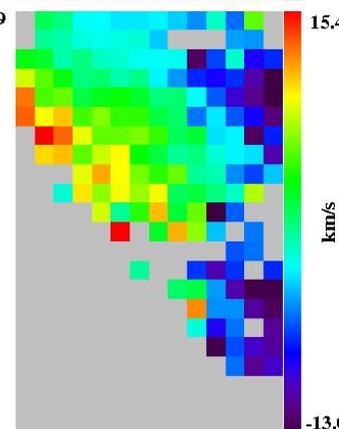
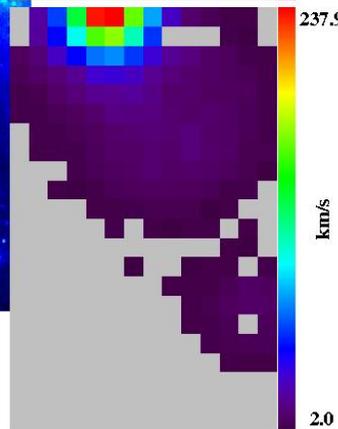
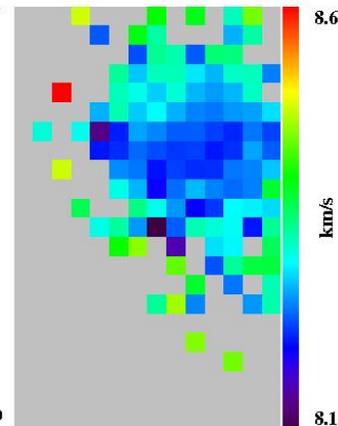
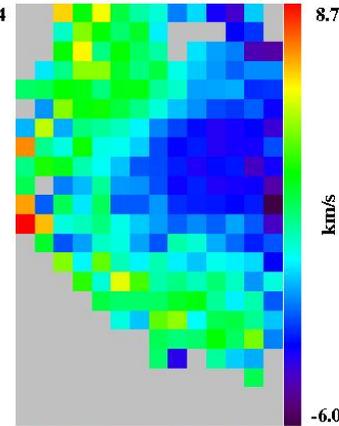
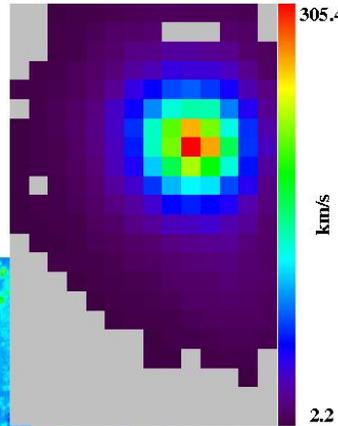
Metallicity NII/Ha



WR region



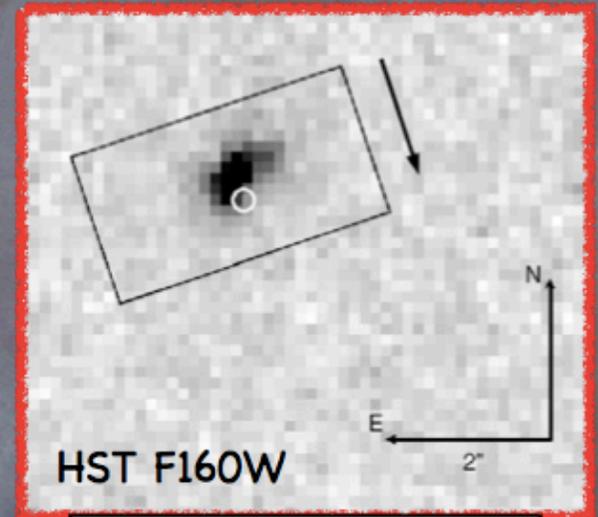
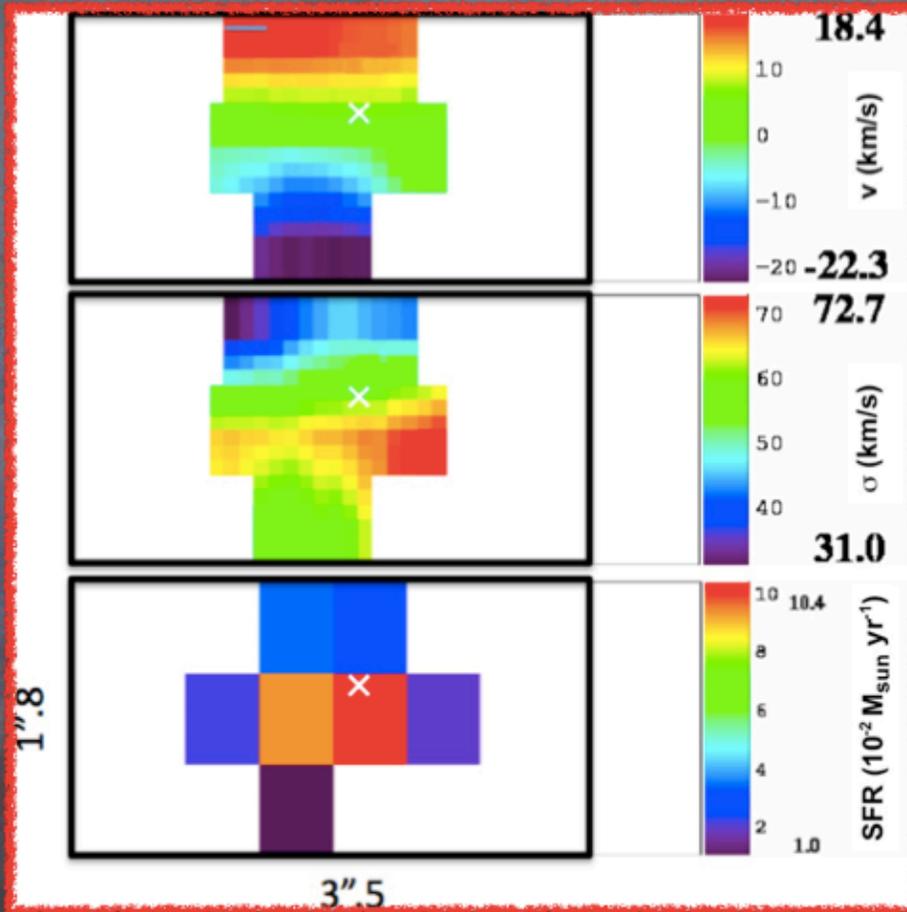
GRB



GRB091127/SN2009nz $z=0.49$ (Vergani+11)

X-shooter IFU spectroscopy

velocity



HST F160W

spaxels: $0.6 \times 3.6 \text{ kpc}^2$

Galaxy with perturbed rotation (see Flores+06, Puech+06)

Next step: check the metal map

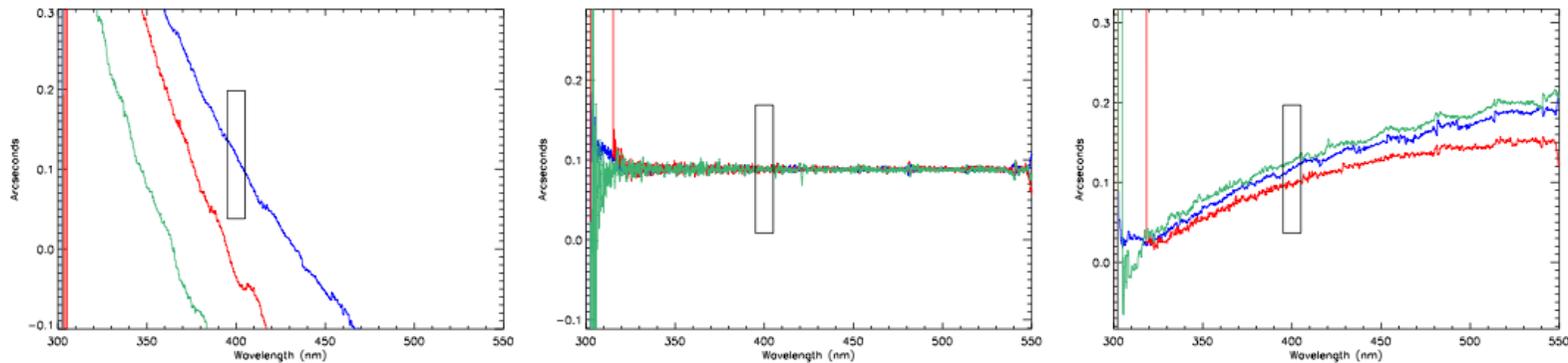
Status of the IFU program:

Target	# of runs
GRB990712	2
GRB020903	2
GRB030329	
GRB031203	3
GRB050223	
GRB050709	
GRB050826	
GRB060505	2
GRB060614	No detected
GRB060729	
GRB091127	
GRB100620A	
GRB100316D	2

Galaxies under analyses, method to reconstruct the datacube validate by ESO
Present in the release of the DRS

Main problem.....

UVB the arm more affected by the AD

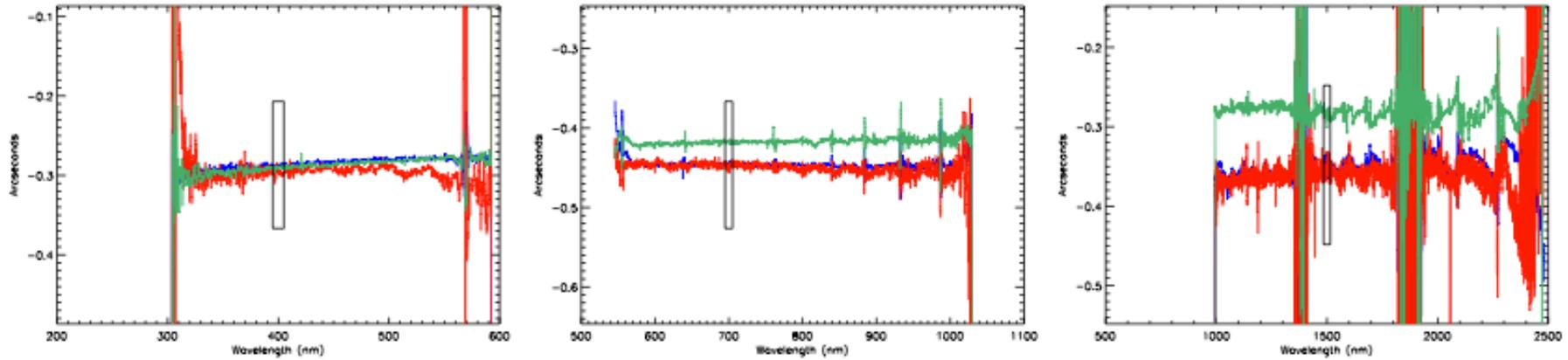


Left: Traces without correction, the traces are not aligned, the effect of differential refraction is very strong.

Center: A self calibrated cube at airmass 1.16, the traces are perfectly aligned

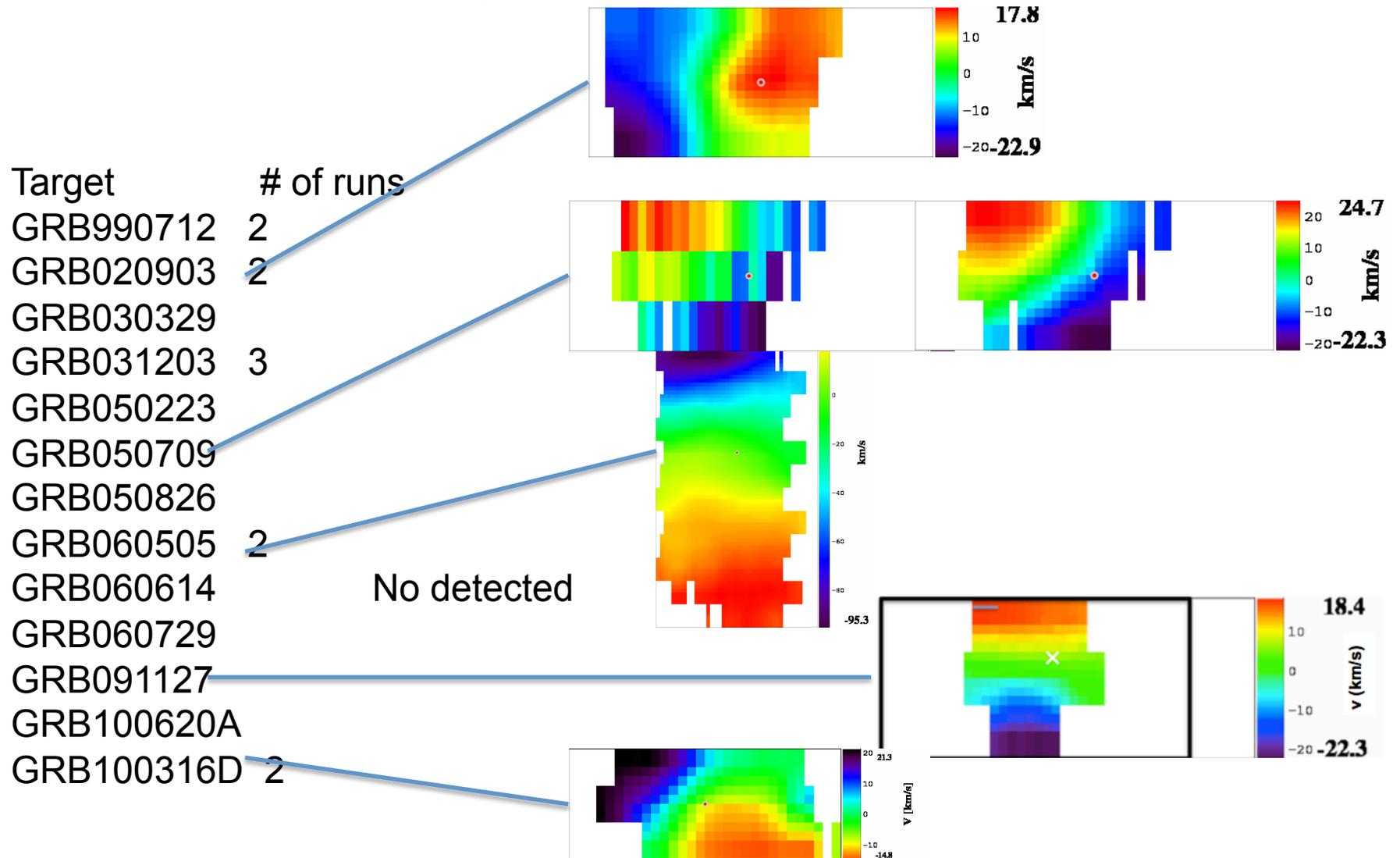
Right: Cube of the first star calibrated with the tables from another star observed with the same airmass.

A second example, the alignment is better than 0.1 arcsec



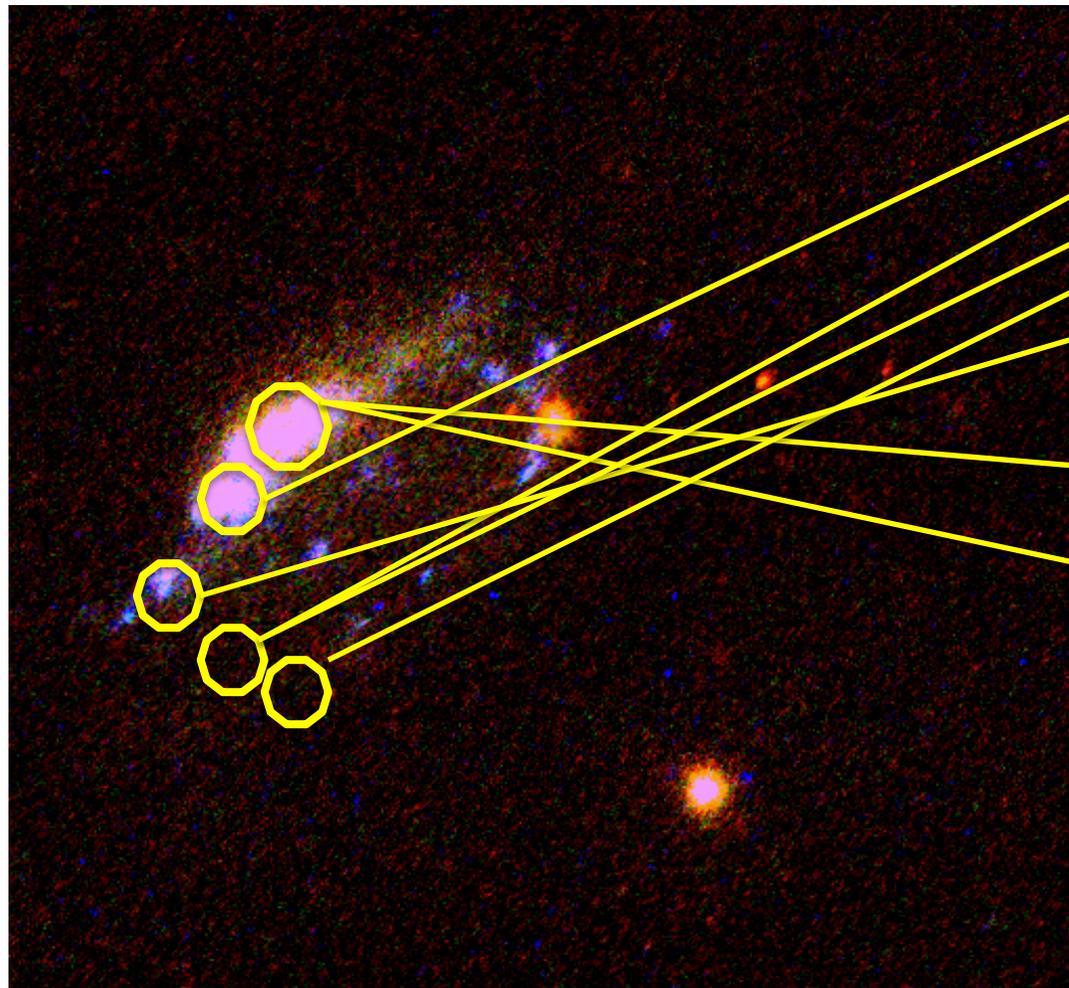
The traces are well aligned and the effects of atmospheric dispersion are much smaller than before ($<$ spaxel size).

Status of the IFU program:



Galaxies under analyses, method to reconstruct the datacube validate
 Present in the release of the DRS

GRB100316D: X-Shooter Long slit observation



DATE-OBS
2010-03-17_1
2010-03-17_2
2010-03-17_3
2010-03-17_4
2010-03-17_5
2010-03-19
2010-03-17

A_v from $H\gamma$, $H\beta$ and $H\alpha$
Z from preliminary measures
Of OII OIII and NII

New observations with X-Shooter / IFU mode reduced

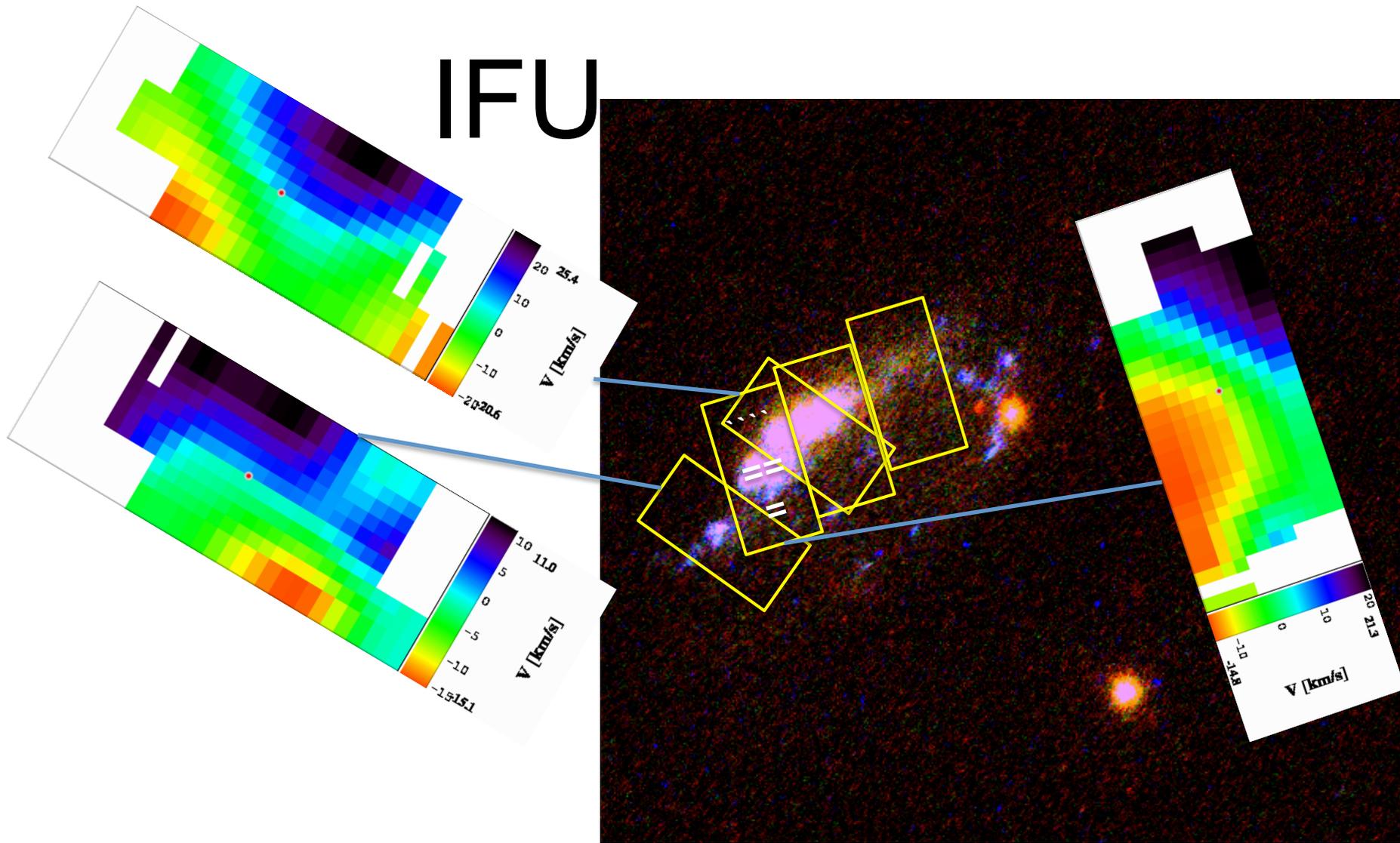
(Flores et al, in prep)

Properties

DATE-OBS	A_v	$Z (\pm 0.25)$	Ne [OII]/cm ³	
1. 2010-03-17_1	0.00-0.33	8.25	1025.8	SN
2. 2010-03-17_2	0.18-0.25	8.32	991.7	
3. 2010-03-17_3	0.20-0.50	8.27	996.7	
4. 2010-03-17_4	0.98-0.40	8.47	1482.6	
5. 2010-03-17_5	0.00-0.00	8.26	958.2	
6. 2010-03-19	0.23-0.00	8.23	998.0	
7. 2010-03-17	0.30-0.59	8.26	1043.0	

Detection of He in the region 6 :: possible signature of WR, analysis ongoing....

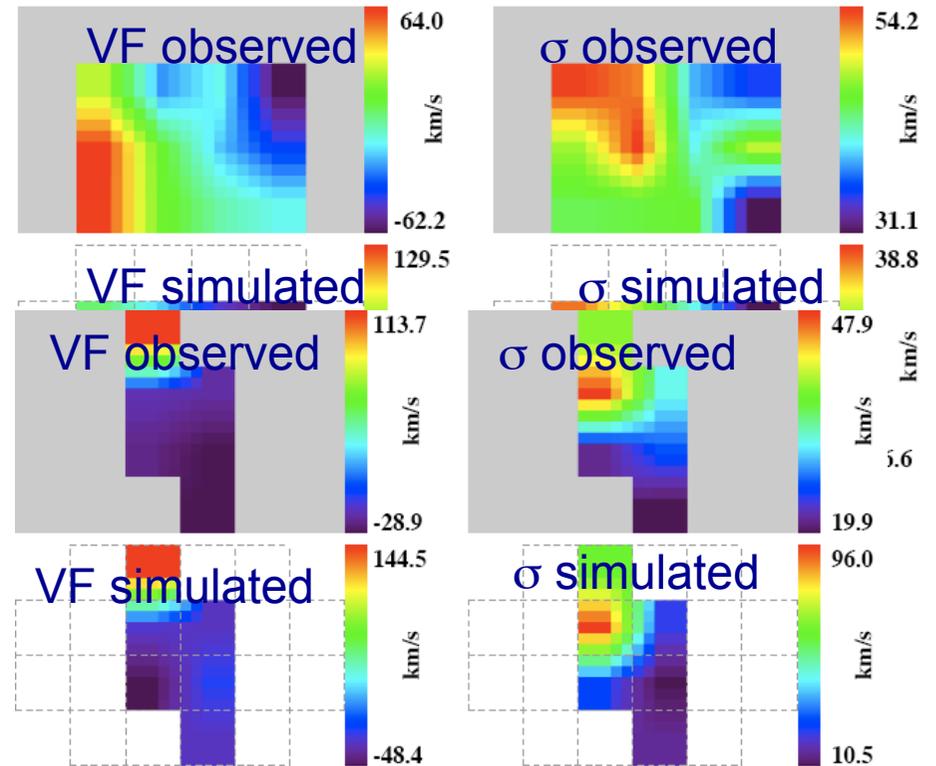
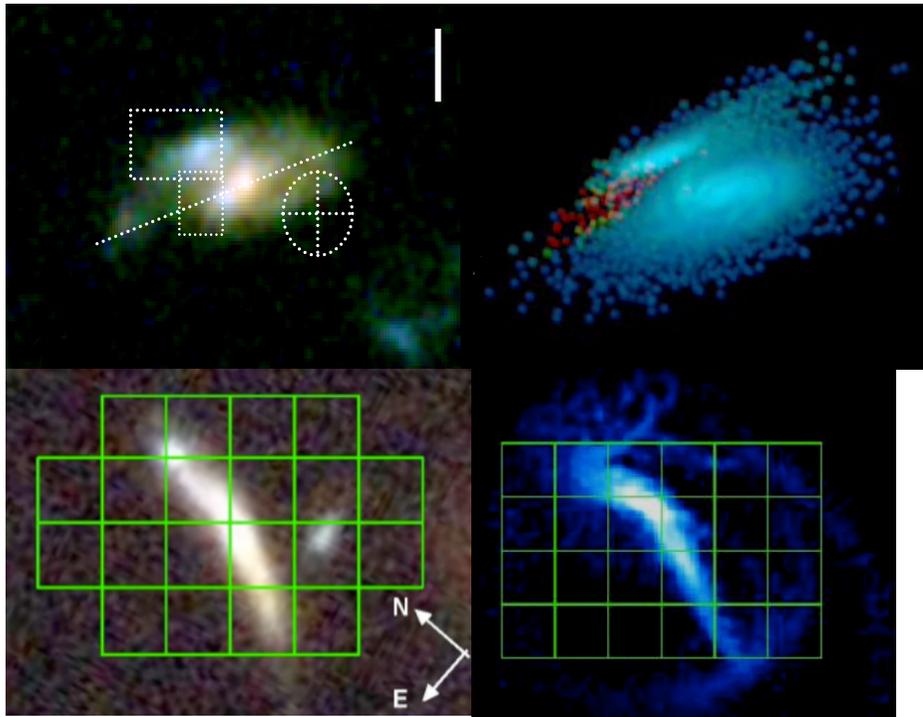
IFU



Next step : Mosaic of 5 exposure VF sigma, metal content etc.....

Goal: check whether its environment is comparable to the one of super star clusters known to be capable of ejecting stars at high velocities.
Distance between HII region and GRB close to 400pc....

Next step : a grid of numerical model



Field galaxies at $z \sim 0.4-0.8$

Hammer et al. 2009, A&A, 507, 1313

Fuentes-Carrera et al. 2010, A&A, 513, 43

Summary & Conclusions

French Italian GTO SLIT: All the data is already reduced IFU: soon.

IFU: Distant GRBs at low z : V_F & σ showing perturbed rotations or complex kinematics

→ First “flux calibration” test with the GRB091027: SFR map:: (Vergani et al 2011)

→ Next galaxy used to test the flux calibration GRB020903 & the mosaic of GRB101603D

→ host galaxy GRB10316D : IFU (5 pointing) and SLIT (7 pointing) analysis ongoing with the

possible signature of WR? Secure?

