

Multi-purpose InSTRument for Astronomy at Low resolution



Credit: http://www.obs-hp.fr/guide/mistral/MISTRAL_spectrograph_camera.shtml

How to analyse MISTRAL data: hunting for GRB redshifts with low-resolution spectroscopy

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07/04/2022 - Observatoire de Haute-Provence

MISTRAL instrument

Multi-purpose
InSTRument for
Astronomy at
Low resolution

- Low resolution spectro-imager on the 193 cm telescope at Observatoire de Haute-Provence
- Spectral resolution of ~ 700
- 2 channels:
 - Blue (4 000 to 8 000 Å)
 - Red (6 000 to 10 000 Å)
- 9 filters for photometry (SDSS g'r'i'z' + narrow band filters)

Common absorption lines in GRB afterglow spectra

OI	CII	AlII	AlIII	ZnII	MgI	MnII	MgII	CaII
1302.2 (1304.9) (1306.0)	1334.5 (1335.7)	1670.8	1854.7 1862.8	2026.1 2062.7	2026.5	2576.9 2594.5 2606.5	2796.3 2803.5	3934.8 3969.6

SiII	SiII	SiII
1260.4 1304.4 (1309.3)	1526.7 (1533.4)	1808.0 (1816.9) (1817.5)

FeII	FeII	FeII	FeII	FeII
1608.4	2344.2 2374.5	2382.8 (2411.3)	2249.9 2260.8	2586.7 2600.2
... many FS	... many FS	... many FS	... many FS	... many FS

CIV	SiIV	NV
1548.2 1550.8	1393.3 1402.7	1238.8 1242.8

Lyman limit	Lyman alpha
912	1215.7

Wavelength in Å
() = Fine Structure (FS)

Concrete examples on FORS2 data

- GRB050730 ($z=3.9693$, easy)
 - Lyman limit ($13.6 \text{ eV} \Rightarrow 912 \text{ \AA}$, guarantees GRB redshift)
 - Lyman alpha (1216 \AA)
 - Lyman alpha forest
 - Fine Structure (FS) lines are a strong clue for GRB redshift
 - Intervening systems
 - Tellurics

Summary

- Use 1D and 2D spectra !
- Most important features:
 - Lyman limit
 - Lyman alpha
 - Doublets (SiII, CII, FeII, MgII, CaII, CIV, SiIV...)
- For GRB redshift, look for fine structure lines (OI, SiII, FeII...) or Lyman limit
- Be aware that at low resolution, certain doublets and fine structure lines will be blended
- Beware of telluric absorption and sky emission

Concrete examples on FORS2 data

- GRB060210 ($z = 3.9112$)
 - Many features, strong lines
- GRB050401 ($z = 2.8983$)
 - Wide Damped Lyman-Alpha (DLA)
- GRB050319 ($z = 3.2425$)
 - Lyman alpha not as evident
- GRB050908 ($z = 3.3467$)
 - GRB is not always a DLA
- GRB050408 ($z = 1.2356$)
 - High SNR but no Lyman alpha
 - Redshift we find is not necessarily GRB redshift
 - Need FS lines but they are gone after more than a few hours

Concrete examples on FORS2 data

- GRB070611 ($z = 2.0394$)
 - Only MgII from intervening system
 - No information below/above 4000/8000 Å for MISTRAL
- GRB050802 ($z = 1.7102$)
 - Non-trivial, complicated case
- GRB060512 ($z = 2.1?$)
 - No redshift, just limit from absence of Lyman alpha drop
- GRB060719 ($z < 4.6$)
 - Only noise, too faint
- GRB060115 ($z = 3.5328$)
 - Double trace on the 2D
- GRB060708 ($z < 2.8, z = 1.92?$)
 - Double trace on the 2D but GRB is the fainter one !