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The host galaxies of GRBs & peculiar/extreme SNe

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The host galaxies of GRBs & peculiar/extreme SNe

LGRB & MASSIVE STARS

LGRBrate = efficiency x SFR ?

Which are the progenitor star conditions needed to have a LGRB?

Single star models predict very low metallicity for the progenitor star

Aim: infer information on the progenitor through host galaxy studies

How: Comparison of the properties of LGRB host galaxies
with those of star-forming galaxies
(weighted by their SFR)

LGRB HOST GALAXIES

POPULATION STUDIES: COMPLETE UNBIASED SAMPLES

- TOUGH: 69 galaxies, z completeness 85%, photometry
  Hjorth+12

- X-Shooter sample: 96 galaxies, complete up to z<1, spectroscopy
  Krühler+15

- ***Swift*/BAT6: 58 galaxies, z completeness 97%, photometry & spectroscopy**
  Salvaterra+12

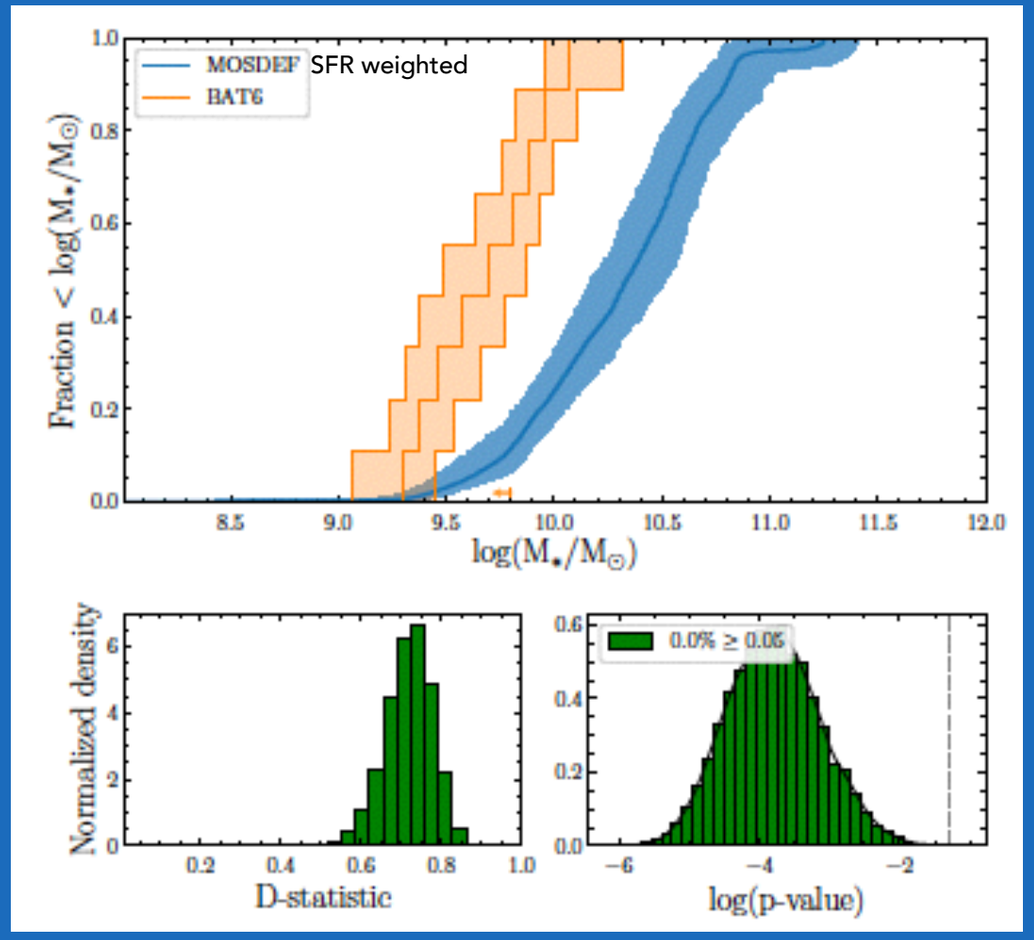
- SHOALS: 119 galaxies, z completeness 92%, photometry
  Perley+16

LGRB HOST GALAXIES

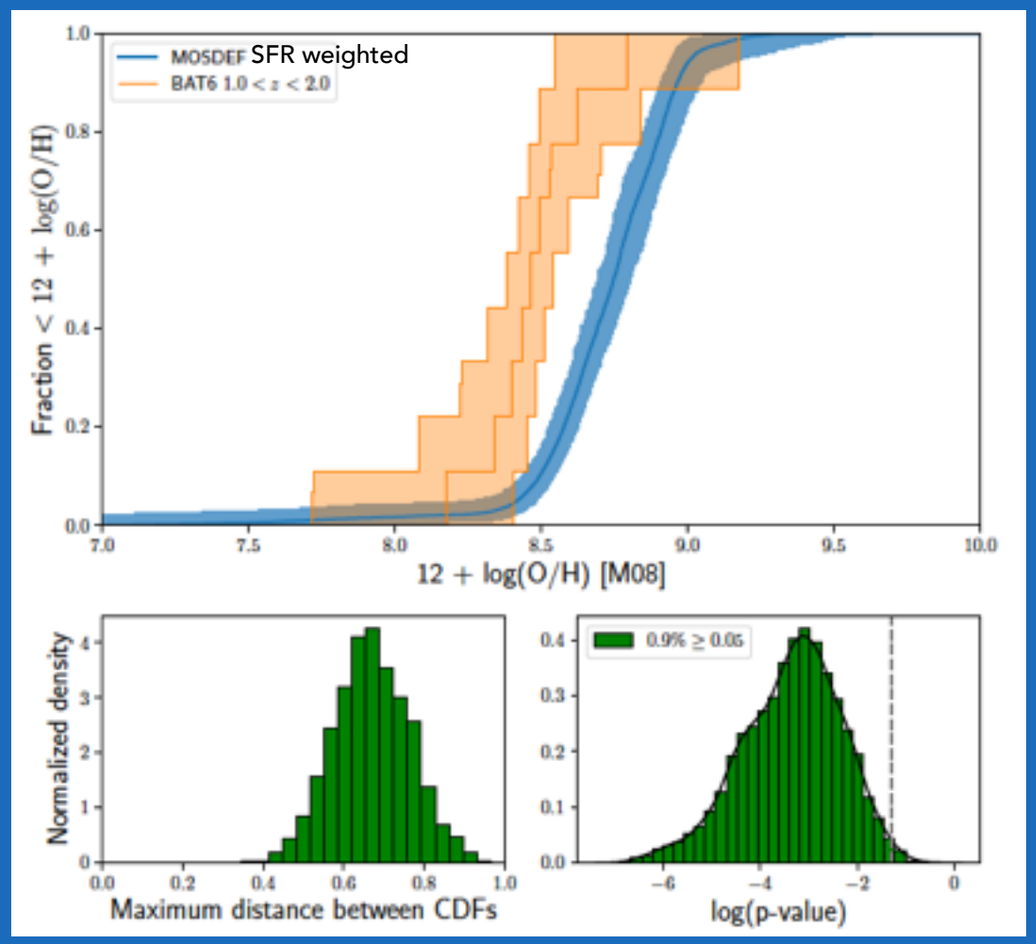
POPULATION STUDIES: COMPLETE UNBIASED SAMPLES

- 0.3<z<1 Vergani+15; Japelj, Vergani+16
- 1<z<2 Vergani+17; Palmerio, Vergani+18 subm.

Host galaxy stellar mass



Host galaxy metallicity



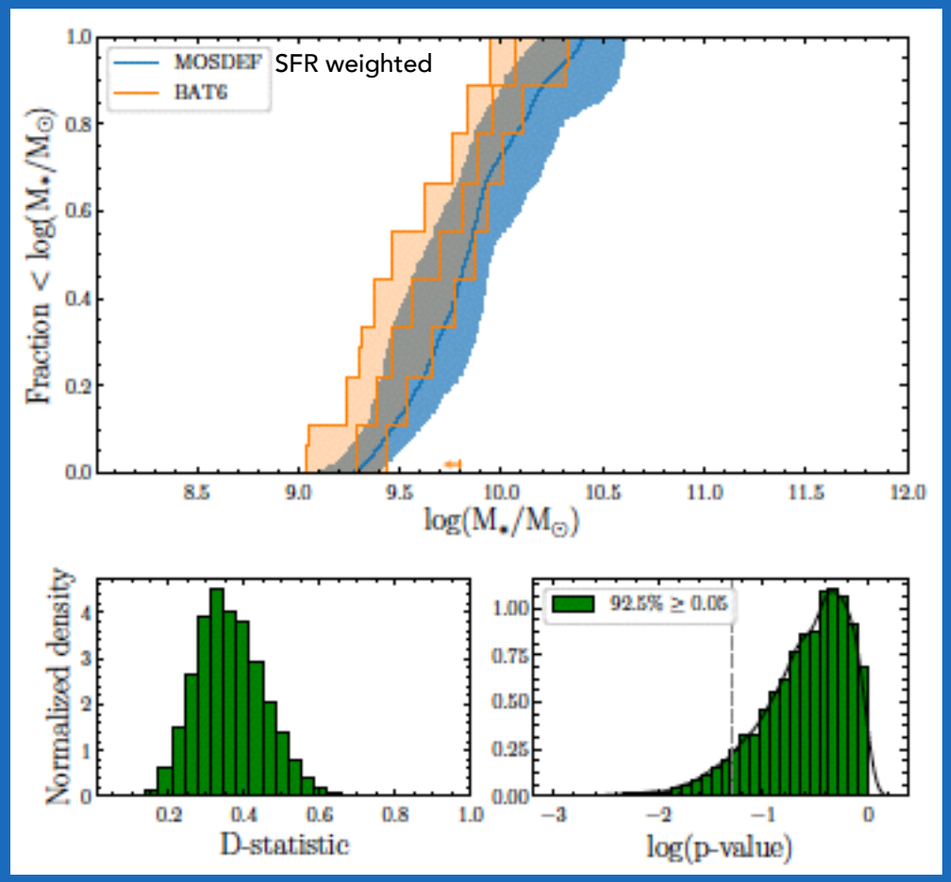
LGRB HOST GALAXIES

POPULATION STUDIES: COMPLETE UNBIASED SAMPLES

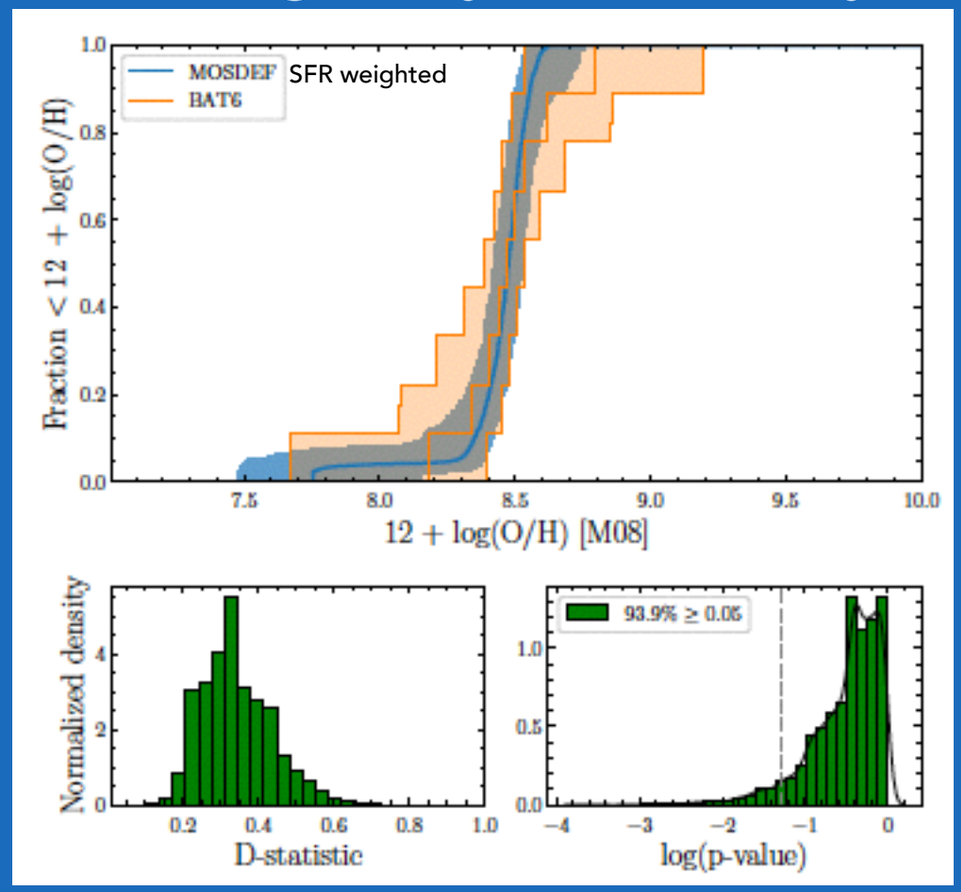
Z_{th}: $0.7Z_{sun}$

Perley+16 : Z_{th}~Zsun

Host galaxy stellar mass



Host galaxy metallicity



Metallicity is the driving factor,
but Z_{th} higher than expected form single star models

INDIRECT CONSTRAINT ON LGRB PROGENITOR MODELS

- integrated metallicity good proxy of GRB site metallicity
- $Z_{th} \sim 0.7 Z_{sun}$ is a relative value (oxygen)
- Single star models need $Z < 0.2\ Z_{sun}$ (iron)

Christensen+08
Levesque+11
Izzo+17
Krüler+17

- Single star models with (e.g.:Georgy+12) :
  - rapid rotation
  - chemically homogeneous mixing
  - weak magnetic core-envelope coupling
- Binary stars (e.g.:Song+16)
- More than one channel?
- High O/Fe abundances

Rates!

CONCLUSIONS

- **Metallicity plays a key role in LGRB production, but thresholds higher than expected**
  can we accommodate single star progentior models? binary stars?

LGRBs VS Ic-BL SNE

- Has every Ic-BL SNe an associated LGRB (orphan)?

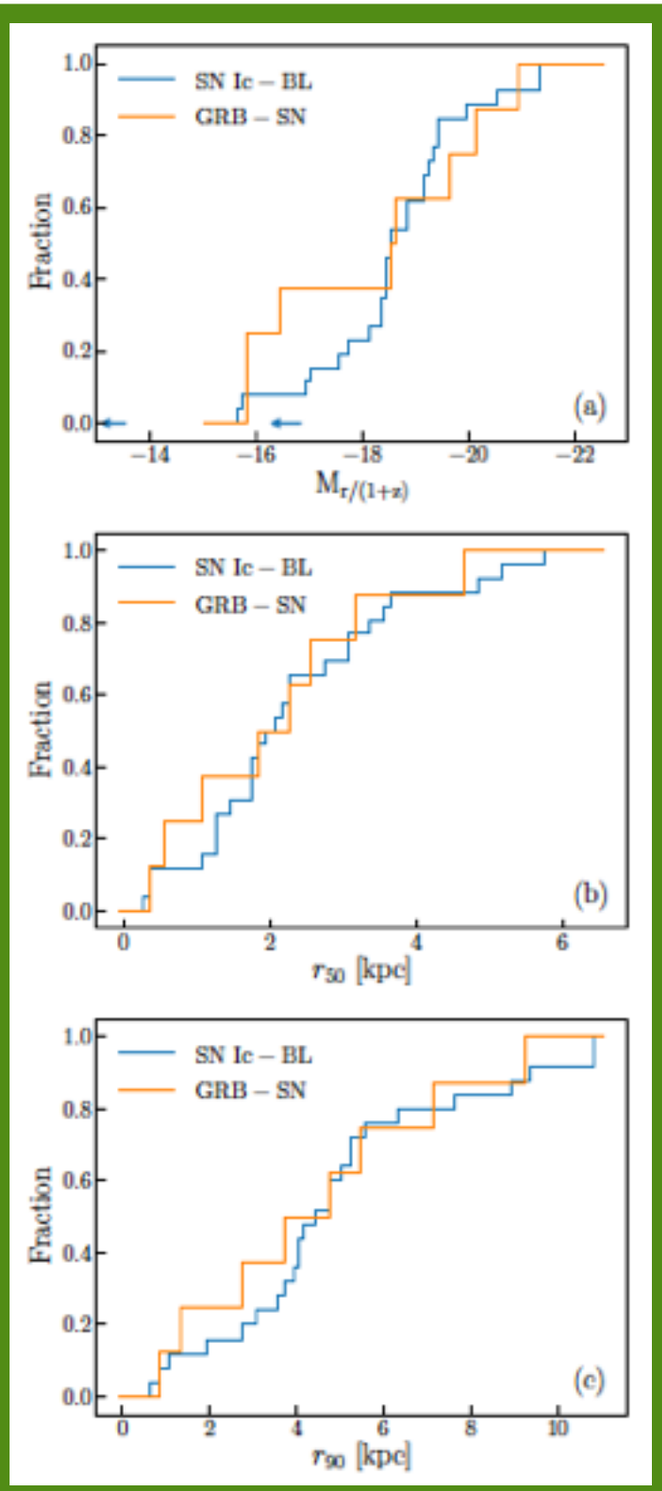
It seems not : radio works (Corsi+2016) + spectroscopic comparison (Modjaz+2017)
less Mej, less KE (e.g.: Mazzali+2002)

- Why some Ic-BL SNe do not have an associated LGRB?
- Are their progenitor stars different? How?
- Past works on the host galaxies are based on targeted samples or put the two classes together

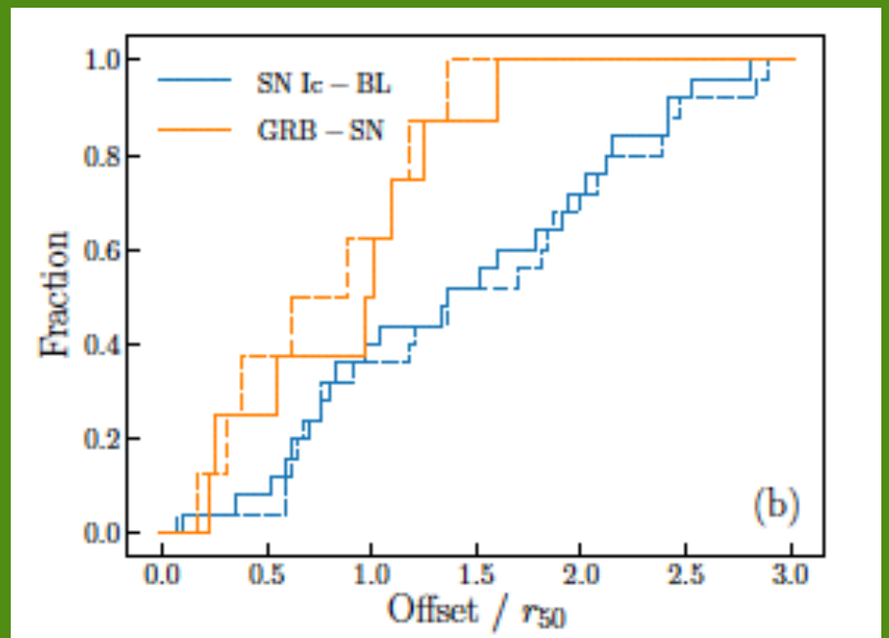
LGRBs VS Ic-BL SNE

z<0.2

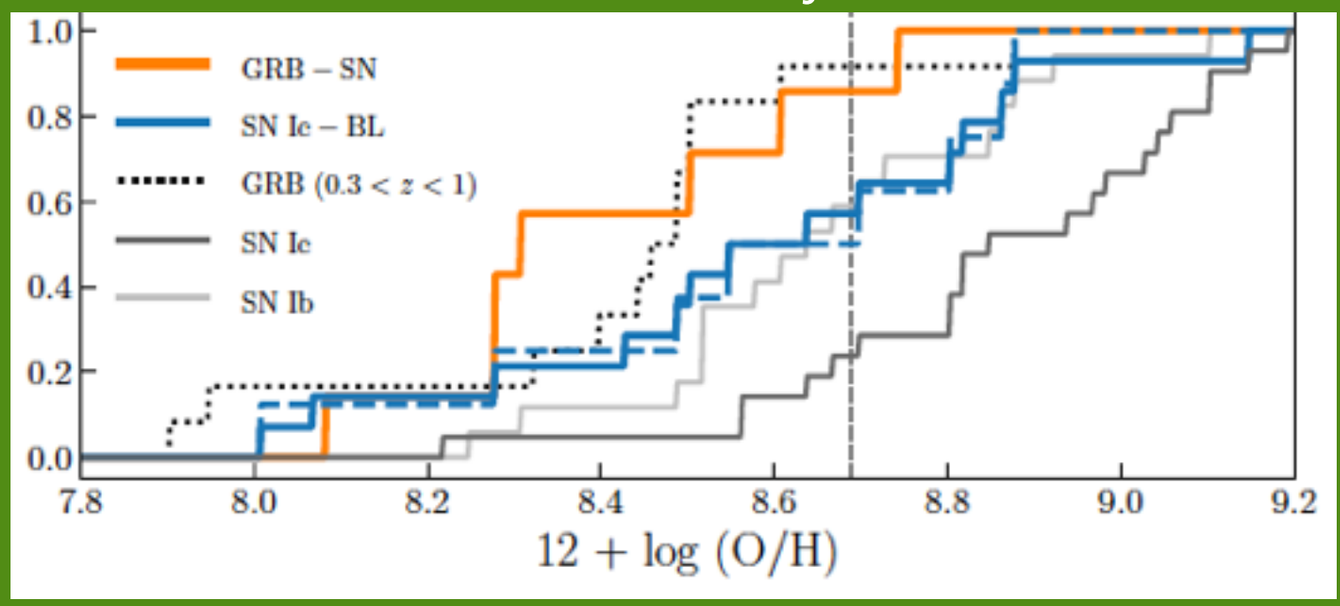
Japelj, Vergani et al. 2018



Normalized offset



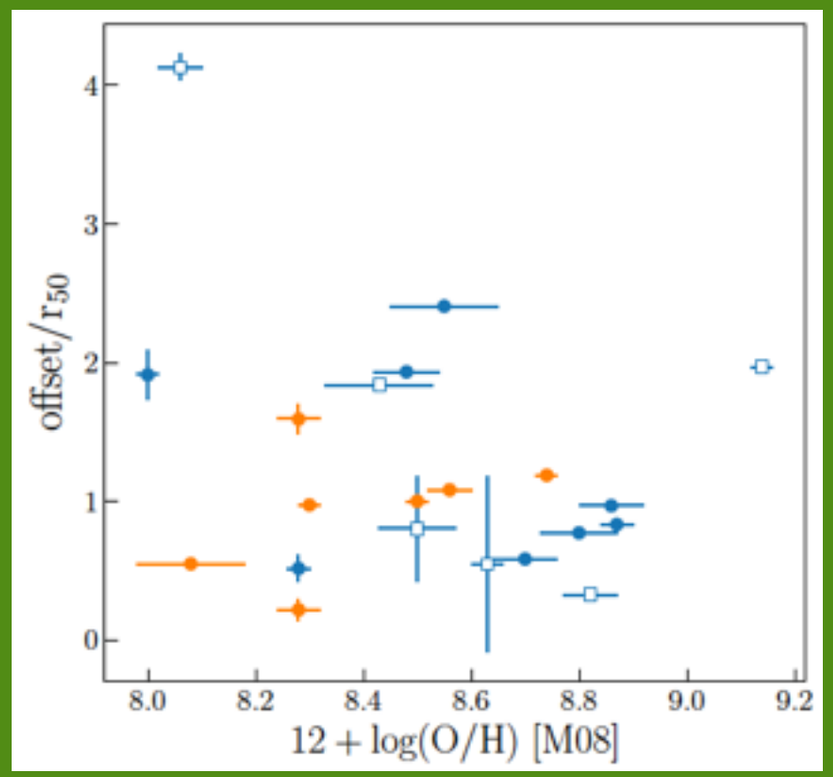
Metallicity



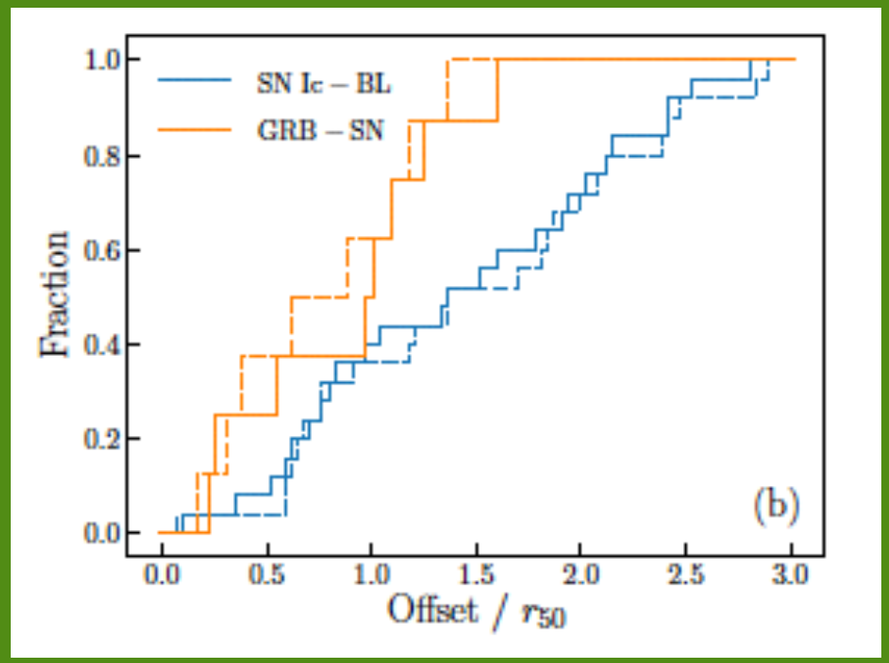
LGRBs VS Ic-BL SNE

z<0.2

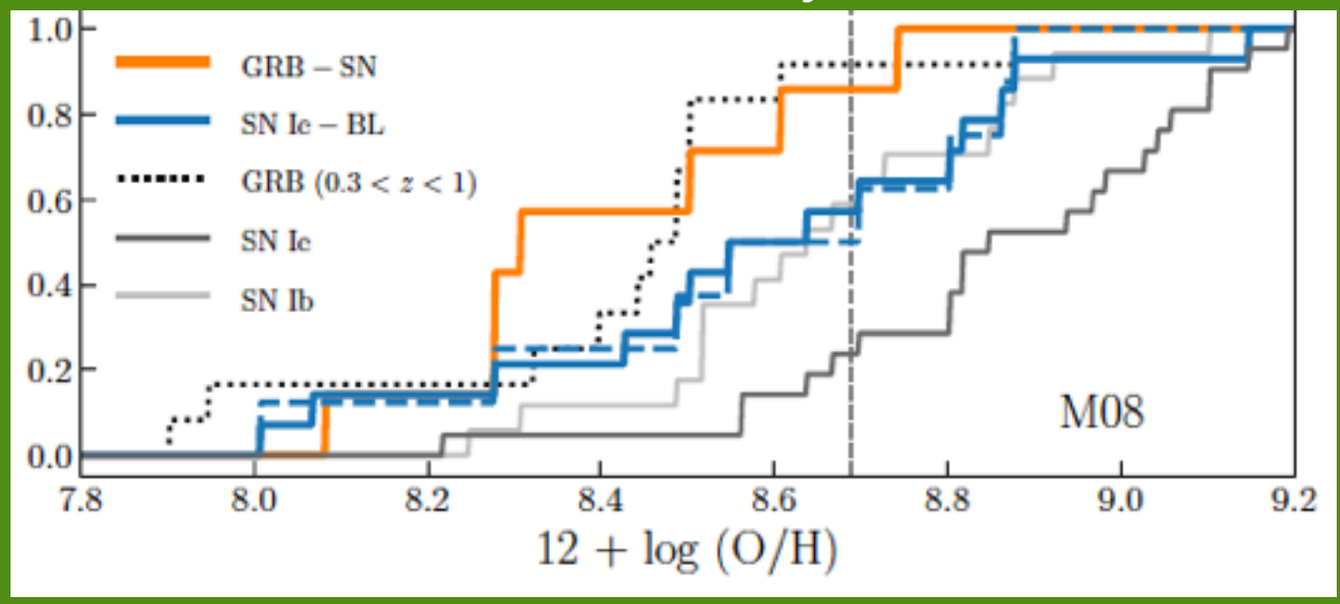
Japelj, Vergani et al. 2018



Normalized offset



Metallicity



LGRBs VS Ic-BL SNE

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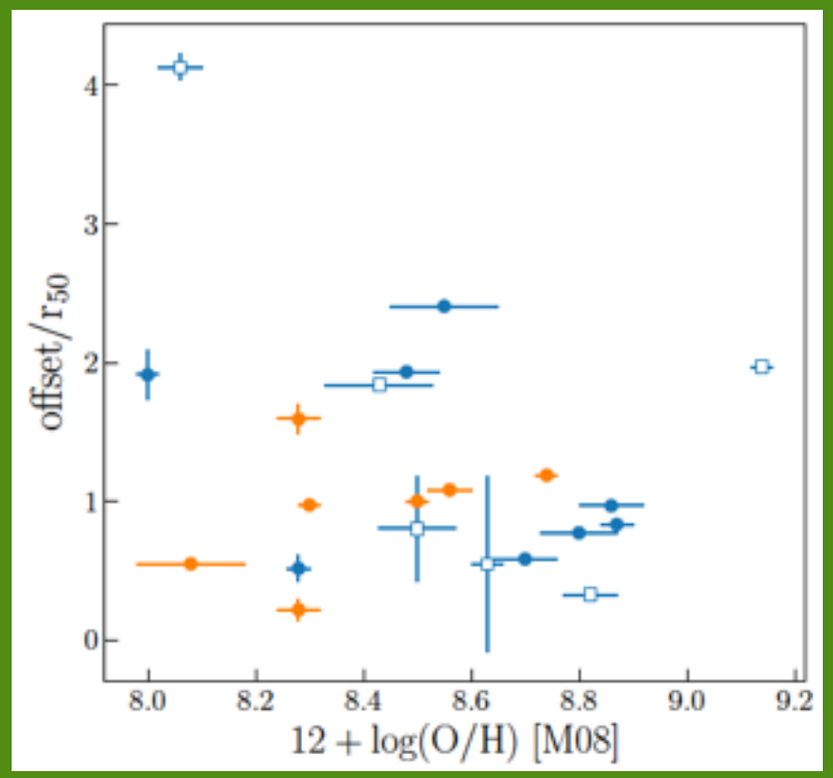
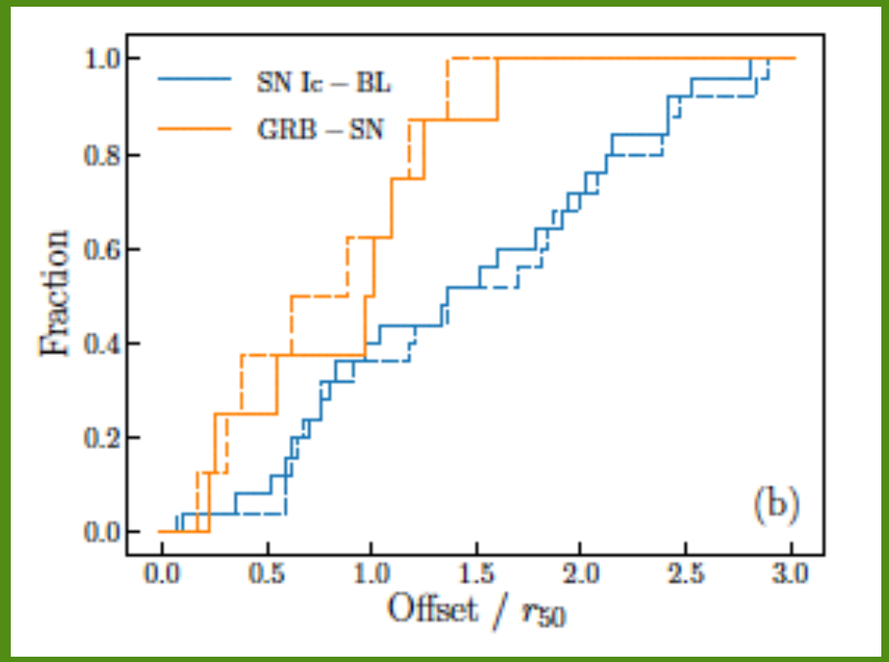
Japelj, Vergani et al. 2018

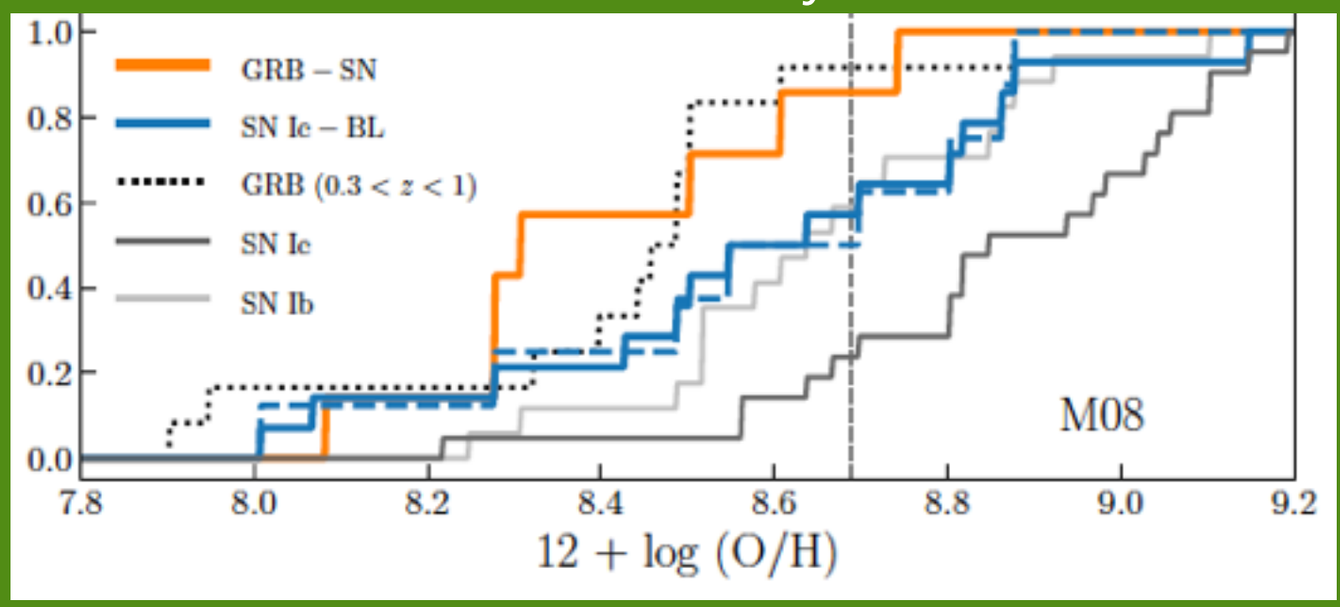


Limited by
low-number statistics

Normalized offset



Metallicity



CONCLUSIONS

- **Metallicity plays a key role in LGRB production, but thresholds higher than expected**
  can we accommodate single star progentior models? binary stars?

- **the host galaxies of Ic-BL SNe with and without GRBs are similar, but larger offsets and higher Z for Ic-BL SNe without GRBs**
  there is a genuine population of Ic-BL SNe
  same progenitor star but GRB only if Z below Z_{th}?

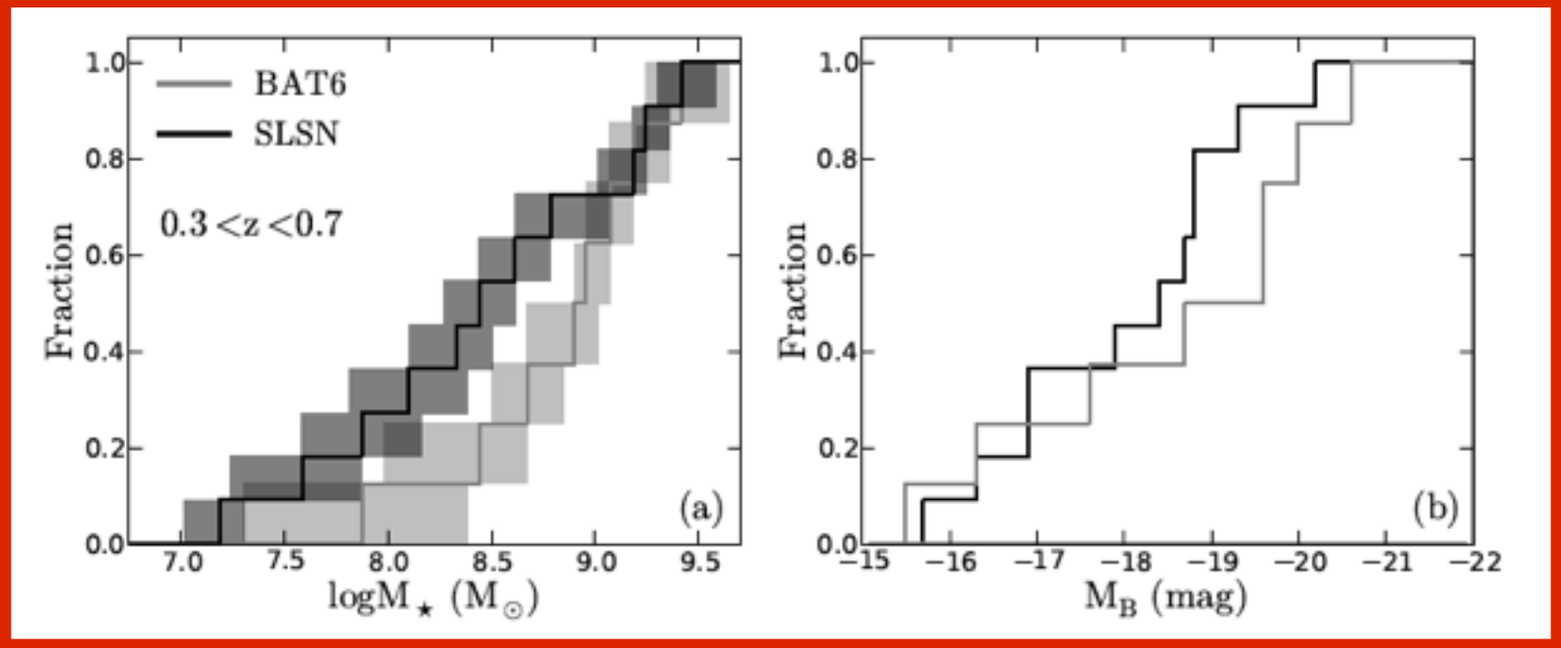
LGRBs VS HI-POOR SLSN

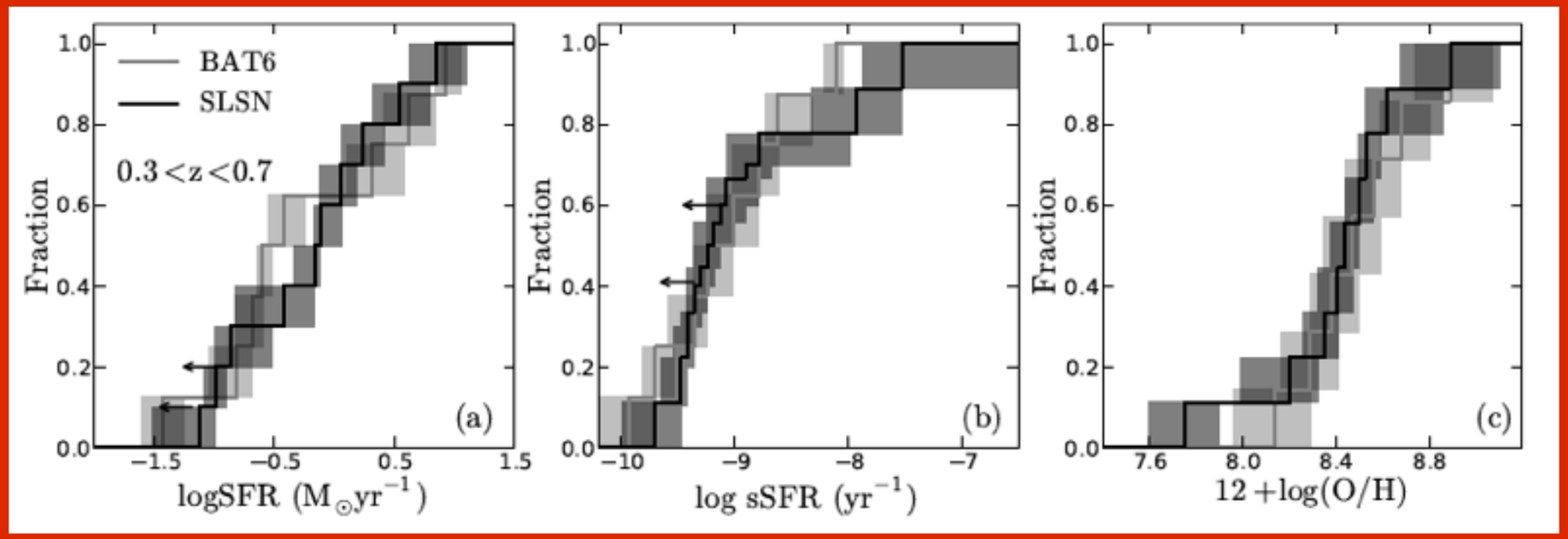
As less biased as possible

- LGRB host galaxies: *Swift*/BAT6 sample
- redshift range $0.3<z<0.7$
- NIR photometry necessary (upper limits & detections) : stellar masses
- spectroscopy

LGRBs VS HI-POOR SLSN

Japelj, Vergani+2016





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- **LGRB and HI-poor SLSN host galaxies at 0.3<z<0.7 are similar, maybe SLSN host are less massive (see also Lunnan+14; Schulze+17)**
  common progenitors? what makes the difference?

Thank you!