S.D. Vergani (CNRS-Observatoire de Paris/GEPI)

Are LGRBs biased tracers of star formation?

Clues from the host galaxies of the *Swift*/BAT6 complete sample of LGRBs

Nice - Journées PNCG 2015 - 16/12/2015

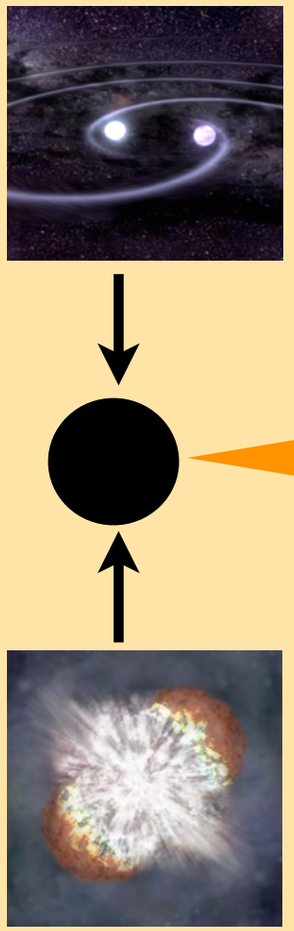
Gamma-ray bursts (GRBs)

Ultra-relativistic jets associated with black holes formation

merging of compact objects — massive star explosion

SGRB

LGRB



LGRB as SFR tracers

- LGRBs connected with massive stars
- LGRBs connected to the SFR

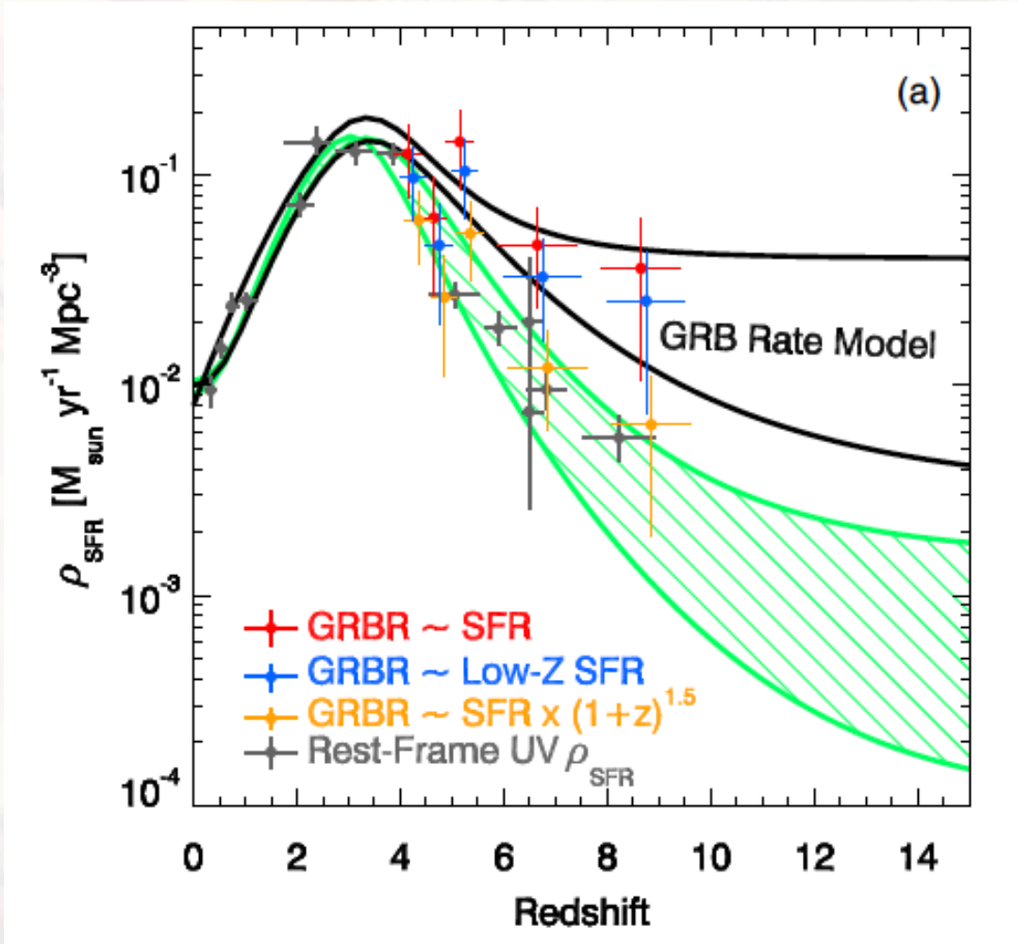
GRBrate = eff. x SFR ?

eff. = eff.(z) ?

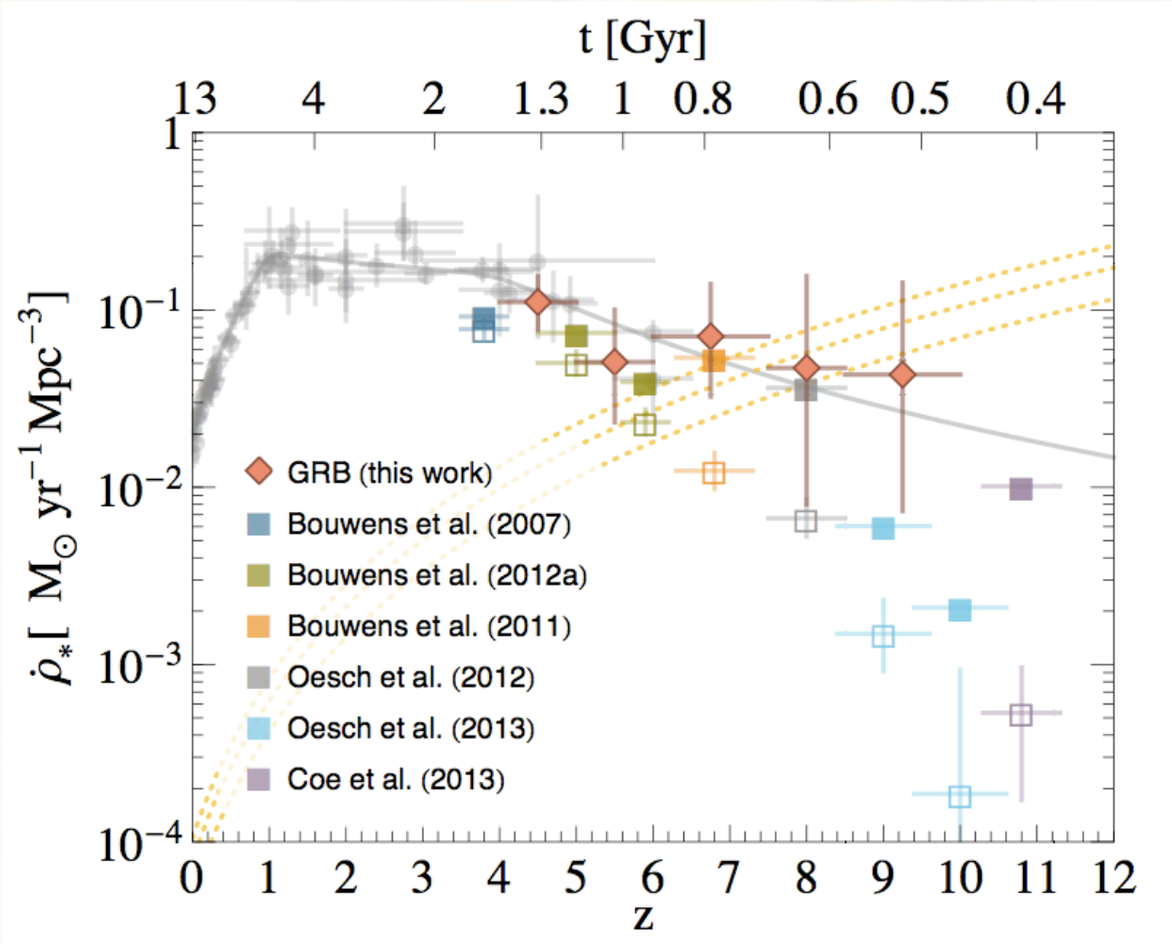
LGRBs progenitor stars

- LGRB associated with type Ic-bl SNe
- WR progenitor?
- Which are the conditions necessary to produce LGRBs?
  - Rotation
  - Mass loss
  - Low-metallicity?
  - Binary system?

LGRB as SFR tracers



Robertson&Ellis12

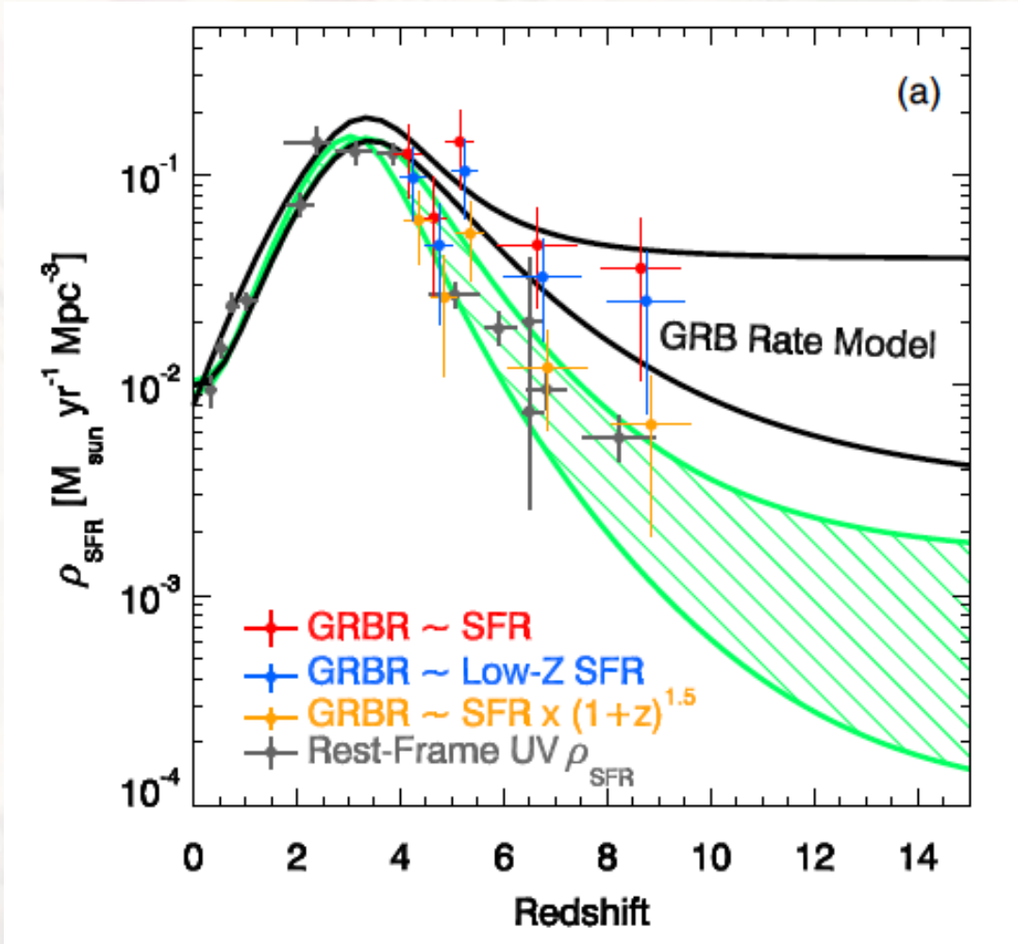


Kistler+13

Knowledge of the GRB vs SFR efficiency needed

Need of well defined (unbiased) complete samples

LGRB as SFR tracers



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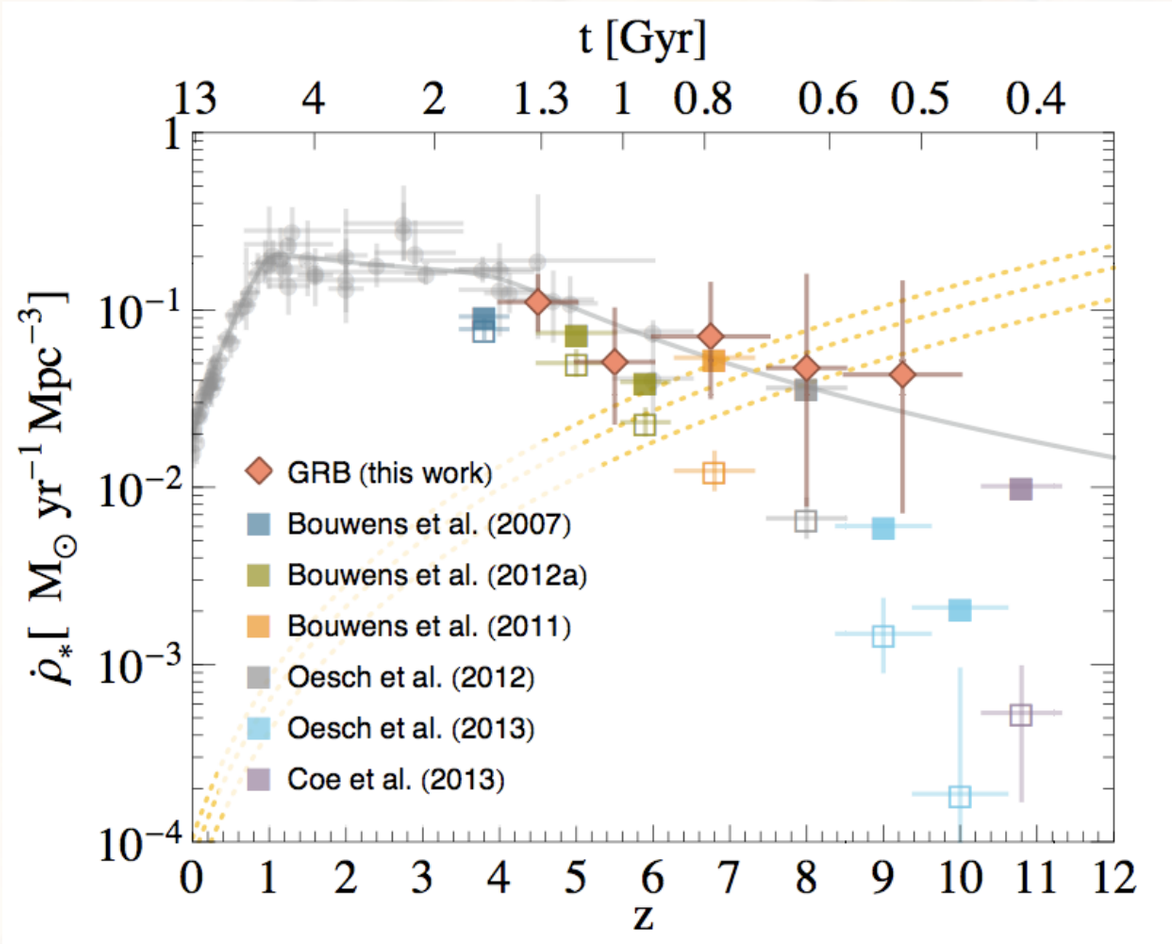


Kistler+13

GRBs are rare! (~1000 with afterglow)
only 30% have redshift determination
good localisation + quick follow-up + NIR

The *Swift*/BAT6 sample

Salvaterra+12

- selection dependent only on prompt gamma-ray emission
- 58 LGRBs, 97% redshift completeness
- The extendedBAT6:100 LGRB, 82% z completeness

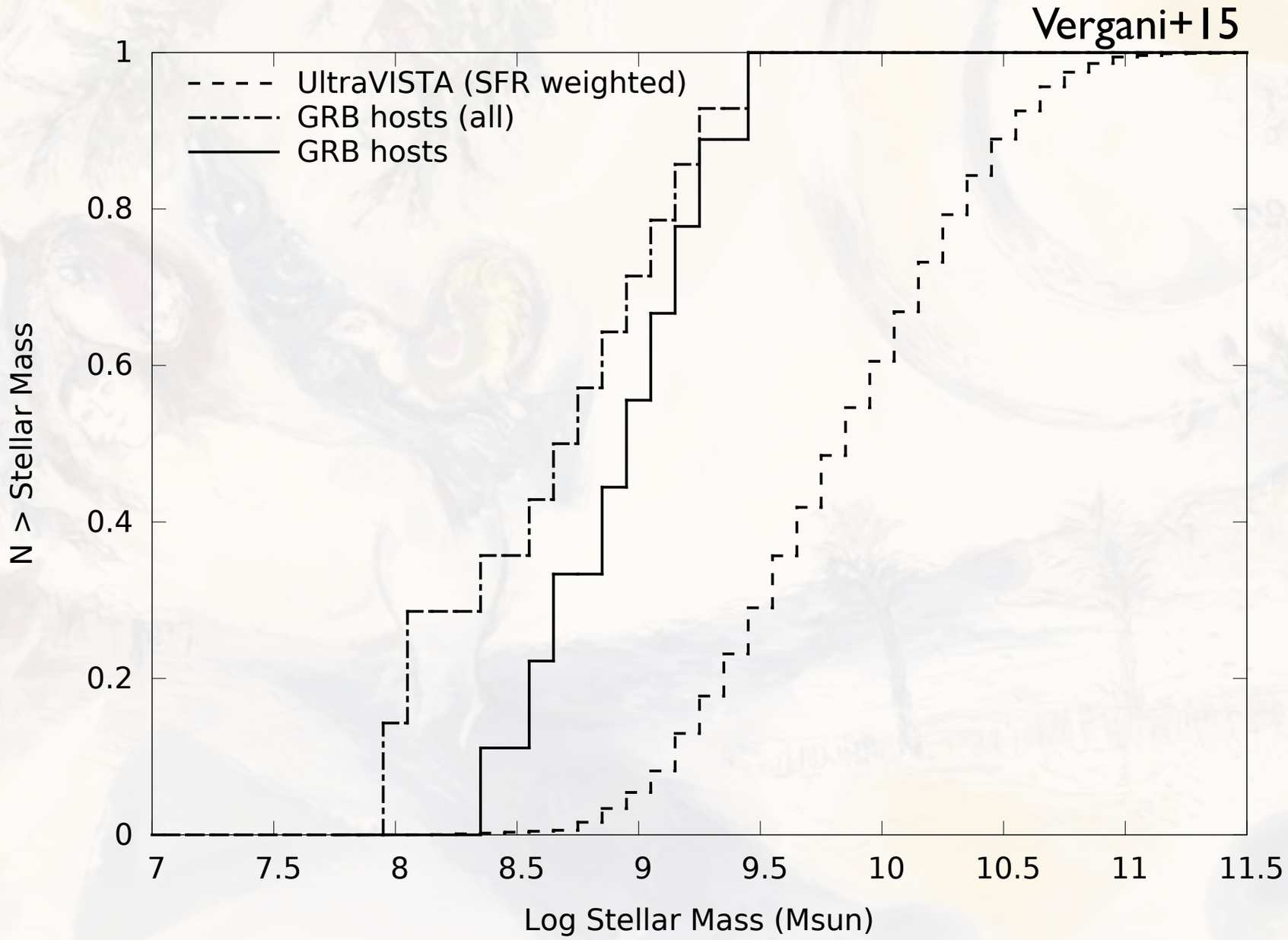
Nava+2012; D'avanzo+2012; Campana+2012;
Melandri+2012; Covino+2013; Ghirlanda+2013; +++

The z<1 BAT6 host galaxies

- 14 hosts
- VLT, GTC, TNG, NOT, GROND + available data (incl. HST & Spitzer)
- Stellar Masses (Vergani+15, A&A)
- SFR (Japelj+16)
- Metallicity (Japelj+16)

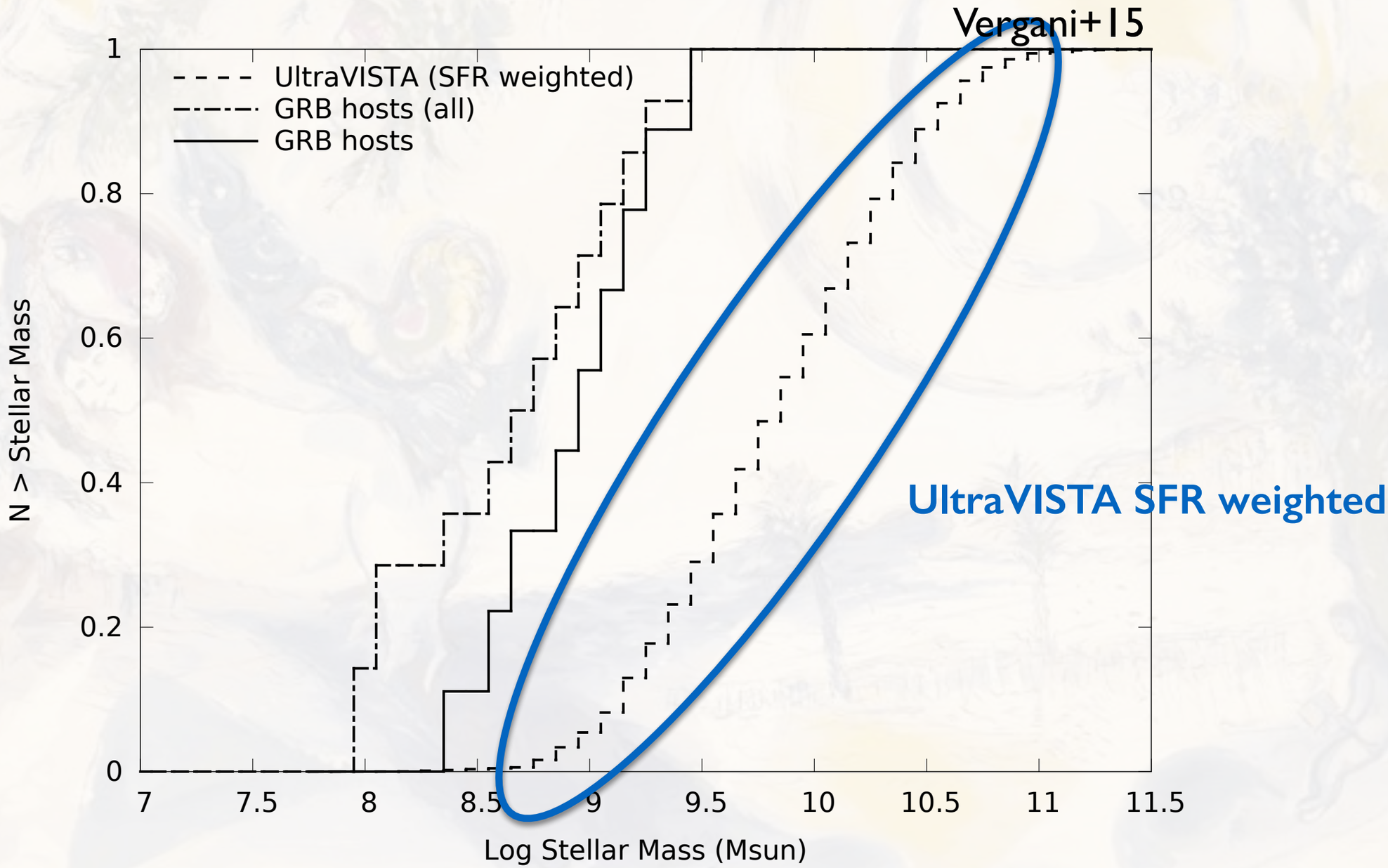
Stellar Mass distribution

LGRB hosts vs UltraVISTA



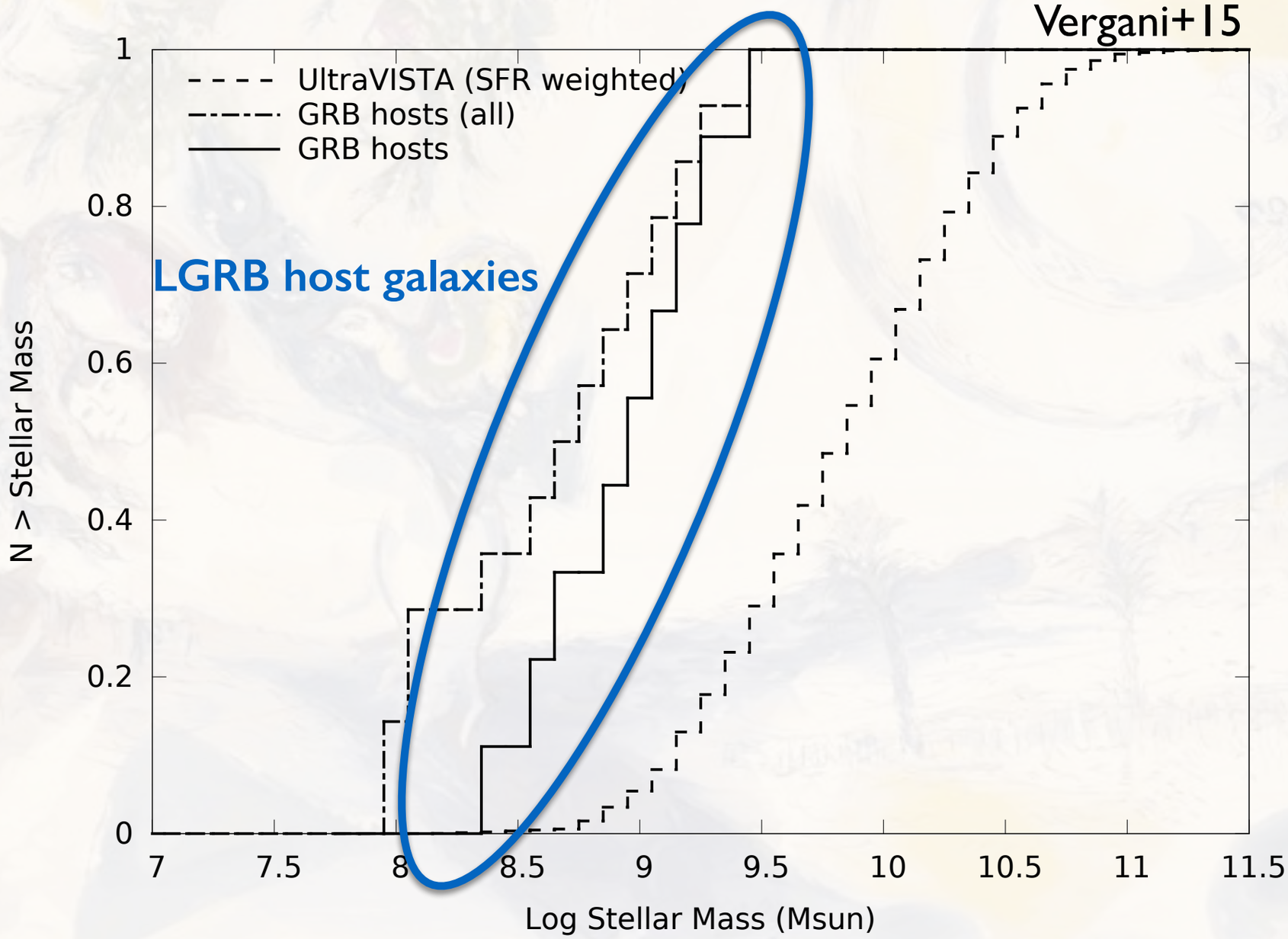
Stellar Mass distribution

LGRB hosts vs UltraVISTA



Stellar Mass distribution

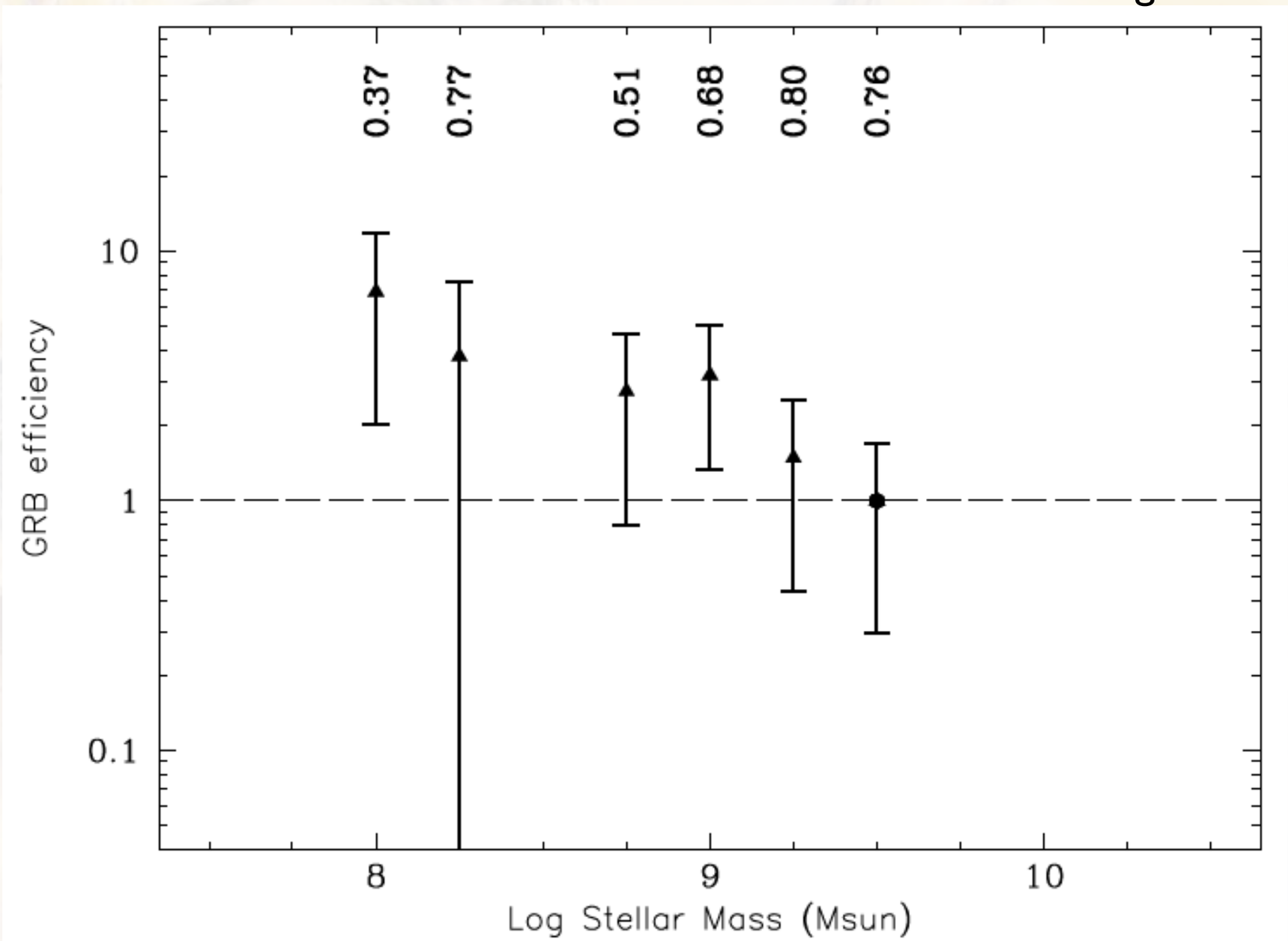
LGRB hosts vs UltraVISTA



Stellar Mass distribution

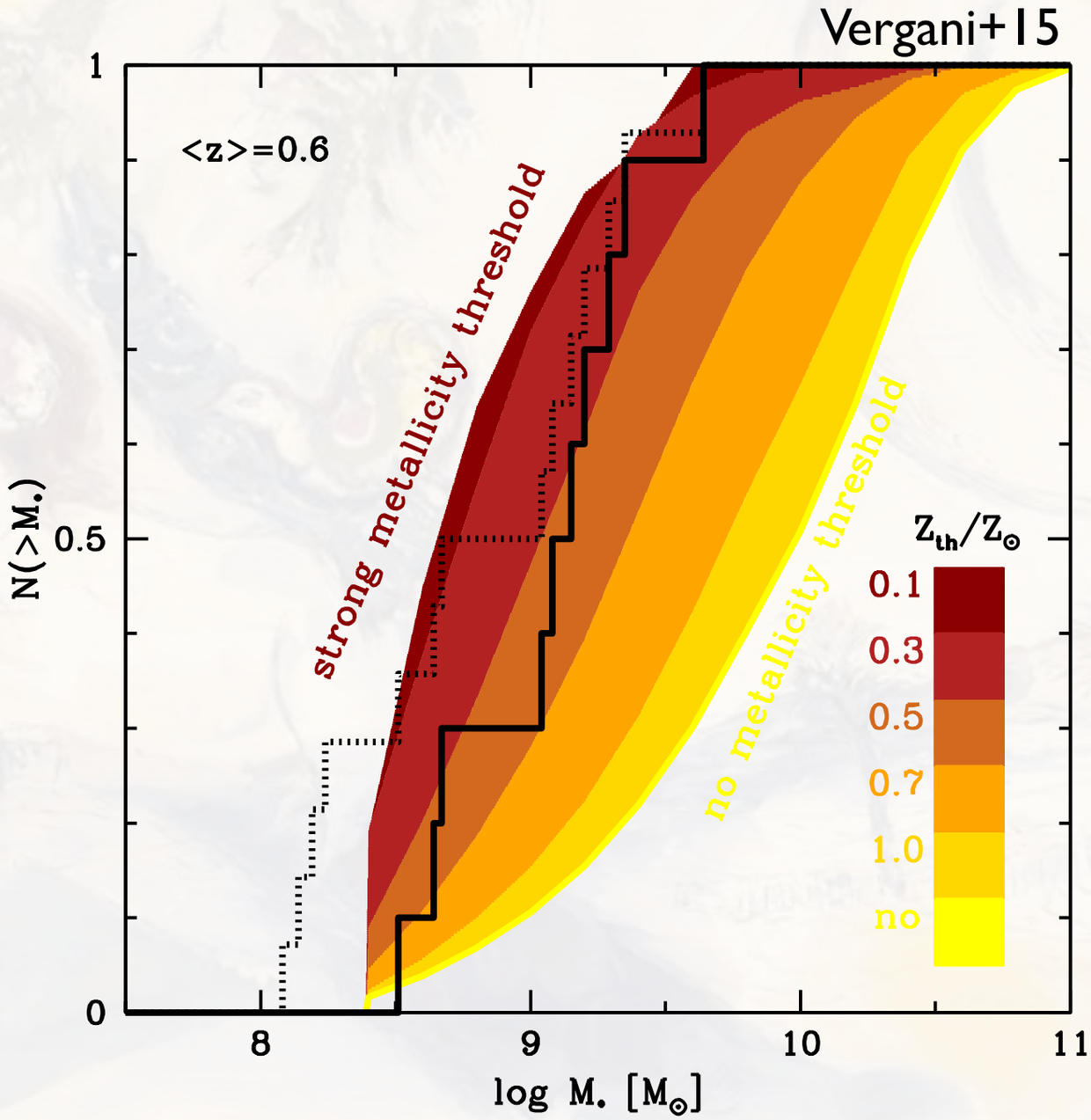
Boissier's method

Vergani+15



Stellar Mass distribution

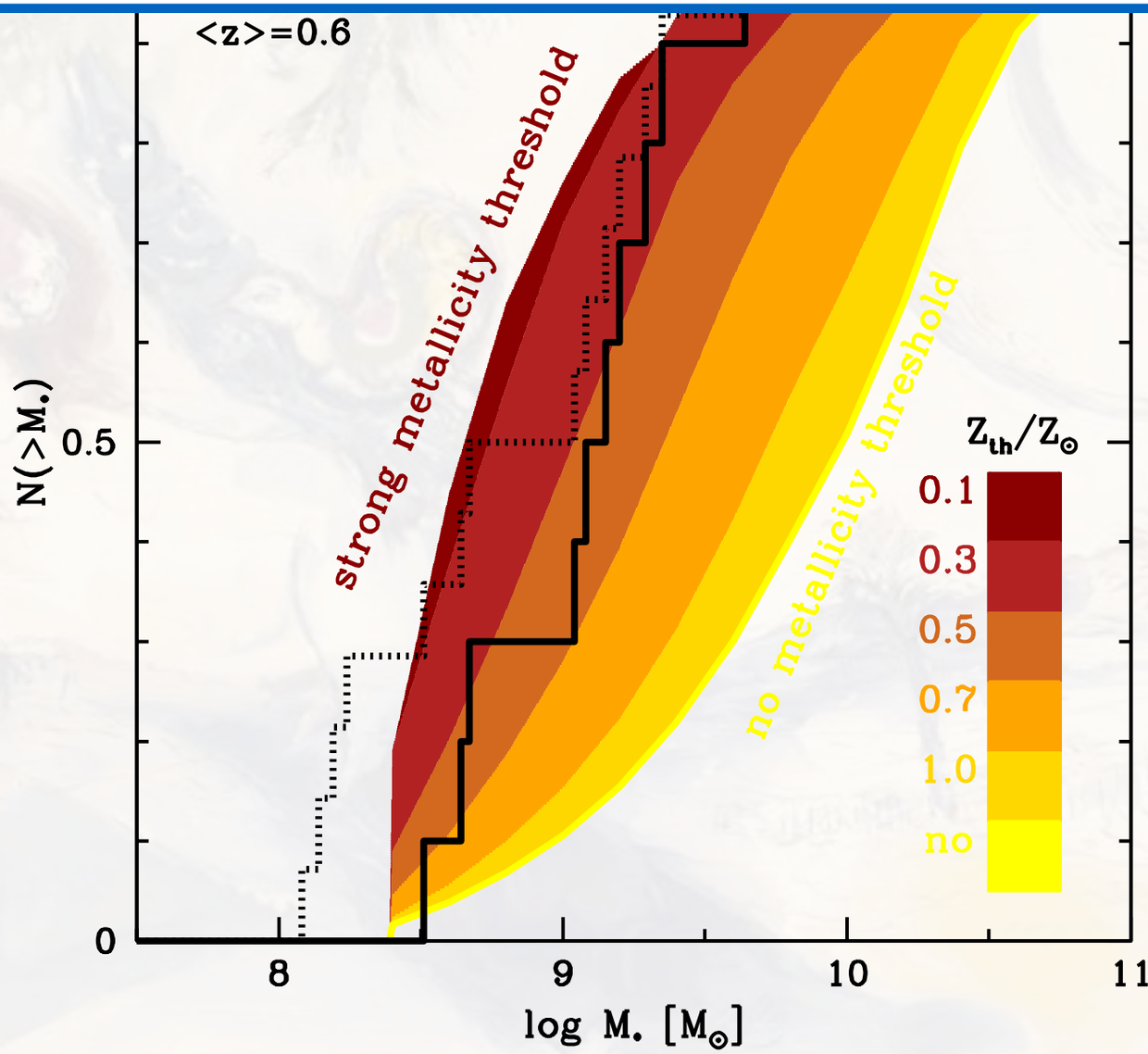
Comparison with numerical simulations (see Campisi+09,11)



Stellar Mass distribution

Comparison with numerical simulations (see Campisi+09,11)

Metallicity plays a role, but no extreme thresholds

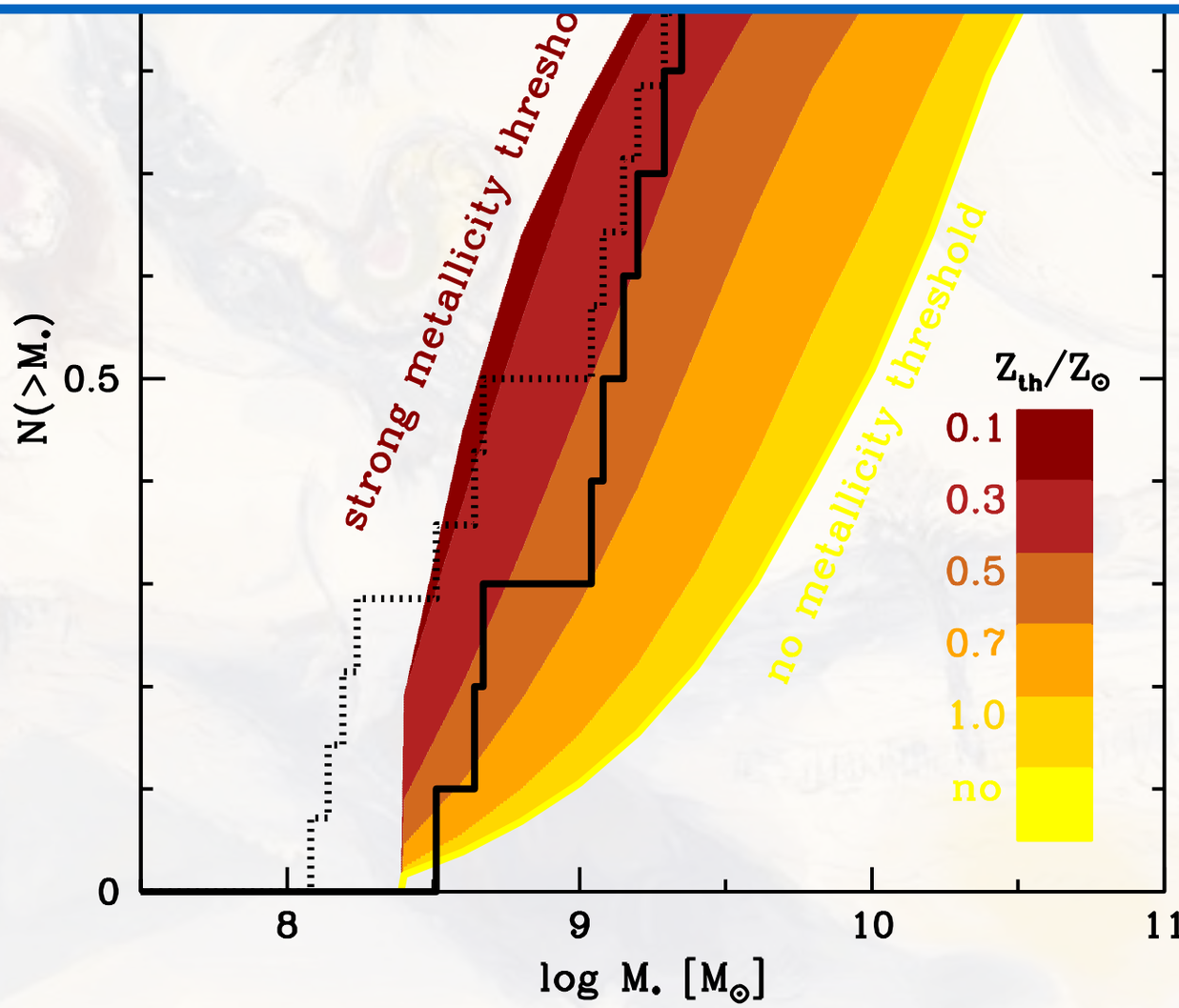


Stellar Mass distribution

Comparison with numerical simulations (see Campisi+09,11)

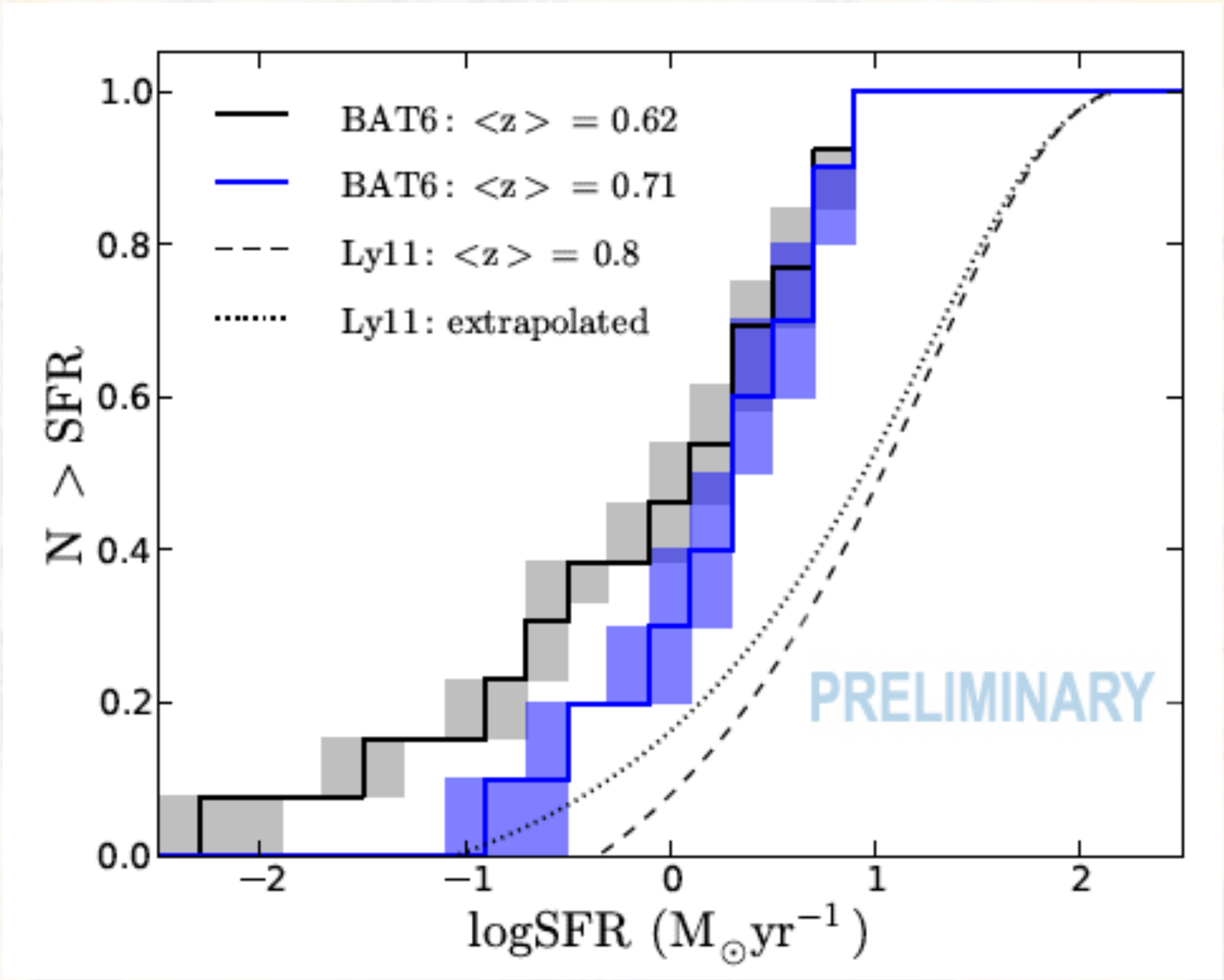
Under basic assumptions, LGRB direct SFR tracers at z~4

(see also Greiner+15 and Perley+15)



Star formation rate

Japelj+in prep. (see also **Boissier+13**, Kruhler+15, Perley+15)



Star formation rate

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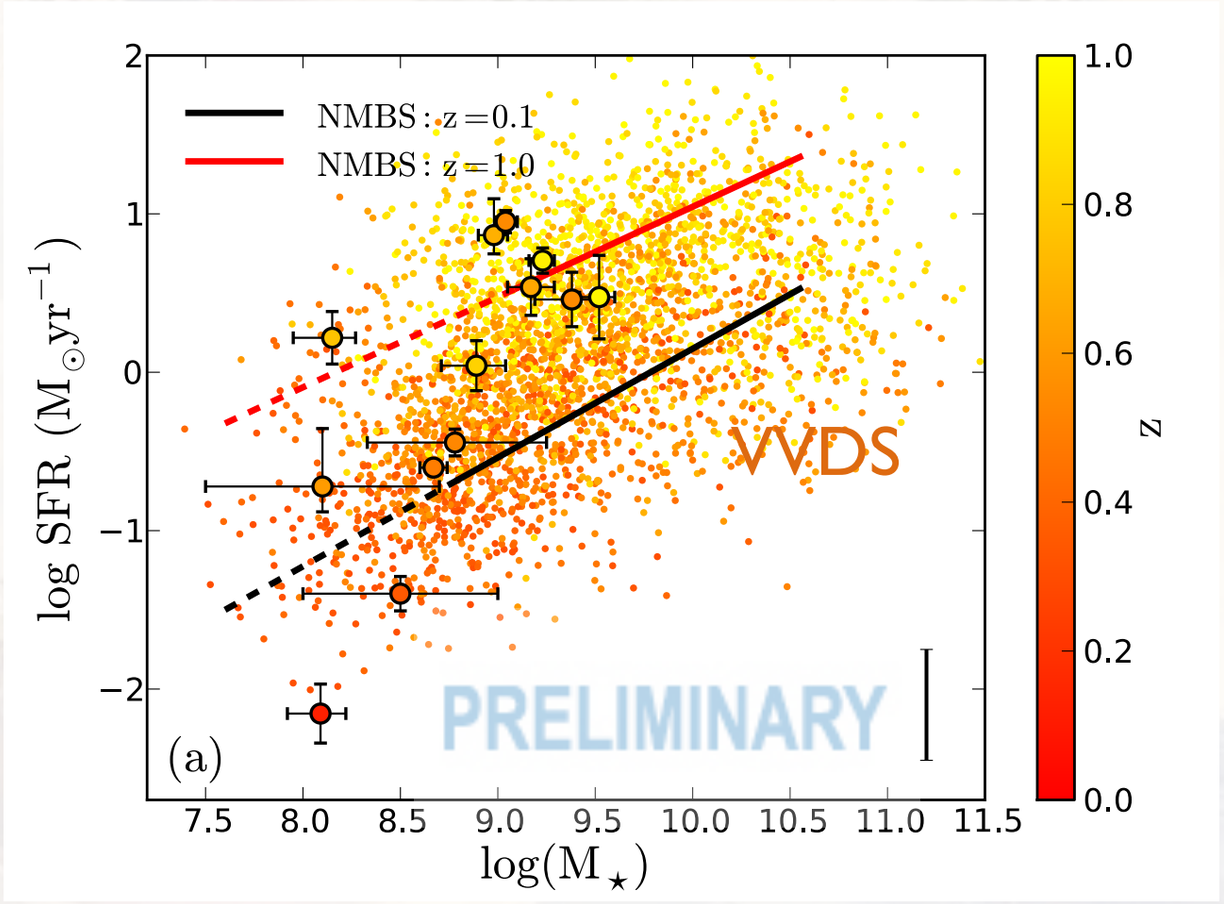

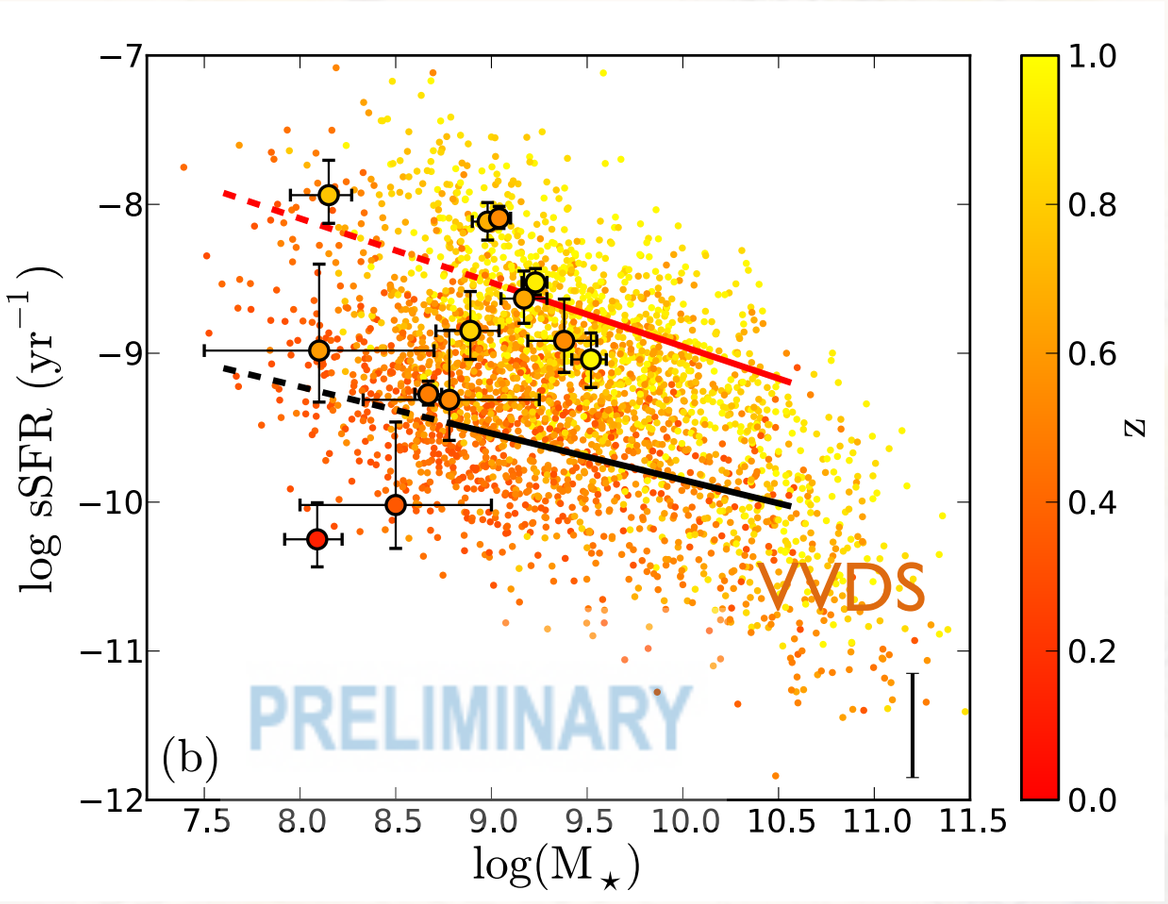

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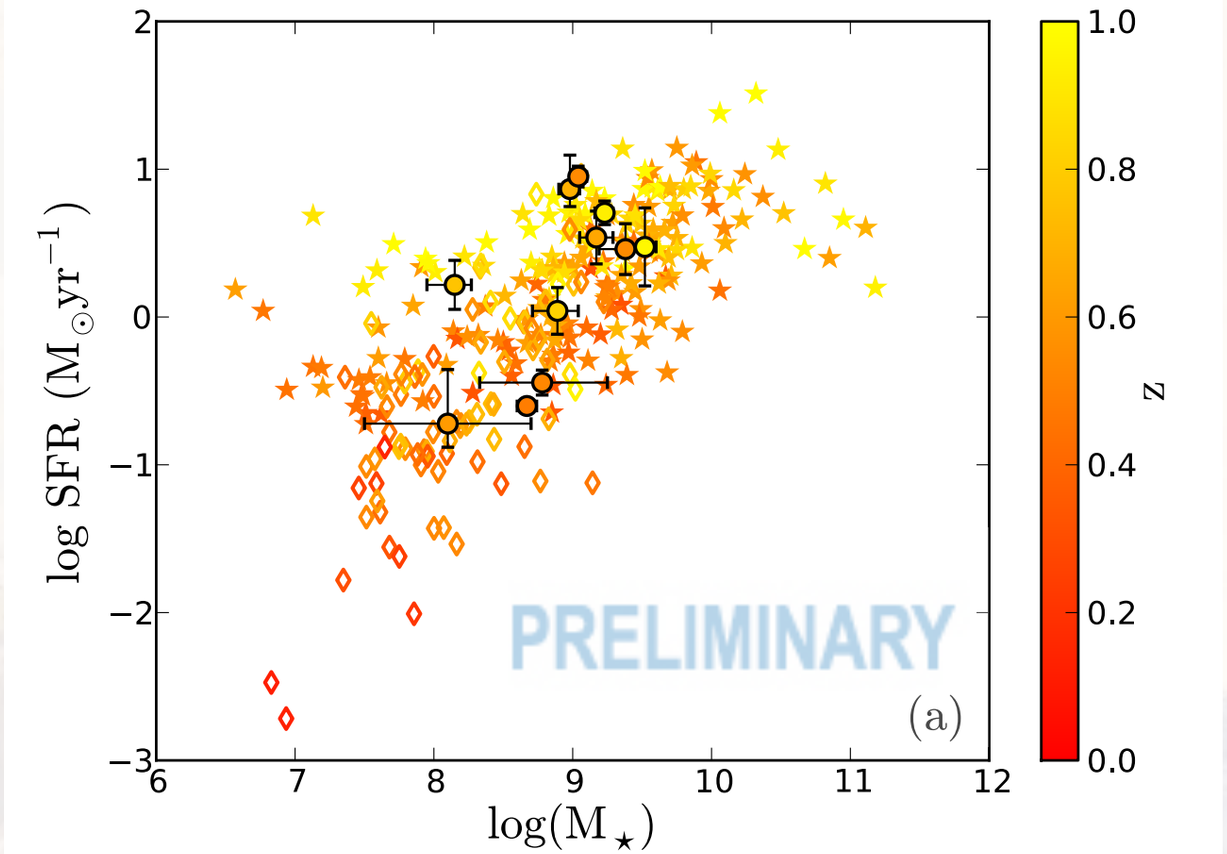
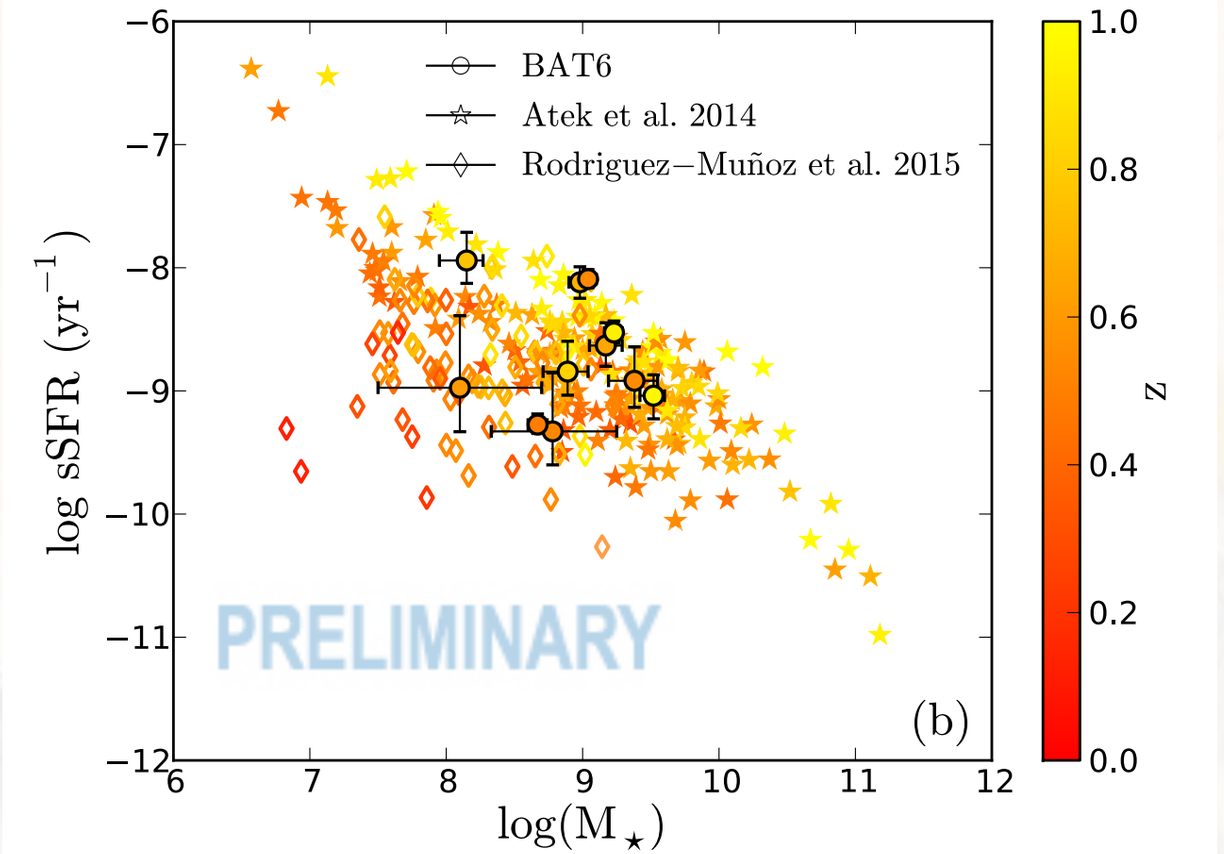
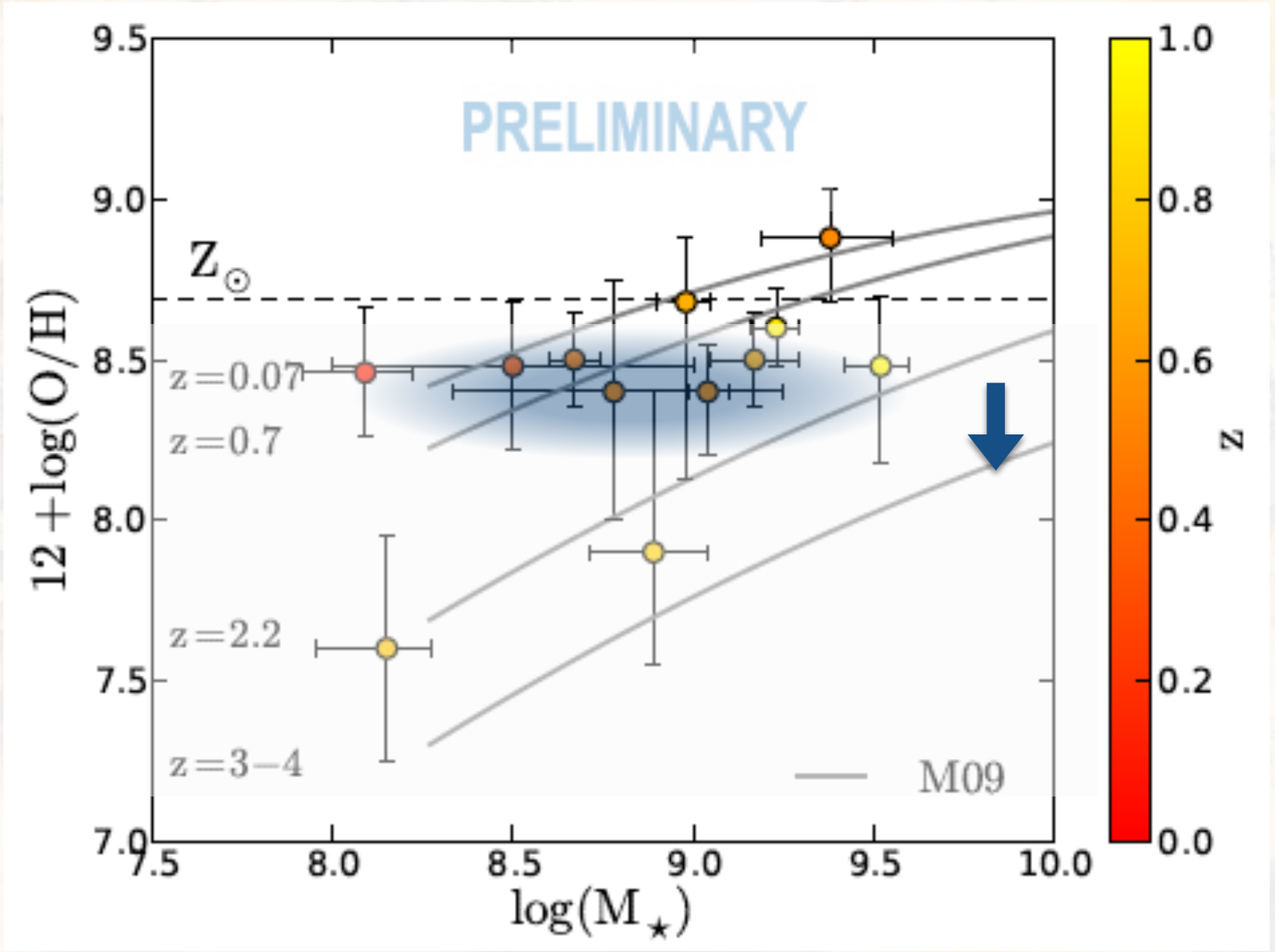




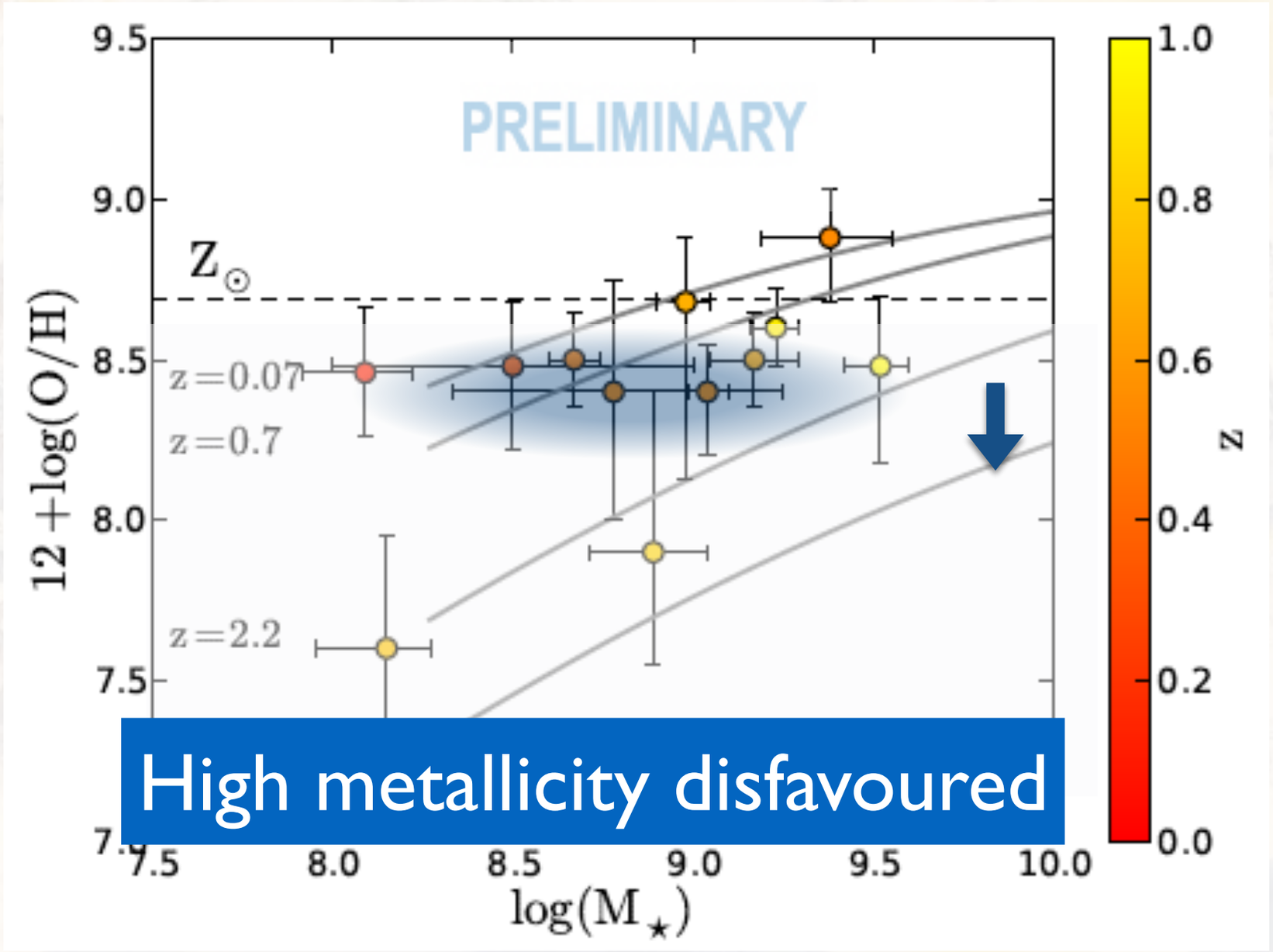
BAT6 metallicities <z=0.6>

Japelj+in prep.



BAT6 metallicities <z=0.6>

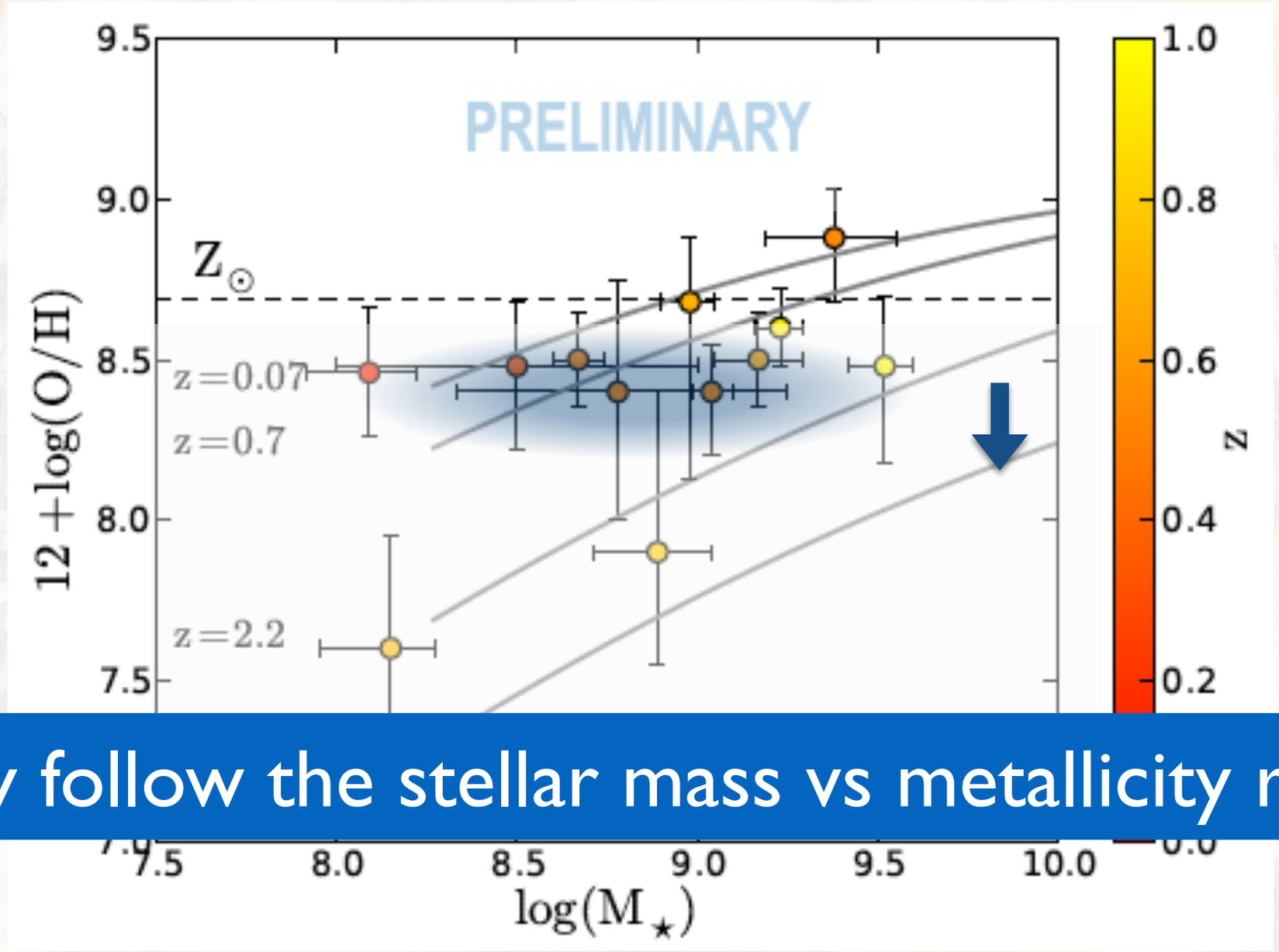
Japelj+in prep.



High metallicity disfavoured

BAT6 metallicities <z=0.6>

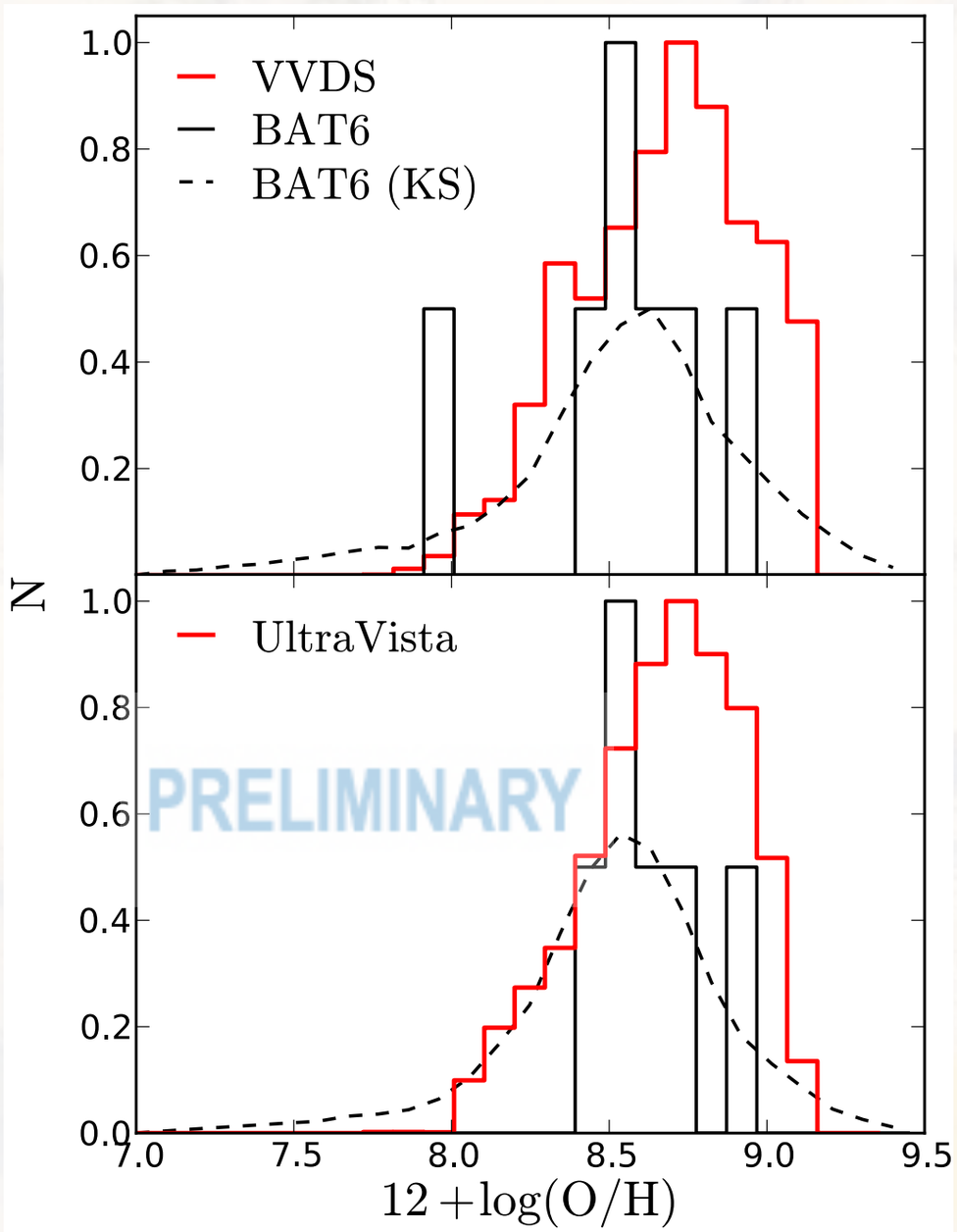
Japelj+in prep.



But they follow the stellar mass vs metallicity relation

BAT6 metallicities <z=0.6>

Japelj+in prep.



Conclusions

- At z<1 low LGRB vs SFR efficiency
- Metallicity plays a role

  BUT very low metallicity thresholds are not needed

  Progenitors? Binary stars?

Future work

- Look for evolution
- Improve the statistics

- Extend to higher z
- Extend to the BAT6 extended sample

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- Look for evolution
- Improve the stati

!!! Post-doc position open !!! (2 years)
with E. Le Floc'h & S.D.Vergani
LabEx UnivEarthS
Deadline: January 31st, 2016

- Extend to higher z
- Extend to the BAT6 extended sample


Merci