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LONG GAMMA–RAY BURSTS AND THEIR HOST GALAXIES AT HIGH REDSHIFT

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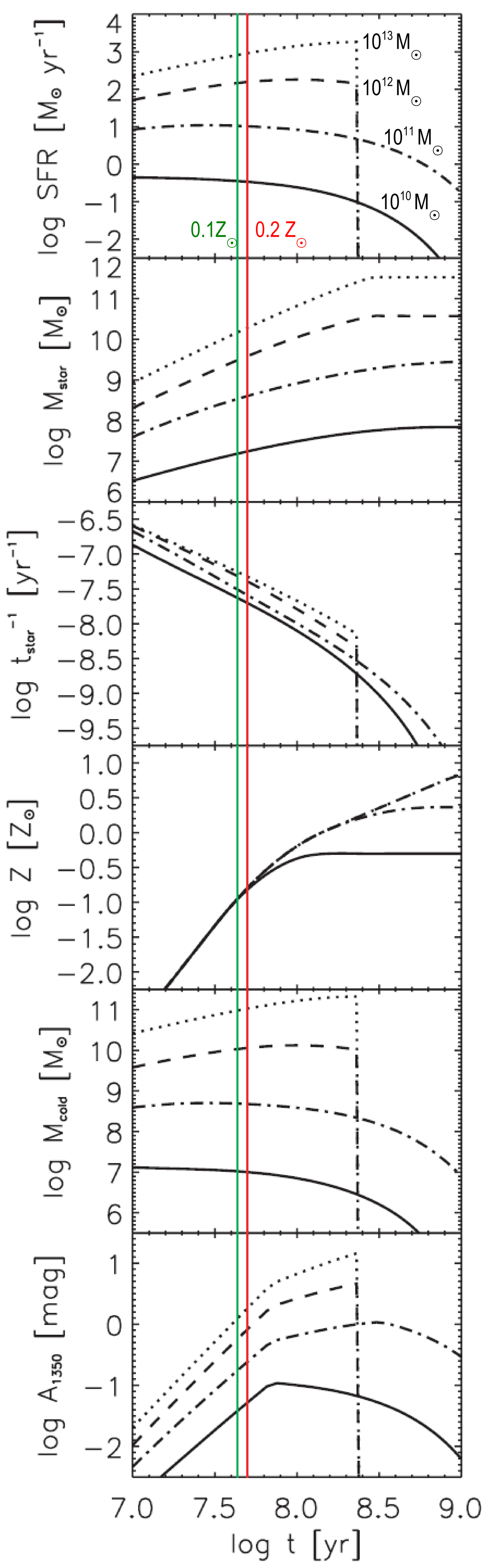
Properties of GRB host galaxies



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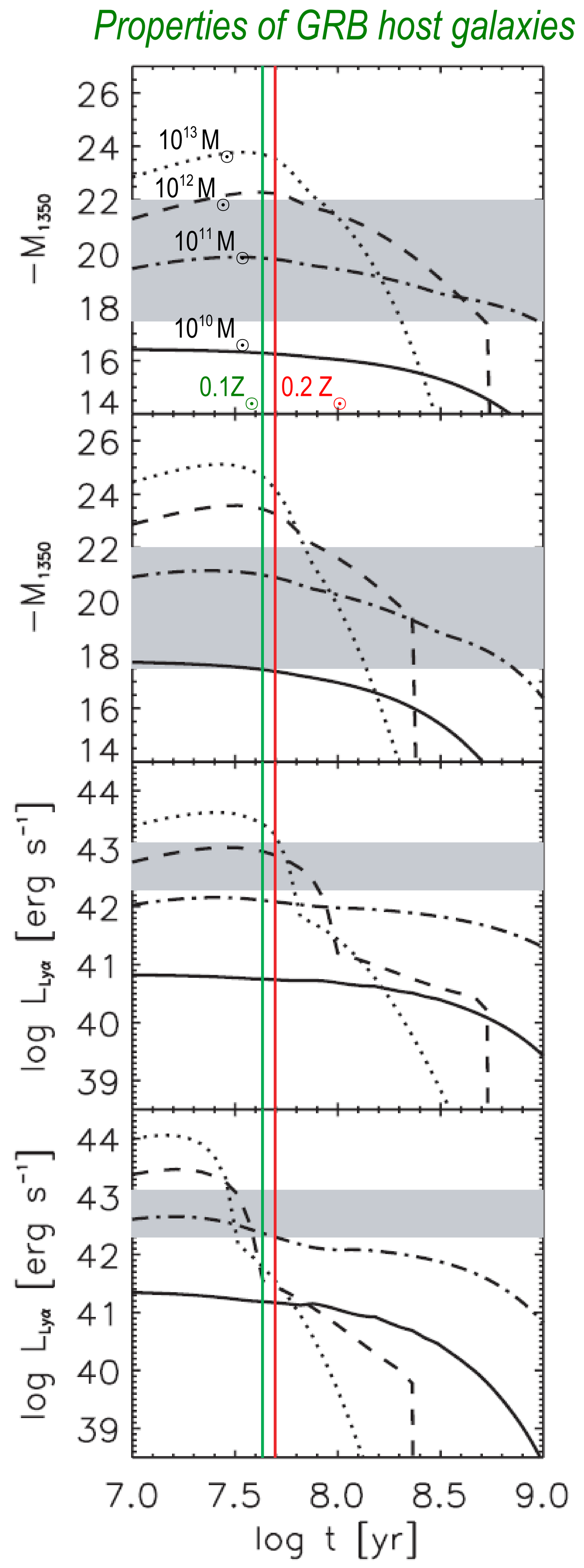


MOTIVATION, AIM, AND METHOD

Motivated by the recent observational and theoretical evidence that long γ-ray bursts (GRBs) are likely associated with low metallicity, rapidly rotating massive stars, we examine the cosmological star formation rate (SFR) occurring in environments with gas metallicity below a critical threshold 0.1 - 0.2 $Z_{\odot}$, to estimate the event rate of long GRBs progenitors.

To this purpose, we exploit our previously proposed galaxy formation scenario, already succesfully tested on a wealth of observational data on (proto-)spheroids, Lyman break galaxies, Lyman-α emitters, submm bright galaxies, quasars, and local early-type galaxies.

GRB COUNTS AND z-DISTRIBUTION

We find that the expected long GRB progenitor rate peaks at redshifts significantly higher than the cosmic SFR, with the two mirroring in shape only at high z.

We compute the overall long GRB rate, that amounts to approximately 300 yr^{-1} sr^{-1}. The counts of bright GRBs observed by *SWIFT* are reproduced on assuming a standard, non-evolving prompt luminosity function.

We predict that above a flux limit of 1 ph s^{-1} cm^{-2} about 30% of the GRBs are to be located at z > 6 and about 10% at z > 8. Since only one have been discovered at z > 6 during two years of *SWIFT* operation, a redshift determination efficiency around 10% is implied.

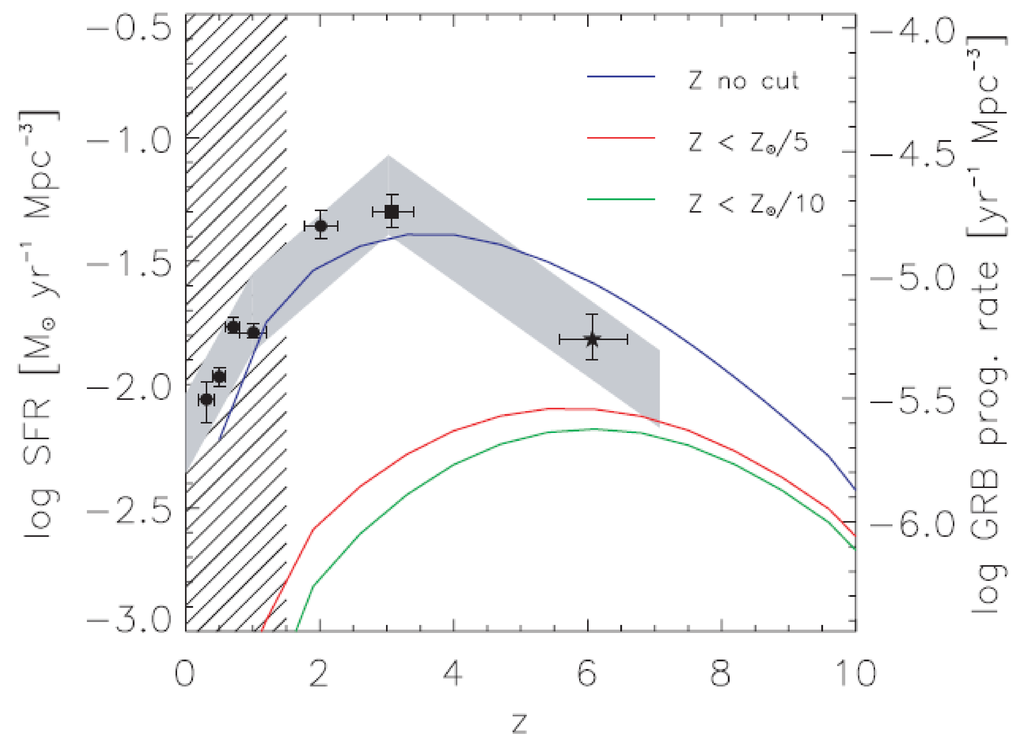
PROPERTIES OF GRB HOST GALAXIES

Our galaxy formation model enables us to predict the properties of the GRB host galaxies. We find that most GRBs are associated with small galaxies, residing in haloes with masses around 10^{11} $M_{\odot}$. These hosts are predicted to be younger than 10^{8} yr, gas rich, but poorly extincted because of their chemical immaturity; they should also show high specific SFRs and quite extreme α-enhancements.

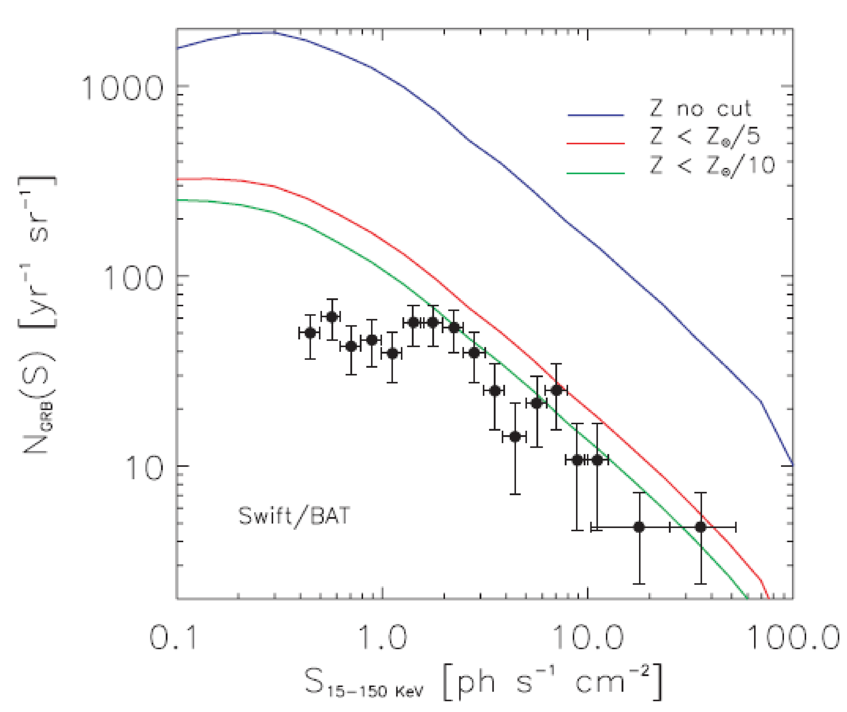
Only the minority of hosts residing in haloes more massive than 10^{11} $M_{\odot}$ is to show appreciable extinction, and SFRs higher enough to make the system detectable in the submm band.

Finally, most of the hosts have UV magnitudes $-20 < M_{1350} < -16$, and Lyman α luminosity 2×10^{40} erg s^{-1} < $L_{Ly\alpha}$ < 2×10^{42} erg s^{-1} ; thus they are tracing the faint-end luminosity function of Lyman break galaxies and Lyman-α emitters.

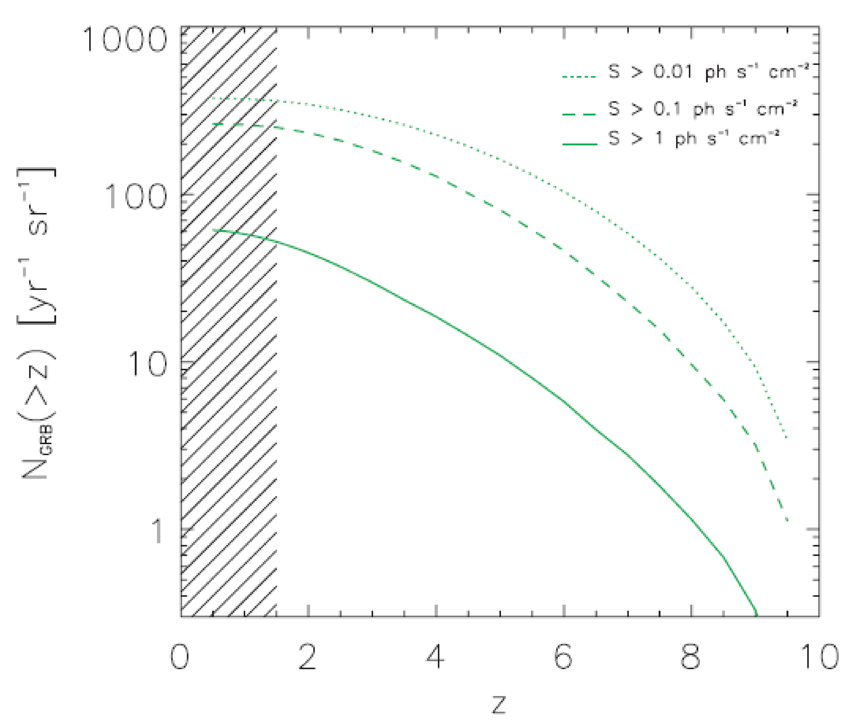
Cosmic SFR and GRB progenitor rate



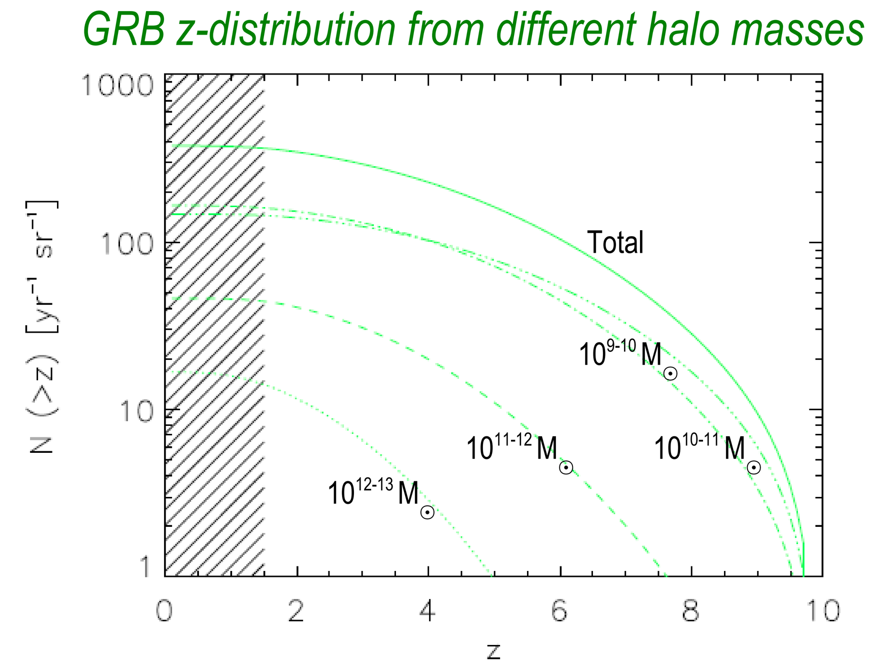
GRB number counts



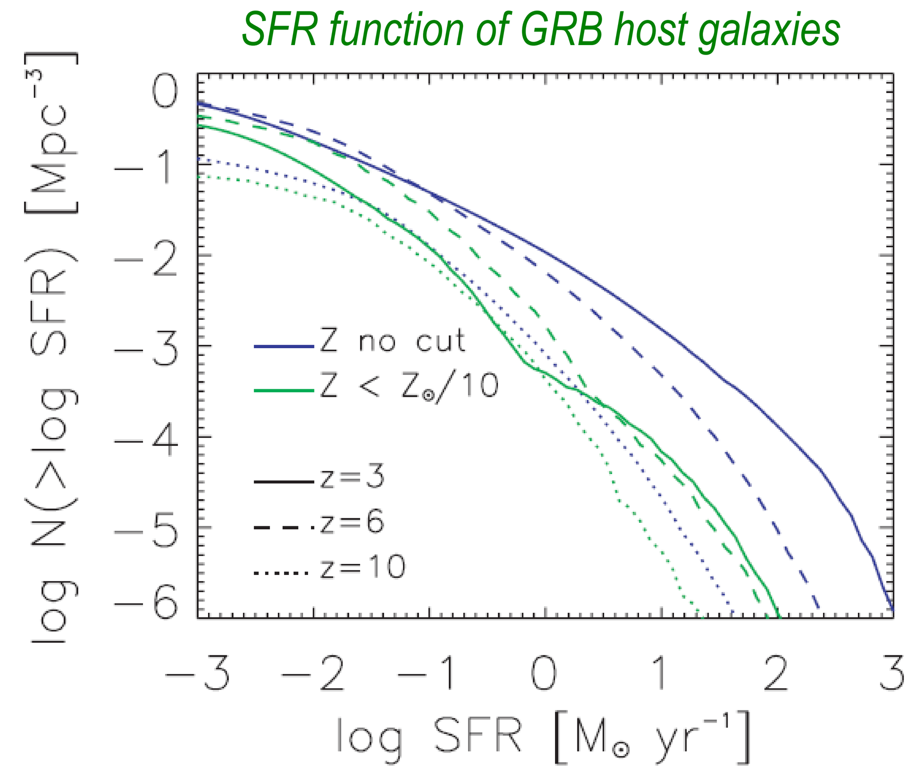
GRB z-distribution at different fluxes



GRB z-distribution from different halo masses



SFR function of GRB host galaxies



Lapi, A. et al., MNRAS 386 (2008), 608; lapi@roma2.infn.it