Host Galaxy of Long Gamma-ray Burst at high redshift

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Outline

- Gamma-ray burst
- Host galaxy
- Simulated galaxy sample
- Conclusions

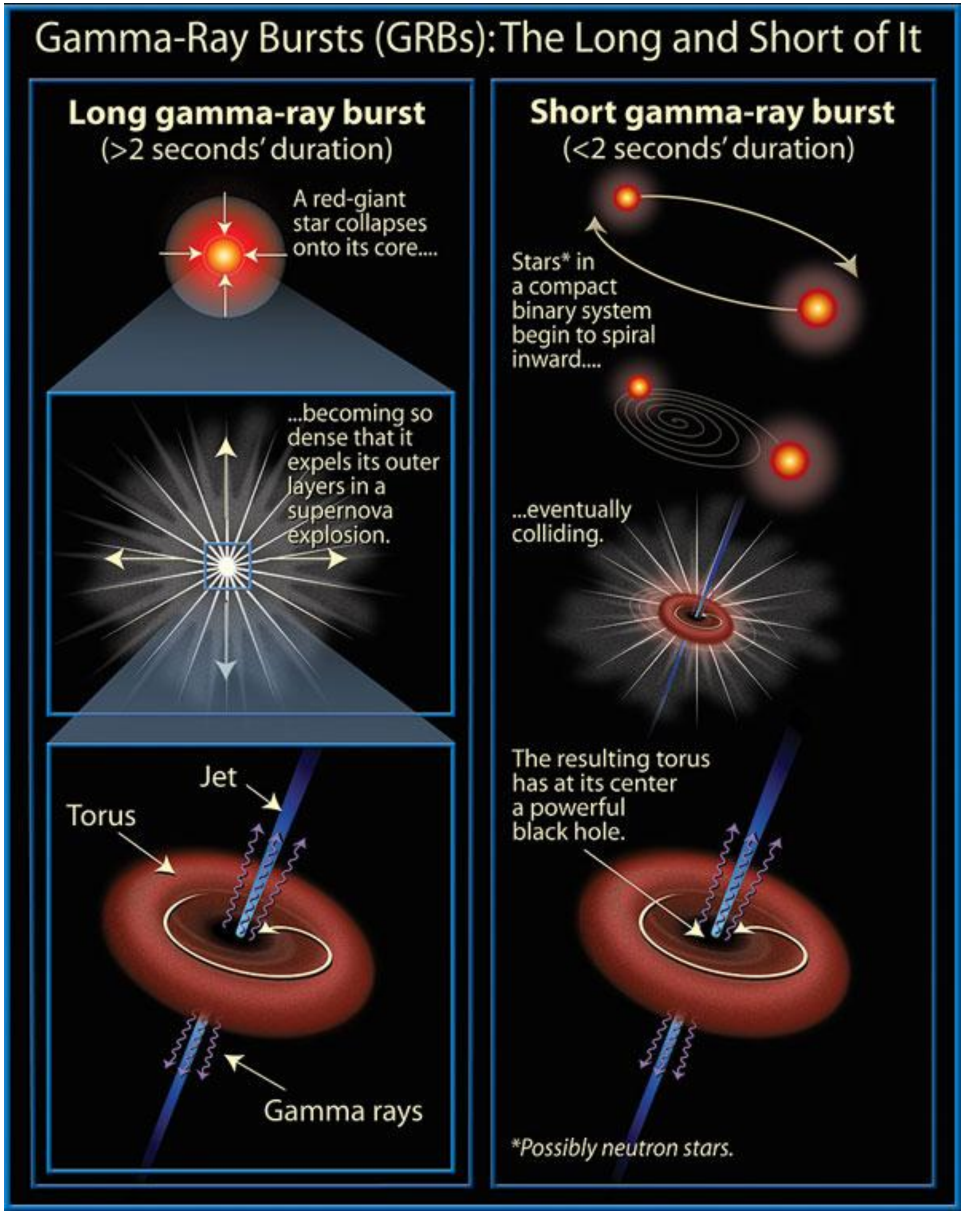
What we know from observations…

1. GRBs are the brightest events in the Universe
2. Are distribuited isotropically in the sky
   →cosmological distribution
3. Bimodal burst distribution (Long and Short)

Gamma-ray burst...

Long GRB

Core Collapse of massive stars



Short GRB

Merger of compact objects

Why GRBs Are Important???

- Are 100-1000 times brighter at early times than the high redshift QSOs
- Can be detected at high redshift with minimal extinction by intervening gas or dust
- Offer exciting possibilities to study astrophysics in extreme environments, e.g. radiative processes in highly relativistic ejecta
- Provide light candles in the universe to study the intergalactic medium
- The rate of LGRBs should be a biased tracer of the SFR in the universe
- Their cosmological distance give us the potential to probe regions of the universe that are otherwise unknown…

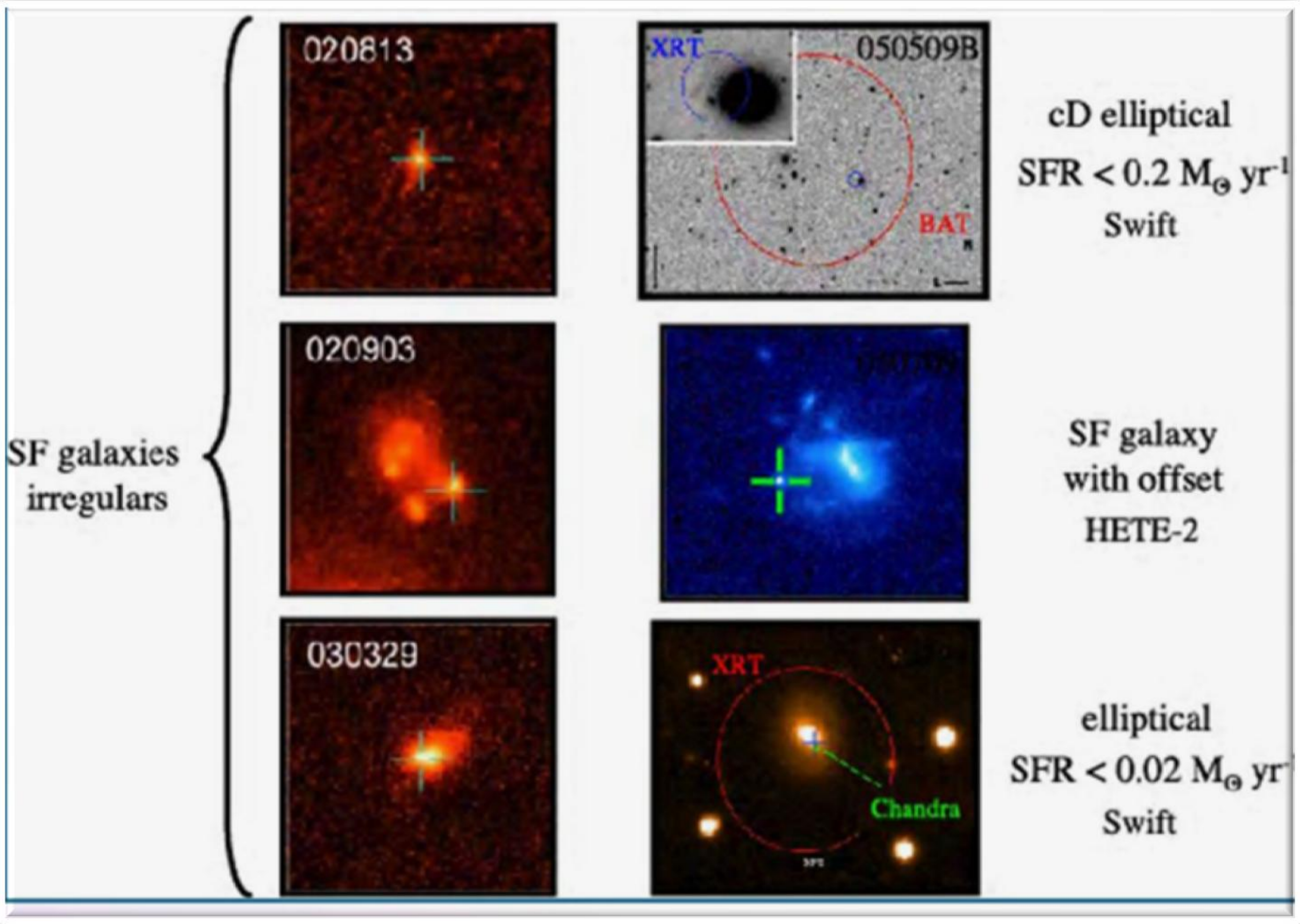
…thanks to the GRBs we are able to study:
Reionization, Star Formation Rate and the First Generation of Stars…

Host galaxies...

What we know from observations...

Host galaxies...

Long GRB **Short GRB**



In my PhD research, I am focusing my study on Gamma-ray Bursts host galaxies…

Observations of GRBs' host galaxies are useful to understand the nature of GRBs…but until now only ~60 GRB have associated host galaxies…

…what my contribution is?

I select possible Host galaxies of long GRBs from a simulated catalog of galaxies to study their properties

Simulated galaxy sample

CATALOG: We use the galaxy catalogues constructed by **Wang et al. 2008** (MNRAS 384,1301) from two simulations with WMAP1 (same parameters of the MILLENNIUM simulation) and WMAP3 and redshift up to z~10

IDENTIFICATION of HOST GALAXY:
We adopt the ***Collapsar Model*** for Long Gamma-Ray Burst

Young stars with high mass and low metallicity form GRBs

$T_c < 5x10^7$ yr

$M > 30 M_{sun}$

$Z < 0.1\text{-}0.3 Z_{sun}$

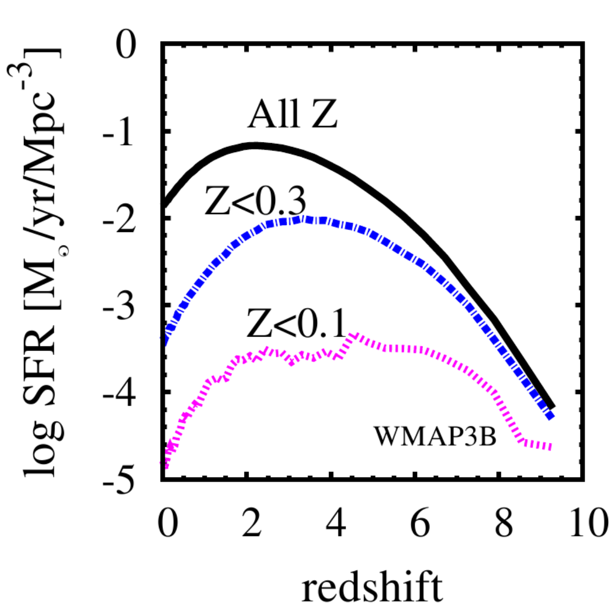
We make use of 3 host sample obtained using stars with:

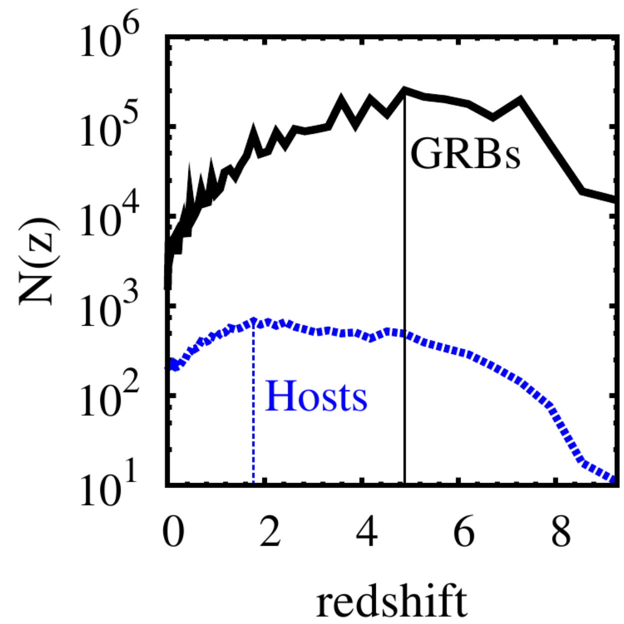
- **HOST1** : young and massive
- **HOST2** : young, massive and $Z < 0.3 Z_{sun}$
- **HOST3** : young, massive and $Z < 0.1 Z_{sun}$

Assuming Salpeter IMF and to have 1 GRB per 1000 SNe
each galaxy hosting **at least one GRB** event is **host galaxy**

Results in brief

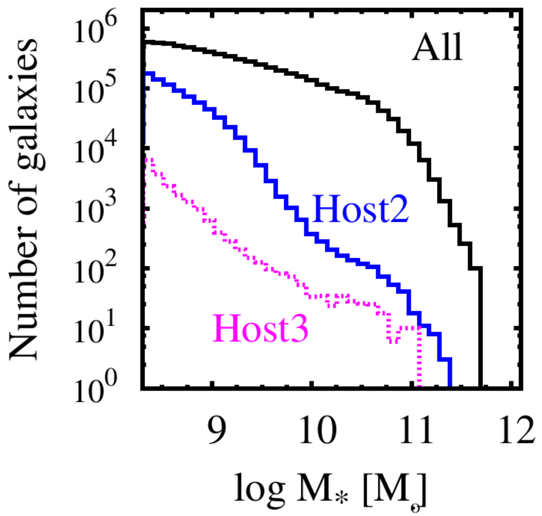
Do LGRBs provides a biased tracer of the cosmic star formation rate?





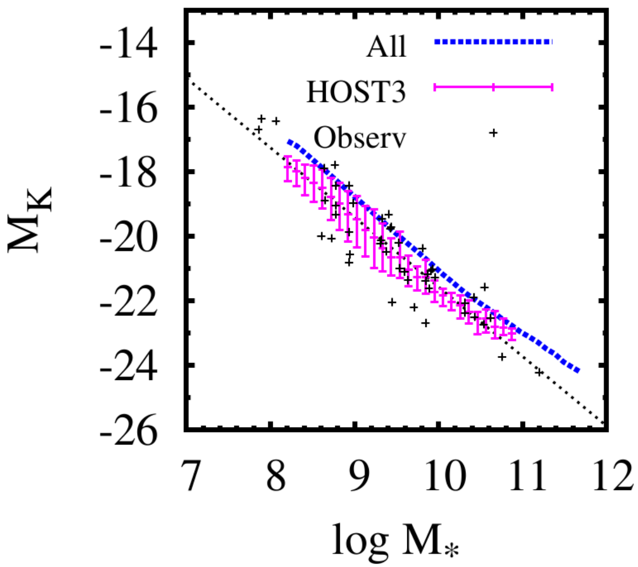
- LGRBs SFR peaks at higher redshift than cosmic SFR
- The ratio between cosmic SFR and host SFR decrease with redshift
- a z~5 HOST2 measure about 30% of the global SF density and HOST3 only ~10%
- Galaxies at higher redshift form stars at higher rate and lower metallicity
- The redshift distribution shows as the rate of LGRB peaks at z~5 and the number of host is maximum at z~2

Results in brief

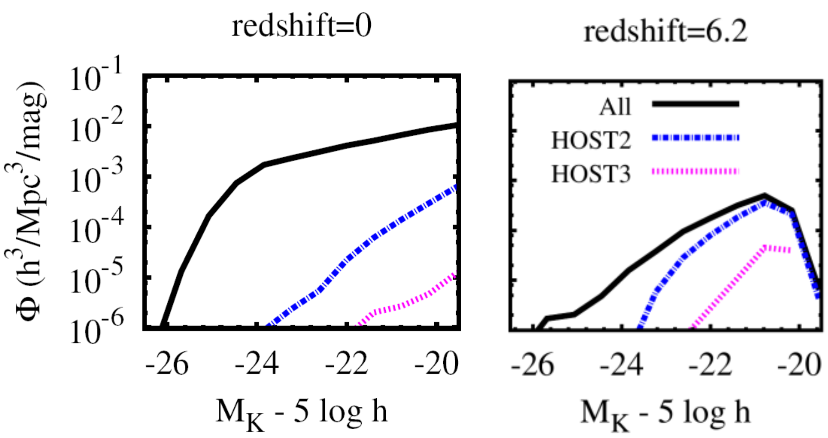


- Typical LGRBs host galaxies tend to occupy preferentially the low mass end of the galaxy mass function
- The figure clearly shows that HOST3 sample have 90% $M<10^{10}M_{sun}$

- The K-band distribution of simulated host galaxies is in agreement with observations
- In average host galaxies have K-band magnitude lower than normal galaxies

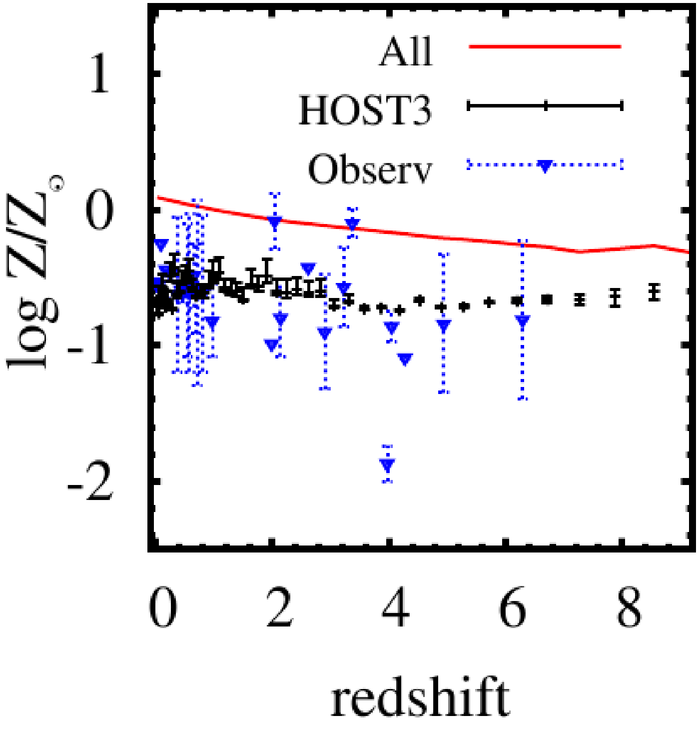


Results in brief



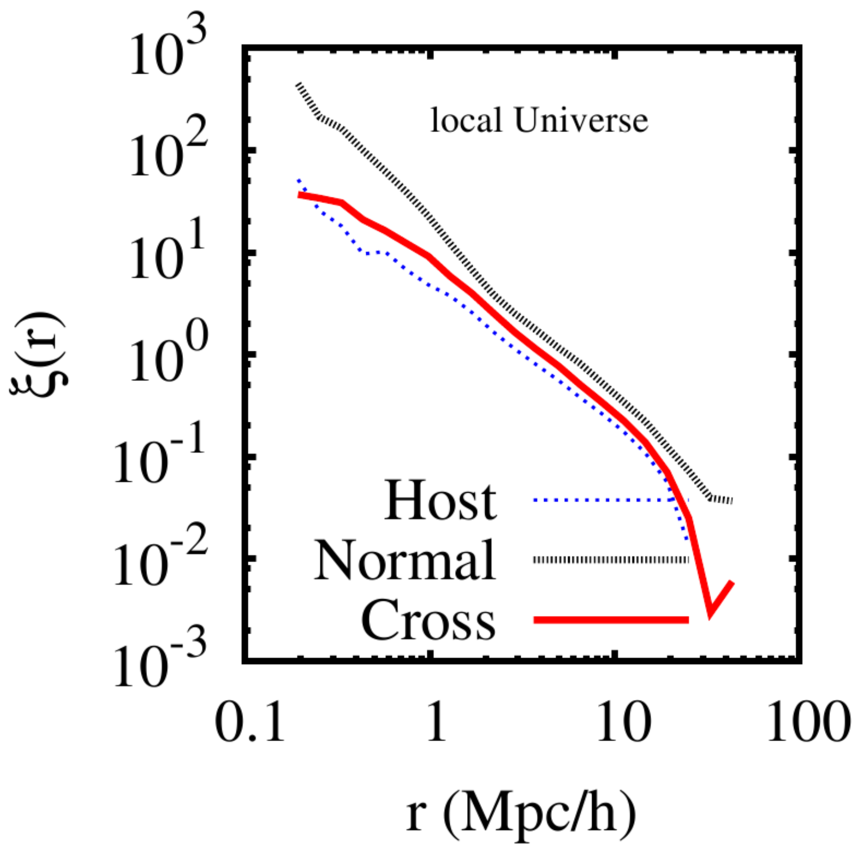
- The host galaxies' luminosity is well below the L*
- While total LF evolve with z, the rate density and the range of L of host galaxies vary midle

- The metallicity of host is in average lower than normal galaxies
- Inner bars errors, model predictions are compatible with them



Results in brief

- Cross correlation function suggests that the probability of findings another host near a GRB host is lower than the probability to find a normal galaxy



Host galaxies do not reside in high density environments

Conclusions...

In our simulations we find that

- GRBs may not be a good tracer of cosmic SFR
- The rate of LGRBs per host galaxies increases with redshift
- Typical LGRBs host galaxies have low mass
- In average their mass to light ratio is typical of young galaxies
- The host galaxies have luminosity well below the characteristic luminosity and their metallicity is lower than normal galaxies
- Correlation function suggests that host do not reside in high density environments

**I am sorry if this talk is not perfect…
But I have been busy with something else...........**

Just married. . . .

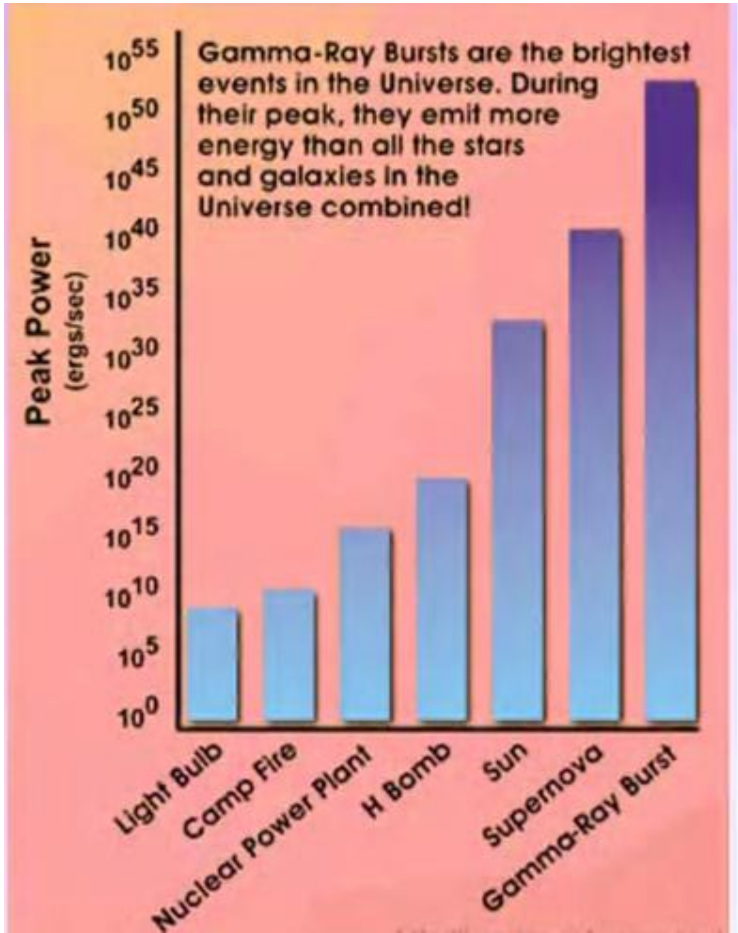
Thanks…

-Campisi et al. 2009, accepted MNRAS,http://www.mpa-garching.mpg.de/~campisi/campisi09.pdf
-Campisi et al. 2009, in preparation…

Gamma-ray burst...

What we know from observations...

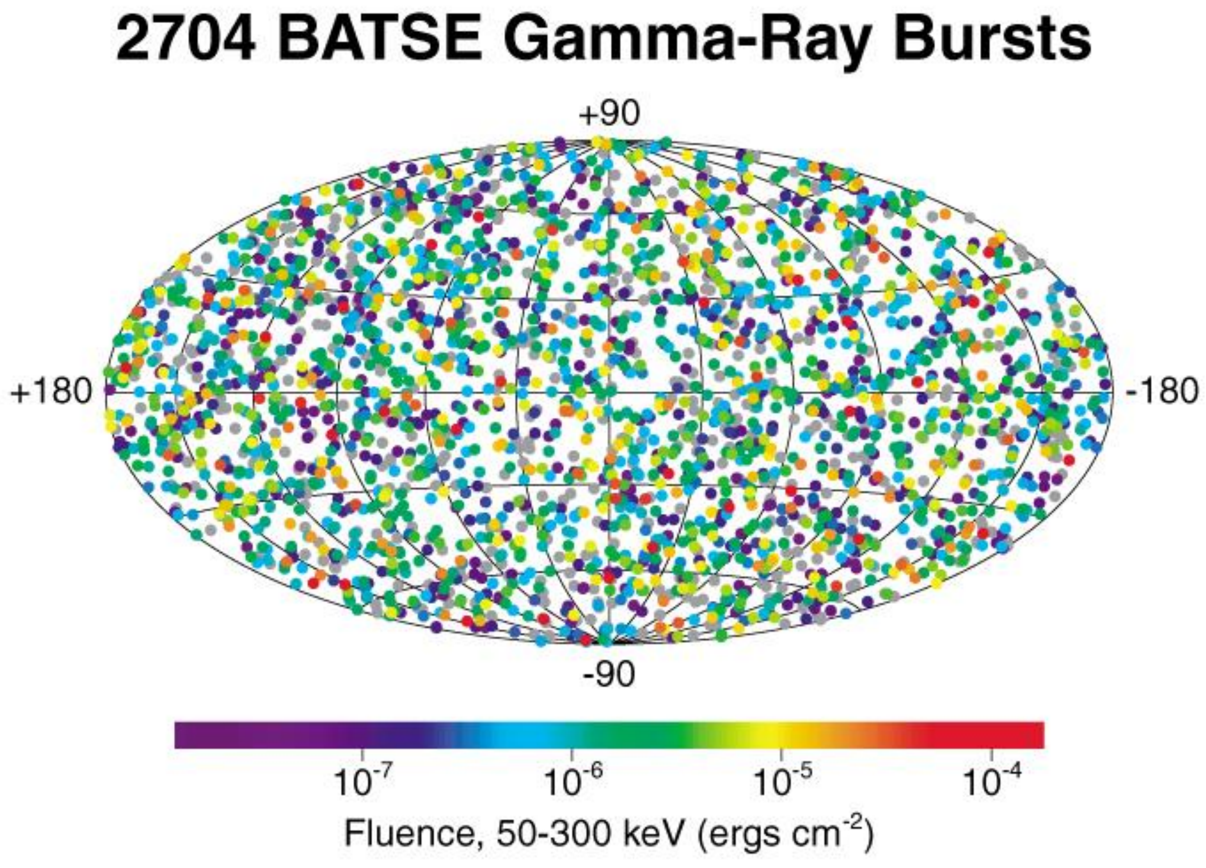
1. What GRBs are the brightest events in the Universe



Gamma-ray burst...

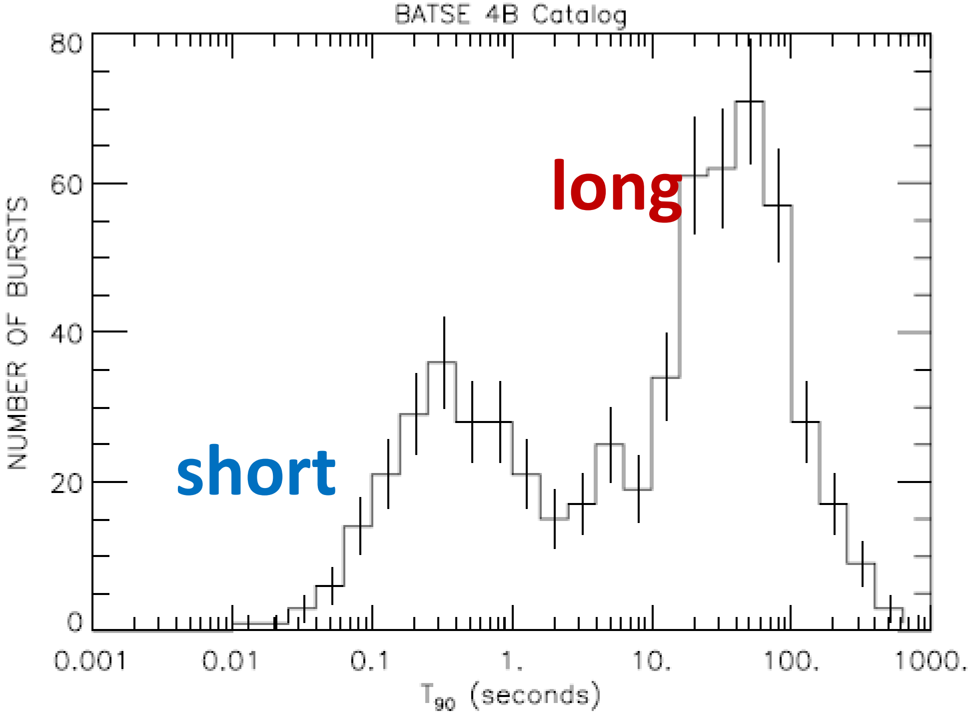
What we know from observations…

2. Are distribuited isotropically in the sky
   → **cosmological distribution**



What we know from observations...

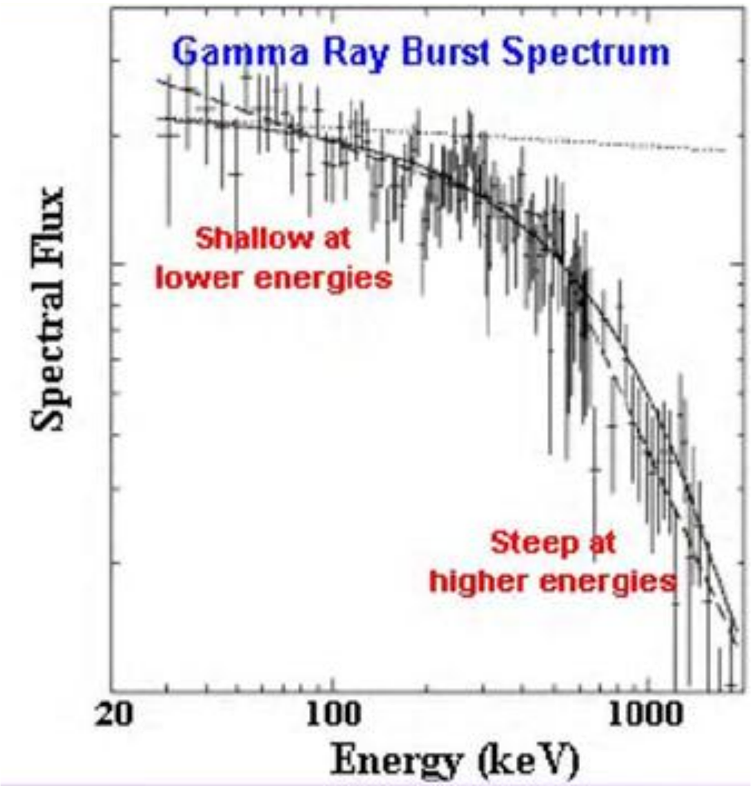
3. What Bimodal burst distribution

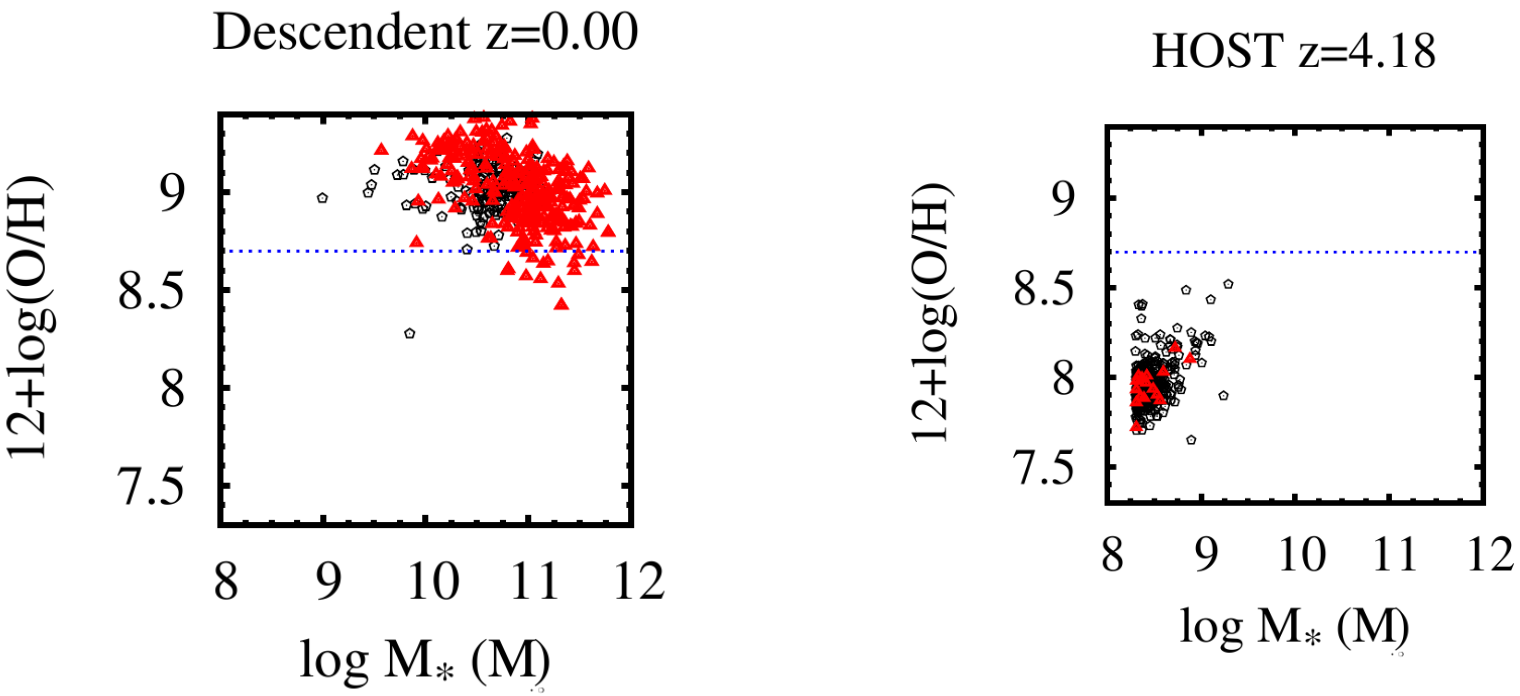


Gamma-ray burst...

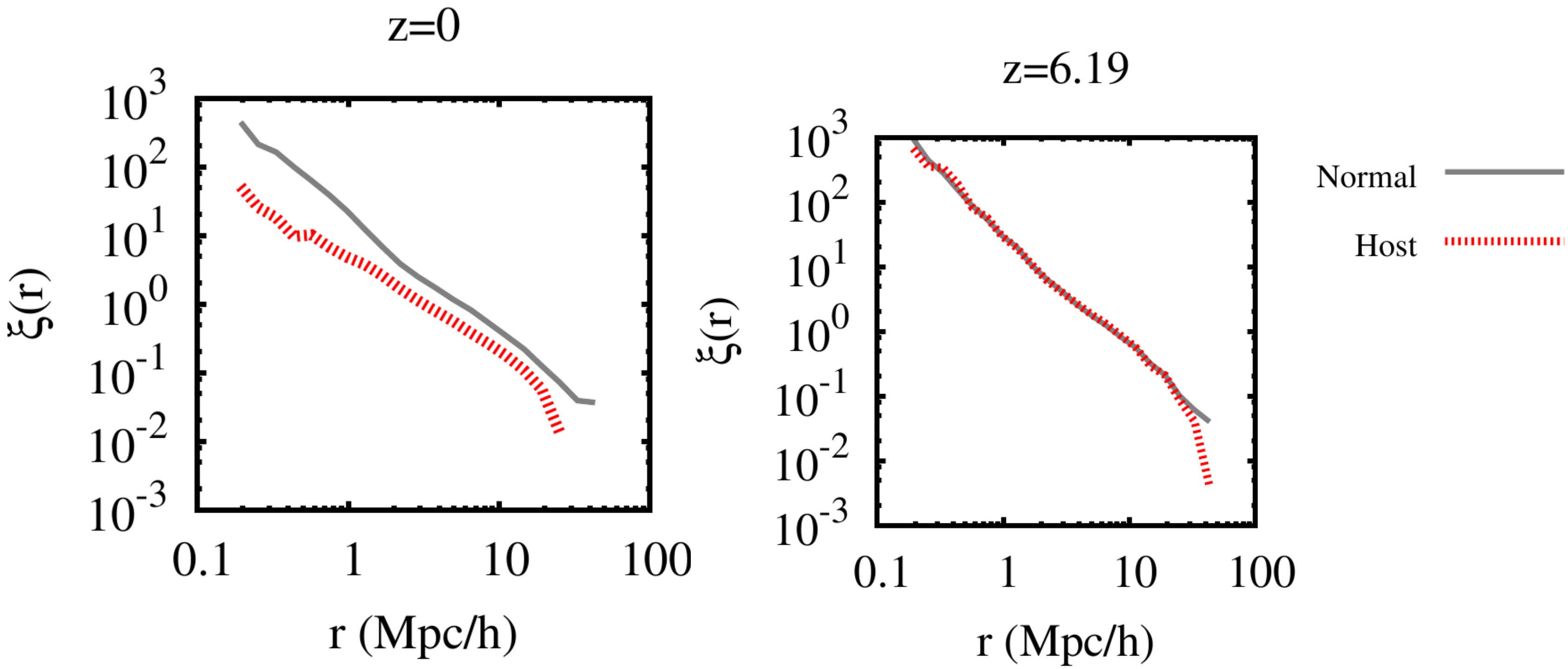
What we know from observations...

4. The energy spectrum is fitted by the Band function (two power-law)





Descendent z=0.00
12+log(O/H)
9
8.5
8
7.5
8
9
10
11
12
log M* (M)
HOST z=4.18
12+log(O/H)
9
8.5
8
7.5
8
9
10
11
12
log M* (M)



z=0
z=6.19
ξ(r)
10^3
10^2
10^1
10^0
10^-1
10^-2
10^-3
0.1
1
10
100
r (Mpc/h)
Normal
Host