The rate and luminosity function of long Gamma Ray Bursts

David Wanderman
Tsvi Piran

The Hebrew University of Jerusalem

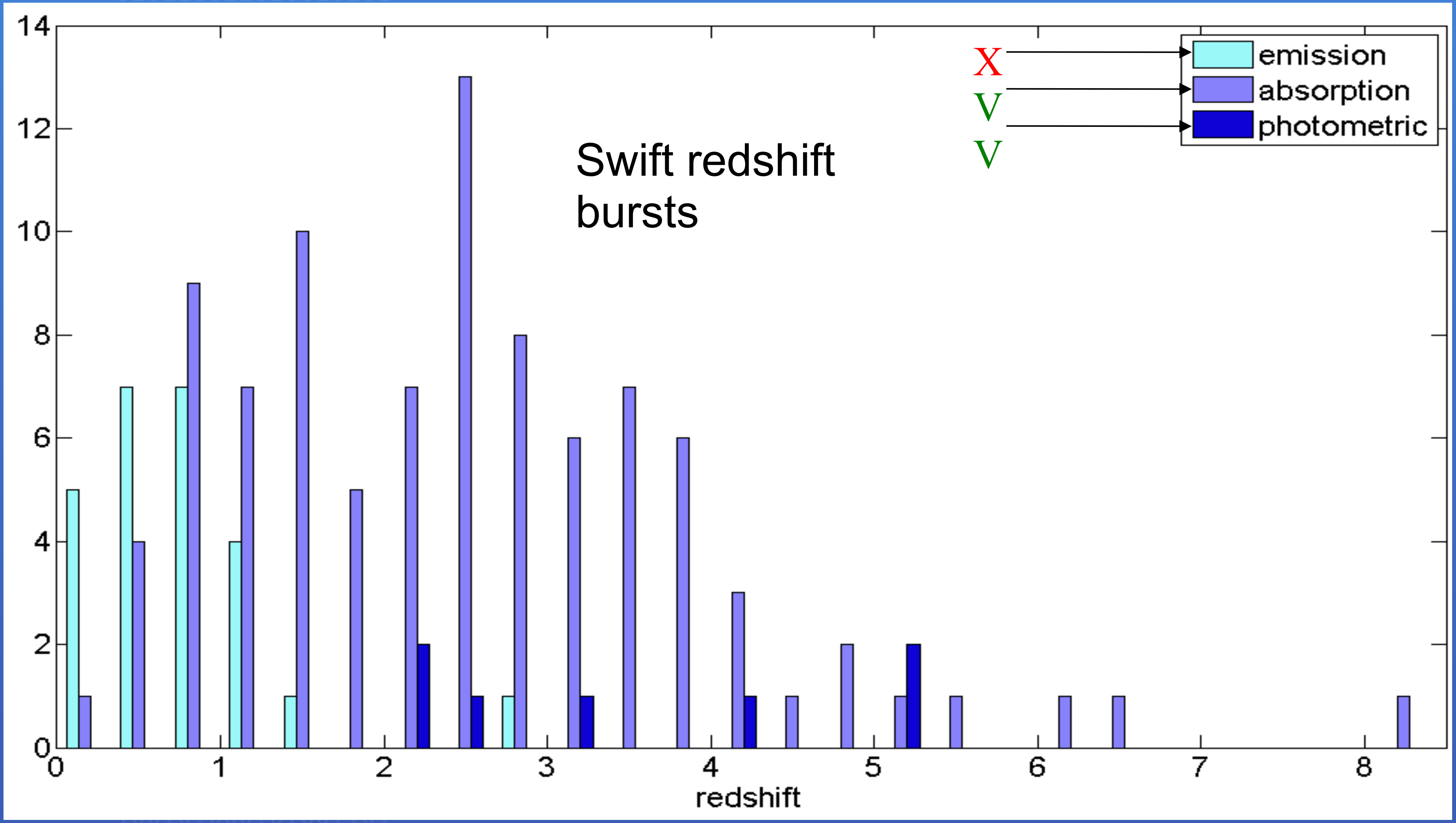
Goal

- To measure the GRB rate and luminosity function accurately

Issues

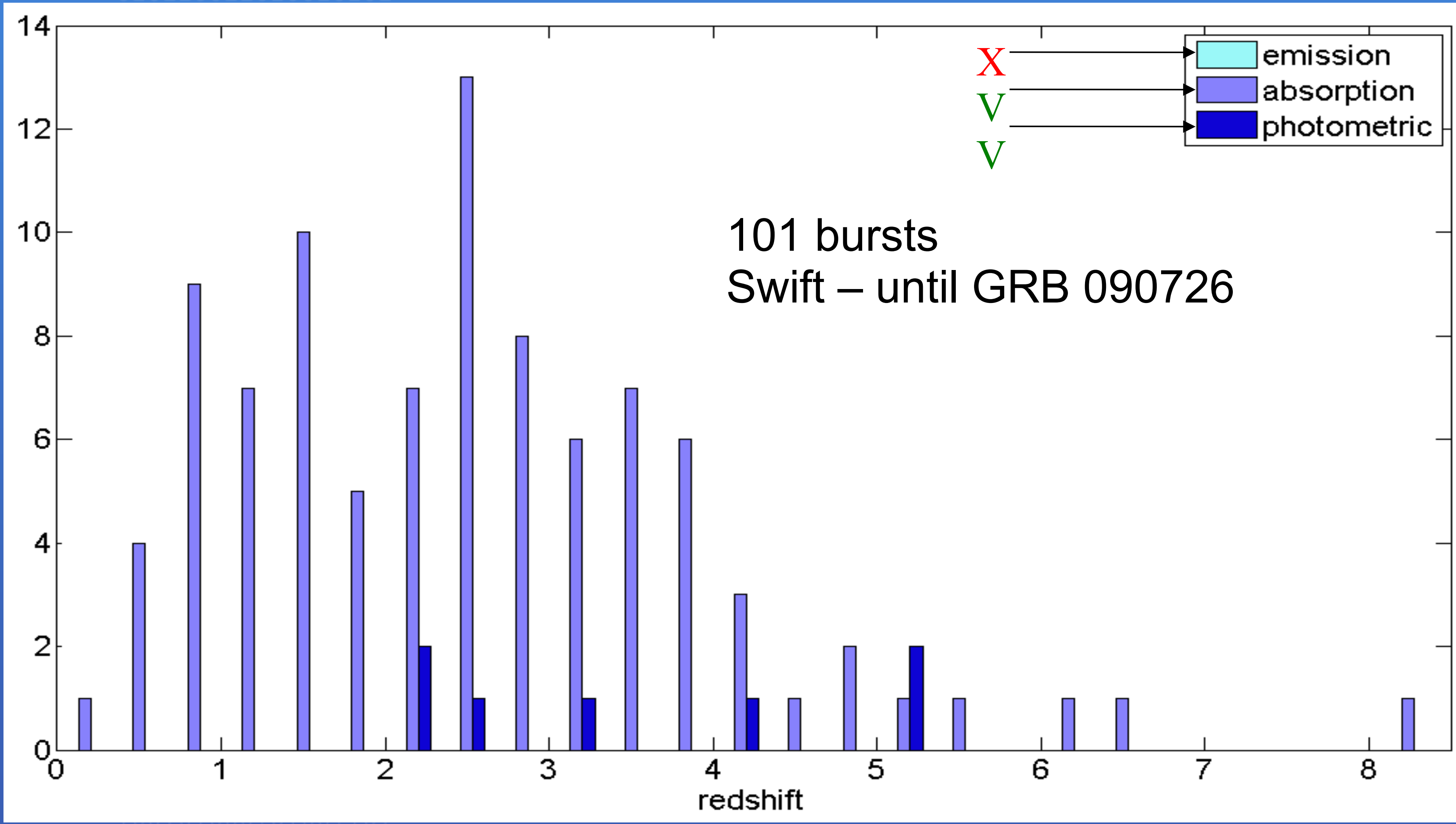
- Building a representative data sample.
- Is there a redshift evolution of the luminosity function?
- Local GRB rate and the energy deposit rate

The Sample



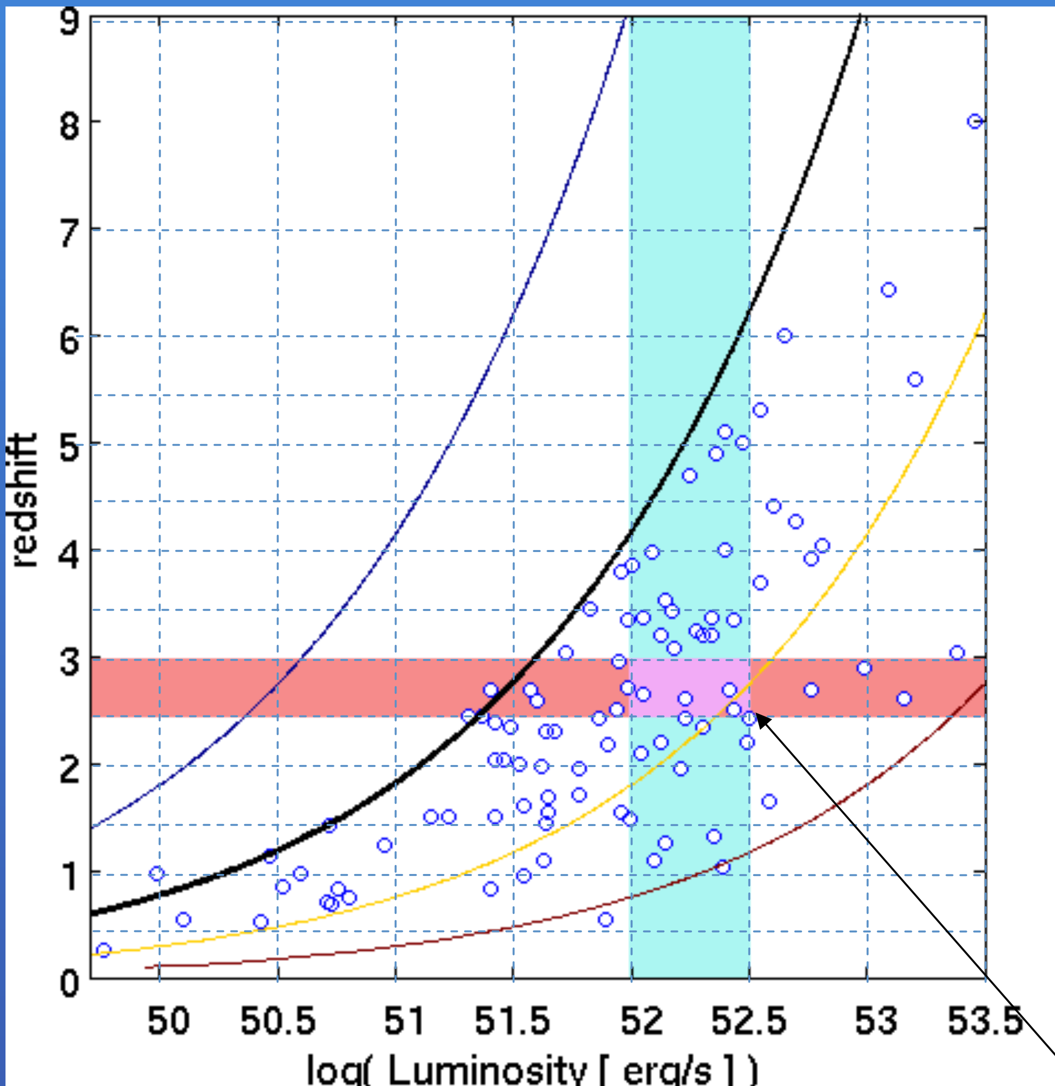
Swift redshift bursts
X
V
V
emission
absorption
photometric
redshift
0
1
2
3
4
5
6
7
8
0
2
4
6
8
10
12
14

The Sample



X
V
V
emission
absorption
photometric
101 bursts
Swift – until GRB 090726
0
2
4
6
8
10
12
14
0
1
2
3
4
5
6
7
8
redshift

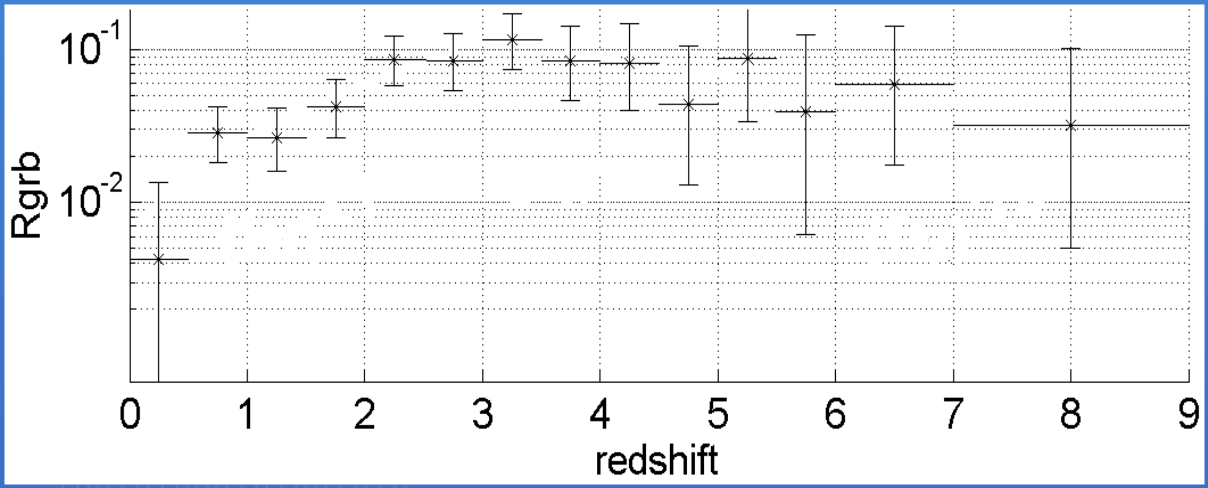
Direct inversion of the data

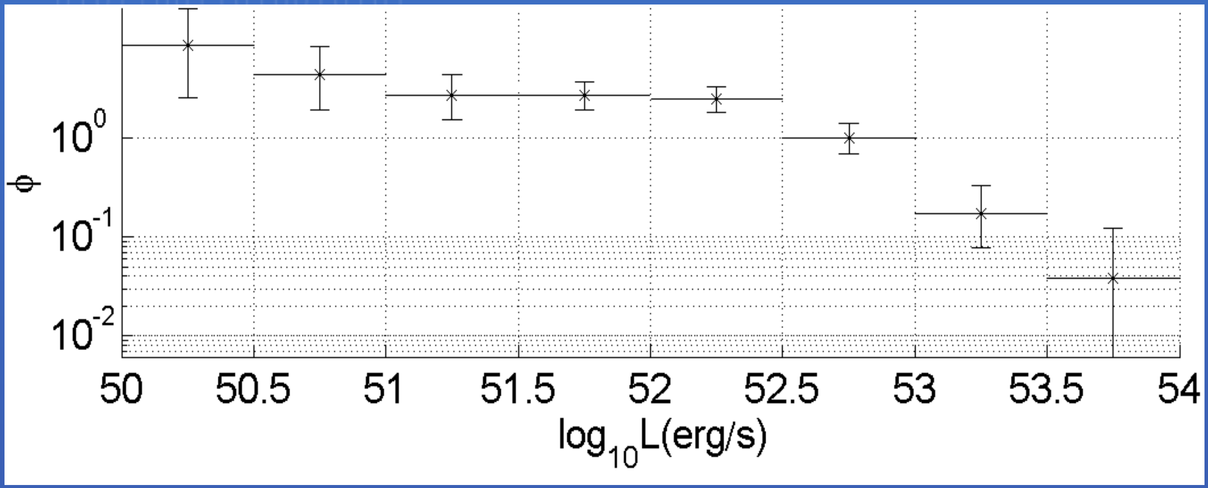


- The observed Redshift – Luminosity distribution is a convolution of the intrinsic rate and luminosity function
- Assume the functions are independent
- Inverse the bin burst count matrix N_{ij}
- Show that the functions found are consistent with the observations.

N_{ij}

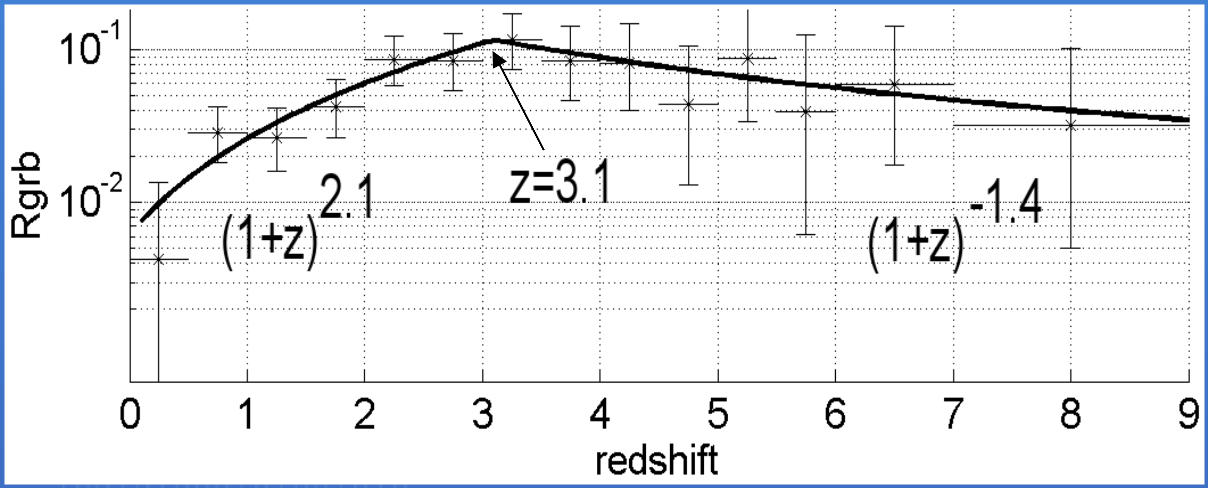
Results

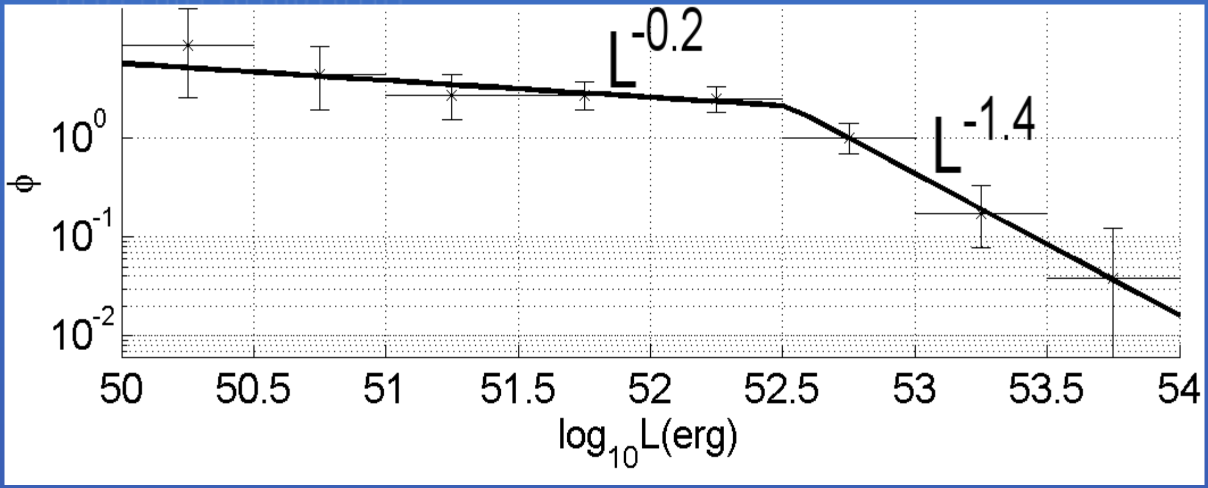




The rate and the luminosity function

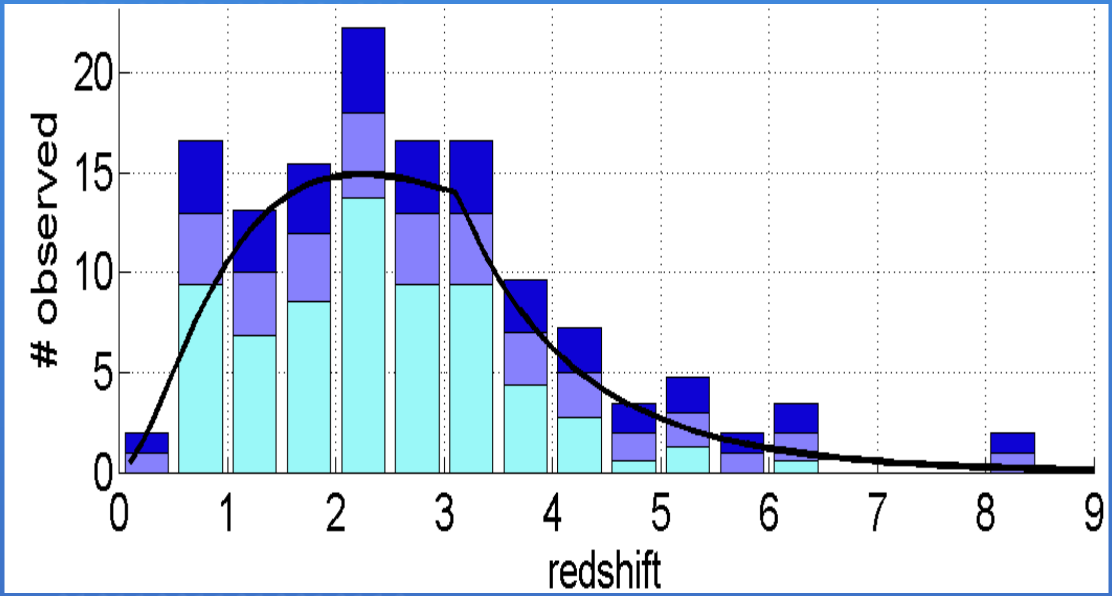
Results

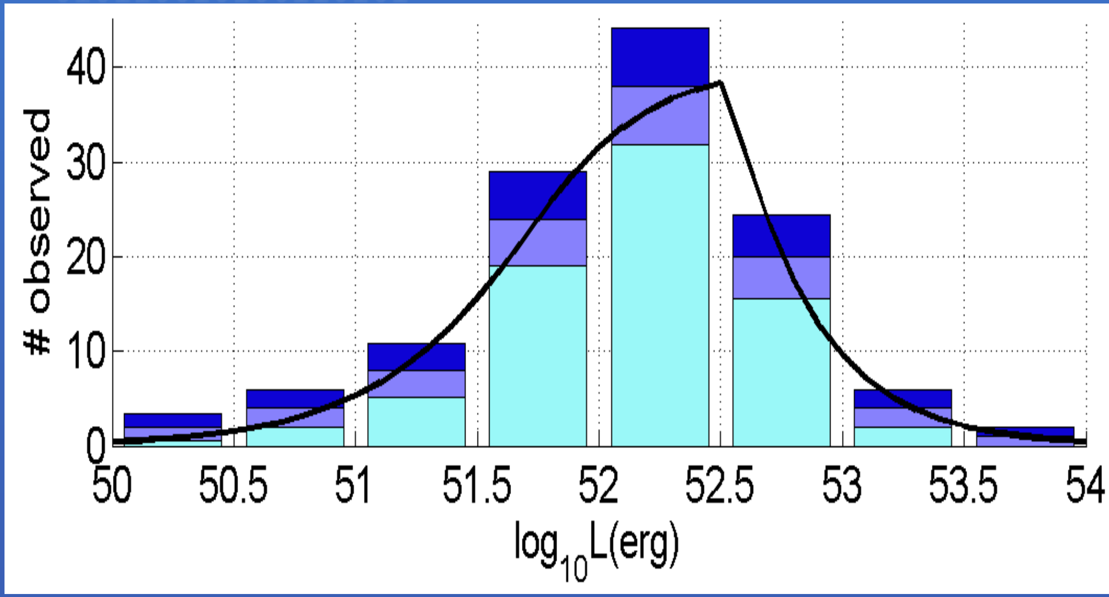




The rate and the luminosity function

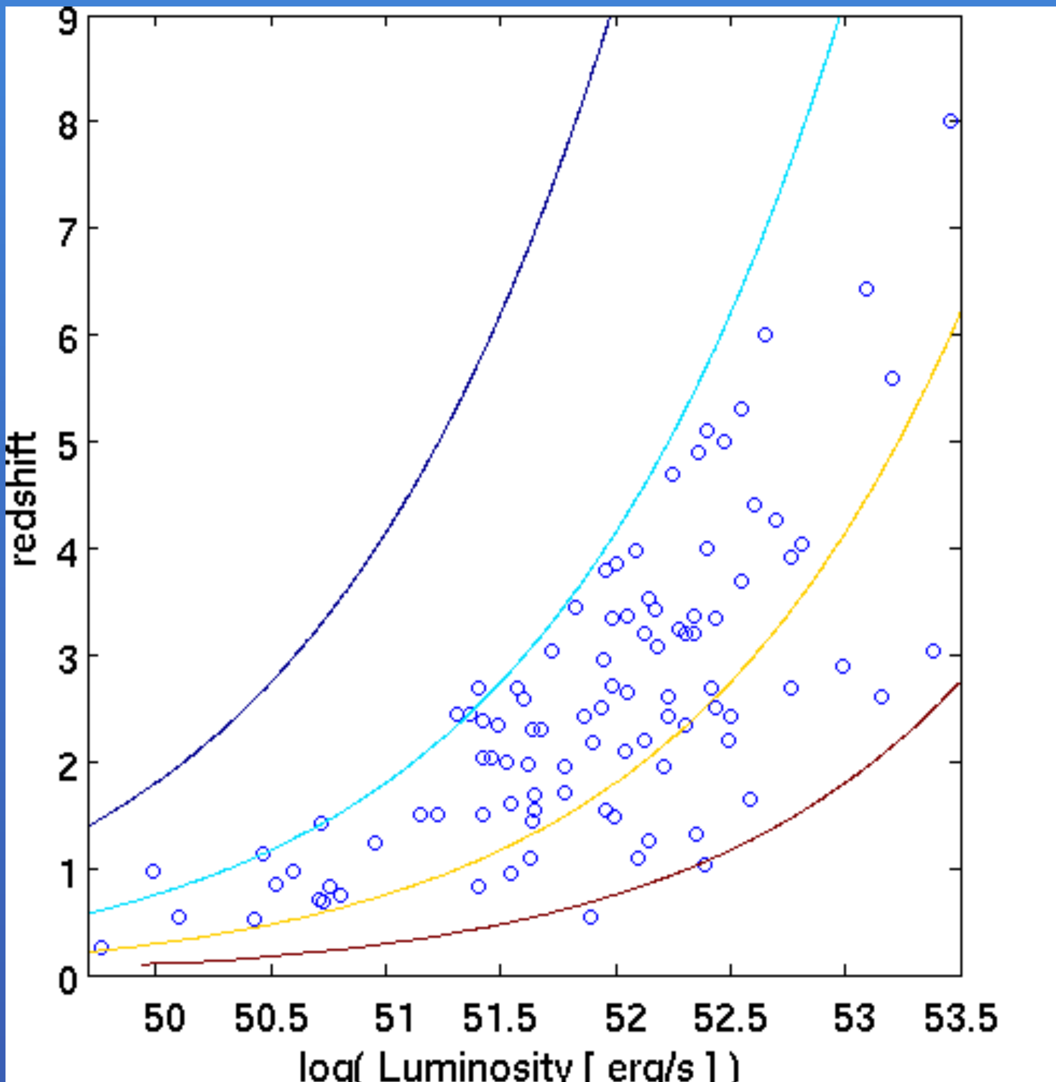
fit to power-laws





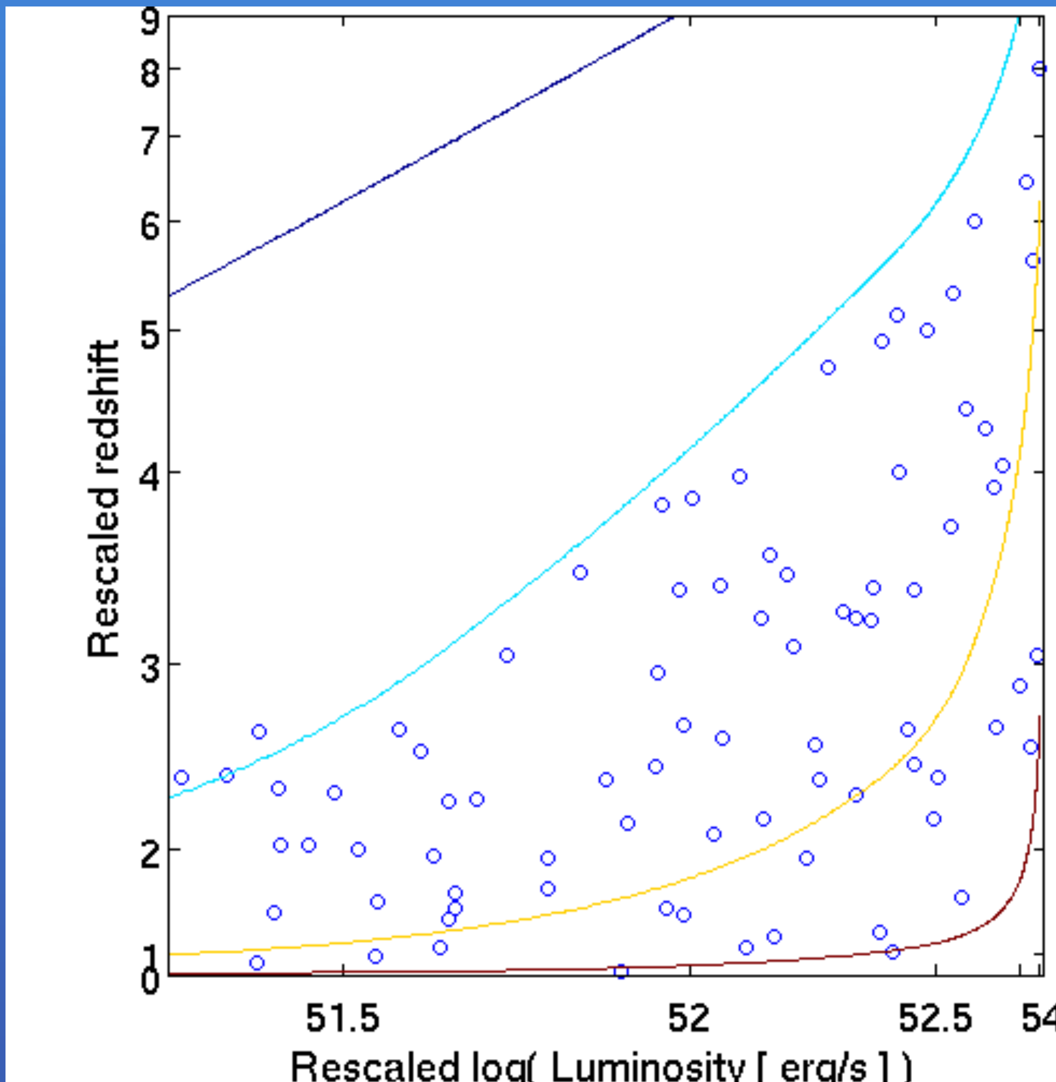
Comparison with the observed redshift and luminosity distributions

Rescaling the luminosity-redshift plane



We rescale the luminosity-redshift plane to yield a uniform density - up to the detection efficiency

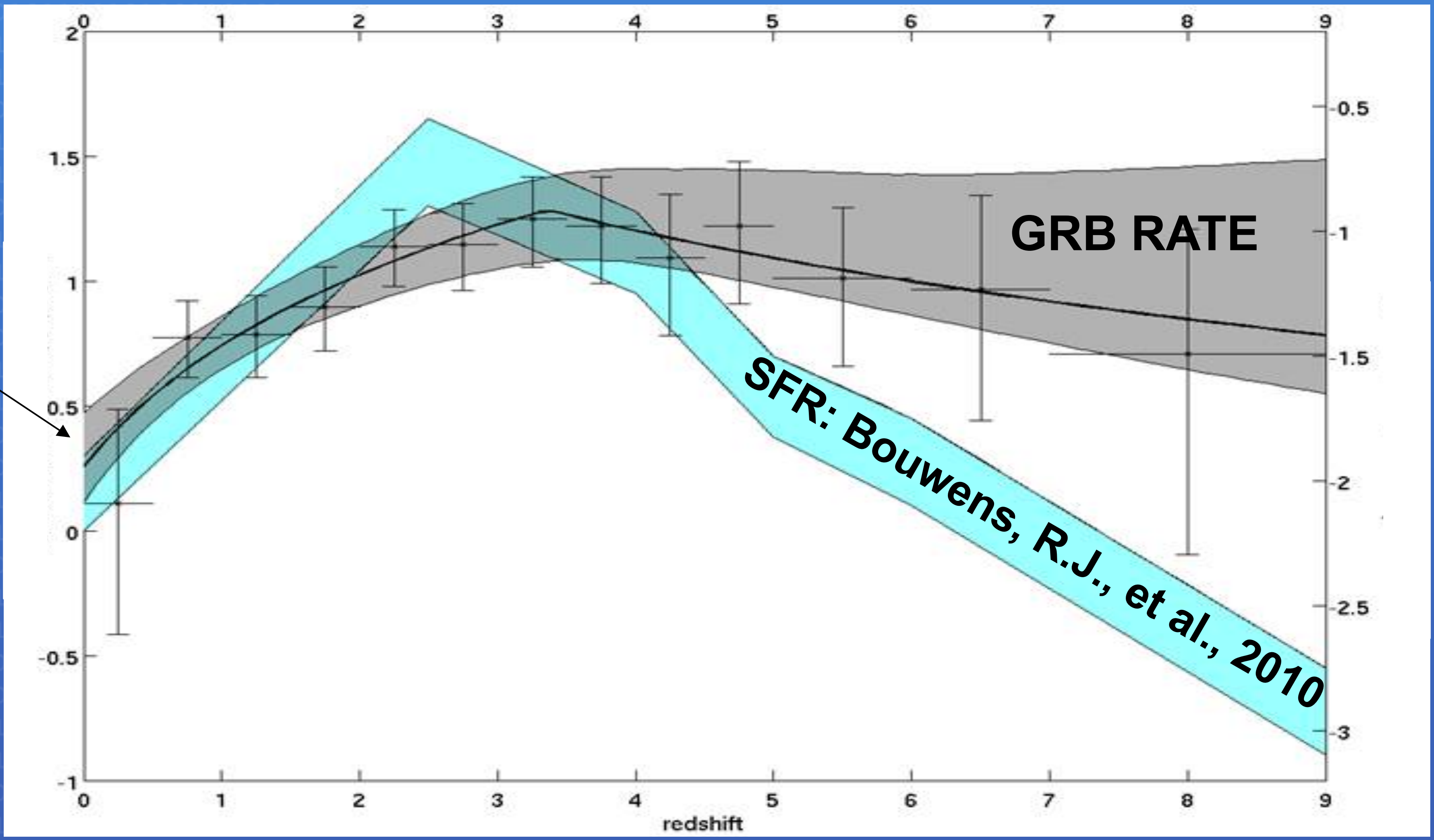
Rescaling the luminosity-redshift plane



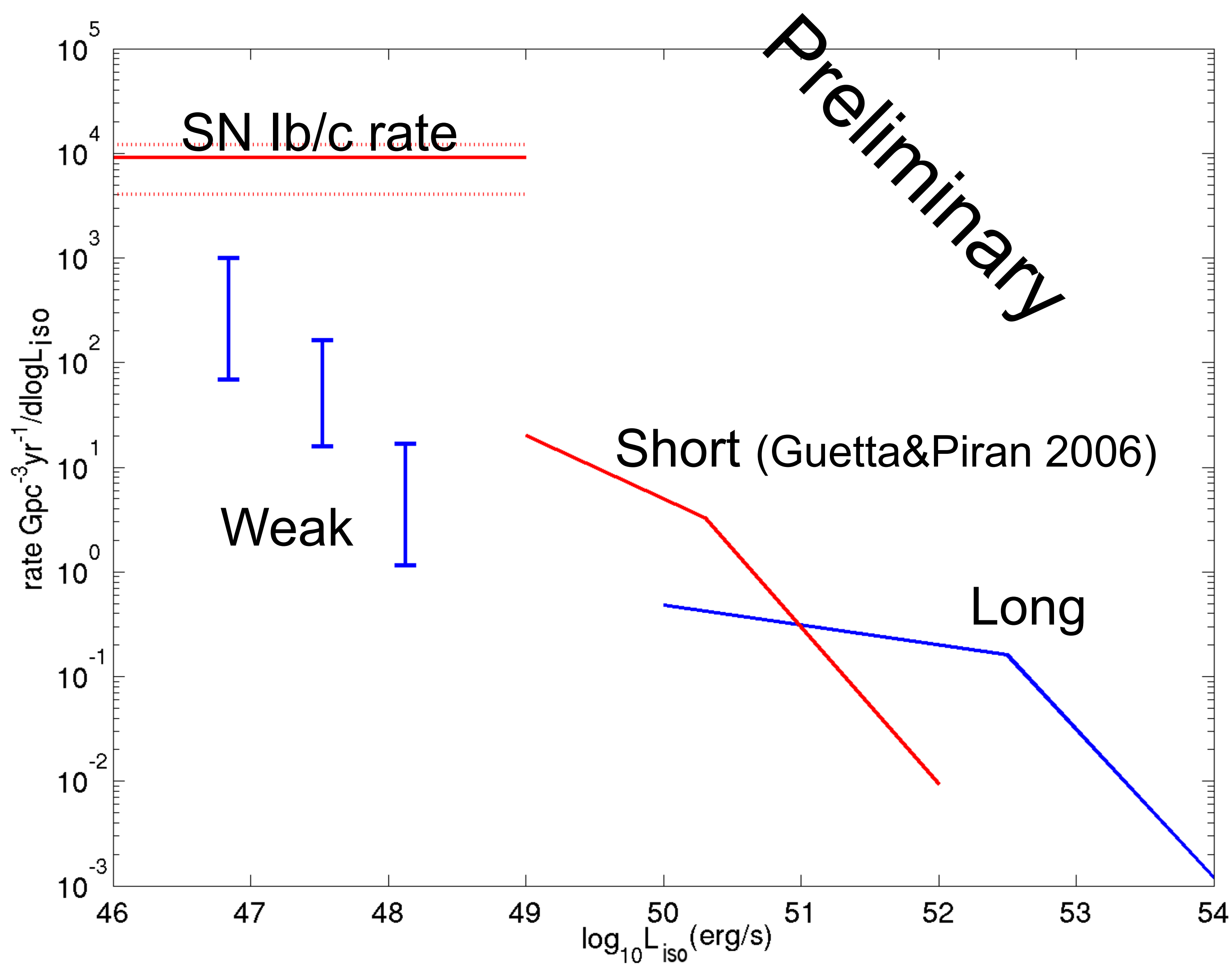
Uniform density - *indicating consistency*.

The GRB rate vs. the SFR

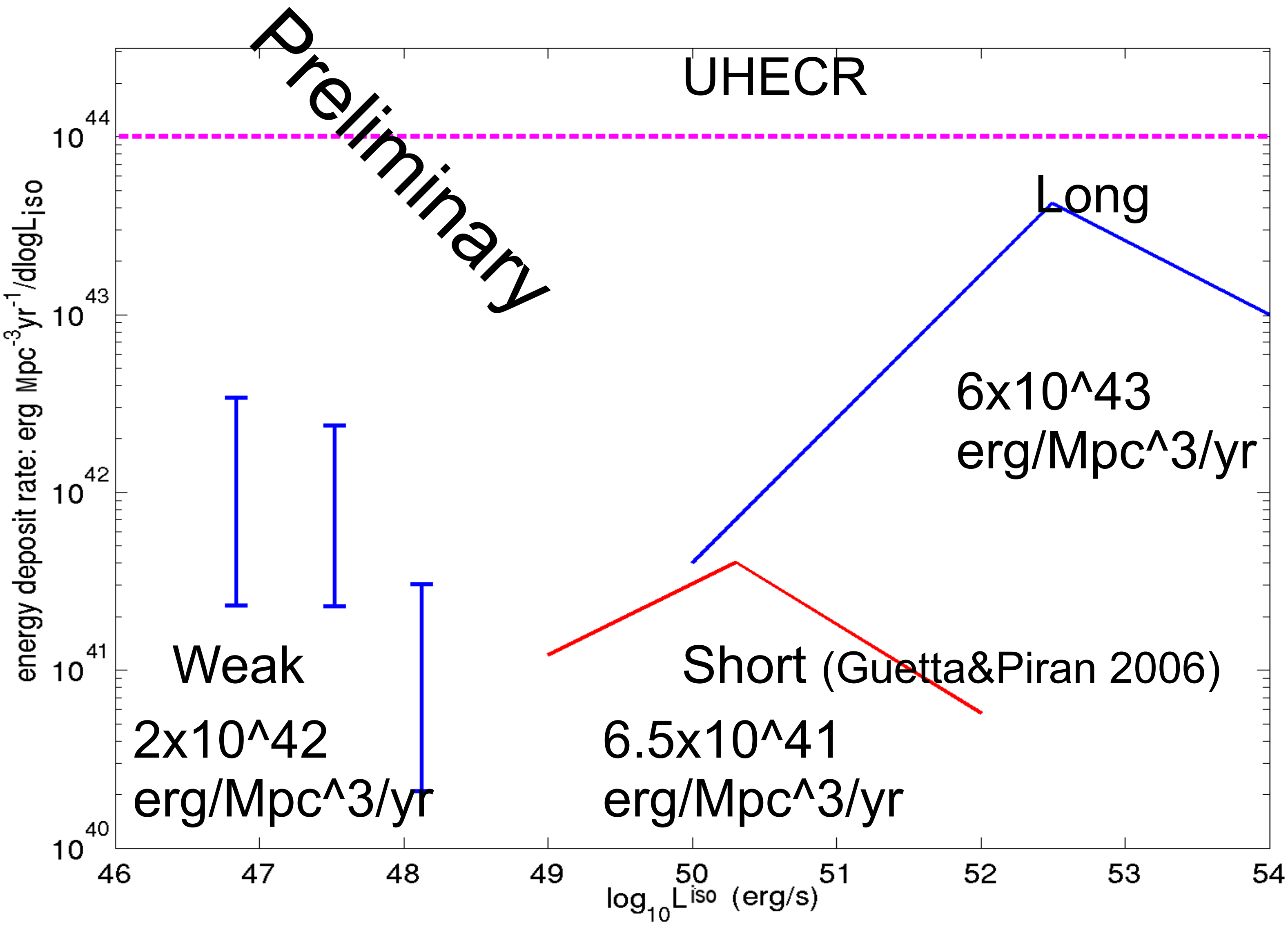
Local rate = 1.3 Gpc^-3 yr^-1



The local event rate and luminosity function



The local energy deposit rate



Conclusions

- We calculate the GRB luminosity function and rate
- Show that GRB rate at high redshift is higher than expected from the SFR
- Measure the local long-GRB rate
- Calculate the energy deposit rate into the ISM, and find it close to the UHECR requirement