GRANDMA S190814bv Limits vs. Real SGRB Afterglows: FIGHT!!!

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200225.60417

In Memory of Katherine Johnson

1918 - 2020

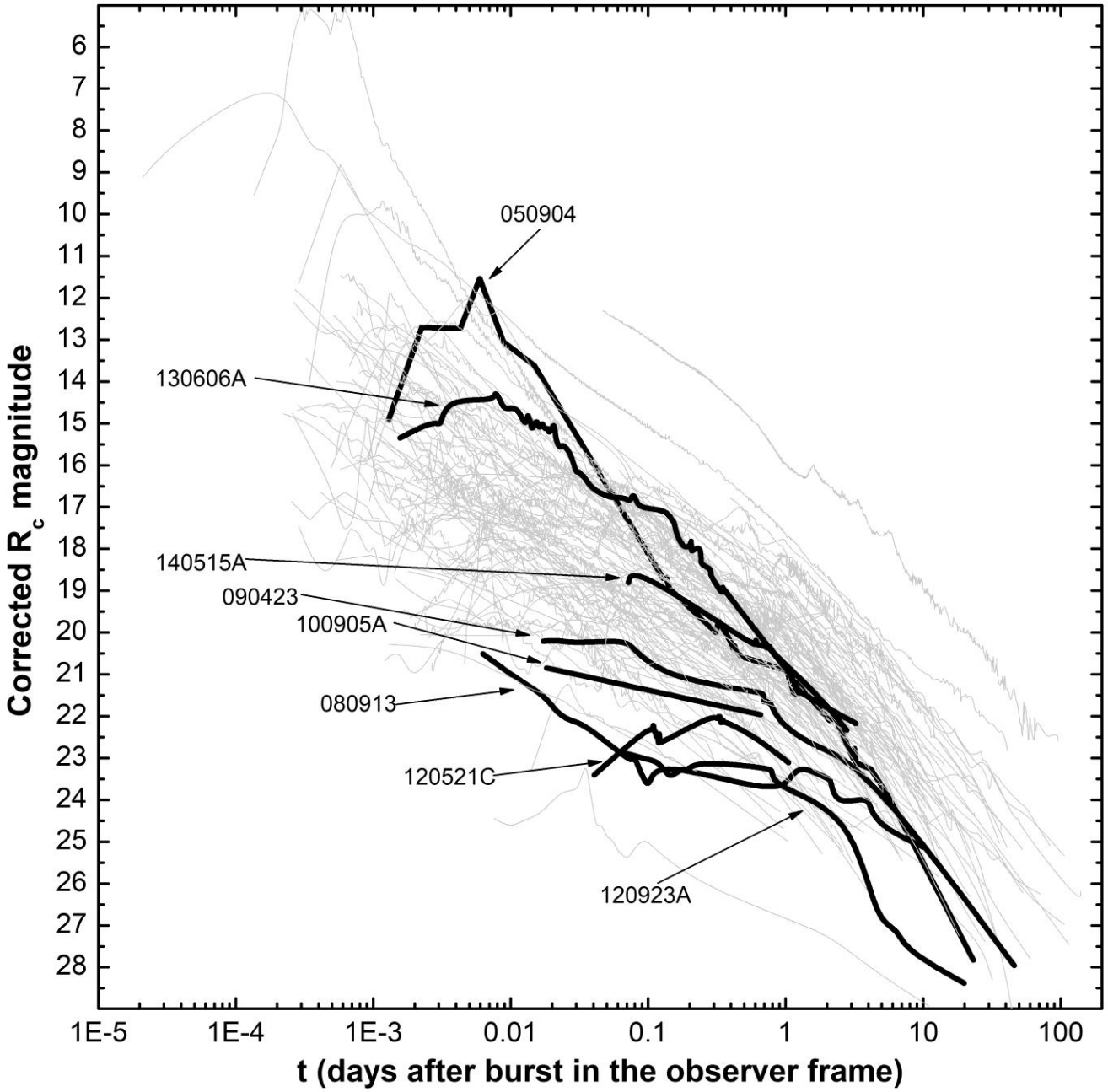
„They call it the Kann Plot“:

Working with S. Klose at the end of my diploma thesis (2004), we devised a method to correct Gamma-Ray Burst afterglow light curves for intrinsic extinction and redshift effects.

This allows the derivation of the actual luminosity distribution at different redshift.

First step:

- Collect data
- Fit light curves jointly (assume achromaticity)
- Derive Spectral Energy Distributions (SEDs) from fits
- Use colors to create „master“ light curves (LCs)
- Use derived spectral slope to shift master LCs to R_C band (assumption of „transparent Universe“) if needed

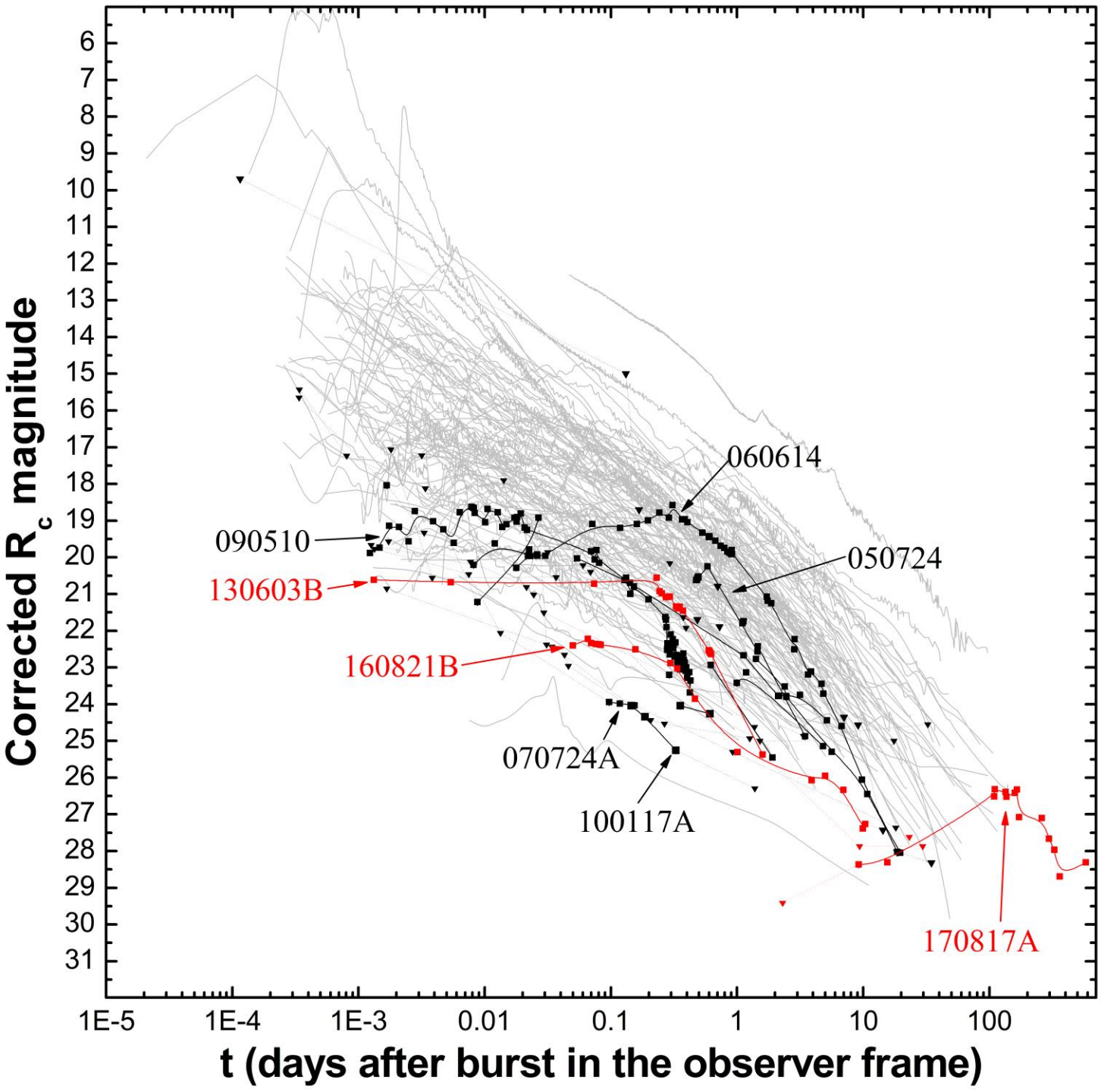


Here is an example of a high-redshift LONG GRB sample I recently collected for another project, set against my general collection.

The high-*z* after-glows are generally among the fainter ones (of course) but there are some very bright cases.

Now let‘s have a look how Short GRBs compare:

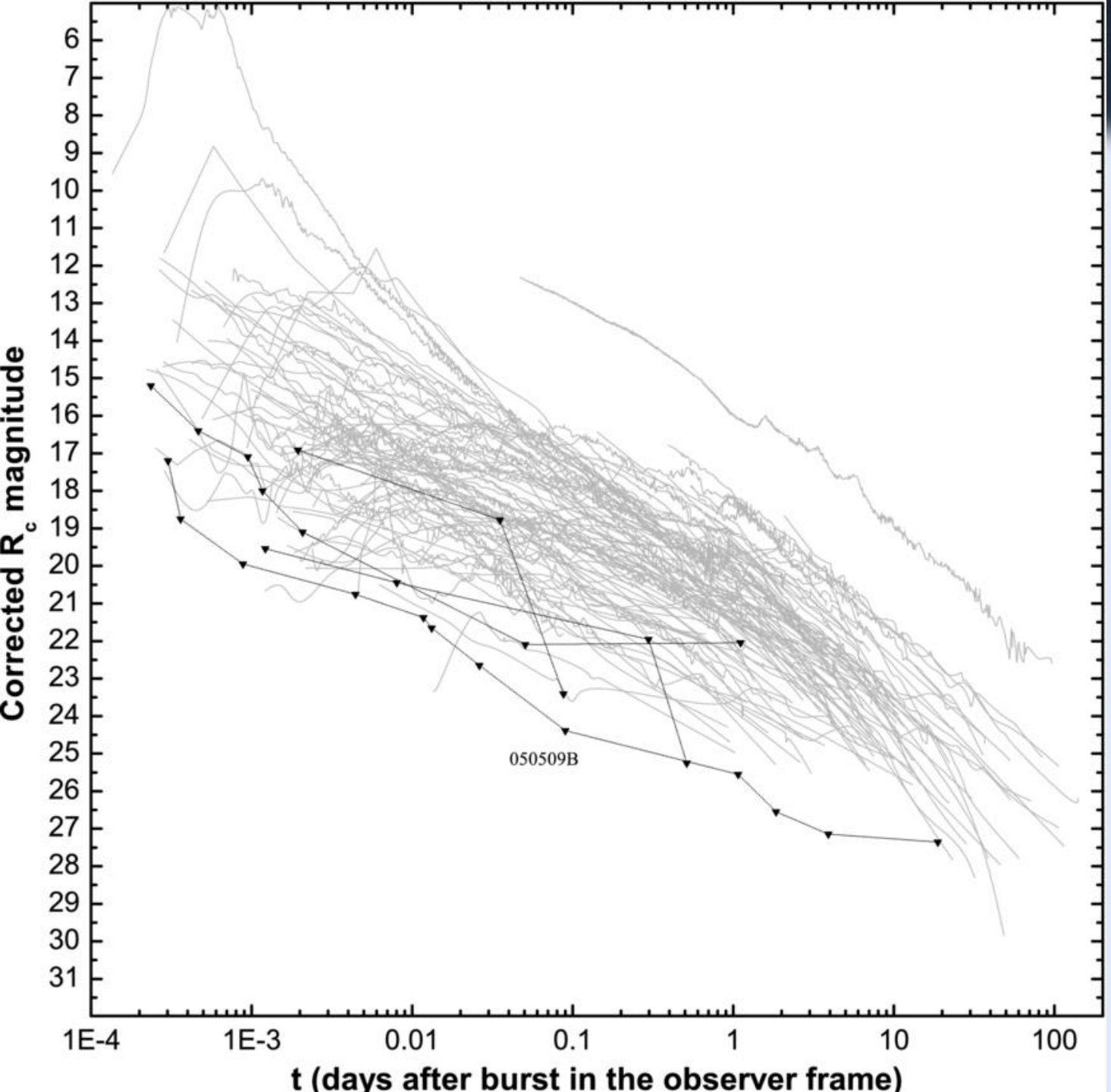
- In this case, I‘m only going to show SGRB afterglows (or upper limits thereon) with redshifts I consider secure.
- In case no optical/NIR afterglow was ever discovered, the positions of the SGRBs are still well-known from XRT afterglow detections, allowing the identification of host galaxies in or near the error circle.



Already observationally, the short GRB afterglows are for the most part fainter than the long GRB afterglow sample.

Note that even for the quite bright short GRB afterglows (esp. GRB 090510), there are no bright early afterglows.

GRANDMA would likely not detect these with TAROT/FRAM.

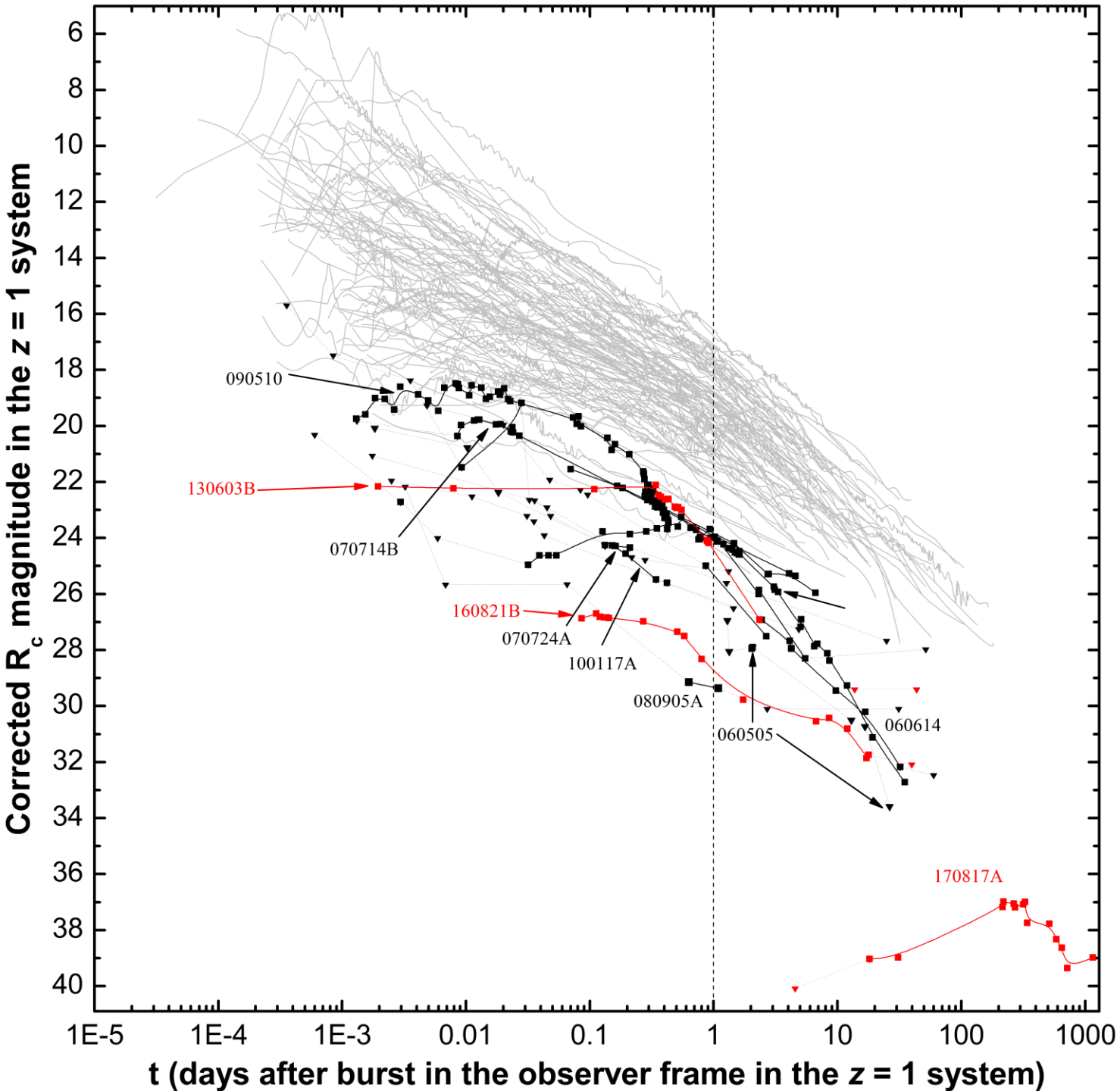


The situation is even more drastic for the non-detections.

GRB 050509B was the first-ever X-ray-localized short GRB, leading to an intensive follow-up campaign.

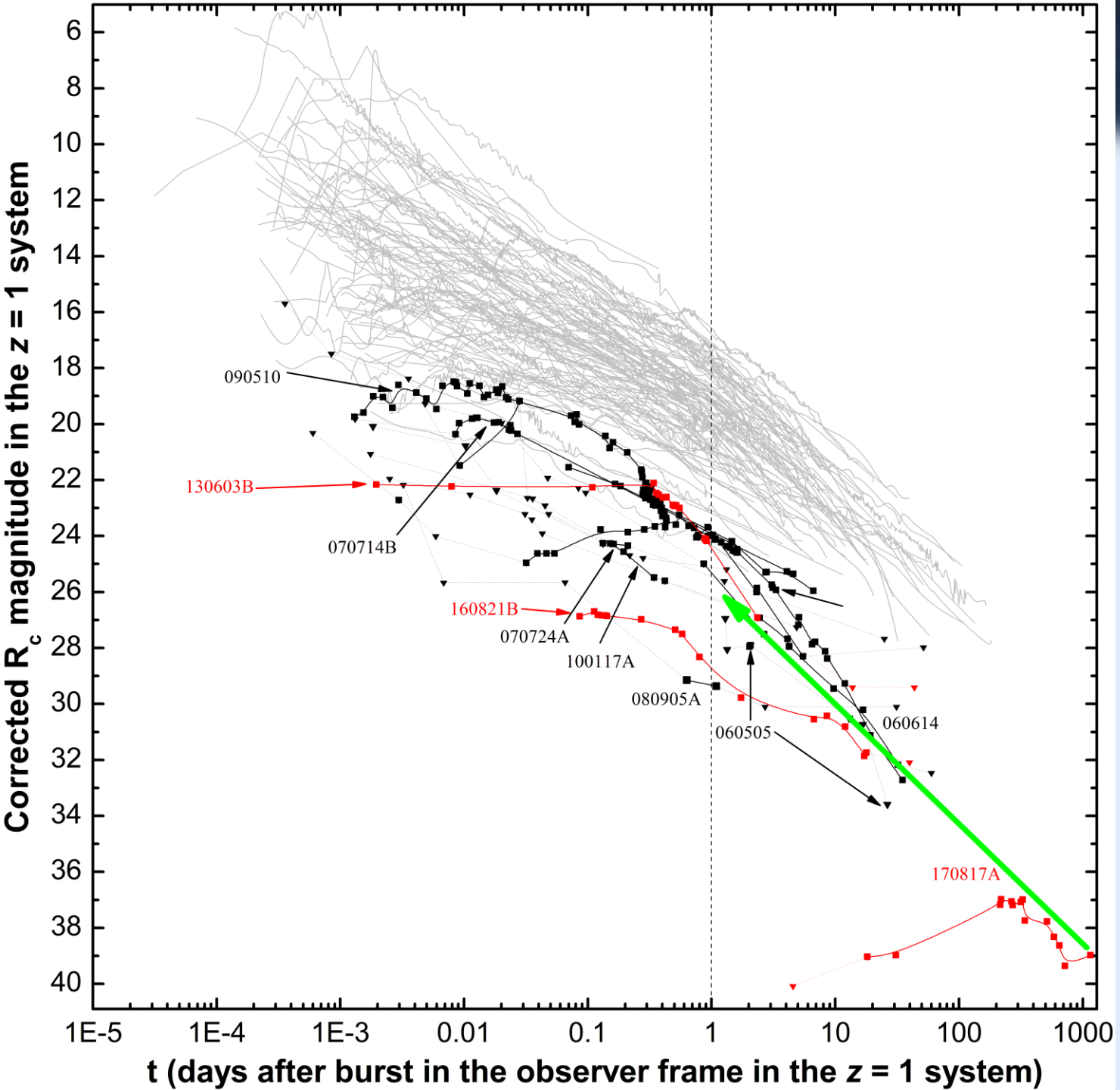
Second step:

- Using knowledge of *z*, the spectral slope, and possible dust contribution, transform all light curves to *z* = 1 following Kann et al. (2006).
- Gives all light curves as if the GRBs occurred at *z* = 1 with no dust, no host contribution, no SN contribution (if needed, for long GRBs).
- For short GRB afterglows, remove the kilonova if possible (X-ray observations).



Whoa...

Even the most luminous SGRB afterglows are just at the level of faint long GRB after-glows (warning: some sample bias!).



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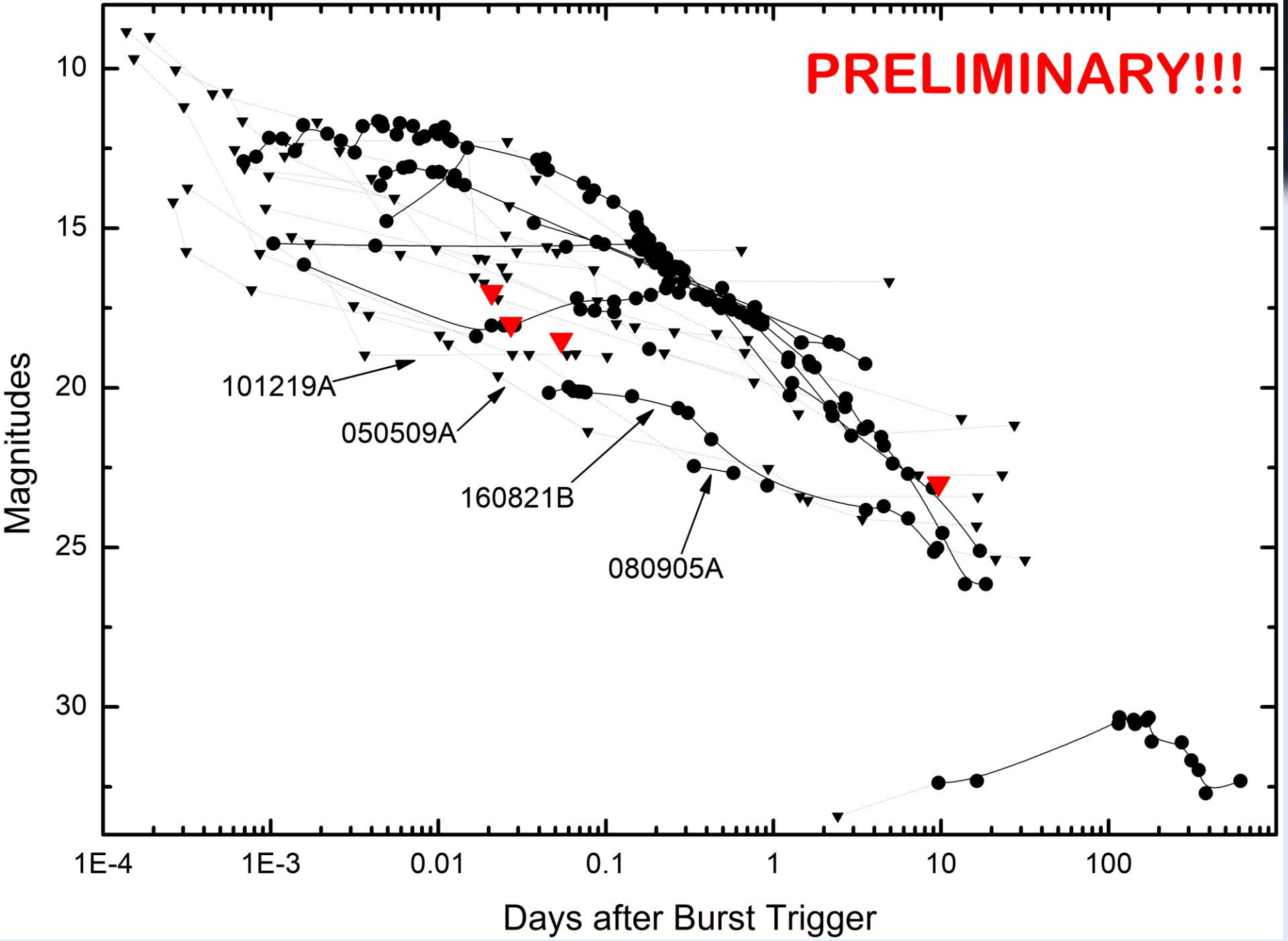
GRB 170817A, the off-axis afterglow, is incredibly faint – but comparable to others if you extrapolate backwards.

Third step:

- And now, time for the comparison to our limits on S190814bv!!
- This event lies – according to GW data – at 267 Mpc, close, but that is already $z = 0.0605$.
- Excepting GRB 170817A, no SGRB has ever been detected this close, but there are multiple cases in the range $z = 0.1 \ldots 0.2$ already.


PRELIMINARY!!!
Magnitudes
10
15
20
25
30
101219A
050509A
160821B
080905A
1E-4
1E-3
0.01
0.1
1
10
100
Days after Burst Trigger

So!

Ideas for further research:

- Hydrodynamic modelling of off-axis short GRB afterglows?
- Research into the expected luminosities of black-hole neutron-star mergers?
- Generally no research into the kilonova as this has been done by GROWTH, ENGRAVE...
- Try to keep paper simple, straightforward and fast?

გმადლობთ ყურადღებისთვის!