Dark Cosmology Centre

Groundbased GRB follow-up

Building a complete sample is a crucial, but laborious task.
Friendly competition is good, but some coordination would be useful.

Swift is powerful mashine to study the z>5 Universe, but the ground based follow-up should improve.

Rapid spectroscopy is giving new insight.

Johan P. U. Fynbo

Collaborators

Björnsson, Castro-Ceron,
Chapman, Curran, Fruchter,
Hjorth, Jakobsson,
Jaunsen, Jensen, Kann,
Klose, Ledoux, Levan,
Malesani, Møller, Ovaldsen,
Holger Pedersen, Priddey,
Rol, Selj, Sollerman,
Smette, Starling, Tanvir,
Thöne, Velasces-Ruiz,
Vreeswijk, Watson,
Wiersema, Wijers, Xu,...

Building a complete sample

The great potential of GRBs as probes of star-formation in the Universe has long been heralded, but so far this potential has not been (fully) harvested.

Most statistical conclusions about GRBs are based on very incomplete and biased samples.

So far: ∃ but not ∀

Swift makes it possible build a statistical sample (due to frequent, accurate and reliable localizations). Although friendly competition is good some coordination of the ground based follow up would be beneficial.

Building a complete sample

Sample definition: (Jakobsson et al. 2006, A&A, 447, 897):

1. XRT localized within 12 hr.
2. Galactic $A_V < 0.5$.
3. $+70^o$ < declination < -70^o
4. $\theta_{Sun} > 55^o$.

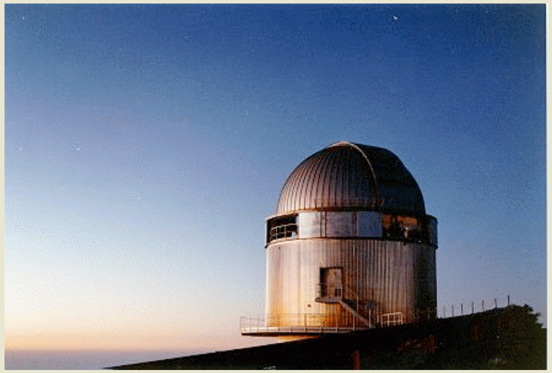
http://astro.ku.dk/~pallja/GRBsample.html

Building a complete sample

What we do:

1. Detect the afterglow if not detected by UVOT or other groups
2. Measure the redshift from the afterglow (about 20 so far)
3. Detect the hosts (R and K) and then redshifts from the hosts (5 so far - more to come; only southern targets)

VLT

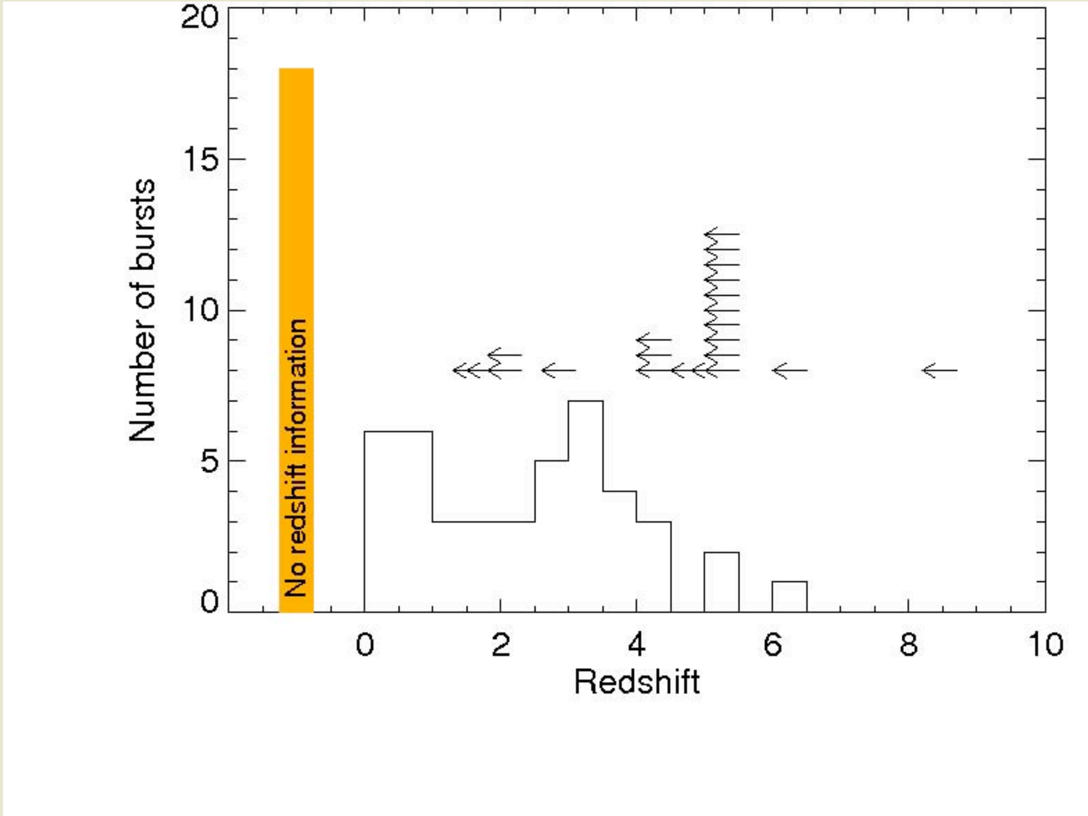


NOT

D1.5m

Building a complete sample

- 83 bursts (ultimo 2006)
- 43 redshifts
- 20 optical/near-IR afterglow, but no z
- 20 no optical/near-IR afterglow detected



(From Velasces-Ruiz et al., submitted to ApJ)

Hunting high-z events

Cost of Swift: ~$160M

Cost of JWST: >$1.6B (for development and launch)

Still, for the study of the dark ages *Swift* may do some science that JWST cannot do:

– Locate bright z>6 near-IR sources for spectroscopic follow-up

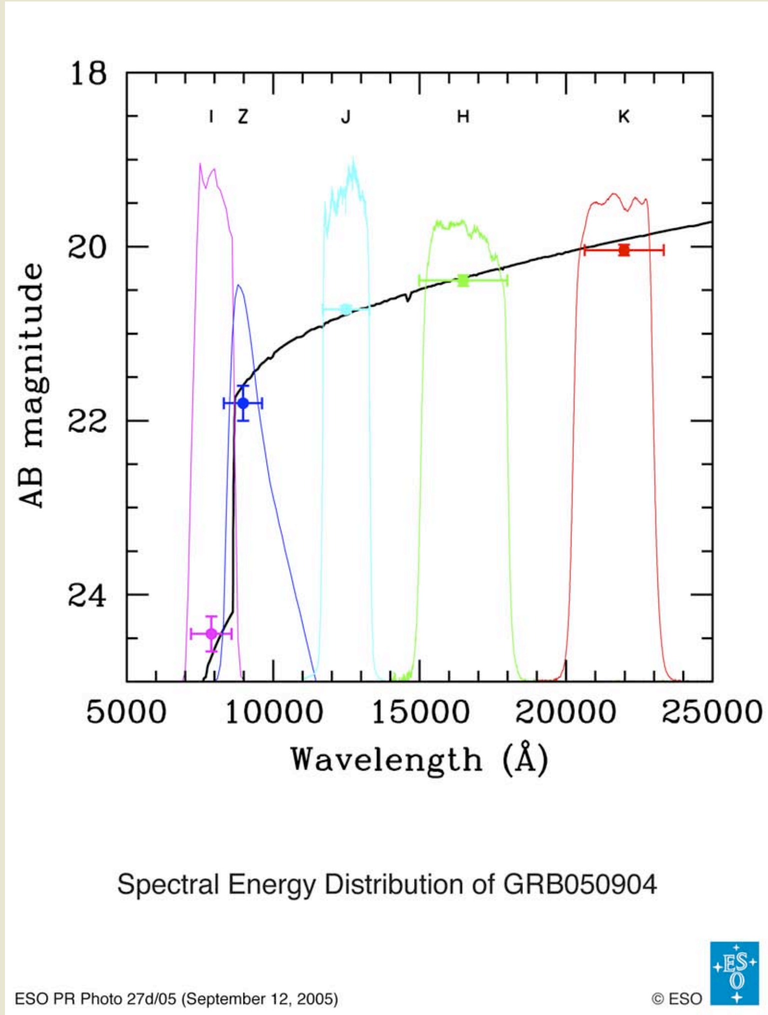
– Locate *typical* star-forming galaxies at z>6 for further study

– Establish if pop-III stars made GRBs

A *Swift2* mission optimized for z>6 GRBs would very powerful!

Hunting high-z events

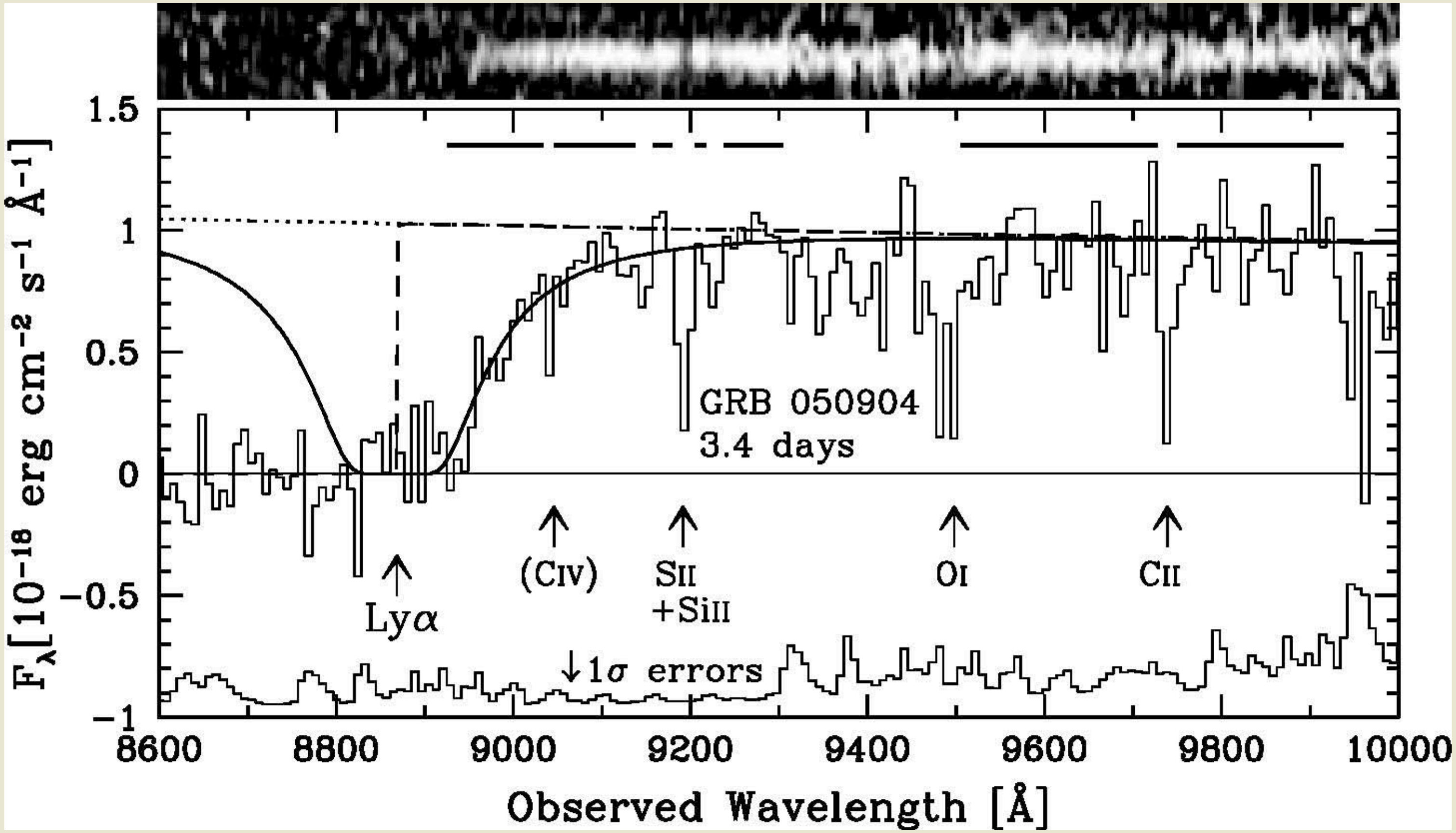
We need more rapid near-IR follow-up. Just by starting to use the z-band would take us out to z~7, but we really need more near-IR follow-up.



Tagliaferri et al. 2005, A&A, 443, L1

Hunting high-z events

GRB050904, z=6.30

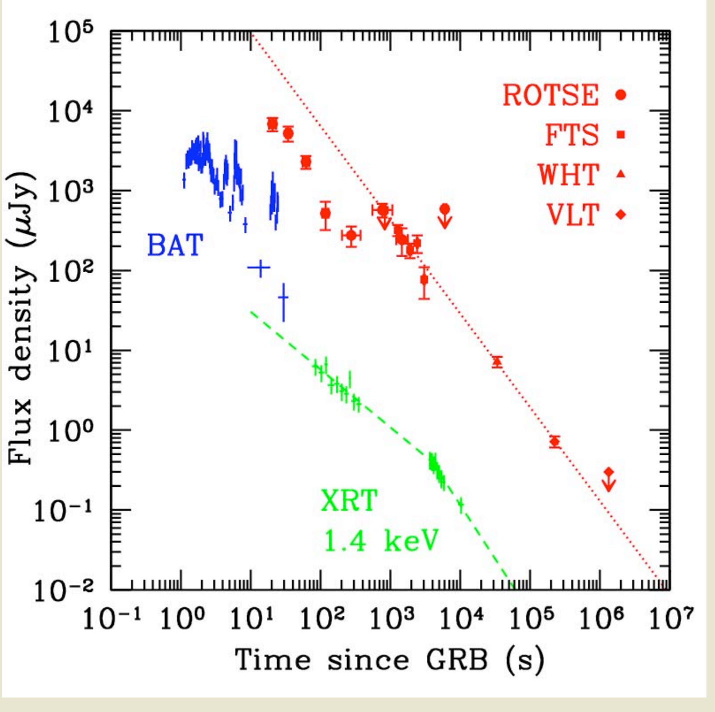


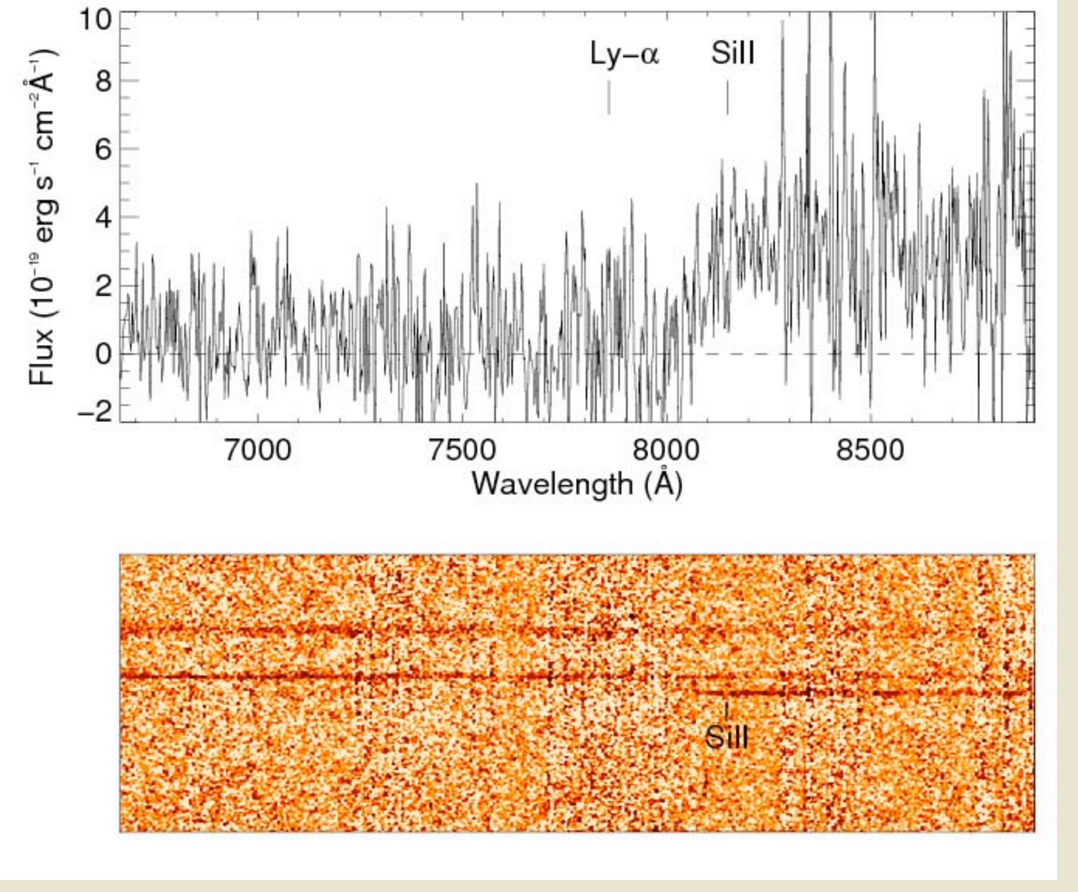
Totani et al. 2006, PASJ, 58, 485

Dark Cosmology Centre

Hunting high-z events

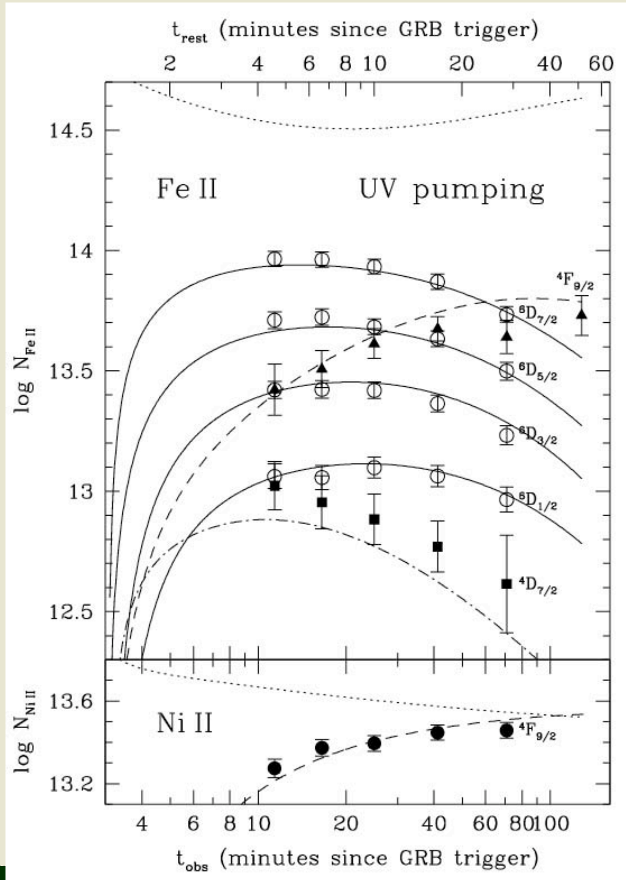
GRB060927, z=5.47

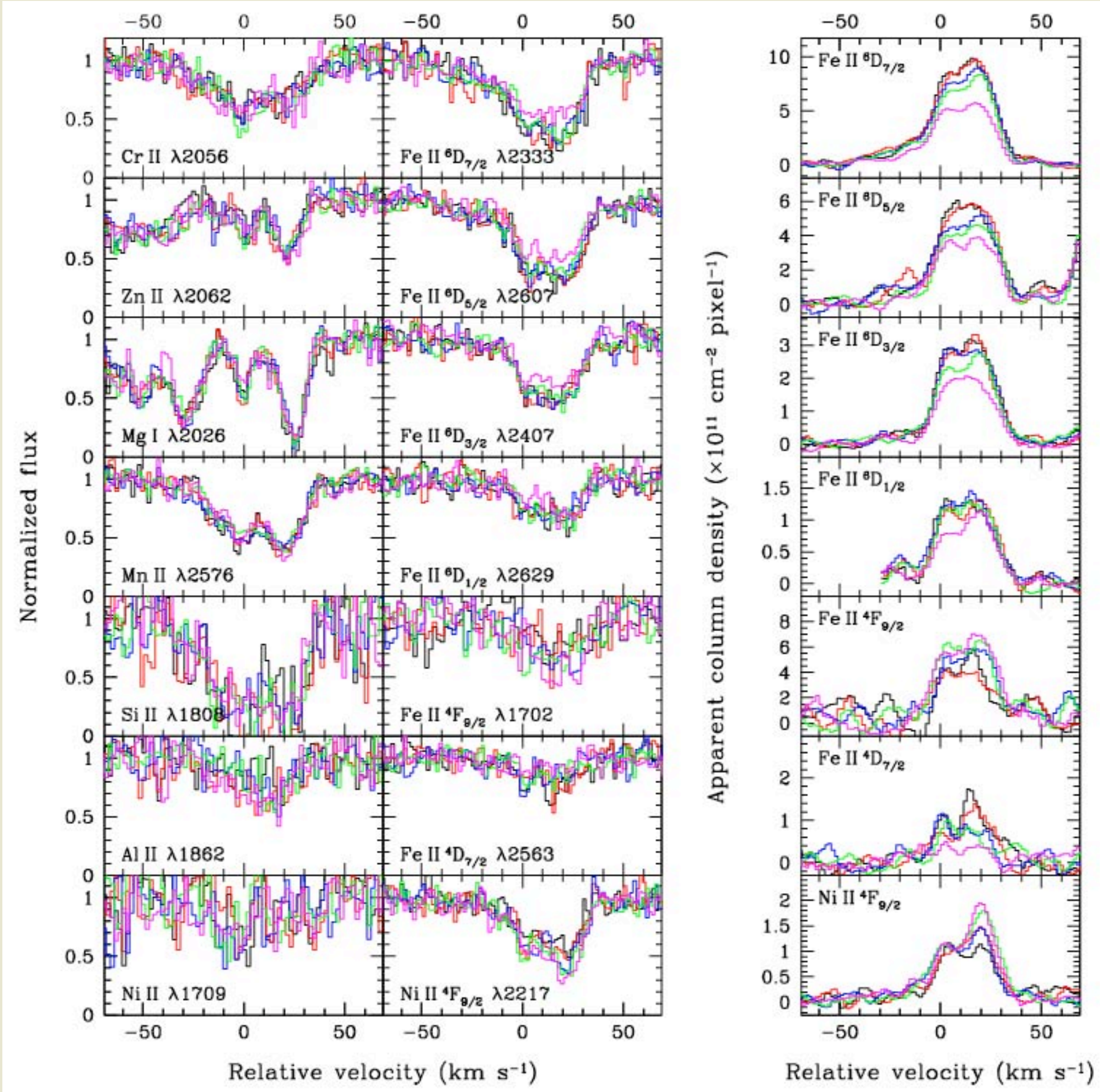




Velasces-Ruiz et al., submitted to ApJ

New insights from rapid spectroscopy





Vreeswijk et al. 2007, astro-ph/06110690

Dark Cosmology Centre

Summary

Building a complete sample is a crucial, but laborious task.
Friendly competition is good, but some coordination would be useful.

Swift is powerful mashine to study the z>5 Universe, but the ground based follow-up should improve.

Rapid spectroscopy is giving new insight.

Thanks for your attention

Building a complete sample

Our approach (Jakobsson et al. 2006, A&A, 447, 897):

1. Long bursts (>2 sec so far).
2. Small error circles, hence the bursts have to be localized with the XRT.
3. The XRT error circle should be distributed quickly (within 12 hours) for a relatively rapid follow-up. Although the automatic slewing of Swift was enabled in the middle of January 2005, part of the following month was dedicated to calibration which could not be interrupted. Therefore, we have only included bursts occurring after 1 March 2005.
4. The Galactic extinction in the direction to the burst has to be sufficiently small or $A_V < 0.5$.
5. Rejection of bursts with a declination unsuitable (above $+70^o$ or below -70^o) for follow-up observations.
6. The Sun-to-field distance has to be large enough, with $\theta_{Sun} > 55^o$.

http://astro.ku.dk/~pallja/GRBsample.html