Investigate Origin of Optically Dark GRBs with CFHT

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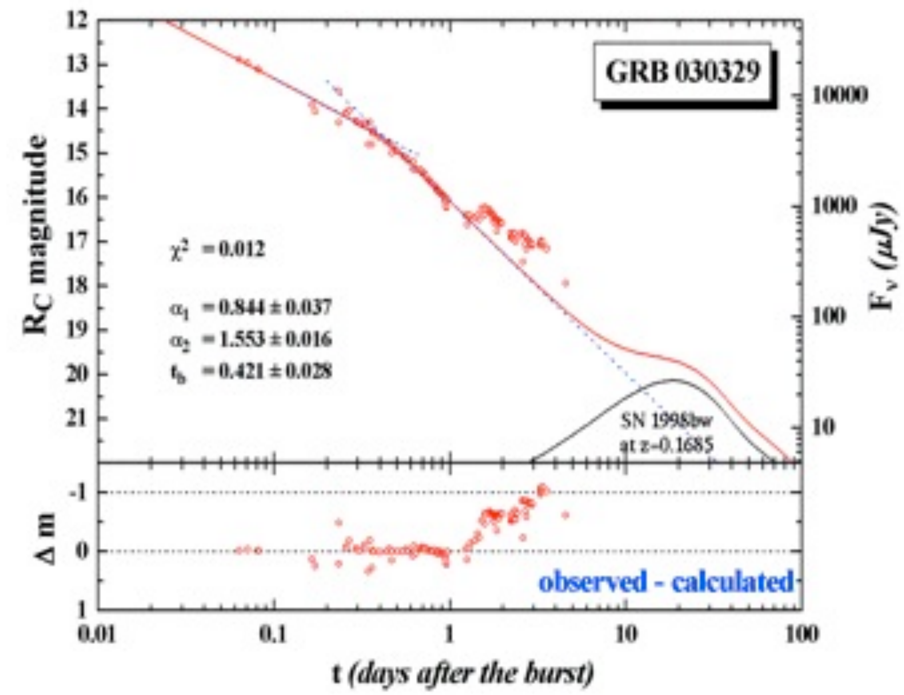
GRBs and their afterglows

- GRBs are :
  (1) Extremely luminous gamma-ray sources. (release 10^50-52 ergs energy);
  (2) cosmological (z ~ 0.0085-8.1);
  (3) classified to long bursts (T90>2s) and short bursts (T90 <2s).

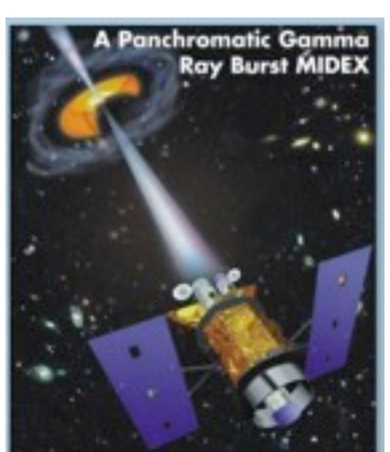
- Afterglows were found in X-ray, optical and radio wavelength.

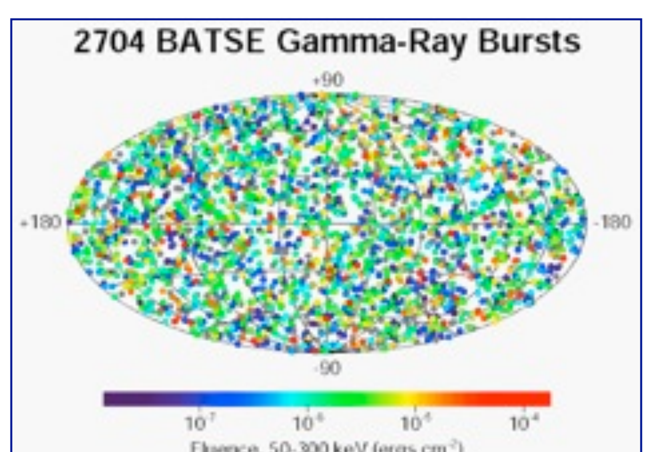
- Supernovae are associated with some long GRBs. (e.g. SN2003dh/GRB030329 at z=0.165)

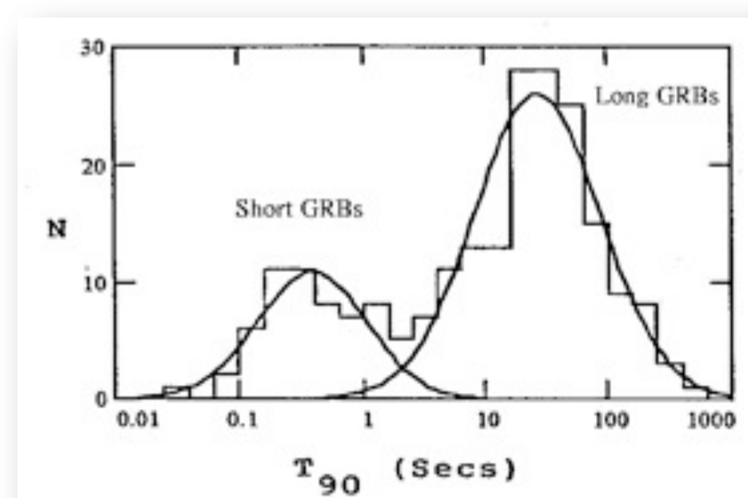


- Observational investigations indicate most of triggered GRBs have X-ray emission and only 40%-60% triggered GRBs have optical emission.

- At lest 40% of triggered GRBs are optically dark.





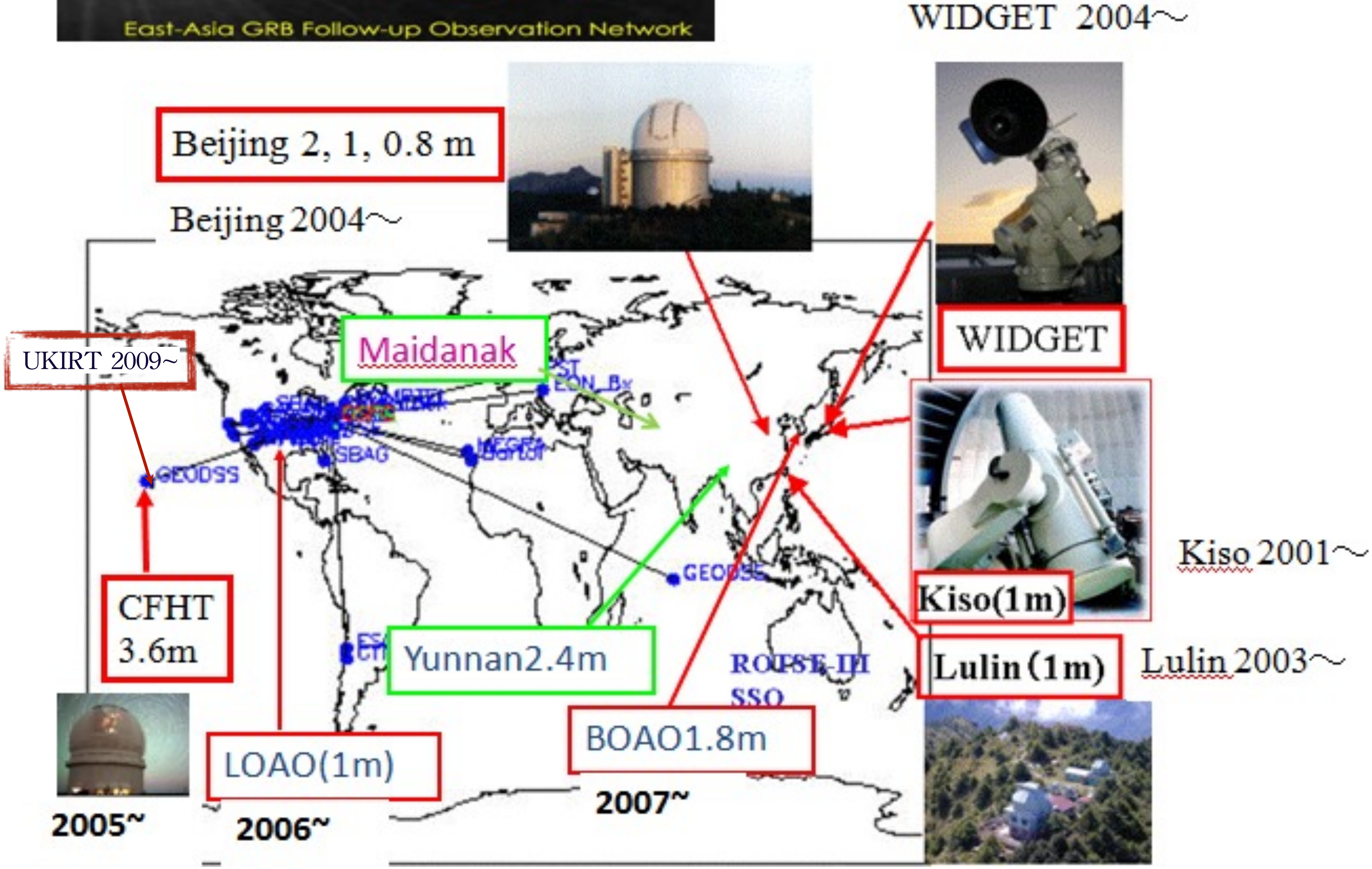


Origin of optically dark GRBs

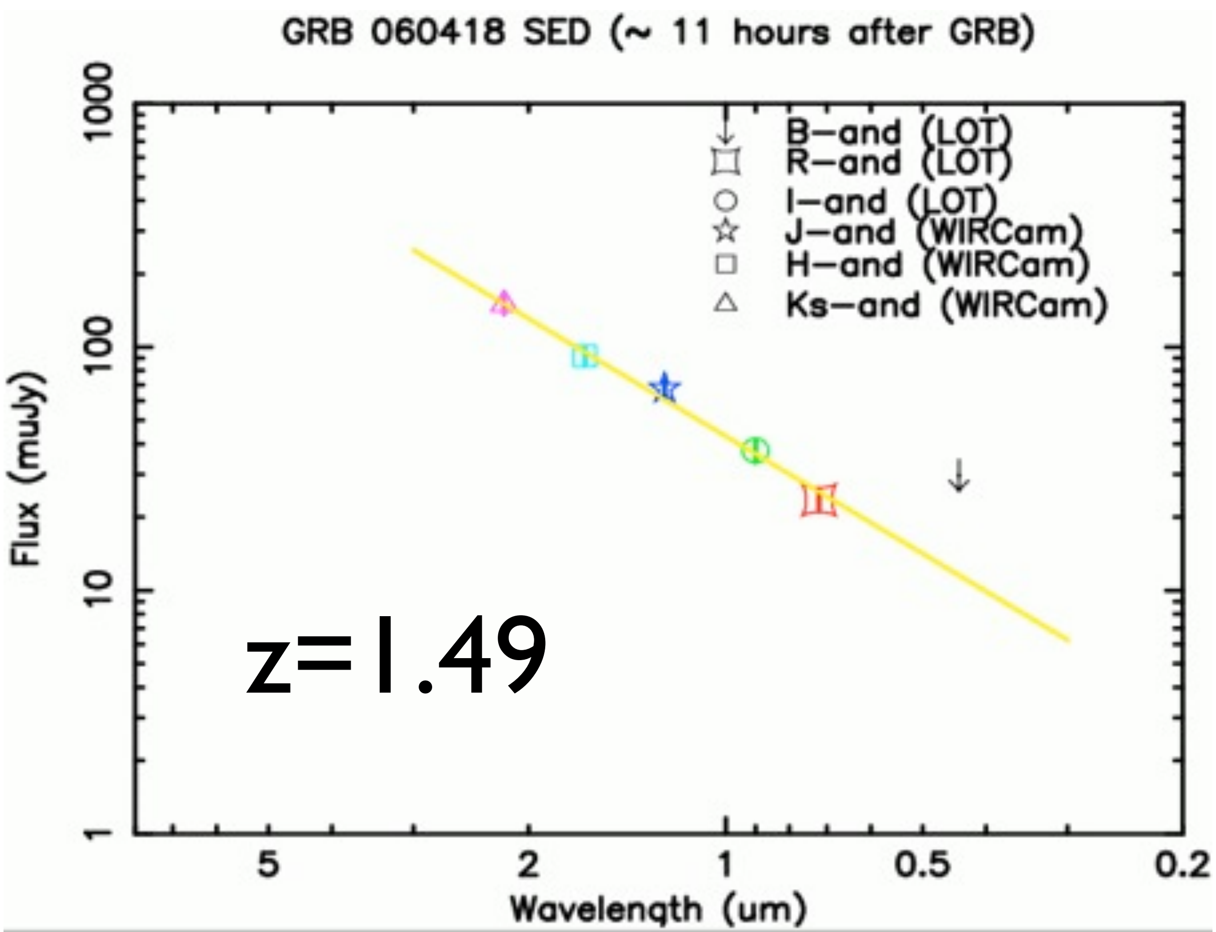
- No accompany optical afterglows or faint afterglows with R> 23mag at 1 day (Fynbo et al. 2001)
- Intrinsically Dark
  non standard emission mechanism
- Extinction along the light of sight or osculated by host galaxy (Woosely & Bloom 2002)
  long GRBs with the deaths of massive stars and with star formation region.
- Locate at high redshift (Lamb &Reichart 2000)
  Lyman break is observed redward of optical band
  Most distant GRB -- GRB 090423 z=8.2

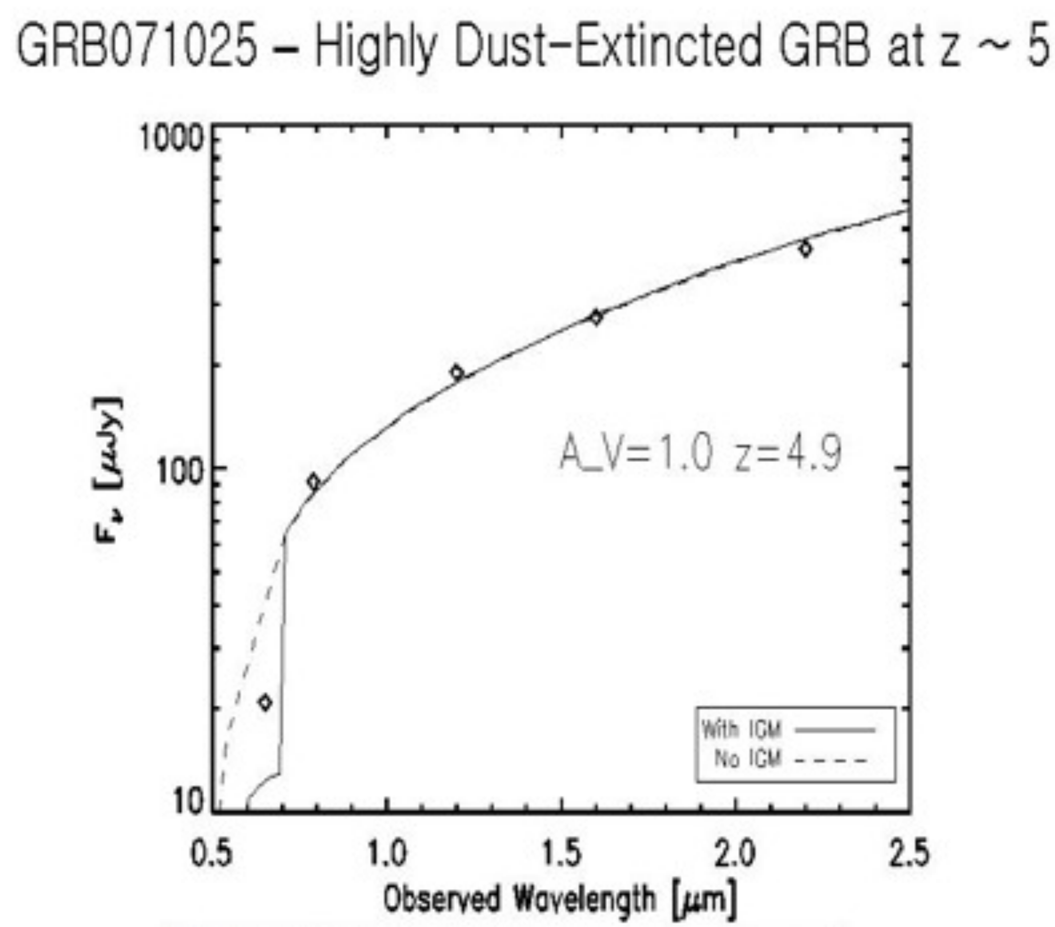
EAFoN

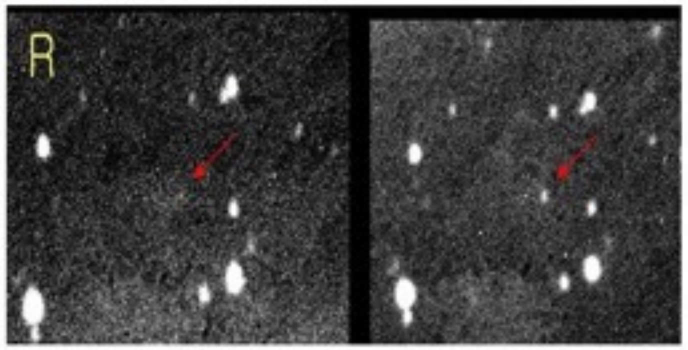
East-Asia GRB Follow-up Observation Network



Explore high-z GRBs with optical/NIR SED







R and I band images 20 min after the burst taken by LOAO.

GRB 090423 (z~8.1)

- P60 (optical) : r' >21.5, z' > 20.5 at 22 mins after burst
- UKIRT(IR) : K ~ 17.5 at 20 mins
- Gemini-North (IR) : J ~ 19.29, H ~ 18.57

  → red J-H = 1.1 (AB), I-J > 1.7 (AB)

  blue H-K color

  No Y-band detection (9x 60s exposure)

  → If due to Ly_ α absorption, z~ 9
- TNG(3.6m spectrum) : 14.5 hrs after the burst

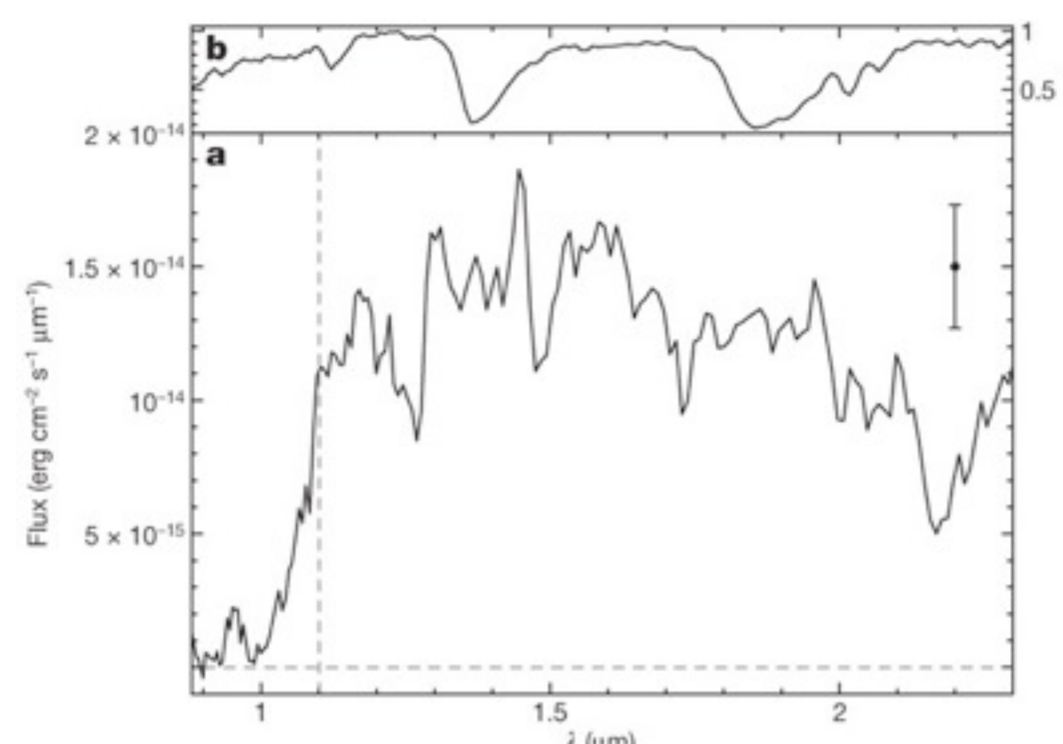
  → shows a very weak signal at the position of NIR afterglow

  → No signal is observed below observed λ ~ 10500A

  → If Ly_ α absorption, z~ 7.6
- VLT (spectrum)17.5 hrs

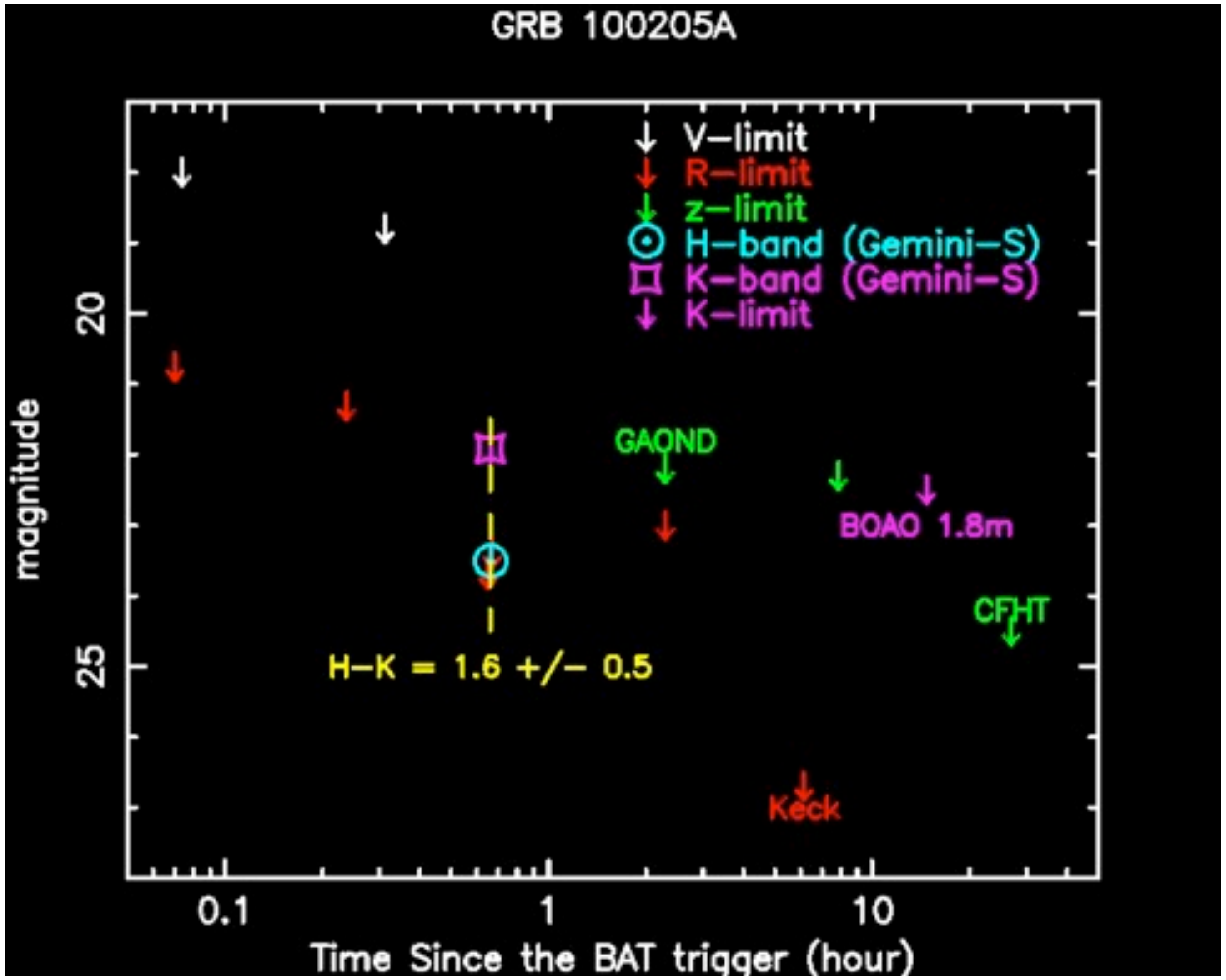
  → a clear continuum at red wavelengths but no flux below at 11200A

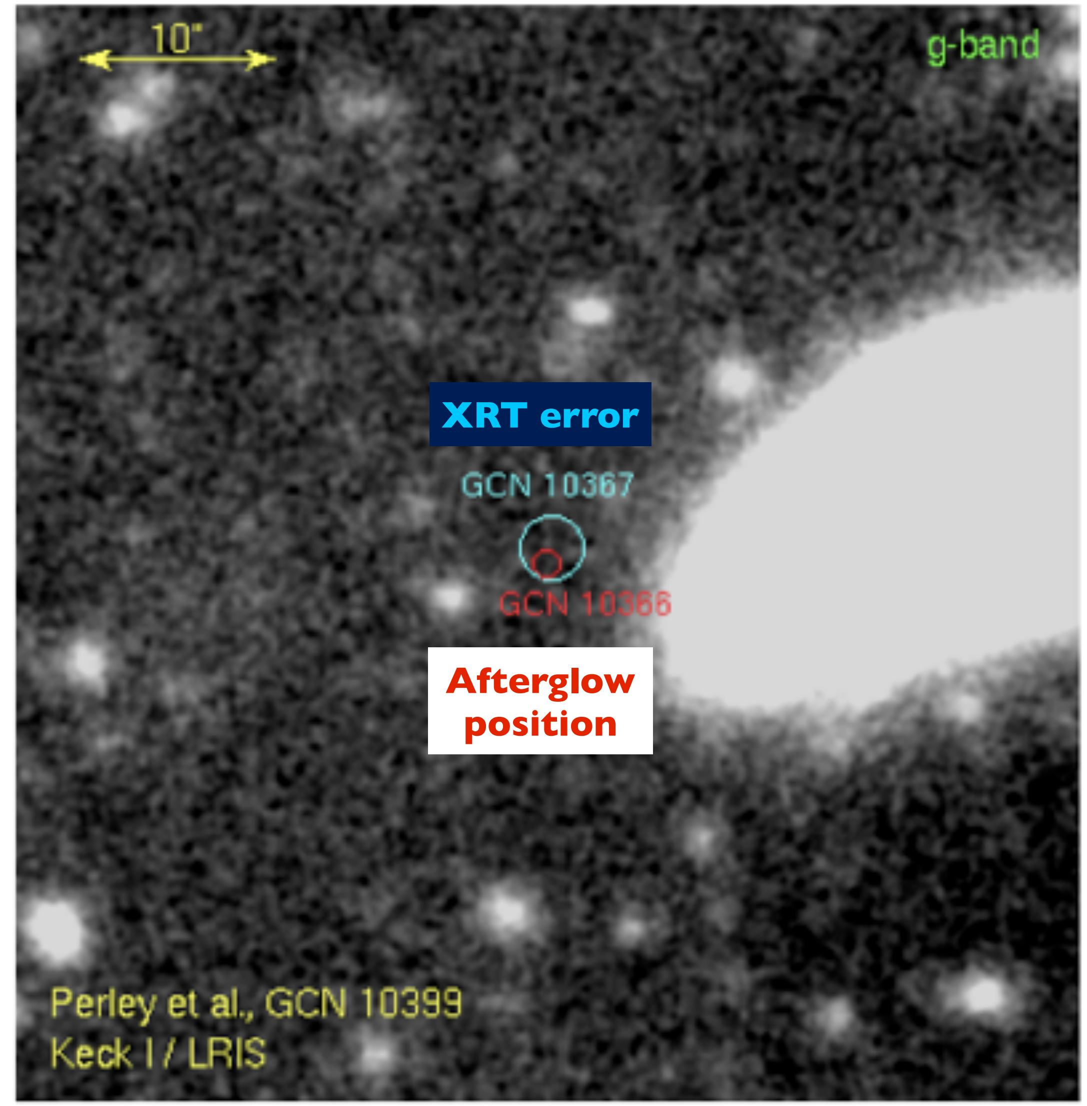
  → consistent with a break due to Ly_α absorption at z~ 8.2



IR spectrum taken
by TNG (3.6m) at 14h (Salvaterra et al 2009, Nature)

Recent results for dark GRBs (I)- GRB100205A





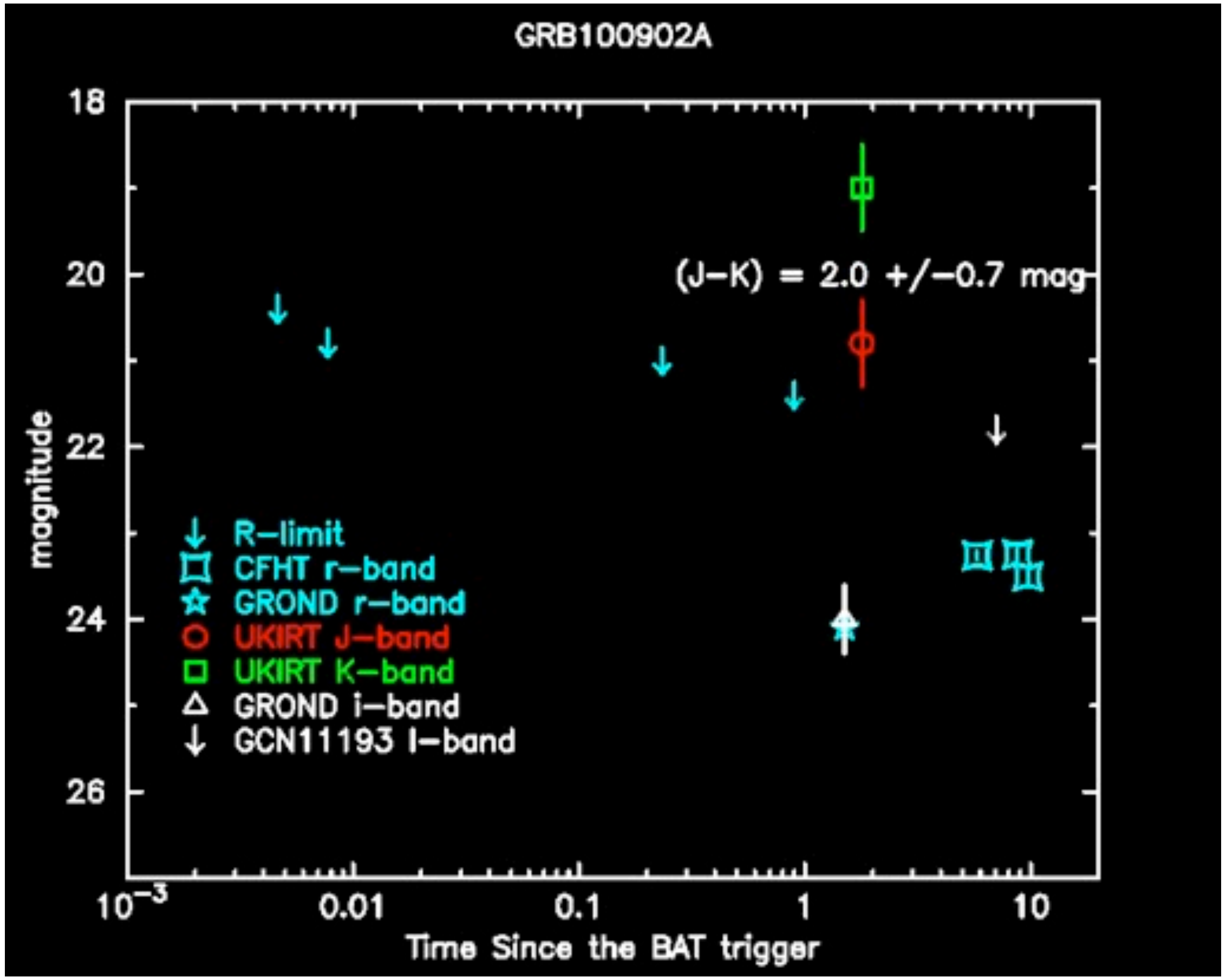
1. if (H-K) ~1.6 is due to Lyman-alpha absorption with H, it implies a redshfit of 11 < z < 13.5

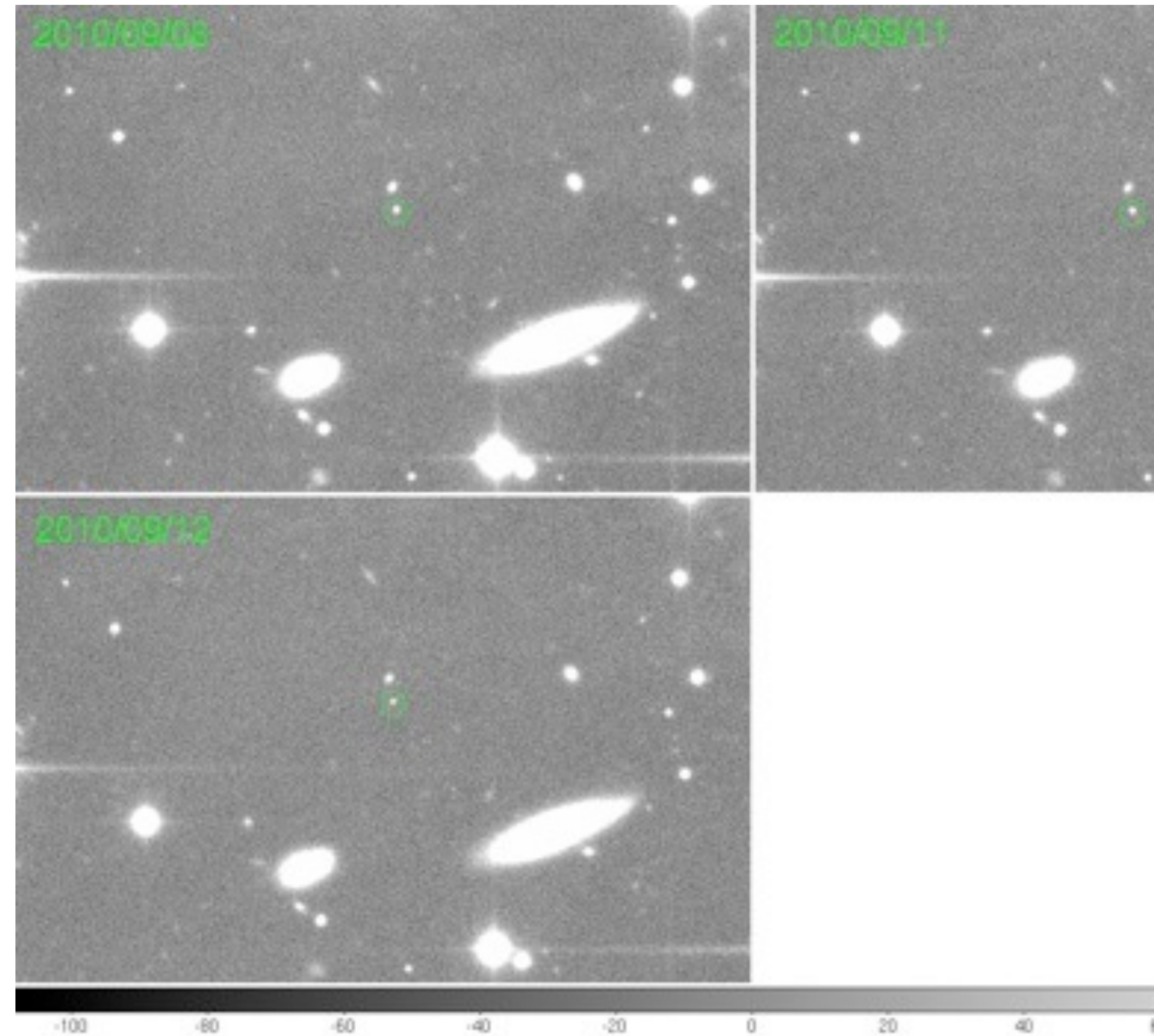
Lack early time optical detection; an apparently fading afterglow only in H and K bands;
Lack of host galaxy to deep limits; limited X-ray absorption N_H(z=0)=(7+/-5)x10^20 cm^-2

2. It is still possible that significant dust absorption at lower-z

(e.g. Av~ 3mag at z =4)

Recent results for dark GRBs (II)-- GRB100902A





Red afterglow with possible supernovae component

galactic column density 1.1 x 10^21 cm^-2;
intrinsic column density N_H(z=4) = (2.3+/-0.4)x10^23 cm^-2
-> possible intermediate redshift and large absorbing column density

Study GRB lights from z > 3

redshift	GRB	Telescope
5.47	GRB060927	Kiso+Xinglong
~5	GRB071025	LOAO+CFHT
4.813	GRB100302A	Lulin
4.048	GRB 060206	Lulin
3.78	GRB060605	Xinglong
3.44	GRB 061110B	CFHT
3.24	GRB050319	Kiso+Lulin
3.221	60526	Lulin

We thank CFHT SAC gave us opportunities to access DDT for GRB 100902A

We thank CFHT staffs for quick PH2 arrangements and quick data archive.