

GRB 090423: the new beacon at the frontier of the Universe

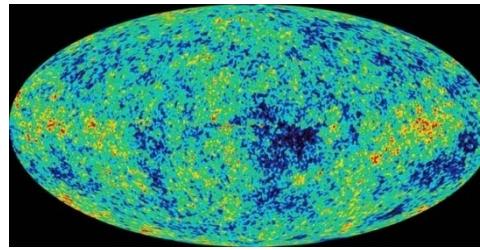
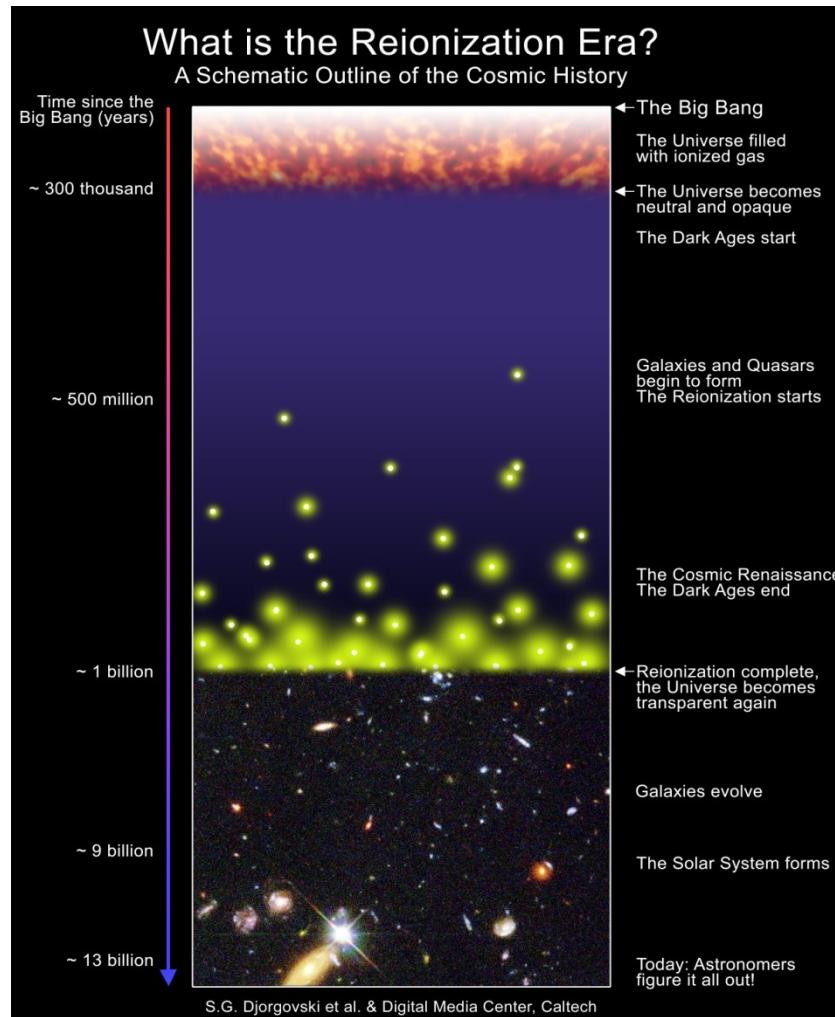
Paolo D'Avanzo (INAF/OA-Brera)

on behalf of :

Consorzio **I**taliano **Burst **O**ttici
Swift team**



Overview: the cosmic “dark ages”

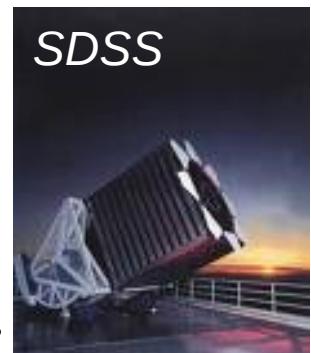


WMAP

?????????????????

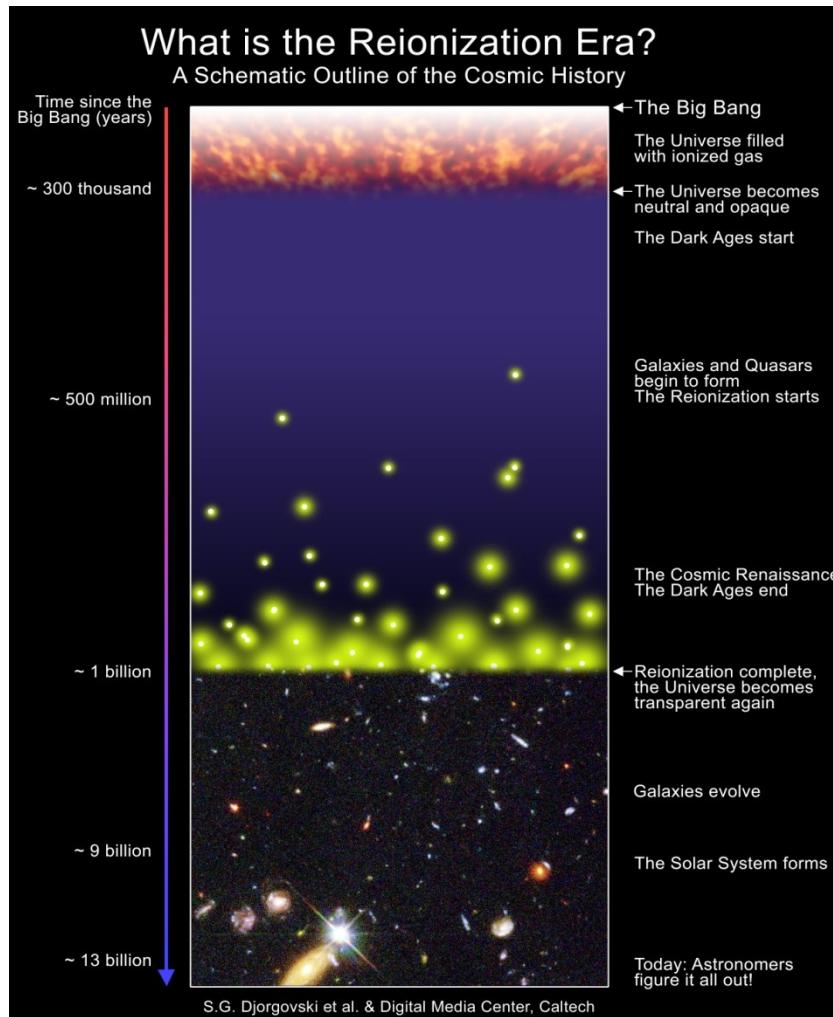


Hubble Space Telescope



SDSS

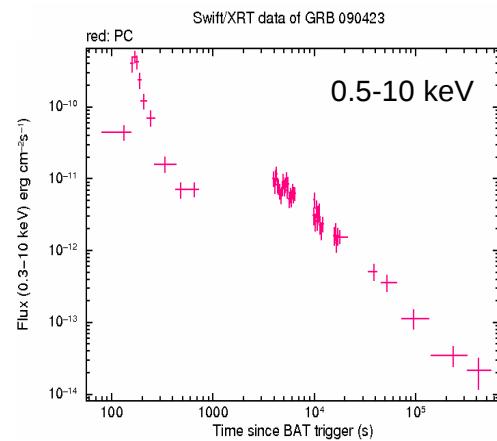
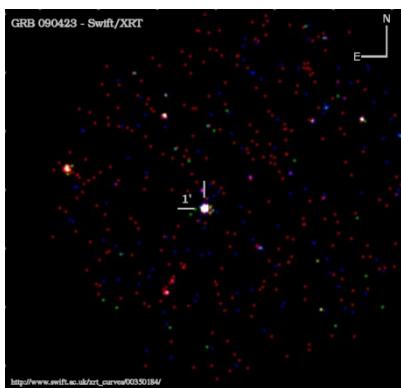
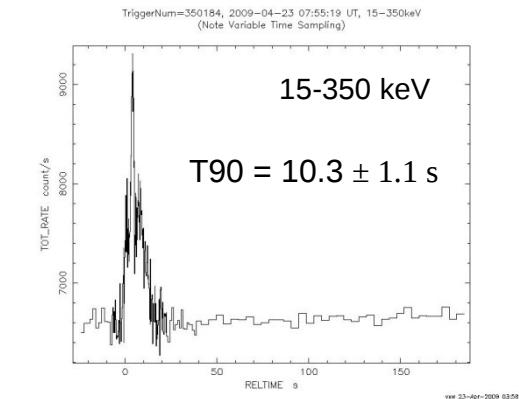
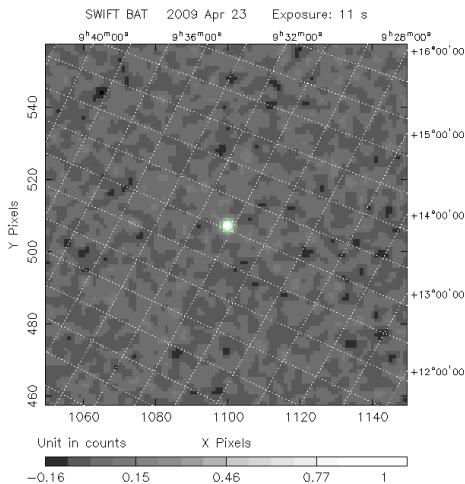
Overview: the reionization history



Many open questions:

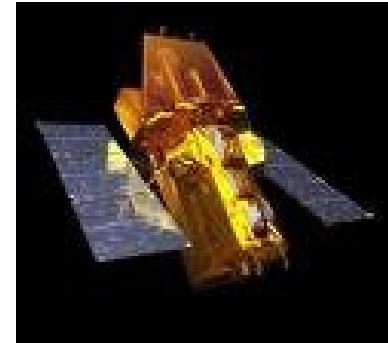
- when did the reionization happen?
- what are the main sources of ionizing photons?
- what is the relative contribution of PopIII/PopII stars?
- what are the feedback effect at play?
-

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No UVOT detection @ $t-t_0 = 77$ s

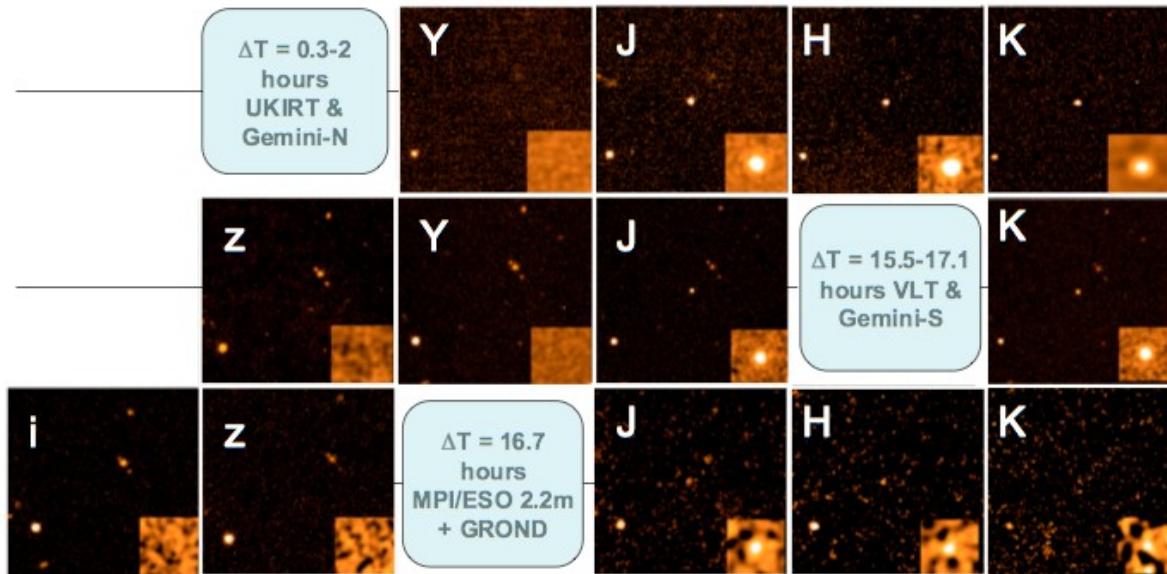
Krimm et al. GCN 9198
Palmer et al. GCN 9204



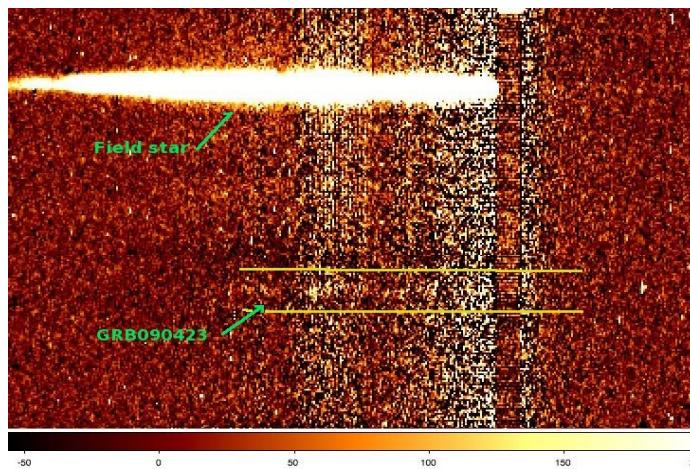
Evans et al. GCN 9205
Stratta & Perri GCN 9212

De Pasquale & Krimm GCN 9210

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Tanvir et al. 2009

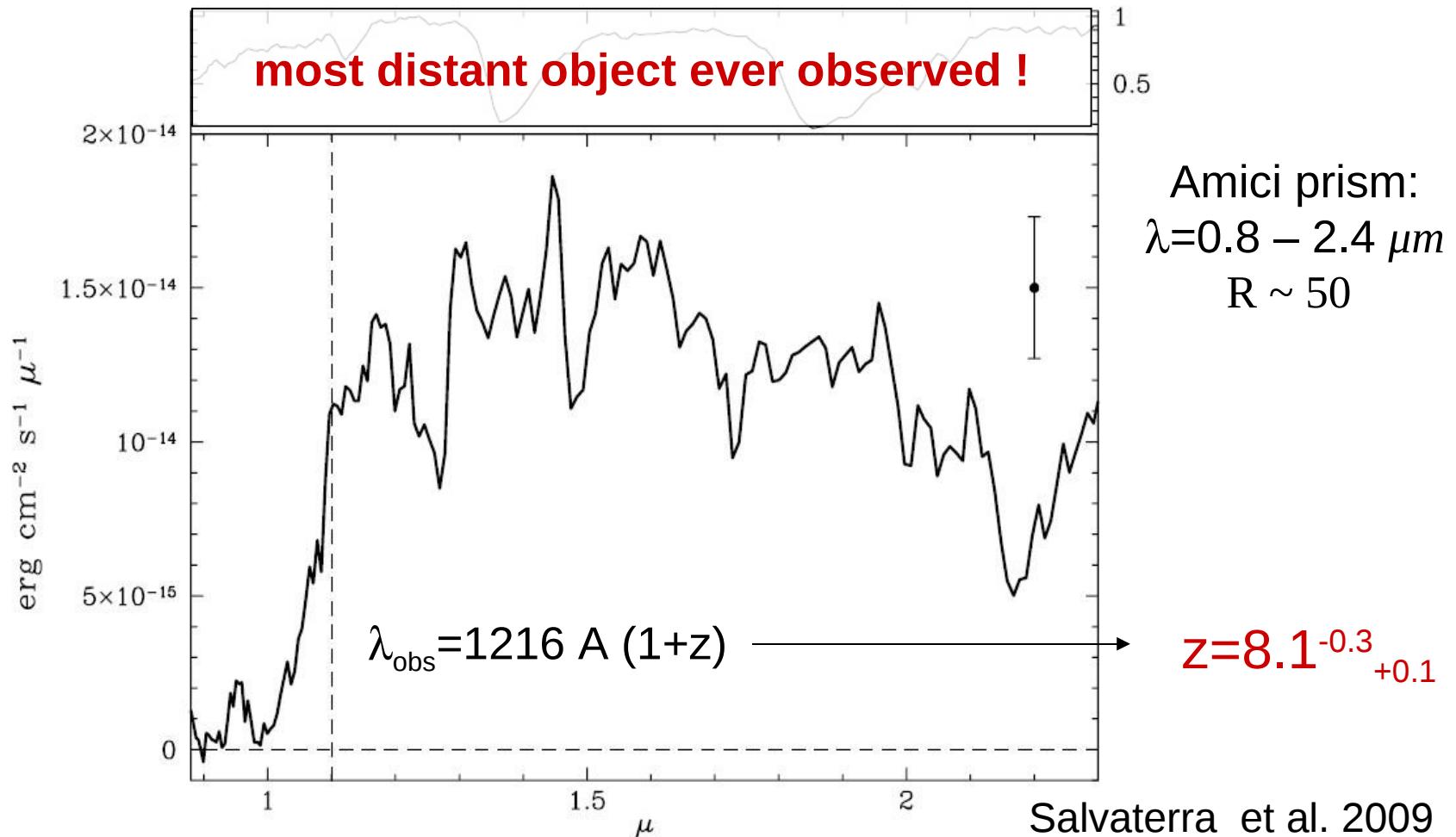


**Telescopio
Nazionale
Galileo**
~14hrs after
Trigger

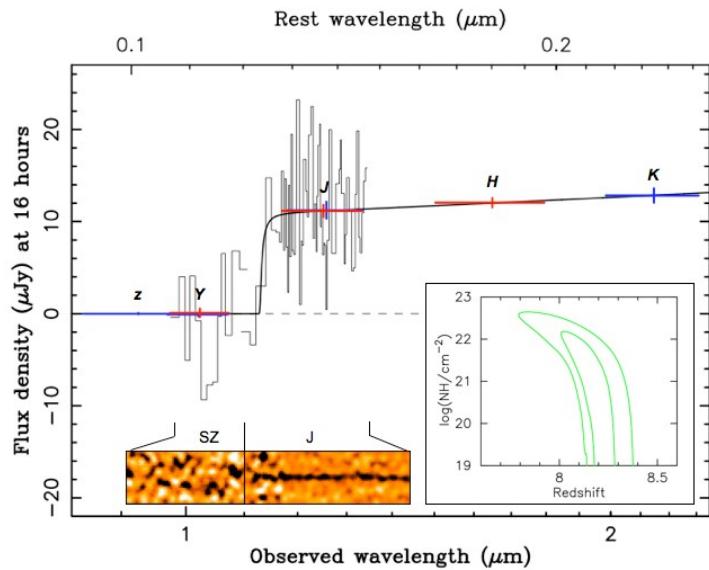
Thoene et al. GCN 9216
Fernandez-Soto et al. GCN 9222

GRB 090423: TNG spectrum

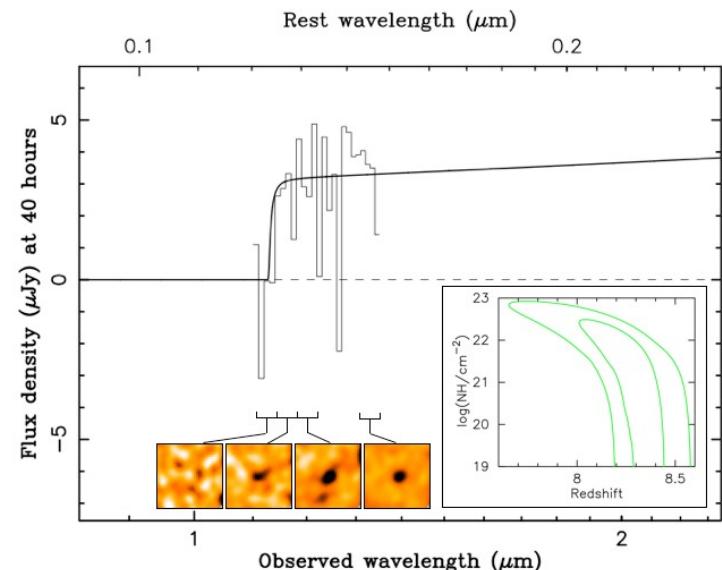
spectrum taken with the Amici prism on the TNG/NICS camera at ~ 14 hrs



GRB 090423: VLT spectrum



VLT-ISAAC

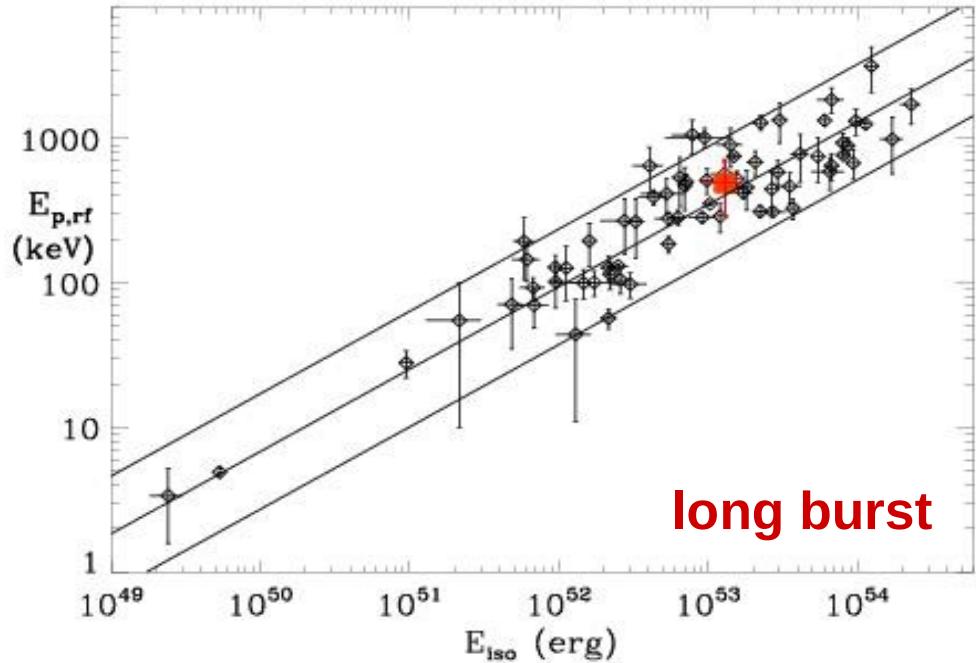
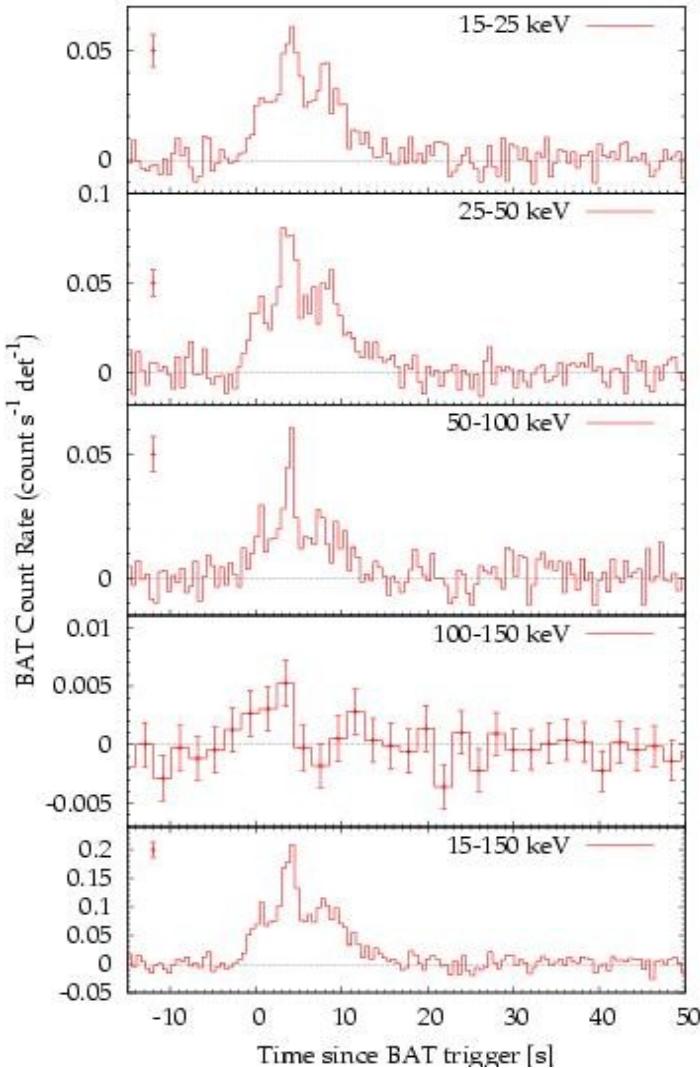


VLT-SINFONI

$$z=8.26^{-0.08}_{+0.07}$$

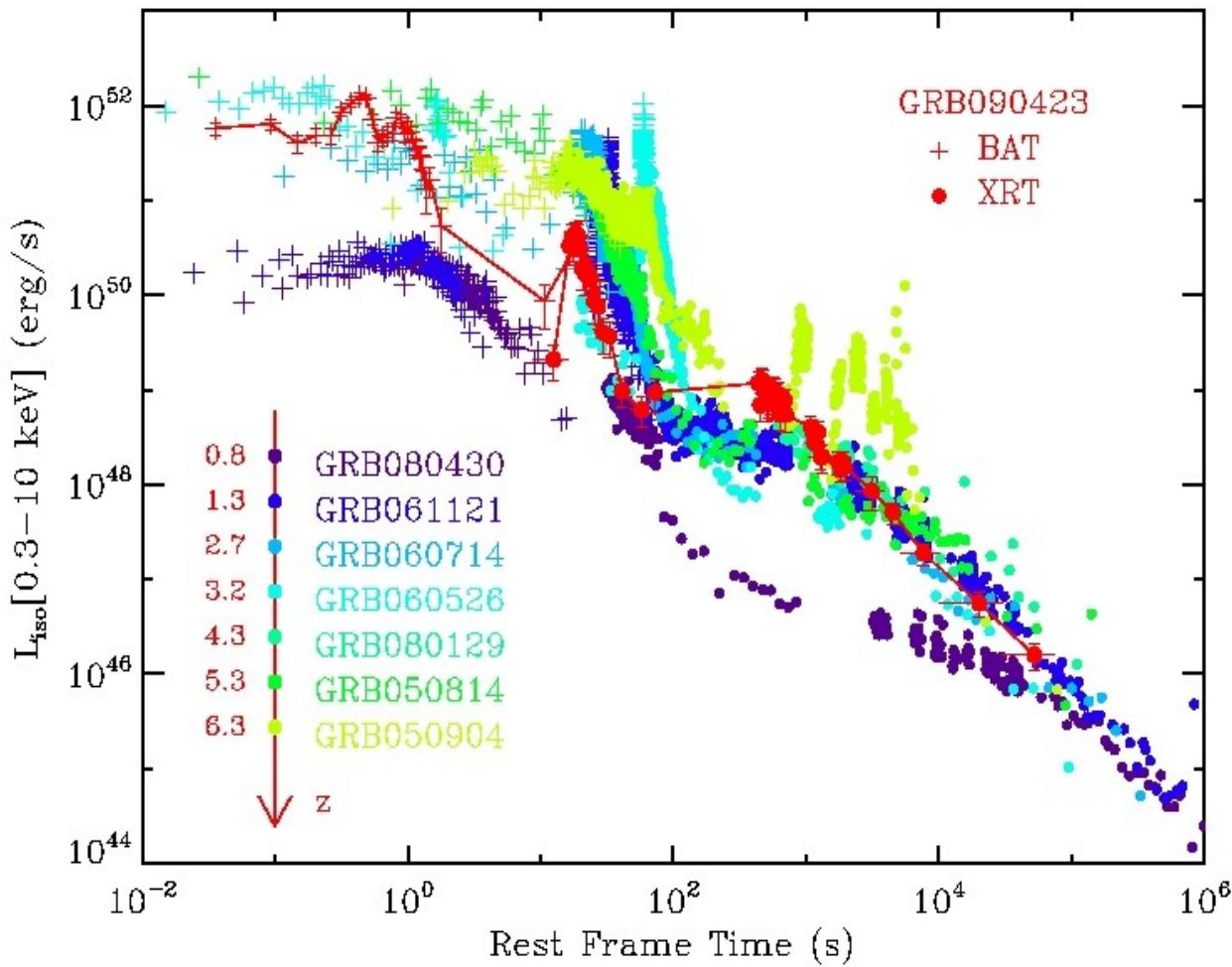
Tanvir et al. 2009

GRB 090423: prompt



Rest frame properties:
 $T_{90,rf} = 1.34$ s
 $E_{iso} = 10^{53}$ erg (Fermi)
 $E_{p,rf} = 440$ keV

GRB 090423: X-ray afterglow



canonical light curve

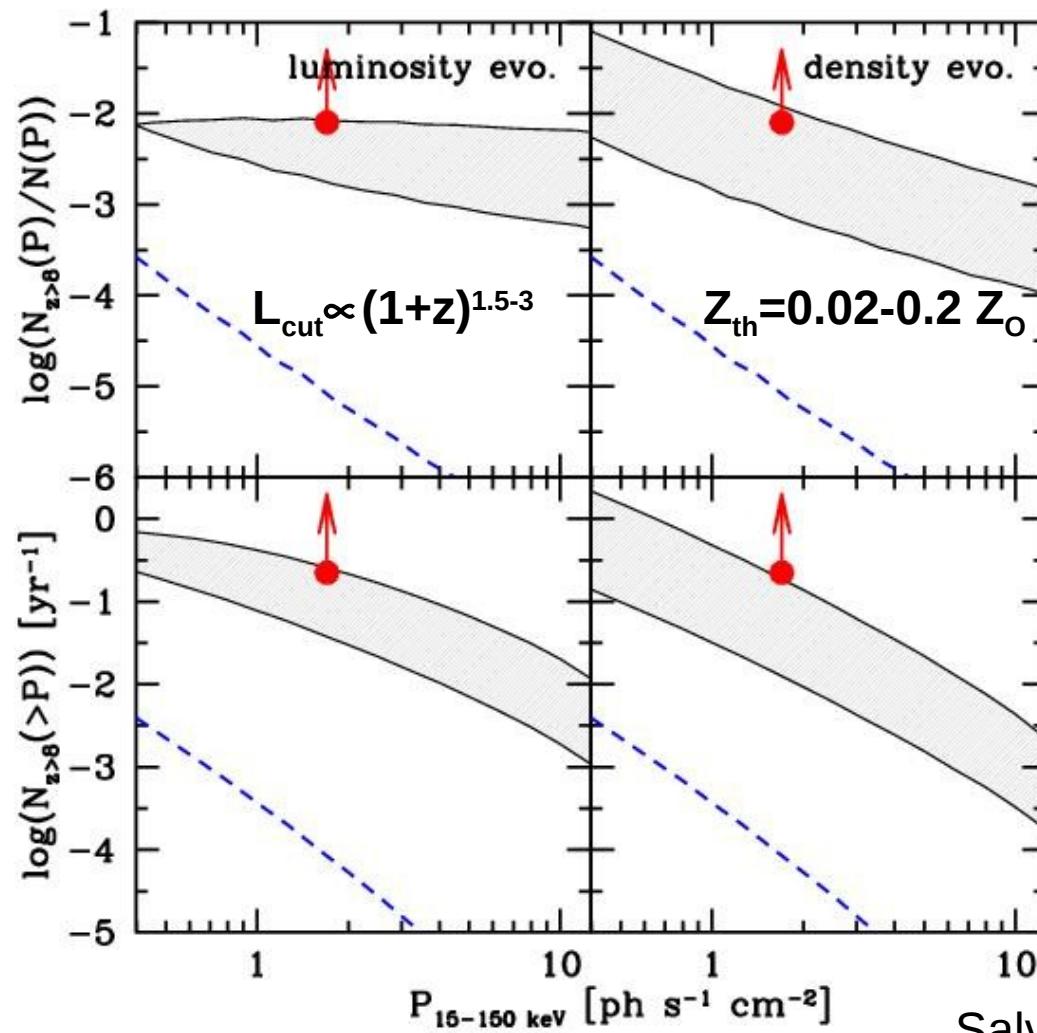
analysis of the XRT
spectrum shows
intrinsic absorption
 $N_H = 7 \times 10^{22} \text{ cm}^{-2}$

Lower limit on the
metallicity of the
circum-burst medium
 $Z > 0.04 Z_\odot$

Above critical
metallicity for PopIII:

$$Z_{\text{crit}} = 10^{-6} - 10^{-4} Z_\odot$$

GRB 090423: a rare event

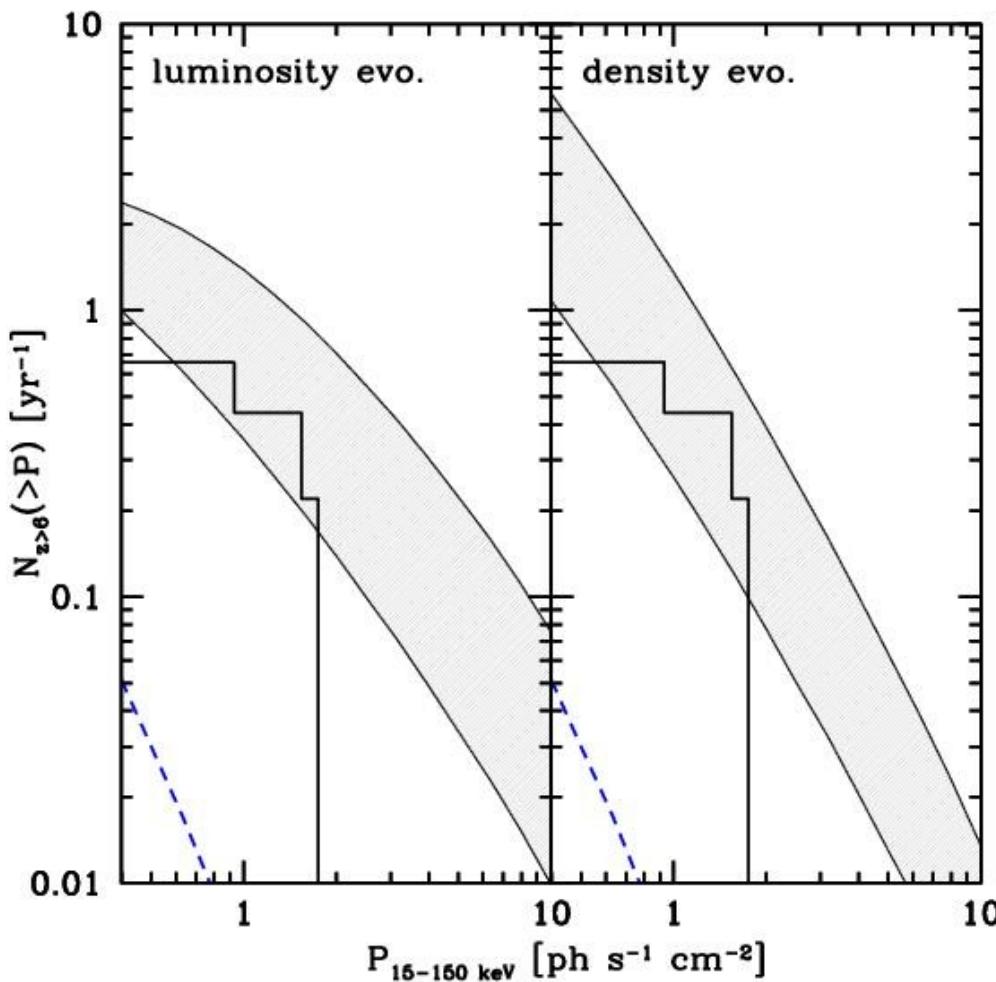


probability

numbers yr^{-1}

Salvaterra et al. 2009

Expected GRBs/yr at z>6



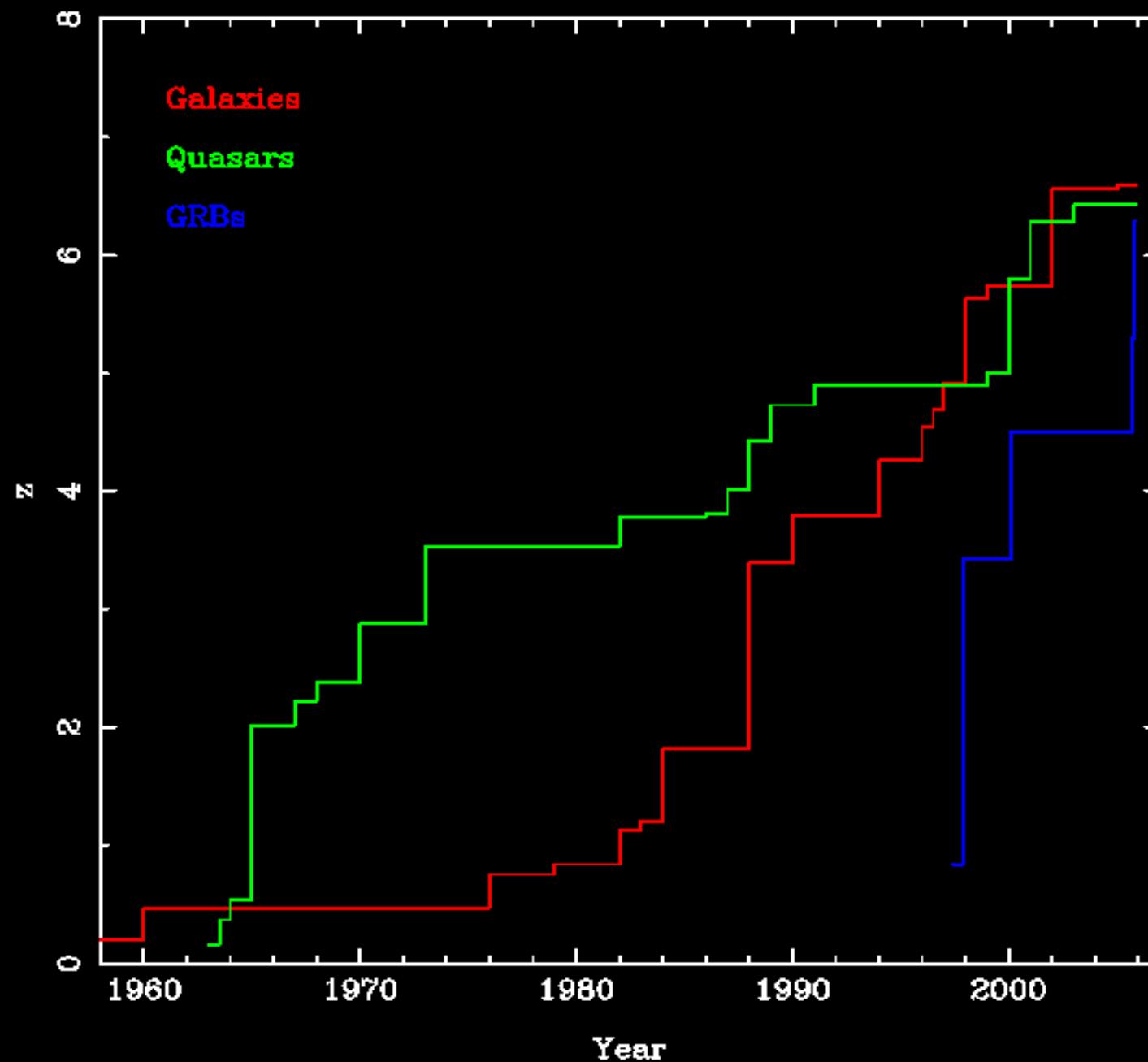
The high-z population:

GRB 050904 @ $z=6.3$
GRB 080913 @ $z=6.7$
GRB 090423 @ $z=8.1$

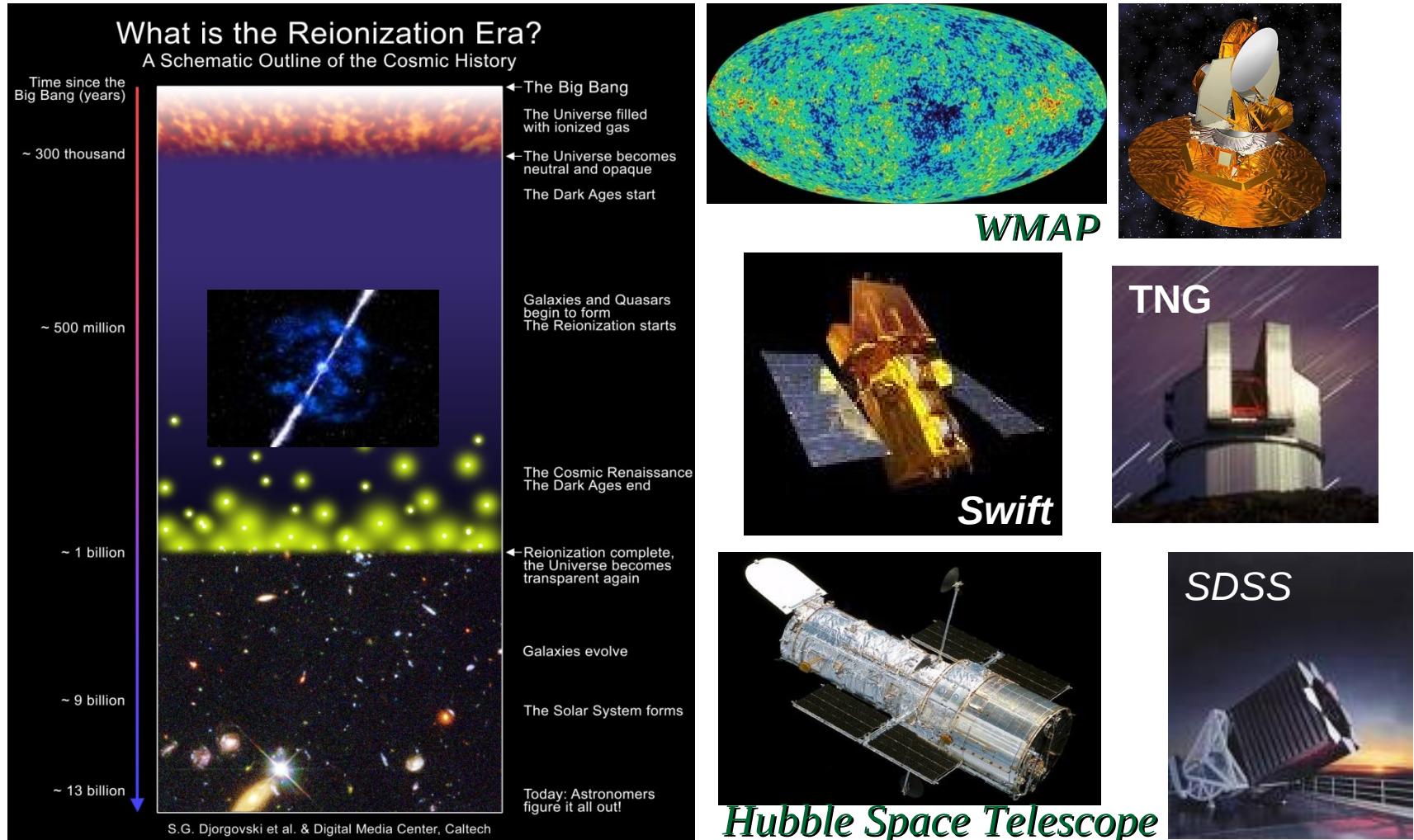
1-7% of all Swift GRBs at $z>6$
for $P_{\text{lim}}=0.4 \text{ ph/s/cm}^2$

Salvaterra et al. 2009

Redshift records (compiled by R. McMahon, N. Tanvir)



Exploring the “dark ages”



Further details: Salvaterra et al. 2009, Nature, arXiv:0906.1578