Radiation from the Early Generations of Galaxies

- The first GRBs
- Ly-α scattering and the 21-cm power spectrum

Smadar Naoz

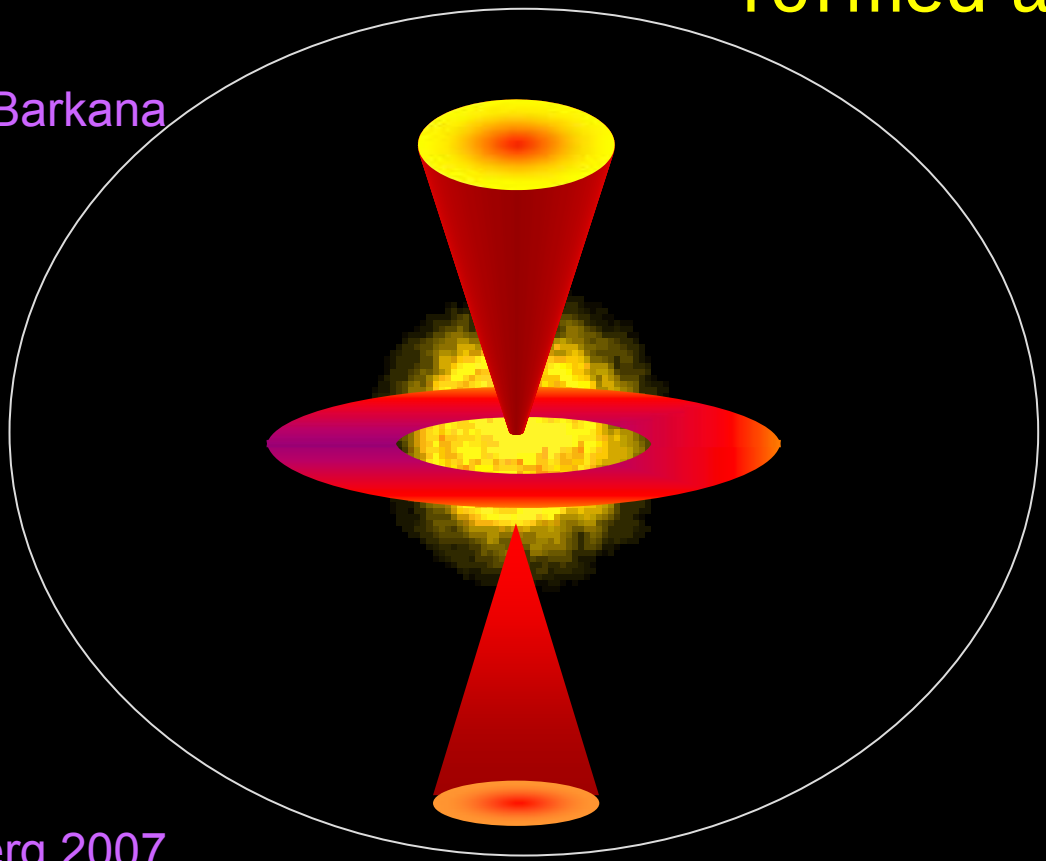
The first GRBs

The scenario:

Starting from the first star at z=65....

The first observable GRB (potentially) formed at z=60

Naoz, Noter & Barkana 2006

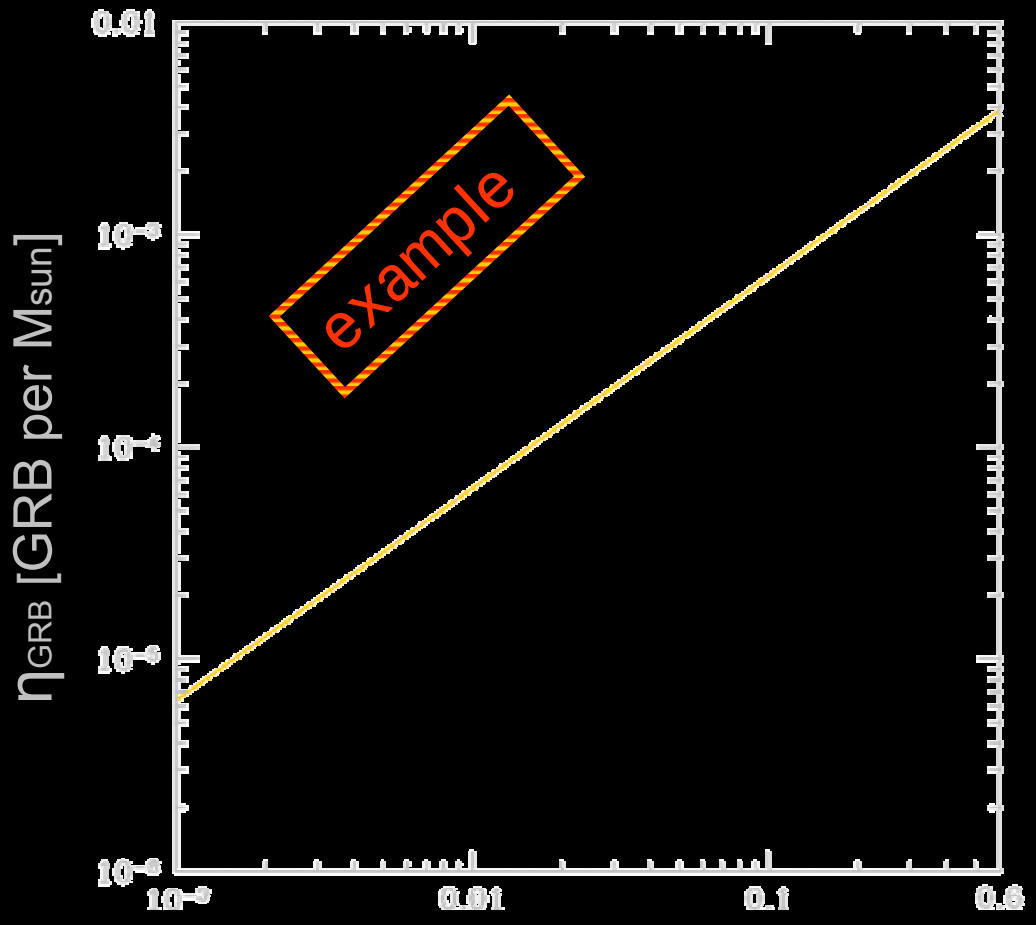


Naoz & Bromberg 2007

The first GRBs

For a given observed rate of high redshift GRBs, what is the efficiency of GRB formation from those objects?

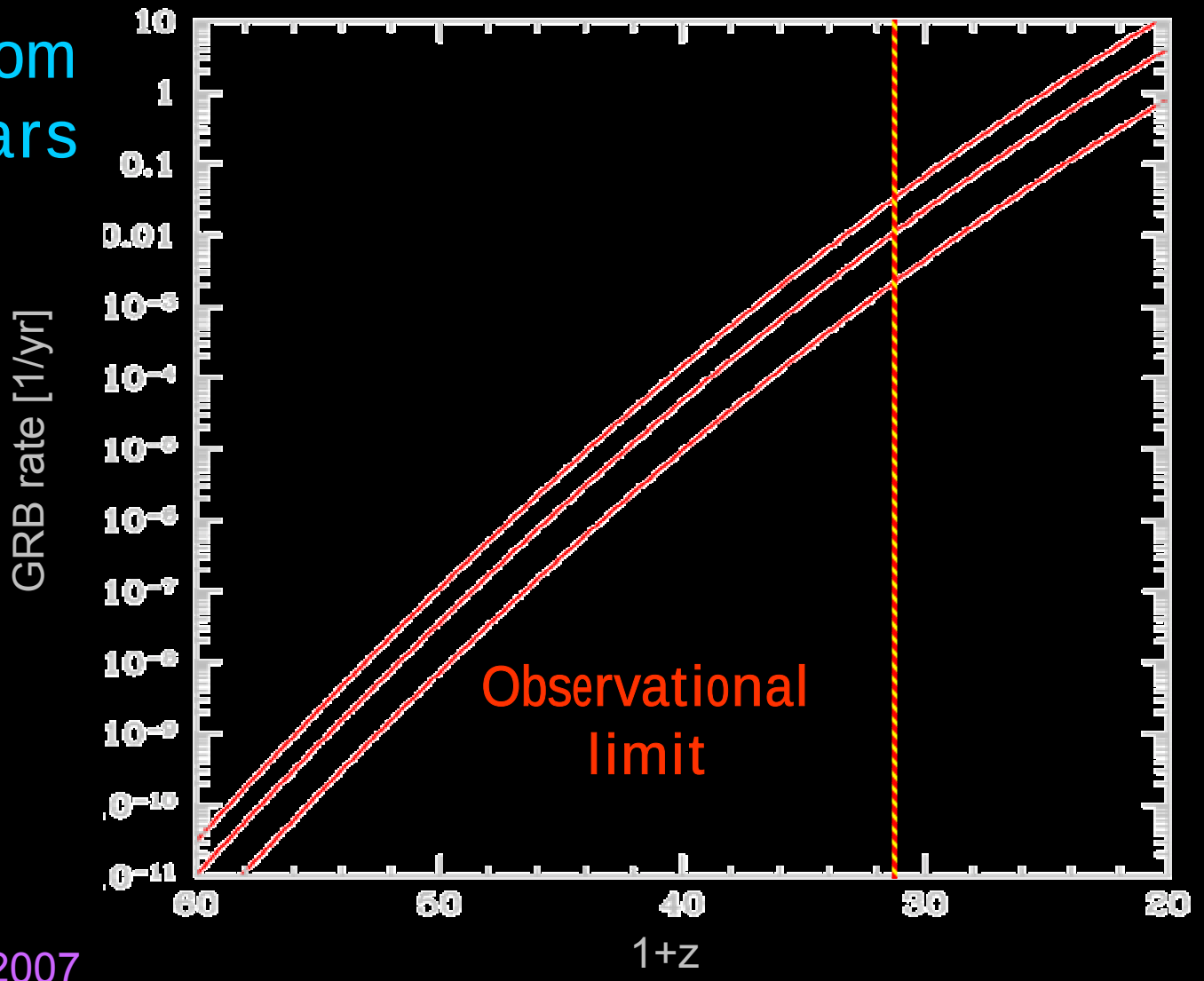
The efficiency (per mass in stars) of forming GRBs from the first stars



Naoz & Bromberg 2007

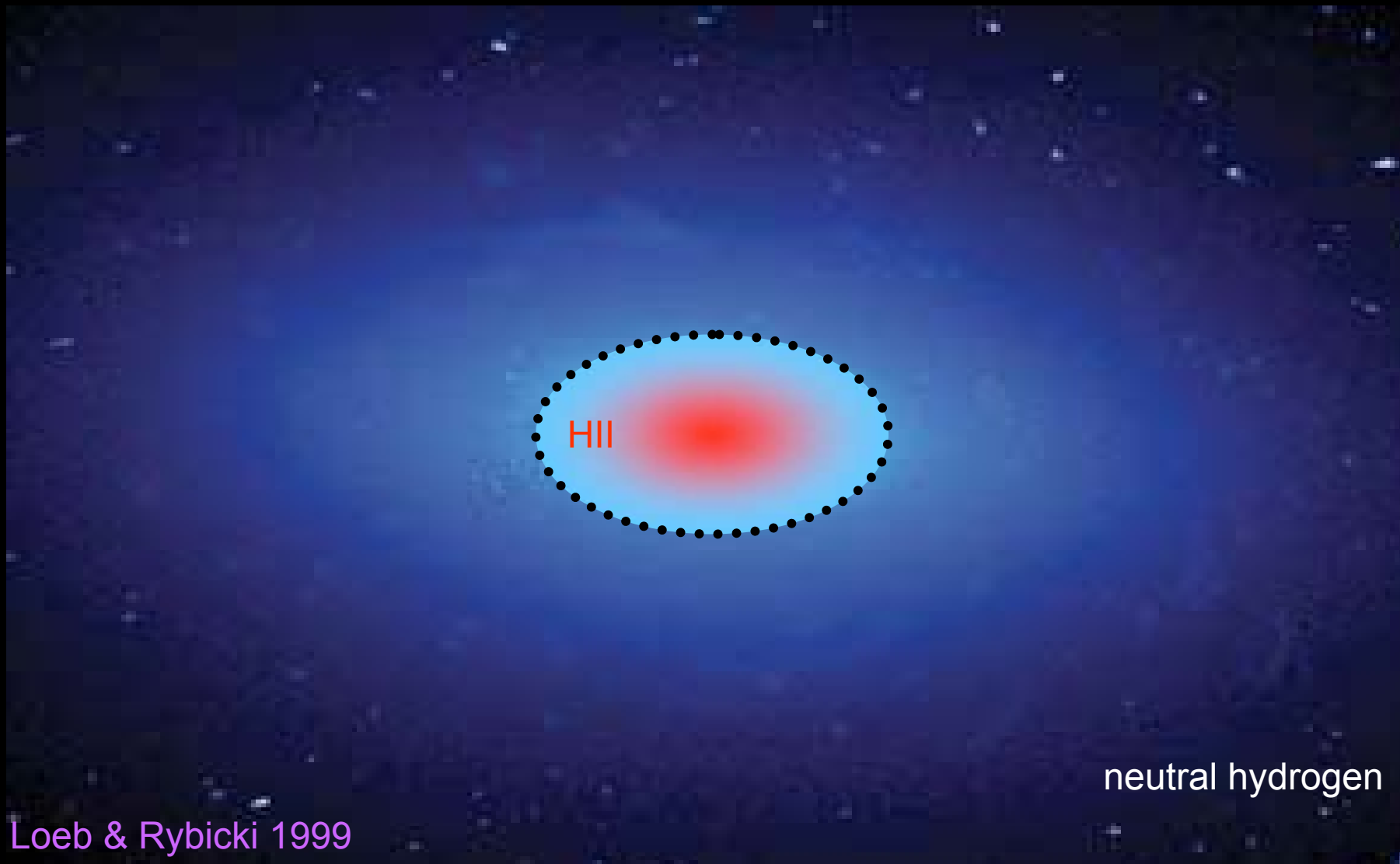
The first GRBs

GRB rate from the first stars



Naoz & Bromberg 2007

Ly-α Scattering



Loeb & Rybicki 1999

Ly-α Scattering

Defining important variables: υ_* the frequency that sets the optical depth to one. r_* physical, at which the redshift due to Hubble expansion produces υ_*

$$r_* \approx 1 Mpc$$

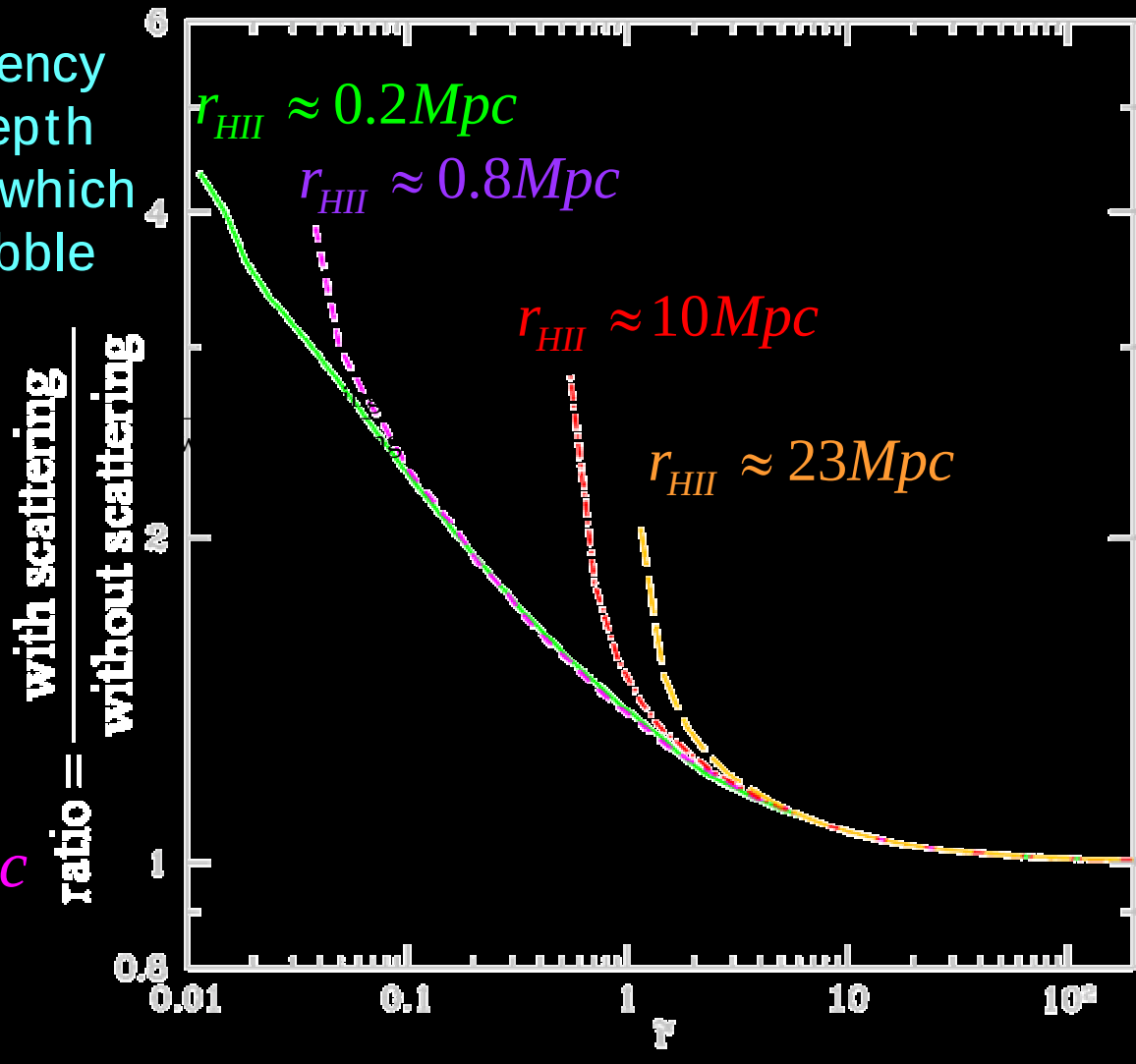
$$\tilde{r} = r / r_*$$

Loeb & Rybicki 1999

$$0.2 Mpc \le r_{HII} \le 10 Mpc$$

comoving

Naoz & Barkana 2007



21cm power spectrum

Barkana & Loeb 2004

+ Pritchard & Furlanetto 2006; Hirata 2006

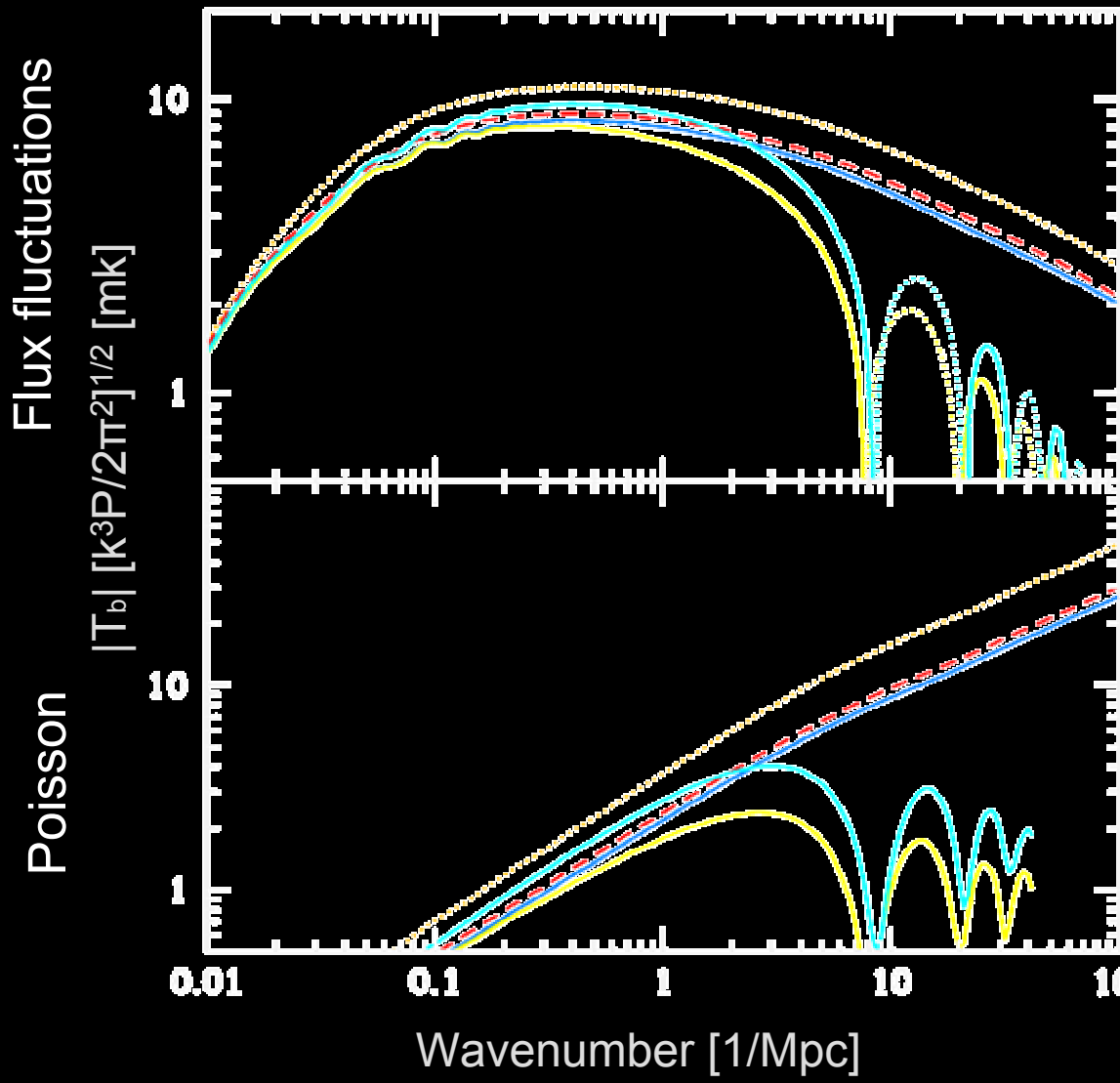
+ Naoz & Barkana 2005

+ HII Cutoff

+ scattering

z=20

Minimum mass for Atomic cooling

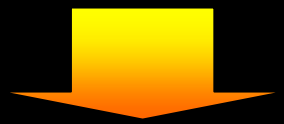


Naoz & Barkana 2007

Summary

- The first observable GRB most likely appeared at z~60, 35 Myr after the Big Bang
- The GRB observational "horizon" is z~30

- HII regions around galaxies produce a cutoff in the 21-cm power spectrum
- Lyman scattering enhances the signal



- Detecting the early generations of galaxies