What (if anything) do dwarf galaxies tell us about reionization?

PHY 689
Roberto Sepulveda
12/10/2009

Papers

- Wyithe, J.S.B. & Loeb, A. Suppression of dwarf galaxy formation by cosmic reionization. Nature 441, 322(2006).
- Bovill, M.S. & Ricotti. Pre-reionization fossils, ultra faint galaxies and the missing satellite problem. ApJ 693, 1859 (2009).
- Ricotti, M & Gnedin, N. Formation histories of galaxies in the local group. ApJ 629, 259 (2005).
- Barkana, R. & Loeb, A. Identifying the reionization redshift from the cosmic star formation rate. ApJ 539,20 (2000).

Motivation

- In order to study the ionization state of the universe is necessary to understand the formation of the earliest
- CDM N-Body simulations predict more DM halos around milky way than observed
  - > suppression of dwarf galaxy formation?

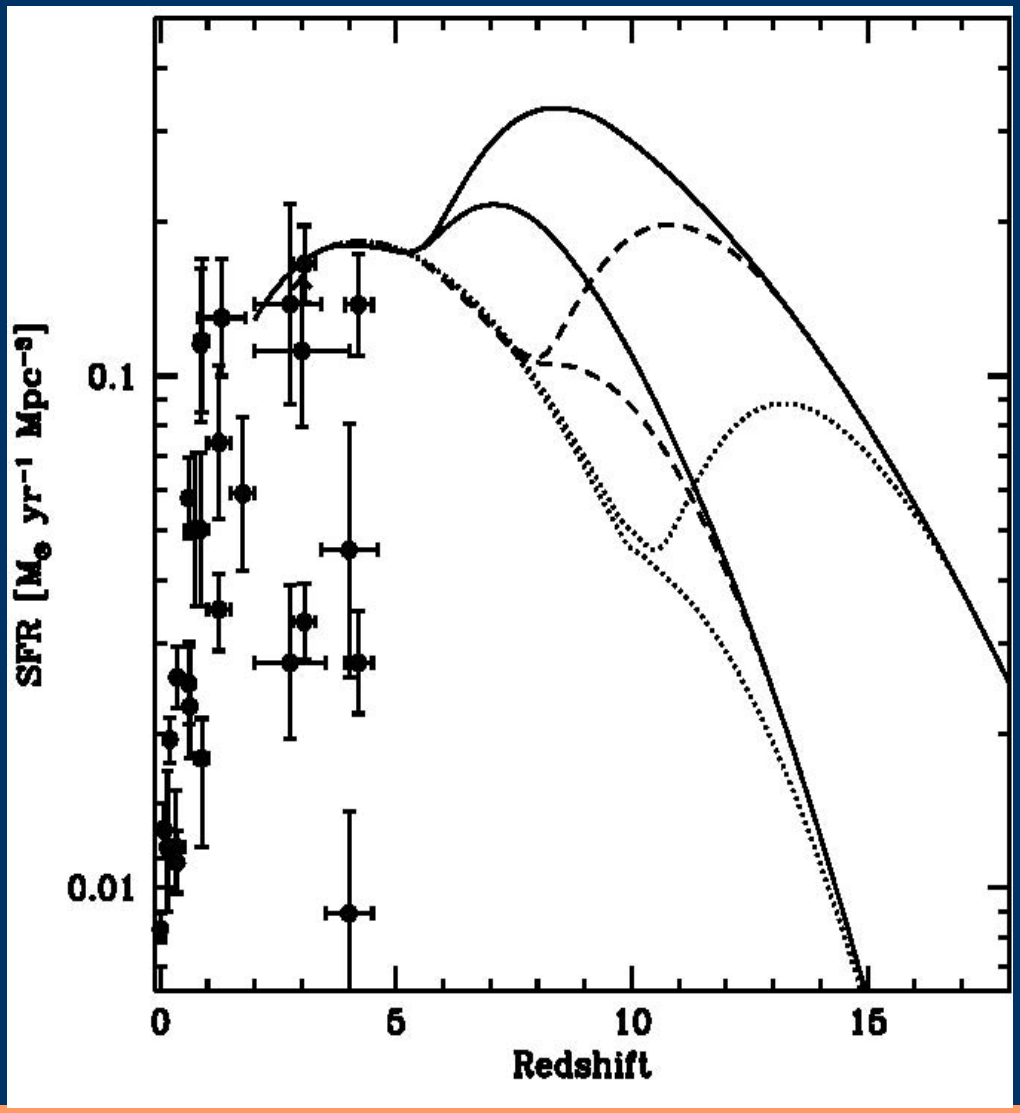
Overview

- Effect of reionization on dwarf galaxies.
- Reionization at z=6.
- Dwarf galaxies in local universe.

Reionization from SFR

- Small galaxies have lower virialized temperatures.
- Least massive systems to collapse have $T_{vir} \approx 10^4$K, collapsing through molecular hidrogen cooling.
- Reionization breaks H_2, heats gas and thus precludes star formation in the halo.

Reionization from SFR



- Barkana & Loeb, ApJ 539, 20 (2000)

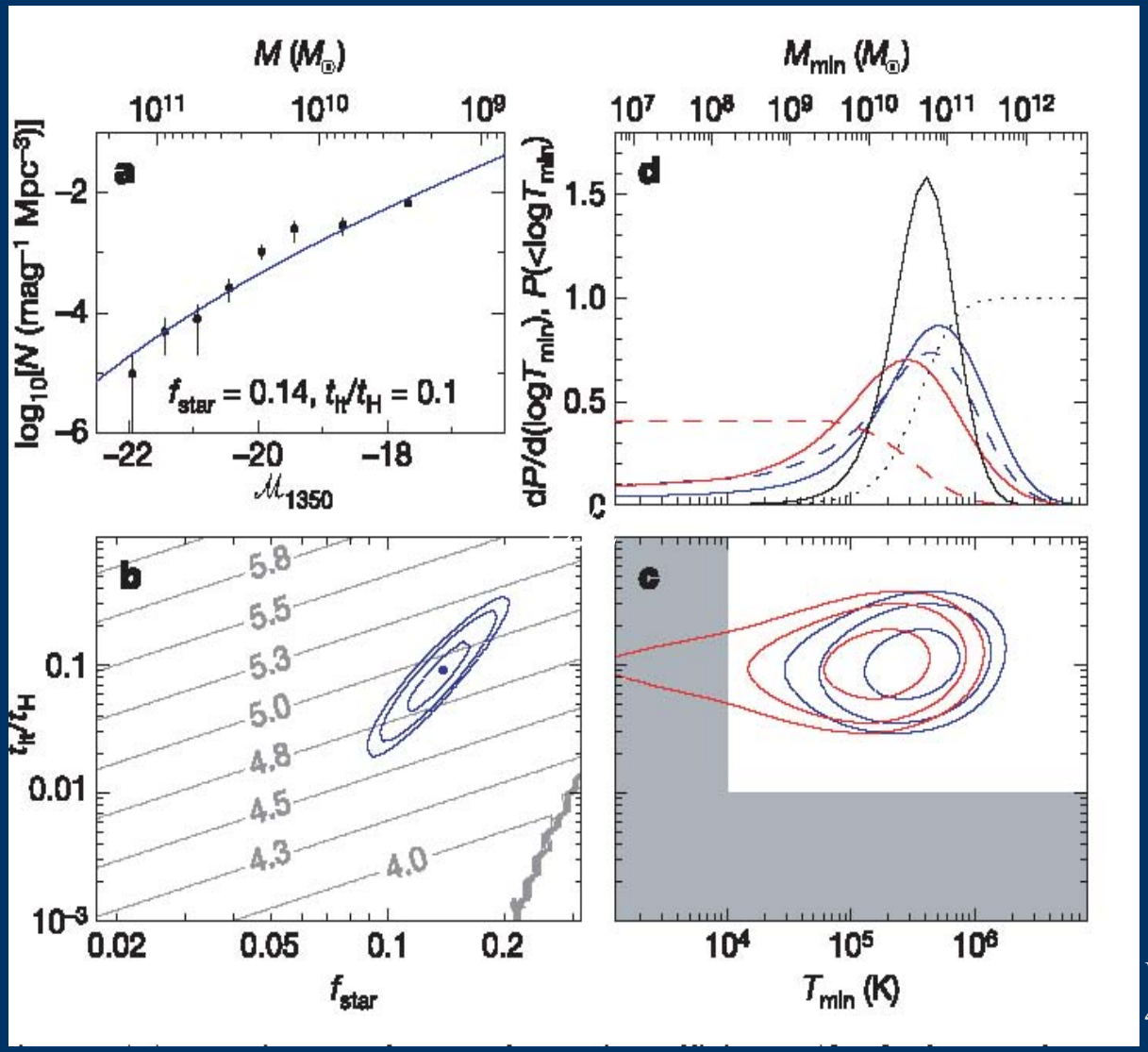
Suppression of dwarf galaxy formation

- Faint galaxies hard to observe
- Even if they can't be observed effect should be felt in ionization of IGM.
- Use scatter on optical depth to quasars at $z \approx 6$ to study sources of ionizing radiation by the end of reionization.

Suppression of dwarf galaxy formation

- Use HSF UDF galaxies between z = 5.5-6 (Bowens et at, 2006) to constrain the luminosity function.
- Fit to model depending on lifetime of starburst and star producing efficiency.
- Compare scatter to optical depth to z = 6 quasars (Fan et al, 2006).
- Get lower virial temperature of halos contributing to scattering.

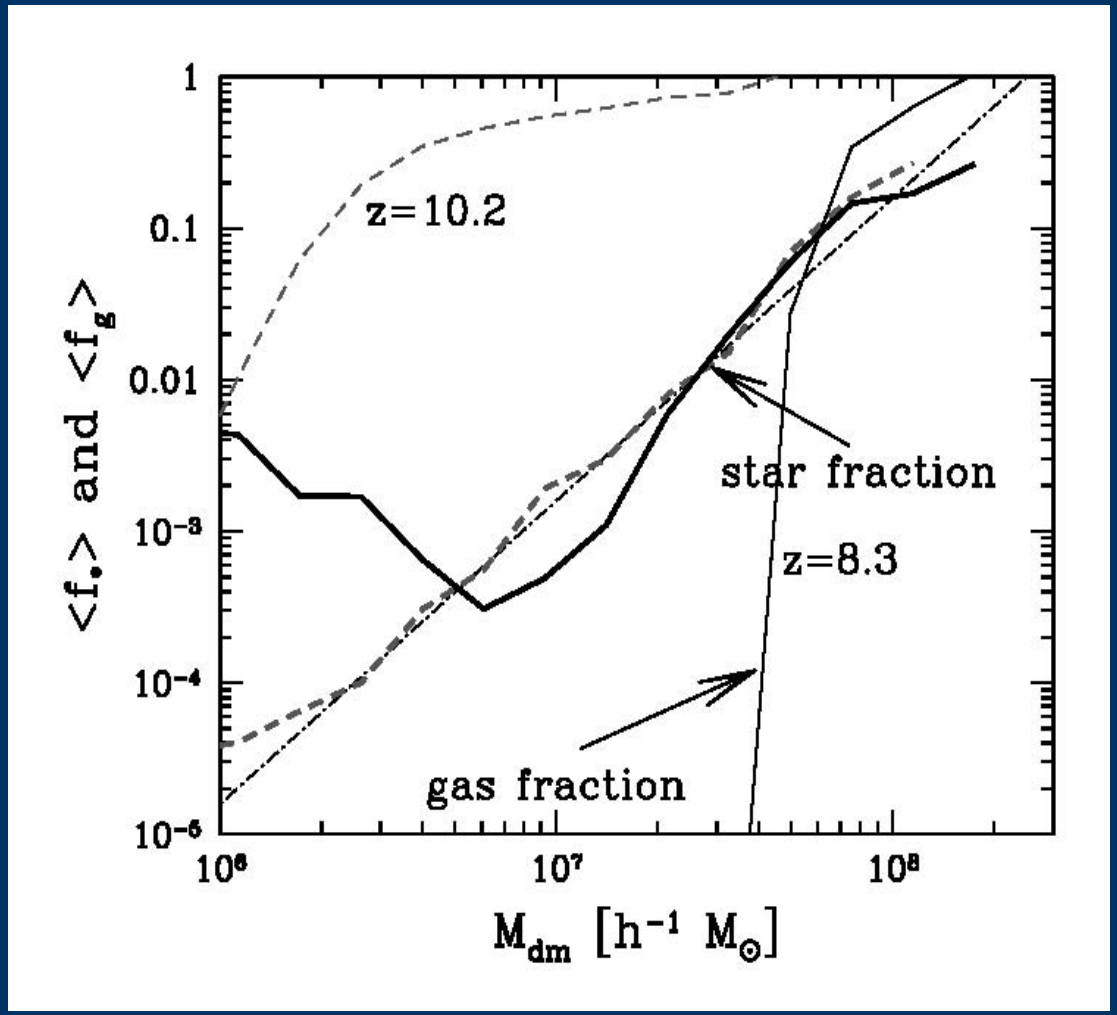
Suppression of dwarf galaxy formation



Wythie & Loeb, Nature 441, 322 (2006)

Do we see them?

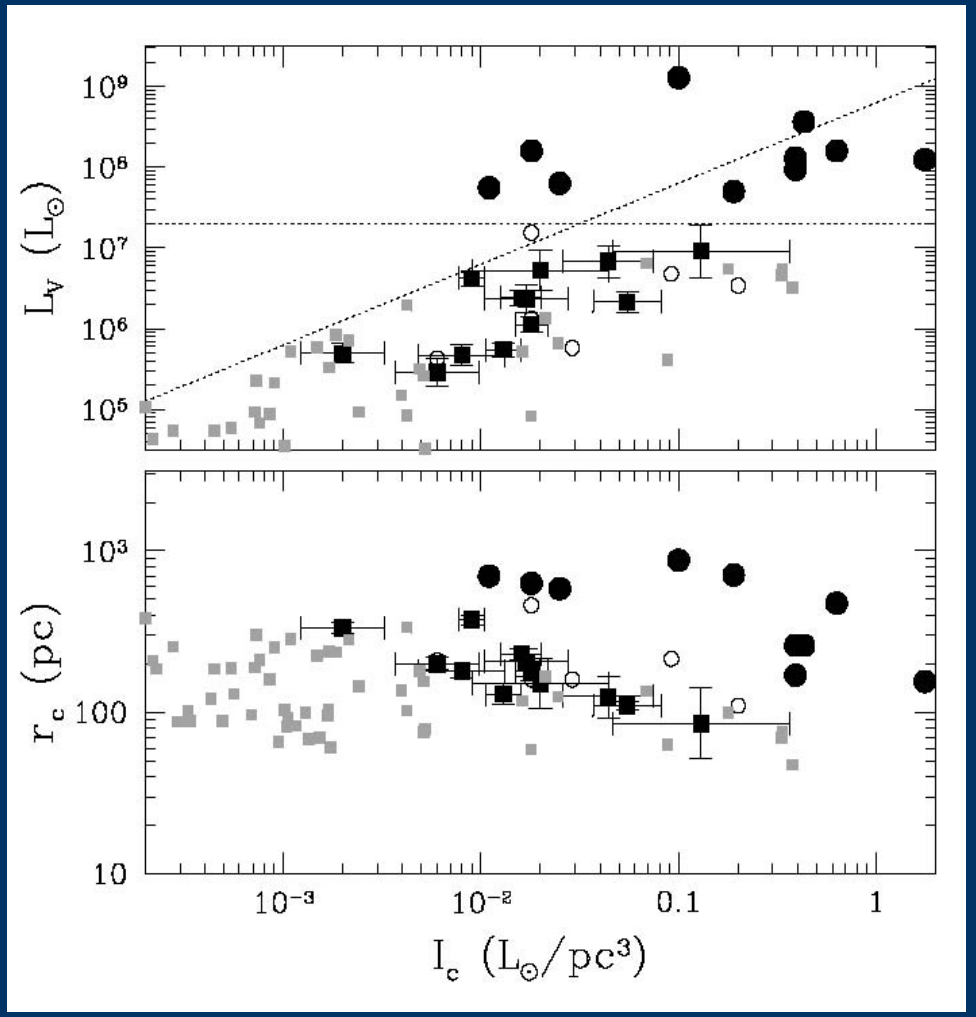
- Simulations show that low mass halos evaporate gas even before reionization.
- "positive feedback" for H_2 more halos to form galaxies.
- After they are depleted of gas, evolved until z=0 and see.



Ricotti & Gnedin, ApJ 629, 259 (2005)

Do we see them?

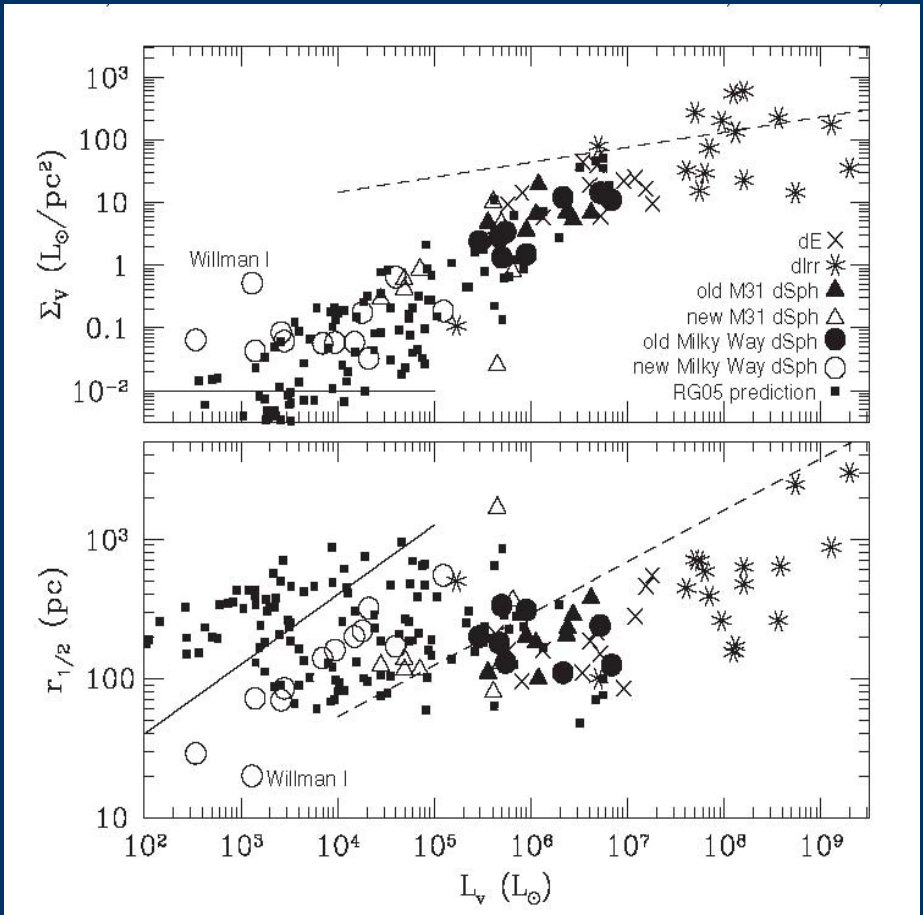
- Faint dwarf galaxies prediction



- Ricotti & Gnedin (2005)

Do we see them?

- New observations (SDSS).
- True Fossills, polluted Fosssils and survivors.
- Tidal Stripping.



- Bovill & Ricotti, ApJ 193, 1859 (2009)

Summary

- Complex relation w/ ionization field
- Don't seem to trigger ionization at $z \approx 6$, even if affected.
- New population of dwarf galaxies appears to be present in local group.