The effect of gas bulk rotation in the morphology of the Lyα line.

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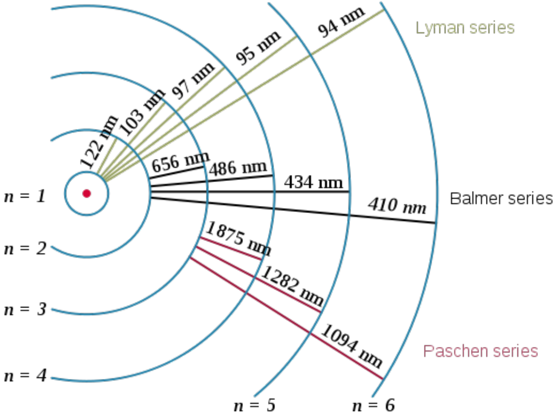
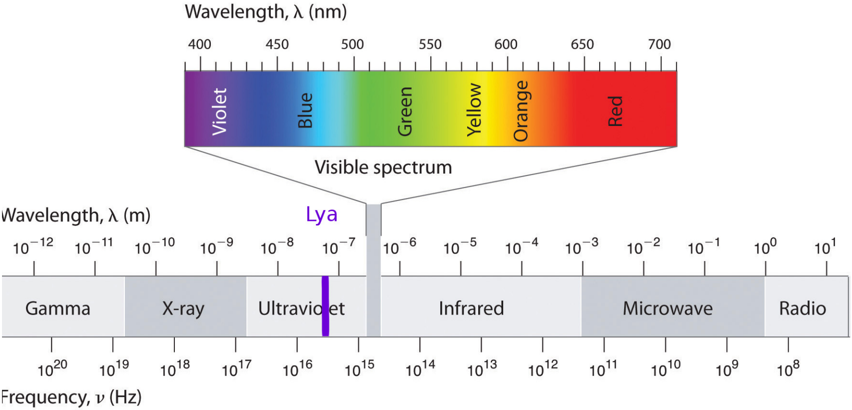
Lyman α emission line:

A Lyα photon is emitted with a $\lambda = 121.56nm$.



Lyα is in the vacuum UV part of the EM spectrum



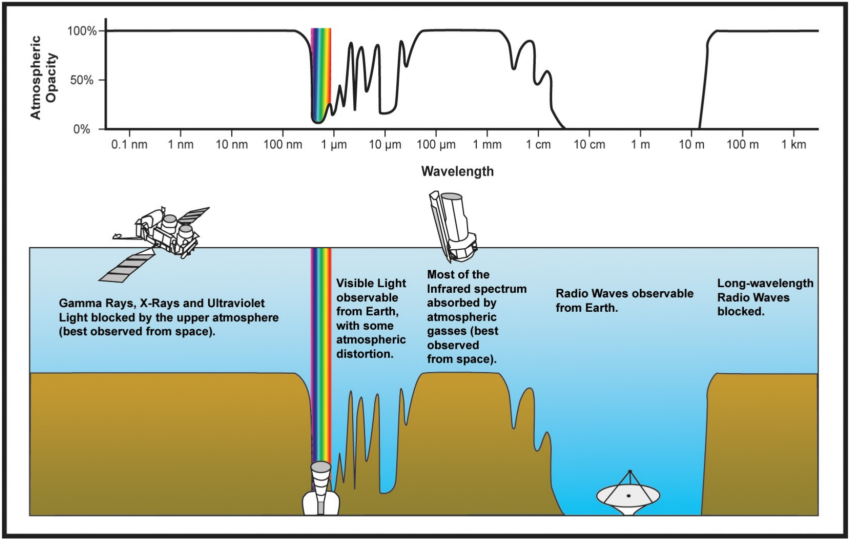


Figure : Atmospheric radiation absorption

Cosmological Redshift & the observable LAEs in the visible regime.

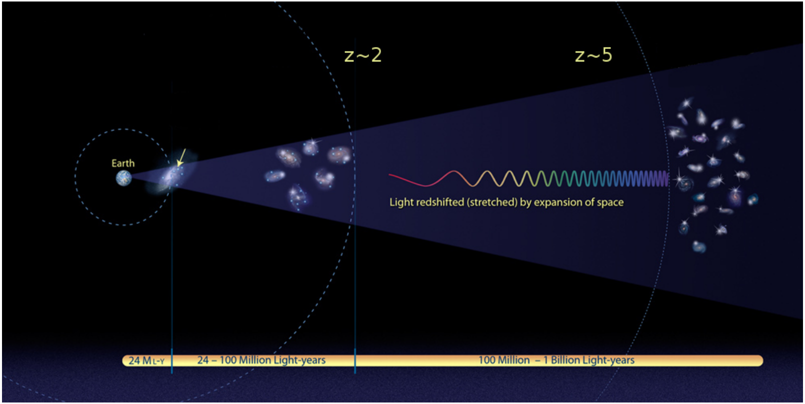


Figure : Image credit: NASA, ESA, and A. Feild (STScI).

Do galaxies radiate Lyα photons?

Hydrogen in the most abundant element in the Universe.

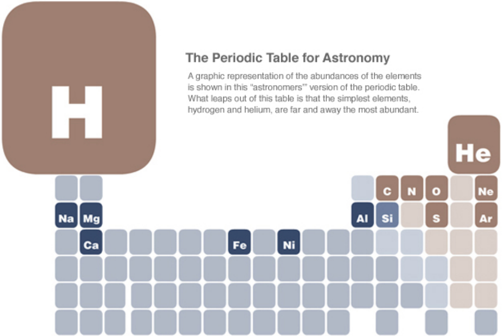


Figure : Astronomers periodic table. Image credit: http://chandra.harvard.edu

UV radiation mechanisms and sources:

- UV stellar radiation
- Gravitational cooling
- UV background radiation

ARE YOUNG GALAXIES VISIBLE?

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Received August 5, 1966; revised September 8, 1966

ABSTRACT

The purpose of this paper is to assess the general possibility of observing distant, newly formed galaxies. To this end a simple model of galaxy formation is introduced. According to the model galaxies should go through a phase of high luminosity in early stages of their evolution. The estimated luminosity for a galaxy resembling our own is $\sim 3 \times 10^{46}$ ergs/sec, roughly 700 times higher than the present luminosity. The bright phase would occur at an epoch of about 1.5×10^8 years, corresponding to a redshift between 10 and 30, depending on the cosmological model assumed.

The possibility of detecting individual young galaxies against the background of the night sky is discussed. Although the young galaxies would be numerous and would have sufficiently large angular diameters to be easily resolved, most of the radiation from the young galaxies would arrive at wavelengths of 1–3 μ where detection is difficult. However, it seems possible that the Lyman-α line might be detected if it is a strong feature of the spectra of young galaxies.

It is also shown how such an experiment might help us to distinguish between various cosmological models.

25 years later ...

SEARCHES FOR PRIMEVAL GALAXIES

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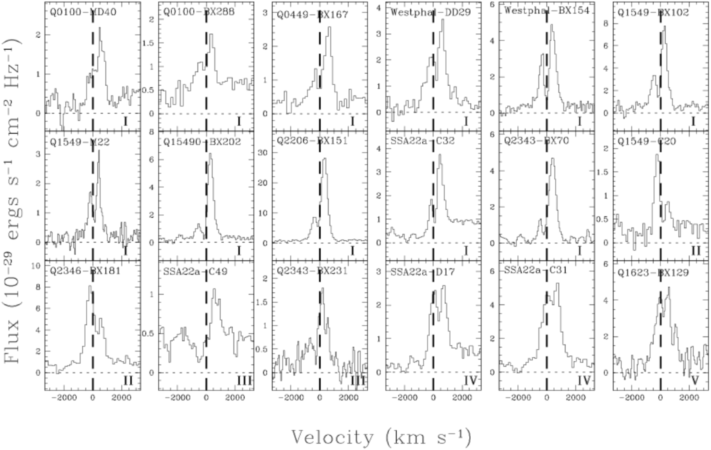
ABSTRACT. We review primeval galaxy searches based on the Lyα line emission. Simple arguments are given which suggest that primeval galaxies (interpreted here as ellipticals and bulges undergoing their first major bursts of star formation) should be detectable with present-day technology. Many active objects are now known at large redshifts, which may be plausibly interpreted as young galaxies, but there is so far no convincing detection of a field population of forming normal galaxies. This suggests that either primeval galaxies were obscured, and/or are to be found at higher redshifts, $z_{gf} > 5$.

Ly α as an important tool in extragalactic astronomy

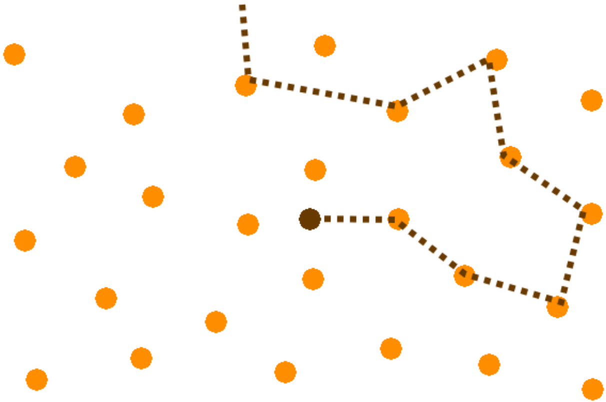
Units convention:

$$V = \frac{\nu_{obs} - \nu_{\alpha}}{c} \tag{1}$$

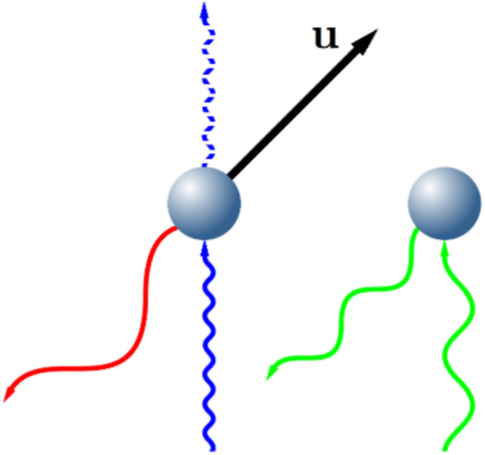
LAEs spectra



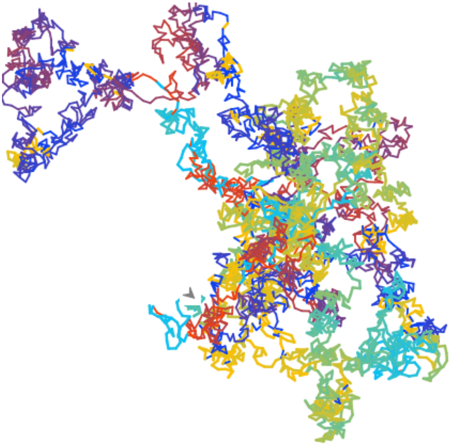
Radiative transfer through a static medium:



Radiative transfer through a non-static medium:



Lyα photons undergoes a random walk in space and wavelength



Dust and escape fraction of Lyα photons

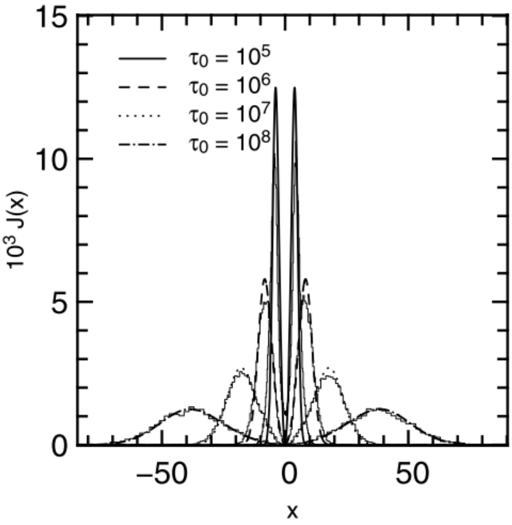
Radiative transfer theory I:*

Radiative transfer theory II:*

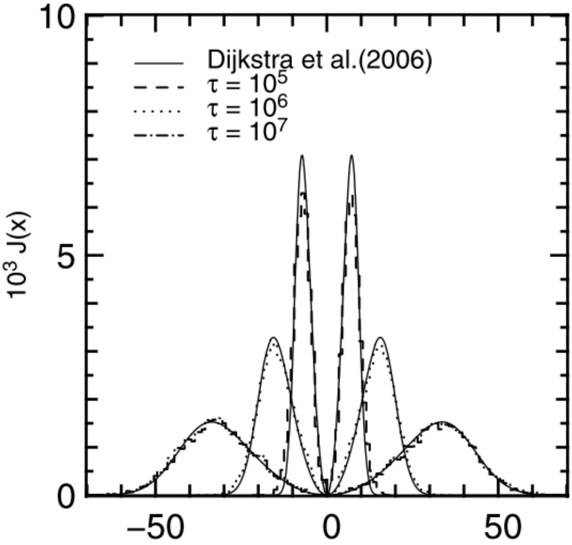
Radiative Transfer via Monte-Carlo methods:

- Set up the initial conditions (Temperature, gas distibution & kinematics).
- Set the Lyα photons initial positions x_{in}.
- Generate the photon random displacement τ_0 in a random direction $\vec{n}$.
- Derive the HI atom velocity components from the initial field and generate random components for the thermal movements.
- Set the new Lyα direction after the scattering.
- Set the absorption probability due to dust encounters.
- Iterate from step 2.

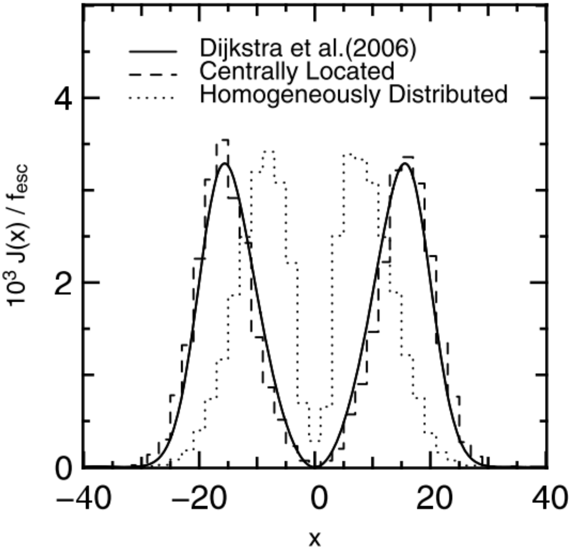
Infinite slab:



Sphere with central sources:

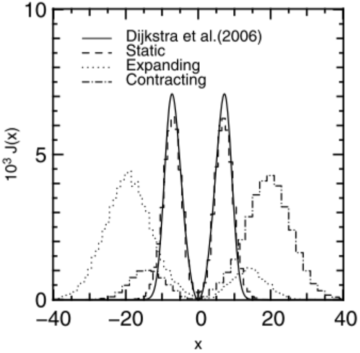


Sphere with homogeneous and central sources:



Different geometries have an impact on the morphology of the Lyα spectrum.

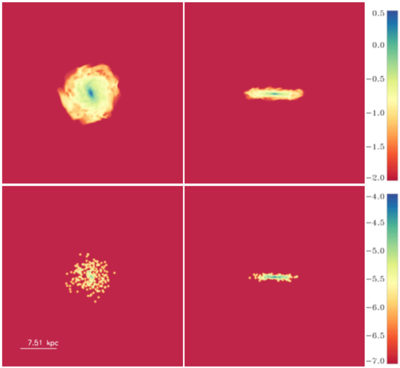
Expanding/Contracting sphere:

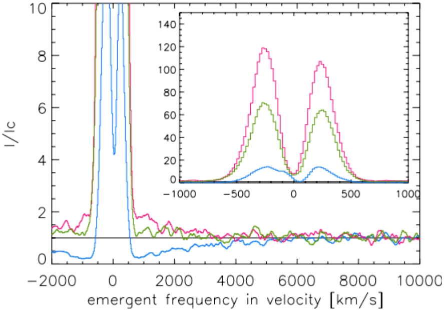


Cavities

Zheng/Zheng and Dijkstra

A SPH simulated galaxy spectrum



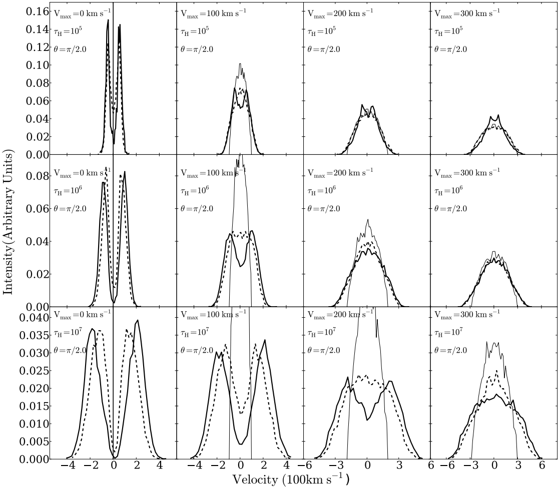


Physical Parameter (units)	Symbol	Values
Velocity (km/s)	$V_{\rm max}$	0, 100, 200, 300
Hydrogen Optical Depth	τ_H	10^5, 10^6, 10^7
Dust Optical Depth	τ_a	0,1
Photons Distributions		Central, Homogeneous

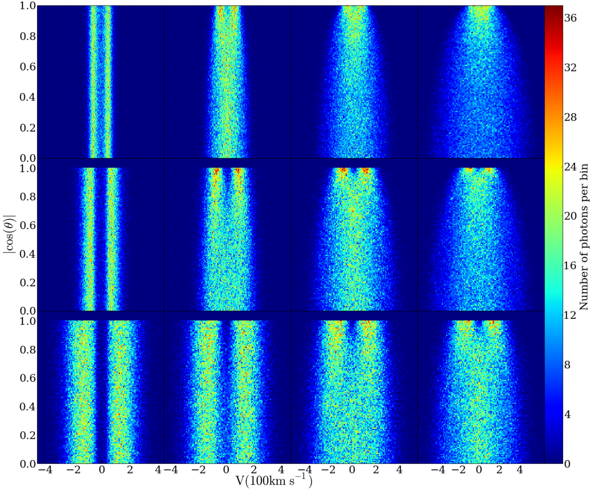
Table : Summary of Physical Parameters of our Monte Carlo Simulations.

We measure the impact of rotation and viewing angle θ in the main line characteristics characteristics

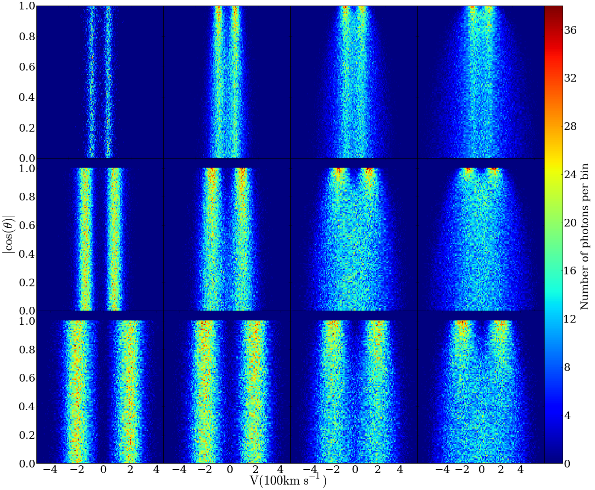
Simulated spectra



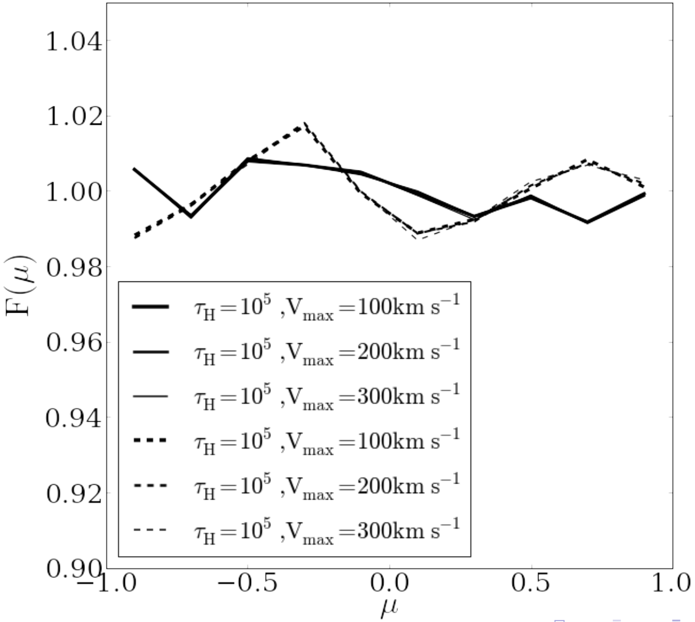
Simulated spectra



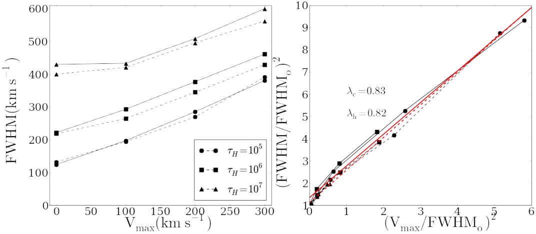
Simulated spectra



Simulated spectra



The width of the line increases proportional with the rotation velocity.



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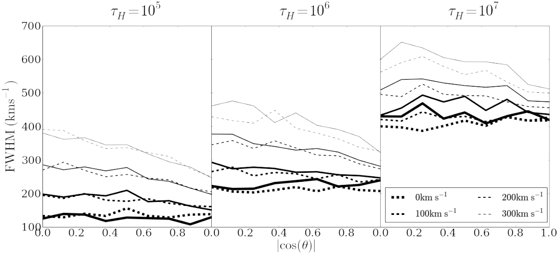

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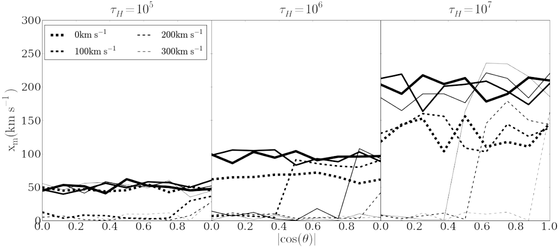

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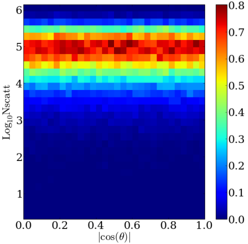

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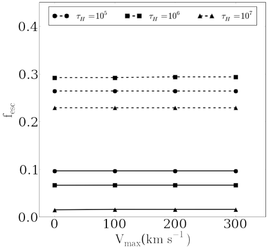

Analytic aproximation

Analytic aproximation

Lyman alpha observed in rotation

Conclusions

Work in progress

fit of the line

Work in progress

rotation + outfloes