A Connection Between Star Formation Rate and Dark Matter Halos at $Z \sim 6$ Using 2013 Plank Cosmology.

F.L. Gómez-Cortés[1]

Departamento de Fsica, Universidad de los Andes, Colombia

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ABSTRACT

This work relates baryonic matter and dark matter at redshift $z = 5.9$ using observational data from CFHTLS(Willott 2013), HUDF09(Bouwens 2006, 2012), UKIRT and SDXS(McLure 2009), and results of the Multidark Simulation (Riebe 2013) in a cubic box of length 1000Mpc h^{-1}. Cosmic variance effects are studied on smaller boxes of length 250Mpc h^{-1}. The luminosity function is fitted in booth sizes. Using the relationship between the UV continuum and Star Formation Rate (SFR) by Kennicutt (1998) we get the relationship between the Dark Matter Halos Mass and Star Formation Rate.

Subject headings: Dark Matter, LF, SFR, High Redshift Galaxies, Reionization

1. Introduction

1.1. Halo Mass Function (HMF)

The HMF is created using the DMH catalog from the Multidark Database.

1.2. Cosmic Variance

Is important to know and understand the existence of local fluctuations or inhomogeneities due the observed scale.

For this part is necesary to study the HMF on smaller boxes

2. Relationship between Galaxy Luminosity Function (GLF) and Dark Matter Halo (DMH) mass

In one hand we have observational results: the GLF for star-forming galaxies at high redshift (z=5.9)(Bouwens 2006; Willott 2013) expressed in terms of magnitude in the ultraviolet range (M1350). In the other hand we have a DMH catalog, result from the Multidark Simulation with Plank Cosmology.

A 1000 $\mathrm{Mpc}^3\mathrm{h}^3$ cubic box containing near to 11×10^6 dark matter halos.

The idea is to connect the observed GLF with the DMH catalog. We assume that each halo contains one and just one galaxy, and its luminosity is given by:

$$L_{\mathrm{galaxy}} = \alpha M_{\mathrm{halo}}^{\beta} \tag{1}$$

but this function is given in magnitude units. Is necesary to convert magnitude to luminosity.

3. Magnitude to Luminosity

The Luminosity is an intrinsic propertie of the stars. It doesn't deppends of the distance. It's directly related to the energy flux emmited. The luminosity L_ν at a given frecuency ν is has [WHz^{-1}] or [erg $\mathrm{s}^{-1}\mathrm{Hz}^{-1}$] units.

The magnitude is brightnes star classification inherited from ancient Greeks. It deppends of the stellar distance. The absolute magnitude is a modern classification independent of distance. Taking the Sun as reference, the absolute magnitud at a given wavelengt is given by:

$$M_\lambda = M_{\lambda\odot} - 2.5\log_{10}\left(\frac{L_\lambda}{L_{\lambda\odot}}\right)$$

The solar absolute magnitude in the U filter is:

$$M_{\mathrm{U}\odot} = 5.61$$

and the luminosity:

$$1L_{\mathrm{U}\odot} = 10^{18.48}\mathrm{ergs\ s^{-1}Hz^{-1}}$$

$$1L_{\mathrm{U}\odot} = 3.02\times10^{18}\mathrm{ergs\ s^{-1}Hz^{-1}}$$

Replacing in the absolute magnitude equation:

$$M_\mathrm{U} = 5.61 - 2.5\log_{10}(L_\mathrm{U}) + 25\times18.48$$

gives:

$$M_\mathrm{U} = 51.82 - 2.5\log_{10}(L_\mathrm{U})$$

3.1. Best Fitting Parameters

A big mistake.

$$\log \neq \log_{10}$$

–Here comes the fitting graph–

And the fitting parameters

$\alpha =?$

$\beta =?$

4. Stelar Formation Rate

4.1. The UV Continuum

The UV region is dominated by big blue young stars, is possible to make an extrapolation to small young stars.

On stellar-formation galaxies the spectrum has a UV continuum nearly flat. This is a good approximation:

$\mathrm{SFR}\,(M_\odot \mathrm{yr}^{-1}) = 1.4 \times 10^{28} L_\nu \left(\mathrm{erg\ s}^{-1}\mathrm{Hz}^{-1}\right)$

With Initial Mass Function (IMF) between $0.1M_\odot$ and $100M_\odot$, in the range of $1250 - 2500\text{Å}$

4.2. The Fitting Model

This fitting model contains four parameters: $(m/M)_0$, M_1, β and γ, where $m :=$ Stellar mass, and $M :=$ Dark Matter Halo mass.

$$\frac{m}{M} = 2\left(\frac{m}{M}\right)_0 \left[\left(\frac{M}{M_1}\right)^{-\beta} + \left(\frac{M}{M_1}\right)^{\gamma}\right]^{-1} \tag{2}$$

Another model cited in the article contains five parameters: m_0, M_1, β, γ_1 and γ_2.

$$m(M) = m_0 \frac{(M/M_1)^{\gamma_1}}{[1 + (M/M_1)^{\beta}]^{(\gamma_1 - \gamma_2)/\beta}}$$

5. Observations

Willott

Bowens

McLure

5.1. The Drop-out Technique - Lyman Break Technique

6. Discussion

7. Summary

A. Appendix material

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