

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

F.L. Gómez-Cortés<sup>1</sup>

Departamento de Física, Universidad de los Andes, Colombia

Received \_\_\_\_\_; accepted \_\_\_\_\_

## ABSTRACT

This work relates baryonic matter and dark matter at high redshift using observational data from the HST and results of the Multidark Simulation. Luminosity Function - Dark Matter Halos, Star Formation Rate - Dark Matter Halos.

*Subject headings:* 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 necessary 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; Willot 2007) 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 Planck Cosmology.

A  $1000 \text{ Mpc}^3 h^3$  cubic box containing near to  $11 \times 10^6$  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:

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

but this function is given in magnitude units. Is necessary 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  $L_\nu$  at a given frecueny  $\nu$  is has  $[\text{WHz}^{-1}]$  or  $[\text{erg s}^{-1}\text{Hz}^{-1}]$  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:

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

and the luminosity:

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

$$1L_{\text{U}\odot} = 3.02 \times 10^{18} \text{ergs s}^{-1}\text{Hz}^{-1}$$

Replacing in the absolute magnitude equation:

$$M_{\text{U}} = 5.61 - 2.5 \log_{10}(L_{\text{U}}) + 25 \times 18.48$$

gives:

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

#### 3.1. Best Fitting Parameters

A big mistake.

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

–Here comes the fitting graph–

And the fitting parameters

$$\alpha = ?$$

$$\beta = ?$$

## 4. Stellar 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:

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

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

## 4.2. The Fitting Model

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

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

Another model cited in the article contains five parameters:  $m_0$ ,  $M_1$ ,  $\beta$ ,  $\gamma_1$  and  $\gamma_2$ .

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

## 5. Observations

Willott

Bowens

McLure

## 6. Discussion

## 7. Summary

Gracias Totales

## A. Appendix material

## REFERENCES

- Bouwens, R. J. et al. 2006, ApJ, 653, 53
- Willott, Chris J. et al. 2013, AJ, 145, 4