

A Connection Between Star Formation Rate and Dark Matter Halos at $z \sim 6$ in 2013 Planck Cosmology

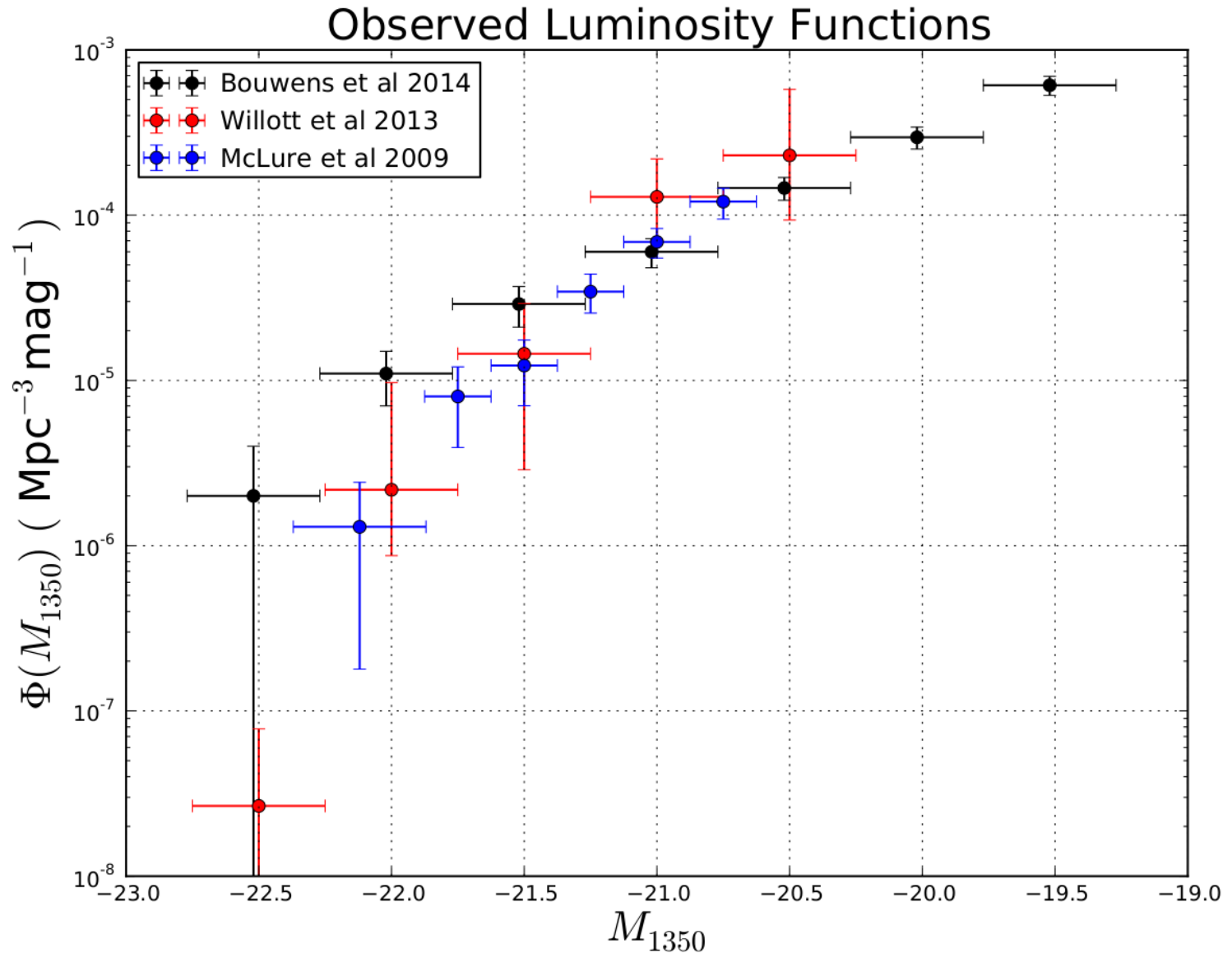
Felipe L. Gómez-Cortés
Universidad de Los Andes
Bogotá, Colombia

Objetivo

To find an analytical relation between Dark Matter Haloes (DMH) from cosmological simulations, and Galaxy UV Luminosity Functions (LF) from observations at redshift 5.9 using the Markov Chain Monte Carlo method.

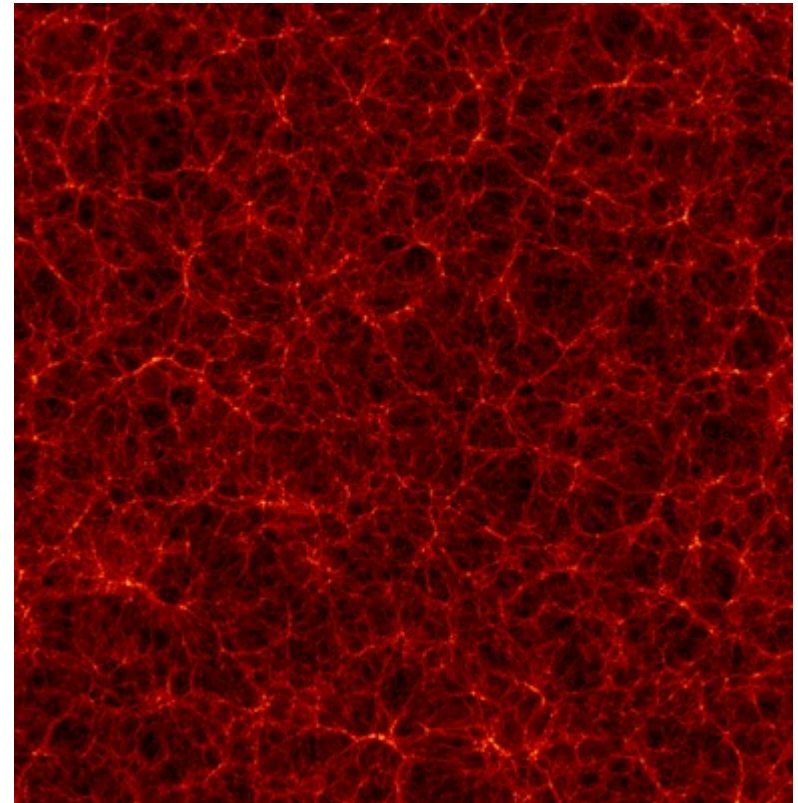
Observational Data

- McLure *et al* 2009: UKIRT & Subaru
- Willott *et al* 2013: CFH
- Bouwens *et al* 2014a: HST



DMH Catalog

In 2013 the Multidark
Consortium
performed the
Big MD simulation
using 2013 Planck
Cosmology

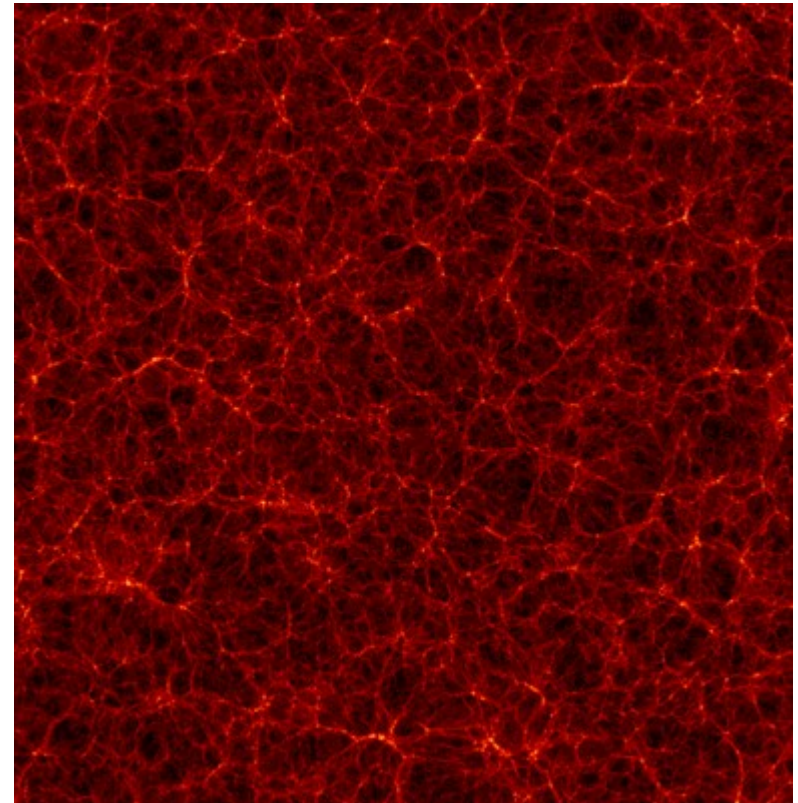


DMH Catalog

$$V = (1 \text{ Mpc } h^{-1})^3$$

Mass Range:

$$10^{10} - 10^{14} M_{\text{SUN}}$$

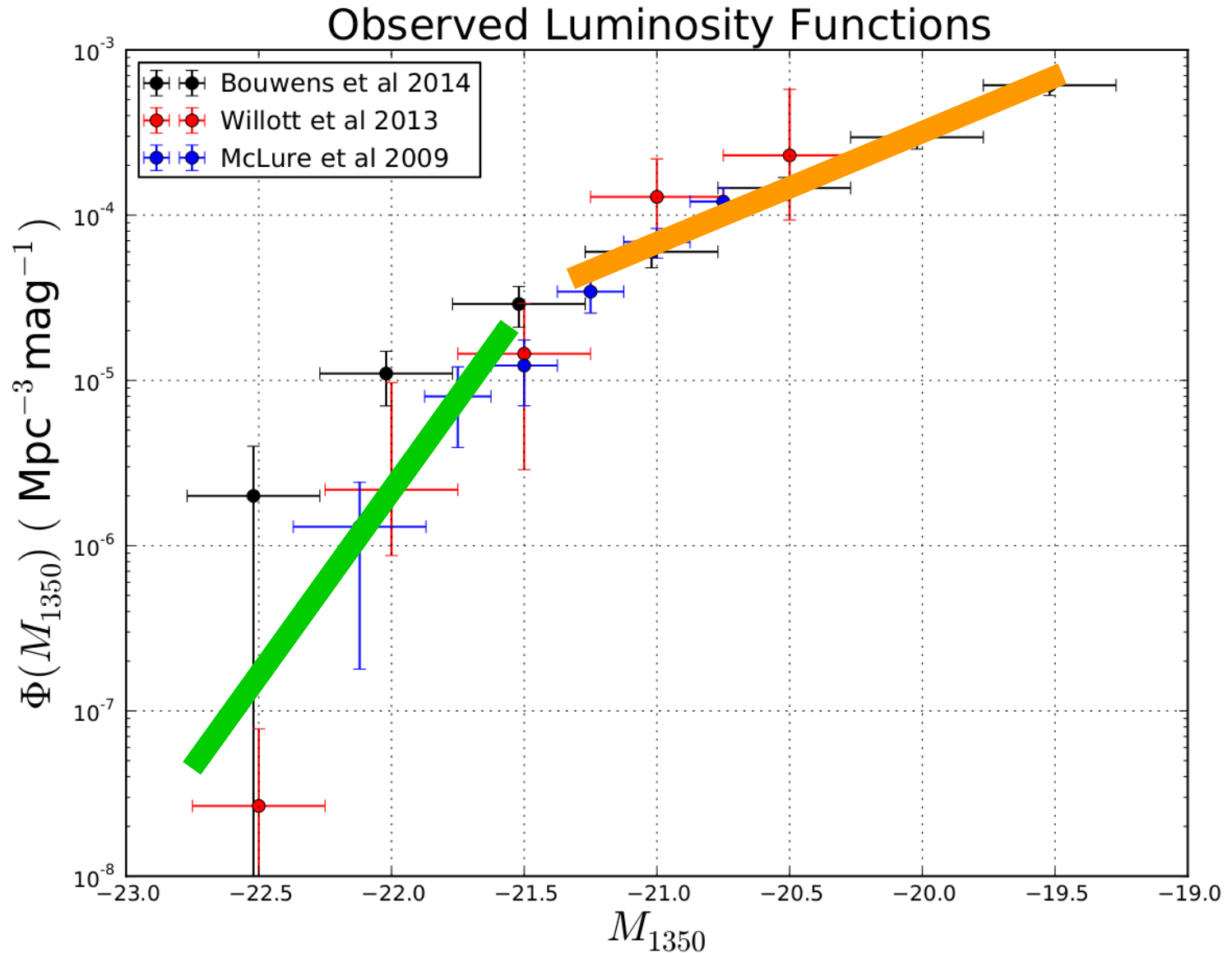


<http://www.multidark.org/>

Galaxy Luminosity

Each DMH hosts one galaxy with luminosity given by:

$$L = L_0 M \left[\left(\frac{M}{M_0} \right)^{-\beta} + \left(\frac{M}{M_0} \right)^{\gamma} \right]^{-1}$$



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Galaxy Intrinsic Magnitude

The Intrinsic magnitude comes from the luminosity as:

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

Dust Attenuation

The dust attenuation effect may be taken account.

Faint & small galaxies have less dust than
Bright & bigger galaxies.

Meurer *et al* 1999,

Smit *et al* 2012 & Bouwens *et al* (2012, 2014b)

Dust Attenuation

$$A_{1600} = 4.43 + 1.99\beta$$

$$\langle\beta\rangle = \frac{d\beta}{dM_{\text{UV}}} (M_{\text{UV}} + 19.5) + \beta_{M_{\text{UV}}}$$

$$M_{\text{obs}} = \frac{M_{\text{UV}} - 4.61455}{1.2587}$$

Meurer *et al* 1999,

Smit *et al* 2012 & Bouwens *et al* (2012, 2014b)

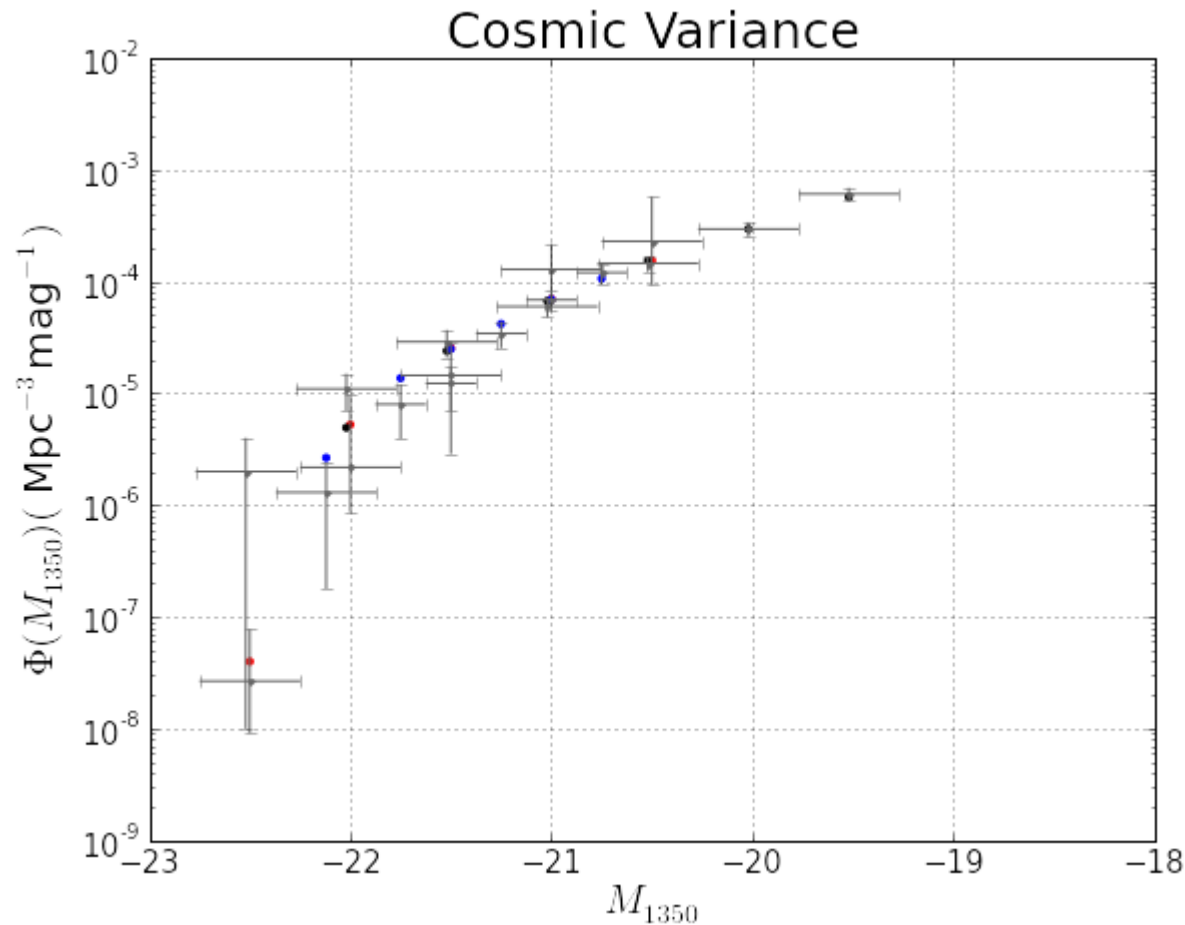
Star Formation Rate

Once having the UV luminosity from each galaxy, we can compute the SFR:

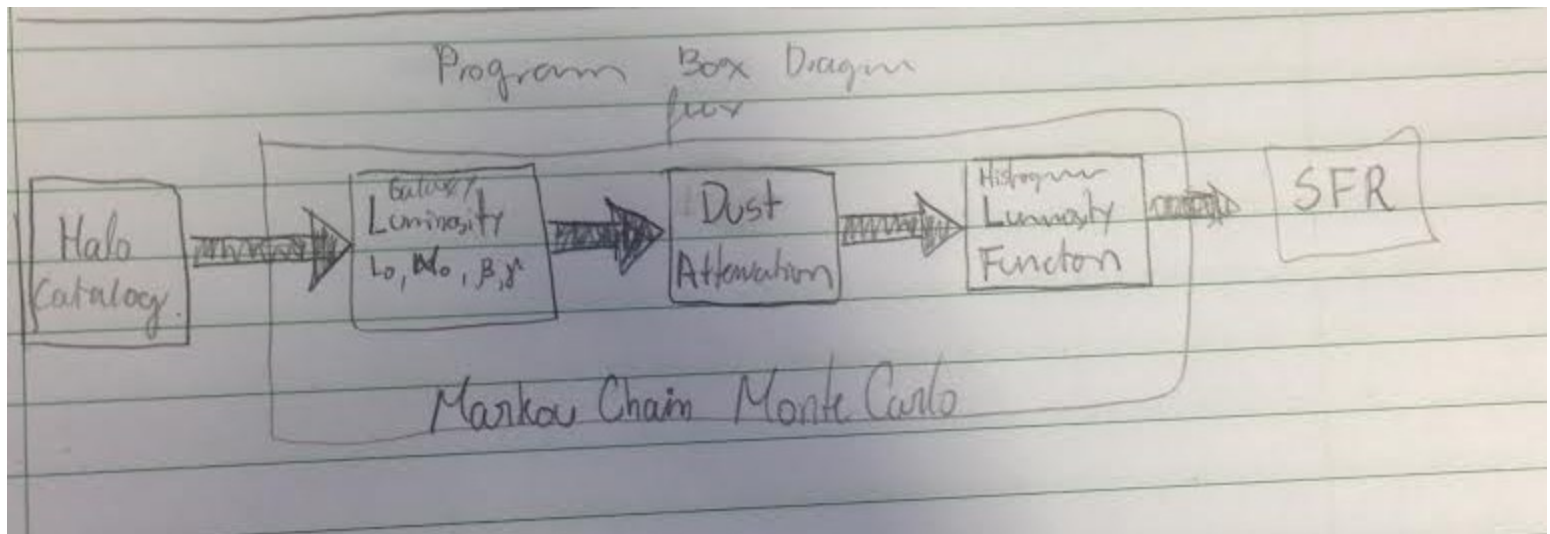
$$\text{SFR} (M_{\odot} \text{yr}^{-1}) = 1.4 \times 10^{-28} L_{\nu} (\text{erg s}^{-1} \text{Hz}^{-1})$$

Madau *et al* 1998, Kennicutt *et al* 1998.

Markov Chain Monte Carlo - One Box

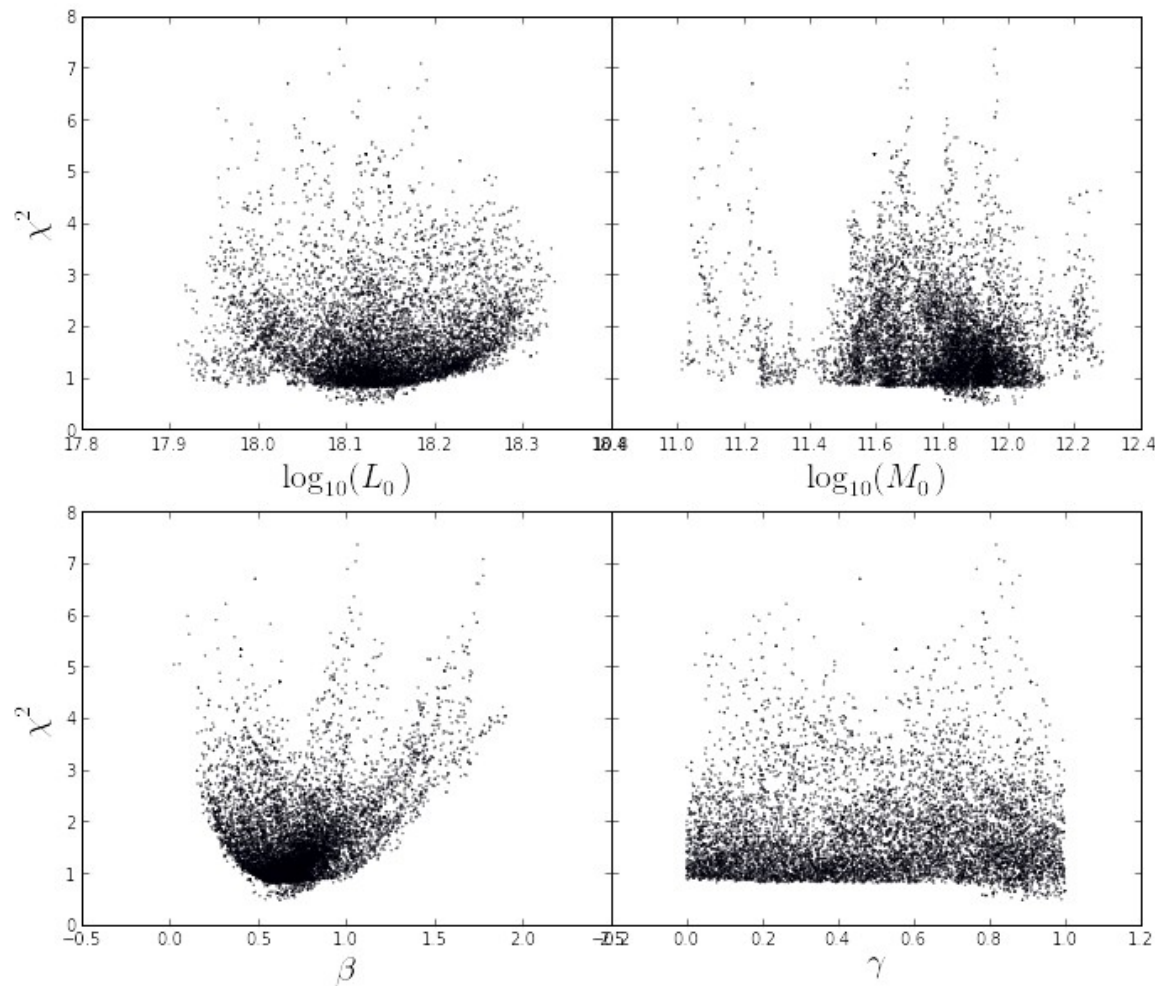


Markov Chain Monte Carlo - One Box

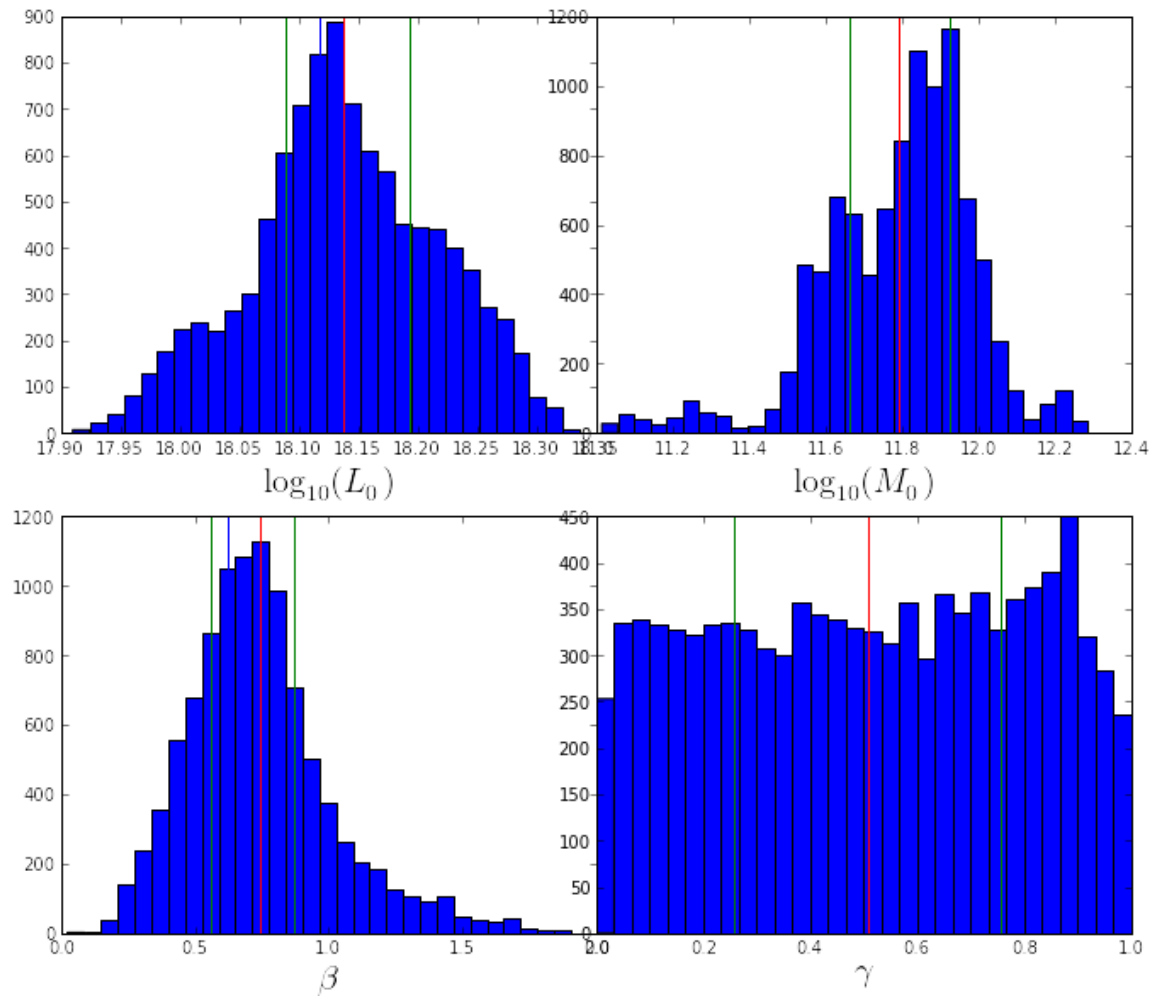


$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

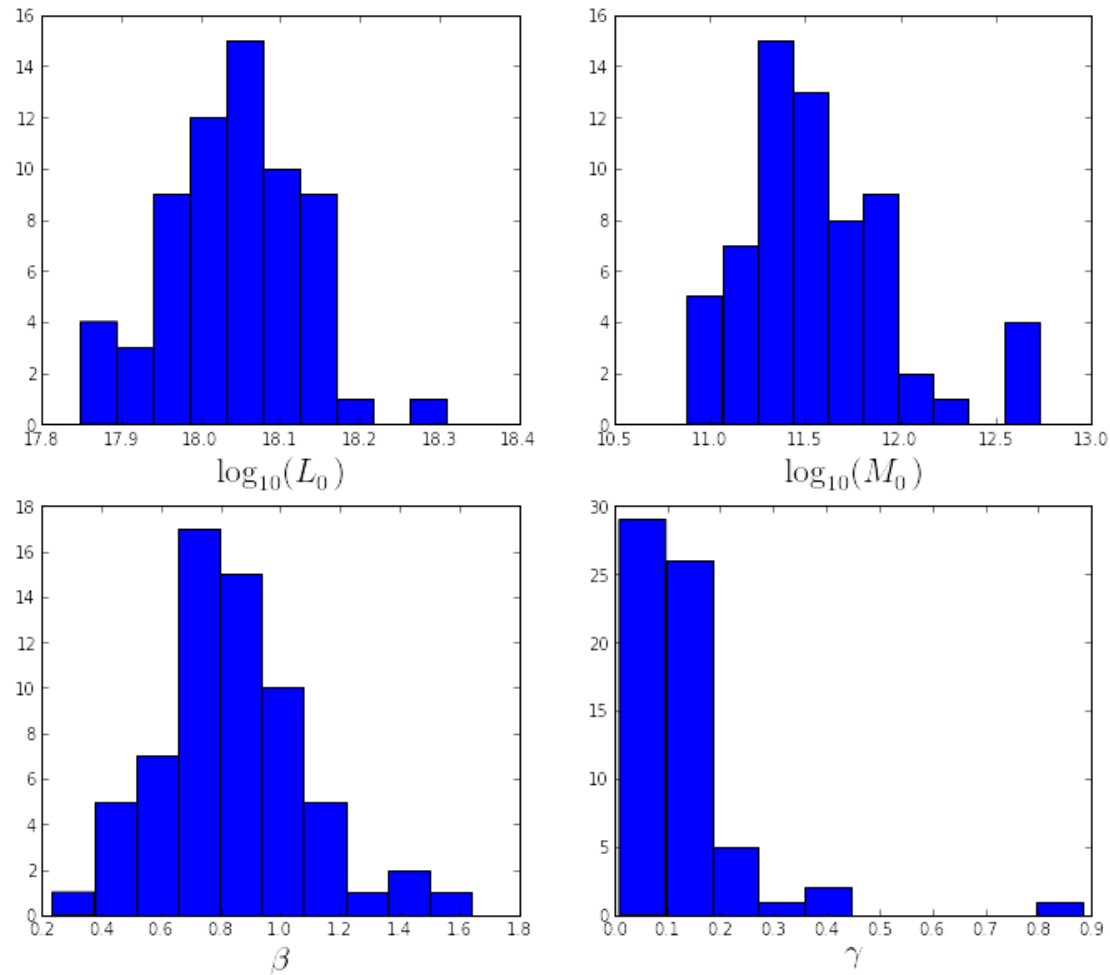
Markov Chain Monte Carlo - One Box



Markov Chain Monte Carlo - One Box



Markov Chain Monte Carlo 64-boxes



SFR & DMH

When the correct set of parameters is found, we get the relation:

$$SFR = k \times L_0 M \left[\left(\frac{M}{M_0} \right)^{-\beta} + \left(\frac{M}{M_0} \right)^{\gamma} \right]^{-1}$$

SFR as function DMH at $z \sim 6$

