Reproducing the Correlation Function of Halos at $z = 3$

Felipe Gómez-Cortés

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1 Introduction

The first goal is to reproduce the halo correlation function at $z = 3$ in the Conroy et. al. (2006)[1] paper (figure 4). The number density of halos in this paper is $n = 1.5 \times 10^{-2} h^3 \mathrm{Mpc}^{-3}$.

$$\omega_p(r_p) = 2 \int_0^\infty \xi \left(\sqrt{r_p^2 + r_\parallel^2} \right) dr_\parallel \tag{1}$$

2 Dark Matter Halo Catalog

The DM halo catalog was retreived from the BolshoiP Simulation.[1] This is contained in a cubic box of lenght $L = 250\mathrm{Mpc}\ h^{-1}$, The halos where choosen form the BDM[2] catalog in the snapshot 87 ($z = 2.952$).

3 Correlation Function using AstroML library

The astroML Library uses a *k-d Tree method*. This is a extremly efficient method to calculate correlation functions. With a 230.000 points catalog, the brute force method takes around 84.000 seconds to find the correlation function, while the k-d tree method takes only 27 seconds.

There is only one issue with the code: the normalization factor seems to be corrected by the boxlenght L.

Installation using Conda on Mac, or in Linux:

```
sudo pip install scipy
sudo pip install astropy
sudo pip install astroML
sudo pip install astroML_addons
```

[1] Available at `https://www.cosmosim.org/cms/simulations/bolshoip-project/bolshoip/`

[2] Bound Density Maximum $\Delta = 360\rho_{\mathrm{background}}$

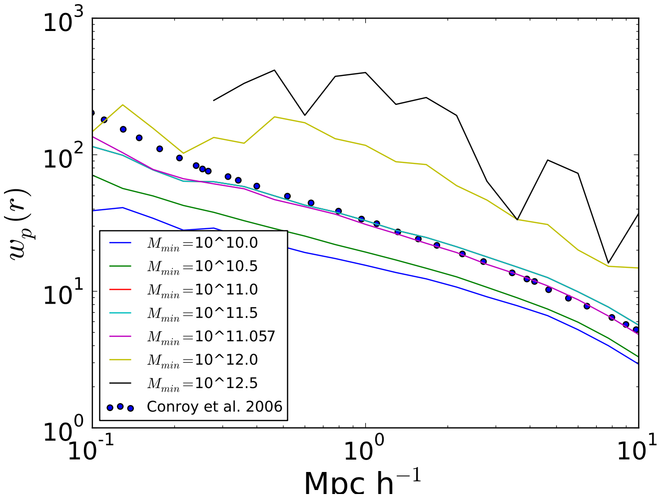

Figure 1: Halo Projected Correlation Function with different cuttoff masses. $\log_{10}(M_{\text{halo}}/M_{\odot}) = 10.0, 10.5, 11.0, 11.5, 11.057, 12.012.5$

```
sudo pip install scikit-learn
```

References

[1] Charlie Conroy, Risa H. Wechsler, and Andrey V. Kravtsov. Modeling luminosity-dependent galaxy clustering through cosmic time. 647:201–214.