1 Attempt to get redshift distribution of halo $M200_m > 10^{14} M_\odot$

1.1 Halo Mass Function

Attempting to calculate Tinker or Bouquet Mass function. The 3D matter power spectrum is provided by CAMB. **ALL UNITS USED ARE IN HUBBLE UNITS, i.e $h^{-1}Mpc$ or $hMpc^{-1}$ etc**

We first attempt to calculate the Radius of the cluster

$$R = \left[\frac{3M_{200m}}{4\pi\rho_{m,0}}\right]^{1/3} \mid \rho_{m,0} = \Omega_{m,0}\rho_{crit,0}$$

where, $\rho_{crit,0} = 2.775 \times 10^{11} h^2 M_\odot Mpc^{-3}$

Then we want to find the sigma R value for a redshift

$$\sigma^2(R,z) = \int_{10^{-4}}^{10} dk \frac{k^2}{2\pi^2} P_m(k,z)|W_{TH}(kR)|^2$$

We can then use this and find it to a mass function: **Tinker 2010**

$$\frac{dn}{d\ln M} = \nu f(\nu)\frac{\rho_{m,0}}{M}\frac{d\ln\sigma^{-1}}{d\ln M} \mid \nu = 1.686/\sigma$$

$$\alpha = 0.368$$
$$\beta = 0.589(1+z)^{0.20}$$
$$\gamma = 0.864(1+z)^{-0.01}$$
$$\phi = -0.729(1+z)^{-0.08}$$
$$\eta = -0.243(1+z)^{0.27}$$
$$f(\nu) = \alpha(1+(\beta\nu)^{-2\phi})\nu^{2\eta}\exp\left\{-\frac{\gamma\nu^2}{2}\right\}$$

Similarly for Bocquet 2016 mass function:

$$\frac{dn}{d\ln M} = g(\sigma)\frac{\rho_{m,0}}{M}\frac{d\ln\sigma^{-1}}{d\ln M} \mid \nu = 1.686/\sigma$$

For $M200_m$:

$$A = 0.175 * (1+z)^{-0.012}$$
$$b = 1.53 * (1+z)^{-0.040}$$
$$c = 2.55 * (1+z)^{-0.194}$$
$$d = 1.19 * (1+z)^{-0.021}$$
$$g(\sigma) = A\left(\left(\frac{\sigma}{b}\right)^{-a} + 1\right)\exp\left\{-\frac{c}{\sigma^2}\right\}$$

The plots are included in the github and code is in the halo_mass_function.py

1.2 Calculation on dN/dz

We have applied a $\sim 40\%$ mask on the sky, hence the $\Omega_{sky} \sim 0.4 \times 4\pi(180/\pi)^2$ degrees squaree

We simply take the integral over $M_{min} = 10^{14} h^{-1} M_{\odot}$

$$\frac{dN}{dz} = \Omega_{sky} \int_{M_{min}}^{M_{max}} d\ln M \frac{dn}{d\ln M} \frac{\chi(z)^2 c}{H(z)}$$

Where, H and χ are both provided by CAMB in units of Mpc:

$$H(z) = H_0(\Omega_m (1+z)^3 + \Omega_{DE}(1+z)^{3(1+w)})$$

$$\chi(z) = \int_0^z \frac{dz'}{H(z')}$$

We can then plot results from this and compare it to our bin data samples. The plots are the two HalfDome Redshift Distribution.png and the calling code is in Testing_zone.py with the actual code in halo_mass_function.py