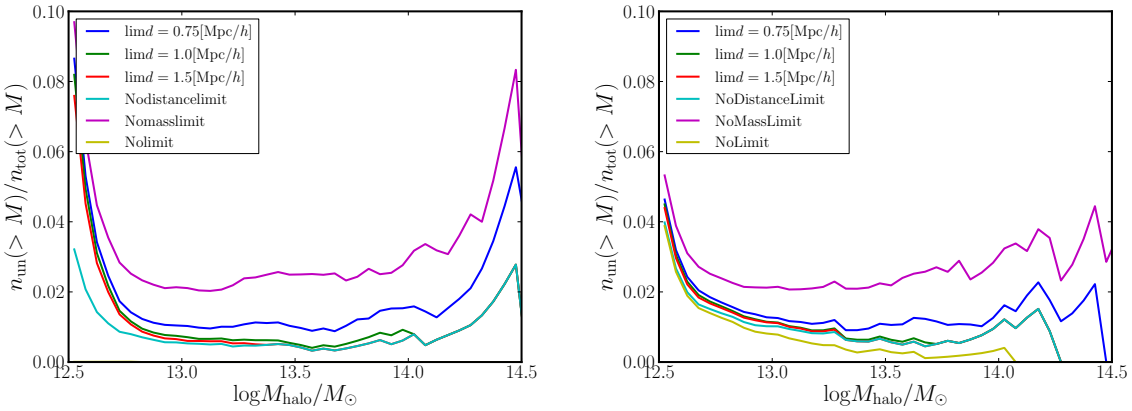


Figure 1. Left: Ratio of unmatched halo number densities for sample halos with respect to the corresponding total number densities. The sample simulation has 256^3 particles with 450 large steps and 5 inner steps. We compare this sample file to the simulation with the same particle number but different stepsizes, which is 300 large steps and 2 inner steps. The right plot shows the same ratios of this simulation. Both plots are at redshift $z = 0.15$. To find matched halos among different stepsize simulations (with the same initial condition), we have two criteria that 1)distance limit: two halos should not be separate more than $0.5h^{-1}$Mpc and 2)mass limit: mass ratio of two halos should not be differ more than $10^{0.5}$M$_\odot$. Those plots indicate that distance limits are more sensitive as a criterion for matching halos (compared to halo mass limit).

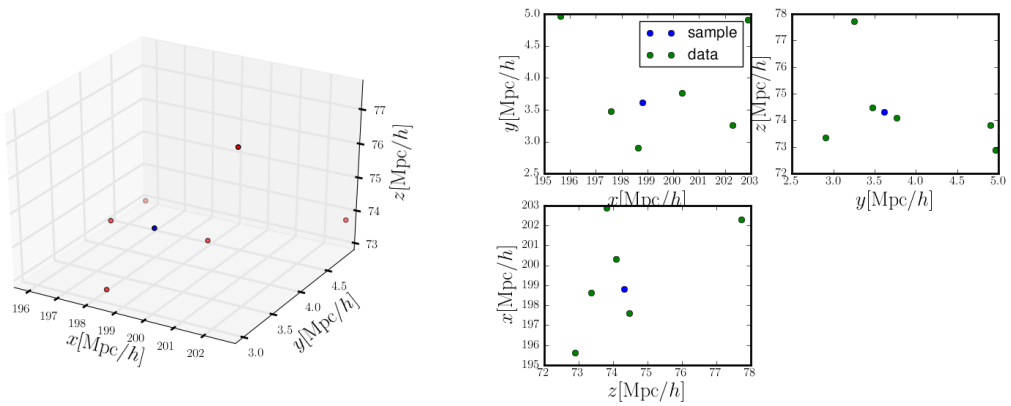
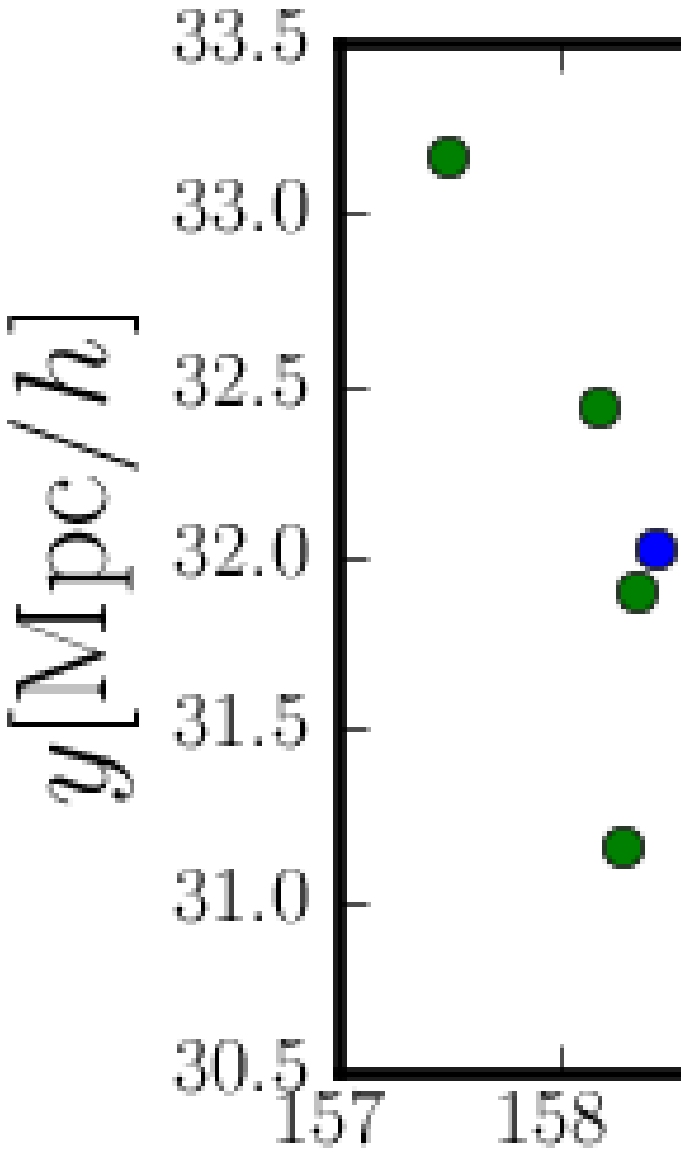
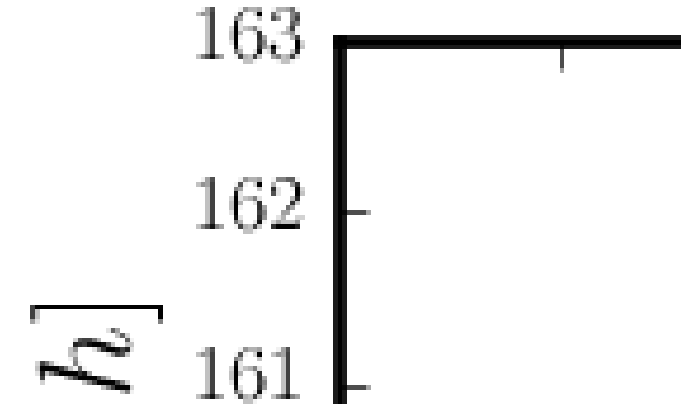


Figure 2. One of unmatched halos whose mass is above 10^{14}M$_\odot$. A blue point indicates an unmacthed halo from the simulation whose particle number is 256^3 and whose large stepsize is 450 steps with 5 inner steps in both plots. Red (left) and Green (right) points are halos around the unmatched halo from the simulation with the same number of particles but with a large stepsize of 300 and inner stepsize of 2. Clearly, there is no close halos from the simulation of 300 steps around the halo from 450 steps. The redshift of this simulation is $z = 0.15$.

- Change the conditions for matching halos:


33.5
33.0
32.5
32.0
31.5
31.0
30.5
157
158
$y\,[\mathrm{Mpc}/h]$


163
162
161
h