PRELIMINARY WORK WITH ILLUSTRIS-3 (Z=0)

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Contents

0.1 Introduction

The task given to me was to play around with the data provided on the Illustris/TNG website and do some exercises.
Continuing with my work on completing the exercises and better understanding the dataset, I analysed several aspects of various files like that of Halocatalogs, Snaps and the fof-subhalo catalogs and relating several fields from one file to the other.

Primarily, I understood how to load specific particles given the conditions and finding several quantities of the group of those particles like the total mass, etc and finding possible relations with other quantities, doing this all with a code which doesn't consume much time.

0.2 Completed Exercises

0.2.1 Exercise 1

Exercise: Plot galaxy sizes vs stellar masses

To plot this, I used the first 3 fof-subhalo catalogs to find the Centre of mass and Radius (I used the Group_R_Crit200 attribute for that) of various Subhalos. Then for the plot, I browsed through the first 140 entries of Groups and scanned across all the Snaps to find all such Stellar Particles which lie in the corresponding region and took the sum of all those stars.
This, I plotted with the Radius values and got the plot:

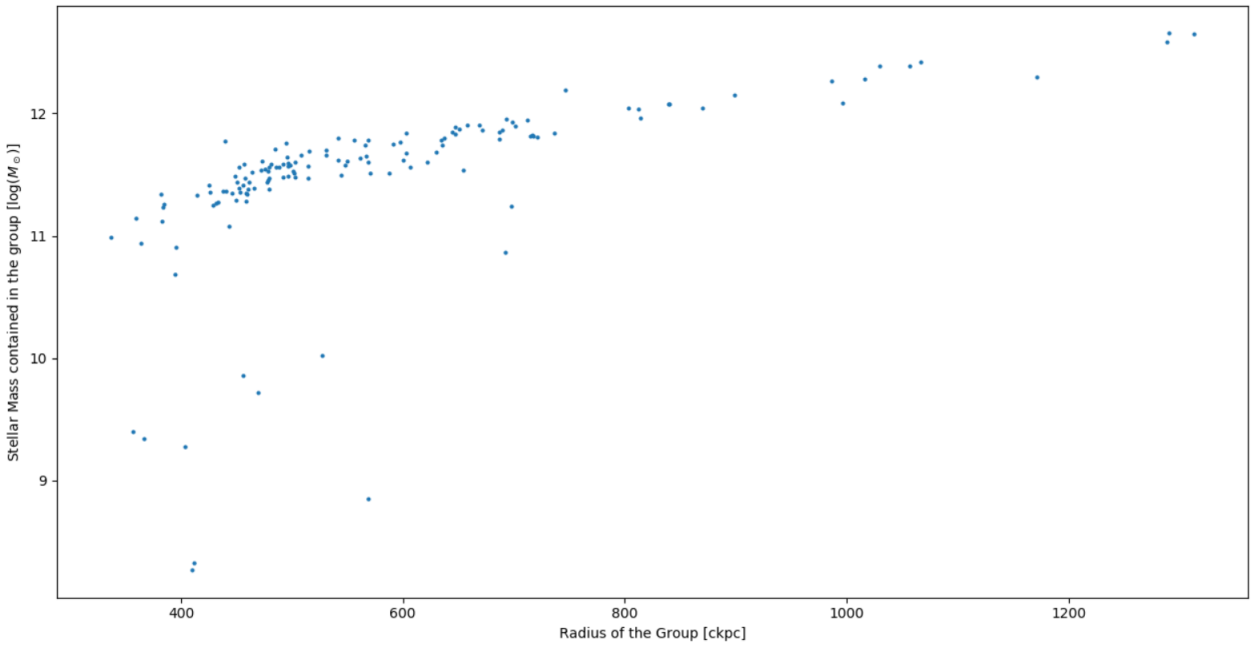

Figure 1: Stellar mass (plotted logarithmically) Vs Halo Radii

There seems to be a linear relation between the Halo radii and the log of the Stellar mass minus a few outliers. For the Subhalos, one can follow a similar regime.

0.2.2 Exercise 2

Exercise: Plot: Mgas vs Mhalo To plot this, I used a similar regime as used in the last exercise but instead, calculated the mass of gas and the total mass (gas + dark matter + Stellar mass + Black holes) and plotted these two in a log scale.
The Plot I got:

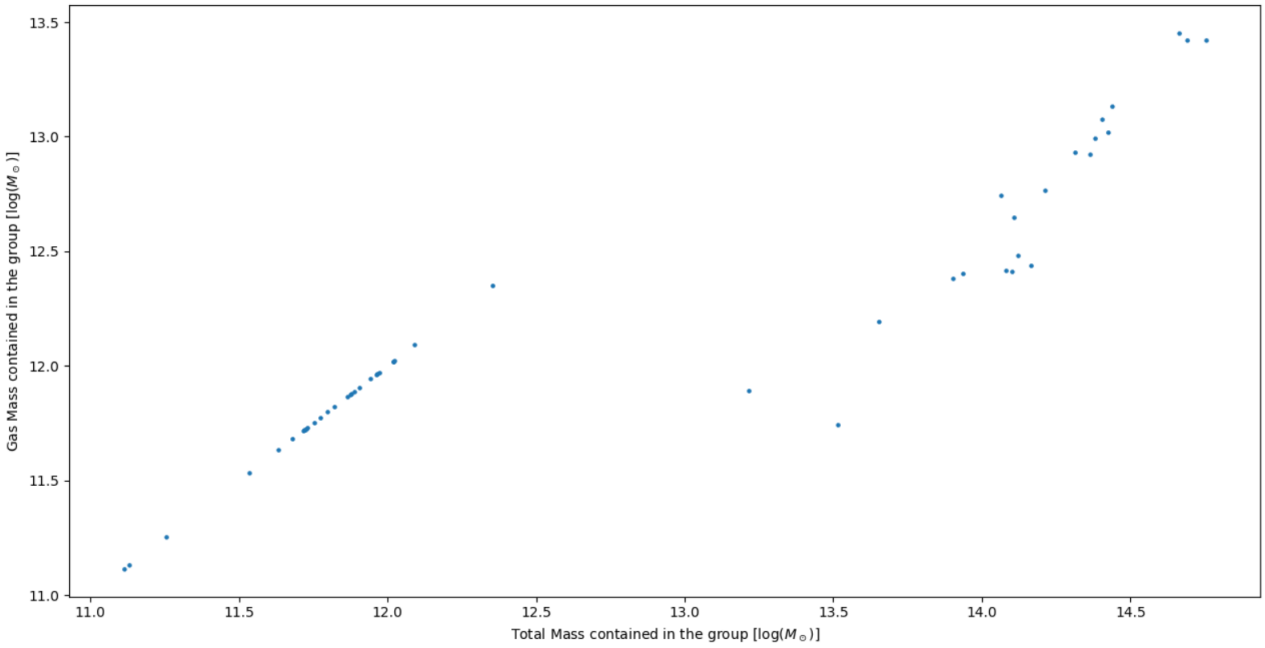

Figure 2: Mass of gas Vs Mass of Halo (both in the log10 scale)

As one can see, the graph shows a nearly perfect linear relation for values lying between $10^{11} M\odot$ and $10^{12.5} M\odot$. There is an almost linear relation for the greater values ($10^{13} M\odot$ and more) but the the mean square error is pretty high.

0.2.3 Exercise A1

Exercise: Plot the radial distribution of sub haloes around haloes of a given mass:

- Select 1 (n) Halo(n) in FoF Halos of a given: Mtot = 10^{13} - $5x10^{13}$ Msun, where Mtot = Group_M_Crit200
- Identify all Subfind objects in Subfind Subhalos belonging to the selected FoF (use GroupFirstSub, GroupNsubs)
- Plot the x,y positions of all the identified objects
- Plot their radial distribution from the center of the FoF = position of the FirstSub

The Plot I got :

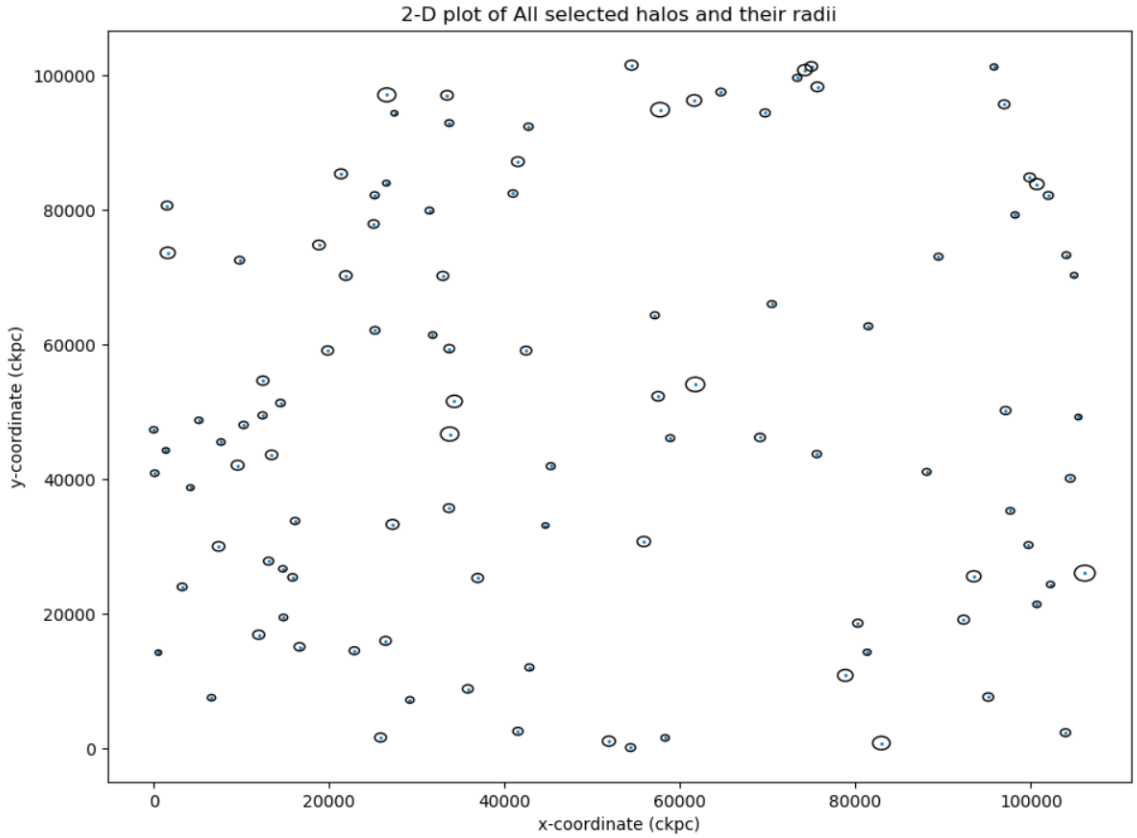

Figure 3: 2D Plot of Selected Halos (with radii marked with a circle)

0.2.4 Exercise 3

Exercise: Load the particles of a Halo as Group, load the particles of its central SUBFIND halo. Of those particles, take the coordinates and plot them.

The Plot I got:

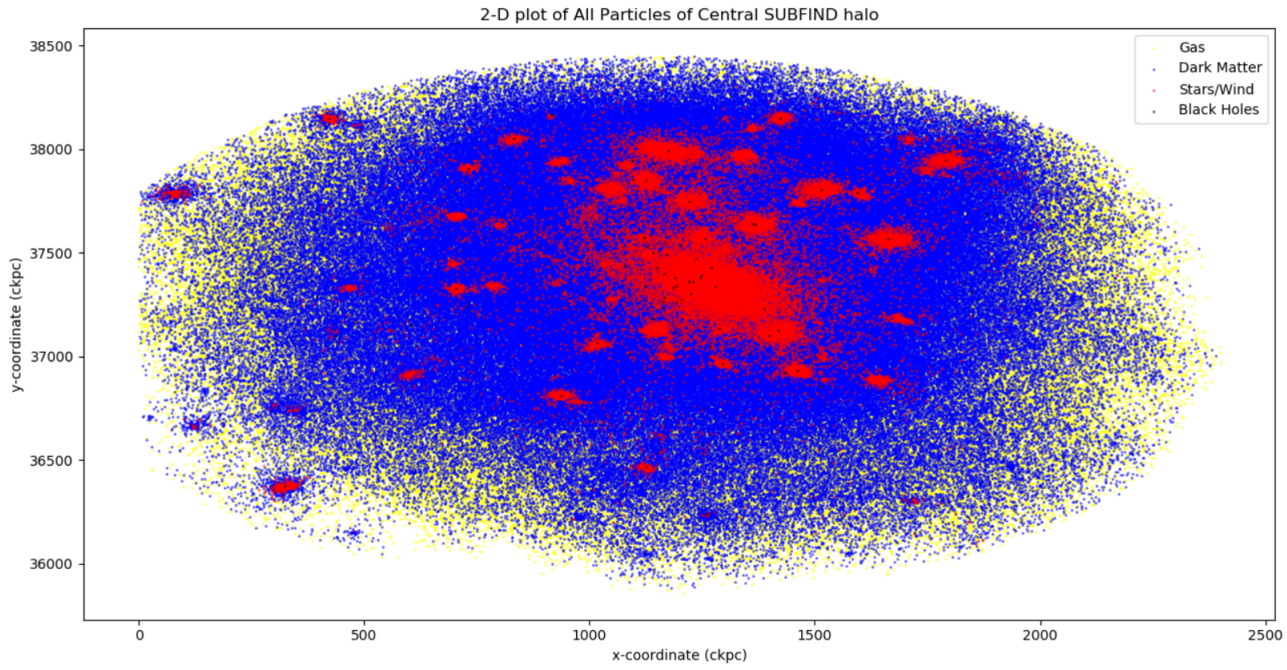

Figure 4: 2D Plot of Particles of Central Halo

0.2.5 Exercise 4

Exercise: Load particles of a whole volume of a small sim (one chunk after after the other): plot their positions (2D) projection and overplot the positions of haloes

The Plot I got:

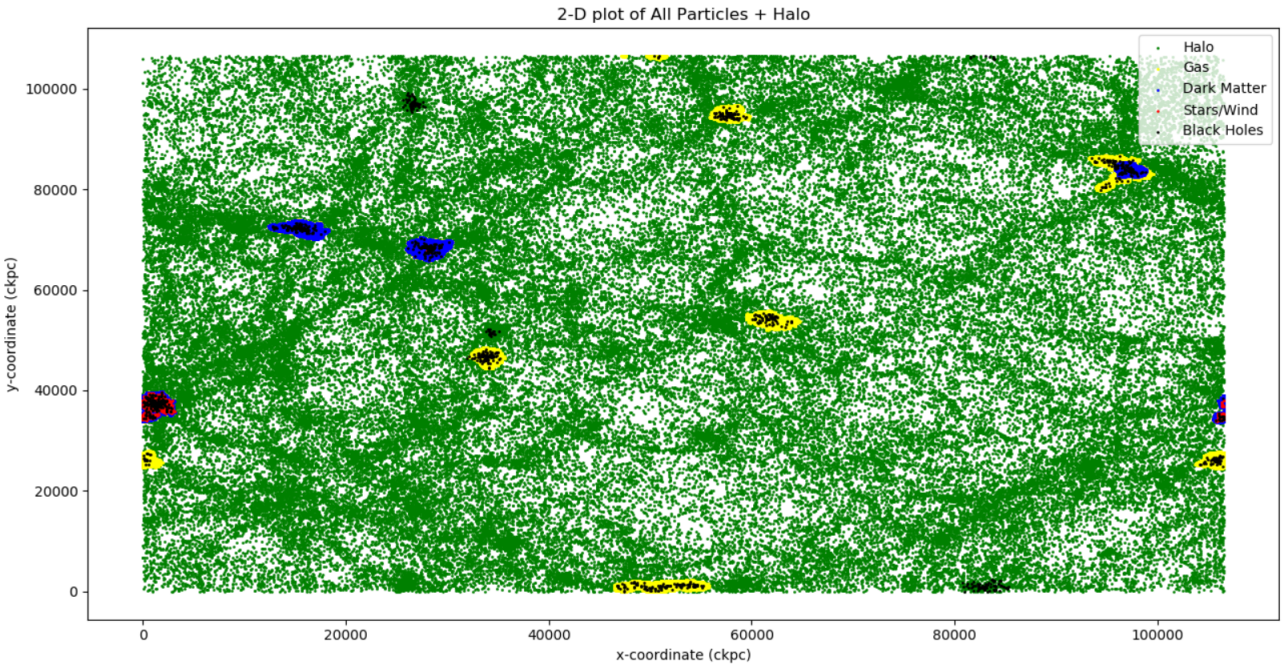

Figure 5: 2D Plot of All particles plus halo overpllotted

0.2.6 Exercise 5

Exercise: Load particles of a given type of a Halo where Halo = Fof or Subfind: compare the particle distribution (2D projections) of a FoF with a) its SUBFIND sub haloes centres and b) with the particle distribution where the particles are those of its central SUBFIND halo.

The Plot I got:

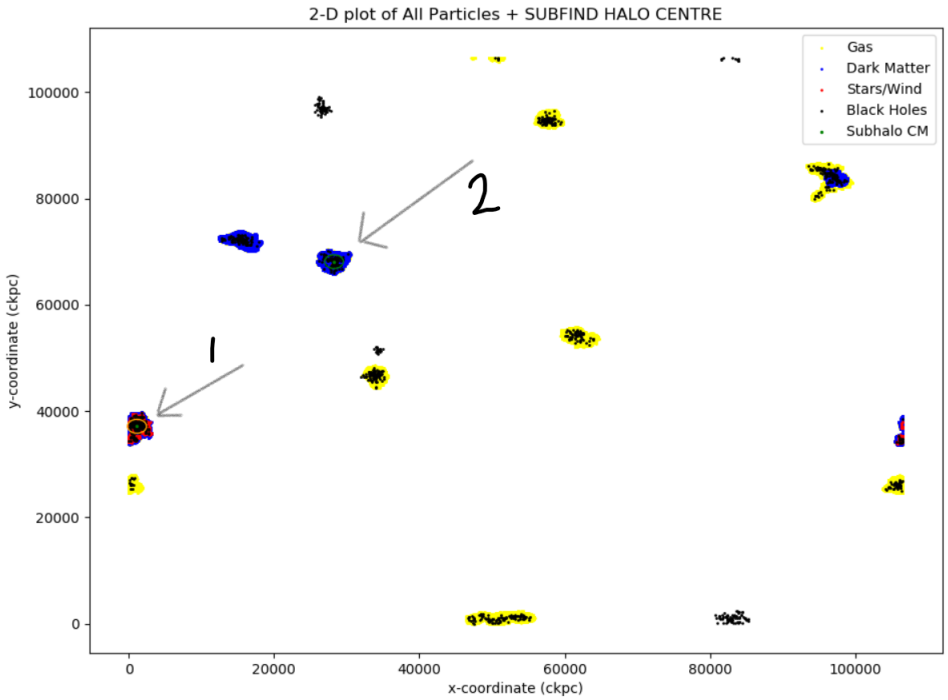

Figure 6: 2D Plot of Particles of Central Halo

Here, the 1 represents the Primary/Central Subgroup and the Orange circle repesents it's radius. Similarly, the 2 represents the Secondary/Satellite Subgroup present in the snap.

0.2.7 Exercise 6

Exercise:Load N haloes, measure their total mass and compare to halo catalogs

I ran a loop for each snapshot and calculated the total mass contained in each snapshot. The result I got was:

Total mass contained in the snapshot 0 is: $1.403969e+15M\odot$
Total mass contained in the snapshot 1 is: $1.436087e+15M\odot$
Total mass contained in the snapshot 2 is: $1.457679e+15M\odot$
Total mass contained in the snapshot 3 is: $1.410175e+15M\odot$
Total mass contained in the snapshot 4 is: $1.415534e+15M\odot$
Total mass contained in the snapshot 5 is: $1.390961e+15M\odot$
Total mass contained in the snapshot 6 is: $1.417857e+15M\odot$
Total mass contained in the snapshot 7 is:$1.413165e+15M\odot$
Total mass contained in the snapshot 8 is: $1.414219e+15M\odot$
Total mass contained in the snapshot 9 is: $1.384510e+15M\odot$
Total mass contained in the snapshot 10 is: $1.417219e+15M\odot$
Total mass contained in the snapshot 11 is: $1.396175e+15M\odot$
Total mass contained in the snapshot 12 is: $1.406673e+15M\odot$
Total mass contained in the snapshot 13 is: $1.427379e+15M\odot$
Total mass contained in the snapshot 14 is: $1.422915e+15M\odot$
Total mass from all Snapshots combined is : $2.121452e+16M\odot$
Total Group mass in Halocatalog is: $1.9489870618619028e+16M\odot$

Which is very close to the actual value, an error of about 8%.