CTA200 Project

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CTA 200

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Question 1. Retrieving the data from the file provided, we can plot a slice of the data. Here, we plot the first slice, and only include the logarithm of the data so that small scale variations are better visible.

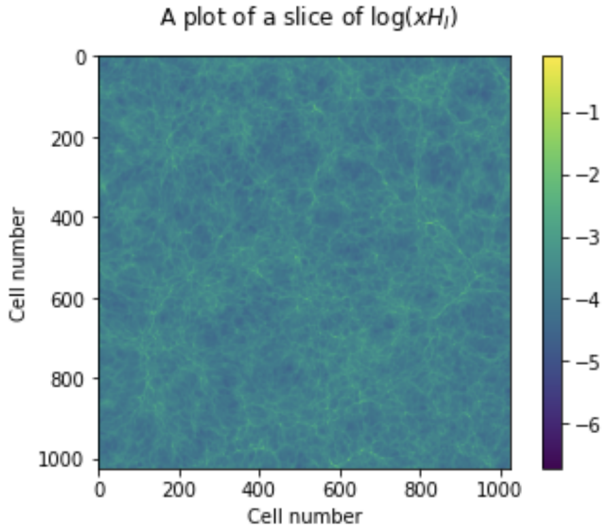

Figure 1

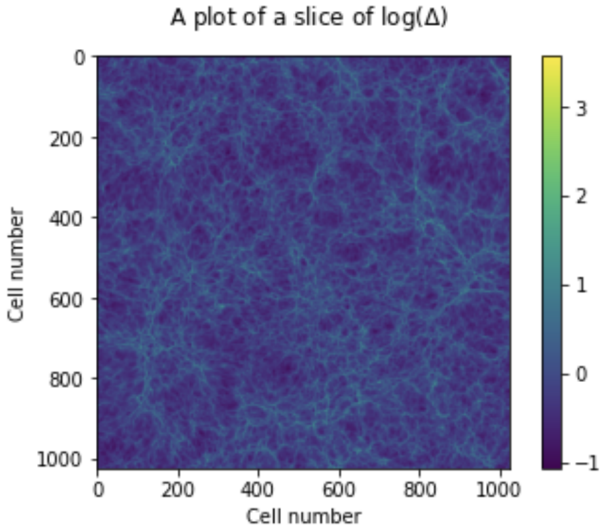

Figure 2

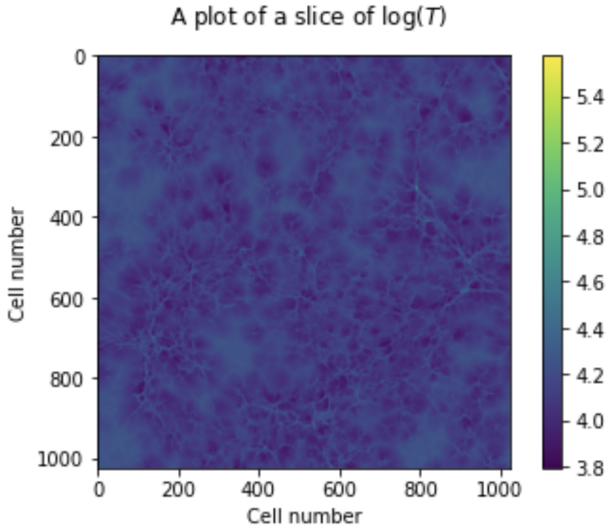

Figure 3

Here, xHI is the neutral hydrogen fraction, Δ is the density contrast and T is the temperature.

Question 2. Here, we will calculate the mean gas density at $z = 6$. Using astropy, we can find the critical density at that time, as well as the fraction of matter that was baryonic at that time. Then, the mean gas density is the product of these and found to be: 1.43×10^{-28} gcm^{-3}.

Question 3. We can calculate that the Lymann-α optical depth for the densest cell is given by:

$$d\tau_{Ly\alpha} = \sigma_{Ly\alpha} n_{HI} ds = 2.91 \text{ cm}^{-2}$$

n_{HI} was calculated by first observing that roughly 76% of the gas is made up of hydrogen. So the mean gas density was multiplied by this number to get the mean mass density of hydrogen. Then this was divided by the mass of a proton to get the mean number density of hydrogen, this was divided by the mass of a proton. This number was then multiplied by the neutral hydrogen fraction to obtain the number density of neutral hydrogen n_{HI}.

Question 4. The percentage of light that remains after passing through the densest cell is given by:

$$e^{-d\tau_{Ly\alpha}} = 5.45$$

Question 5. Using the column of virial mass from the halo data, we can make the following histogram:

ht

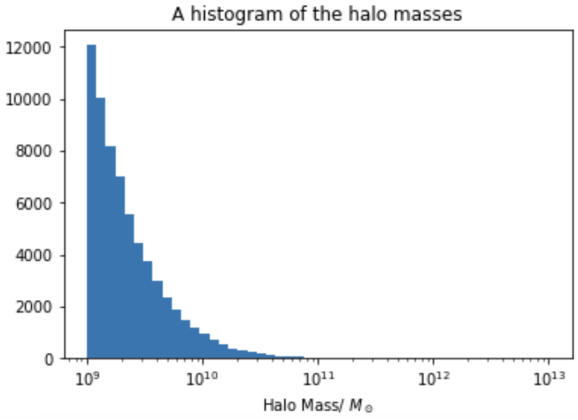

Figure 4: Caption

This histogram shows that there is an exponential decrease in the number of glactic halos as the mass of the halo increases.