ASTR 400B Homework 3

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Galaxy	Halo Mass ($10^{12} M_\odot$)	Disk Mass ($10^{12} M_\odot$)	Bulge Mass ($10^{12} M_\odot$)	Total Mass ($10^{12} M_\odot$)	f_{bar}
MW	1.975	0.075	0.01	2.06	0.041
M31	1.921	0.12	0.019	2.06	0.067
M33	0.187	0.009	0.0	0.196	0.046
Local Group	4.083	0.204	0.029	4.316	0.054

1 Answers to Questions

1. The total mass of the MW and M31 are the same. The components that primarily dominate are the Halo's Mass where the majority of the dark matter is contained.

2. The stellar mass of MW is about 0.085 ($10^{12} M_\odot$) while M31 is 0.139 ($10^{12} M_\odot$), where

$$\frac{MW_{S.M}}{M31_{S.M}} = \frac{0.075+0.01}{0.12+0.019} = \frac{0.085}{0.139} \approx 0.61$$

   We can see that the MW is about 0.6 times the mass of M31. I expect M31 to be brighter because it contains more mass the MW.

3. Examining the second column in the table we can see compare the dark matter masses of MW and M31 where we find

$$\frac{MW_{D.M}}{M31_{D.M}} = \frac{1.975}{1.921} \approx 1.03$$

   thus the MW galaxy contains more Dark Matter than M31. I find this to be surprising because the MW baryon fraction is less than M31 fraction. But The MW has more Dark Matter. I would've assumed that baryons would scale with Dark Matter, where more massive the galaxy is the more Dark Matter it would contain, but in this simulation it showed otherwise.

4. Column 5 shows the baryon fraction for each galaxy. Comparing the total stellar mass to the total mass we find that each Galaxy has a fraction $f_{bar} \leq 7\%$. So most of the mass with in the galaxies is contained by the Dark Matter component. Comparing the the Universe baryon fraction to each of the galaxies, we can see the the Local Group itself is only a significant fraction of the Universe Baryon fraction. The Universe fraction can differ because there is more dark matter in the universe and baryons tend to be more concentrated in areas where the Dark Matter is more dense.