ASTR400B HW3

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February 2020

1 Table

Galaxy Name	Halo Mass [$M_\odot$]	Disk Mass [$M_\odot$]	Bulge Mass [$M_\odot$]	Total [$M_\odot$]	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	.204	0.029	4.316	0.054

2 Questions

Question 1

How does the total mass of the MW and M31 compare in this simulation? What galaxy component dominates this total mass?
MW and M31 have the same total mass. The Halo Mass dominates for each.

Question 2

How does the stellar mass of the MW and M31 compare? Which galaxy do you expect to be more luminous?
The stellar mass is the disk mass plus the bulge mass. For MW it is 0.085, and 0.139 for M31. $\frac{MW}{M31} = \frac{0.085}{0.139} = 0.61$ therefore $MW = 0.61M33$. I would expect M31 to be more luminous.

Question 3

How does the total dark matter mass of MW and M31 compare in this simulation (ratio)? Is this surprising, given their difference in stellar mass?
Dark matter = Halo mass.

$$\frac{M31}{MW} = \frac{1.921}{1.975} = 0.97 \tag{1}$$

$$M31 = 0.97MW \tag{2}$$

This is not necessarily surprising since we know that dark matter makes up about 96% of the mass of the universe and that it is a unique characteristic of galaxies.

Question 4

What is the ratio of stellar mass to total mass for each galaxy (i.e. the Baryon fraction)? In the Universe, $\frac{\Omega_b}{\Omega_m} \sim 16\%$ of all mass is locked up in baryons (gas and stars) cs. dark matter. How does this ratio compare to the baryon fraction you computed for each galaxy? Given that the total gas mass in the disks of these galaxies is negligible compared to the stellar mass, any ideas for why the universal baryon fraction might differ from that in these galaxies?

The baryon fraction for the universe is more than twice the f_{bar} value of each galaxy for which the values are given in the table. The galaxies throughput the Universe have different amounts of stellar mass, which could change the Baryon ratio.