

Homework 3 Astr 400B

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1 Table for Mass breakdown for local Group

Mass Breakdown of the Local Group					
Galaxy Name	Halo Mass($10^{12}M_{sun}$)	Disk Mass ($10^{12}M_{sun}$)	Buldge Mass ($10^{12}M_{sun}$)	Total($10^{12}M_{sun}$)	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	0.196	0.046
Localgroup	4.083	0.204	0.029	4.316	0.054

2 Extra Questions

Question 1: How does the total mass of the MW and M31 compare in this simulation? What galaxy component dominates this total mass?

Solution: The total mass of MW and M31 is same in this simulation. The dark matter (halo mass) component dominates most of the mass.

Question 2: How does the stellar mass of the MW and M31 compare? Which galaxy do you expect to be more luminous?

Solution: The stellar mass of M31 is greater than MW : ratio($MW/M31 = 0.59$). We know that stellar luminosity goes as : $L \propto M^x$, so we expect M31 to be more luminous than MW.

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?

Solution: The ratio of total dark matter mass is $MW : M31 = 1.03$. So, their dark matter component are almost equal. So, yes this is surprising , and I think that the main reason is the Disk Mass, which is way more in M31 than MW.

Question 4: What is the ratio of stellar mass to total mass for each galaxy (i.e. the Baryon fraction)? In the Universe, Ω_b/Ω_m 16% of all mass is locked up in baryons (gas and stars) vs. 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?

Solution: This is given by the f_{bar} column in the table: MW : 0.041 , MW31 : 0.067 , M33 : 0.046 . The given ratio of 0.16 is much larger than the baryon fractions we found for galaxies above. This is because, most of the mass is inter spread between galaxies in the form of warm hot intergalactic medium, (VIM) only 10% of this is baryonic mass.