ASTR400b Homework 3

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Galaxy Name	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	0.010	2.060	0.041
M31	1.921	0.120	0.019	2.060	0.067
M33	0.187	0.009	0.000	0.196	0.046
Total	4.083	0.204	0.029	4.316	0.054

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

  The total mass of M31 is the same as the mass of the MW. The dark matter halo dominates the total mass for both galaxies.

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

  The stellar mass of M31 is larger than MW by about 1.6 times. We expect M31 to be more luminous because it has a larger stellar mass.

- 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?

  The dark matter mass of MW is 1.028 times the dark matter mass of M31 (ie. $\frac{MW_{DM}}{M31_{DM}} = 1.028$). This is surprising because we would think the dark matter mass is directly proportional to the stellar mass.

- 4. What is the ratio of stellar mass to total mass for each galaxy (i.e. the Baryon fraction)? In the Universe, Ωb/Ωm 16% of all mass is locked up in baryons (gas & 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?

  The f_{bar} column shows the Baryon fraction for each galaxy which is 4.1%, 6.7%, and 4.6%, for the MW, M31, and M33 respectively. This is much lower than the baryon fraction for the universe. There could be more

baryonic matter in the form of gas and dust in the interstellar medium that is not accounted for in the galaxies, or this could be because we are not taking into account the dark matter that is located between galaxy groups, and there might be higher concentrations of dark matter in dense clusters of galaxies.