ASTR 400B: Lab-2 Table

Chirag Rathi

5 February 2020

1 Table

Galaxy Name	Halo Mass	Disk Mass	Bulge Mass	Total Mass	f_{bar}
Milky Way (MW)	1.975	0.075	0.01	2.060	0.041
Andromeda (M31)	1.921	0.12	0.019	2.060	0.067
M33 Galaxy	0.187	0.009	0.0	0.196	0.046
Local Group	4.083	0.204	0.029	4.316	0.154

2 Questions

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

   MW and M31 have the same total mass and the halo mass dominates their total mass fraction.

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

   The total stellar mass of M31 is greater than that of MW. Consequently, I expect M31 to be more luminous than MW.

3. **How does the total DM mass compare in MW and M31? Is this surprising given the difference in stellar masses?**

   They almost have the same amount of dark matter.

   $$\frac{MW_{DM}}{M31_{DM}} = 1.028$$

   This is indeed surprising because I expect more fraction of mass to be domninated by the halo mass (DM mass) in M31 comparatively.

4. **What is the ratio of stellar mass to total mass for each galaxy (i.e. the Baryon fraction)? In the Universe, $\Omega_b/\Omega_m \approx 0.16$ 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?

The baryon fraction values are given in the last column of the table. The baryon fraction in those galaxies compared to the Universe's baryon fraction are 0.256 (for MW), 0.419 (for M31) and 0.288 (for M33). The universal baryon fraction is different from that in the galaxies because of the different dark matter fractions in the galaxies (since halo mass also contributes to the baryon fraction).